3D Environmental
vegetation analysis and mapping specialists

Arrow Energy – Surat Gas Project

Terrestrial Ecology Impact Assessment

Prepared by

3d Environmental

in association with

Ecosmart Ecology

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ECOSMART ECOLOGY
Ecological Research, Survey and Assessment

Executive Summary

Arrow Energy is seeking to expand its coal seam gas operations in Queenslands Surat Basin with the proposed Surat Gas Project expected to meet growing demand for gas supply into the future, including domestic and potential export markets. An environmental impact assessment report has been prepared for terrestrial ecological values over the study area which extends from Wandoan in the north to Goodiwindi in the south, covering an area of approximately 8600 km^2. The project proposes a number of activities which have potential to impact on terrestrial ecological values which include:

- Exploration and appraisal well drilling
- Production well design and installation and well workovers.
- Gathering iInfrastructure design and installation
- Electricity grid (Overhead) design and Installation
- Integrated production facility design and iInstallation
- Operation and maintenance
- Decommission and rehabilitation.

Ecological values from within the PDA that are identified as being at risk from project development activities:

- Six ecological communities listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) as endangered or critically endangered.
- Regional ecosystems (REs) comprising 12 endangered REs and eight of concern REs.
- Thirty-eight flora species listed under state or federal legislation including, 35 of which are listed as endangered, vulnerable or near-threatened under the *Nature Conservation Act, 1999* (NCA) and 18 listed as endangered or vulnerable under the EPBC Act.
- Twenty-seven fauna species listed under state or federal legislation including 12 listed as endangered or vulnerable under the EPBC Act and 24 species listed as endangered, vulnerable, or near-threatened under the NCA.
- Twenty-nine migratory fauna species.
- Environmentally sensitive areas as regulated under the *Environmental Protection Act 1994* (EP Act) including Category A, Category B and Category C areas.
- Protected estate and areas of special biodiversity significance including two National Parks, Conservation Parks, Wetlands of National Significance, an extensive system of

State Forest Reserves, wildlife and riparian corridors and essential habitat for threatened flora and fauna.

Potential sources of impact to terrestrial ecological values associated with the gas field development activities include:

- Vegetation clearing resulting in plant and animal mortality, loss of habitat and increased erosion or sedimentation. This may be associated with all project activities with exception of facility operation and decommission. Vegetation clearing has the potential to directly affect a number of ecological communities, ecosystems and terrestrial flora and fauna species listed under state and federal legislation.
- Dissection and fragmentation of habitat and populations through development of infrastructure, including exploration activities, gas field development and facility development;
- The loss or modification of habitat important for threatened flora and fauna species, including the creation of dispersal and movement barriers, potentially isolating existing populations and reducing genetic flow. This may be associated with all project development activities;
- Edge effects associated with vegetation clearing, including weed invasion, increased predation and competition, and changes in abiotic conditions;
- Changes to other ecological processes, such as fire frequency, fire extent, surface water availability, and surface water flow and potential discharge of saline waters into vegetation and/or wetland areas.

A range of mitigation and management measures are proposed to manage impacts to terrestrial ecological values. It is intended that these measures be employed to maintain the risk to ecological values at levels that are as low as practically possible. The recommended measures, listed in order of decreasing effectiveness, comprise:

- **Avoidance:** Avoiding vegetation clearing, avoiding sensitive vegetation patches or species assemblages, applying buffers to sensitive areas and preclearing surveys to identify key ecological values prior to disturbance (allowing specific management measures to be employed.
- **Minimisation:** Minimising disturbance to sensitive vegetation or habitats through reduction in development footprints, minimisation of habitat dissection and minimisation of edge creation.

- **Active management:** Including rehabilitation, propogation, translocation and development of biodiversity offsets for impacted habitats and ongoing monitoring programs.

An assessment of the residual impact that project development activities pose to a range of ecological values has been prepared. This provides a subjective assessment of the effectiveness of mitigation measures and levels of residual impact once all mitigation measures have been implemented to levels as far as practically possible. The residual impact has been assessed on a project development activity basis for ecologically sensitive areas, threatened or otherwise sensitive ecological communities and regional ecosystems, flora and fauna species and species assemblages listed as threatened or near threatened under state or federal legislation.

Summary residual impact assessments for these values are provided in **Table A** to **Table D** below.

The assessment reflects a range of impact significance scores that sub-activities within the eight broader activity groupings pose to ecological values. The tables are provided as a means to identify project development activities which provide the greatest threat to ecological values. It should be recognised that considerable variation in the level of residual impact may apply to sub-activities within these activity groupings, and also to specific components contained within grouped ecological values. An assessment of the residual impact posed to individual values is contained within the report body, identifying those values that are particularly susceptible to project development activities, and require active management or attention throughout all phases of project development to decommission.

Table A. Residual impact posed by project development activities to threatened or otherwise sensitive ecological communities and regional ecosystems.

Activity	Unmitigated Impacts	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Exploration and Appraisal Well Drilling	Low (5) to Extremely High (25)	Insignificant (2) to Moderate (11)	Low (4) to High (20)
Production Well Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11	Low (5) to High (20)
Gathering Infrastructure Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Electricity Grid (Overhead) Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Integrated Production Facility Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)

Operation and Maintenance	Low (5) to High (20)	Insignificant (2) to Moderate (11)	Insignificant (2) to Moderate (16).
Export of Gas from Field to Downstream Use	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Decommission and Rehabilitation	Low (5) to High (20)	Insignificant (2) to Moderate (11)	Insignificant (2) to Moderate (16).

Table B. Residual impact posed by project development activities to Ecologically Sensitive Areas

Activity	**Preliminary Impact**	**Residual Impact Significance Through Avoidance**	**Residual Impact Significance Through Other Management Actions**
Exploration and Appraisal Well Drilling	Moderate to (13) to Extremely High (25)	Low (4) to Moderate (11)	Moderate (12) to Extremely High (23)
Production Well Design and Installation	Low (4) to Extremely High (25)	Low (4) to Moderate (11)	Low (4) to High (20)
Gathering Infrastructure Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Electricity Grid (Overhead) Design and Installation	Low (5) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23
Integrated Production Facility Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Operation and Maintenance	Low (8) to High (20)	Low (4) to Moderate (11)	Low (4) to Moderate (16)
Export of Gas from Field to Downstream Use	Moderate (13) to Extremely High (25)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Decommission and Rehabilitation	Low (8) to High (20)	Low (4) to Moderate (11)	Low (4) to Moderate (16)

Table C. Residual impact posed by project development activities to flora species listed as threatened under state and federal legislation.

Activity	**Preliminary Impact**	**Residual Impact Significance Through Avoidance**	**Residual Impact Significance Through Other Management Actions**
Exploration and Appraisal Well Drilling	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)

Activity	Preliminary Impact	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Production Well Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Gathering Infrastructure Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Electricity Grid (Overhead) Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Integrated Production Facility Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Operation and Maintenance	Low (8) to High (20)	Not Applicable	Insignificant (2) to Moderate (16)
Export of Gas from Field to Downstream Use	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Decommission and Rehabilitation	Low (8) to High (20)	Not Applicable	Insignificant (2) to Moderate (16)

Table D. Residual impact posed by project development activities to fauna species listed as threatened under state and federal legislation.

Activity	Preliminary Impact	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Exploration and Appraisal Well Drilling	Low (5) to High (21)	Insignificant (2) to Low (7)	Insignificant (2) to High (21)
Production Well Design and Installation	Insignificant (2) to Moderate (17)	Insignificant (2) to Low (7)	Insignificant (2) to Moderate (17)
Gathering Infrastructure Design and Installation	Low (5) to High (21)	Low (5) to Low (7)	Insignificant (2) to Moderate (17)
Electricity Grid (Overhead) Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Integrated Production Facility Design and Installation	Low (5) to Extremely High (24)	Low (5) to Low (7)	Insignificant (2) to Extremely High (24)

Activity	Preliminary Impact	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Operation and Maintenance	Insignificant (2) to Low (7)	Not Applicable	Insignificant (2) to Low (7)
Export of Gas from Field to Downstream Use	Low (5) to High (7)	Insignificant (2) to Low (7)	Insignificant (2) to Moderate (17)
Decommission and Rehabilitation	Insignificant (2) to Moderate (12)	Not Applicable	Insignificant (2) to Low (7)

An assessment of cumulative impacts indicates 3 ecological communities, 14 flora species and 11 fauna species with high potential for cumulative impact. These communities and species typically have a restricted distribution and are often endemic to the Brigalow Belt South Bioregion. The potential for cumulative impact is extenuated by the considerable number of contiguous projects with similar impact pathways and temporal scales of operation. There are also a number of highly restricted endemic species that have limited potential for cumulative impact. These include the flora species Forster's wiregrass (*Aristida forsterii), Macrozamia machinii* (a cycad), the reptile collared delma *(Delma torquate)* and the butterfly bulloak jewel (*Hypochrysops piceatus).* Species endemicity in these cases is centred on the Arrow Surat Gas PDA, highlighting the necessity for effective long term management by the proponent.

Cumulative Impacts to ecological communities, REs and threatened flora and fauna species can best be managed at the individual project scale. The successful management of cumulative impacts will however be assisted by a collaborative approach between the proponents of interacting projects, particularly in regards to ecological research and effective habitat offsetting.

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GLOSSARY

Term	Definition
abiotic	Pertaining to physical and inorganic components of the environment.
alluvial	Sediments deposited by flowing water.
alluvium	A general term for unconsolidated deposits of inorganic materials (clay, silt, sand, gravel, boulders) deposited by flowing water.
arboreal	Relating to or moving within a tree (refering to fauna)
basal area	A measure of the total cross-section area of stems at breast height (1.3 metres above the ground).
benchmark	A description of a regional ecosystem that represents the median characteristics of a mature and relatively undisturbed ecosystem of the same type (Eyre *et al.* 2006).
Industry standard environmental management	Management of an activity to minimise environmental harm through cost-effective measures, assessed against measures currently used for the activity by the petroleum industry in Queensland and the world.
biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: ▪ genetic diversity – the variety of genes (or units of heredity) in any population ▪ species diversity – the variety of species ▪ ecosystem diversity – the variety of communities or ecosystems.
biodiversity significance	The ranked significance of an area according to specified biodiversity values to account for ecological concepts such as rarity, diversity, fragmentation, habitat condition, resilience, threats, and ecosystem processes. Biodiversity Planning Assessments identify three levels of Biodiversity Significance – State, Regional and Local –based on a number of data queries that simultaneously integrate an array of information for a bioregion. They may also indicate areas that have not been assigned a Biodiversity Significance because they have not met the criteria for State, Regional or Local Significance based on current information (EPA 2002).
biodiversity status	DERM (formerly EPA) classifies Regional Ecosystems as “Endangered”, “Of Concern” or “Not Of Concern” using the rules described on its website which is based on a blend of the definitions in Sattler and Williams (1999) and the *Vegetation Management Act 1999* (EPA 2002).
bioregion (biogeographical region)	Queensland is divided into 13 bioregions based on broad landscape patterns that reflect the major underlying geology, climate patterns and broad groupings of plants and animals. Also defined in a national system of regionalisation by Thackway & Creswell (1995). (adapted from Sattler and Williams 1999).
Bitterlich Stick	A gauge used to measure the basal area in a vegetation habitat in m^2.
braun-blanquet (method)	A method of describing an area of vegetation devised by J. Braun-Blanquet in 1927. It is used for rapid survey of large areas. It uses two scales consisting of a plus sign and a series of numbers from 1 to 5 denoting both the numbers of species and the proportion of the area covered by that species.
Brigalow belt	A bioregion that spans inland and Eastern Queensland from Townsville in the north to northern New South Wales, covering an area of about six million hectares.

Term	Definition
canopy	Defined in Beadle and Costin (1952) as a cover of foliage formed either by the community as a whole or by one of its component layers. It may be continuous or discontinuous (Neldner *et al.* 2005).
Category A Environmental Sensitive Area	The *Environmental Protection Regulation 2008* provides a mechanism to enforce the EP Act and allows for an assessment of the risk that an ERA poses to Environmentally Sensitive Areas (ESAs). Category A ESAs are all areas designated as National Park under the *Nature Conservation Act 1999* (NCA) as well as: • conservation parks; • forest reserves, and • the Wet Tropics World Heritage area.
Category B ESAs	Relevant to the following natural terrestrial ecology elements: • areas designated under the NCA as Co-ordinated Conservation Areas, Wilderness Areas, World Heritage Management Areas, areas of critical habitat under a conservation plan or areas subject to interim conservation orders; • conventions to which Australia is signatory including the 'Convention on the Conservation of Migratory Species of Wild Animals' and the 'Convention on Wetlands of International Importance (Ramsar) Convention, Iran, (1971); • Feature Protection Areas (e.g. State Forest Park); and • Regional Ecosystems listed as endangered (Biodiversity Status) by Queensland Department of Environment and Resource Management (DERM).
Category C ESAs	Not listed under the schedules of the Environmental Protection Regulations although are provided within the *Draft Code of Environmental Compliance for Level 2 Petroleum Activities* (DERM 2008) forming part of the environmental compliance and conditioning framework.
core habitat	A combination of Essential and/or General Habitat (as defined by the experts) where DERM is sufficiently confident that the identified areas are important for the taxon concerned, whether or not the taxon has actually been recorded there.
CORVEG	Queensland Herbarium database for field data.
critically endangered	Designated as 'critically endangered' under the EPBC Act. Refer to definition of 'EPBC Act conservation status' for meaning of critically endangered under the Act.
crown cover	The percentage of the sample site occupied by the vertical projection of the periphery of the tree crowns. Crowns are treated as opaque (Neldner *et al.* 2005).
declared pests	An animal or plant may be declared under the *Land Protection (Pest and Stock Route Management) Act 2002.*
dissect corridors	Corridors of vegetation that results in a break of more than 50 metres wide across a corridor.
disturbance	The physical displacement of existing features that leads to impacts.
ecological community	An assemblage of species occupying a particular area.

Term	Definition
ecological condition	The health/condition of an ecological community, as assessed against the following criteria: ▪ disturbance (whether this be natural or human) including its degree or severity, its extent and distribution within the community ▪ weed content — description of species abundance, horizontal and vertical distribution of each species ▪ ecological viability — measure of a community's ability to survive in the longer term ▪ ecological health — measure of regeneration, size structure and number of dead or dying plants within a community ▪ ecological relationships — the sequential relationship of one community to another.
ecological value	Referring in this report to a value placed on a terrestrial fauna or flora species or habitat.
Endangered	Under the Queensland *Nature Conservation Act 1992*, a species may be classified as endangered if: (a) there have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the life cycle or form of the wildlife, or (b) the habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction, or (c) the population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction, or (d) the survival of the wildlife in the wild is unlikely if a threatening process continues. Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, a species may be classified as endangered if: (a) it is not critically endangered, and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Endemic	Taxon that has at least 75% of its known range within a bioregion or which has a total range of 100,000 km^2 or less (Commonwealth of Australia 1995) (EPA 2002).
environmental offset	An action taken to counter-balance any unavoidable negative impacts that might result from an activity or a development.
environmental weed	A plant that invades native plant communities (it may also invade farmland and urban areas) and which may hinder the survival and regeneration of native vegetation, thus affecting native fauna and, in some cases, permanently altering both vegetation structure and composition. Most environmental weeds are exotic plants, however there is a significant, and increasing, number of Australian plant species that are causing problems outside their normal range.
environmentally relevant activity	Usually industrial activities with the potential to release contaminants to the environment.
environmentally sensitive area (ESA)	A location however large or small, that has environmental values that contribute to maintaining biological diversity and integrity, have intrinsic or attributed scientific, historical or cultural heritage value, or are important in providing amenity, harmony or sense of community.
EPBC Act conservation status	Under the EPBC Act 1999, listed threatened species and ecological communities are assigned a conservation status of 'extinct in the wild', 'critically endangered', 'endangered' or 'vulnerable'. Definitions of these terms under the EPBC Act areas follows:

Term	Definition
	Extinct in the wild ▪ known only to survive in cultivation, in captivity or as a naturalized population well outside its past range' or ▪ not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form. Critically endangered ▪ facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria. Endangered ▪ not critically endangered and ▪ facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria. Vulnerable ▪ not critically endangered or endangered and ▪ facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
erosion	The wearing away of rock or soil caused by physical or chemical processes.
essential habitat	An are identified for a species of wildlife listed as endangered, vulnerable, or near-threatened under the *Nature Conservation Act 1992* on a map prepared by the chief executive officer of the Department of Environment and Resource Management and certified by the chief executive officer of the Department of Environment and Resource Management for the purposes of the *Vegetation Management Act 1999*.
EVNT species or taxon/taxa	A species of wildlife listed as endangered, vulnerable, or near-threatened under the *Nature Conservation Act 1992,* and/or under the EPBC Act 1999, as 'extinct in the wild', 'critically endangered', 'endangered' or 'vulnerable'.
gathering line	A pipeline to convey gas or water from a production facility to a processing plant, compressor station, flow line or transmission pipeline.
general habitat	An area or location that has been used by transient individuals of a EVNT taxon, or where a EVNT taxon has been recorded but there is insufficient information to assess the area as essential. General Habitat may be defined from known records or considered potential according to expert knowledge of habitat relationships, and may include areas of suboptimal habitat.
grey literature	non peer reviewed scientific articles
groundwater	Subsurface water, generally saturating the soil or rock in which it occurs.
habitat	An area or areas permanently, periodically or occasionally occupied by a species, population or ecological community, including any and all biotic and abiotic features of the area or areas occupied.
heterogeneous RE polygon	An area (polygon) delineated on a map of regional ecosystems (REs) comprising a mixture of RE types.
homogeneous RE polygon	An area (polygon) delineated on a map of regional ecosystems (REs) comprising a single RE.
impact	Any event or series of events that disrupt ecosystem, community, or population structure and alter the physical environment, directly or indirectly.
individual	A genetically discrete organism (within the genetic and morphological confines of a species, subspecies or variety) that has arisen from sexual reproduction, *viz.* a seed. Individuals may spatially comprise singletons (i.e.

Term	Definition
	a tree by itself) or may comprise many ramets that lack physical connection (i.e. clonal disintegration). It should be noted that for plants, many ‘individuals’ are genetically indistinguishable due to inbreeding and the accumulation of similar genes or the mode of seed .
Insectivorous	An organism that feeds on insects
lake	A natural or artificial body of water either permanent or intermittent.
land degradation	Land degradation includes the following: • soil erosion. • rising water tables. • the expression of salinity. • mass movement by gravity of soil and rock. • stream bank instability. • a process that results in declining water quality.
land zones	Land zones represent major differences in geology and in the associated landforms, soils, and physical processes that gave rise to distinctive landforms or continue to shape them (Sattler and Williams 1999). Land zones are generally derived by amalgamating a range of geological, land system and/or soil mapping units at 1:100 000 to 1:250 000 scale. Twelve land zone classes have been defined for Queensland and are numbered from 1-12.
Limited Petroleum Activities	Activities including: ▪ Geophysical exploration (including seismic) ▪ Well sites and pads ▪ Sumps ▪ Flare pits ▪ Flow Lines and supporting access tracks Limited Petroleum Activities do not include ▪ Petroleum storage areas ▪ Dams ▪ Compressor Stations ▪ Campsites and workforce accomodation ▪ Power sites ▪ Waste disposal areas Limited activities are defined in the Queensland Co-ordinator General’ report on environmental impact statement - APLNG Project (Qld Government, 2010).
Matters of National Environmental Significance (NES)	Those areas, places, species, communities or activities listed in Part 3 of EPBC Act as Matters of National Environmental Significance. These are: ▪ World Heritage properties ▪ National heritage ▪ wetlands listed as Ramsar wetlands of international importance ▪ threatened species and communities listed under the EPBC Act (note that these species may not be the same as those listed under state legislation) ▪ migratory species listed under the EPBC Act (these are migratory species protected under international agreements) ▪ nuclear actions, including uranium mining ▪ the marine environment (which for the purposes of the Commonwealth is generally Australian waters beyond the 3 nautical mile limit of state waters ▪ any other matter prescribed by regulation
metapopulation	One to many subpopulations (geographically contiguous or disjunct) that share genetic connectivity. The ultimate aim of conservation biology is to

Term	Definition
	conserve the different subpopulations and genetic variation (total taxon variation and subpopulation variation). The greater the genetic variation within a taxon or subpopulation, then the greater potential exists for 'adaptation' in response to stochastic events (i.e. climate change). A subpopulation may consist of one to many individuals of a species, subspecies or variety (collectively taxon). A taxon may comprise one to many metapopulations.
migratory species	An animal that periodically or occasionally migrates to, or visits, Australia.
native (flora)	The definition of native plants is based on that provided in Bostock and Holland (2007). This is plant taxa that have evolved in Queensland unaided by human intervention, or have migrated to and persist in Queensland unaided by human intervention. This does not include taxa that are naturalised to Queensland or a particular bioregion. Bostock and Holland (2007) lists plant taxa that are accepted as native to Queensland (adapted from Neldner *et al.* 2005).
naturalised	The definition of naturalised plants or vegetation is based on that provided in Bostock and Holland (2007). This is plant taxa that have originated outside Queensland or a bioregion that have been introduced to Queensland or a bioregion by or with the help of humans intervention, and persist there unaided by human intervention. Bostock and Holland (2007) lists plant taxa that are naturalised in Queensland or particular pastoral districts (adapted from Neldner *et al.* 2005).
NCA 1992 conservation status	Under the NCA, protected species are assigned a conservation status of 'extinct in the wild', 'endangered', 'vulnerable', 'near-threatened', or 'least concern'. Definitions of these terms under the NCA are as follows: Extinct in the wild ▪ there have been thorough searches conducted for the wildlife and ▪ it has not been seen in the wild over a period that is appropriate for the life cycle or form of the wildlife. Endangered ▪ there have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the life cycle or form of the wildlife, or ▪ the habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction, or ▪ the population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction, or ▪ the survival of the wildlife in the wild is unlikely if a threatening process continues. Vulnerable ▪ its population is decreasing because of threatening processes, or ▪ its population has been seriously depleted and its protection is not secured, or ▪ its population, while abundant, is at risk because of threatening processes, or ▪ its population is low or localised or depends on limited habitat that is at risk because of threatening processes. Near-threatened ▪ the population size or distribution of the wildlife is small and may become smaller, or ▪ the population size of the wildlife has declined, or is likely to

Term	Definition
	decline, at a rate higher than the usual rate for population changes for the wildlife, or ▪ the survival of the wildlife in the wild is affected to an extent that the wildlife is in danger of becoming vulnerable. Least concern ▪ the wildlife is common or abundant and is likely to survive in the wild. Native wildlife may be prescribed as least concern wildlife even if: ▪ the wildlife is the subject of a threatening process, or ▪ the population size or distribution of the wildlife has declined, or ▪ there is insufficient information about the wildlife to conclude whether the wildlife is common or abundant or likely to survive in the wild.
near-threatened	Designated as 'near-threatened' under the NCA. Refer to definition of 'NCA conservation status' above for meaning of near-threatened.
niche	A term describing the relational position of a species or population in its ecosystem to each other.
non-remnant vegetation	All vegetation that is not mapped as remnant vegetation by DERM and/orthat fails to meet DERM criteria for 'remnant vegetation'. May include regrowth, heavily thinned or logged and significantly disturbed vegetation that fails to meet the structural and/ or floristic characteristics of remnant vegetation. It also includes urban and cropping land. Non-remnant vegetation may retain significant biodiversity values (Neldner *et al.* 2005).
not of concern	Designated as 'not of concern' under the VMA. Refer to definition of 'VMA status' for meaning of 'not of concern' under the Act.
of concern	Designated as 'of concern' under the VMA. Refer to definition of 'VMA status' for meaning of 'of concern' under the Act.
palustrine	Palustrine wetlands are primarily vegetated non-channel environments of less than eight hectares. They include billabongs, swamps, bogs, springs, soaks etc.
perennial species	Perennial species are long-lived plants, tending to persist for three or more years. Generally characterized by larger bulk than annual grasses i.e forming tussocks and large root mass with evidence of previous seasons growth i.e. remains of last years tiller bases, and presence of stolons or rhizomes (or underground rooting systems) (Eyre *et al.* 2006).
permanent infrastructure	Any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, pipelines etc), which is to be left by agreement with the landowner
petroleum activity	Defined in the EP Act as an activity: • authorised on a petroleum tenure granted under the Petroleum Act 1923; or • authorised on the petroleum authority granted under the Petroleum and Gas (Production and Safety) Act 2004; or • exploring for or mining minerals under a licence, permit, pipeline licence, secondary licence or special prospecting authority granted under the Petroleum (Submerged Lands) Act 1982; or • rehabilitating or remediating environmental harm because of an activity mentioned in paragraphs (a) or (c); or • action taken to prevent environmental harm because of an activity mentioned in paragraphs (a) to (d); or • required under a condition of an environmental authority (petroleum activities); or

Term	Definition
	• required under a condition of an environmental authority (petroleum activities) that has ended or ceased to have effect, if the condition: (i) continues to apply after the authority has ended or ceased to have effect; and (ii) has not been complied with
petroleum authority	Includes Authority to Prospect, Petroleum Lease, Data Acquisition Authority, Water Monitoring Authority, Petroleum Facility Licence, Survey License and Pipeline Licence issued or granted under the Petroleum Act 1923 or Petroleum and Gas (Production and Safety) Act 2004.
petroleum project	Refered to in this document as all petroleum activities conducted on one or more petroleum authorities as a single integrated operation.
population	In the absence of genetic data, disjunct locality records (those that are separated by areas of different habitat, i.e. Regional Ecosystems where the taxon is absent). A population may consist of one to many individuals. Greatly disjunct populations are inferred to harbour significant genetic variation due to historical patterns of genetic drift. A species, subspecies or variety that has population groups in e.g. the Wet Tropics and Border Ranges, would be inferred to comprise several metapopulations.
project development area	An approxaimtely 8,600-km^2 area extending from the township of Wandoan in the north towards Goondiwindi in the south, in an arc through Dalby, and encompasses all the area containing the proposed Surat Gas Project; It represents the area that could potentially be affected by the project either directly or indirectly. This also corresponds to the area in which biodiversity surveys were completed .
putrescible	Matter that is likely to become putrid (rotten).
quaternary site	Quaternary site data are used primarily as a record of field traverses and to verify regional ecosystem/vegetation mapping. These sites are generally collected throughout the field survey and entered on spreadsheets or databases. Quaternary sites may be collected at regular intervals along a traverse, and/or made where REs/vegetation communities change.
Ramet	An individual member of a clone.
Ramsar wetland	A wetland listed under *The Convention on Wetlands* (1975), an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation of wetlands.
regional ecosystem (RE)	A vegetation community, within a bioregion, that is consistently associated with a particular combination of geology, landform and soil. REs may be classified under schedules 1–3 of the Vegetation Management regulation as either endangered, of concern or not of concern. Refer to 'VMA conservation status' for meaning of endangered, of concern or not of concern under the VMA.
regrowth vegetation	Non-remnant vegetation that has a significant woody component but fails to meet the structural and/or floristic characteristics of remnant vegetation. Includes vegetation that has regrown after clearing or been heavily thinned or logged and may retain significant biodiversity values.
regrowth vegetation code	Allows for regulation of the clearing of high value regrowth vegetation (HVR) defined as regrowth vegetation that has not been cleared post December 31, 1989. Exemptions to the code apply to clearing of regrowth vegetation for extractive industry within key resource areas, clearing for a number of prescribed land management practices (e.g. fencing or firebreaks) or for significant community projects.

Term	Definition
remnant vegetation (or remnant regional ecosystems)	Remnant vegetation for areas of woody vegetation where there is evidence of past clearing. ?It follows that used in the *Vegetation Management Act 1999* for areas for which no regional ecosystem or remnant vegetation cover mapping exists. Remnant woody vegetation is defined as vegetation where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy (Neldner *et al.* 2005).
riverine area	Refers to land confined to the flood flow channel of a watercourse.
runoff	All surface flow from within a catchment.
saline water	Water that is generally considered unsuitable for human consumption or for irrigation because of its high content of dissolved solids.
secondary site	Vegetation survey sites used for classification and detailed descriptions of regional ecosystems and vegetation communities. Data collected include all location, environmental and overall structural information as well as a list of all species present and basal area (of woody stems using the Bitterlich stick method), percentage cover and stem density measures of abundance within a 50x10m plot.
Senescing	Reaching late maturity
sensitive place	A sensitive place means any of the following places: • a dwelling • a library, childcare centre, kindergarten, school, college, university or other educational institution: • hospital, surgery or other medical institution; • a protected area or an area identified under a conservation plan as a critical habitat or an area of major interest, under the Nature Conservation Act 1992; • a marine park under the Marine Parks Act 1982; and • a park or garden that is open to the public.
sensitive receptor	Those areas sensitive to the predicted environmental impacts (from air emissions and noise etc). For the purpose of this project, sensitive receptor means any of the following places: • a dwelling. • a library, childcare centre, kindergarten, school, college, university or other educational institution. • a hospital, surgery or other medical institution. • a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest, under the Nature Conservation Act 1992 (Qld). • a marine park under the Marine Park Act 1982 (Qld). • a park or garden that is open to the public for use other than for sport or organised entertainment. This excludes dwellings owned by Arrow Energy and which are un-occupied (or will be un-occupied at the time of operations).
significantly disturbed land and significant disturbance	Land that is: • contaminated land: or • disturbed and human intervention is needed to rehabilitate it: • to a state required under the relevant environmental authority: or

Term	Definition
	• if the environmental authority does not require the land to be rehabilitated to a particular state-to its state immediately before the disturbance.
site (survey)	An area of vegetation with relatively uniform structure, floristics and geology where botanical data are collected such as primary, secondary, tertiary or quaternary sites. For trees, the site includes the area covered by a basal area sweep (Bitterlich stick or prism) (Neldner *et al.* 2005).
state wildlife corridor	An area identified as State Wildlife corridor on a map prepared by the chief executive office of DERM and certified by the chief executive officer of DERM for the purposes of the *Vegetation Management Act 1999*.
stratum	A layer in a community produced by the occurrence at approximately the same level (height) of an aggregation of plants of the same habit (Beadle and Costin 1952 in Neldner *et al.* 2005).
stochastic	A process involving a random set of variables interacting over time.
structure	The spatial arrangement of plants within a vegetation community (Beadle and Costin 1952 in Neldner *et al.* 2005).
study area	The project area including a 10km buffer.
subregion (province)	A subdivision of a bioregion. Subregions delineate the major geomorphic patterns within bioregions (Morgan 2001) and may be defined by a suite of land systems, geological units and associated landforms, or environmental domains. Subregions are referred to as provinces in Sattler and Williams (1999), Neldner *et al.* 2005).
taxon (plural taxa)	Any group or rank in a biological classification into which related organisms are classified (e.g. phylum, order, family, genus or species).
tertiary site	Vegetation survey sites used for classification and descriptions of regional ecosystems and vegetation communities. Data collected include all location, environmental and overall structural information as well as a comprehensive list of woody species and basal area measure of abundance (of woody stems using the Bitterlich stick method). Generally only the dominant or conspicuous species in the ground layer are recorded.
threatened	Used with reference to ecological communities, REs or species of that are Endangered, Vulnerable or Of Concern as listed under the NCA, the VMA or the EPBC Act (see NCA conservation significance, the VMA conservation significance and EPBC Act conservation significance for more details).
threatened ecological community	Three categories exist for threatened ecological communities under the Commonwealth *Environment and Biodiversity Conservation Act 1999.* *Critically Endangered* If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future. *Endangered* If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future. *Vulnerable* If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.
threatening process	A threatening process is any process that is capable of: ▪ threatening the survival of sensitive areas including any protected area, area of major interest, protected wildlife, community of native wildlife or native wildlife habitat, or ▪ affecting the capacity of any protected area, area of major interest,

Term	Definition
	protected wildlife, community of native wildlife or native wildlife habitat to sustain natural processes.
top soil	The top layer of soil, alluvium or weathered rock that forms a suitable plant growth medium. Top soil should be non-crusting and low in salinity.
traverse	The route travelled by vehicle or on foot in the field. For determination of relative reliability it represents a record of where the surveyor has been and is an index to the amount of informal observations (Neldner *et al.* 2005).
vegetation community	A component of a regional ecosystem that has similar structure and floristics and generally occurs within the same land zone. These components of regional ecosystems are generally mappable at scales larger than 1:100 000. A number of vegetation communities may make up a single regional ecosystem, and is usually distinguished by differences in dominant species composition, frequently in the shrub or ground layers (Neldner *et al.* 2005).
vegetation map	A map whose primary purpose is to show the geographical distribution of the various vegetation types of a given area (Neldner *et al.* 2005).
VMA conservation status	Under the VMA 1999, REs may be classified as either 'Endangered', 'Of Concern' or 'Not of Concern'. Definitions of these terms under the VMA are: Endangered ▪ less than 10% of pre-clearing extent of remnant vegetation (see following definition) exists in the bioregion, or 10 to 30 % of pre-clearing extent remains and the remnant vegetation is less than 10 000 hectares. In addition, for biodiversity planning purposes DERM also classifies a regional ecosystem as endangered if: ▪ less than 10% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss or ▪ 10-30% of its pre-clearing extent remains unaffected by severe degradation, and/or ▪ biodiversity loss and the remnant vegetation is less than 10,000 hectares; or it is a rare regional ecosystem subject to a threatening process. Of concern ▪ 10 to 30% of pre-clearing extent of remnant vegetation exists in the bioregion, or more than 30% of pre-clearing extent remains and the remnant vegetation is less than 10 000 ha. In addition, for biodiversity planning purposes DERM also classifies a regional ecosystem as of concern if: ▪ 10-30% of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss. Not of concern ▪ more than 30% of pre-clearing extent of remnant vegetation exists in the bioregion, and it is greater than 10, 000 ha. In addition, for biodiversity planning purposes DERM also classifies a regional ecosystem as not of concern if the degradation criteria listed above for endangered or of concern REs are not met.
vulnerable	Designated as 'Vulnerable' under the EPBC Act and/or NCA. Refer to definitions of 'EPBC Act conservation status' and 'NCA conservation status' for meaning of 'Vulnerable' under these Acts.
waterlogging	The saturation of soil by soil water.
watertable	The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.
WildNet	Queensland Department of Environment and Resource Management WildNet Database which contains recorded wildlife sightings and listings of plants, fungi, protists, mammals, birds, reptiles, amphibians, freshwater fish,

Term	Definition
	marine cartilaginous fish and butterflies in Queensland.

Acronyms and Abbreviations

Abbreviation	Description
ANRA	Australian Natural Resources Atlas
ATP	Authority to prospect
BA	Birds Australia
BAMM	Biodiversity Assessment and Mapping Methodology
BBS	Brigalow Belt South (bioregion)
BPA	Biodiversity Planning Assessment as published by DERM.
CFN	Chinchilla Field Naturalists
DECC	Department of Environment and Climate Change (NSW).
DEEDI	Queensland Department of Employment Economic Development and Innovation
DERM	Queensland Department of Environment and Resource Management
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (obsolete: now DSEWPC)
DEWR	Commonwealth Department of the Environment and Water Resources (obsolete: now DEWHA)
DNRM&W	Queensland Department of Natural Resources, Mines and Water (obsolete: now DERM)
DPI	Queensland Department of Primary Industries
DSEWPC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EIS	environmental impact statement
EIA	environmental impact assessment
EM Plan	environmental management plan required under *Environmental Protection Act 1994* (Qld)
EP Act	*Environmental Protection Act 1994* (Qld)
EP Regulation	Environment Protection Regulation 1998 (Qld)
EPA	Environmental Protection Agency (obsolete: now DERM)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cwlth)
ERA	environmentally relevant activity
ES	Ecosmart Ecology
ESAs	environmentally sensitive areas
EVNT	A species of wildlife listed as endangered, vulnerable or near-threatened under the *Nature Conservation Act 1992,* and/or under the EPBC Act 1999, as 'extinct in the wild', 'critically endangered', 'endangered' or 'vulnerable'.
GIS	Geographical Information Systems
GPS	global positioning system
Ha	hectare
HERBRECS	Queensland Herbarium plant data base.
HVR	High Value Regrowth as defined under *Queenslands Regrowth Vegetation Code (2009).*
km	kilometre
km^2	square kilometre
LNG	liquefied natural gas
LPA	*Land Protection (Pest and Stock Route Management) Act 2002* (Qld)
m	metre
m^3	cubic metre
mm	millimetre
MNES	Matter of National Environmental Significance
Mtpa	million tonnes per annum
MW	Megawatt
NCA	*Nature Conservation Act 1992* (Qld)
NCR	*Nature Conservation (Wildlife) Regulation* 2006 (Qld)

Abbreviation	Description
NSW	New South Wales
P & G Act	*Petroleum and Gas (Production and Safety) Act 2004* (Qld)
PDA	Project development area
PL	petroleum lease
PLA	petroleum lease application
PPCP	Nature Conservation (Protected Plants) Conservation Plan 2000
Qld	Queensland
QM	Queensland Museum
QPWS	Queensland Parks and Wildlife Service
RE	Regional Ecosystem
REDD	The Regional Ecosystem Description Database which contains the latest descriptions of regional ecosystems and available online through DERM.
ROW	right of way
SEWPAC	Department of Sustainability, Environment, Population and Communities
TOR	Terms of Reference (for an EIS)
TJ/d	Terajoules of gas per day (TJ/d)
VMA	*Vegetation Management Act 1999* (Qld)
VC	vegetation community
WN	DERMs Wildnet Database
WONS	Weeds of National Significance
* appended to species name	Indicative of exotic species

1. INTRODUCTION

1.1 Project Proponent

Arrow Energy Pty Ltd (Arrow) is an integrated energy company with interests in coal seam gas field developments, pipeline infrastructure, electricity generation and a proposed liquefied natural gas (LNG) projects. Arrow has interests in more than 65,000 km^2 of petroleum tenures, mostly within Queensland's Surat and Bowen basins. Elsewhere in Queensland, the company has interests in the Clarence-Moreton, Coastal Tertiary, Ipswich, Styx and Nagoorin Graben basins.

Arrow's petroleum tenures are located close to Queensland's three key energy markets; Townsville, Gladstone and Brisbane. The Moranbah Gas Project in the Bowen Basin; and the Tipton West, Daandine, Kogan North and Stratheden projects in the Surat Basin near Dalby comprise Arrow's existing coal seam gas production operations. These existing operations currently account for approximately 20% of Queensland's overall domestic gas production.

Arrow supplies gas to the Daandine, Braemar 1 and 2, Townsville and Swanbank E power stations which participate in the National Electricity Market. With Arrow's ownership of Braemar 2, and the commercial arrangements in place for Daandine and Townsville power stations Arrow has the capacity to generate to up to 600 MW of power .

Arrow and its equity partner AGL Energy have access rights to the North Queensland Pipeline, which supplies gas to Townsville from the Moranbah Gas Project. They also hold the pipeline licence for the proposed Central Queensland Gas Pipeline between Moranbah and Gladstone.

Arrow is currently proposing to develop the Arrow LNG Project, which is made up of the following aspects:

- Arrow LNG Plant – The proposed development of an LNG Plant on Curtis Island near Gladstone, and associated infrastructure, including the gas pipeline crossing of Port Curtis.
- Surat Gas Project – The upstream gas field development in the Surat Basin, the subject of this assessment.
- Arrow Surat Pipeline Project – (Formerly the Surat Gladstone Pipeline), the 450 km transmission pipeline connects Arrow's Surat Basin coal seam gas developments to Gladstone.
- Bowen Gas Project – The upstream gas field development in the Bowen Basin.

- Arrow Bowen Pipeline – The transmission pipeline which connects Arrow's Bowen Basin coal seam gas developments to Gladstone.

1.2 Project Overview

Arrow proposes to expand its coal seam gas operations in the Surat Basin through the Surat Gas Project. The need for the project arises from the growing demand for gas in the domestic market and global demand and the associated expansion of LNG export markets. The project development area (PDA) covers approximately 8,600 km^2 and is located approximately 160 km west of Brisbane in Queensland's Surat Basin. The PDA extends from the township of Wandoan in the north towards Goondiwindi in the south, in an arc adjacent to Dalby. Townships within or in close proximity to the PDA include (but are not limited to) Wandoan, Chinchilla, Kogan, Dalby, Cecil Plains, Millmerran, Miles and Goondiwindi. Project infrastructure including coal seam gas production wells and production facilities (including both water treatment and power generation facilities where applicable) will be located throughout the PDA but not in towns. Facilities supporting the petroleum development activities such as depots, stores and offices may be located in or adjacent to towns.

The conceptual Surat Gas Project design presented in the environmental impact statement (EIS) is premised upon peak gas production from Arrow's Surat Basin gas fields of approximately 1,050 TJ/d. The peak gas production comprises 970 TJ/d for LNG production (including a 10% fuel gas requirement for facility operation) and a further 80 TJ/d for supply to the domestic gas market. A project life of 35 years has been adopted for EIS purposes. Ramp-up to peak production is estimated to take between 4 and 5 years, and is planned to commence in 2014. Following ramp-up, gas production will be sustained at approximately 1,050 TJ/d for at least 20 years, after which production is expected to decline.

Infrastructure for the project is expected to comprise:

- Approximately 7,500 production wells drilled over the life of the project at a rate of approximately 400 wells drilled per year.
- Low pressure gas gathering lines to transport gas from the production wells to production facilities.
- Medium pressure gas pipelines to transport gas between field compression facilities and central gas processing and integrated processing facilities.
- High pressure gas pipelines to transport gas from central gas processing and integrated processing facilities to the sales gas pipeline.
- Water gathering lines (located in a common trench with the gas gathering lines) to transport coal seam water from production wells to transfer, treatment and storage facilities.

- Approximately 18 production facilities across the PDA expected to comprise six of each of the following:
  - Field compression facilities.
  - Central gas processing facilities.
  - Integrated processing facilities.
- A combination of gas powered electricity generation equipment that will be co-located with production facilities and/or electricity transmission infrastructure that may draw electricity from the grid (via third party substations).

Further detail regarding the function of each type of production facility is detailed below.

Field compression facilities will receive gas from production wells and are expected to provide 30 to 60 TJ/d of first stage gas compression. Compressed gas will be transported from field compression facilities in medium pressure gas pipelines to multi-stage compressors at central gas processing facilities and integrated processing facilities where the gas will be further compressed to transmission gas pipeline operating pressure and dehydrated to transmission gas pipeline quality. Coal seam water will bypass field compression facilities.

Central gas processing facilities will receive gas both directly from production wells and field compression facilities. Central gas processing facilities are expected to provide between 30 and 150 TJ/d of gas compression and dehydration. Coal seam water will bypass central gas processing facilities and be pumped to an integrated processing facility for treatment.

Integrated processing facilities will receive gas from production wells and field compression facilities. Integrated processing facilities are expected to provide between 30 and 150 TJ/d of gas compression and dehydration. Coal seam water received at integrated processing facilities is expected to be predominantly treated using reverse osmosis and then balanced to ensure that it is suitable for the intended beneficial use. Coal seam water received from the field, treated water and brine concentrate will be stored in dams adjacent to integrated processing facilities.

It is envisaged that development of the Surat Gas Project will occur in five development regions: Wandoan, Chinchilla, Dalby, Kogan/Millmerran and Goondiwindi. Development of these regions will be staged to optimise production over the life of the project.

Arrow has established a framework to select sites for production wells and production facilities and routes for gathering lines and pipelines. The framework will also be used to select sites for associated infrastructure such as access roads and construction camps. Environmental and social constraints to development that have been identified through the EIS process, coupled with the application of appropriate environmental management controls, will ensure that protection of ecological values (resources) is considered in project planning. This approach will maximise the opportunity to select appropriate site locations that minimise potential environmental and social impacts.

Arrow has identified 18 areas that are nominated for potential facility development to facilitate environmental impact assessment (and modelling). These are based on circles of approximately 12 km radius that signify areas where development of production facilities could potentially occur.

Arrow intends to pursue opportunities to select equipment (including reserve osmosis units, gas powered engines, electrical generators and compressors) and design facilities to the cost effective and efficient scaling of facilities to meet field conditions. This flexibility will enable Arrow to better match infrastructure to coal seam gas production. It will also enable Arrow to investigate the merits of using template design principles for facility development that may generate further efficiencies as the gas reserves are better understood, design is finalised, or as field development progresses.

1.3 Project Activities

This section provides a summary of the exploration, field development, operation and eventual rehabilitation activities associated with the project. Due to the nature of the coal seam gas development, many of the activities will be occurring concurrently at different locations in the field. Each of the activities does not represent a 'phase' of development but rather a discrete type of activity that is a component of the overall development. Activities are described in **Table 1.**

Table 1. Activities associated with project development

Component	Associated Project Activities	Purpose of Project Activities
Exploration and Appraisal Well Drilling	• Seismic Data Collection Drilling of: ▪ Stratigraphic holes ▪ Core holes ▪ Pilot Well (and associated water storage)	Drilling of stratigraphic holes, core holes and pilot wells to more accurately define and characterise gas reserves in the PDA. If viable gas resources are confirmed, the next step is field development.
Field Development	Production Wells: • Design and Installation • Operation and Maintenance • Decommissioning and Rehabilitation	• Extract gas through the removal of water from the coal seam. • Separate the gas from water. • Measure and control gas and water flow from each well. • Partial rehabilitation of land disturbed around well sites (after drilling) and complete rehabilitation of well sites after production has ceased.
	Gathering Infrastructure: ▪ Design and Installation ▪ Operation and Maintenance	• Transport gas and water separately from producing wells to processing and treatment facilities. • Provide ancillary services, such as communications and telemetry, electricity supply (where not generated at the well site) and in-field compression (if required)

Component	Associated Project Activities	Purpose of Project Activities
	▪ Decommissioning and Rehabilitation	to the production wells. • Partial rehabilitation of land disturbed around and over gathering infrastructure (after installation) and complete complete rehabilitation of gathering infrastructure after production has ceased.
	Access Tracks: ▪ Design and Installation ▪ Operation and Maintenance ▪ Decommissioning and Rehabilitation	▪ Provide access to well sites, gathering infrastructure and other project development facilities. ▪ Maintenance of site access. ▪ Partial rehabilitation of land disturbed around access tracks (after installation) and complete complete rehabilitation of access tracks after the need for access has ceased.
	Electricity Supply being a combination of grid based (overhead lines) network and local power generation including gas drives. ▪ Design and Installation ▪ Operation and Maintenance ▪ Decommissioning and Rehabilitation	▪ Ensure viable sources of electricity are available to assist field development . ▪ Supply electricity supplied to plant, equipment and facilities. ▪ Rehabilitate land disturbed around and over grid development area.
Facility Development	**Field Compression Facility, Central Gas Processing Facility and Integrated Processing Facility (IPF) Design and Installation**	
	Field Compression Facility, Central Gas Processing Facility, Integrated Processing Facility: • Design and Installation • Operation and Maintenance • Decommissioning and Rehabilitation	• Receive gas from production wells and transport to compression facilities. • Compress the gas received at the facility to pipeline transport pressure. • Dehydrate the gas received at the facility to transport pipeline and/or LNG plant quality. • Meter and control the flow of gas to the gathering pipeline as required. • Generate power from the gas and distribute for use in the facility and the field. • Provide a control centre for activities in the facility and the associated field(s). • Partial rehabilitation of land disturbed around field compression, central gas processing and integrated integrated processing facilities and complete rehabilitate land disturbed around these facilities after gas production has ceased.
	Water Storage and Treatment Facility (at IPF): • Design and Installation • Operation and Maintenance • Decommissioning and Rehabilitation	• Receive associated water from wells located within reasonable proximity to the facility. • Treat associated water to a suitable quality for beneficial use, e.g., irrigation. • Transport the treated water to beneficial water users. • Manage and store the concentrated brine produced by the water treatment process for eventual disposal or treatment and beneficial re-use. • Partial rehabilitation of land disturbed around dams (after installation) and complete rehabilitation of dam sites after production has ceased.
	Power Generation Facility:	• Generate power from gas for use in the field

Component	Associated Project Activities	Purpose of Project Activities
	• Design and Installation • Operation and Maintenance • Decommissioning and Rehabilitation	compression facility, central processing facility and integrated processing facility. • Partial rehabilitation of land disturbed around power generation facility (after installation) and complete rehabilitation of power generation facility sites after production has ceased.
	Sewerage Treatment Facility: • Design and Installation • Operation and Maintenance • Decommissioning and Rehabilitation	▪ Provide sanitary facilities for the construction and operation workforce. ▪ Partial rehabilitation of land disturbed around sewage treatment facilities (after installation) and complete rehabilitation sewage treatment facilities after production has ceased.

1.4 Site Context

The PDA lies entirely within the Brigalow Belt South bioregional area (as per Sattler and Williams, 1999), spanning the Barakula Province in northern sections, the Eastern Darling Downs Province the central areas, and the Inglewood Sandstones and Moonie River-Commoron Creek Flood Out in the south. South-eastern portions of the study area fringe the New England Tableland Bioregion. The Brigalow Belt is a major pastoral and agricultural area with much of the natural vegetation heavily fragmented, resulting from land development schemes in the 1960's. Within the PDA, agricultural development has utilised the fertile alluvial clay plains of the Condamine River that flow in a northerly direction through the central portion of the PDA. Larger population centres include the towns of Dalby, Chinchilla, Millmerran and Miles.

The PDA encompasses high value ecological areas, including endangered REs and nationally significant ecological communities, threatened flora and fauna under both state and federal legislation, environmentally sensitive areas including National Parks and Conservation Parks and Wetlands of National Significance. The study area considers the PDA buffered to a distance of 10 km for the purpose of comprehensive ecological assessment.

2. STUDY OBJECTIVES

The objective of the study is to assess the terrestrial ecological values and prepare an environmental impact assesessment across the PDA. The assessment will focus on petroleum lease (PL) and petroleum lease application (PLA) areas where gas production activities are currently proposed or underway, and results from these areas will be extrapolated across the broader PDA. The study aims to:

- Fulfill the requirements of the final terms of reference (TOR) for the Surat Gas Project.
- Identify legislation at National, State and regional level specifically relevant to terrestrial ecology (flora and fauna) that may be applicable to the Surat Gas Project.
- Review existing relevant desktop information relating to terrestrial ecology in the area, and its ability to inform the EIS process.
- Undertake a field survey, considering the seasonal requirements of ecological entities or factors, to supplement existing information and provide information sufficient to fulfill the project TOR information requirements in relation to terrestrial ecology.
- Place terrestrial ecological values into a significance assessment framework to identify the significiance of impacts (based on project activities) on ecological values as a function of their sensitivity and the magnitude of the potentail impact.
- Identify appropriate mitigation measures to reduce risk to ecological values to acceptable levels where possible.

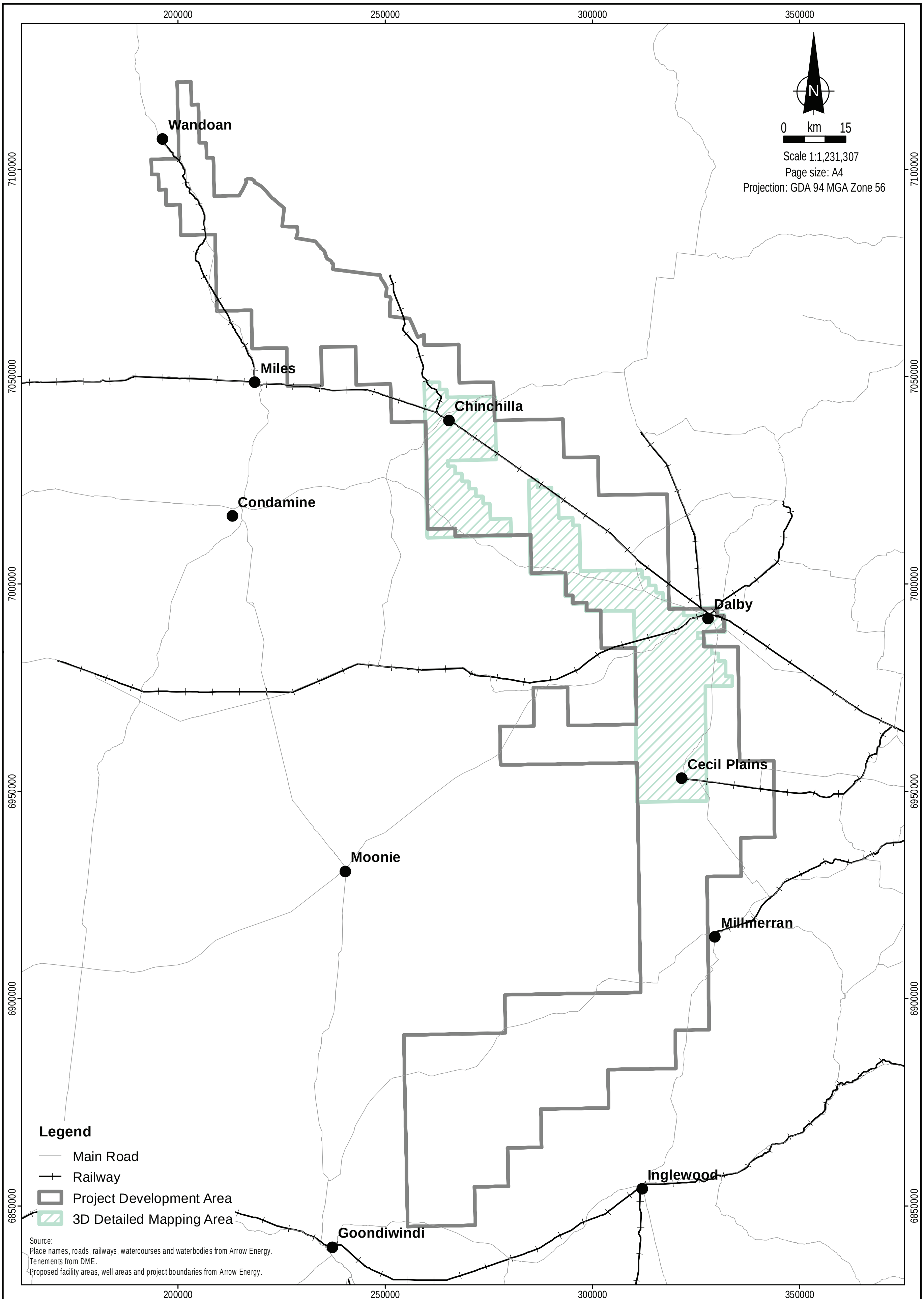
3. REGULATORY FRAMEWORK

Regulation of the environmental aspects of petroleum related activities is governed primarily by the *Environmental Protection Act 1994 Queensland* (Qld) (EP Act 1994). A range of additional statutory mechanisms at both state and federal levels may be triggered during petroleum related activities. These mechanisms are detailed in the sections below.

3.1 Queensland Government

3.1.1 Environmental Protection Act (Qld) 1994

Environmental authorisation for a petroleum related activity is regulated by the EP Act 1994. The EP Act regulates Environmentally Relevant Activities (ERAs), including those relating to mining and petroleum through the development of EISs. The *Environmental Protection Regulation 2008* provides a mechanism to enforce the EP Act and allows for an assessment of the risk that an ERA poses to Environmentally Sensitive Areas (ESAs). Details of ERAs for the petroleum industry are listed below:



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 11-07-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11 .mxd File Name: 3D_F1 _GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Project Development Area Location and Facilities11	Figure No: 1

1) ‘Level 1’ Petroleum Activities, which are activities considered to have a high risk of causing significant environmental damage; and
2) ‘Level 2’ Petroleum Activities, being activities considered to have low potential to cause environmental harm.

Arrow Energy is preparing a voluntary EIS under the EP Act 1994 for the Surat Gas Project. As outlined in the EPA Guideline “Assessment and approval process for environmental authorities for petroleum activities” petroleum activities considered as triggers for the EIS process include those that:

- have a significant impact on Category A or B ESAs;
- involve activities in a marine area;
- involve activities less than 500 m from highest astronomical tide;
- involve the construction of a new pipeline under a pipeline licence for a transmission pipeline; and
- involve the construction of a petroleum refining or processing facility (ERA 12 or ERA 13, as defined in Schedule 1 of the *Environmental Protection Regulation 1998*).

The classification of Category A, Category B or Category C ESAs is based on a ranking of environmental sensitivity.

Category A ESAs relevant to natural terrestrial ecology values include the following:

- all areas designated as National Park under the *Nature Conservation Act 1999* (NCA);
- conservation parks;
- forest reserves, and
- the Wet Tropics World Heritage area.

Category B ESAs relevant to natural terrestrial ecology values include the following:

- areas designated under the NCA as Co-ordinated Conservation Areas, Wilderness Areas, World Heritage Management Areas, areas of critical habitat under a conservation plan or areas subject to interim conservation orders;
- conventions to which Australia is signatory including the ‘Convention on the Conservation of Migratory Species of Wild Animals’ and the ‘Convention on Wetlands of International Importance (Ramsar Convention; Iran 1971);
- Feature Protection Areas (e.g. State Forest Park); and

- Regional Ecosystems (REs) scheduled as endangered (Biodiversity Status) by Queensland Department of Environment and Resource Management (DERM).

Category C ESAs are not listed under the schedules of the Environmental Protection Regulations although they are provided within the *Draft Code of Environmental Compliance for Level 2 Petroleum Activities* (EPA 2008a) forming part of the environmental compliance and conditioning framework. Category C ESAs include state forest and REs with an 'of-concern' biodiversity status. Level 2 petroleum activities must not cause impact to Category A or Category B ESAs. Authority for Level 1 petroleum activities may be granted in association with an approved Environmental Management Plan (EM Plan) with impacts to Category A and Category B ESAs addressed within this plan or assessed within the EIS Framework.

3.1.2 Nature Conservation Act (Qld) 1992

Actions relevant to the description of ecological values under the NCA include the provision for eleven classes of protected areas ranging from:

- national parks (scientific);
- world heritage management and international agreement areas;
- national parks (Aboriginal land);
- nature refuges,
- coordinated conservation areas involving private property; and
- seven classes of wildlife are defined by the *Nature Conservation (Wildlife) Regulation* 2006 (NCR) **-** extinct in the wild, endangered, vulnerable, near-threatened, least concern (previously referred to as 'common'). These classes collectively relate to native species and are protected wildlife. International and prohibited wildlife classes relate to non-native species.

3.1.3 Vegetation Management Act (Qld) 1999

The *Vegetation Management Act 1999* (VMA) is the planning initiative underlying regional management of vegetation in Queensland, including clearing of vegetation types, termed REs. The regional ecosystem classification of Sattler and Williams (1999) is a hierarchical system formed by a three part code with the primary subdivision being bioregion, followed by land zone, and then vegetation. The biogeographic region or bioregion is the primary level of classification for biodiversity values in Queensland describing where the regional ecosystem is found on a state wide basis. Land Zones are geological and geomorphic categories that describe the major geologies and landforms of Queensland. The system is based primarily on geology, with geologic age considered an important determinant. The classification of Land Zone is generally based on available geological information (Neldner *et al*. 2005) although field inspection is utilised as a supplementary measure where geological mapping is inadequate.

The status of REs is based on their pre-clearing and remnant extent, and is gazetted under the VMA and listed in the RE Description Database maintained by DERM. The Vegetation Management Status of a regional ecosystem is described in line with the following:

Endangered regional ecosystem: a regional ecosystem that is prescribed under a regulation and has either:

- < 10% of its pre-clearing extent remaining; or
- 10% to 30% of its pre-clearing extent remaining and the remnant vegetation remaining is less than 10 000 hectares (ha).

Of concern regional ecosystem: means a regional ecosystem that is prescribed under a regulation and has either:

- 10% to 30% of its pre-clearing extent remaining; or
- > 30% of its pre-clearing extent remaining and the remnant vegetation remaining is < 10 000 ha.

Least concern regional ecosystem: means a regional ecosystem that is prescribed under a regulation and has more than 30% of its pre-clearing extent remaining and the remnant vegetation remaining is more than 10 000 ha.

Essential Habitat: The VMA also has provision for the regulation of essential habitat for species of state significance. Essential habitat is vegetation in which a species that is endangered, vulnerableor near threatened has been known to occur. Clearing or disturbance to areas of essential habitat will require compensatory habitat measures to be developed.

Regrowth Vegetation Code: The *Regrowth Vegetation Code* which took effect on October 8, 2009 allows for regulation of the clearing of high value regrowth vegetation (HVR) defined as regrowth vegetation that has not been cleared post December 31 1989. Exemptions to the code apply to clearing of regrowth vegetation for extractive industry within key resource areas, clearing for a number of prescribed land management practices (e.g. fencing or firebreaks) or for significant community projects.

The code applies three levels of protection for regrowth vegetation derived from:

- endangered regional ecosystems;

- of concern regional ecosystems; and
- least concern regional ecosystems.

The code also applies protection to regrowth watercourse vegetation.

Mining and Petroleum activities as defined under the EP Act (1994) undertaken on freehold or leashold land are interpreted to be exempt from the vegetation management framework although must account for impacts to biodiversity. The nature and quality of regrowth vegetation is thus assessed accordingly with high value regrowth areas considered in the broader habitat management strategy and impact assessment process.

3.1.4 Land Protection (Pest and Stock Route Management) Act (Qld) 2002

The Land Protection (Pest and Stock Route Management) Act 2002 (LPA) provides a framework and powers for improved management of weeds, pest animals and the stock route network. The act provides for designation of threat classes to exotic species which:

- degrade natural resources;
- threaten conservation of biodiversity;
- threaten remnant vegetation;
- reduce rural production; and
- interfere with human health and recreational activities.

Exotic species that pose threat under the listed categories are declared under one of the following three categories detailed below.

- ***Class 1 Pest:*** fauna or flora species that has potential to become a very serious pest in Queensland in the future.
- ***Class 2 Pest:*** fauna or flora species has already spread over substantial areas of Queensland, but its impact is considered sufficiently serious to warrant control.
- ***Class 3 Pest:*** fauna or flora species that is commonly established in parts of Queensland but its control by landholders is not warranted unless the plant is impacting, or has potential to impact on a nearby ESA.

The mapping of flora species declared under the LPA provides a measure of vegetation condition, particularly when applied to non-statutory assessment measures as described in Eyre *et al.* (2006).

3.2 Commonwealth Government

The *Environment Protection and Biodiversity Conservation Act (Cth) 1999* (EPBC Act) provides for:

- identification and listing of species and ecological communities as threatened;
- development of conservation advice and recovery plans for listed species and ecological communities;
- development of a register of critical habitat;
- recognition of key threatening processes.

If a proponent proposes to undertake an action that will have, or is likely to have, a significant impact on a matter of national environmental significance, it may be deemed a ‘controlled action’ under the EPBC Act. The Minister for the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) will decide whether assessment and approval is required under the EPBC Act, and what level of assessment by the Commonwealth is appropriate.

3.3 Non-statutory Mechanisms

DERM’s *Biodiversity Assessment and Mapping Methodology* (BAMM) provides for a consistent state wide approach for the assessment of biodiversity values at the landscape scale in Queensland (EPA 2002a). The assessment is based largely on vegetation mapping data generated or approved by the Queensland Herbarium, and the methodology is used to generate Biodiversity Planning Assessments (BPAs) for each of Queensland's bioregions, the Brigalow Belt South BPA being relevant to the study area. These assessments are used by DERM staff, other government departments, local governments or members of the community to advise a range of planning or decision-making processes. Applying the methodology is used to identify areas of significance solely for biodiversity reasons, including threatened ecosystems or species, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes.

The *Nature Conservation (Protected Plants) Conservation Plan 2000* (PPCP) outlines how clearing permits, licenses and exemptions can be issued to take protected plants. In Queensland, all plants that are native to Australia are “protected plants” under the NCA 1992. Under Section 89 of the NCA, a licence, permit or authority (issued under the NCA) or an exemption is required to ‘take ‘ protected plants. It is an offence to take protected plants including ‘least concern’ plants, other than under a licence, permit, authority or exemption under the NCA. Section 29 of the PPCP outlines the restrictions on grant clearing permits.

Other non-statutory mechanisms include listings for Weeds of National Significance (WONS) that lists 20 species regarded as posing the greatest threat to a range of Australia’s natural values and primary industries. Identifying WONS within the study area supplements the broader assessment of vegetation community bio-condition.

4. METHODS

The size of the PDA, (approximately 8600 km^2), imposes logistical constraints on the comprehensive sampling of all vegetation and habitat types identified through desktop studies. Recognising these constraints, a risk assessment was undertaken, aiming to highlight those areas or habitats that are potentially most sensitive to project related disurbance. This risk assessment approach was undertaken in the following phases:

1. Desktop literature and database review.
2. Habitat suitability assessments.
3. Field assessments.
4. Habitat suitability assessment refinement.

Three(3)d Environmental were primarily responsible for assessment of floristic ecology, whilst Ecosmart Ecology provided technical expertise regarding fauna habitat and ecology. The project stages undertaken are described below.

4.1 Desktop Literature and Database Review

4.1.1 Flora Methods

Available literature was reviewed and analysed. It included raw data derived from database searches, information held by agencies and/or individuals, and interpretive reports. This information is analysed in the following section. Database searches from state and federal agencies provided the basis for the majority of background information regarding the presence and distribution of flora species, listed under legislation or otherwise, known from or likely to be in the PDA. The major databases searched include the following:

- Commonwealth's EPBC Online Protected Matters Search Tool completed on 21[t] February, 2011 (DSEWPC 2011).
- Queensland Herbarium's records system (HERBRECS) (DERM 2011).
- Queensland Herbariums site-based floristic database (referred to as the CORVEG database).
- DERMs WildNet (October 2009).
- DERMs Regional Ecosystem Description Database (REDD)(DERM 2009c).
- DERMs Regional Ecosystem digital data (DERM 2009b).
- Chinchilla Field Naturalist Club species database for the Charlies Creek Catchment (Chinchilla Field Naturalists Club, 2007)

- Queensland's predictive weed maps (Biosecurity Queensland 2008a) and annual pest distribution survey (Biosecurity Queensland 2008b).

The Biodiversity Planning Assessment for the Brigalow Belt (EPA 2008b) was analysed to provide additional information relevant to biodiversity significance, essential habitat and regional wildlife corridors. Additional bioregional values were reviewed within expert panel reports for landscape and flora (EPA 2002b, c). In addition, information derived from relevant books, scientific journals, unpublished technical and planning reports, and personal communications with relevant experts has been reviewed with references provided throughout the document where appropriate. These sources were used extensively to develop profiles on EVNT (Endangered, Vulnerable and Near-threatened) flora species and toward understanding potential project impacts.

4.1.2 Fauna Methods

Recent (1980 onwards) records of vertebrate species from within study area were collated from numerous public and private sources, including the Queensland Museum's collections database, Birds Australia Atlas, DERMs WildNet database and the Ecosmart Ecology dataset. Each database has inherent limitations that must be considered when analyzing the data (**Table 2**).

Table 2. Database sources

Source	Notes	Abbreviation
Queensland Museum collections database	Specimen-backed, so highly reliable. Geographic co-ordinates available.	QM
Birds Australia Atlas	Highly reliable observations. Geographic co-ordinates available. Only data collected from 1980 onwards was used.	BA
DERM WildNet	Moderately reliable observations. No geographic co-ordinates available. Only data collected from 1980 onwards was used.	WN
EPBC Protected Matters search tool	Predictive only. Of limited use for vertebrates. Most of the relevant species returned by this tool are also included in the search results from the other sources.	EPBC Online
Osmotic Ecology database	Observations only. Geographic co-ordinates available. Dataset has been compiled from field surveys in which Ecosmart Ecology personnel have participated. These include surveys conducted in conjunction with DERM and private surveys conducted by Ecosmart Ecology.	OS
Other literature	Primary literature; personal communications with relevant personal, including DERM staff; books; technical reports; Biosecurity Queensland's predictive and annual pest mapping database (Biosecurity Queensland 2008b).	References are provided throughout document where appropriate.
Biodiversity Planning Assessment Methodology	A geographical information tool used to generate Biodiversity Planning Assessments (BPAs). The methodology can be used to identify areas of various levels of biodiversity significance.	BAMM

Specific locations were available from the Queensland Museum, Birds Australia and Ecosmart Ecology, allowing records from these sources to be plotted within the study area. Location data is not available from WildNet, hindering distributional predictions and masking species relevance. To reduce artifacts caused by these constraints, the study area was divided into 14 blocks numbered from 1 in the north to 14 in the south. Individual data searches were conducted for each of these blocks, providing increased spatial resolution.

The DERM WildNet database may contain records that are also in the Queensland Museum or Birds Australia databases. Very little metadata is provided with search results from WildNet, so it is not possible to determine if WildNet records represent duplicates from other sources. As such, the site-wide species list presented in the **Appendix G** may be optimistic regarding the number of sources from which a species' record has been obtained.

Compiling the datasets allowed a list of known EVNT species as listed under state and federal legislation to be generated. It also provided an estimate of relative abundance, or record frequency, of those EVNT species present. While useful, recording frequency must be used cautiously as databases are biased towards obvious taxa such as birds.

It is also important to note that a species' presence in a database does not mean that the species is regularly seen in the study area. Single, unusual records may represent a transient individual that has been observed in the area. These individuals do not represent breeding populations and these records are of little value in the environmental planning process. Such records need to be carefully evaluated against the species' current known distribution and habitat requirements.

To provide additional information on the project and relevant EVNT species, a literature review was conducted, using books, reports, scientifically reviewed journal articles and grey literature (i.e. non peer reviewed scientific articles). This review also included geographical products produced by various government departments such as the BAMM for the Brigalow Belt. These sources were extensively used to provide project background, develop EVNT species dossiers and understand potential impacts. Any specific location details for EVNT species were recorded for consideration in the impact assessment process.

4.2 Habitat Suitability Assessment

An assessment of habitat suitability for individual EVNT species (both flora and fauna) was undertaken to identify areas of 'core' habitat and areas of 'general' habitat. Core habitat areas reflect those REs that are likely to be regularly inhabited by, or of high importance to, the species, while general habitats are those REs that may be used less regularly by fauna. Core and general habitat types were determined using the following steps:

1. Compiling a list of REs from the essential habitat factors provided by DERM under the VMA (see DERM 2009c).

2. Compiling a list of REs based on cross-referencing RE maps and known location data.
3. Vetting the resulting RE list for each species, based on known habitat requirements, to remove erroneous REs.
4. Segregating the REs into core and supplementary categories by comparing the REDD (DERM 2009c) with each species' known habitat requirements.
5. Testing the validity of the resulting RE list for each species in field investigations (using rapid habitat assessment).
6. Modifying the resulting maps to account factors for factors that cannot be included in RE descriptions (e.g. species distributions, proximity to highly valuable habitat, patch size etc.).

Due to the method used by DERM to develop their essential habitat factors, many irrelevant REs were included for most fauna species. Hence, the vetting of data was an important step. The essential habitat data for some species, particularly those recorded infrequently within the study area were not readily available. Core and supplementary REs for these species were developed by comparing the REDD with their known habitat requirements.

Numerous fauna species select habitats based on specific habitat factors that cannot be assigned to individual REs, such as rock outcrops or the presence of water or mistletoe. In such cases, core habitat included those REs that regularly contained the necessary habitat feature.

4.3 Aerial Photograph Analysis

A review and compilation of hard copy stereographic imagery, both recent and historical, from the Queensland Department of Natural Resources, Mines and Water (DNRM&W) aerial photographic library was completed to determine the most appropriate image base for vegetation mapping and assessment purposes with the PDA. A list of photographic imagery used in the assessment is provided in **Table 3**. Historical aerial photography was extensively utilised to determine the remnant and EPBC status of sensitive vegetation communities as well as broadly indicating past land management practices relevant to an assessment of vegetation condition. Certified RE mapping (DERM 2009b) was referenced during all stages of stereoscopic assessment to provide a preliminary indication of the limitations of existing mapping as well as assisting the selection of survey site locations. There is currently no available digital photographic imagery providing comprehensive coverage of the PDA although satellite imagery from google was consulted where necessary.Detailed review of stereoscopic imagery was undertaken in PL areas central to the Dalby and Chinchilla areas only, while PL(A) areas 305, 306, 307 and 308 in the northern portion of the PDA not assessed in detail.

Table 3. Stereoscopic aerial photographic imagery utilised

Map Name/ Film Number	PL/ PLA Areas Assessed*	Year	Scale	Run/ Photograph
State Flying				
Dalby / QAP6203	PL230 PL252 PL253 PL260 PL238 PL198	2006	1:40 000	Run 1, 120-124 Run 2, 114-119 Run 3, 093-102 Run 4, 075-085 Run 5, 052-062 Run 6, 041-048 Run 7, 021-026 Run 8, 008-013 Run 9, 181-186
Kogan / QAP5922	PL194 PL230	2001	1:40 000	Run 1,059-062 Run 2, 085-088 Run 3, 097-096
Milmerran / QAP 6174	PL258	2005	1:40 000	Run 1, 023-029 Run 2, 43-50
Dalby - Millmerran	PL230 PL252 PL260 PL238 PL198	1981	1:75 250	Run 2, 128-152 Run 1, 015-027
Commonwealth Flying				
Chinchilla / AUS171	PLA 185, PLA253, PL194	1989	1:82 000	Run 8, 852–860 Run 9, 903-913
Chinchilla/ CAB 237	PLA 185, PLA253, PL194	1963	1:82 000	Run 7, 5019- 5029 Run 8, 5021-5031

*Excludes PL areas 305, 306, 307 and 308 which were not subject to detailed assessment.

4.4 Field Survey

4.4.1 Ecological Site Selection and Survey

Results of the literature review and the aerial photographic interpretation were used to select patches of remnant and non-remnant vegetation for targeted fieldwork. These patches, which represented most REs known from the PDA, were selected in consultation with the Arrow landholder liaison staff, based on an initial assessment of habitat sensitiity perceived likelihood of exposure to threatening processes. Surveyed sites were thus located within:

- ecosystems where limited information on condition or structure within the PDA is available;
- areas identified as possessing, or potentially possessing significant or sensitive vegetation, flora and vertebrate species; and
- areas with representative examples of remnant vegetation which provide reference condition for a number of sensitive vegetation communities REs

Fieldwork was conducted over several periods, for a total of 29 days between 21 October and 4 December 2009, and for an additional six days between the 4 and 9 May, 2010. The earlier periods of field survey specifically targeted PL areas in the vicinity of Dalby. These were supplemented by surveyed sites completed during later survey periods. The weather during the late 2009 surveys was hot to very hot with days of 35-40˚C and afternoon and evening thunder and hailstorms. The May 2010 seasonal survey was conducted in dry and mild weather conditions and focused on condition assessment of grassland ecosystems and targeted surveys for EVNT flora.

A total of 399 sites were recorded during the field survey area comprising 74 secondary, six tertiary and 319 quaternary sites. The majority of these were collected from within the PDA. Up to nine sites were assessed in habitats outside the PDA to confirm habitat requirements for particular species. Further sites were added opportunistically during the field survey to provide complete data coverage and allow mapping unit verification. The location of ecological survey sites is shown in **Figure 2**. A summary of survey sites including structural and floristic information is provided in **Appendix A.**

4.4.2 Vegetation Community Mapping

Detailed assessment is restricted to PL areas where mapping revision was undertaken utilising stereo-photographic images over an area approximating 1200km^2 at a spatial scale of 1:40 000 with polygons delineated down to 0.5ha, particularly where EPBC listed communities are confirmed to be present. Due to the lack of detailed infrastructure planning areas across the PDA, available ecosystem mapping at a scale of 1:100 000 (DERM 2009b) was utilised as a basis for biodiversity assessment and preliminary sensitivity assessment. It is considered that from detailed assessment of PL areas, sufficient information would be obtained to allow assumptions in regard to the utility of the existing certified ecosystem mapping to be made and management requirements identified. The sampling scale for remnant vegetation equates roughly to 1:50 000 in revised mapping areas.

4.4.3 Flora Methods

Field survey methods followed Queensland Herbarium standards as identified in Neldner *et al.* (2005) using a combination of formalised secondary, tertiary and quaternary level sampling procedures, as well as informal site observation.

Secondary sites consisted of a 50 m x 10 m plot located along contour with attempts made to avoid sampling across Vegetation Community (VC) boundaries. Crown intercept transects were extended to 100 m for the purpose of providing sufficient data for reference sites as required for map amendment procedures. Bitterlich measurements, as described in Grosenbaugh (1952), were used to record community basal area at all sites except in highly linear communities where the method proved inappropriate.

Full species lists for all strata were established during the secondary sampling procedure wherein the 500 m^2 plot was intensively sampled, followed by a detailed search of the vicinity. The abundance of all species within the plot was recorded by stem counts and by a visually assessed

1-5 cover-abundance ranking using the braun-blanquet method. Groundcover was assessed using five 1x1 m subplots placed at 10 m intervals along the transect with visual cover estimations of dominant species. Ecological and structural data together with full species lists were also recorded.

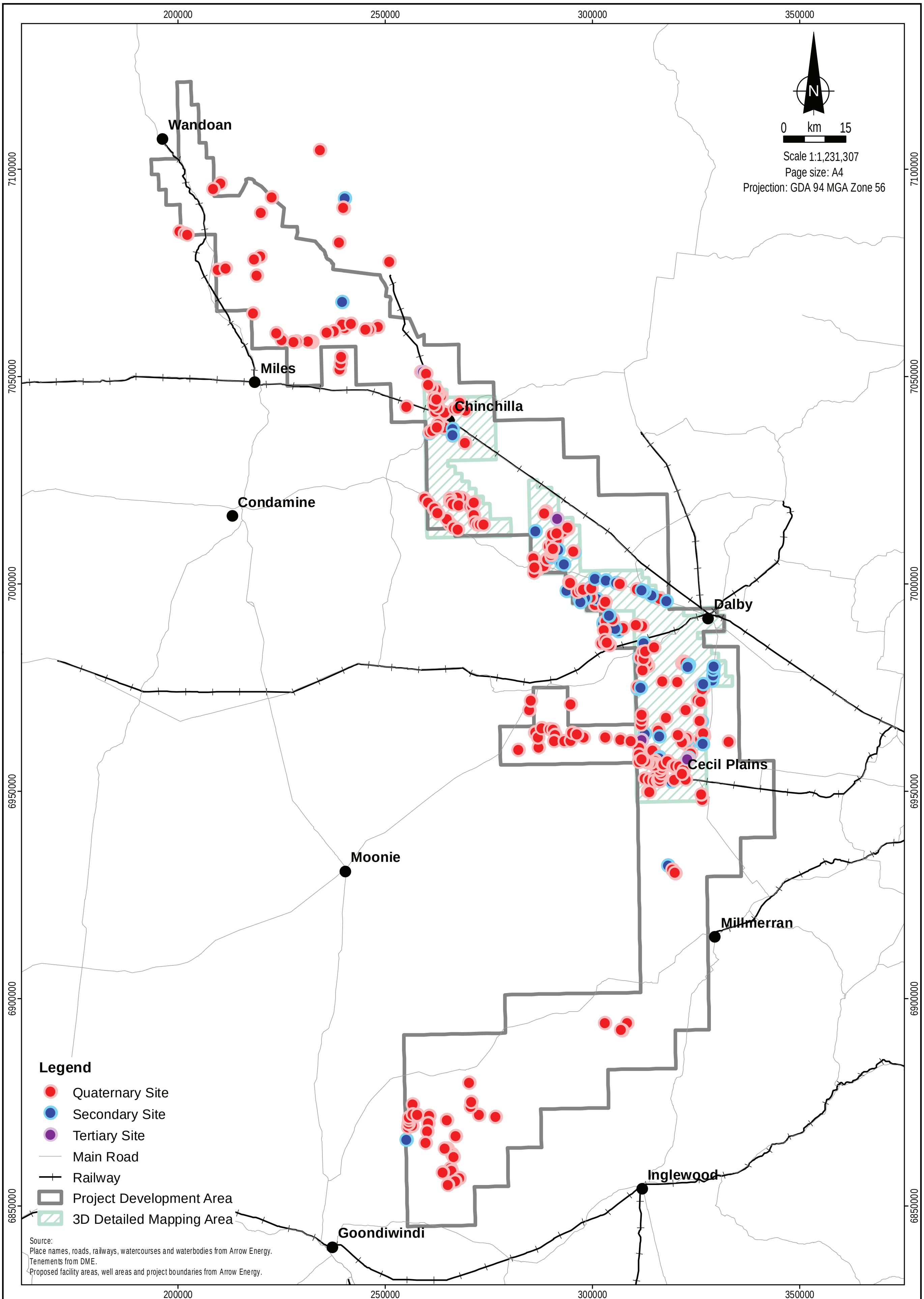
Tertiary sites were completed in a similar fashion to the secondary sampling procedure, although non-woody species were not recorded. Quaternary sites comprised a description of floristic structure, composition, and associated landform. Wherever a VC was considered to be potential critical habitat for EVNT species, the search area was broadened and a more extensive species list was established from an extended search area. Flora species were also recorded on walking traverses, again with particular attention toward known and potential habitats of EVNT species as well as declared weeds and locally important taxa. Botanical voucher specimens were collected throughout the field survey to verify site floristics and enable identification of those species that were problematic. Identifications were provided by Queensland Herbarium. Vouchers of all EVNT species were sent to the Herbarium for incorporation.

Reference sites established in undisturbed or lightly disturbed vegetation communities within the PDA form a basis from which an assessment of the remnant/non-remnant status of a specific VC or RE can be made. These sites also provide a benchmark for the assessment of VC condition and biodiversity values. Reference locations established in the flora study were chosen from aerial photography and on-ground scrutiny as areas with intact canopy signature and representative of the best preserved or ‘type’ example of a given VC within the PDA. Supplementary assessment of grassland condition was carried out using detailed cover measurements of all species within ten 1x1 m subplots placed at 10 m intervals along 50m transects, together with full floristics and cover/abundance estimates within the plot area.

4.4.4 Fauna Methods

All survey locations were visited concurrently by fauna and flora survey teams and structural features were recorded. These include trees that are important food sources for various species (such as eucalypts for koalas, flowering trees for honeyeaters). Important habitat features were also recorded including hollow-bearing trees; rocky outcrops; ground structure, such as fallen logs and soil cracks; and exfoliating bark. Habitat modification, such as invasive weed species, thinning of timber, clearing of understorey, etc was also recorded. This data was used to further refine the RE lists used in habitat mapping.

While the primary objective of visitatation was to assess the habitat structure, species lists were also compiled. Habitat searches (such as log/rock rolling, inspection of exfoliating bark, etc) were conducted for sheltering terrestrial vertebrates such as reptiles. Mammals, such as foxes and wallabies, taking flight from field staff were identified and recorded. Birds were also identified and recorded, either by direct observation or by call. Traces, such as droppings and claw marks on trees, were identified. This method was particularly useful for assessing the presence of koalas.



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_ 3D_P_A4_July11 .mxd File Name: 3D_F2 _GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	**Ecological Survey Site Locations**	Figure No: 2

4.5 Impact Assessment Methods

The assessment of ecological impacts undertaken in this study draws from both extensive desk top investigating as well as the targeted field assessment. It should be noted that although quantification of impacts is not provided, this qualitative assessment defines the sensitivity of ecological values within the PDA, predicts the significance of impacts to those values prior to implementation of management procedures (preliminary impact), and predicts the significance of impacts following thorough implementation of recommended management actions (residual impact).

4.5.1 Impact Significance Assessment

There is currently no standard or legislated methodology for assessing the significance of impacts on species and/or vegetation communities in Queensland. New South Wales and Commonwealth guidelines have been developed to assess the ecological significance of an impact (DEWHA 2009b; EPBC Act Policy Statement 1.1 2006) and as such have been used as a guide for the determining impact significance. These guidelines assess impacts at *a population level* and consider factors such as whether the impact has the potential to:

- adversely affect the life cycle of a local community/population leading to local extinction;
- affect the size, extent (short-term or long-term) or viability of a local community/population or its habitat;
- adversely modify the community composition or species habitat (e.g. introduction of weeds or aggressive species);
- fragment or isolate an existing community/population; and
- interfere with the recovery of the community/species or is inconsistent with objectives and actions of a recovery plan or threat abatement plan.

The above factors consider a range of direct and/or indirect impact exposure pathways including, but not limited to:

- clearing/habitat loss and associated direct and indirect mortality;
- habitat fragmentation
- exotic species invasion; and
- the alteration of hydrological regimes or nutrient cycles critical to the survival of a community/species.

Accumulation or reinforcement of these impacts must also be considered as one or two pathways alone may not incur significant impacts, but when combined may produce highly significant adverse effects (e.g., fragmentation and weed invasion).

4.5.2 Approach to Impact Significance Assessment

The approach used to assess impact significance considers the sensitivity of the ecological value to impact (both direct and indirect impact) as well as the predicted magnitude of the impact. The implementation of this approach aims to reduce the subjectivity of standard risk assessment procedures which consider impact likelihood and impact consequence. The approach adopted is conservative in nature and assumes:

1. that the identified impacts will occur
2. proven mitigation measures will be utilised and applied successfully.

In this case, mitigation measures which have not been tested, or are not known to be successful, are not considered in the recommended management actions. Scope is allowed to identify those species, which are considered by their ecology and habit, to be amenable to a particular mitigation method (e.g. translocation) even though the effectiveness of this mitigation method has not been practically tested.

***Sensitivity of Ecological Values*:** The sensitivity of ecological values considers a number of criteria including but not limited to:

- The legislative status (conservation status) of an ecological value
- The intactness of an ecological value
- The rarity of an ecological value
- The resilience of an ecological value to cope with change
- The ability of an ecological value to recover from an impact
- The potential for any losses of the ecological value to be replaced with an equivalent example.

Communities and species protected by legislation have been determined to be declining in either extent or abundance and further loss of any population is contrary to fundamental conservation principles. Sensitivity definitions provided in **Table 4** therefore have a bias towards the sensitivity of populations rather than individuals. However, some scope has been included to assess those individual species which appear to be abundant in Queensland despite their status.

Table 4. Sensitivity ranking definitions.

Sensitivity Ranking	Descriptor
Not Sensitive (1)	No short-term or long-term project impacts are likely to adversely affect the population/community, or the population/ community may benefit from the project (e.g. coloniser species) and is resilient to changes in habitat structure or condition. The species is not considered threatened under state or federal legislation. Impacted habitats may be have a low degree of intactness due to previous disturbance regimes.
Low Sensitivity (2)	The community/species is not listed as threatened under legislation and has a high resilience to project related impacts. Short-term impacts may occur but are unlikely to cause local extinction. The community/species is resilient to change and able to quickly recover and no long-term impact is expected on abundance, extent or integrity. Impacted habitats may be have a low degree of intactness due to previous disturbance regimes, *or* The species is not listed as threatened under legislation and has a moderate resilience to disturbance. Short-term impacts (over one - two generations) may lead to a loss of abundance or extent, but are unlikely to cause local extinction. The species can recolonise or recruit and only minor long-term impacts are expected on the abundance, extent and integrity of the community/population. The community/species is well represented in the bioregion and state (not applicable to critically endangered, endangered or vulnerable values).
Moderate Sensitivity (3)	The species is listed as near threatened or threatened under relevant state or federal legislation but has a moderate resilience to disturbance. Short-term impacts (over one - two generations) may lead to a loss of abundance or extent, but are unlikely to cause local extinction. The species can recolonise or recruit and only minor long-term impacts are expected on the abundance, extent and integrity of the community/population. The community/species is rare or uncommon but widely distributed throughout the state, or may be common and largely restricted to the bioregion.
High Sensitivity (4)	The species is listed as threatened under state or federal legislation and has a low resilience to disturbance. Impacts may lead to a long-term decrease in its abundance and/or extent, or may affect the long-term integrity of the community/population. The community/species regenerates/recolonises with difficulty after disturbance. The community/species is rare but widespread outside the PDA within the broader bioregion. Habitats typically demonstrate a high degree of intactness or integrity. *or* The species is listed as threatened under state or federal legislation and has a moderate resilience to disturbance. Short-term impacts may lead to a loss of abundance or extent, but are unlikely to cause local population extinction. The species is able to recolonise or recruit and only minor long-term impacts are expected on the abundance, extent and integrity of the community/population. The community/species may occur outside the PDA, but core populations and/or known distribution are heavily centred on the PDA. Habitats typically demonstrate a high degree of intactness or integrity.
Extreme sensitivity (5)	The species/ population is listed as threatened, endangered or critically endangered under state or federal legislation and has low resilience to disturbance. Impacts may or are likely to lead to the long-term extinction of a local community/population. Natural recruitment or colonization would not replace or restore the community/population within several generations. Habitats typically demonstrate a high degree of intactness and may represent benchmark condition in reference to examples of the habitat across its broader range.

Assessment of Impact Magnitude

As utilised in this impact assessment approach, the magnitude of an impact on a specific ecological value is an assessed in accordance with:

- the geographical extent of an impact, with particular reference to:
  - The relative importance of a habitat to the survival of a population

- the proportion of an ecological value relative to its local, bioregional, statewide or national extent,

- The duration of an impact whether it be short term (months), medium term (years) or long term (decades).
- The severity of an impact, being the degree of change from existing condition considered in relation to the impact extent.

Fauna species do not use or inhabit vegetation uniformly with areas of high use, areas of partial or occasional use, and areas of avoidance. The relative importance of a habitat to a particular population of threatened wildlife has been assessed and mapped in this exercise, based on both desktop and field assessment. The habitat maps categorise vegetation within the PDA as “core habitat known”, “core habitat possible”, “general habitat”, “absence possible” and “absence known” for a particular threatened species. Habitat mapping allows the relative importance of a habitat to be assessed with greater confidence and considered within the assessment of impact magnitude. Summary definitions of impact magnitude are provided in **Table 5** below.

Table 5. Impact Magnitude Ranking Definitions.

Magnitude Ranking	Descripton
Extremely Low Magnitude (1)	The impact is restricted to a local population and impacts do not extend beyond the direct impact footprint. The impact will be difficult to detect when the source of impact is removed. The area of impact generally coincides with areas mapped as ‘absence possible‘
Low Magnitude (2)	The impact is restricted to a local population and impacts do not extend beyond the area of direct impact. The impact will be detectable although recovery will occur in the short term (months) without the risk of long term impacts to the local population. The area of impact generally coincides with areas mapped as ‘general habitat’.
Moderate Magnitude (3)	The impact may extend beyond the immediate boundary of disturbance although is contained within a regional population. Impacts are short term and it is feasible to manage local impacts with species/ population specific management protocols or actions. The area of impact is generally associated with areas mapped as ‘core habitat possible’ or ‘general habitat’.
High Magnitude (4)	An impact extends beyond the area of a local population and may affect an entire bio-regional population or species. Impacts are medium to long term and impact management procedures do not rapidly reverse the impact. . The area of impact generally coincides with areas mapped as ‘core habitat known’ or ‘core habitat possible’ for a threatened species.
Extremely High Magnitude (5)	An impact extends to an entire population or group of populations whether this be at a national, regional or local level. Impact management procedures have not been tested or provide limited impact amelioration and there is limited potential for the population to recover once the disturbance has been removed.. The area of impact is generally associated with areas mapped as ‘core habitat known’ or ‘core habitat possible’ for a threatened species.

<u>Impact Significance Assessment</u>

The significance of an ecological impact is derived from the risk matrix as provided in **Table 6** being determined from the sensitivity of an ecological value and the magnitude of the impact it experiences. Descriptors for the impact significance ranking are given in **Table 7.**

Table 6. Matrix for the assessment of the significance of an ecological impact.

		Ecological Sensitivity				
		Extremely Sensitive	**Highly Sensitive**	**Moderately Sensitive**	**Low Sensitivity**	**Not Sensitive**
Impact Magnitude	**Extremely High Magnitude**	25	24	22	19	15
	High Magnitude	23	21	18	14	10
	Moderate Magnitude	20	17	13	9	6
	Low Magnitude	16	12	8	5	3
	Extremely Low Magnitude	11	7	4	2	1

Impact Significance Ranking	**Extremely High**	**23-25**
	High	**20-22**
	Moderate	**11-19**
	Low significance	**4-10**
	Insignificant	**1-3**

Table 7. Impact significance ranking definitions

Significance Ranking	**Descriptor**
Insignificant	An impact occurs to an ecological value that is of limited importance on a local or regional basis. The impact is largely reversible with degradation controlled by a range of standard mitigation and management measures that have been proven to be extremely effective.
Low Significance	An ecological value is of local importance only and impacts will be of a transient nature that will not affect the long term viability of a local population. A range of mitigation and management measures are known to ameliorate or reverse the process of degradation.
Moderate Significance	Although resilient to change, further degradation of an ecological value will occur due to the impact scale, or the activity has potential to increase the susceptibility of the ecological value to further change. Although important in the local ecological context, the value is widespread outside the area of impact and a range of management measures are known to facilitate recovery or replacement of the ecological value.
High Significance	A high magnitude impact occurs when proposed activities exacerbate or accelerate the degradation of a unique or rare ecological value. Whilst management actions are known to ameliorate impacts, a full recovery of the value to pre-impact condition is a long term process (decades) which will require rigorous active management. In these cases, avoidance is the preferred primary mitigation measure.
Extremely High Significance	An impact occurs that causes major, long term and widespread harm to a habitat or ecological value that is irreplaceable because of its uniqueness or restricted occurrence. The impact is largely irreversible and no mitigation measures have been proven to ameliorate the impact, and avoidance is considered the only effective mitigation

4.5.3 Impact Management

Mitigation measures are applied to alleviate project impacts to ecological values as well as reduce the magnitude of ecological impact. As many impacts may reinforce each other or accumulate, a variety of impact mitigation measures may be recommended for management of a particular ecological value. It must be noted that the effectiveness of chosen mitigation measures must be certain prior to application. Without evidence providing certainty for the effectiveness of a proposed mitigation technique, the precautionary principle is applied and the lowest level of mitigation effectiveness is assumed. Further research to test the effectiveness of a potential mitigation measure must be undertaken prior to implementation. In many situations, complete removal of all environmental impact may not be possible and some residual impact will remain after implementing the mitigation measures. Whilst avoidance is the preferred mitigation measure in all cases, it may be the only practical mitigation measure where the impact of an activity is assessed to be of High or Extremely High Significance.

4.5.4 Residual Impact Significance Estimation

Residual impact evaluation identifies those impacts associated with various impacts of the project in the broadest sense, from project construction, operational phases and decommission. It considers impacts known to be associated with the project, or may draw from case studies associated with similar operations. The residual impact evaluation considers impacts remaining following implementation of management/mitigation procedures. Therefore, the residual impact assessment is based on the assumption that the sensitivity of the ecological value does not change, but the magnitude of the impact does. Reducing ecological impact by avoiding important habitat (i.e. infrastructure placed in “absence likely”,) is the most effective mitigation measure. In the majority of cases, if sensitive habitats are avoided altogether then other mitigation measures will not be necessary. Habitat avoidance is therefore identified as a mitigation measure independent of other mitigation measures, although in reality a variety of methods are likely to be used through operational stages of the project.

5. Existing Environment and Ecological Values

5.1 Vegetation Communities and Regional Ecosystems

5.1.1 EPBC Threatened Ecological Communities

A search of the EPBC database including a 5km buffer (DEWHA 2011)(database extract included as **Appendix B**) for the study area indicates the potential presence of the following threatened ecological communities:

1. Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered)
2. Natural grasslands on basalt and fine textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered).
3. Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered).
4. Weeping Myall Woodlands (Endangered).
5. White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered).
6. Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions (listing March, 2011 subsequent to generation of EPBC MNES online report).

Of these communities, two were identified during the field survey and the remaining four are considered as 'possible' or likely occurrences. The extent, distribution and condition of these communities is discussed briefly below with detailed information for each ecological community provided in **Appendix C.** Spatial representation of these communities for PL areas, based on field survey, is provided in **Figure 3**, with **Figure 4** showing distribution of EPBC communities based on certified RE mapping (DERM 2009b) for the broader PDA (ATP areas).

<u>**EPBC Threatened Ecological Communities Observed**</u>

Brigalow (Endangered): *Acacia harpophylla* dominant and co-dominant communities are a common, although highly fragmented ecosystem type. The community encompasses REs 11.9.5, 11.4.3 and 11.3.1 as well as a number of advanced brigalow regrowth communities determined as greater than 15 years old as per guidelines of Environment Australia (2001b). Classification of regrowth is determined through examination of historical aerial photography. The community was identified within PLs 185, 194, 198, 252, 258 and 230.

Natural grasslands on basalt and fine textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered): The occurrence of natural grassland communities was confirmed during the field survey. The ecological community forms generally linear fragmented remnants in the area between Dalby and Cecil Plains within ATP 683, PL 238 and PL 258, and along the Dalby-Kogan Road. The current preservation of the ecological community is due largely to the presence of stock routes and road reserves where remnant vegetation has been historically retained. In some locations, the confirmed distribution of the community varies markedly from certified ecosystem mapping which may include significant areas of derived grassland. Some well preserved examples identified during field survey have also not been previously recognised in RE mapping.

<u>Other EPBC Threatened Ecological Communities</u>

The following EPBC threatened ecological communities were identified as potentially occurring in the project by the EPBC search (DEWHA, 2011) although their presence was not confirmed during the field survey.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered): The ecological community comprises REs 11.11.18, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.13 and 11.9.4 (Threatened Species Scientific Committee [TSSC] 2001b). Regional ecosystem 11.9.4a, and a single mapped occurrence of RE11.8.3 provide the only example of these ecosystems in the PDA as represented in certified ecosystem mapping (DERM 2009b). Regional ecosystem 11.9.4a occurs to the west of Chinchilla (PL185/ATP747) where it is mapped as a subdominant component of heterogeneous polygons (11.9.5/11.9.4a). Examination of a number of these small occurrences of brigalow in the vicinity indicates vine forest elements are generally suppressed and brigalow-belah comprises the dominant canopy. There is some potential for this ecological community to occur in association with small patches of brigalow (RE 11.9.5) throughout the broader PDA. Potential also exists for this community to occur on basalt landscapes to the south of Millmerran, particularly in association with RE11.8.2a within which small pockets of RE11.8.3 might be scattered. The ecological community should be considered as possibly occurring within the PDA.

Weeping Myall Woodlands (Endangered): No occurrence of weeping myall (*Acacia pendula*) Woodland was observed during the field survey. In Queensland, the ecological community is known to occurs as small patches within REs 11.3.2 and 11.3.28 (TSSC 2008b). The best preserved examples are typically associated with road reserves and stock routes. The community does not form woodland communities of sufficient extent to be consistently separated as an ecosystem. As such, the community is not recognised as an individual ecosystem within the framework of Queensland's VMA. The patchy nature of the community also makes community delineation difficult, hence the community is relatively easily overlooked. The only occurrence where weeping myall that was observed to form a dominant canopy during the field survey was observed as a small copse (approx. 0.25 ha) within RE 11.4.12 on a stock route to the west of Chinchilla (within PL185). The restricted size of the community is not consistent with the ecological community which has a minimum patch size of 0.5 ha. It does however, indicate the possibility that the community may also be associated with RE11.4.12. Based on the information provided within EPBC Policy Statement 3.17 (2009) the community should be considered as having a possible occurrence within the PDA.

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered): A number of relatively extensive occurrences of RE 11.8.2a (*Eucalyptus tereticornis* and *E. melliodora* woodland) is mapped in the certified RE mapping (DERM 2009b) in the Captains Mountain area approximately 9-10 km to the south south west of Millmerran. This RE forms a primary component of the ecological community (TSSC 2006a). Access constraints prevented the survey team confirming the habitat in this area although the occurrence of yellow box (*E. melliodora*) in roadside regrowth vegetation in the vicinity suggests that these communities are likely to be accurately mapped in certified ecosystem mapping. Occurence of the ecological community should therefore be considered likely in the areas to the south of Millmerran.

Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered): The Coolibah woodland ecological community is mapped by DERM (2009b) as occurring in the Chinchilla region (PL185/ATP747) where it is occurrence is focused on the Charlie Creek Flood Plain and other tributaries of the Condamine River in the vicinity. The ecological community, is represented as RE11.3.3 and is mapped as a sub-dominant component of flood plain woodland mosaics (dominated by non EPBC listed REs 11.3.25 and RE11.3.4). Field survey of flood plain vegetation in the area did not confirm the presence of the ecological community. Although *Eucalyptus coolibah* was identified as a component of riparian open forest vegetation, it was in no case observed to be a dominant species, mixing with *Eucalyptus camaldulensis, Eucalyptus tereticornis* and *Casuarina cunninghamiana* within RE11.3.25. Thresholds for the ecological community, as described by TSSC (2011), require *Eucalyptus coolibah* to be the dominant contributor to the total canopy cover (> 50%). Whilst revised mapping does not indicate its presence in the detailed mapping area, it is likely that small pockets of the ecological community occur in flood plain habitats in the PDA, particularly in areas from Chinchilla northwards.

5.1.2 Regional Ecosystems

REs within the project area are identified in **Table 8** with a summary of those ecosystems significant to impact assessment provided in **Table 10**. Spatial representation of REs with a VM status or biodiversity status of 'endangered' or 'of concern' within the detailed mapping area (PL areas) are indicated in **Figure 5** with spatial representation of biodiversity status only provided in **Figure 6**. These habitats are regarded to have specific value in terms of susceptablility to degredation or legislative status. Other REs within the PDA may have specific value as habitat for listed flora or fauna species athough are not considered specifically in this section. The biodiversity status of REs outside the detailed mapping area (within ATP areas) based on certified RE mapping (DERM 2009b) is provided in **Figure 7**.

Based on a combination of detailed mapping and desktop assessment, remnant vegetation totals 260811 ha (30% of the project area). This includes 40290 ha with a biodiversity status of 'endangered and of concern, 220521ha of REs with a biodiversity status of 'no concern at present' with a balance of 602 009 ha of non-remnant vegetation comprising mostly cleared pastoral and grazingland. A total of 38 REs (excluding RE sub-types) are mapped within the PDA including representation of 9 endangered REs (Biodiversity Status) with 7 listed as 'of concern'. Heterogeneous polygons constitute a considerable proportion of the mapped remnant vegetation in certified ecosystem mapping (DERM 2009b) and these ecosystems have been differentiated wherever possible during mapping revision. DERM's RE mapping is presented at a scale of 1:100 000 which generally delineates polygons of >20 ha with a minimum polygon size for remnant vegetation (isolated by non-remnant vegetation) of 5 ha. Impacts to regional ecosystems are assessed on a state wide basis at 1:50 000 scale and the scale of current DERM mapping (DERM 2009b) is unsuitable for detailed impact assessment purposes. Detailed descriptions of the extent, distribution and condition of all sensitive Res, both observed and inferred to be within the PDA is provided in **Appendix C** in conjunction with description of EPBC listed communities.

5.1.3 Non-remnant and Regrowth Habitats with Conservation Value

Non-remnant vegetation considered significant to impact assessment is discussed briefly below with unit descriptions provided in **Table 9**. Mapping of these ecosystems within PL areas is provided in **Figure 8** with 'high quality regrowth mapping' produced by DERM (2009d) for the broader PDA provided in **Figure 9**.

<u>Derived Mixed Native/Exotic Grasslands</u>

The flood plain of the Condamine River, particularly within PL 238, contains a number of grassy fragments which formed as a result of ring barking and clearing of former grassy woodland communities. Although these areas are non-remnant vegetation by definition, the soil structure is preserved to a degree that viable habitats for a range of EVNT flora and vertebrate species are maintained.

Regrowth Open Forests and Woodlands:

Fragmented slivers of vegetation are common on roadside reserves, where their occurrence as regrowth communities comprising a range of secondary trees and shrubs, are often too narrow to be represented in the remnant vegetation coverage. Roadside fragments are most common on heavy clay soils throughout the PDA. The classification also includes extensive areas of regrowth woodland and shrubland derived from a range of parent ecosystem types.

Table 8. Regional ecosystems in PDA.

RE	Description
Land Zone 3 - Quaternary Alluvial Plains	
11.3.1**	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.
11.3.14**	*Eucalyptus* spp., *Angophora* spp., *Callitris* spp. woodland on alluvial plains.
11.3.17**	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.
11.3.18**	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium.
11.3.19*	*Callitris glaucophylla, Corymbia* spp. and/or *Eucalyptus melanophloia* open-forest to woodland on Cainozoic alluvial plains.
11.3.2**	*Eucalyptus populnea* woodland on alluvial plains.
11.3.21**	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.
11.3.24*	*Themeda avenacea* grassland on alluvial plains. Basalt derived soils.
11.3.25**	*Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines.
11.3.26*	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains.
11.3.27a**	Lacustrine wetland (e.g. lake)
11.3.27b	Palustrine wetland (e.g. vegetated swamp)
11.3.27c***	Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species.
11.3.27d***	Palustrine wetland *Eucalyptus camaldulensis* and/or *E. tereticornis* woodland
11.3.3*	*Eucalyptus coolabah* woodland on alluvial plains.
11.3.4**	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.
Land Zone 4 – Pleistocene Alluvial Terraces	
11.4.10**	*Eucalyptus populnea* or *E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.
11.4.12**	*Eucalyptus populnea* woodland on Cainozoic clay plains.
11.4.3**	*Acacia harpophylla* and/or Casuarina cristata shrubby open forest on Cainozoic clay plains.
11.4.3a**	Palustrine wetland (e.g. vegetated swamp). *Melaleuca bracteata* woodland associated with *Acacia harpophylla* communities.
Land Zone 5 – Tertiary Plains	
11.5.1**	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces
11.5.1a**	*Eucalyptus populnea* woodland with *Allocasuarina luehmannii* low tree layer.
11.5.20**	*Eucalyptus moluccana* and/or *E. microcarpa/E. pilligaensis*[1] ± *E. crebra* woodland on Cainozoic sand plains.
11.5.21*	*Corymbia bloxsomei* ± *Callitris glaucophylla* ± *Eucalyptus crebra* ± *Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces.
11.5.4*	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands.
11.5.4a*	*Callitris glaucophylla* ± *Eucalyptus* spp. and *Corymbia* spp. woodland.

[1] *E. pilligaensis* has been recently consumed within the broader reclassification of *E. woollsiana.*

RE	Description
Land Zone 7 - Tertiary Rises	
11.7.2**	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone
11.7.4**	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust.
11.7.4c*	*Eucalyptus decorticans* ± *Eucalyptus* spp. ± *Acacia* spp. Occurs on low hills and ranges with shallow soils.
11.7.5**	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.
11.7.6**	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust.
11.7.7**	*Eucalyptus fibrosa* subsp. *nubila* ± *Corymbia* spp. ± *Eucalyptus* spp. on Cainozoic lateritic duricrust.
Land Zone 8 - Cainozoic Igneous Rocks	
11.8.2a*	*Eucalyptus tereticornis* and *E. melliodora* occurring on low hills.
11.8.3*	Semi-evergreen vine thicket on Cainozoic igneous rocks.
Land Zone 9 – Fine Grained Sedimentary Rocks	
11.9.10*	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks.
11.9.4a*	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine grained sedimentary rocks.
11.9.5**	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.
11.9.6*	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks.
11.9.7**	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks.
11.9.9**	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks.
11.9.9a*	*Eucalyptus albens* ± *E. crebra* ± *E. tereticornis* ± *Callitris baileyi* woodland. Occurs in southern part of bioregion.
Land Zone 10 – Coarse Grained Sedimentary Rocks	
11.10.1*	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks.
11.10.1a*	*Corymbia watsoniana* ± *C. citriodora*, ± *C. trachyphloia* ± *C. henryi* woodland.
11.10.1d**	*Eucalyptus crebra* woodland.
Land Zone 12 – Igneous Rocks	
13.12.5*	*Eucalyptus youmanii* on igneous rocks.

* Identified in certified ecosystem mapping only.
** Identified in certified ecosystem mapping and observed in detailed mapping survey.
*** Not identified in certified ecosystem mapping although observed in the mapping survey.

Table 9. Non-remnant vegetation observed in PDA

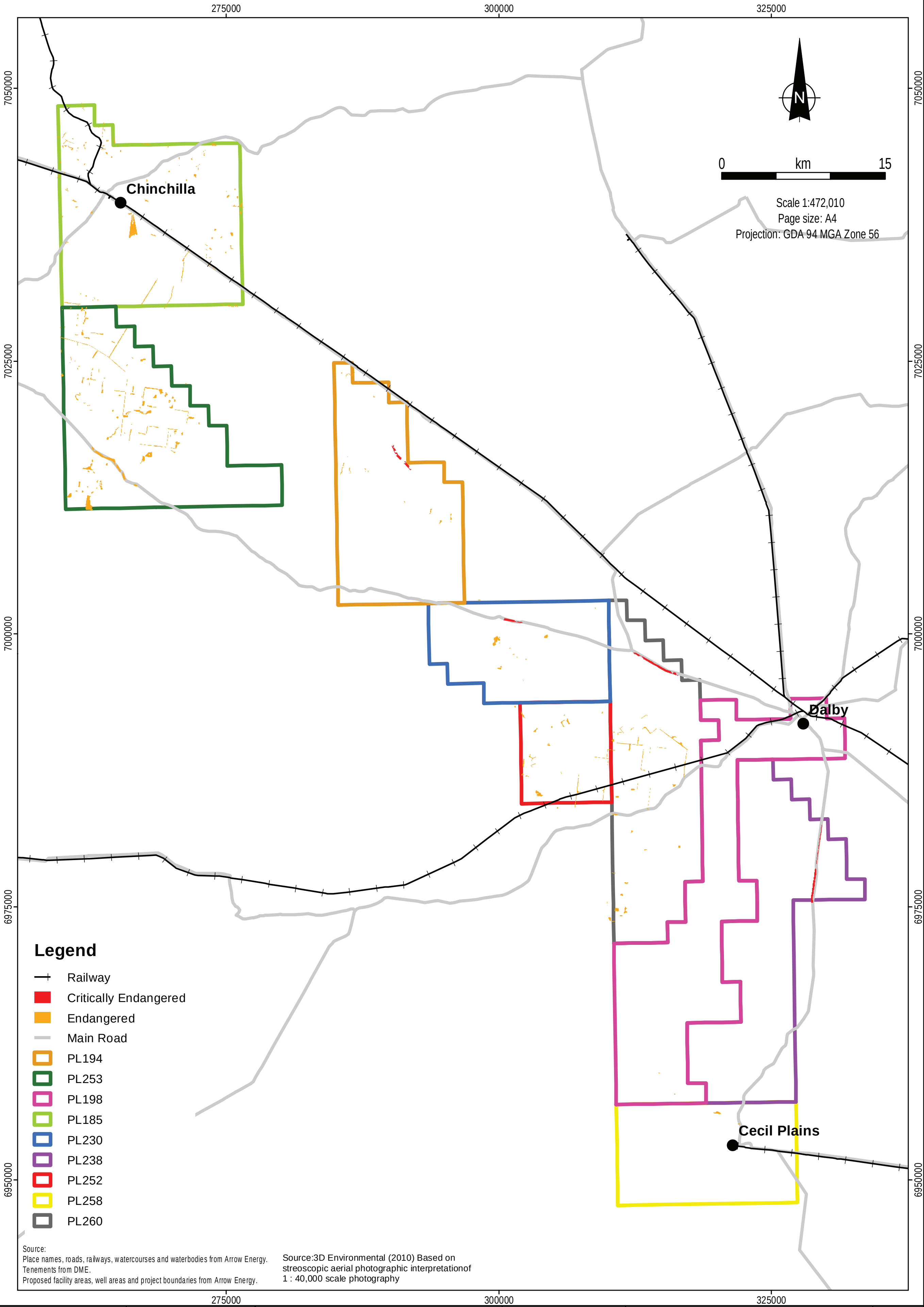
Regrowth Vegetation Unit	Description	Significance
Brigalow_small	Isolated brigalow stands (with remnant structure) of less than 1ha in total area (RE11.3.1/11.4.3)	Listed under EPBC Act as endangered if >0.5ha
Derived grassland.	Mixed native/ exotic grassland derived from clearing of woodland vegetation	Potential habitat for listed grassland species
Regrowth brigalow (>15yrs)	Regrowth brigalow (>15yrs old) (RE11.4.3/11.3.1)	Listed under EPBC Act as endangered if >0.5ha
Regrowth brigalow (<15yrs)	Regrowth brigalow (<15yrs old)	Suitable for habitat offset
Regrowth (11.3.2)	Regrowth *Eucalyptus populnea +/- Casuarina cristata* shrubland and low woodland (RE11.3.2)	Suitable for habitat offset
Regrowth (11.3.4)	Regrowth derived from RE11.3.4.	Suitable for habitat offset
Regrowth (11.3.4/11.3.25)	Regrowth derived from REs 11.3.4 and 11.3.25	Suitable for habitat offset
Regrowth_undifferentiated	Undifferentiated regrowth	Not significant unless for corridor revegetation or as habitat for listed species
Regrowth (11.5.1/11.7.4)	Regrowth *Eucalyptus crebra* woodland	Not significant unless for corridor

Regrowth Vegetation Unit	**Description**	**Significance**
	(RE11.5.1/11.7.4)	revegetation or as habitat for listed species
Regrowth (11.5.20a)	Regrowth *Eucalyptus pilligaensis* shrubland (RE11.5.20a)	Not significant unless for corridor revegetation or as habitat for listed species
Regrowth_*C. cristata*	Regrowth of *Casuarina cristata* (RE11.3.1)	Not significant unless for corridor revegetation or as habitat for listed species
Regrowth *C. leuhmannii*	Secondary (derived) shrubland of *Allocasuarina leuhmannii* + *Callitris* sp.	Not significant unless for corridor revegetation or as habitat for listed species
Regrowth_cypress	Regrowth woodland / shrubland of *Callitris* sp. (RE11.3.14 / RE11.5.1 / RE11.3.18)	Not significant unless for corridor revegetation or as habitat for listed species
Regrowth_undifferentiated.	Undifferentiated regrowth	Not Significant
Cl.	Cleared areas	Not Significant
Cu	Cultivated areas	Not Significant
DAM	Artificial waterbody	Not Significant
Imp_water.	Impounded watercourse	Not Significant

Table 10. Regional ecosystems of relevance to impact assessment.

RE	Bio Stat.	VM Stat.	EPBC Stat.	EPBC Comm.[1]	Detailed Mapping Area (Ha) as per 3d Env.[2]	Detailed Mapping Area (Ha) as per DERM, 2009b[3].	ATP Areas (Ha) [4]	Area (Ha) in Bioregion[5]	Area (Ha) in National Park[5]	Area (Ha) in Conservation. Reserve[5]	Area (Ha) in State Forest[5]
11.3.1	E	E	E	1	189	225	585	80679	9920	105	207
11.3.17	E	OC	NA.	NA	167	288	4245	36294	1421	0	439
11.3.21	E	E	CE	2	200	291	517	54459	150	3	43
11.3.24	E	E	CE	2	0	0	53	125	0	0	0
11.4.3	E	E	E	1	502	287	4077	77389	5439	0	3672
11.4.3a	E	E	NA	NA	35	0	2	No data	No data	0	No data
11.4.10	E	E	E	1	0	0	1784	6307	1581	0	686
11.4.12	E	E	NA	NA	234	301	712	7526	0	0	466
11.9.4a	E	E	E	3	0	8	12	No data	6686	25	2866
11.9.5	E	E	E	1	1	65	3791	168841	20800	240	11002
11.9.6	E	E	E	1	0	0	151	371	0	0	9
11.9.7	OC	OC	NA	NA	50	55	654	109286	650	0	2824
11.9.10	E	OC	NA	NA	0	0	175	83507	6166	51	756
11.3.2	OC	OC	NA	NA	1183	2962	4150	528081	8119	45	39437
11.3.25	OC	LC	NA	NA	2018	3674	7532	515948	7527	450	21472
11.3.27	OC	LC	NA	NA	655	335	255	49875	613	1366	197
11.3.3	OC	OC	NA	NA	0	135	259	282541	5807	358	269
11.3.4	OC	OC	NA	NA	2401	1359	2544	186652	3260	94	16364
11.8.3	OC	OC	E	NA	0	0	19	26458	2584	184	641
11.8.2a	NCAP	LC	CE	5	0	0	1138	10267	No data	No data	No data

Bio Status: E = Endangered; OC = Of Concern, NCAP=No Concern at Present, **VMA Categories:** E = Endangered; OC = Of Concern, LC=Least Concern,
EPBC Categories: E = Endangered; CE = Critically Endangered; NA = Not Applicable.
1. EPBC community description listed as per **Section 5.1.1.**
2. Derived from detailed mapping of PL areas produced by 3d Environmental
3. Derived from certified RE mapping in PL areas produced by DERM (2009b)
4. Derived from certified RE mapping in ATP areas produced by DERM (2009b)
5. Derived from Accad et al (2008).
6. Data derived from TSSC (2006b)



3D Environmental
Vegetation Assessment & Mapping Specialists
P. O. Box 959
Kenmore, Qld 4069
Phone: (07) 3411 9072
Phone: (07) 3878 4344
Mobile: 0404 577 285
Mobile: 0409 426 916
www.3denvironmental.com.au

Date: 09-05-2011

MXD: C:\3D Environmental\Arrow\DS_Info\Arrow_3D_P_A4.mxd

File Name: 3D_F3_GIS

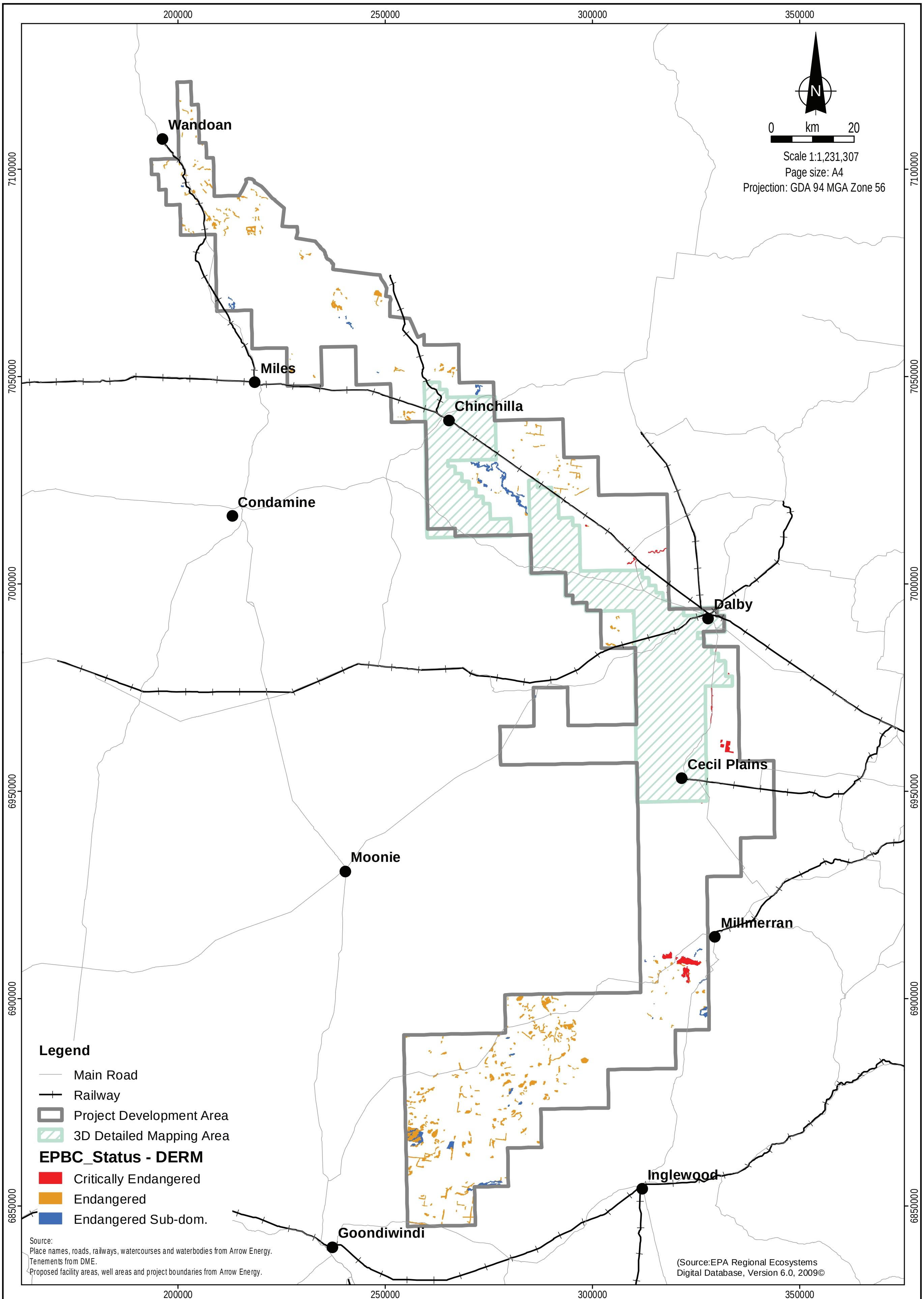
Arrow Energy Limited

Surat Gas Project

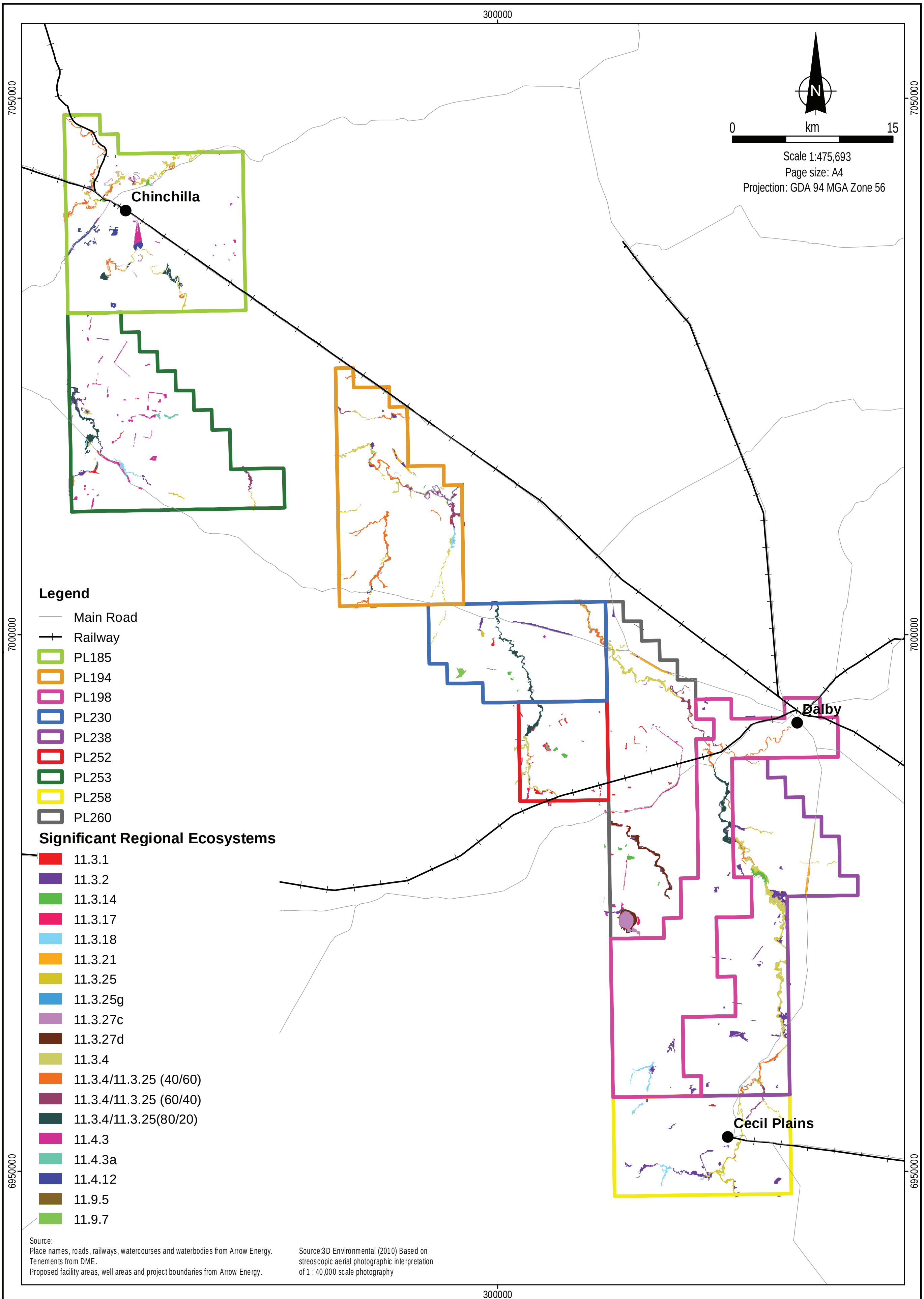
arrow energy go further

EPBC Listed Vegetation Communities in Detailed Mapping Area (PL Areas)

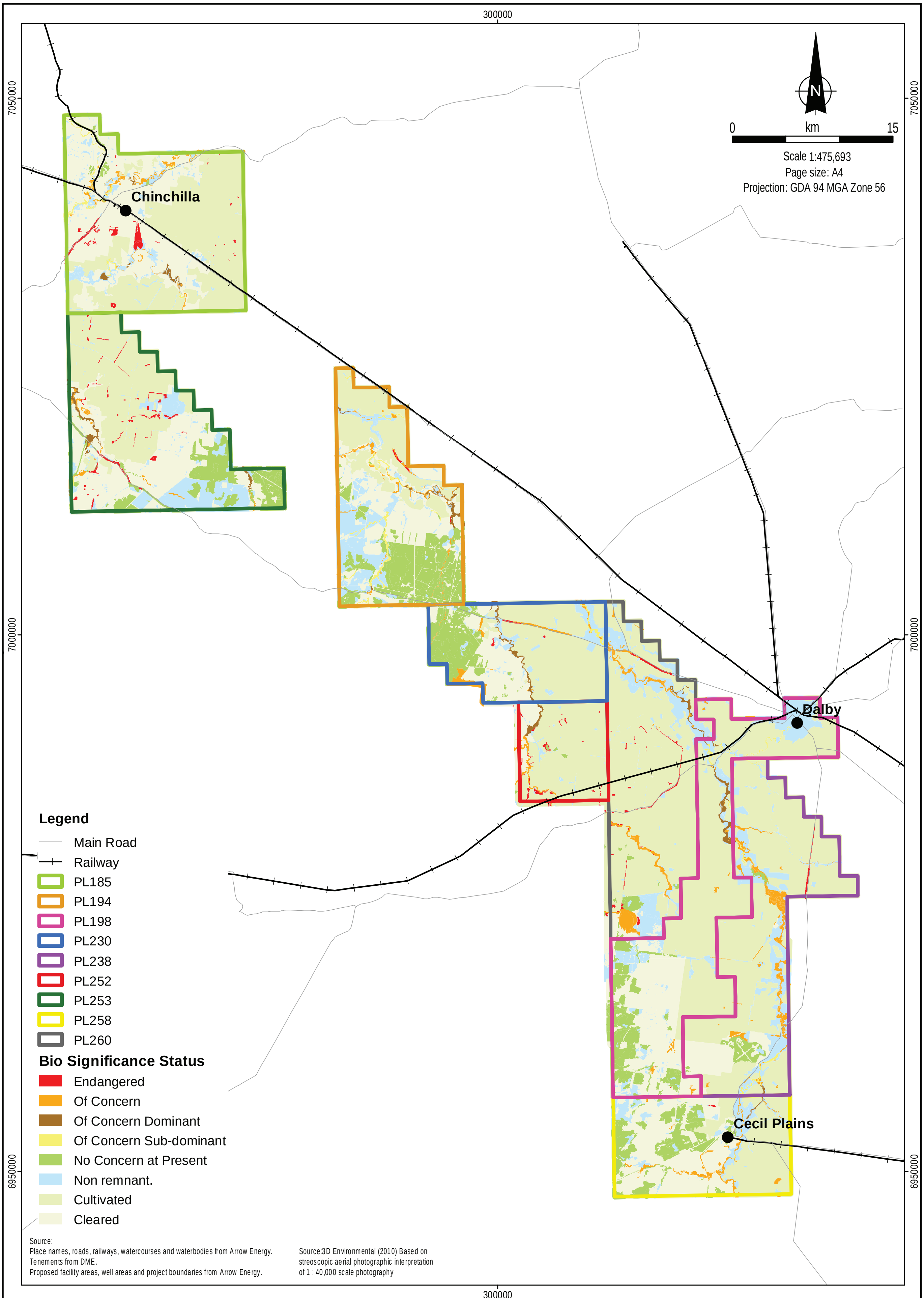
Figure No: 3



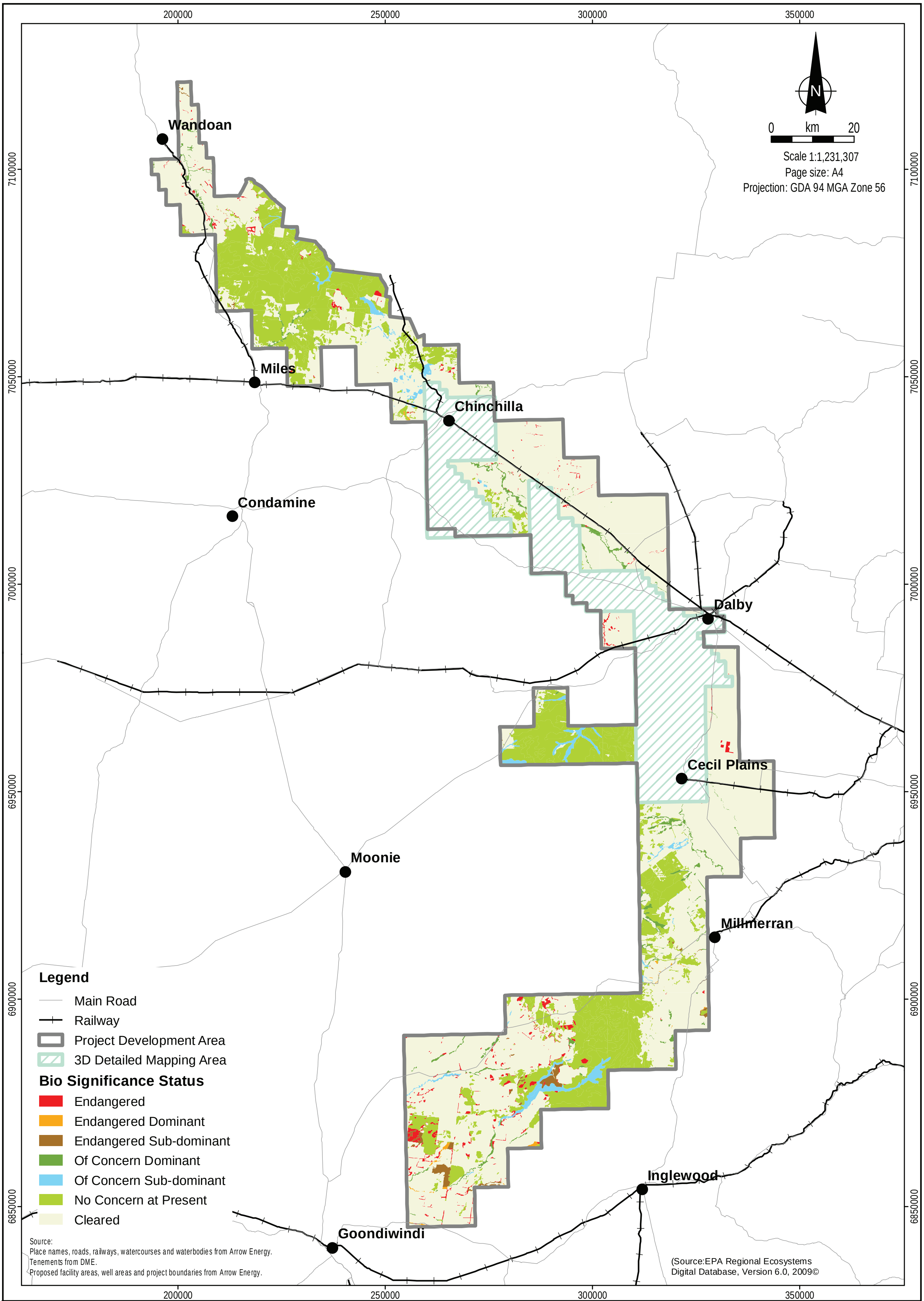
3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11.mxd File Name: 3D_F4_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	EPBC Listed Vegetation Communities (DERM, 2009b) in Project Development Area	Figure No: 4



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11.mxd File Name: 3D_F5_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Relevant Regional Ecosystems in Detailed Mapping Area (PL Areas)	Figure No: 5



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11.mxd File Name: 3D_F6_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Biodiversity Status in Detailed Mapping Area (PL Areas)	Figure No: 6



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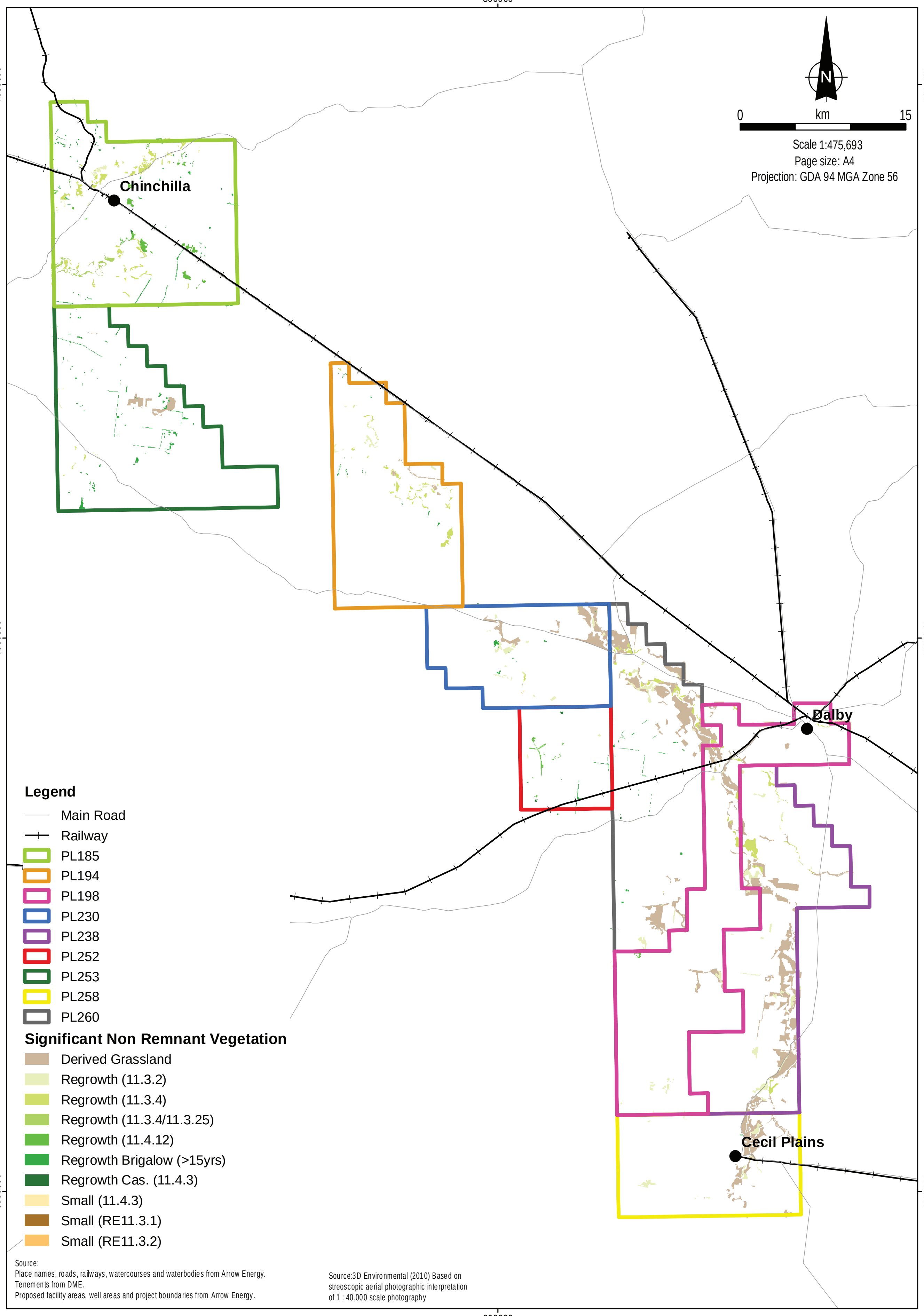
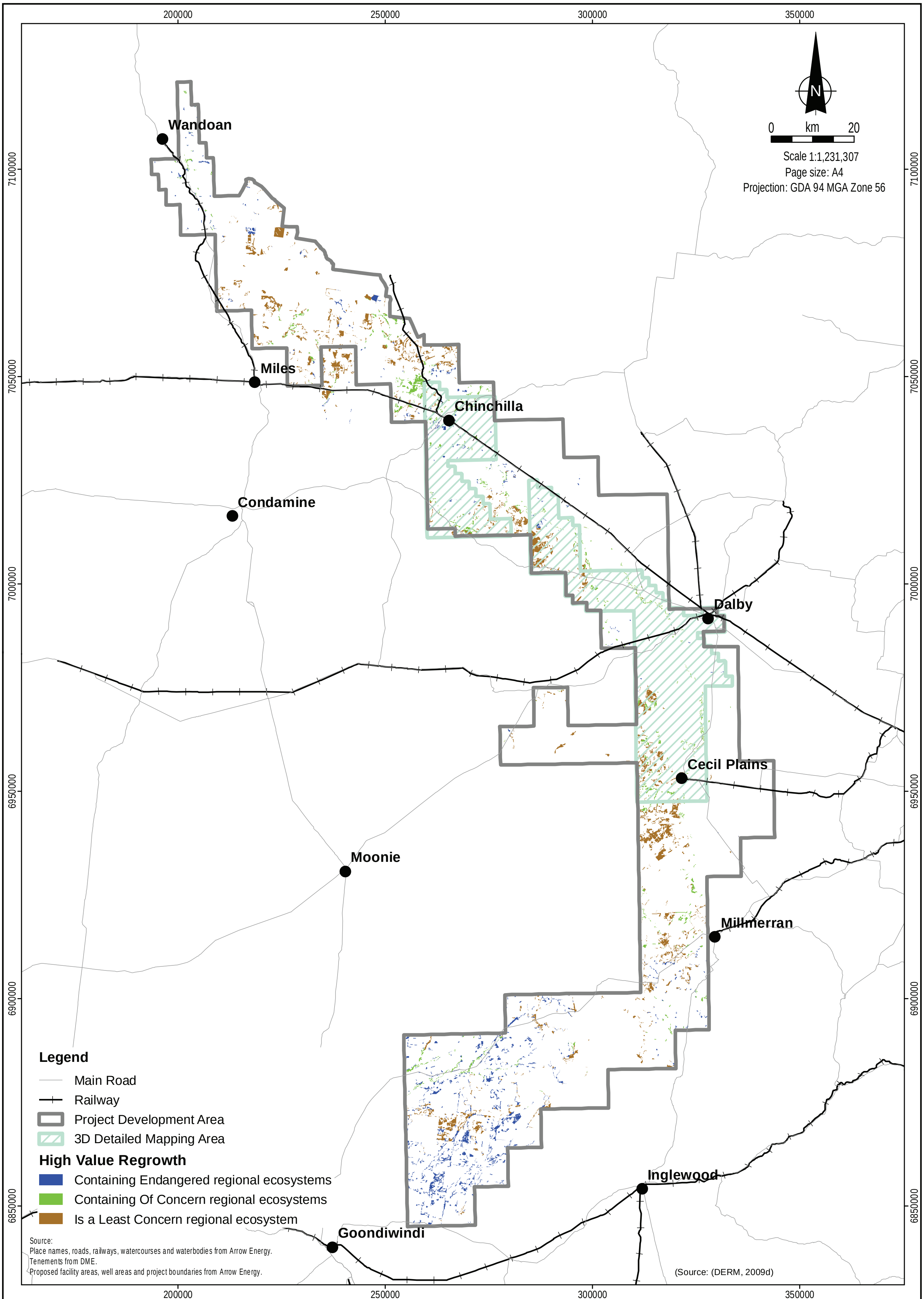


3D Environmental Vegetation Assessment & Mapping Specialists	Date: 09-05-2011	Arrow Energy Limited	arrow energy go further	Significant Non Remnant Vegetation in Detailed Mapping Area (PL Areas)	Figure No: 8
	MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11.mxd	Surat Gas Project			
	File Name: 3D_F8_GIS				



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11. mxd File Name: 3D_F9_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Significant Non Remnant Vegetation (DERM, 2009d) in Project Development Area	Figure No: 9

5.2 Flora Values

5.2.1 Flora Species Diversity

An indicative flora list for the study area presented in **Appendix D** is based on searches of DERM databases (Wildlife Online, CORVEG, HERBRECS), data supplied for the Charleys Creek catchment by the Chinchilla Field Natuarlists Club (2007) and field surveys.

The flora of the study area is considered well known with a highly diverse vascular flora of 1 390 taxa that are known to occur within or in close proximity. The flora represents approximately 14% of the known 9890 species of Queensland flora as per Bostock and Holland, 2007. It comprises 38 EVNT species (deemed to potentially occur within or in the vicinity of the study area); eight regionally sensitive species; and 218 species of non-native flora (16% of total flora). Twenty species are declared under the LPA although many of these are known from single or widely scattered records often on roadsides or town areas. Four EVNT flora species were recorded during the survey.

No systematic sampling of cleared lands was undertaken with records attained by observation and miscellaneous collections made during walking traverses and roadside observations. Additional site information in these areas would undoubtedly increase the number of herbaceous groundcovers, graminoids and exotic species, however it would provide minimal additional information above that gained from examination of HERBRECS and CORVEG data for the areas outside of the PDA.

5.2.2 Extinct, endangered, vulnerable or near-threatened Flora Species

Search results from all available datasets retrieved a total of 80 species listed as either endangered, vulnerable or near-threatened under Federal and State legislation which may potentially occur within or in proximity to the study area. This included 41 species of National Significance under the EPBC Act and 74 species of State Significance under the NCA.

Further analysis of the HERBRECS data supported by review of relevant literature and field survey clearly indicated that 42 species were unlikely to occur due to low precision records and lack of suitable habitat. These include a number of species known only from often endemic and restricted populations well outside the study area boundaries such as the Waaje Scientific Area (Barakula Sate Forest) and locations south-southwest of Munduberra such as Beeron Holding and Brovinia.Consequently, 38 species listed as either endangered, vulnerable or near-threatened under Federal and State legislation may potentially occur within or in proximity to the project area.

A summary of the numbers of EVNT flora species is provided below with reference to **Table 11** which lists those EVNT species with potential to occur (known, likely, possible, and unlikely) in the study area based on desktop analysis and field survey. Profiles for all EVNT species considered known, likely, or possible including notes on habitat, and disturbution are provided in **Appendix E.** Results of database searches, and an assessment of likelihood is provided in **Appendix F** with species identified in field survey also indicated. The location of EVNT species derived from the HERBRECS database, the grassland dataset of Goodland (2000), and the field survey is provided in **Figure 10** with habitat values for EVNT flora derived from habitat assessment across the study area is represented spatially in **Figure 11.**

EPBC species

- 11 known (1 endangered, 10 vulnerable)
- 1 likely (0 endangered, 1 vulnerable)
- 6 possible (1 endangered, 5 vulnerable)
- 21 unlikely (5 endangered, 16 vulnerable)

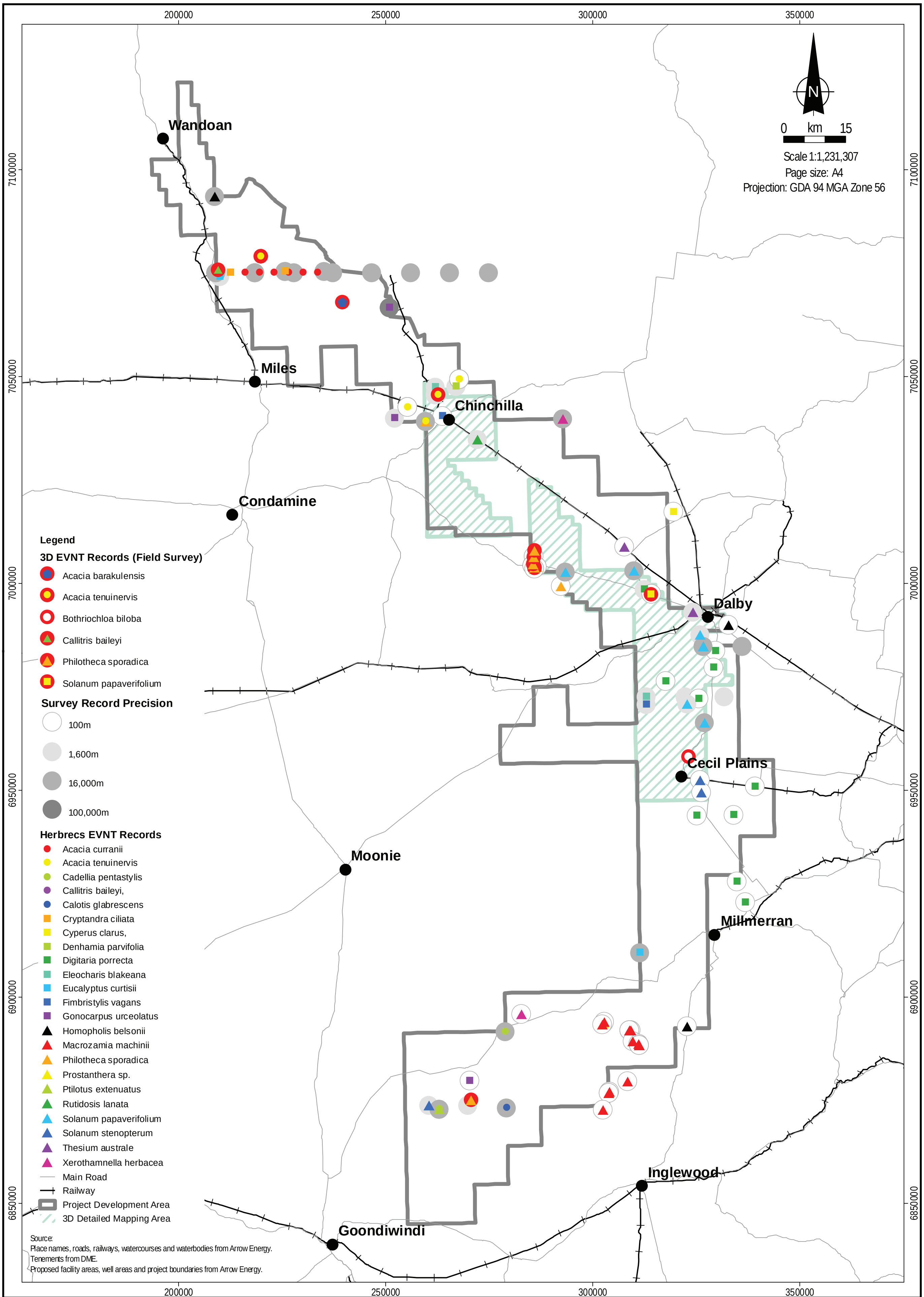
NCA species

- 24 known (6 endangered, 11 vulnerable, 7 near-threatened)
- 2 likely (0 endangered, 1 vulnerable, 1 near-threatened)
- 9 possible (2 endangered, 6 vulnerable, 1 near-threatened)
- 40 unlikely (7 endangered, 17 vulnerable, 16 near-threatened)

Table 11. Summary of EVNT flora likelihood of occurrence in PDA based on data searches.

Status	Known	Likely	Possible	Unlikely
EPBC Act				
Endangered	*Digitaria porrecta*	-	*Microcarpaea agonis*	*Acacia porcata* *Bertya granitica* *Lepidium peregrinum* *Leucopogon* sp. (Coolmunda D.Halford Q1635) *Tylophora linearis*
Vulnerable	*Acacia curranii* *Bothriochloa biloba* *Macrozamia machinii* *Denhamia parviflora* *Homophilis belsonii* *Philotheca sporadica* *Prostanthera sp. (Dunmore)* *Pterostylis cobarensis* *Thesium australe* *Xerothamnella herbacea*	*Picris evae*	*Acacia handonis* *A. wardellii* *Cadelia pentalsylis* *Calytrix gurulmundensis* *Rhaponticum australe*	*Acacia eremophiloides* *A. lauta* *A. pubiflora* *Bothriochloa bunyensis* *Commersonia argentea* *Dichanthium queenslandica* *Eucalyptus argophloia* *E. virens* *Haloragis exaltata var. virens* *Homoranthus decumbens*

Status	Known	Likely	Possible	Unlikely
				Macrozamia conferta *M. crassifolia* *Newcasltia velutina* *Polianlthion minutiflorum* *Westringia parviflora* *Zieria verrucosa*
		NCA Act		
Endangered	*Aristida forsteri* *Homophilis belsonii* *Pomaderris coomingalensis* *Rutidosus lanata* *Solanum papervifolium* *Xerothamnella herbacea*	*Ptilotus extenuatus*	*Microcarpaea agonis* *Micromyrtus carinata*	*Acacia porcata* *Bertya granitica* *Eucalyptus broviniensis* *E. pachycalyx subsp. waajensis* *Leucopogon* sp. (Coolmunda D.Halford Q1635) *Micromyrtus patula* *Tylophora linearis*
Vulnerable	*Acacia barakulensis* *A. curranii* *Cyperus clarus* *Denhamia parviflora* *Gonocarpus urceolatus* *Macrozamia machinii* *Philotheca sporadica* *Picris barabrorum* *Prostanthera sp. (Dunmore)* *Solanum stenopterum* *Thesium australe*	*Picris evae*	*Acacia handonis* *A. wardellii* *Apatophyllum teretifolium* *Calytrix gurulmundensis* *Calotis glabrescens* *Rhaponticum australe*	*Acacia eremophiloides* *A. lauta* *A. pubiflora* *Bothriochloa bunyensis* *Commersonia argentea* *Dichanthium queenslandica* *Eucalyptus argophloia* *E. taurina* *E.virens* *Haloragis exaltata var. virens* *Homoranthus decumbens* *Macrozamia conferta* *M. crassifolia* *Newcasltia velutina* *Polianlthion minutiflorum* *Westringia parviflora* *Zieria verrucosa*
Near Threatened	*Acacia tenuinervis* *Callitris baileyi* *Cryptandra ciliaris* *Digitaria porrecta* *Eleocharis blakeana* *Eucalyptus curtisii* *Fimbristylis vagans*		*Calotis glabrescens*	*Acacia calantha* *A. centrinervia* *Cerbera dumicola* *Corymbia petalophylla* *Diuris parvipetala* *Eucalyptus rubiginosa* *Hibbertia montana* *Kunzea bracteolate* *K. flavescens* *Melaleuca groveana* *Notelaea pungens* *Peripluera sericea* *Prasophyllum campestris* *Rutidosus glandulosa* *Senna acclinus* *Zornia pallida*



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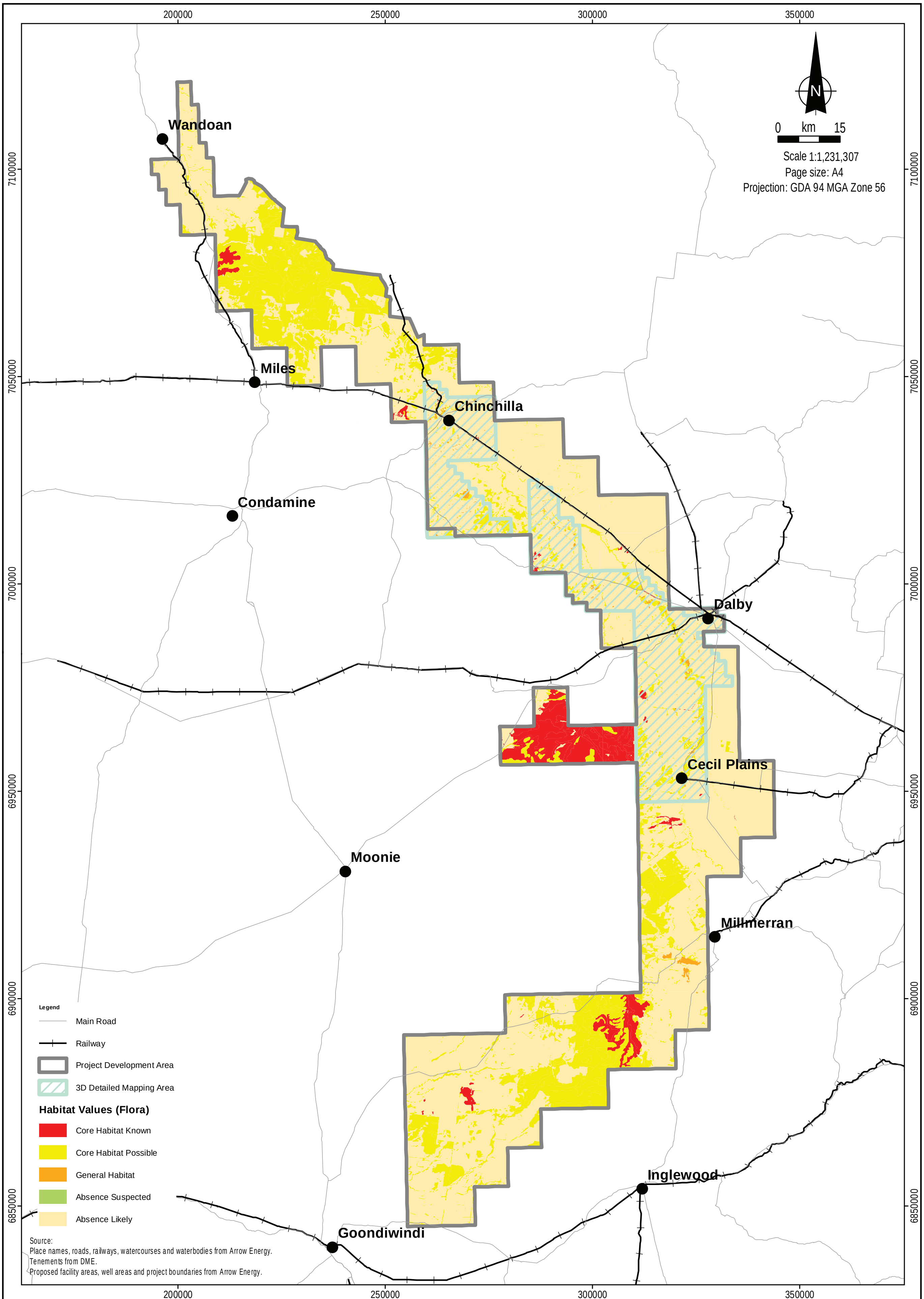


3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11 .mxd File Name: 3D_F11 _GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Habitat Values (Flora).	Figure No: 11

5.2.3 Bioregionally Significant Species

The application of a range of generic criteria may be applied to define or classify non-EVNT or bioregionally significant flora species. These include regional endemicity, isolated distribution, disjunction, reaching limits of geographical range, or special scientific, cultural and commercial interest species. Preliminary analysis of HERBRECS data indicates eight bioregionally significant species occurring in the study area as indicated in **Table 12.**

Table 12. Bioregionally significant flora species

Regionally Significant Species	Preferred Habitat
Acacia melvillei	Occupies roadside remnants often in association with disturbed poplar box, belah and brigalow on alluvium. Provides important potential habitat for Painted Honeyeater particularly with high mistletoe component.
Acacia omalophylla	A mulga lands species known from the study area in the Chinchilla and Barakula areas. These occurrences represent the eastern limit of distribution within the bioregion. Preferred habitat is belah and poplar box associations on plains and slopes.
Acacia shirleyi	Populations in northern parts of study area represent the eastern limits of distribution. Occurs in woodland/open forest with *E. fibrosa* subsp. *nubila* + *E. crebra* on sandstone rises 11.7.7.
Corymbia bloxsomei	A narrow endemic known from within the north of the study area in the Barakula area where it associated with on sandplains in 11.5.1, 11.5.4, 11.5.21.
Eucalyptus bakeri	Widely scattered disjunct populations in the study area which are often an indicator for other EVNT and endemic flora on land zone 7 jump ups.
Eucalyptus tenuipes	Bioregional endemic reaching southern limit of distribution in the study area. Occurs in the northern parts of study area on *E. crebra, E. fibrosa* subsp. *nubila* woodlands on land zone 7 and 5.
Eucalyptus terrica	Endemic to southern Qld with a restricted distribution in the Warwick-Inglewood district. Records and habitat in the Wondul Range represent the northern limit of distribution. Conserved in Wondul Range NP.
Prostanthera sp. (Baking Board V. Hando)	Undescribed species with restricted distribution from Barakula, Baking Board, Wondul Range and Wyaga localities on rocky lateritic sandstone breakaways.

5.2.3 Pest Plants

Of the 218 species of non-native flora recorded in the HERBRECS database, 20 are declared under the LPA. A full list of declared flora species extracted from database searches and field survey is provided in **Table 13.** Under the LPA Act, landowners must take reasonable steps to keep their land free of Class 2 pests. It should be noted that the declared recorded exotic species favour high fertility soils and are typically associated with brigalow and clay and flood plain vegetation types. A high proportion of infested ecosystems are classed a Category B environmentally sensitive areas highlighting the requirement for stringent management controls in the vicinity of these areas. It should be noted that due to the pervasiveness of weed infestion in many ecosystems, point locations for exotic species are not represented with indicative distribution of observed occurences best made in reference to RE distribution.

Table 13. Summary of declared weeds and weeds of national significance (WONS) known to occur in study area from database searches and field survey.

Pest Class	Common Name	Species Name	Field Sites	RE	Comments
Class 2	velvet pear	*Opuntia tomentosa*	8, 12, 17, 18, 26, 48, 53, 78	11.3.4, 11.3.14, 11.3.17, 11.3.26, 11.9.5, 11.9.7	The majority of occurrences were <5% cover.
Class 2	prickly pear	*Opuntia stricta*	4, 24, 33, 42, 44, 48, 77, 79	11.3.1, 11.4.3, 11.5.1, 11.101d, 11.3.26	Occasional dense patches in RE11.3.1 otherwise scattered occurrences at <5% cover.
Class 2	tiger pear	*Opuntia aurantiaca*	Not recorded	-	-
Class 2	harrisia cactus	*Eriocereus martiniii*	15, 29, 30	11.3.1, 11.3.2, 11.3.14	All occurrences were <5% cover.
Class 2	harrisia cactus	*Eriocereus tortuosa*	Observation only	11.3.1 11.5.1	Occurs in woodland of brigalow and wilga on heavy soils and in woodland with Casuarina luechmannii on sandy clay flats.
Class 2	mother of millions	*Bryophyllum delagoensis*	28, 33, 37, 38, 44	11.3.1, 11.3.2, 11.3.17, 11.3.25,	Dense infestations of >50% groundcover recorded in 11.3.17. Infestations otherwise scattered on disturbed road margins.
Class 2	mother of millions	*Bryophyllum x houghtonii*	33, 38,	11.3.1, 11.3.2, 11.3.17, 11.3.25	Recorded with infestations of Bryophyllum delagoensis. Common along riparian zones throughout project area.
Class 2	annual ragweed	*Ambrosia artemisiifolia*	Not recorded	Non remnant	May occur on disturbed roadsides. Known from a HERBRECS record 10km east of Dalby on the Warrego Highway growing alongside highway.
Class 2	groundsel bush	*Baccharis halimifolia*	Not recorded	Non remnant	HERBRECS data indicates widely scattered occurrences such as near Chinchilla

Pest Class	Common Name	Species Name	Field Sites	RE	Comments
					in scrub country on heavy brigalow soil. A record from the Jandowae district on a seasonally flooded roadside indicates potential for gradual spreading along water courses.
Class 3	balloon vine	*Cardiospermum grandiflorum*	Not recorded	11.3.25	A Herbariun record from Charleys Creek, Chinchilla in fringing woodland of Eucalyptus tereticornis, Angophora floribunda, Acacia salicina, Callistemon viminalis, Salix babylonica. Indicates potential to occur along disturbed riparian zones of major rivers and creeks.
Class 3	Chinese celtis	*Celtis sinensis*	Obervation only	11.3.25	Potential for scattered trees to occur within disturbed riparian zones of Condamine River and major tributaries.
Class 3	camphor laurel	*Cinnamomum camphora*	Not recorded	11.3.25	A Herbariun record from Charleys Creek, Chinchilla in fringing woodland of Eucalyptus tereticornis, Angophora floribunda, Acacia salicina, Callistemon viminalis, Salix babylonica. along a 200 m section of creek. Indicates potential to occur in disturbed RE11.3.25.
Class 2 WONS	parthenium	*Parthenium hysterophorus*	Not recorded	Non remnant	A few widely scattered occurrences have been recorded on roadsides within and in the vicinity of the study area. No major infestations within the study area are known.
Class 2	water lettuce	*Pistia stratiotes*	Not recorded	Non remnant	Known from a record in urban parkland at Dalby.
Class 2 WONS	mesquite	*Prosopis glandulosa* var. *glandulosa*	Not recorded	Non remnant	Known from a few scattered records around Brookstead and Millmerran on heavy

Pest Class	Common Name	Species Name	Field Sites	RE	Comments
					soils.
Class 2 WONS	Quilpie mesquite	*Prosopis velutina*	Not recorded	Non remnant	Known from a single Herbarium record on roadside 4 km west of Dalby along Warrego Highway on dark clay.
Class 1 WONS	willow	*Salix babylonica*	Not recorded	11.3.25	Herbariun record from Charleys Creek, Chinchilla in fringing woodland of Eucalyptus tereticornis, Angophora floribunda, Acacia salicina, Callistemon viminalis indicates potential to occur along disturbed riparian zones of major rivers and creeks within study area.
Class 2 WONS	salvinia	*Salvinia molesta*	Not recorded	Non remnant	Known within PDA only from a record in urban parkland at Dalby. Potential to occur in farm dams.
Class 3	broad leaf pepper tree	*Schinus terebinthifolius*	Not recorded	11.3.25 11.3.27	Herbarium record from 7 km north of Cecil Plains on the Condamine Floodplain on lagoon shoreline on brown cracking clay. Potential for widely scattered occurrences in RE11.3.25 and RE11.3.27
Class 2	fireweed	*Senecio madagascariensis*	Not recorded	Non remnant	Single herbarium record on roadside on the western edge of Dalby township indicates a potential for scattered occurrences on similar situations.

Table 14 below provides an assessment of the potential for a range of exotic species to proliferate in the study area as a result of project activities. The assessment includes those that are known to occur in the study area, or are considered to possess considerable potential for introduction based on climate and habitat suitability. Comments on species distribution and potential distribution are derived from Biosecurity Queensland's predictive weed maps (Biosecurity Queensland 2008a) and annual pest distribution survey (Biosecurity Queensland 2008b).

Table 14. Terrestrial exotic plant species with potential for significant ecological impact.

Common Name	Pest Class	Comments
velvet pear (*Opuntia tomentosa*)	Class 2	Found predominantly throughout the Brigalow Belt Bioregion where it is found as dense shrubs or small trees. Climate within the study area is considered highly suitable to suitable for species proliferation (Biosecurity Queensland 2008a). Populations previously under biological control by the Mealy Bug (*Dactylopius opuntiae).* Spread facilitated by consumption of fruit by a range of species (Department of Employment, Economic Development and Innovation (DEEDI) 2009a)
prickly pear *(Opuntia stricta)*	Class 2	Generally found as small to large clumps of varying density scattered plants. Heavily impacted by the biological control (Cactoblastis cactorium). Spread facilitated by consumption of fruit by a range of species (DEEDI 2009a). Climate within the study area is considered highly suitable to suitable for species proliferation (Biosecurity Queensland 2008a).
tiger pear (*Opuntia aurantiaca)*	Class 2	Prevalent in southern Queensland where it forms an impenetrable spiny ground cover. Current biological control is the Mealy Bug (*Dactylopius austrinus)* although requires re-introduction once an infestation has been eliminated (DEEDI2009a). Climate within the study area is considered highly suitable to suitable for species proliferation (Biosecurity Queensland, 2008a).
harrisia cactus (*Eriocereus martinii, Eriocereus tortuosa)*	Class 2	Abundant in the Northern Brigalow Belt bioregion with scattered distribution in the Brigalow Belt South Bioregion. Climate within the study area is considered unsuitable for proliferation (Biosecurity Queensland 2008a). A pest of brigalow and associated soils where it forms dense infestations that choke pasture species. Spreads from seed as well as vegetatively by branches that root when in contact with ground as well as from broken plant material. A deep tuberous root system aid survivals following land disturbance (DEEDI 2009b; DPI 2004a). Displaces native ground covers in remnant brigalow communities.
mother of millions (*Bryophyllum delagoensis, Bryophyllum x houghtonii)*	Class 2	Climate ranges from marginally suitable in the south to highly suitable in the northern portion of the study area (Biosecurity Queensland 2008a). A fleshy pest plant that establishes in disturbed areas. The plant regenerates profusely from vegetative components (plantlets)and is poisonous to stock (Biosecurity Queensland 2008c). Extensive occurrence found within riparian zones in the study area.
annual ragweed (*Ambrosia artemisiifolia)*	Class 2	An erect plant of 1-2m high that colonises bare areas on roadsides and waterways, occasionally infesting pasture areas (DEEDI 2009b). The species is naturalised in southeast Queensland with infestations known from the Inglewood area. Localised occurrences are predicted within the southern portion of the study area (Biosecurity

Common Name	Pest Class	Comments
		Queensland 2008a). Predictive habitat mapping for the species indicates that climatic factors in the study area are marginally suitable for species proliferation (Biosecurity Queensland 2008b).
groundsel bush (*Baccharis halimifolia)*	Class 2	A densely branched shrub that spreads rapidly from wind borne seed. The species colonises disturbed areas, competing with pasture species and displacing native ground covers in some communities (Biosecurity Queensland 2007a). Southeast Queensland provides a population stronghold for the species. Localised and occasional occurrences are predicted within the southern portion of the study area (Biosecurity Queensland 2008b). Predictive mapping for the species indicates the climate is unsuitable to marginally suitable for species proliferation (Biosecurity Queensland 2008a).
balloon vine (*Cardiospermum grandiflorum)*	Class 3	A densely growing climbing herb with tendrils that twirl around supporting structures. The plant smothers supporting vegetation (Biosecurity Queensland 2007b). Annual distribution maps produced by Biosecurity Queensland (2008b) show the pest to be largely absent from the study area. Predictive distribution mapping indicate that the climate in the study area ranges from moderate to high suitability for species proliferation (Biosecurity Queensland 2008a). Most likely to inhabit riparian zones.
chinese celtis (*Celtis sinensis)*	Class 3	A fast growing tree species that densely colonises stream banks and prevents regeneration of native riparian vegetation (Biosecurity Queensland 2007c). Predictive mapping (Biosecurity Queensland 2008a) shows marginal climatic suitability for weed proliferation in the study area. Most likely to inhabit riparian zones.
camphor laurel (*Cinnamomum camphora)*	Class 3	A large woody tree that aggressively displaces native vegetation, particularly in disturbed riparian areas. Predictive mapping indicates unsuitable habitat in the study area for weed proliferation (Biosecurity Queensland 2008a).
parthenium (*Parthenium hysterophorus)*	Class 2 WONS	An annual herb with a deep tap root that becomes woody with age. The species colonises weak pastures with disturbed ground cover with alkaline clay loams highly suitable (DEEDI 2009c). Predictive mapping by Biosecurity Queensland (2008a) indicates climate within the study area ranges from marginally suitable in the southwestern portion to suitable in the northeast. Weed distribution mapping for the species shows localised occasional occurrences in the study area (Biosecurity Queensland 2008b).
mesquite (*Prosopis glandulosa* var. *glandulos, Prosopis velutina)*	Class 2 (WONS)	A multi-stemmed tree or shub that was introduced as an ornamental to towns and homesteads. The species forms dense impenetrable thickets in riparian areas that can out compete native vegetation (Biosecurity Queensland 2007d). Predictive mapping indicates climatic conditions

Common Name	Pest Class	Comments
		that are favourable and highly favourable to proliferation (Biosecurity Queensland 2008a). Current mapping indicates localised occasional occurrences in the study area. A species risk assessment based on climatic factors indicates that mesquite has the potential to become established on grazing land over 60% of Queensland (DNRM 1996).
willow (*Salix babylonica)*	Class 1	Predictive mapping indicates unfavourable climatic conditions for weed proliferation (Biosecurity Queensland 2008a). Localised occurrences are known along degraded riparian zones in the north of the study area (DERM 2011) with other occurrences known in the New England Tableland Bioregion to the south of the study area.
broad leaf pepper tree (*Schinus terebinthifolius)*	Class 3	Potential distribution mapping indicates unsuitable climatic conditions for proliferation in the study area. Localised occasional occurrences are indicated in the study area (Biosecurity Queensland 2008b). Most likely to inhabit riparian zones.
fireweed (*Senecio madagascariensis)*	Class 2	Biosecurity Queensland (2008a) predictive mapping indicates unsuitable climatic conditions in the study area. Mapping by Biosecurity Queensland (2008b) indicates the species is absent from the study area although records of the species are recorded in the Herbrecs database (DERM 2011).
rubber vine (*Cryptostegia grandiflora)*	Class 2 WONS	A vigorous climber that smothers native vegetation, typically on riparian zones. The plant is spread by wind blown seed and is poisonous to stock (DEEDI 2009d). Habitat suitability mapping indicates marginally suitable habitat in the northern portion of the study area with suitable habitat in the Wandoan area (Biosecurity Queensland 2008a). Weed distribution mapping indicates that the species is currently considered absent from the study area (Biosecurity Queensland 2008b).
lippia (*Phyla canescens)*	Not Declared	A prostrate perrenial herb that forms dense mats that replaces native vegetation. The species spreads both vegetatively and by seed. Severely threatens grazing productivity . Its deep rooting nature may be associated with stream bank erosion and is considered a major threat to flood plain vegetation and native pasture grasses (DNRME 2004). The species is widespread on floodplains in the study area.
African love grass *(Eragrostis curvula)*	Not Declared	A naturalised grass in southern Queensland where it spreads along roadsides and into areas of disturbance. The species has the long-term potential to displace native pasture grasses and decrease grazing productivity (Biosecurity Queensland 2009). Provides a potential threat to the integrity of native grassland areas and associated EVNT species.

Environmental Weeds: Environmental weed species may pose a threat to ecological processes and economic activities and may be encouraged by various land uses and disturbance. The most widespread environmental weed encountered was maynes pest (*Verbena aristigera*) which commonly occurs in the groundcover of the alluvial regional ecosystems 11.3.2, 11.3.4, 11.3.14, and 11.3.25. Riparian woodlands and open forests showed varying degrees of infestation of pasture grasses such as rhodes grass (*Chloris gayana*) and giant panic (*Megathyrsus maximus* var*. maximus, M. maximus* var*. pubiglumis*) with sporadic occurrences of mimosa bush (*Acacia farnesiana*). Infestations of african love grass (*Eragrostis curvula*) are concentrated on roadsides throughout the area and may invade adjoining pastures and remnant vegetation. The invasive ground cover 'lippia' (*Phyla canescens)* was a prominent ground cover in flood plain woodlands, although native species were often smothered by this pest in seasonal wetlands.

5.3 Fauna Values

Based on the results of the desktop study, a total of 497 vertebrate species have been previously recorded from the study area including 29 frogs, 97 reptiles, 308 birds and 63 mammals. An additional 49 butterfly species and 14 dragonfly species have been recorded. No previous data were available for dragonflies, with all species recorded for the first time during the current survey. A full list of species recorded, incorporating results of database searches and field survey is provided in **Appendix G.**

5.3.1 Dragonflies

Only 14 species of dragonfly have been recorded from the study area, all within the current survey. These species were recorded opportunistically. All species were observed around either temporary ponds or permanent waterholes (typically dams and billabongs), reflecting the types of dragonfly habitats available. These habitats are common and widespread within the PDA. No dragonfly species are currently listed under state or federal legislation. They can, however, be used as indicator species to assess waterway health. Commonly encountered dragonfly species included scarlet percher (*Diplacodes haematodus*), common bluetail (*Ischnura heterosticta*), blue skimmer (*Orthetrum caledonicum*), common glider (*Tramea loewii*) and red and blue damsel (*Xanthagrion erythroneurum*).

5.3.2 Butterflies

A total of 49 butterfly species have been recorded from within the study area, 14 of these from the current survey. Many butterflies within the study area are uncommon, or subject to local eruptions and migratory patterns that are influenced by climatic conditions. As a group, they are therefore not conspicuous. Butterflies may be more abundant and diverse within certain vegetation communities, such as semi-evergreen vine thickets or softwood scrubs (e.g., REs 11.8.3, 11.9.4a, and 11.9.5). These communities are uncommon within the study area and several have been significantly reduced in extent.

Some butterfly species that are commonly observed within the region include meadow argus (*Junonia villida*), common grass-blue (*Zizina labradus*), caper white (*Belenois java*), lesser wanderer (*Danaus chrysippus*) and common Australian crow (*Euploea core*). Typically, the larvae of these species feed on a number of food plants that are relatively abundant.

Two species of note are the pale imperial hairstreak (*Jalmenus eubulus*) and bulloak jewel (*Hypochrysops piceatus*). Both these species have very specific food plant requirements and their habitats have been significantly reduced by human activities. These species are now listed under the NCA and are discussed in more detail in **Section 5.3.7**. No other butterfly species protected by legislation are known to occur within the study area or local vicinity.

5.3.3 Amphibians

A total of 29 amphibian (frog and toad) species have been recorded from within the study area. While some rain fell during the current survey, the lack of flooding rainfall affected frog activity and hence detection, limiting the number of species recorded to eight. Nine (approximately 31%) of the 29 known species are burrowing in habit, remaining underground for extended periods of time until substantial rainfall causes the pooling of surface water.

Abundant and widespread species following rainfall would include green-striped burrowing frog (*Cyclorana alboguttata*), eastern snapping frog (*Cyclorana novaehollandiae*), green tree frog (*Litoria caerulea*), broad-palmed rocket frog (*Litoria latopalmata*), emerald-spotted tree frog (*Litoria peronii*) and desert tree frog (*Litoria rubella*).

Two of the three non-EVNT priority species within the Brigalow Belt South (BBS) have been recorded from the study area. These are the salmon-striped frog (*Limnodynastes salmoni*) and sandy gungan (*Uperoleia fusca*). Only one listed EVNT species, the rough collared frog (*Cyclorana verrucosa*; listed as near-threatened under the NCA), is known from the study area. This species has been extensively recorded throughout the study area and was recorded during the current survey. It may be locally common on low-lying lands, particularly those with clay soils. This species is discussed further in **Section 5.3.7**.

One introduced amphibian species, the cane toad (*Rhinella marina*), has been recorded from the study area. This species is not declared under the LPA, but has the potential to cause significant environmental harm. Biological effects, including lethal toxic ingestion, caused by cane toads (*Bufo marinus*[2]*),* is now a listed Key Threatening Process under the EPBC Act.

5.3.4 Reptiles

A total of 97 reptile species have been recorded from the study area (30 in the current survey), representing approximately 75% of the 130 reptiles known from the BBS (**Table 15**) All five of Australia's lizard families, four of the six snake families and one of the four turtle families have been recorded within the study area.

Table 15. Percentage of Brigalow Belt South bioregion reptile species represented within the study area.

	Study area (number of species)	Brigalow Belt South (number of species)	Percentage
Total reptile species	97	130	75%
Non-EVNT priority species	13	16	81%
EVNT species	9	12	75%

Most of these species are listed as 'Least Concern' under legislation, being widespread and/or relatively common. However, the study area has a high representation (13 of the 16; approximately 81%) of species identified as non-EVNT priority species for the Brigalow Belt South (BBS) (**Table 16**). These species are of regional concern because of population declines, shrinking distributions, or because they are restricted to habitats under pressure/decline (e.g., native grasslands) or habitats subject to heavy modification (e.g., waterways and riparian vegetation). The presence of these species can be used as an indication of vegetation/habitat integrity and connectivity. Within the study area, 10 out of the 12 SBB EVNT species (approximately 83%) have been recorded. These species are discussed in detail within **Section 5.3.7**.

Table 16. Non-EVNT priority reptile species known from study area.

Family	Species known from the study area	Total priority species from BBS (number of species)
Cheluidae	broad-shelled tiver turtle (*Chelodina expansa*) Murray short-necked turtle(*Emydura macquarii*)	3
Geckonidae	None	1
Pygopodidae	patternless delma(*Delma inornata*) common delma (*Delma plebeia*)	2
Scincidae	Ingram's ctenotus (*Ctenotus ingrami*)	3

[2] The taxonomy of the Cane Toad has changed from *Bufo marinus* to *Rhinella marina* (Chaparro 2007).

Family	Species known from the study area	Total priority species from BBS (number of species)
	pink-tongued lizard (*Cyclodomorphus gerrardii*) shingleback(*Tiliqua rugosa*)	
Agamidae	jacky lizard (*Amphibolurus muricatus*) eastern water dragon (*Physignathus lesueurii*)	3
Varanidae	yellow-spotted monitor (*Varanus panoptes*)	1
Elapidae	Carpentaria snake (*Cryptophis boschmai*) pale-headed snake (*Hoplocephalus bitorquatus*) spotted black snake (*Pseudechis guttatus*)	3

The very high representation of reptile species within the study area reflects the diversity and integrity of reptilian habitats. Only semi-evergreen vine thickets and vegetation on large sandstone masifs associated with the Carnarvon, Chesterton and Lynd Ranges are poorly represented within the study area. Key habitat areas are likely to be large, intact, contiguous vegetation (e.g. Barakula State Forest, Braemar State Forest, Western Creek State Forest, and Whetstone State Forest), areas with unusual habitat features (e.g., Lake Broadwater Conservation Park, Wondul Range National Park, Waaji Scientific Area) or areas with habitats in heavy decline (e.g., native grasslands and brigalow; stock and roadside reserves, Bendidee National Park).

5.3.5 Birds

At present, 308 bird species have been recorded within the study area (146 in the current survey), representing approximately 80% of bioregional bird diversity (**Table 17**). While this is likely to approximate the total number of species present within the study area, additional species may be sporadically recorded. Many bird species are nomadic and transient, able to appear unexpectedly as one-off vagrants. For example, current surveys located varied triller and spectacled monarch for the first time within the study area, despite substantial bird survey work having taken place within the area in the past. One-off vagrants such as these do not contribute to bird communities and the possible addition of further vagrant species is of little consequence to the environmental planning process.

Table 17. Percentage of Brigalow Belt South bioregion bird species represented within the study area.

	Study area (number of species)	Brigalow Belt South (number of species)	Percentage
Total bird species	308	384	80%
Non-EVNT priority species	9	10	90%
EVNT species	18	31	58%

As some birds are vagrants, seasonal migrants or subject to sporadic influxes, species abundance varies greatly. Exceptionally abundant species include pied butcherbird, Australian magpie, laughing kookaburra, sulphur-crested cockatoo, galah, brown falcon, welcome swallow, masked lapwing, black-faced woodswallow, noisy miner, yellow-throated miner and willie wagtail. These species are tolerant of severe habitat disturbance and are often located in open grazing areas. Other species are also common, but generally restricted to remnant woodlands. Examples include inland thornbill, grey fantail, white-throated honeyeater, weebill, striated pardalote, grey shrike-thrush, leaden flycatcher, yellow-faced honeyeater, double-barred finch and peaceful dove.

Within the study area, 9 of the 10 non-EVNT priority bird species from the Brigalow Belt South are known to occur (**Table 18**). This represents 90% of regionally important bird species. In addition to these species, the eastern yellow robin, red-capped robin, jacky winter and southern whiteface are sensitive to habitat fragmentation and subsequent structural simplicity (Freudenberger 2001; Cogger *et al.* 2003; Olsen *et al.* 2005), or have declined and are of regional significance.

Table 18. Non-EVNT priority bird species known from study area.

Family	Species known from the study area
Acanthizidae	speckled warbler (*Chthonicola sagittata*)
Burhinidae	bush stone-curlew (*Burhinus grallarius*)
Climacteridae	brown treecreeper (*Climacteris picumnus*)
Estrildidae	diamond firetail (*Stagonopleura guttata*)
Petroicidae	hooded robin (*Melanodryas cucullata*)
Pomatostomidae	grey-crowned babbler (*Pomatostomus temporalis*) white-browed babbler (*Pomatostomus superciliosus*)
Strigidae	barking owl (*Ninox connivens*)
Tytonidae	masked owl (*Tyto novaehollandiae*)

Many bird species, particularly the above species and several other EVNT species, are patch-size sensitive, and cannot persist in small remnant patches below a particular threshold (Olsen *et al.* 2005; Radford *et al.* 2005). As a result, many woodland bird species have disappeared from heavily fragmented landscapes. Other populations are only viable due to the immigration of new individuals from nearby source populations. Several large patches occur within the study area, including Barakula State Forest, Braemar State Forest, Western Creek State Forest, Whetstone State Forest and connected habitats. These areas may be important to retaining local area woodland bird diversity.

A total of 18 bird species listed as EVNT under legislation have been identified from the study area. A number of these species are represented by only a few records, are at the very edge of their known range, or are located in unusual habitats. Hence, the number of species expected to occur regularly within the study area is likely to be fewer. Threatened bird species are discussed in more detail in **Section 5.3.7**.

Ten introduced bird species are known to occur (refer to **Appendix G**). These species are likely to be concentrated around towns and other human settlements, although a few species may extend into agricultural lands. Exotic species within remnant woodlands are uncommon.

5.3.6 Mammals

A total of 63 mammal species are known to occur within the study area, with 18 species recorded on the current survey. Within the SBB bioregion, 23 non-EVNT priority species have been identified. Approximately 12 of these species are known from the study area (52%) (**Table 19**).

Table 19. Non-EVNT priority mammal species known from the study area.

Family	Species known from the study area	Total priority species from Brigalow Belt South (number of species)
Ornithorhynchidae	platypus (*Ornithorhynchus anatinus*)	1
Dasyuridae	brush-tailed phascogale (*Phascogale tapoatafa*) narrow-nosed planigale (*Planigale tenuirostris*)	3
Peramelidae	northern brown bandicoot (*Isoodon macrourus*)	2
Phascolarctidae	koala (*Phascolarctos cinereus*)	1
Phalangeridae	ccmmon brushtail possum (*Trichosurus vulpecula*)	1
Pseudocheiridae	greater glider (*Petauroides volans*) common ringtail possum (*Pseudocheirus peregrinus*)	2
Petauridae	squirrel glider (*Petaurus norfolcensis*)	3
Potoroidae	rufous bettong (*Aepyprymnus rufescens*)	1
Macropodidae	black-striped wallaby (*Macropus dorsalis*)	1
Vespertilionidae	*Scotorepens* sp. (parnaby)	6
Muridae	None	2

Most native mammal species are absent from, or very uncommon within, modified landscapes such as grazing or agricultural areas. While some species, including the eastern grey kangaroo (*Macropus giganteus*), red-necked wallaby (*Macropus rufogriseus*) and white-striped mastiff bat (*Tadarida australis*), will often forage in cleared areas, they still require some remnant or advanced regrowth vegetation for shelter. Most mammal species are therefore associated with large, intact vegetation patches.

Within remnant vegetation, the abundance and diversity of small and medium ground-dwelling species,including the narrow-nosed planigale (*Planigale tenuirostris*), northern brown bandicoot (*Isoodon macrourus*) and rufous bettong (*Aepyprymnus rufescens*) are often affected by ground strata condition. Mammal diversity and abundance is typically lower in areas where the soil structure has been affected, and debris or native grasses have been reduced by grazing or fire.

In contrast to ground-dwelling mammals, impacts on ground strata have little effect on arboreal species such as the brush-tailed phascogale (*Phascogale tapoatafa*), common brushtail possum (*Trichosurus vulpecula*), greater glider (*Petauroides volans*), squirrel glider (*Petaurus norfolcensis*) and bats (including *Scotorepens* sp. parnaby). Rather, these species rely on old-growth vegetation with trees of sufficient age to be senescing, thereby producing roosting hollows in a variety of sizes. Fire and heavy logging activities may reduce the occurrence of such hollows. While logging occurs within many state forests (e.g., Barakula State Forest), these are managed to avoid large trees or entire patches, thereby ensuring the existence of a mosaic of habitats and biological diversity.

Finally, exotic predators are far more common within modified artificial landscapes or fragmented habitats. Roads and tracks can act as conduits for predatory species, allowing penetration into otherwise inaccessible areas.

Due to the above factors, key mammal areas within the project site are likely to be associated with large vegetation patches such as state forests, conservation reserves and selected areas of private land that have not experienced grazing, fire or heavy logging.

Four EVNT mammal species have been identified from within the project site. These species are discussed in **Section 5.3.7**.

5.3.7 Threatened Fauna Species

A total of 34 EVNT fauna species under the NCA and/or the EPBC have been recorded from the study area and local surrounds since 1980, including two butterflies, one amphibian, nine reptiles, 18 birds and four mammals (**Table 20**). Representation of these records, which excludes spatial data from Wildnet (which was not made available for non-government agencies or purposes) is provided in **Figure 12.** The 34 EVNT fauna species were evaluated based on the number of records, record date, species habits (e.g., highly mobile/nomadic) and their habitat/known ranges. A number of species identified in database searches were removed from the assessment as they are likely to be transient individuals of highly mobile species, with little relevance to the project (e.g., swift parrot). Justification for the removal of each species is detailed in **Appendix H.**

Table 20. Database records of EVNT fauna species from the study area.

GROUP		Status*		Source#					
Scientific Name	Common Name	NCA	EPBC	Current	QM	BA	WN	Ecosmart	Other
BUTTERFLIES									
Hypochrysops piceata	bulloak jewel buttterfly	E					X	X	
Jalmenus eubulus	pale imperial hairstreak	V					X		X
AMPHIBIANS									
Cyclorana verrucosa	rough collared frog	NT		X	X		X	X	X
REPTILES									
Strophurus taenicauda	golden-tailed gecko	NT			X		X	X	X
Delma torquata	collared delma	V	V		X		X		
Paradelma orientalis	brigalow scaly-foot	V	V		X		X	X	X
Anomalopus mackayi	five-clawed worm-skink	E	V		X		X		
Egernia rugosa	yakka skink	V	V				X		X
*Tympanocryptis cf tetraporophora***	grassland earless dragon	E	E					X	
Acanthophis antarcticus	common death adder	NT					X		
Furina dunmalli	Dunmall's snake	V	V		X		X		
Hemiaspis damelii	grey snake	E			X		X	X	X
BIRDS									
Accipiter novaehollandiae	grey goshawk	NT				X	X		X
Erythrotriorchis radiatus	red goshawk	E	V				X		X
Lophoictinia isura	square-tailed kite	NT		X		X	X	X	X
Nettapus coromandelianus	cotton pygmy-goose	NT				X	X		
Stictonetta naevosa	freckled duck	NT				X	X		
Calyptorhynchus lathami	glossy black-cockatoo	V		X		X	X	X	X
Lophochroa leadbeateri	Major Mitchell's cockatoo	V					X		
Ephippiorhynchus asiaticus	black-necked stork	NT		X		X	X		X
Geophaps scripta scripta	squatter pigeon (southern)	V	V			X	X		
Anthochaera phrygia	regent honeyeater	E	E	X	X	X	X	X	
Grantiella picta	painted honeyeater	NT				X	X		X
Melithreptus gularis	black-chinned honeyeater	NT				X	X		X
Pedionomus torquatus	plains wanderer	V	V				X		
Neophema pulchella	turquoise parrot	NT				X	X		X
Rostratula australis	Australian painted snipe	V	V			X	X		

GROUP			Status*		Source#					
–	Scientific Name	Common Name	NCA	EPBC	Current	QM	BA	WN	Ecosmart	Other
	Poephila cincta	black-throated finch	E	E		X				
	Lathamus discolor	swift parrot	E	E				X		
	Ninox strenua	powerful owl	V			X		X		X
MAMMALS										
	Dasyurus m. maculatus	spotted-tailed quoll	V	E				X		
	Petrogale penicillata	brush-tailed rock-wallaby	V	V				X		
	Chalinolobus picatus	little pied bat	NT					X	X	X
	Nyctophilus corbeni	south-eastern long-eared bat	V	V				X	X	X

* Status: NT = Near-threatened; V = Vulnerable; E = Endangered;
\# Source: QM = Queensland Museum; BA = Birds Australia Atlas; WN = WildNet; an 'X' indicates one or more records of that species from that source. ** known as *Tetraporophora pinguicolla* under the EPBC Act

Habitat requirements and ecology of 27 EVNT fauna species assessed as known from or possibly occurring in the study are individually outlined in **Appendix I.** These species occur within the study area with varying regularity. Some are highly restricted in extent and habit (e.g., bulloak jewel butterfly, five-clawed worm-skink), while others are widely distributed (e.g., golden-tailed gecko, brigalow scaly-foot) and others are nomadic and probably vagrant (e.g., grey goshawk, Australian painted snipe).

Habitat mapping, based on previous records, known habitat requirements and current vegetation maps for the PDA, have been developed into GIS layers for each species. These show the potential distribution of EVNT species throughout the PDA and designate core habitat areas. Several areas or habitats consistently appear as containing core habitat for EVNT species, as listed below.

- Lake Broadwater Conservation Park.
- Bendidee National Park.
- Larger remnant vegetation patches such as Barakula State Forest, Braemar State Forest, Western Creek State Forest and Whetstone State Forest.
- Regional Ecosystems of Brigalow/Belah (i.e., REs 11.3.1, 11.4.3, 11.9.1, 11.9.4b, 11.9.5, 11.9.6, 11.9.10).
- Native grasslands and grassy woodlands (i.e., REs 11.3.2, 11.3.3, 11.3.21, 11.3.24) and derived native grasslands.

5.3.8 Migratory Fauna Species

A total of 29 migratory bird species, as listed under the EPBC Act, have been recorded from the study area as indicated in **Table 21.** A significant proportion of these species (14 species; 48%) are shorebirds that inhabit costal mudflats and estuarine areas but may occur inland on the edges of dams or suitable waterways. Habitat for this group within the PDA is limited as the edges of permanent dams and billabongs typically become overgrown with semi-aquatic plants, rendering them unsuitable. Most records are likely to originate from Lake Broadwater where these species may occur with seasonal regularity if the lake fills with water (Scott 1988).

Other migratory wetland species include Latham's snipe, eastern great egret, cattle egret, cotton pygmy-goose and white-breasted sea-eagle. Eastern great egrets are abundant and common on farm dams within the PDA and will also occur in flooded paddocks, billabongs, creeks and on the Condamine River. Latham's snipe may inhabit similar waterways to eastern great egrets, but isgenerally more readily observed in larger waterways with abundant semi-aquatic vegetation

Table 21. Migratory species known from study area.

Scientific name	Common name	Notes
Haliaeetus leucogaster	white-bellied sea-eagle	Found around waterways.
Nettapus coromandelianus	cotton pygmy-goose	Uncommon within region.
Apus pacificus	fork-tailed swift	Nomadic.
Hirundapus caudacutus	white-throated needletail	Nomadic.
Ardea ibis	cattle egret	Uncommon within region.
Ardea modesta	eastern great egret	Common throughout study area and bioregion.
Pluvialis fulva	Pacific golden plover	Shorebird.
Chlidonias leucopterus	white-winged black tern	Shorebird.
Hydroprogne caspia	Caspian tern	Shorebird.
Anthochaera phrygia	regent honeyeater	Considered in Section 5.3.7
Merops ornatus	rainbow bee-eater	Common throughout PDA and bioregion
Monarcha melanopsis	black-faced monarch	Found in semi-evergreen or riparian vegetation.
Myiagra cyanoleuca	satin flycatcher	Vagrant/uncommon
Symposiarchus trivirgatus	spectacled monarch	Found in semi-evergreen or riparian vegetation.
Rhipidura rufifrons	rufous fantail	Found in semi-evergreen or riparian vegetation.
Rostratula australis	Australian painted snipe	Found around waterbodies. Probably restricted to Lake Broadwater.
Actitis hypoleucos	common sandpiper	Shorebird.
Calidris acuminata	sharp-tailed sandpiper	Shorebird.
Calidris ferruginea	curlew sandpiper	Shorebird.
Calidris ruficollis	red-necked stint	Shorebird.
Gallinago hardwickii	Latham's snipe	Found around waterbodies.
Limosa lapponica	bar-tailed godwit	Shorebird.
Limosa limosa	black-tailed godwit	Shorebird.
Numenius minutus	little curlew	Shorebird.

Scientific name	Common name	Notes
Numenius phaeopus	Whimbrel	Shorebird.
Philomachus pugnax	Ruff	Shorebird.
Tringa glareola	wood sandpiper	Shorebird.
Tringa nebularia	common greenshank	Shorebird.
Tringa stagnatilis	marsh sandpiper	Shorebird.

Cattle egrets, which may occur in open paddocks and waterways, and cotton pygmy-geese are much less common within the study area.

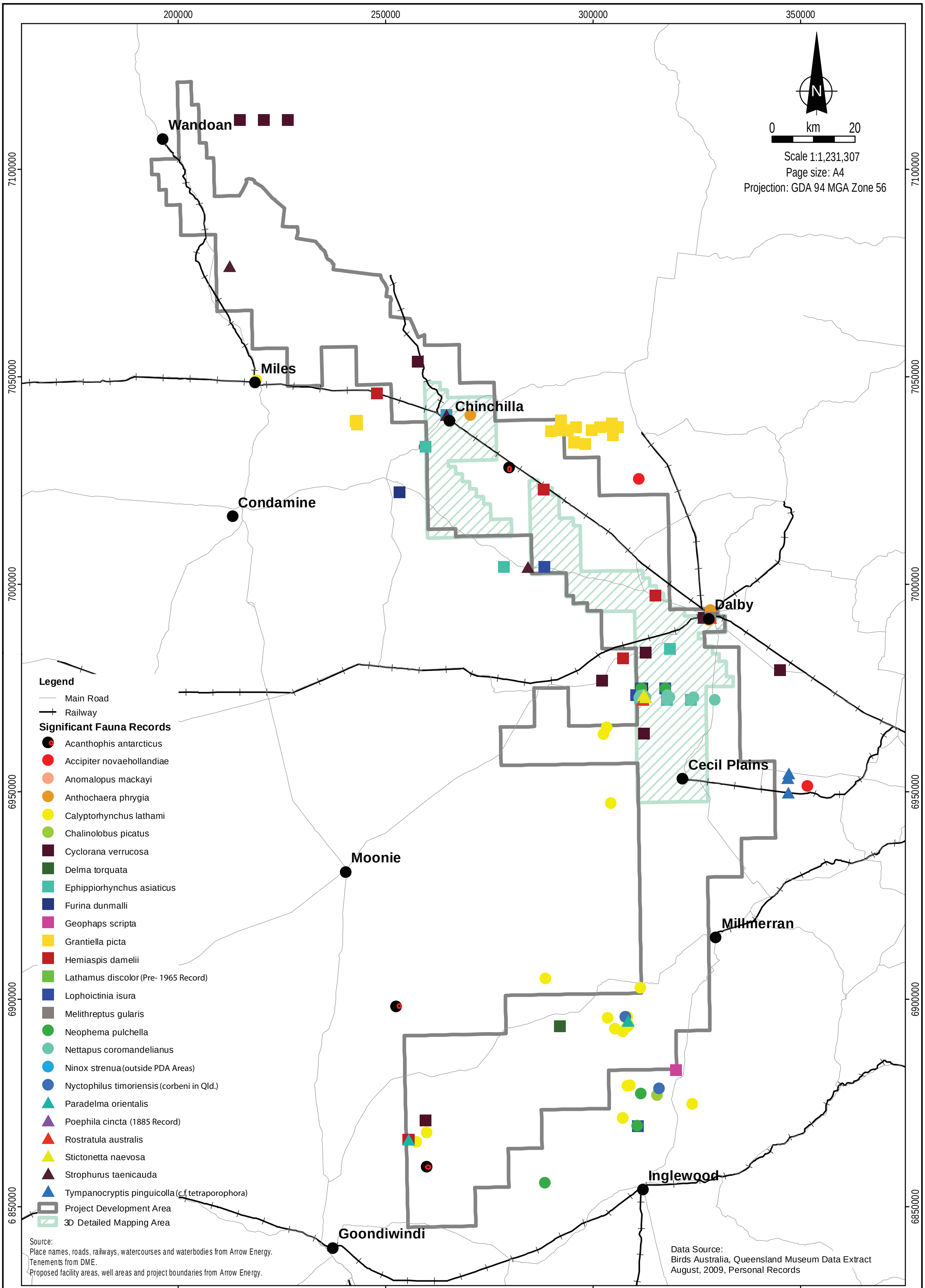
Remaining terrestrial species include spectacled monarch, satin flycatcher, regent honeyeater, rufous fantail, black-faced monarch, rainbow bee-eater, white-throated needletail and fork-tailed swift. With the exception of the rainbow bee-eater, these species are likely to be uncommon, or sporadic. Rufous fantails, black-faced monarchs and spectacled monarchs are more likely in semi-evergreen forest ecosystems or along thick riparian vegetation. These habitats are uncommon within the PDA. White-throated needletails and fork-tailed swifts are aerial species that rarely land,and may be observed over all terrestrial habitats, including urban areas. They are both nomadic and sporadic and flocks are often associated with weather fronts.

The most common migratory species within the study area, as observed during current surveys and indicated in database records, is the rainbow bee-eater. This species will be most prevalent during the summer months when breeding pairs nest in areas of sandy-loam soils. However, they may also be observed during winter. Rainbow bee-eaters are common throughout eastern Australia and can be observed in modified habitats such as grazing land.

5.3.9 Exotic Pest Fauna

A total of 22 feral terrestrial vertebrate species have been recorded from the study area. These include six listed as Class 2 declared animals under the LPA. Class two declared animals, considered as a high biodiversity risk within suitable habitats, are feral species established in Queensland that have, or may have, a substantial negative economic, environmental or social impact. **Table 22** lists all known feral terrestrial vertebrate species from the study area. Four pest species are known to pose significant risks to biodiversity: the feral dog/dingo, fox, cat and cane toad

Exotic pest species abundance within the study area may vary, as detailed in **Table 23**. This information has been sourced from the Queensland's predictive pest animal maps (Biosecurity Queensland 2008a), annual pest distribution surveys (Biosecurity Queensland 2008b) and WildNet (see **Appendix G**). **Table 23** also provides comments on habitat suitability for particular species.



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_Oct.11.mxd File Name: 3D_F12_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Database EVNT Fauna Records	Figure No: 12

Table 22. Feral vertebrate species recorded from the study area.

Common Name ***Scientific Name***	**LPA classification**	**Potential Biological Impacts**
cane toad *Rhinella marina*	ND	Is highly toxic, and may fatally poison anything that tries to prey upon it. Preys upon a wide variety of small native animals. May compete for resources with native animals "The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)" is a key threatening process listed under the EPBC Act.
feral dog/dingo *Canis lupus*	Class 2	Can carry diseases, such as distemper and parvovirus. Competes with native fauna for resources and preys upon a wide variety of native animals.
european fox *Vulpes vulpes*	Class 2	Preys upon a wide variety of native fauna, particularly small mammals and has been implicated in the extinction of a number of native species. "Predation by European Red Fox" is a key threatening process under the EPBC Act.
feral cat *Felis catus*	Class 2	Preys upon a wide variety of native animals and has been implicated in the extinction of a number of native species (Burbidge and Manley 2002; DEWHA 2008). Competes for resources with native species. "Predation by Feral Cat" is a key threatening process under the EPBC Act.
house mouse *Mus musculus*	ND	May possibly compete for resources with native species during periods of ecological stress (i.e., drought).
black rat *Rattus rattus*	ND	May possibly compete for resources with native species during periods of ecological stress (i.e., drought).
European cattle *Bos taurus*	ND	These records probably represent domestic animals or recent escapees, unlikely to be true feral cattle.
feral goat *Capra hircus*	Class 2	Degrades land through grazing and competes for resources with native species. "Competition and land degradation by unmanaged goats" is a key threatening process under the EPBC Act.
feral horse *Equus caballus*	ND	These records probably represent domestic animals or recent escapees, unlikely to be true feral horses.
European hare *Lepus capensis*	ND	This species occurs in low numbers and probably does not pose a significant environmental threat
rabbit *Oryctolagus cuniculus*	Class 2	Competes for resources with native species and degrades land through burrowing and grazing. "Competition and land degradation by Rabbits" is a key threatening process under the EPBC Act.
feral pig *Sus scrofa*	Class 2	Degrades waterbodies through wallowing and foraging, may spread diseases and weeds, preys on nesting ground birds and competes for resources with native species. "Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs" is a key threatening process

Common Name *Scientific Name*	LPA classification	Potential Biological Impacts
		under the EPBC Act.
northern mallard *Anas platyrhynchos*	ND	Can interbreed with some native species, but generally poses little environmental threat
muscovy duck *Cairina moschata*	ND	Pose no environmental threat.
feral pigeon *Columba livia*	ND	Found mainly in association with human settlements. May spread disease, but generally pose no significant environmental threat.
spotted turtle-dove *Streptopelia chinensis*	ND	Found mainly in association with human settlements. May spread disease, but generally pose no significant environmental threat.
house sparrow *Passer domesticus*	ND	Found mainly in association with human settlements. May spread disease, but generally pose no significant environmental threat.
Indian peafowl *Pavo cristatus*	ND	Likely to be found mainly in association with human settlements. Peafowl are voracious predators of smaller lizards and snakes. Impacts will be limited in extent and generally this species poses no environmental threat.
ring-necked parakeet *Psittacula krameri*	ND	Likely to be an aviary escapee. Poses no environmental threat.
ostrich *Struthio camelus*	ND	Unusual records, perhaps of escaped individuals.
common myna *Sturnus tristis*	ND	Found mainly in association with human settlements. A very aggressive competitor with native species that can pose significant impacts within areas it occupies and adjacent native bushland.
common starling *Sturnus vulgaris*	ND	Found mainly in association with human settlements. May compete for resources such as hollows, but impacts restricted to urban areas and nearby bushland.

Key:- Class 2: Class 2 declared animal; ND: Non-declared animal; LPA: *Land Protection* (*Pest and Stock Route Management) Act* 2002

Table 23. Terrestrial pest fauna species with potential for proliferation.

Common Name	Pest Class	Comments
cane toad (*Rhinella marina*)	Not Declared	Cane Toads are not common within the study area and habitat assessment suggests that habitat values are marginal. The species is highly toxic to native predators and can have significant impacts on species which prey on frogs (e.g. numerous snakes and carnivorous mammals).
european red fox (*Vulpes vulpes*)	Class 2	The European Red Fox is a veracious exotic predator which is common within the study area. It has been linked to the decline of many Australian native species (DEWHA 2008b) and has the potential to affect both EVNT species and common species.

Common Name	Pest Class	Comments
european rabbit (*Oryctolagus cuniculus*)	Class 2	European Rabbit surveys suggest that the species is occasionally recorded within the study area. Modelling suggests that it could occur throughout the area, albeit in low abundances. European rabbits compete with native herbivorous species and inhibit regeneration. There is also a strong correlation between rabbits and European Fox occurrence and abundance (DEWHA 2008b).
feral cat (*Felis catus*)	Class 2	Feral Cats are veracious predators of native birds, mammals and reptiles. They can have serious impacts when abundant and have been linked to the decline and local extinction of a number of species (DEWHA 2008c). They are currently common within the study area, although less common in the very southern areas.
feral deer (*Cervus* spp.)		Occasion records of both Fallow (*Cervus dama*) and Red Deer (*Cervus elaphus*) have been recorded within the Brigalow Belt South. None are known to occur within the study area. Both these species may have deleterious impacts through competition with native herbivores and habitat destruction.
feral donkey (*Equus asinus*)	Not Declared	Not known to occur within the study area.
feral goat (*Capra hircus*)	Class 2	Feral Goats may be occasionally recorded within the study area, predominantly in the south. The species may affect native values through competition for resources and habitat degradation (including reducing floristic recruitment).
feral horse (*Equus caballus*)	Not Declared	Not known to occur within the study area. Potential to degrade habitat values and increase competition
feral pig (*Sus scrofa*)	Class 2	Biosecurity data suggests that this species is occasionally recorded in the south of the study area and locally common in the north. However WildNet records suggest that it is uncommon. Feral pigs may predate on native species, destroy habitat, spread disease and compete for resources. They can have serious deleterious impacts on native values.
indian mynah (*Acridotheres tristis*)	Class 1	Currently, Indian Mynas are not widely distributed, restricted to urban areas and their immediate surrounds. Around these urban areas they can be extremely abundant (e.g. Dalby). Indian Mynas compete for resources (e.g. nesting hollows) and spread disease. In other bioregions, the species may occur well away from urbanisation in altered pasture and cropping areas.
house mouse (*Mus musculus*)	Not Declared	House Mice are abundant and widespread. They may occur in both artificial and native landscapes. Where present in large numbers, the house mouse can compete with native species for resources.
wild dog (*Canis familiaris*)	Class 2	The abundance of Wild Dogs within the study area varies from localised and occasional in the south to common in the north. Wild Dogs can have deleterious impacts on medium sized ground dwelling fauna species, particularly mammals. However, their impact on native values seems less severe than other exotic predators (e.g. Feral Cat and European Rabbit).

5.4 Biodiversity Values

Natural features with high biodiversity and conservation values within the PDA, as discussed in the following section, have been identified from a number of sources, including:

- Federal Government's Protected Matters search tool.
- Federal Government's Directory of Important Wetlands (Environment Australia 2001).
- Queensland Government's Brigalow Belt South expert fauna, flora and landscape panel reviews (EPA 2008).
- Queensland Government's Biodiversity Assessment and Mapping Methodology (BAMM).
- Results of recent fieldwork.
- Discussion with relevant groups (e.g., Chinchilla Field Naturalists Club).

5.4.1 Biodiversity Assessments

The biodiversity significance and values of the BBS are identified in BPAs prepared by the EPA (EPA 2008). **Figure 13** provides an extract of the BPA showing spatial distribution of areas considered to have special biodiversity significance in the PDA and surrounds. In relation to the PDA, state, regional and local significance and special biodiversity values are assigned to the following features.

- **Bendidee National Park**. The park is surrounded entirely by cleared land and is afforded State Significance under Criteria Ib, refuge from clearing (EPA 2002a).
- **Lake Broadwater**. Identified as possessing ecological values of State Significance under Criteria Ib (special biodiversity values – wildlife refugia).
- **Vine Thickets**. All vine thickets within the BBS are assigned State Significance due to high diversity and refugia values under Criteria Ib (special biodiversity values – wildlife refugia) and Criteria Ig (areas containing REs with distinct variation in species composition due to geomorphology and other variables). This includes REs 11.8.3 and RE11.9.4a mapped within the PDA.
- **Riparian Vegetation**. All riparian vegetation in fragmented sub-regions (remnant threshold <30%) is assigned State Significance under Criteria Ib (special biodiversity - fragmented landscapes).
- **High D2 Criteria**. Any RE remnant where Criteria D2 is very high (>75% of the largest known representation of a single regional ecosystem tract within the bio-region) is assigned State Significance.

- **Large Vegetation Tracts**. State Significance is applied to the 10 largest tracts of vegetation in the BBS Bioregion (under Criteria C - tract size) as bioregional corridors.
- **Vegetation Intersecting Rivers**. All vegetation intersecting rivers on 250 000 scale base mapping are classified as Bioregional corridors of State Significance (under Criteria J - corridors).
- **Dalby–St George Road Reserve.** The Dalby–St George Road Reserve is assigned State Significance (under Criteria 1b, refuge from clearing) due to areas of RE 11.3.17 supporting populations of Belson's panic grass (*Homopholis belsonii*).
- **Wyaga–Kindon Ooline populations**. Wyaga–Kindon ooline tree (*Cadellia pentastylis)* populations are assigned State Significance as they are disjunct populations approaching their eastern limit of distribution.
- **Remnant Grasslands**. The remnant grasslands, Eastern Darling Downs are assigned State Significance. The grasslands provide refuges from clearing, contain endangered ecological community (grasslands) & high diversity of EVNT species including (*Digitaria porrecta, Rhaponticum australis, Thesium australe, Solanum papaverifolium*) many of which are disjunct or at limits of their geographic range. Includes stockroute and rail reserves surrounding Dalby.
- **Poplar box Woodland**. Poplar box (*Eucalyptus populnea)* woodland on alluvial plains of the Eastern Darling Downs are assigned State Significance. This is a unique RE type (11.3.2) with open woodland restricted to subregion 31. It provides habitat for EVNT species including Belson's panic grass (*Homopholis belsonii*) and other priority grassland taxa.

A biodiversity assessment of the Brigalow South bioregion (Australian Natural Resources Atlas (ANRA) 2007b) provides additional information relevant to the assessment of regional biodiversity values. Of particular note are assessments for relevant sub-regions including the Eastern Darling Downs, Barakula and Inglewood Sandstones sub-regions which identify high value ecosystems,summarised in **Table 24.** Major points of note are listed.

- Condition on the extensive plains is poor and declining, whilst ranges tend to be in reasonable condition due to preferential development of high fertility areas located on the plains.
- A large number of sub-regions comprise <30% remnant vegetation with ongoing clearing, while areas in ranges tend to be in reasonable condition and stable. This

reflects areas of higher fertility being extensively cleared and developed, while less fertile areas are used for extensive grazing and forestry.

- The highly fragmented nature of the remnant vegetation constrains conservation options to being reliant upon community engagement in management of remnants and re-establishment of heavily cleared ecosystems.
- The Southern Brigalow Belt Bioregion represents some of the most intensively cleared areas in southern Queensland with riparian areas on the plains significantly degraded due to broadscale vegetation clearing and intensive agricultural and pastoral development.

Table 24. Biodiversity values for three major sub-provinces intersected by the PDA as defined by ANRA (2007).

Sub-province	Areas/ecosystems identified as having high biodiversity value
Eastern Darling Downs	• The sub-region is indicated as having 56 endangered or vulnerable species which have been recorded in the sub-region; 76% of ecosystem types are listed as endangered or vulnerable, and; has the greatest number of ecosystems (5) which are endemic to the sub-region. • Regional ecosystem 11.5.1 which provides habitat for a number of EVNT flora species including *Dodonea macrossani* and *Corymbia bloxsomei.* • Regional Ecosystem 11.3.21 providing habitat for EVNTspecies including *Thesium australe, Picris evae, Stemmacantha australis, Dicanthium queenslandicum, Bothriochloa biloba* and *Digitaria porrecta.* • Regional Ecosystem11.8.8 which represents the northern limit of a temperate vegetation type which extends to Victoria and has been extensively cleared throughout its geographical range. The ecosystem provides habitat for *Muellerina myrtifolia, Indigofera baileyi, Discaria pubescens, Cryptocarya floydii and Acacia brunioides subsp. brunioides.* • Regional Ecosystem 11.3.2 which provides habitat for EVNT species including *Homopholis belsonii.*
Barakula	• Regional Ecosytem 11.4.3 providing habitat for EVNT species including *Eucalyptus argophloia.* • Regional Ecosystem 11.5.1 providing habitat for EVNT species including *Dodonea macrossani, Corymbia bloxsomei.* • Regional Ecosystem 11.10.4 providing habitat for EVNT species including *Acacia curranii, A handonis, A. holotricha, A. islanda, A. lauta, A. pubicosta, A. tenuinens, Bertya spp., Calytrix islensis, Eucalyptus beaniana, E. curtsii and E. rubiginosa.* • Regional Ecosystem 11.5.4 habitat for EVNT species. • Regional Ecosystem 11.3.18 providing habitat for EVNT species including *A. curranii, A. lauta, Dodonea macrossanii, Grevillea cyanostigma, and Lomandra teres.* • Regional Ecosystem 11.9.4 providing habitat for EVNT species including *Cadellia pentastylus.* • Also identified are values which include Barakula State Forest as a species hot spot; 50% of ecosystem types are threatened (endangered or vulnerable) and; 41 species of plant and animals listed as endangered or vulnerable have been recorded in the subregion
Inglewood Sandstones	• The sub-province provides a regional corridor for migration with high faunal diversity.

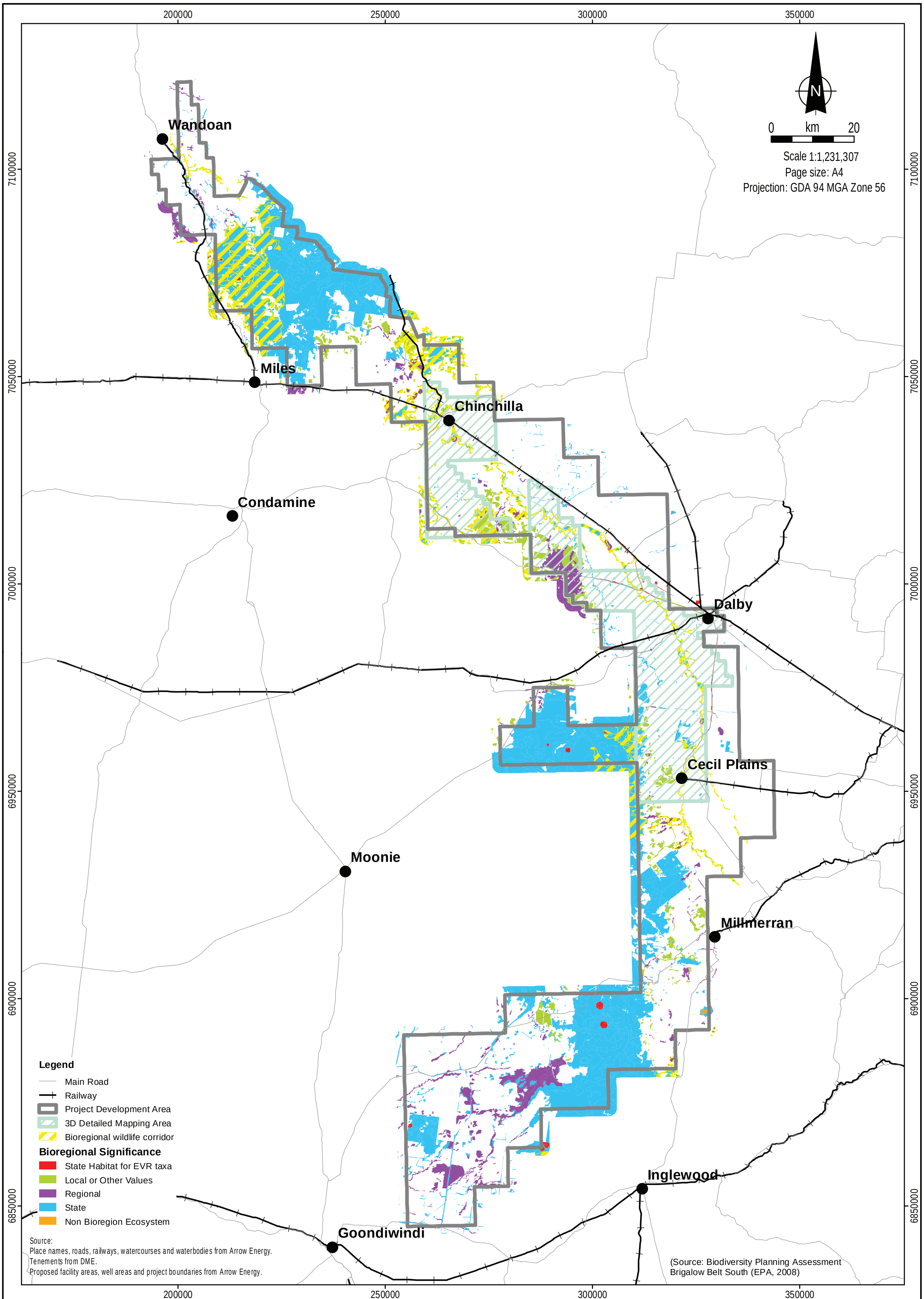
Sub-province	Areas/ecosystems identified as having high biodiversity value
	• Regional ecosystem 11.5.14 is endemic to the sub-region. • Subregion has high levels of species endemicity, particularly relating to sandstone communities. • Regional ecosystem 11.7.5 providing habitat for EVNTspecies including *Acacia wardellii.* • Regional ecosystem 11.10.4 providing habitat for the EVNT species*Acacia curranii, A handonis, A. holotricha, A. islanda, A. lauta, A. publicosta, A. tenuinens, Bertya spp., Calytrix islensis, Eucalyptus beaniana, E. curtsii* and *E. rubiginosa.* • Regional Ecosystem 11.5.4 provides habitat for EVNT species including *Eucalyptus curtisii, Homoranthus melanostictus, Indigofera baileyi, Dodonaea macrossanii, Dodonaea biloba.* • Regional Ecosystem 11.3.18 provides habitat for EVNT species including *A. curranii, A. lauta, Dodonea macrossanii, Grevillea cyanostigma,* and *Lomandra teres*. • Regional Ecosystem 11.5.1 provides habitat for EVNT species including *Dodonea macrossani, Corymbia bloxsomei*. A total of 23% of ecosystem types are listed as endangered or vulnerable and 30 endangered or vulnerable species have been recorded within the subregion.

5.4.2 Protected estate

The PDA encompasses a number of blocks of protected estate, such as National Parks, Conservation Parks and State Forests. Generally, these blocks of vegetation have avoided, or have less severe historical impacts from activities that may affect vegetation complexity such as cattle grazing, increased fire and heavy thinning. Furthermore, they are the largest intact habitat blocks remaining in an otherwise fragmented landscape. Larger, more structurally complex patches typically contain high species diversity and abundance (Olsen *et al.* 2005; Lindenmayer and Fischer 2006). The largest, and potentially most significant, of these blocks are listed below:

- Wondul Range and Bendidee National Parks.
- Lake Broadwater Conservation Park.
- Barakula, Braemar, Whetstone , Kumbarilla, Dunmore, Western Creek, Boondandilla, Dalby, Binkey, Quandong and Bendidee State Forests.

All these reserves are considered to be of State Significance under the BPA mapping derived from (EPA 2008) due to:



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11 .mxd File Name: 3D_F13_ GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Bioregional Significance (EPA, 2008)	Figure No: 13

- many areas of ‘very high’, ‘high’ or ‘medium’ habitat for EVNT taxa (criterion A);
- all vegetation mapped as ‘very high’ tract size (criterion C);
- large areas mapped as ‘very high’, ‘high’ or ‘medium’ relative size of regional ecosystem (criterion D);
- all vegetation mapped as ‘very high’ condition (criterion E);
- large areas of ‘very high’ and ‘high’ ecosystem diversity (criterion F);
- extensive areas of ‘very high’ and some areas of ‘high’ context and connection (criterion G);
- areas of ‘high’ core habitat for priority (both EVNT and non-EVNT) taxa within Barakula State Forest (criterion H);
- all vegetation within Barakula State Forest, Whetsone State Forest, Western Creek State Forest, Wondul Range National Park, Lake Broadwater Conservation Park, Dunmore State Forest, and Kumbarilla State Forest of ‘state’ significance for special biodiversity values (criterion I);
- a corridor of state significance running north-south through Whetstone State Forast, Wondul Range Nationl Park, Western Creek State Forest, Dunmore State Forest, Kumbarilla State Forest and Barakula State Forest (criterion J), and
- ‘state’ recognised corridor vegetation running east-west through Barakula State Forest (criterion J).

5.4.3 Important wetlands

Lake Broadwater is listed on the Directory of Important Wetlands and is recognised as significant at a national and state level due to it being a rare example of a semi-permanent freshwater lake in the bioregional area (Environment Australia 2001a, Blackman *et al.* 1999). Lake Broadwater is listed in the Federal Government’s Directory of Important Wetlands for the reasons listed below (Environment Australia 2001a):

- It is a wetland that plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.
- It is a wetland that is important as it contains the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
- The lake supports a seasonally rich aquatic flora and a diverse fauna (Scott *et al.* 1988).
- A host of EVNT species have been recorded from Lake Broadwater and in surrounding vegetation including holarctic water bird species protected under

CAMBA (China-Australia Migratory Bird Agreement, JAMBA (Japan-Australia Migratory Bird Agreement) and ROKAMBA (Republic of Korea – Australia Migratory Bird Agreement) as identified in Blackman *et al.* (1999). The wetland supports native plant or animal taxa or communities that are considered endangered or vulnerable at the national level.

- The ecology, vegetation and flora of the Lake Broadwater Conservation Park documented by the Lake Broadwater Natural History Association (1998), describes 355 vascular species within seven vegetation communities. The flora comprises 210 genera within 80 families, with 32 introduced species. Two flora species, *Eleocharis blakeana* and *Fimbristylis vagans* are listed as near-threatened under the NCA.

Along with the lake itself, Lake Broadwater Conservation Park protects a large area of remnant vegetation that is of significance in the region.

Downstream wetland values of Ramsar Convention importance include:

- Narran Lake Nature Reserve within the Condamine Catchment; and
- Shoalwater and Corio Bays, downstream of Auburn River in the very northern area of the PDA.

5.4.4 Special Flora Habitat Values

Grassland / Grassy woodland ecosystems

Grassland and grassy woodland ecosystems have been the focus of previous studies of the vegetation and flora within the PDA. Fensham and Fairfax (1997), Fensham (1998), Goodland (2000) and Silcock and Scatini (2007) identify the ecological and conservation importance of these ecosystems and consider aspects of their management.

Grasslands originally extended for 390 000 hectares across the Darling Downs with poplar box (*Eucalyptus populnea*) grassy woodlands making up 100 000 hectares of the 920 000 hectares. Extensive land use in the form of cropping and grazing of the fertile alluvial soils of the Condamine River valley has drastically reduced grasslands to some 1.25% of the original extent (Fensham 1997). Now listed as an “Endangered” regional ecosystem (11.3.21), they represent some of the last remaining blue grass (*Dichanthium sericeum*) grassland communities in Queensland (Goodland 2000). Similarly, other alluvium ecosystems such as brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) (11.3.1), and poplar box grassy woodlands (11.3.2) have been drastically reduced (Sattler 1998).

Goodland (2000) examined remnant native grasslands of the Darling Downs formulating an overall roadside management strategy that aimed to secure the future of the remaining significant grassy ecosystems. The assessments and management recommendations formed an information base for the Department of Main Roads, Department of Natural Resources, Environmental Protection Agency, Local Councils, relevant utilities and interested community groups. Roadsides and stock routes were found to support a significant proportion of the remnant native grasslands on the Darling Downs, providing habitat for endangered vegetation communities, and a number of near-threatened and threatened species. The study identified four highly significant stock route sites in the Darling Downs area, two of which are located within the PDA. These sites are reported to have been modified from natural condition and are subject to considerable edge effect due to their lineal nature, adjacent land uses and management regimes such as spray drift, fertilisers, access tracks, altered hydrology, and slashing.

The Dalby - Cecil Plains Road reserve which extends from 1.8km south of the Warrego Highway along the Dalby - Cecil Plains Road to 13km northeast of Cecil Plains is located wholly within the PDA, and is identified by Goodland (2000) as an area of national botanical significance. The reserve supports significant Queensland blue grass grasslands, limited open woodlands of poplar box on alluvium, and populations of the near-threatened and threatened species *Digitaria porrecta* (Endangered) and *Solanum stenopterum* (Vulnerable). The naturally treeless grassland is dominated by queensland blue grass, with mitchell grass (*Astrebla lappacea*), satin top (*Bothriochloa erianthoides*), kangaroo grass (*Themeda triandra*), white speargrass (*Aristida leptopoda*), and a variety of inter-tussock herbs (Goodland 2000). National botanical significance is also assigned to the Dalby-Kogan Road reserve which is identified as a 150m wide strip of Queensland blue grass grassland and poplar box open woodland on the south side of the Warrego Highway extending from five kilometres west of Dalby to the Condamine River on the Kogan Road (Goodland 2000). This site is an excellent example of its type supporting the near-threatened and threatened species *Digitaria porrecta* and *Solanum papaverifolium*, with conservation values compromised by flooding and incursion of gravel pits.

Grasslands were assessed specifically during this study using a site based transect approach in order to determine condition and conservation status according to the thresholds identified by the listing advice of the EPBC Act. Data on the cover and abundance of species was collected from eight representative sites located in mapped remnant grassland habitats within the PDA (**Appendix M)**. Four sites were placed within grasslands along the Dalby-Kogan Road and another four along the Dalby-Cecil Plains Road. Species were grouped into broad life form categories with calculations of mean cover values and species richness utilised. Key findings of the survey are summarised as follows:

- In all grasslands surveyed the total vegetative groundcover was high. The robust cover is indicative of good condition grassland in the absence of recent grazing pressure within the road reserve areas with values ranging from 74% to 100%.
- Total cover of native species was significantly higher in the grasslands within the Dalby-Kogan Road sites (mean 83%) than in the Dalby-Cecil Plains sites (66%). In the former, native cover was consistently dominated by perennial native grasses over perennial and annual native herbs.
- The mean values for total native cover and total exotic cover in the the Dalby-Cecil Plains Road grasslands show a significantly lower average for total native cover than the Dalby-Kogan Road sites, and display considerable variation of condition between sites. The dominance of exotic species cover at Site 355 for example is influenced by widespread infestation of lippia (*Phyla canescens*) an exotic herb typically occupying inter-tussock spaces. Lippia infetstation has a stronger influence than exotic grasses throughout the Dalby-Cecil Plains sites. Species composition is dominated by natives with almost identical mean values between the two grasslands areas.
- On the basis of the data collected in May 2010 the grasslands on the Dalby-Kogan Road exhibit high integrity and are consistent with the 'best quality' EPBC endangered classsifcation on the basis that they: a) have a minimum patch size at least 0.5 ha; b) support at least four native perennial grass species from the indicator species list; c) support at least 200 native perennial grass tussocks; d) have a total projected canopy cover of shrubs is less than 30%; and e) where perennial non-woody introduced weed species are less than 5% of the total projected crown cover.
- Whilst the Dalby-Cecil Plains Road grasslands also meet EPBC criteria they are assessed as 'good quality' grasslands under the EPBC threshold criteria. They exhibit a higher incidence of weeds (i.e. perennial non-woody introduced weed species are less than 30% of the total projected crown cover), however this is heaviy influenced by the widespread occurrence of lippia rather than widespread infestations of exotic grasses. Exotic grasses such as rhodes grass (*Chloris gayana*), African love grass (*Eragrostis curvula*), and pasplaum (*Paspalum notatum*) are more prolific on roadside margins and along disturbance associated with drainage works, fence lines and other linear infrastructure.
- The results of the condition survey are broadly consistent with the findings of Goodland (2000) who notes the overall high integrity of grasslands within the Dalby-Kogan stockroute, and the lower signficance of the Dalby-Cecil Plains stock route. Goodland (2000) also notes that the influence of lippia is more pronounced along the Dalby-Cecil Plains sites. It is likely that the widespread flooding events of 2011 will have facilitated

its further dispersal of lippia adding to increased modification of the groundcover through displacement of native herbs in inter-tussock spaces.

Stock Routes

The ecological values preserved in historical stock routes should also be identified. Although narrow (400m or less) and generally interrupted by roads and access tracks, these routes provide vestiges for the preservation of a number of highly significant ecosystems. The preservation of natural grassland ecosystems (RE11.3.21) within the PDA can be largely attributed to protection afforded by stock routes. Similarly, some of the better preserved examples of brigalow (RE11.4.3 and RE11.3.1), and RE11.4.12 are found in stock routes within PL253 and PL185 in the central portion of the PDA. Stock routes may also provide valuable corridors for faunal movement along roadsides and habitat linkage between disjunct areas of remnant vegetation.

Chinchilla Sporting Shooters Range

The Chinchilla Sporting Shooters Range provides representation of the best preserved tract of remnant brigalow on freehold land in the PDA. The site comprises 100ha of intact brigalow (RE11.4.3), 50 ha of RE11.4.12 (Endangered) and provides one of the few examples where floodplain vegetation has been preserved and is continuous with the riparian fringe of the Condamine River. Despite degradation from the exotic species (indicated with *) *Opuntia tomentosa** and *Eriocereus martinii*,* the remnant vegetation warrants specific conservation value. The location is also the site of considerable paleontological significance.

Scientific Areas

The Binkey State Forest in the northern portion of the PDA (ATP 787 and ATP 810) is known to support a proposed ‘Scientific Area’. The proposed area which is located in the southern portion of the State Forest in the L Tree Creek catchment, seeks to protect an area of important wildflower habitat within Triodia shrubland RE11.7.5. Protection is afforded under the provisions of the Section 34E of the *Forestry Act 1959*. This habitat is known to support populations of EVNT flora species such as baileys cypress (*Callitris baileyi*). More specific information of the location of this area is required.

Wildflower Recreation Trail Areas

The Dalby Regional Council (formerly the Murilla Shire Council) has erected interpretive signage at a site located to the east of the Liechhardt Highway near Gurulmundi as part of a local wildflower recreation trail. The signage provides interpretive detail on threatened and common species of wildflower. The natural values of these areas, both for recreational and biodiversity values, warrant additional protection and they typically possess high value as habitat for EVNT species. The precise location of these areas is not known although a single area was identified in the Binkey State Forest in the northern portion of the PDA .

5.4.5 Special Fauna Biodiversity Values

Due to existing natural characteristics, or anthropogenic habitat modification, areas within the PDA do not represent uniform ecological values. Cleared areas such as cropped paddocks may hold low ecological values, while units of intact remnant vegetation will generally hold higher values.

Using these sources, several areas within or near the PDA have been highlighted as being of special biodiversity value for fauna. Generally, these are:

- waterways and riparian corridors;
- remnant units of endangered REs (e.g., brigalow communities, native grasslands);
- large, natural waterbodies and the surrounding vegetation;
- large units of intact remnant vegetation;
- areas with high biodiversity indices (i.e., areas containing many species);
- areas known to contain populations of EVNT species;
- areas of protected estate, such as National Parks and State Forests, and any connected areas of remnant vegetation; and
- downstream wetlands of international significance (e.g., Ramsar-listed areas).

Some of these areas are discussed below.

Waterways and riparian corridors

Within fragmented landscapes, riparian vegetation associated with waterways often provides the only corridor for native species. Accordingly, riparian corridors associated with the Condamine River, Wilkie Creek and Charlies Creek are of significance. These areas are mapped as State Significant wildlife corridors in BPA mapping (EPA 2008) and have been identified as containing a number of waterholes significant for semi-aquatic vertebrates (Chinchilla Field Naturalists Club pers. com.). Furthermore, a number of EVNT species have been recorded from within these waterways and corridors.

Endangered Vegetation

Endangered units of brigalow (RE 11.3.1, 11.4.3, 11.9.1, 11.9.4b, 11.9.5, 11.9.6, 11.9.10) and native grasslands and grassy woodlands (RE 11.3.2, 11.3.21, 11.3.24) provide habitat for a number of EVNT species. In particular, species that are heavily dependant on these vegetation types include pale imperial hairstreak, rough collared frog, Brigalow scaly-foot, five-clawed worm-skink, grassland earless dragon, grey snake, and painted honeyeater. These areas are also recognised in several BPA criteria as important for fauna species and biodiversity.

Chinchilla Sporting Shooters Range

The Chinchilla Sporting Shooters Range includes a large area of Endangered brigalow vegetation. This area is known to be inhabited by EVNT species including the pale imperial hairstreak butterfly and is likely habitat for a variety of others.

Bendidee National Park and State Forest

Bendidee National Park and adjacent State Forest is known habitat, and likely habitat, for a number of EVNT species. In particular, this area represents one of only two documented extant populations of bulloak jewel butterfly within Australia.

5.5 Sensitive Environmental Areas

Category A and Category B ESAs as defined in the Environmental Protection Regulation (2008) and codes of compliance for mining and petroleum tenures are described in this section . Category A ESAs, as shown in **Figure 14** include the following.

- Wondul Range National Park (ATP689).
- Bendidee National Park (ATP689).
- Lake Broadwater Conservation Park (PL260).

Category B ESAs within the project area are restricted to REs with a Biodiversity status of 'endangered'. Certified RE mapping (DERM 2009b) may considerably exaggerate the extent of Category B ESAs due to the representation of heterogeneous polygons where 'endangered' vegetation is mixed with vegetation classified as either 'of concern' or 'no concern at present'. **Figure 15** shows the distribution of Category B ESAs based on detailed mapping of PL areas undertaken in this exercise. Category B ESAs for the broader ATP areas, based on certified RE mapping (DERM, 2009b) are shown in **Figure 16** with 'endangered dominant' and 'endangered sub-dominant' categories representing differing levels of ecological constraint.

Category C ESAs apply to regulation of Level 2 petroleum industries although specific conditions may apply when conducting Level 1 ERAs within these areas. Category C ESAs include the following:

- Referable wetlands
- Regional ecosystems of 'of concern' biodiversity status (refer to **Section 5.1.2**, **Figure 7**);
- Declared catchment areas;
- Resources Reserves;
- Nature Refuges;
- River improvement areas; and
- State forests.
- Essential habitat (see **Section 5.6** and **Figure 17**))

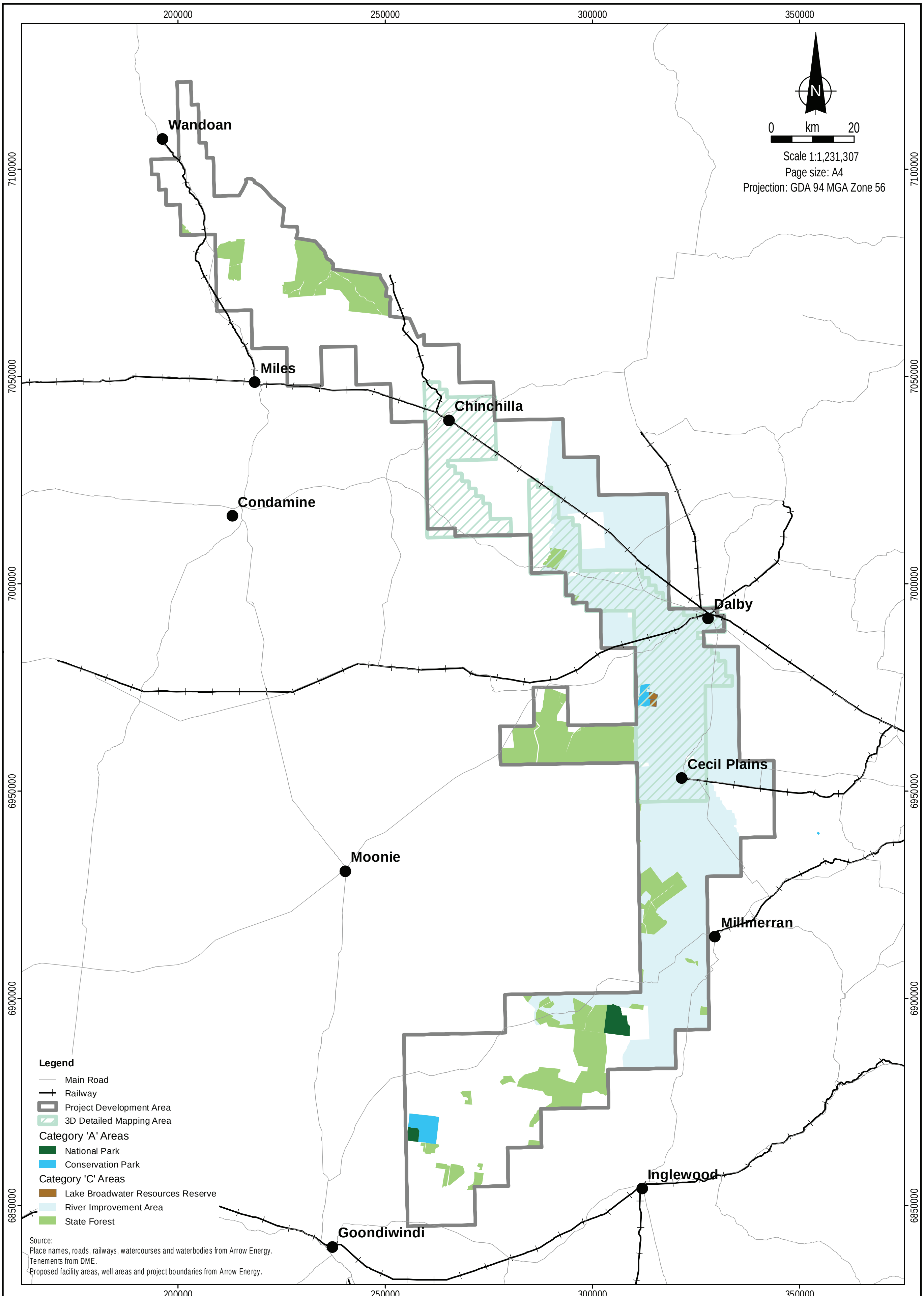
A number of State Forests fringe the PDA including Braemar and Kumbarilla State Forest adjacent to PL260, PL198, PL258 respectively. The central portion of the PDA falls within a River Improvement Area. Category C ESAs are represented in **Figure 14.** This mapping excludes 'of concern' REs and essential habitat which are shown in **Figure 7** and **Figure 17** respectively.

5.6 Essential Habitat

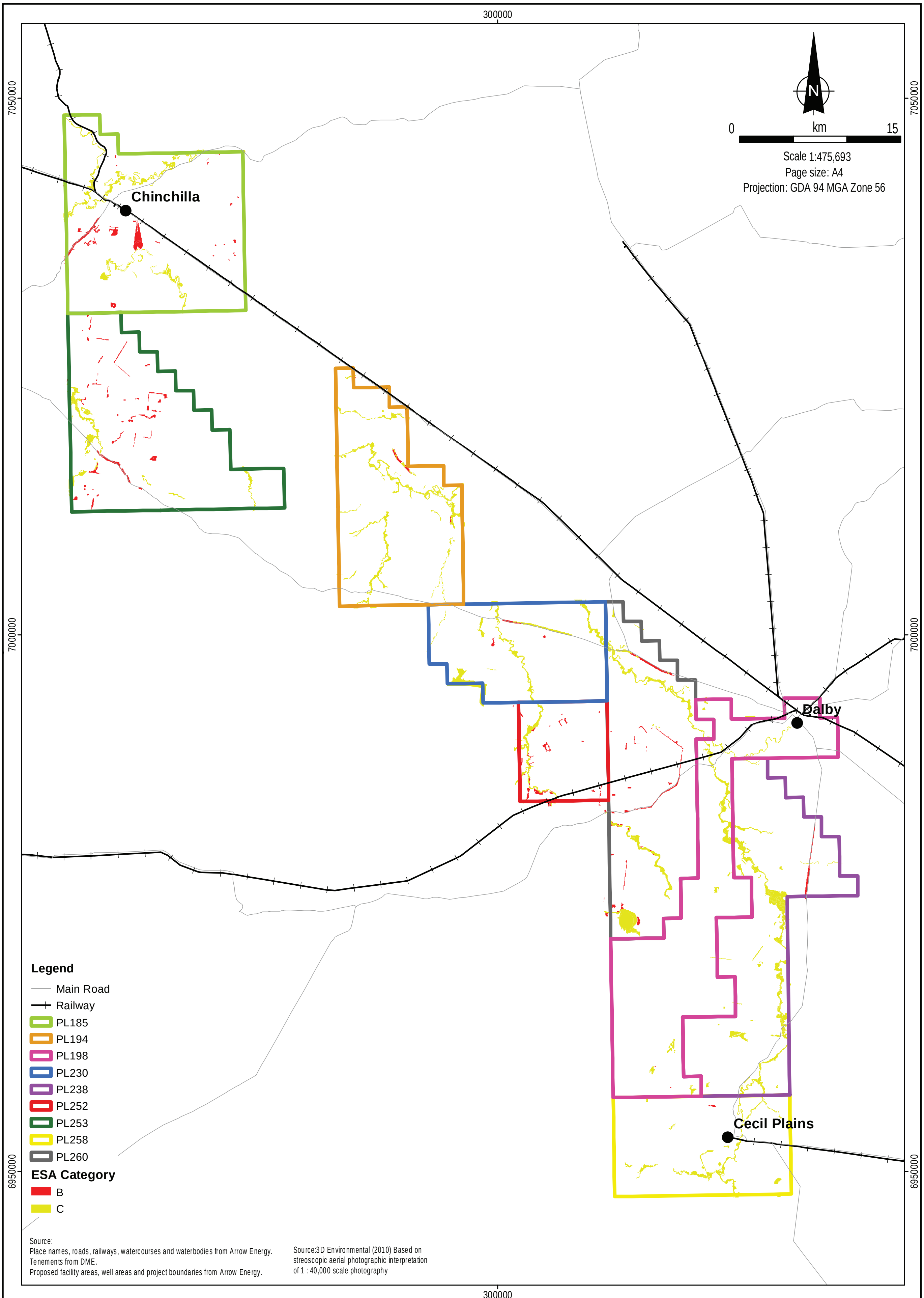
Essential habitat is mapped by DERM under the BPA framework (EPA 2003) and is used in the determination of applications to clear vegetation. Essential habitat represents those areas considered essential for the maintenance of populations of priority taxa (which includes threatened and non-threatened species of regional significance). Essential habitat is generally defined from known records, although expert knowledge may be used to identify specific areas providing habitat factors critical to the concerned species. Essential habitat is considered known when:

- the taxon is present (based on accurate records);
- there are indications of reproduction, or where a significant number of individuals are present, or important resources, and
- important movement corridors for breeding and/or non-breeding (including migratory) individuals have been identified.

Essential habitat is considered possible where there exists suitable habitat 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. An un-attributed layer of essential habitat locations has been provided by DERM (2010a) for the purpose of this study, represented in **Figure 17**. Species attributes were not provided and must be sourced individually as required. As previously identified, essential habitat is considered a Category C ESA.



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11. mxd File Name: 3D_F14_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Category A and Category C Environmentally Sensitive Areas	Figure No: 14



3D Environmental
Vegetation Assessment & Mapping Specialists
P. O. Box 959
Kenmore, Qld 4069
Phone: (07) 3411 9072
Phone: (07) 3878 4344
Mobile: 0404 577 285
Mobile: 0409 426 916
www.3denvironmental.com.au

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File Name: 3D_F15_GIS

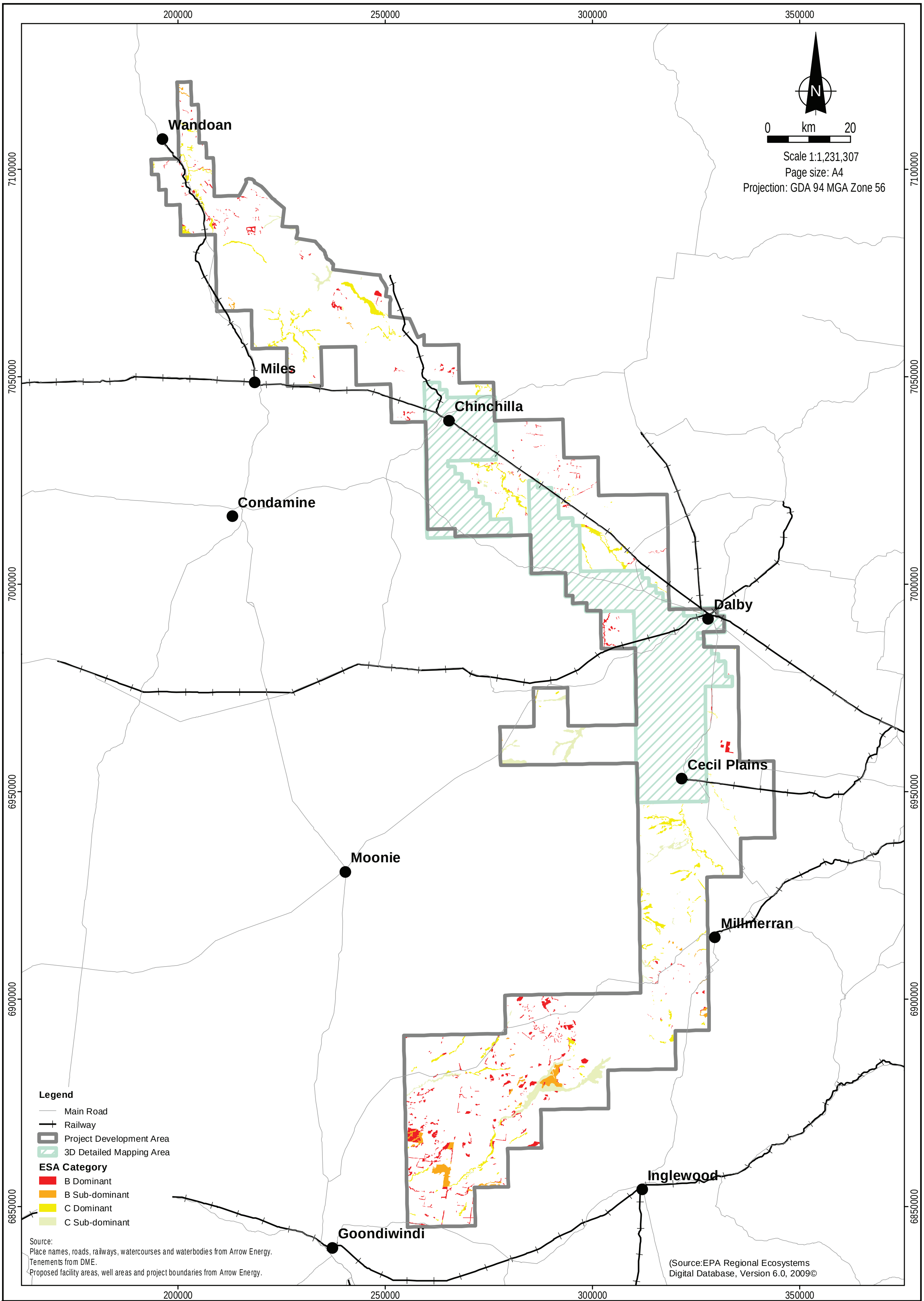
Arrow Energy Limited

Surat Gas Project

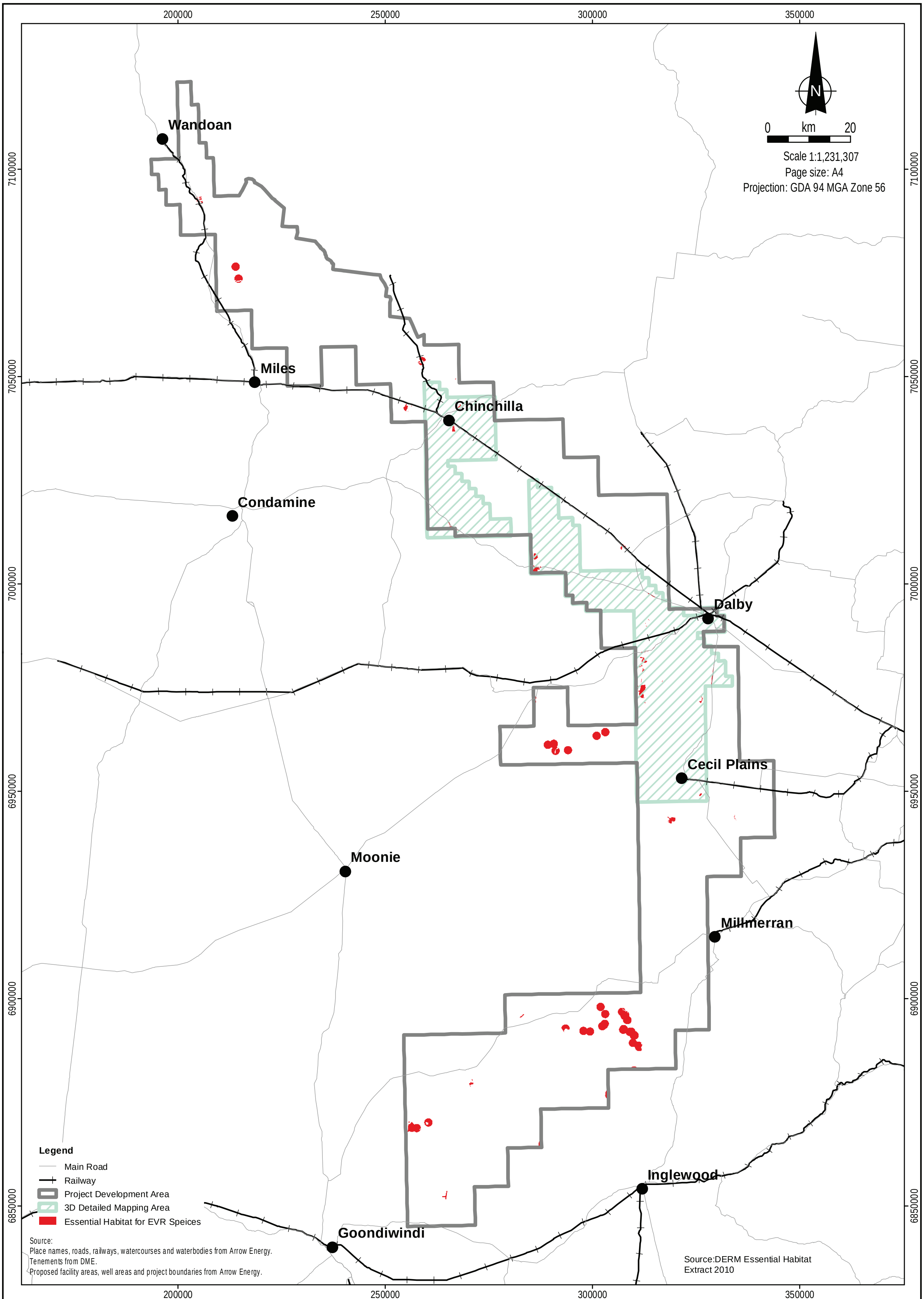
arrow energy go further

Category B & C Environmentally Sensitive Areas (Vegetation) in Detailed Mapping Area

Figure No: 15



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11 .mxd File Name: 3D_F16_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Category B & C Environmentally Sensitive Areas (Vegetation) in Project Development Area	Figure No: 16



3D Environmental Vegetation Assessment & Mapping Specialists www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11 .mxd File Name: 3D_F17 _GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Essential Habitat for EVNT Species	Figure No: 17

5.7 Overall Condition of Existing Vegetation

The PDA traverses a number of landscapes, ranging from the broad river flood plains centred on the Condamine River and its associated tributaries, rolling hills on fine grained sedimentary rocks in the Wandoan area, rangeland woodlands formed on skeletal rocky soils and ironstone jump ups, to broad sedentary clay plains which are abundant to the west of Millmerran. Landuse impacts vary across the landscape dependant largely on the fertility of the underlying substrate. Floristic values of the groundcover were depleted by widespread invasion of lippia and by robust introduced grasses such as giant panic (*Megathrysus maximus* var. *maximus*), and rhodes grass (*Chloris gayana*).

The productivity of the alluvial clay soils on the Condamine River floodplain has resulted in heavy utilisation of these areas for agricultural purposes, predominantly tilled dryland and irrigated cropping. Floodplain vegetation is generally restricted to the immediate river channel and associated flood pockets, scattered areas on crown or council owned land and as isolated fragments on soils of less favourable physical properties (swamps). These areas may also be subject to grazing pressures. The effects of fragmentation are clearly evident within the residual vegetation and some relevant features are summarised below:

- Vegetation associated with the Condamine River is generally in poor condition with a high proportion of dead or senescing canopy trees. A considerable extent of riparian woodland has drowned through flooding associated with numerous weirs and impoundments with the most notable example being the Condamine Weir near Chinchilla.

- The best preserved example of riparian vegetation noted in the detailed study occurs on Wilkie Creek within the western margins of PL252 where a large proportion of mature canopy trees and native grassy ground cover has been retained within a riparian corridor of up to 400m wide. A number of other drainage and catchment areas including Braemar and Back Creeks in PL194 and the Wild Dog Creek Catchment within ATP747 have a moderate condition with riparian forest fringes intact and generally continuous with adjacent remnant vegetation. These systems often traverse landscape types less favourable to broad scale (e.g. ironstone jump-ups and scarps) development which has benefited the retention of remnant vegetation.

- Brigalow communities (RE 11.3.1, RE 11.4.3) and brigalow/eucalypt associations (RE11.3.17) have been cleared to the margins of adjacent vegetation types and generally exist as small unviable remnants, slivers along the margins of riparian forest types, or as secondary forests with limited structural complexity or floristic diversity. The vulnerable grass *Homopholis belsonii* has potential to occur in these remnants. Native ground and low shrub covers, although naturally sparse in these communities are often displaced by exotic species including prickly pear (*Opuntia stricta*), mother of millions (*Bryophyllum delagoense*) and harrisia cactus (*Eriocereus martiniii*).

Small, isolated patches less than 10ha in extent of brigalow (*Acacia harpophylla*) and/or belah (*Casuarina cristata*) have reduced vertebrate values. By contrast, the very few larger patches which may support resident populations or those within close proximity (less than approximately 500m) to remnant vegetation, may have high vertebrate habitat values. A variety of species may occur in these locations including rough frog (*Cyclorana verrucosa)*, golden-tailed gecko (*Strophurus taenicauda)* , dunmall's snake *(Furina dunmalli)*, grey snake (*Hemiaspis daemeli*), glossy black-cockatoo (*Calyptorhynchus lathami*), painted honeyeater *(Grantiella picta)* and little pied bat (C*halinolobus picatus)*. Notable examples are found in the PL252 and PL260 to the west of Lake Broadwater where glossy black-cockatoos were recorded.

- The numerous flood plain wetlands are almost universally heavily infested with lippia (*Phyla canescens)* during seasonal drying periods. This severely limits the ability of native aquatic species to re-colonise these areas during wetter, more favourable seasons.

Although ecosystem types on soils of low fertility, typically those REs associated with land zones 5, 7, 9 and 10, form the largest and most continuous tracts of vegetation in the PDA, these ecosystems have invariably been heavily utilised for their timber resources with varying degrees of impact. Some notes relevant to vegetation condition are provided below.

- The most heavily disturbed examples of RE11.5.1 and 11.7.4 occur on the western fringes of PL198 and 258. These have been logged to a degree that all mature canopy trees have been removed and vegetation comprises secondary growth with a thickened shrub layer often forming the canopy. Examination of 1981 aerial photography for the PDA demonstrates closely spaced rip-lines through large areas of remnant vegetation indicating the intensity of historical timber extraction practices.

- Similar heavy logging regimes are evident in the majority of state forests within the PDA including Braemar, Kumbarilla to the west of Dalby, Barakula State Forests to the north of Chinchilla, and Bendidee State Forest in the southern portion of the PDA. These logging regimes have generally been less severe than those applied on freehold land. The southern portion of Barakula, where it intrudes into the PDA, shows strong evidence that management practices have altered the natural environment to promote commercial timber values. Several areas examined on the ground show clear evidence that the original ironbark canopy has been ring-barked to promote regeneration of the cypress resource. It is expected that this would have been a widespread practice in state forests throughout the region and many of the denser cypress forest and woodland areas are likely to be the result of active management practices rather than a natural structural expression. It was noted that both Kumbarilla and Barakula State Forests were being actively logged for cypress at the time of the survey. Barakula does have some extremely high value and well preserved habitats including Waaji Scientific Reserve although these are generally outside the PDA.
- With the exception of extremely heavily logged areas on freehold land, these heavily disturbed ecosystems do provide habitat for vertebrate species. Areas where grazing has been excluded, or is minor, retains a ground cover mosaic of native grasses, loose soil, leaf litter and abundant fallen debris. Threatened vertebrates that are likely to use these habitats include little pied bat (*Chalinolobus picatus*), square-tailed kite (*Lophoictinia isura*), golden-tailed gecko (*Strophurus taenicauda*) and painted honeyeater.
- Wondul Range National Park provides one of the reserves in the PDA where natural values and condition of habitats are in relatively pristine condition with no evidence of logging, weed invasion and associated processes of land degradation.
- A number of ecosystems appear more resilient to landscape wide processes of degradation. In particular, blue leaved ironbark (*Eucalyptus fibrosa s*ubsp. *nubile)* forest communities (RE11.7.7) have in general a better preserved canopy structure, a greater number of mature canopy trees and fewer large canopy gaps. This preservation is likely to be due to the quality and usefulness of the timber resource rather than an inherent ability to recover from disturbance.

Similar to alluvial landforms, the extensive clay plains in the southern portion of the PDA (within ATP 689) are heavily fragmented with the majority of remnant vegetation formed by narrow slivers along roadsides, fencelines, stock routes and in areas possessing soil conditions unfavourable to intensive agriculture. There are some high value habitats in these areas however Bendidee National Park forms the best preserved tract of brigalow (RE11.4.3) in the PDA and its values have been previously recognised (EPA 2002a).

5.8 Summary of Ecological Values

Table 25 provides a summary of environmental values identified within the PDA. The potentail impacts of the project on these values are discussed in **Section 6.** These are the major values against which the potential impacts of project activities are assessed.

Table 25. Summary of ecological values in the PDA

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Flora Values			
EPBC Relevant Vegetation Communities	Brigalow (*Acacia harpophylla* dominant and co-dominant – includes regrowth brigalow > 15yrs)	Endangered	Known to occur.	High
	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Known to occur	Extremely High
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Possibly occurring.	High
	Weeping Myall Woodlands	Endangered	Possibly occurring.	High
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Likely to occur	Extremely High
	Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	Endangered	Likely to occur.	Moderate
Relevant Regional Ecosystems	**11.3.21 -** *Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.	Endangered	Known to occur	Extremely High
	11.3.24 - *Themeda avenacea* grassland on alluvial plains. Basalt derived soils.	Endangered	Possibly occurring	Extremely High
	11.3.1 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	Known to occur	High
	11.3.17 - *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.	Endangered	Known to occur	High
	11.4.3 - *Acacia harpophylla* and/or Casuarina cristata shrubby open forest on Cainozoic clay plains	Endangered	Known to occur	High
	11.4.10 - *Eucalyptus populnea* or *E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.	Endangered	Known to occur	High
	11.4.12 - *Eucalyptus populnea* woodland on Cainozoic clay plains.	Endangered	Known to occur	High
	11.9.4a - Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket	Endangered	Known to occur	High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	understorey on fine grained sedimentary rocks			
	11.9.5 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Known to occur	High
	11.9.6 - *Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks.	Endangered	Likely to occur	HIgh
	11.9.10 - *Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks	Endangered	Likely to occur	High
	11.9.7 - *Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	Of concern	Known to occur	Moderate
	11.3.2 - *Eucalyptus populnea* woodland on alluvial plains.	Of concern	Known to occur	Moderate
	11.3.3 - *Eucalyptus coolabah* woodland on alluvial plains.	Of concern	Likely to occur	Moderate
	11.3.25 - *Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines	Of concern	Known to occur	Moderate
	11.3.27 – Palustrine / lacustrine wetland habitats	Of concern	Known to occur	Moderate
	11.3.3 - *Eucalyptus coolabah* woodland on alluvial plains.	Of concern	Likely to occur	Moderate
	11.3.4 - *Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	Of concern	Known to occur	Moderate
	11.8.3 - Semi-evergreen vine thicket on Cainozoic igneous rocks.	Of concern	Possibly occurring	High
	11.8.2a - *Eucalyptus tereticornis* and *E. melliodora* occurring on low hills.	No Concern at Present	Possibly occuring	Extremely High
EPBC and NCA Listed Flora Species Known, Likely and Possibly Occurring	*Digitaria porrecta* (finger panic grass)	Endangered*, N. threatened**	Known to occur	Moderate
	Acacia curranii (curly bark wattle)	Vulnerable*, Vulnerable**	Known to occur	High
	Bothriochloa biloba (lobed blue grass)	Vulnerable, Not Listed**	Known to occur	Moderate
	Macrozamia machinii	Vulnerable*, Vulnerable**	Known to occur	Extremely High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Denhamia parviflora (small leaved denhamia)	Vulnerable*, Vulnerable**	Known to occur	High
	Homopholis belsonii (Belson's panic)	Vulnerable*, Vulnerable**	Known to occur	High
	Philotheca sporadica	Vulnerable*, Vulnerable**	Known to occur	High
	Prostanthera sp. (Dunmore)	Vulnerable*, Vulnerable**	Known to occur	Extremely High
	Pterostylis cobarensis (Cobar greenhood orchid)	Vulnerable*, Not Listed**	Known to occur	Moderate
	Xerothamnella herbacea	Vulnerable*, Endangered**	Known to occur	Extremely High
	Pomaderris coomingalensis	Endangered* Not Listed**	Possibly occuring	High
	Thesium austral (Austral toadflax)	Vulnerable*, Vulnerable**	Known to occur	High
	Picris evae (hawkweed)	Vulnerable*, Vulnerable**	Likely to occur	High
	Acacia barakulensis (Waaje wattle)	Vulnerable*, Vulnerable**	Likely to occur	High
	Dicanthium queenslandicum (king blue grass)	Vulnerable*, Vulnerable**	Possibly occurring	High
	Microcarpaea agonis.	Endangered*, Endangered**	Possibly occurring	Extremely High
	Acacia handonis (handon's wattle)	Vulnerable*, Vulnerable**	Possibly occurring	High
	Acacia wardellii	Vulnerable*, Vulnerable**	Possibly occurring	High
	Cadelia pentastylis (ooline)	Vulnerable*, Vulnerable**	Possibly occurring	High
	Calytrix gurulmundensis	Vulnerable*, Vulnerable**	Possibly occurring	Extremely High
	Rhaponticum austral (Austral cornflower)	Vulnerable*, Vulnerable**	Possibly occurring	High
	Aristida forsterii (Forster's wire Grass)	Not Listed,	Possibly Occuring	Extremely High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
		Endangered**		
	Rutidosus lanata	Not Listed*, Endangered**	Known to occur	High
	Solanum papervifolium	Not Listed*, Endangered**	Known to occur	Moderate
	Cyperus clarus	Not Listed*, Vulnerable**	Known to occur	High
	Picris barbarorum (plain's picris)	Not Listed*, Vulnerable**	Known to occur	High
	Gonocarpus urceolatus	Not Listed*, Vulnerable**	Known to occur	Moderate
	Solanum stenopterum	Not Listed*, Vulnerable**	Known to occur	High
	Acacia tenuinervis	Not Listed*, N. Threatened**	Known to occur	Moderate
	Callitris baileyi (Bailey's callitris)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Cryptandra ciliaris	Not Listed*, N. Threatened**	Known to occur	Moderate
	Eleocharis blakeana	Not Listed*, N. Threatened**	Known to occur	Moderate
	Eucalyptus curtisii (plunkett mallee)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Fimbristylis vagans	Not Listed*, N. Threatened**	Known to occur	Moderate
	Micromyrtus carinata	Not Listed*, Endangered**	Possibly Occurring	High
	Ptilotus extenuatus	Not Listed*, Endangered**	Possibly Occurring	High
	Apatophyllum teretifolium (sandstone prickle bush)	Not Listed*, Vulnerable**	Possibly Occurring	High
	Calotis glabrescens	Not Listed*, N. Threatened**	Possibly Occurring	Moderate
Fauna Values				

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
EPBC and NCA Listed Fauna Species Known or Possibly Occuring	*Anthochaera Phrygia* (regent honeyeater)	Endangered*, Endangered**	Possibly Occurring	Moderate
	Dasyurus m. maculates (spotted tail quoll)	Vulnerable* Endangered**	Possibly Occurring	Moderate
	*Tympanocryptis cf. tetraporophora (*grassland earless dragon)	Endangered*, Endangered**	Known to occur	High
	Delma torquata (collared delma)	Vulnerable*, Vulnerable**	Possibly Occurring	Extremely High
	Paradelma orientalis (brigalow scaly-foot)	Vulnerable*, Vulnerable**	Possibly Occurring	Moderate
	*Anomalopus mackayi (*five-clawed worm-skink)	Vulnerable*, Endangered**	Possibly Occurring	Extremely High
	Egernia rugosa (yakka skink)	Vulnerable*, Vulnerable**	Possibly Occurring	Moderate
	Strophurus taenicauda (golden tailed gecko)	Not Listed* Near –threatened**	Known to occur	Moderate
	Furina dunmalli (dunmall's snake)	Vulnerable*, Vulnerable**	Known to occur	Moderate
	Geophaps s. Scripta (squatter pigeon)	Vulnerable*, Vulnerable**	Known to occur	Moderate
	Rostratula australis (Australian painted snipe)	Vulnerable*, Vulnerable**	Known to occur	Moderate
	Nyctophilis corbeni[3] (south-eastern long-eared bat)	Vulnerable*, Vulnerable**	Known to occur	Moderate
	*Hypochrysops piceatus (*bulloak jewel)	Not Listed*, Endangered**	Known to occur	Extremely High
	Hemiaspis damelii (grey snake)	Not Listed*, Endangered**	Possibly occurring	Moderate
	Jalmenus eubulus (imperial hairstreak)	Not Listed*, Vulnerable**	Known to occur	High

[3] listed as *Nyctophilus timoriensis* under the EPBC

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Calyptorhynchus lathami (glossy black cockatoo)	Not Listed*, Vulnerable**	Known to occur	Moderate
	Accipiter novaehollandiae(grey goshawk)	Not Listed* N. Threatened	Possibly occuring	Moderate
	Cyclorana verrucosa (rough collared frog)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Acanthophis antarcticus (common death adder)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Lophoictina isura (square tailed kite)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Nettapus coromandelianus (cotton pygmy goose)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Stictonetta naevosa (freckled duck)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Ephippiorhynchus asiaticus (black-necked stork)	Not Listed*, N. Threatened**	Known to occur	Moderate
	Grantiella picta (painted honeyeater)	Not Listed*, N. Threatened	Possibly occurring	Moderate
	Melithreptus gularis (black-chinned honeyeater)	Not Listed*, N. Threatened**	Possibly occurring	Moderate
	Neophema pulchella (turquoise parrot)	Not Listed*, N. Threatened**	Possibly occurring	Moderate
	Chalinolobus picatus (little pied bat)	Not Listed*, N. Threatened**	Possibly occurring	Moderate
Migratory Fauna Species	*Chlidonias leucopterus* (white-winged black tern)	Migratory (EPBC)	Known to occur	NA
	Hydroprogne caspia (Caspian tern)	Migratory (EPBC)	Known to occur	NA
	Merops ornatus (rainbow bee-eater)	Migratory (EPBC)	Known to occur	NA
	Monarcha melanopsis (black-faced monarch)	Migratory (EPBC)	Known to occur	NA
	Myiagra cyanoleuca (satin flycatcher)	Migratory (EPBC)	Known to occur	NA
	Symposiarchus trivirgatus (spectacled monarch)	Migratory (EPBC)	Known to occur	NA

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Rhipidura rufifrons (rufous fantail)	Migratory (EPBC)	Known to occur	NA
	Rostratula australis (Australian painted snipe)	Migratory (EPBC)	Known to occur	NA
	Actitis hypoleucos (common sandpiper)	Migratory (EPBC)	Known to occur	NA
	Calidris acuminate (sharp tailed sandpiper)	Migratory (EPBC)	Known to occur	NA
	Calidris ferruginea (surlew sandpiper)	Migratory (EPBC)	Known to occur	NA
	Calidris ruficollis (red necked sandpiper)	Migratory (EPBC)	Known to occur	NA
	Gallinago hardwickii (Latham's snipe)	Migratory (EPBC)	Known to occur	NA
	Limosa lapponica (bar-tailed godwit)	Migratory (EPBC)	Known to occur	NA
	Limosa limosa (black-tailed godwit)	Migratory (EPBC)	Known to occur	NA
	Numenius minutes (lttle curlew)	Migratory (EPBC)	Known to occur	NA
	Numenius phaeopus (whimbrel)	Migratory (EPBC)	Known to occur	NA
	Philomachus pugnax (ruff)	Migratory (EPBC)	Known to occur	NA
	Tringa glareola (wood sandpiper)	Migratory (EPBC)	Known to occur	NA
	Tringa nebularia (common greenshank)	Migratory (EPBC)	Known to occur	NA
	Tringa stagnatilis.(marsh sandpiper)	Migratory (EPBC)	Known to occur	NA
	Anthochaera Phrygia (regent honeyeater)	Migratory (EPBC)	Known to occur	Moderate
Biodiversity Values				
Environmentally Sensitive Areas (Excluding Regional Ecosystems	**Category A ESAs:** Wondul Range National Park (ATP689), Bendidee National Park (ATP689), Lake Broadwater Conservation Park (PL260).	NA	Known to occur (see Figure 14)	Extremely High
	Category B ESAs: See relevant individual assessments for REs with a Biodiversity Status of Endangered.	NA	Known to occur (see Figure 15)	See relevant indivual RE assessments.
	Category C ESAs: Barakula State Forest,	NA	Known to occur (see	Moderate to High (See

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Whetsone State Forest, Western Creek State Forest, Gurulmundi State Forest, Dunmore State Forest, and Kumbarilla State Forest, Lake Broadwater Resources Reserve, See relevant indivual assessments for REs with Biodiversity Status of 'Of Concern'.		Figure 14)	Protected Estate) Excludes 'Of Concern' REs
Areas or Ecosystems with Special Biodiversity Values. Sourced from BBS BPA (EPA 2008).	Bendidee National Park. The park is surrounded entirely by cleared land and is afforded State Significance under Criterion Ib, refuge from clearing (EPA 2002a).	Cat.A ESA	See Figure 14	Extremely High
	Lake Broadwater. Identified as possessing ecological values of State Significance under Criterion Ib (special biodiversity values – wildlife refugia)	Cat.A ESA	See Figure 14	Extremely High
	Vine Thickets. All vine thickets within the BBS are assigned State Significance due to high diversity and refugia values under Criterion Ib (special biodiversity values – wildlife refugia) and Criterion Ig (areas containing REs with distinct variation in species composition due to geomorphology and other variables). This includes REs 11.8.3 and RE11.9.4 mapped within the PDA	State Significance (non-statutory)	See Figure 5	High
	Riparian Vegetation. All riparian vegetation in fragmented sub-regions (remnant threshold <30%) is assigned State Significance under Criterion Ib (special biodiversity - fragmented landscapes)	State Significance (non-statutory)	See Figure 13	High
	High D2 Criterion. Any RE remnant where Criterion D2 is very high (>75% of the largest known representation of a single regional ecosystem tract within the bio-region) is assigned State Significance.	State Significance (non-statutory)	See Figure 13	High
	Large Vegetation Tracts. State Significance is applied to the 10 largest tracts of vegetation in the BBS Bioregion (under Criterion C- tract size) as bioregional corridors	State Significance (non-statutory)	See Figure 13	High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Vegetation Intersecting Rivers. (All vegetation intersecting rivers on 250 000 scale base mapping where classified as bioregional corridors of State Significance.	State Significance (non-statutory)	See Figure 13	High
	Dalby–St George Road. The Dalby–St George Road is assigned State Significance (under Criterion 1b, refuge from clearing) due to areas of RE 11.3.17 supporting populations of *Homopholis belsonii*.	State Significance (non-statutory)	See Figure 13	High
	Wyaga–Kindon Ooline populations. Wyaga–Kindon Ooline populations are assigned State Significance due to disjunct populations of *Cadellia pentastylis* approach eastern limit of distribution	State Significance (non-statutory)	Possibly occurring	High
	Remnant grasslands. The remnant grasslands, Eastern Darling Downs are assigned State Significance. The grasslands provide refuges from clearing, contain endangered ecological community (grasslands) & high diversity of EVNT species including (*Digitaria porrecta*, *Rhaponticum australis*, *Thesium australe*, *Solanum papaverifolium*) many of which are disjunct or at limits of their geographic range. Includes stockroute and rail reserves surrounding Dalby	State Significance (non-statutory)	See Figure 5	Extremely High
	Poplar box Woodland. Poplar box (*Eucalyptus populnea*) woodland on alluvial plains of the Eastern Darling Downs are assigned state significance. This is a unique RE type (11.3.2) with open woodland restricted to subregion 31. It provides habitat for EVNT species including *Homopholis belsonii* and other priority grassland taxa.	State Significance (non-statutory)	See Figure 5	Moderate
	Essential Habitat: Essential habitat represents those areas considered essential for the maintenance of populations of priority taxa (which includes threatened and non-threatened species of regional significance). An un-attributed layer of	Regulated as Essential Habitat under the VMA	See Figure 17	High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	essential habitat locations has been provided by DERM (2010a). Areas shown as essential habitat should be consideredas high value locations for EVNT species (flora or fauna).			
Protected Estate	**National Parks:** Wondul Range National Park, Bendidee National Park.	Category A ESA	See Figure 14	Extremely High
	Conservation Reserves: Lake Broadwater Conservation Park.	Category A ESA	See Figure 14	Extremely High
	State Forests: Braemar, Whetstone , Kumbarilla, Dunmore, Western Creek, Boondandilla, Dalby, Quandong.	Category C ESA	See Figure 15	Moderate
	State Forests: Barakula, Gurulmundi, Binkey, and Bendidee.	Category C ESA	See Figure 15	High
Important Wetlands	**Lake Broadwater**: The lake is listed on the Directory of Important Wetlands and is recognised as significant at a national and state level being a rare example of a semi-permanent freshwater lake in the bioregional area (Environment Australia 2001a;*Blackman et al*. 1999). Lake Broadwater is listed in the Federal Government's Directory of Important Wetlands (Environment Australia 2001a).	Category A ESA	See Figure 14	Extremely High
Areas of Special Flora Habitat Values	**Grassland and grassy woodland ecosystems:** Includes REs 11.3.2, 11.3.21 and 11.3.24. In the Dalby area, these ecosystems are known to provide habitat for populations of near-threatened and threatened species including *Digitaria porrecta* (Endangered) and *Solanum stenopterum* (Vulnerable).National botanical significance is also assigned to the Dalby–Kogan Road reserve which is an excellent example of its type supporting viable populations of near-threatened and threatened species.	Non Statutory Significance (other than NCA, VMA and EPBC significance)	See Figure 5.	Extremely High to Moderate

	Stock Routes: Stockroutes have proven invaluable for the preservation of a number of highly significant ecosystems. The best preserved examples are found in stock routes to the north and south of Dalby in the central portion of the PDA. Stock routes may provide valuable corridors for faunal movement along roadsides and habitat linkage between disjunct areas of remnant vegetation.	Non Statutory Significance (other than NCA, VMA and EPBC significance)	Mostly adjacent to major access routes throughout the study area.	High
	Chinchilla Sporting Shooters Range: The Chinchilla Sporting Shooters Range provides representation of the best preserved tract of remnant brigalow on freehold land in the PDA. The site provides one of the few examples where floodplain vegetation has been preserved and is continuous with the riparian fringe of the Condamine River.	Non-statutory Significance	See Figure 26	Extremely High
Areas of Special Fauna Biodiversity Value	The following landscapes and ecosystems are highlighted as being of special biodiversity value for fauna: • Riparian corridors. • Remnant units of endangered REs (e.g., brigalow communities, native grasslands); • Large, natural waterbodies and the surrounding vegetation; • Large units of intact remnant vegetation; • Areas known to contain populations of EVNT species; • Areas of protected estate, such as National Parks and State Forests, and • any connected areas of remnant vegetation; • Downstream wetlands of international significance (e.g., Ramsar listed);	Varying levels of statutory and non-statutory significance.	Distributed throughout study area	Extremely High to Moderate
	Chinchilla Sporting Shooters Range: Known to be inhabited by a number of EVNT species and an excellent example of brigalow habitat.	Non-statutory Significance	See Figure 26	Extremely High

Ecological Value within PDA	Values of Major Conservation Significance	Status	Occurrence within PDA	Sensitivity of Ecological Value
	Bendidee National Park and State Forest: Provides habitat for a number of EVNT species including one of only two extant populations of bulloak jewel butterfly within Australia.	Category A/ Category C ESA	See Figure 14	Extremely High

*EPBC Significance
**State Significance (NCA/VMA)
NA = Not Assessed
E= Endangered
V= Vulnerable
NT = Near Threatened

6. Potential for Environmental Impact

Landscape modification arising from vegetation clearing by humans causes a number of impacts on terrestrial biological systems. These impacts interact (**Figure 18**) and do not occur in isolation. Vegetation clearing, for example, will inevitably lead to fragmentation and edge effects. While some impacts are immediate (e.g., the death of individuals during clearing), other landscape modification consequences occur over extended periods and are more sinister (e.g., weed invasion). As a consequence, it can often be difficult to isolate the cause and final effect of population declines.

As impacts interact, they can also reinforce one another, triggering a cascade of deleterious effects that can be very difficult to reverse (Lindenmayer and Fischer 2006). Resulting regime shifts may not only impact individual species, but can lead to changes in key variables such as vegetation/habitat structure and species composition. An essential aim of the current project should therefore be to clearly identify all impacts and incorporate strategic mitigation measure for each identified threat.

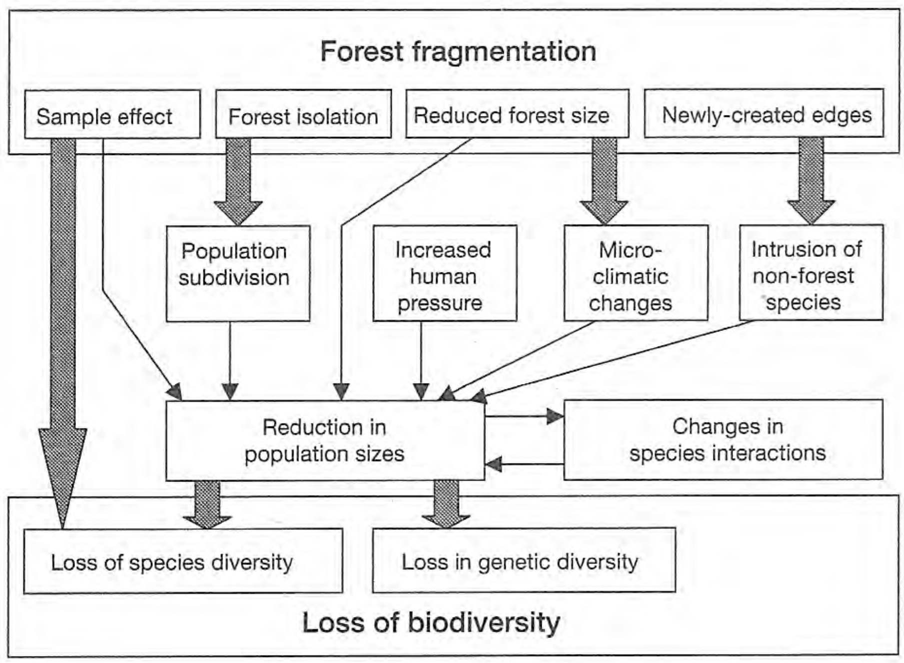


Figure 18. Interacting effects of landscape modification (Lindenmayer and Burgman 2005)

Broadly, potential impacts to terrestrial flora and fauna values associated with the gas field development resulting from vegetation clearing could include the following.

- Plant and animal mortality, loss of habitat and increased erosion or sedimentation.

- Direct loss of ‘endangered’ and ‘of concern’ vegetation (as listed under the VMA) and vegetation communities of EPBC significance (EPBC Act 1999).
- Dissection and fragmentation of habitat and populations through development of infrastructure, including access tracks to well sites.
- The loss or modification of habitat important for EVNT flora and fauna species.
- The creation of dispersal and movement barriers, potentially isolating existing populations and reducing genetic flow.
- Edge effects associated with vegetation clearing, including weed invasion, increased predation and competition, and changes in abiotic conditions.
- Changes to other ecological processes, such as fire frequency, fire extent, surface water availability, and surface water flow.
- Secondary salinity from vegetation removal.
- Degradation of vegetation and wetland areas due to Discharge of saline waters.

The potential for ecological impact from specific activities related to gas field development are described in **Table 26.** Impact pathways and processes are discussed in detail in the following sections whilst measures to mitigate these impacts are described in detail in **Section 7.**

Table 26. Project development activities and associated impacts.

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
Exploration and Appraisal Well Drilling (including well access)		
Exploration well drilling including pilot wells.	• Wells being located in areas of high ecological value including tracts of remnant vegetation. • Tracks and roads for equipment access in areas of high ecological value. • Transport of invasive exotic species on plant and equipment. • Landscape degradation through erosion, sedimentation and ground disturbance. • Release of hazardous materials (e.g. diesel, oils, hydraulic fluid) including saline coal seam water to the surrounding environment. • Generation of increased traffic and increased road access. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct loss of EVNT flora species through land clearing. • Direct loss of EVNT fauna species through land clearing. • Habitat fragmentation and increasedof edge effects, reducing habitat quality for EVNT species and ultimately reducing their population sizes. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Increased animal mortalily on roadsides (due to increased traffic). • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species, • Spread and proliferation of pest species (flora and fauna)
Seismic data collection	• Requirement for equipment access in areas of high ecological value. • Movement of plant and equipment (vector for movement of exotic species). • Landscape degradation through erosion, sedimentation, and ground disturbance (particularly hazardous to wetlands). • Release of Hazardous Materials (e.g. diesel, hydraulic fluid).	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline coal seam water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Spread and proliferation of pest species (flora and fauna)
Production Well Design and Installation		
Site preparation	• Clearance of a work area of up to 85m x 85m. • Preparation and levelling of work pad. • Access to production well and movement of plant and equipment. • Landscape degradation through erosion and ground	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing.

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
	disturbance (particularly hazardous to wetlands). • Release of hazardous materials (e.g. diesel, hydraulic fluid) including saline coal seam water. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline coal seam water. • Degradation of ESAs through edge effects and fragmentation and dust. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Secondary salinity through tree clearing. • Increased animal mortalily on roadsides (due to increased traffic). • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species • Spread and proliferation of pest species (flora and fauna)
Production well drilling	• Release of Hazardous Materials (e.g. drilling fluids, diesel, hydraulic fluid) including saline coal seam water. • Access to production wells and movement of plant and equipment. • Landscape degradation through erosion and ground disturbance (particularly hazardous to wetlands). • Generation and storage of large quantities of wastewater with potential for accidental release.	• Indirect impacts to significant ecosystems, flora and fauna assemblages and ESAs through promotion of edge effects and habitat fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Degradation of sensitive ecosystems (riparian, wetland and grassland) through release of saline coal seam water. • Spread and proliferation of pest species (flora and fauna)
Well site completion	• Transport of weed pathogens during rehabilitation works and vehicle movement. • Soil and sediment transport through erosive processes. • Removal or transport of stored water/ waste.	• Indirect impacts to significant ecosystems, flora and fauna assemblages and ESAs through promotion of edge effects and habitat fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Spread and proliferation of pest species (flora and fauna)
Gathering Infrastructure Design and Installation		
Gathering line installation and management	• Clearing of high value habitat during gathering line installation. Installation of multiple linear gathering lines across the landscape. • Movement of equipment providing vector for exotic species. • Creation of artificial movement corridor for exotic species particularly love grass. • Creation of erosion pathways. • Creation of barriers for faunal movement. • Release of hazardous material during construction. • Generation of increased traffic and increased road access.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline coal seam water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
	• Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	through increased sedimentation. • Increased animal mortalily on roadsides (due to increased traffic). • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species • Spread and proliferation of pest species (flora and fauna)
Pipeline construction	• Clearing and Grading of ROW prior to construction causing direct loss of vegetation and habitat as well as promotion of edge effects. General construction corridor of 30m width maintained. • The pipeline will be buried with the top of the pipe at a minimum depth of 750 mm. Therefore the minimum 'trenching' depth will be 850 mm as the smallest gathering line is 100mm. Trenches left open may entrap animals and interfere with faunal movement pathways. • Backfilling and Rehabilitation. Trench is backfilled using stockpiled materials. Access to operational site and movement of equipment including trucks, cranes, bulldozers and specialised trenching equipment may provide vector for exotic species movement. • Generation of additional traffic on access roads increasing fauna mortalities. • Utilisation of saline water for the purpose of dust suppression in areas of heavy traffic and operation worksites causing scalding of vegetation.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Increased animal mortality. • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Salt movement within soil profile and landscape. • Spread and proliferation of pest species (flora and fauna)
Power Generation and Supply		
Power supply grid development and construction of overhead powerline network	• Clearing of high value habitat during power supply grid network development. Installation of multiple linear overhead electrical powerlines across the landscape. • Movement of equipment providing vector for exotic species. • Creation of artificial movement corridor for exotic species particularly love grass. • Creation of erosion pathways. • Release of hazardous material during construction. • Generation of increased traffic and increased road access. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Increased animal mortalily on roadsides (due to increased traffic).

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
		• Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Spread and proliferation of pest species (flora and fauna)
Integrated Processing Facility Design and Installation		
Integrated processing facility design and installation (The details provided here also account for potential impacts realted to: - Central gas processing facilities - Field compression facilities - Power generation facilties - - Construction camps (and associated sewerage treatment infrstructure	• Requirement for clearance of a work area of up to 800m x 250m plus 1 – 2km^2 for dams. • Top-soil movement and preparation of work site. • Access to facilities and movement of equipment. • Landscape degradation through erosion and ground disturbance (particularly hazardous to wetlands). • Release of hazardous materials (e.g. diesel, hydraulic fluid) including saline coila seam. • Storage of large volumes of coal seam water and brine in dams. • Accommodation for construction team. • Generation of additional traffic on access roads. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct Impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Degradation of sensitive ecosystems (riparian, wetland and grassland) through release of saline coal seam water. • Increased animal mortalily on roadsides (due to increased traffic). • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species • Spread and proliferation of pest species (flora and fauna)
Operation and Maintenance		
Well site operation and maintenance	• Site facility may provide a potential pathway for erosion and sedimentation. • Access to operational site and movement of equipment may provide vector for exotic species. • Potential for release of hazardous waste into nearby environment. • Potential for release of saline coal seam water into nearby environment. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	Indirect impacts to significant ecological through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline coal seam water. • Degradation of ESAs through promotion of edge effects. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation and potential release of saline coal seam. • Degradation of sensitive ecosystems (riparian, wetland and grassland) through release of saline coal seam water. • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Spread and proliferation of pest species (flora and fauna)
Gathering infrastructure operation and maintenance	• Operational area may provide a potential pathway for erosion and sedimentation. • Operation and maintenance may contribute to long term	• Indirect impacts to significant ecological values through habitat fragmentation and promotion of edge effects. • Degradation of ESAs through promotion of edge effects.

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
	degradation of riparian ecosystems at watercourse crossing points. • Access to operational site and movement of equipment may provide vector for exotic species. • Potential for release of hazardous waste into nearby environment. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation and potential release of saline coal seam. • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Spread and proliferation of pest species (flora and fauna)
Integrated processing facility operation and maintenance (The details provided here also account for potential impacts realted to: - Central gas processing facilities - Field compression facilities - Power generation faciltiies - - Construction camps (and associated sewerage treatment infrastructure	• Access to operational site and movement of equipment may provide vector for exotic species. • Use of hazardous material with potential for discharge into sensitive ecosystems. • 24 hour noise • Generation of additional traffic on access roads. • Utilisation of saline coal seam water for the purpose of dust suppression in areas of heavy traffic and operation worksites. • 24 hour light generation.	• Habitat degradation through promotion of edge effects including exotic species proliferation, particularly in ESAs. • Degradation of sensitive ecosystems through release of hazardous materials. • Exposure of fauna / flora to hazardous waste material resulting in sickness or death. • Impacts to local fauna by constant noise causing animals to leave the area. • Increased animal mortalily. • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Enhance feeding opportunities for insectivorous feeding fauna. • Spread and proliferation of pest species (flora and fauna)
Export of Gas from Field to Downstream Use		

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
Pipeline design and construction	• Clearing and Grading of ROW prior to construction. General construction corridor of 30m width maintained. • Pipeline will be buried at a minimum depth of 750mm to top of pipe. • Backfilling and Rehabilitation. Trench is backfilled using stockpiled materials. Access to operational site and movement of equipment including trucks, cranes, bulldozers and specialised trenching equipment may provide vector for exotic species movement. • Generation of additional traffic on access roads. • Utilisation of saline water for the purpose of dust suppression in areas of heavy traffic and operation worksites.	• Direct loss of significant ecological communities through land clearing. • Direct loss of significant regional ecosystems through land clearing. • Direct impact to EVNT flora species through land clearing. • Direct impact to EVNT fauna species through land clearing. • Indirect impacts to those values through habitat fragmentation , promotion of edge effects and access to hazardous waste including saline water. • Degradation of ESAs through edge effects and fragmentation. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation. • Increased animal mortality. • Salt scalding and resultant loss of sensitive floristic values including EVNT flora species. • Salt movement within soil profile and landscape. • Spread and proliferation of pest species (flora and fauna)
Decommission and Rehabilitation		
Well site decommission and rehabilitation	• Access to operational site and movement of equipment may provide vector for exotic species. • Potential for release of hazardous waste into nearby environment. • Long term deterioration of ecological values in adjacent areas. • Long term pathway for erosion and sedimentation.	• Indirect impacts to significant ecological values through habitat fragmentation and promotion of edge effects. • Degradation of ESAs through promotion of edge effects. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation and potential release of saline coal seam water • Exposure of fauna / flora to hazardous waste material resulting in sickness or death. • Spread and proliferation of pest species (flora and fauna).
Gathering infrastructure decommision and rehabilitiation	• Access to operational site and movement of equipment may provide vector for exotic species. • Potential for release of hazardous waste into nearby environment. • Long term deterioration of ecological values in adjacent areas. • Long term pathway for erosion and sedimentation.	• Indirect impacts to significant ecological values through habitat fragmentation, promotion of edge effects and generation of hazardous waste. • Degradation of ESAs through promotion of edge effects. Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation and potential release of saline coal seam water. • Exposure of fauna / flora to hazardous waste material resulting in sickness or death. • Spread and proliferation of pest species (flora and fauna)
Integrated Processing	• Access to operational site and movement of equipment may	• Indirect impacts to significant ecological values through habitat

Activity	Activity Components that Threaten Ecological Values	Potential Impacts
Facility Decommission and Rehabilitation (The details provided here also account for potential impacts realted to: - Central gas processing facilities - Field compression facilities - Power generation faciltiies - Construction camps (and associated sewerage treatment infrastructure)	provide vector for exotic species. • Potential for release of hazardous waste into nearby environment. • Long term deterioration of ecological values in adjacent areas. • Long term pathway for erosion and sedimentation. • Light source removed.	fragmentation, promotion of edge effects and generation of hazardous waste. • Degradation of ESAs through promotion of edge effects. • Loss of habitat condition in adjacent wetlands and watercourses through increased sedimentation and potential release of saline groundwater. • Habitat loss for insectivorous feeding species. • Spread and proliferation of pest species (flora and fauna)

6.1 Potential Impacts from Land Clearing

Vegetation clearing is often used synonymously to describe habitat loss, but the two are not the same. Habitat is species-specific and therefore patches of vegetation may not be uniformly suitable to all taxa. Rather, vegetation patches contain a mosaic of habitats and the greater the number of habitats the greater the community diversity. The integrity of remaining patches may be affected by fragmentation and subsequent edge effects due to the construction of gas gathering lines and wells.

Vegetation clearing, fragmentation and edge effects act in unison and are difficult to consider in isolation. However, this section considers impacts that occur during clearing. Habitat loss, fragmentation and edge effects are considered later in this document.

Vegetation clearing affects flora and fauna in several ways, as listed below:

- The loss of individuals killed or injured as a direct result of clearing activities.
- Displaced individuals that move to nearby vegetation are often unable to compete with resident animals and can result in mortality.
- Reduction of the abundance and distribution of species due to the above effects.
- The removal of perennial vegetation, contributing to erosion, secondary salinity and declines in water quality.

Direct mortality during clearing activities is a difficult impact to avoid. While some species can quickly move from clearing activities (e.g., birds, large mammals), others are unable to (e.g., plants, small lizards, frogs). Immobile organisms (e.g., plants) and small terrestrial species in particular (small mammals, many reptiles and frogs) are highly susceptible to mortality during clearing.

Furthermore, displaced individuals are less effective in competing with neighbours and their survival is also dubious. However, the degree of competition depends largely on the extent of an animal's home range that is modified and the individual's movement patterns. Minor modification within large home ranges will have less of an impact than the clearing of an individual's entire home range. Hence, higher mortality is expected for smaller, less mobile taxa (e.g., small lizards).

Mortality rates therefore vary greatly and are extremely difficult to predict. Factors affecting mortality include abundance, spatial density, habitat, behaviour (e.g., arboreal, fossorial, etc) and clearing methods.

Species with broad habitat requirements, or those that occur in abundant habitats, will be widely distributed throughout the PDA, and therefore losses can be estimated according to the extent of habitat loss. Clearing for linear infrastructure (such as roads and gathering lines) is expected to have a lower magnitude of impact on larger habitat patches in comparison with clearing for larger infrastructure, such as dams or integratedprocessing facilities.

By contrast, clearing within habitats that are comparatively minor in extent, or within areas inhabited by species with restricted distributions, will affect a greater proportion of that area's fauna population. Hence, any clearing within rare or uncommon habitats such as native grasslands, brigalow or waterways will result in proportionally higher individual mortality.

Clearing also has the potential to affect downstream water quality values through increased sedimentation. The contribution of project disturbance to existing water quality will be influenced by the area of disturbance, the duration for which surface soil is exposed, rainfall timing and surrounding land activities. Large areas within the Condamine River catchment have already been highly disturbed by agricultural processes. Sedimentation within these areas is already high and therefore the magnitude of project impacts is anticipated to be lower in these areas in comparison with similar activities in creeklines and waterways within large undisturbed vegetation patches (e.g., Barakula State Forest, Braemar State Forest, Western Creek State Forest, Whetstone State Forest).

6.2 Potential Impacts from Habitat Loss and Fragmentation

Forman (1995) outlined five ways in which fragmentation may be described (see **Figure 19**)**.** Forman's scheme does not account for habitat degradation that occurs due to edge effects and is therefore a simplistic view of fragmentation. However, it does provide a useful framework for discussing the types of fragmentation that might occur due to the proposed project activities. The described project activities will result in some vegetation clearance, which inevitably leads to habitat loss and fragmentation. Habitat loss and fragmentation leads to:

- an altered landscape (and hence habitat) mosaic;
- modification of large core unmodified habitats that may be structurally varied, contain source populations and have high habitat heterogeneity;
- loss of habitat for significant flora and fauna species, as listed under the NCA and EPBC Act;
- increased movement barriers, isolating populations or reducing movement rates (forming metapopulations);
- impacts to significant wildlife corridors, including riparian areas fringing Wilkie Creek, Charlies Creek and the Condamine River;

- increased risk of some stochastic events (e.g., fire) having serious local deleterious consequences (e.g., local population extinction);
- a reduction in the likelihood of some stochastic events (e.g., fire) having broad scale impacts; and
- increased edge effects (discussed in **Section 6.3**).

These impacts may occur concurrently and are discussed in more detail below.

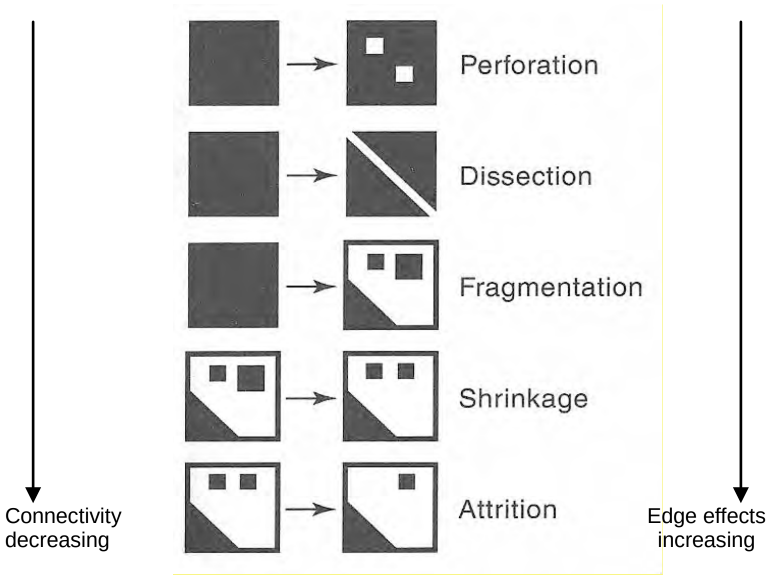


Figure 19. Human induced landscape modifications (from Forman, 1995).

Attrition generally occurs in highly altered landscapes where scattered patches remain and can lead to the loss of metapopulations. The magnitude of attrition due to project related clearing will vary depending on the location of the activity, and whether infrastuture is placed over existing minor remnant units.. Minor remnants similar in size to infrastructure, and hence susceptible to attrition, are typically influenced by edge effects. Weed invasion, canopy dieback and aggressive fauna species are common in these minor patches and community composition and integrity is often low.

However, some habitat patches may remain valuable, particularly if that habitat type is poorly represented within the bioregion. Accordingly, small fragments of brigalow, native or derived native grasslands can still hold important biological values. The significance of impacts to sentitive habitats must consider the size and regional representation of the habitat type.The most common impact on the landscape matrix will be dissection and, to a lesser degree, fragmentation of vegetation and habitats. These can alter an existing contiguous and interacting population into a series of loosely connected subpopulations, with all subpopulations forming part of a metapopulation.

However, the creation of metapopulations may not always lead to positive conservation outcomes. Small patches of vegetation support less taxa than large intact patches and resident populations are more susceptible to extinction (MacArthur and Wilson 1963; Rosenzweig 1995). Species that are resident in smaller patches are typically a subset of communities found in nearby larger habitat patches (Patterson and Atmar 1986; Cutler 1991; Doak and Mills 1994) and the persistence of these populations may be entirely reliant on re-colonisation and immigration. However, the creation of metapopulations is dependent on movement rates, which in turn are influenced by the:

- presence of, and distance to, a nearby source population;
- nature and suitability (e.g., structure) of the modified landscape matrix. The greater the modification of existing habitats, the lower the rate of movement,(see **Figure 20**) and
- ability of an individual organism to migrate or disperse across the modified matrix.

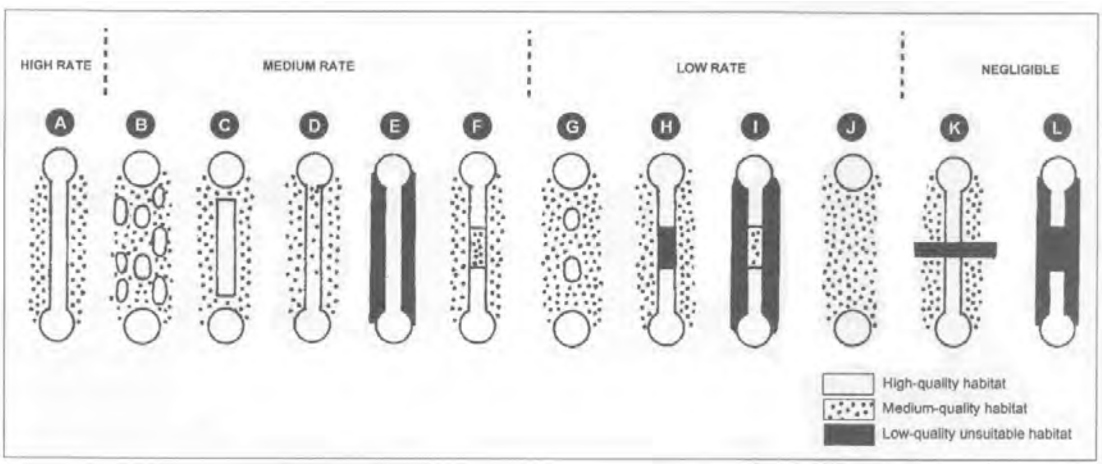


Figure 20. Influence of habitat suitability and structure on movement rates (Department of Main Roads 2000).

It is therefore exceedingly difficult to formulate general comments on the consequences of dissecting existing contiguous habitat patches. Artificial habitats or potential movement barriers created by gathering lines and associated access roads will be relatively narrow (approximately 40 m wide). Many vertebrate species can be observed crossing bitumen roads of similar width, suggesting that these narrow disturbance corridors should not impact movement for most vertebrates. In particular, mobile species such as birds, larger mammals and bats will readily cross these cuttings. However, project-related clearing may be more likely to form metapopulations of species with poor migration abilities (e.g., some arboreal mammals, small lizards and flora species), or species adverse to open ground-strata

Reduced Connectivity

Vegetation clearance has the potential to impact upon intact corridors and stepping stones that connect the landscape (Lindenmayer and Fischer 2006). These corridors may not only facilitate movement of species through suboptimal habitat thereby connecting populations, but can also provide habitat for resident populations and ensure genetic exchange reducing genetic drift and inbreeding depression. Potentially important existing corridors within the landscape matrix of the PDA include vegetation associated with Wilkie Creek, Charlies Creek (and tributaries), and the Condamine River. Clearing within these corridors may therefore isolate populations, or reduce movement forming metapopulations. The severity of modifying vegetation within these corridors will have varied effects on movement rates, based on the factors described above. The magnitude of impact is directly related to the final location of infrastructure and the extent to which sensitive values can be avoided. In the event that avoidance is not possible, facilties are likely to have a greater magnititude of imact than wells, gathering lines and access tracks because these pieces of infrastructure are relatively narrow in extent (approximately 40 m) and will most likely only affect the movement of smaller ground dwelling species (some small lizards) and arboreal mammals

Stochastic Events

Stochastic events are random processes, such as fires, floods, disease, drought and processes relating to a species' life cycle (e.g., random variation in sex ratio, natural mortality, etc). The impact of stochastic perturbations depends on the nature and severity of the process.

The possible creation of metapopulations in some species from the proposed project activities may present some positive conservation outcomes. Serious stochastic extinction events caused by processes such as fire could be restricted to individual vegetation patches and therefore individual metapopulations. Later immigration and recolonisation from nearby populations would ensure the species persistence at a landscape scale.

However, large contiguous populations are generally more resilient to deleterious stochastic perturbations. Fire, for example, may reduce the extent of a large population but if sufficient in size the population is unlikely to be widely affected and therefore fall into local extinction. Furthermore, large populations have greater genetic diversity and are therefore more likely to be resilient to disease. By contrast, the genetic diversity in a reduced number of metapopulations is lower, thereby increasing the risk of extinction from disease.

Accordingly, while fragmentation of existing large habitat patches from gathering lines has the potential to create metapopulations resilient to some stochastic events, these benefits are likely to be outweighed by a number of negative impacts.

6.3 Potential Impacts From Edge Effects

Edge effects refer to the changes in biological and physical conditions that occur at an ecosystem boundary and within adjacent ecosystems (Lindenmayer and Burgman 2005). Generally the magnitude of edge effects is strongly correlated with the degree of contrast in physical and structural condition between remnant vegetation and the surrounding matrix (Mesquita *et al.* 1999; Lindenmayer and Fischer 2006). A variety of edge effects can result from landscape modification, and may impact upon remaining ecological values as described below.

- The ecological values can be impacted by loss of vegetation integrity along disturbed margins or within minor remnants. Canopy dieback and loss of vigour, particularly of the ground cover, may be associated with increased light penetration, disease, altered surface water flow, dust or exotic weed invasion.
- There may be modifications to community interactions (e.g., increased competition, increased aggression, etc.).
- Increased predation levels.
- Degradation of riparian and in-stream habitats through increased sedimentation and changes to hydrological regime.

These impacts are discussed further below.

Vegetation integrity

These impacts may penetrate hundreds of meters into vegetation remnants, thus significantly influencing the distribution and abundance of species that inhabit these areas (Lindenmayer and Fischer 2006).

The creation of an edge alters the environmental conditions and microclimate in existing vegetation. This can affect the condition of the canopy species and, when severe, cause canopy dieback. This impact is particularly harmful as it is not immediately apparent, occurring over years after the edge-inducing event. Furthermore, the retreating canopy exposes new individuals to microclimate change, reducing their vigour. Consequently, the impact is rarely restricted to those individuals immediately located on the edge, but can incur some distance into remnant vegetation.

Some communities are particularly susceptible to this type of impact. Large brigalow trees, for example, can often be observed senescing in minor fragments. Many vegetation communities within the PDA are relatively common and abundant. The loss of canopy vigour for most communities will therefore be minor in the context of their overall extent. However, some communities, such as brigalow, are substantially fragmented from historical land clearing. Further clearing within or even around these communities may affect the vigour of existing stands, reducing their extent.

The greater exposure to wind and surface water flow due to the loss of canopy and shrub features may increase weed propagule movement and weed spread. Weed invasion is one of the most notable and severe edge effects and is further discussed in **Section 6.7.1.** Once established, weeds may have a variety of deleterious effects. Typically aggressive in growth, weeds may out-compete, or reduce the fitness of native plant species. Furthermore, some species promote fire, increasing fire intensity and frequency and causing serious long-term problems in fire-sensitive vegetation. These processes can encourage the movement of weeds into otherwise unaffected areas and, if severe, form monocultures.

Community interactions and predation

Studies have shown that some species avoid edges while others are more common along edges (Fletcher 2005). Edge-dominant species are often adapted to open habitats with little vertical or horizontal structure. These species are typically aggressive in nature, compounding the effects on edge-sensitive species. Noisy Miners, for example, are extremely abundant in simplified habitats. They are aggressive, and scare away most other small insectivorous birds. Their abundance along edges is often at the expense of smaller native bird species (Grey *et al.* 1997).

It is difficult to assess the potential impact that aggressive edge species may have on existing communities. Impacts will be largely influenced by the ability of aggressive edge species to take advantage of the newly created habitats. In most cases, gathering lines and access tracks will be narrow linear strips (up to approximately 40m wide) and therefore not provide large open expanses. The magnitude of impact is related to the size of the created habitats as this dictates its ability to support populations of edge species

Another edge-associated community interaction is predation. While not universal, nest predation and brood parasitism is often higher along edges than in core habitats. This is particularly apparent between strongly contrasting landscapes such as along agricultural land (Lahti 2001), probably due to both greater predator abundance and greater predation efficiency at edges (Luck *et al.* 1999).

Gathering lines and wells, as well as development of access will create clear, contrasting edges throughout areas of previously intact vegetation. This will increase the risk of brood parasitism and predation. The magnitude of this impact is difficult to quantify, and will be dependent upon changes to predator abundance

The creation of access tracks into previously contiguous habitats may facilitate the penetration of exotic predators such as dogs, foxes and cats (Andrews 1990). The penetration of these species may also be facilitated in the event that associated water leaks from well heads or is stored in small dams adjacent to the well. Exotic predators can have significant effects on fauna populations, including numerous EVNT species (Environment Australia 1999). Other exotic pest species (e.g., Feral Pigs) that can also negatively impact biodiversity values may also move freely along access tracks and benefit from increased water availability. Additional information on pest fauna species is provided in **Section 6.7.2.**

6.4 Potential Impacts to Environmentally Sensitive Areas

Category A ESAs

Potential exists for Category A ESAs to be impacted by the project activities. Lake Broadwater, a Category A ESA and Wetland of National Significance, is contained within PL 260 and its catchment traverses and receives water from some of the key areas considered for development (PL 252, PL198). It is considered that unless appropriately managed (see recommendations set out in **Section 7.4**), the most significant threats that the project poses to the area's natural values are potential sediment or saline discharge into the catchment of Lake Broadwater.

Wondul Range and Bendidee National Parks are located in the southern portion of the PDA, within ATP 689. Whilst Wondul Range National Park is buffered by extensive tracts of remnant vegetation, Bendidee is fringed by a highly fragmented landscape on its south-western margins. Increased land use pressure facilitating a range of degrading processes including dust generation, changes to surface water run-off and infestation of exotic weeds all have potential to affect these sensitive areas.

Category B ESAs

Category B ESAs within the PDA include REs 11.3.21, 11.4.3, 11.3.1, 11.9.5, 11.4.10, 11.4.12 and 11.3.17. These ecosystems are generally associated with fertile clay soils that are highly susceptible to both erosion and exotic species invasion. Infestations of prickly pear (*Opuntia stricta, O. tomentosa*), harrisia cactus (*Eriocereus martinii*) and mother of millions (*Bryophyllum delagoense*) were recorded within these communities, typically invading along exposed and highly disturbed margins. Failure to follow weed hygiene protocols coupled with increased vehicular traffic may facilitate increases in the rate and extent of exotic species invasion (particularly mother of millions) into these communities.

Category C ESAs

Category C ESAs designated due to the presence of an 'of concern' RE are often associated with alluvial areas and subject to both erosion and exotic species invasion. Failure to follow weed hygiene protocols coupled with increased vehicular traffic may facilitate increases in the rate and extent of exotic species invasion (particularly mother of millions) into these communities. Other Category C areas including state forests, resources reserves and essential habitat may be subject to fragmentation through placement of access tracks and gathering line infrastructure. This would have a deleterious impact on habitat values in these areas and dramatically increase the extent of cleared edges, facilitating both weed and loss of habitat condition on the margins. Edge effects may have dramatic impacts on the viability of areas as habitats for threatened fauna and flora species.

Wetland Communities

An extensive system of flood plain wetlands is associated with the Condamine River floodplain and its associated tributaries. The majority of these overflow channels were dry at the time of survey and heavily degraded with the exotic speces Lippia (*Phyla canescens).* Those retaining water generally possessed native aquatic macrophytes such as *Ottellia ovalifolia, Azolla pinnata, Nymphoides* spp., and water primrose (*Ludwigia peploides* subsp. *montevidensis).* A large number of these features have been artificially dammed for stock water provision. Although heavily disturbed, increasing pressure on water resources, sedimentation associated with land development, increasing site access, and discharge of saline coal seam from well heads all have potential to impact natural integrity of wetland systems. Impacts may include:

- an overall decrease in the frequency of replenishment;
- long term changes to floristic composition and structure with exotic species incrementally outcompeting native species, and
- loss of habitat for significant wetland species, both flora and fauna.

6.5 Potential Impacts to Floristic Values

6.5.1 Impacts to Significant Vegetation Communities and Regional Ecosystems

The major sources of indirect impact to relevant vegetation communities are habitat fragmentation and edge effects discussed specifically in **Sections 6.2** and **6.3** respectively.

These may promote loss of ecological condition through a number of pathways. Specifically, major indirect hazards and pathways can be summarised as follows:

- A loss of structural integrity and floristic diversity of remnant vegetation may occur through displacement of native ground covers by exotic species. Lippia *(Phyla canescens)* is particularly aggressive, with the observed potential to totally displace native ground covers in floodplain woodland and wetland ecosystems. prickly pears (*Opuntia* spp.) and harrisia cactus (*Eriocereus martinii)* are a major source of degradation in ecosystems on heavy clay soils, in particular RE11.3.1, 11.4.3, 11.9.5 and 11.3.17. Weeds such as lippia and white foxtail grass (*Pennisetum villosum)* are listed as important pests in the Condamine River however are currently undeclared (Purcell 2005). Further information on exotic species in contained in **Section 6.7.1** with management guidelines contained in **Section 7.7.1.**
- Introduced pasture grasses such as African love grass (*Eragrostis curvula*) , rhodes grass (*Chloris gayana*), giant panic grass (*Megathyrsus maximus*), coolatai grass (*Hyparrhenia hirta*), johnson river grass (*Sorghum halepense*), and are common along disturbed roadsides and are known to invade remnant grassland and grassy woodland habitats (RE11.3.2 and RE11.3.4 in particular) particularly following mechanical disturbance (Goodland 2000) (See **Section 6.7.1**).
- Severe canopy dieback is frequently noted in highly fragmented remnants. In particular, brigalow dominated ecosystems (RE11.3.1 and RE11.4.3) and those ecosystems dominated by poplar box (*Eucalyptus populnea*)(RE11.3.2, RE11.4.12, RE11.3.17) appear particularly susceptible. A noted lack of canopy recruitment provides some indication that this trend of degradation is compounding. Riparian woodlands appear to be almost universally affected by canopy dieback.
- Increased sunlight penetration may occur along the disturbed margins of remnant vegetation. This creates a niche for invasion of exotic grass species which may promote fire incursion into the margins of sensitive ecosystem types.
- Long-term changes in the hydrological regime may promote changes to the floristic composition of ground covers in floodplain woodlands, favouring proliferation of exotic species.
- Increased surface water sourced from leaking wells or dams may attract proliferation of exotic weeds.
- Increased fire frequency related to increased human presence. Ignition of stockpiled vegetation may cause impacts to adjoining vegetation.

- Salt spray from dams, and the impacts of dam breaks may have long term impacts on threatened flora species and their habitats, resulting in changing species composition and vegetation structure.

Ground survey works indicate that REs listed with ‘endangered’ biodiversity status are generally the most severely affected by indirect impacts with the majority of fragments observed demonstrating severe degradation. The wetland and riparian ecosystems (RE11.3.27, RE11.3.25, RE11.3.4) are similarly particularly susceptible.

The use of saline water as a means of dust suppression presents another impact pathway requiring consideration. Vegetation communities presenting the greatest impact risk include grassland and grassy woodland ecosystems (RE11.3.21, RE11.3.2) where ground cover may be susceptible to scalding through direct application of saline water or spray drift. This may lead to long term impacts in the floristic integrity and condition of the ground layers. Populations of sensitive EVNT flora species within these ecosystems may be similarly impacted (refer to **Section 6.5.2**). Roadside wetland ecosystems may also be impacted by saline run-off from roadsides, particular during the drier seasonal periods when the impact of saline scalding would be most pronounced.

6.5.2 Impacts to Relevant Flora Species

A total of 38 EVNT flora species listed under state or federal legislation are known to occur within, or within close proximity, to the PDA. Detailed descriptions of the species, their distribution, ecology, habitats and threats are provided in **Appendix E.** Disturbance to vegetation, both remnant and non-remnant has the potential to impact on a range of EVNT flora species. The major potential sources of direct impact are detailed below.

- Clearing of remnant vegetation for linear infrastructure, production wells, exploration activity and other petroleum related activities are considered potentially damaging as these areas form core, general and possible habitat to a range of EVNT flora species. Species particularly threatened are those that have highly specific habitat requirements and occur in discrete and geographically restricted populations such as *Philotheca sporadica* and *Solanum papaverifolium*.
- Water leakage from dams, overtopping, dam break impacts may alter soil chemistry impacting on populations of threatened flora species in the vicinity.
- Disturbance activities within remnant and non-remnant grassland communities are a source of direct impact. The potential occurrence of a number of EVNT species within grassy road reserves and stock routes renders them susceptible to

vegetation clearing and disturbance by machinery, vehicles and weed competition. Susceptible species include *Digitaria porrecta*, *Bothriochloa biloba, Picris evae, Solanum papaverivolium, Solanum stenopterum,* and *Thesium australe.*

- Changes to drainage, hydrology and water quality. Populations of *Eleocharis blakeana* (near-threatened-NCA) and *Fimbristylis vagans* (near-threatened-NCA) are likely to occur in riparian woodlands (RE11.3.25/11.3.25g) and in vegetated swamps supporting river red gum (*Eucalyptus camaldulensis*) and/or Queensland blue gum (*E. tereticornis)* woodlands (11.3.27d). These species are similarly subject to potential impacts from changes to water quality (sedimentation, eutrophication and increased salinity) and interruption to overland flows.
- Potential impacts to sensitive EVNT flora species that are associated with application of saline coal seam waters for the purpose of dust suppression. Grassland species including *Digitaria porrecta*, *Bothriochloa biloba* and *Solanum papaverifolium* may be particularly susceptible.

The pathways for indirect impact to floristic values are similar to vegetation communities. Specifically, edge effects promoting weed invasion have the potential to reduce habitat suitability for a number of EVNT species, if not for total displacement. Changes to fire regime through infestation of fire promoting grasses such as African love grass also has potential to have a similar detrimental impact (see **Section 6.7.1** for additional information).

6.6 Potential Impacts to Fauna Values

6.6.1 Fauna Communities

Fauna communities are an assemblage of interdependent populations of different species interacting with one another, coexisting in a particular area (Knox *et al.* 1995). As species have specific habitat requirements (niches), communities vary from habitat to habitat. Species with broad habitat requirements are able to occur in a wider variety of habitats, and hence there may be a large degree of similarity between fauna communities. Other species may be more specific in their niche selection and the presence or absence of these taxa often defines different communities.

Cleared vegetation, or vegetation that has been modified, is typically less structurally complex than pristine habitats. As a result, there are fewer habitat niches to fill, and vertebrate communities become less diverse. Dramatic community change is therefore associated with landscape modification.

Any widespread project related clearing could result in broad, dynamic community shifts. However, a number of vertebrate species are known to be adversely affected by fragmentation and are generally absent from minor fragments. Such examples include robins, treecreepers and babblers (Freudenberger 2001; Cogger *et al.* 2003; Olsen *et al.* 2005). A number of these species are listed as non-EVNT priority species due to their susceptibility to fragmentation. These species are often the first to decline after land clearing.

The ability of these species to persist within a post-project landscape is influenced by their ability to traverse open areas created by clearing. Fortunately, most of these species will probably have little trouble crossing gathering lines (approximately 40m wide), although their movement rate might be reduced.

6.6.2 Potential Impacts to Relevant Fauna Species

A total of 34 fauna species listed under state or federal legislation have been previously recorded from the study area although a number of these are either likely to be locally extinct (e.g., black-throated finch, brush-tailed rock-wallaby) or vagrants (e.g., red goshawk, Major Mitchell's cockatoo, plains-wanderer). Detailed descriptions of 27 relevant species considered to be currently known from or likely to occur in the Project Development Areea, their distribution, ecology, habitats and threats are provided in **Appendix I.** Common deleterious project-related impacts on EVNT fauna species are detailed below.

- Direct death or injury of individuals during habitat clearing. Highly mobile species such as birds and large mammals are not expected to be significantly affected. Less mobile species such as smaller ground-dwelling taxa and arboreal species may incur increased mortality from clearing.
- Increased mortality of displaced individuals forced to compete for space and resources with nearby individuals.
- Direct loss of habitat, resources and breeding locations for the construction of project infrastructure. The magnitude of impact is likely to be higher for values with limited distributions (e.g., bulloak jewel butterfly, collared delma, painted honeyeater) or where they are restricted to rare habitats (e.g., grasslands: five-clawed worm-skink, grassland earless dragon; brigalow: pale imperial hairstreak, glossy black-cockatoo), Reduced movement rates and therefore partial fragmentation of existing populations (forming metapopulations) from clearing associated with linear infrastructure (gathering lines, access tracks and overhead powerline easements). The magnitude of this impact is influenced greatly by a number of factors including the species' ability to cross structurally simplistic

habitats. Birds and medium-sized mammals are less likely to be affected than small terrestrial species (e.g., golden-tailed gecko, brigalow scaly-foot).

- Increased mortality of individuals from capture in open trenches. Evidence from other trench clearing activities have shown that a large number of EVNT (and non-EVNT) species can become trapped in open trenches. Particularly susceptible are ground-dwelling species (e.g., small mammal and reptiles).
- Edge effects, particularly weed invasion, altering habitat structure. This may result in previously suitable habitat becoming sterile, or less valuable for the species. Edge effects and possibly weed invasion will significantly increase if gas acquisition occurs in previously continuous vegetation patches (e.g., Barakula State Forest, Braemar State Forest, Western Creek State Forest, Whetstone State Forest). Weed invasion could have a greater magnitude of impact to ground-dwelling EVNT species such as collared delma, brigalow scalyfoot, five-clawed worm-skink, grassland earless dragon, common death adder, Dunmall's snake and grey snake.Increased leakage of coal seam water from well heads and water storage dams may alter the soil structure, closing/filling surface cracks and facilitating weed or exotic grass growth. This impact may be restricted to species associated with dark cracking clays (e.g., five-clawed worm-skink, grassland earless dragon, grey snake).
- Increased surface water sourced from leaking wells or dams may attract cane toads, increasing the risk of toxic ingestion in predatory species such as grey snake, common death adder and black-necked stork.
- Weed invasion may alter the ground surface structure of existing habitats, rendering large areas unsuitable.
- Other edge effects (e.g., nest predation) may increase along created edges reducing a population's reproductive success.
- Increased fire frequency related to increased human presence.
- Alterations in surface water flow impacting flood frequency and intensity of Lake Broadwater, and associated drainage channels as well as the Condamine River and other waterways.
- Deterioration of water quality within Long Swamp, Lake Broadwater, the Condamine River and other waterways through processes such as increased sedimentation and/or increased salinity from upstream activities.
- Increased predation from exotic predators. Habitats previously devoid of exotic predators may become more accessible due to gathering lines and increased

surface water associated with dams and potential leakage of associated water from wells.

Impacts on EVNT fauna species will occur wherever clearing coincides with the presence of these species. As each species has particular habitat preferences, it is possible to predict where individual species are most likely to occur. Accordingly, digital mapping has been produced for each species in **Appendix I**. Species have a high likelihood of occurring in areas mapped as "core habitat possible" and are known to occur in "core habitat known". They may occur in "general habitat", but are unlikely to occur in habitats mapped as “absent”.

Gas extraction activities will occur over a number of years and final infrastructure plans, including well locations, are not available. Quantification of habitat modification cannot be determined until these plans are finalised. However, the GIS mapping will allow infrastructure to be located in areas that minimise impacts, and allow future impact assessment on individual species using methods outlined in **Section 8.2.2** (“Assessment of Impact Likelihood”).

Impact significance will vary from species to species according to differences in distribution, abundance and ecology. More resilient species typically have broad habitat requirements (i.e., they are able to complete their life-cycles in a variety of habitats), may be relatively abundant, are widely distributed outside the EIS area, are often highly mobile and can be observed/recorded within modified landscapes. Sensitive species are less abundant, more restricted in their distribution, less mobile and have very narrow habitat requirements. Furthermore, sensitive species often require habitat elements that cannot be easily replaced with remedial rehabilitation (e.g., advanced vegetation growth, soil structure, etc). **Table 27** groups the 27 assessed EVNT fauna species according to their perceived resilience to project-related impacts. Non-ENVT fauna species which are considered to be low/ extremely low sensitivity are not considered in this assessment

Table 27. Sensitivity of EVNT Fauna to project related impacts.

Sensitivity	Species
Extremely High/High (Sensitive)	bulloak jewel butterfly (*Hypochrysops piceatus*), pale imperial hairstreak (*Jalmenus eubulus*), collared delma (*Delma torquata*), five-clawed worm-skink (*Anomalopus mackayi*), grassland earless dragon (*Tympanocryptis cf. tetraporophora*), Australian painted snipe (*Rostratula australis*), regent honeyeater (*Anthochaera phrygia*), painted honeyeater (*Grantiella picta)*
Moderately Sensitive	brigalow scaly-foot (*Paradelma orientalis*), yakka skink (*Egernia rugosa*), common death adder (*Acanthophis antarcticus*), Dunmall’s snake (*Furina dunmalli*), grey snake (*Hemiaspis damelii*), glossy black-cockatoo (*Calyptorhynchus lathami*), squatter pigeon (*Geophaps s. scripta*), turquoise parrot (*Neophema pulchella*), freckled duck (*Stictonetta*

Sensitivity	Species
	naevosa), spotted-tailed quoll (*Dasyurus m. maculatus*), south-eastern long-eared bat (*Nyctophilus corbeni*[4]).
Low / Moderate Sensitivity (resilient)	rough collared frog (*Cyclorana verrucosa*), golden-tailed gecko (*Strophurus taenicauda*), grey goshawk (*Accipiter novaehollandiae*), black-necked stork (*Ephippiorhynchus asiaticus*), square-tailed kite (*Lophoictinia isura*), black-chinned honeyeater (*Melithreptus gularis*), cotton pygmy-goose (*Nettapus coromandelianus)*, little pied bat (*Chalinolobus picatus*).

Combining habitat maps for similarly sensitive species (**Table 27)** allows clear identification of "core habitat known" and "core habitat possible" for Extremely high/ high sensitivity fauna species. Moderately sensitive fauna and resilient fauna (Low / Moderate sensitivity) These habitat Maps are provided in **Figure 21, Figure 22** and **Figure 23.**It should be noted that for impact assessment purposes, resilient fauna species (low/ moderate sensitivity) are considered 'moderate sensitivity' ensuring impact assessment is conservative in approach.

6.6.3 Potential Impacts to Migratory Species

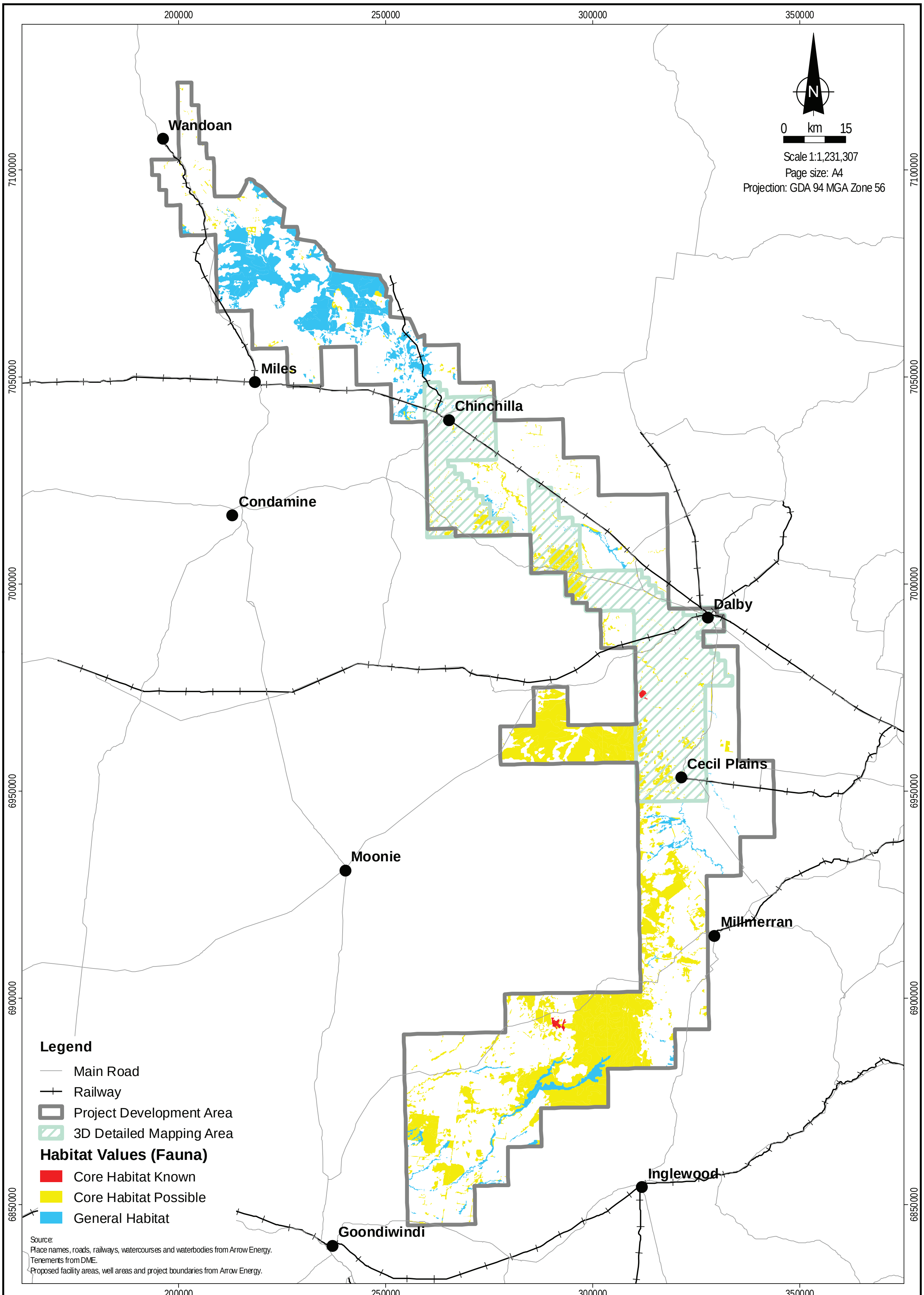
A total of 29 migratory species are known to occur within the study area. Fourteen (48%) of these are wader species, typical of estuarine habitats. These species, and a number of other migratory species commonly observed inland (e.g. cotton pygmy-goose, eastern great egret, white-breasted sea-eagle), will occur at Lake Broadwater. This lake is likely to be important migratory bird habitat and is listed as a wetland of national significance (Environment Australia 2001a). A development exclusion zone has been established around Lake Broadwater and hence direct impacts should not occur. However, indirect impacts may result from upstream development. These impacts could include:

- altered flow regimes resulting from infrastructure development;
- increased sedimentation from exposed soil surfaces following rainfall;
- deleterious impacts on water quality from coal seam water (e.g. increased salinity);
- increased weed incursion and outbreak from propagules transported from upstream infestations., and
- Dam overtopping / dam breaks in the catchment of Lake Broadwater impacting on its habitat value for migratory species.

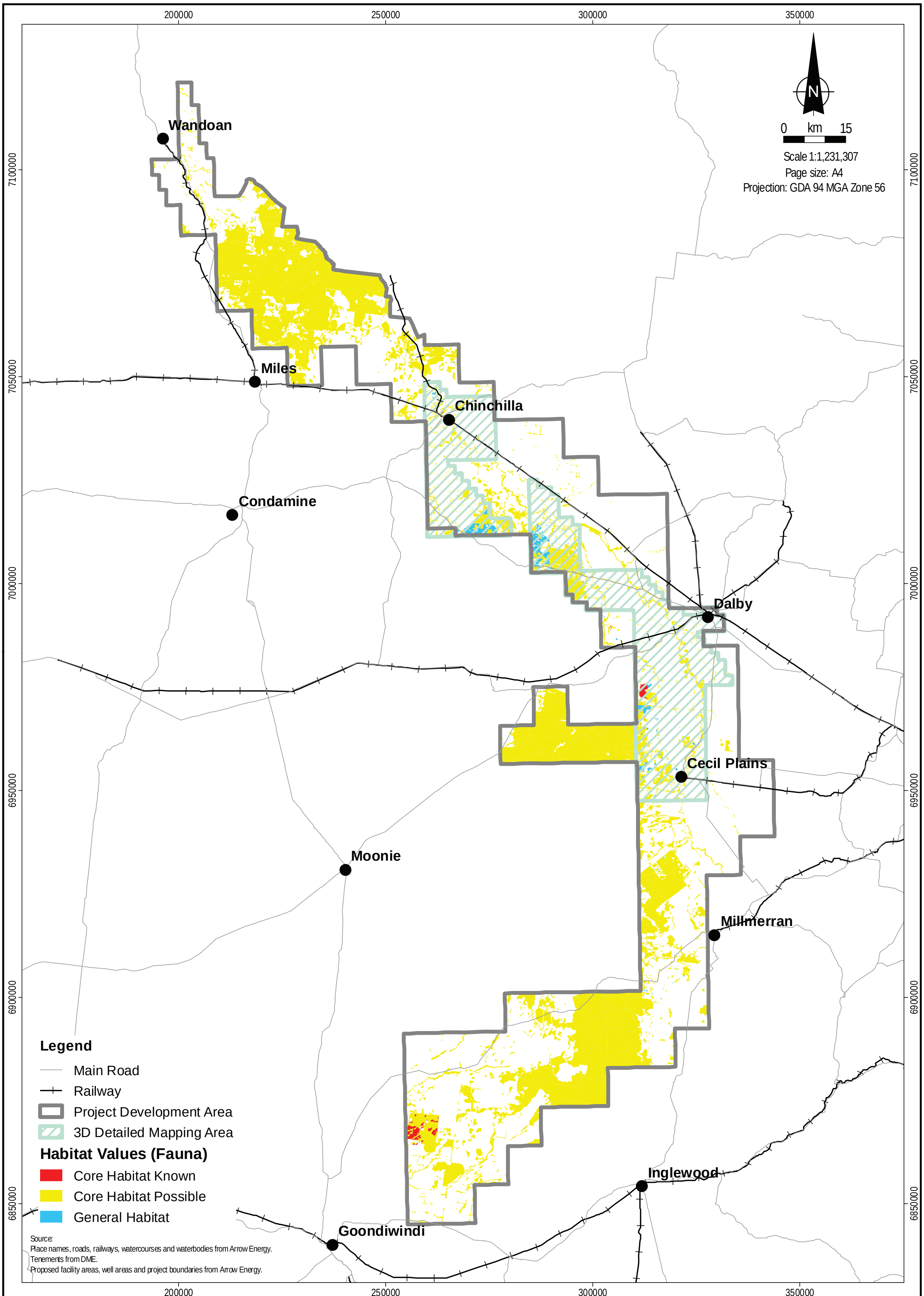
The Lake Broadwater catchment has already been significantly affected by surrounding agriculture. As a result, sedimentation is likely to already be high and minor soil disturbance

[4] listed as *N. timoriensis* under the EPBC Act.

upstream may lead to significant sediment contributions. However, other unmitigated impacts, particularly weed infestation and altered water quality (if saline coal seam water is discharged to the lake's catchment), have the potential to affect lake values. These impacts could reduce the value of Lake Broadwater to migratory species, aquatic species and several EVNT vertebrates.



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 29-09-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_Feb10.mxd File Name: XXXXAA_XX_FXXX_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Habitat Values for Sensitive Fauna Species	Figure No: 21



3D Environmental
Vegetation Assessment & Mapping Specialists
P. O. Box 959
Kenmore, Qld 4069
Phone: (07) 3411 9072
Phone: (07) 3878 4344
Mobile: 0404 577 285
Mobile: 0409 426 916
www.3denvironmental.com.au

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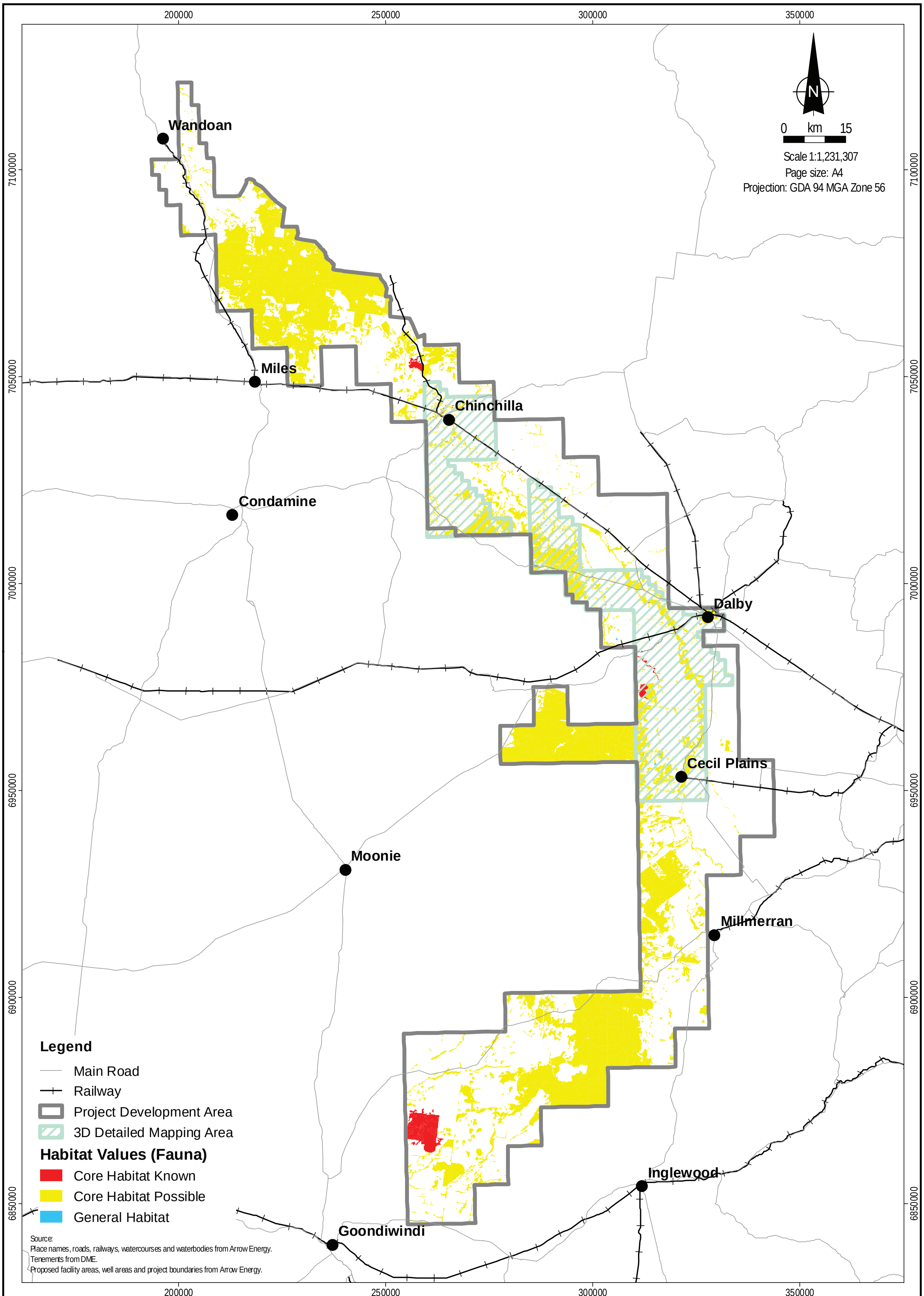
Arrow Energy Limited

Surat Gas Project

arrow energy go further

Habitat Values for Moderately Sensitive Fauna Species

Figure No: **22**



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 29-09-2011 MXD: Arrow\DS_Info\Arrow_3D_P_A4_Feb10.mxd File Name: XXXXAA_XX_FXXX_GIS	Arrow Energy Limited Surat Gas Project	arrow energy go further	Habitat Values for Resiliant Fauna Species	Figure No: 23

Other aquatic waterways such as the Condamine River, Wilkie Creek and Charlies Creek may also be used by migratory species. These waterways may also be affected through the above processes, adversely affecting habitats for these species.

Spectacled monarch, satin flycatcher, rufous fantail, black-faced monarch and fork-tailed swift are vagrants or uncommon within the study area. Impacts on suitable habitat for these species may occur due to the construction of gathering lines, dams and integrated processing facilities. Permanent or even semi-permanent populations of these species are unlikely to occur within the study area. These species are widely distributed within the region, bioregion and state.

Rainbow bee-eater and to a lesser extent white-throated needletail are likely to be the most abundant terrestrial migratory species present. Both these species are highly mobile, widely distributed, relatively common and tolerant of landscape modification. Guidelines of assessment under the EPBC have been applied to all listed migratory species

6.6.4 Potential Benefits to EVNT Fauna Species

Potential benefits from the project for EVNT species could include the following.

- A decreased risk of uncontrolled wildfire due to gathering lines and access tracks forming fire breaks in otherwise contiguous habitat. Clearing for gathering lines and other linear infrastructure may also increase access for fire fighting vehicles and also enhance the ability to undertake a prescribed ecological or fuel reduction burning program safely and efficiently.
- Increased surface water availability increasing the value and accessibility of habitat patches. This may benefit species such as the squatter pigeon, glossy black-cockatoo, spotted-tailed quoll, little pied bat and south-eastern long-eared bat. It is noted, however, that benefits arising from increased surface water are outweighed by the negative impacts (e.g. increased exotic predator abundance).
- Increased lighting at facilities may increase insects and those animals feeding on them (e.g. microbats).

6.7 Impacts to Pest Species

6.7.1 Impacts to Pest Flora Species

The impact of project development on populations of exotic weed species will be dependent on land management practices employed. Unmanaged, the project has the potential to proliferate a number of exotic plant species that may have serious economic and social impacts, as well as devastating impacts on native vegetation and general biodiversity. Activities associated with all stages of project development have the potential to disperse and increase the occupancy of a range of exotic plant species. This includes both the dispersal of currently occurring exotic plant species and the introduction of additional pest species from outside the PDA. Mechanisms of weed dispersal are generally associated with:

- movement of equipment and machinery, particularly machinery sourced from adjacent regions;
- dispersal by stock and stock feed;
- fecal material from herbivorous animal species (both native and exotic);
- flood events and downstream dispersal of seed and vegetative material; and
- ground disturbance such as grading, removal and relocation of topsoil.

Some of the most aggressive and notable weed infestations arise from exotic grass species. These are easily dispersed by wind, stock or vehicles and can quickly take hold in disturbed areas. Unlike many native grass species, which occur in isolated clumps forming a mosaic with bare ground, exotic weeds can form thick, choking monocultures. This inhibits the growth of native grasses and herbs and may also alter the ground structure, reducing value to native ground-dwelling vertebrates. As a result, both flora and fauna biodiversity is reduced where exotic grasses are abundant. African love grass (*Eragrostis curvula*) which is widely established on road verges is an example of an aggressive and difficult to control grassy weed which poses a significant threat to disturbance areas throughout the PDA. Other examples of these deleterious processes have been well documented within the Brigalow Belt bioregion (Goodland 2000, Franks 2002; Butler and Fairfax 2003).

A notable trend in Queensland is the use of exotic pasture grasses in rehabilitation. While these may grow rapidly, thereby ensuring soil stability, most exotic grasses are exceptionally invasive. Their use in rehabilitation adjacent to remnant habitats can pose a severe threat and is contrary to conservation principles.

Table 28 provides an assessment of the potential for a range of exotic species to proliferate in the PDA and facilitate impact. Information on species distribution and potential distribution are derived from Biosecurity Queensland's predictive weed maps (Biosecurity Queensland 2008a) and annual pest distribution survey and (Biosecurity Queensland 2008b) (See **Section 5.2.4**). The potential for impact is based upon the suitability of climatic conditions and habitats in the study area to facilate infestation coupled with a range of other considerations including effectiveness of current biological controls. It is ranked according to the following classification.

1. **High Potential for Impact:** Species is highly suited to the climate and habitats within the study area facilitating rapid proliferation (in absence of biological control)

2. **Moderate Potential:** Species is marginally suited to the climate in the study area although is expected to colonise niche habitats without intervention.
3. **Low potential:** Climate and habitats are not suitable for species proliferation.

Table 28. Terrestrial exotic plant species with potential for significant ecological impact.

Common Name	Pest Class	Potential for Impact
velvet pear (*Opuntia tomentosa*)	Class 2	Moderate
prickly pear *(Opuntia stricta)*	Class 2	Moderate
tiger pear (*Opuntia aurantiaca)*	Class 2	Moderate
harrisia cactus (*Eriocereus martinii, Eriocereus tortuosa)*	Class 2	Moderate
mother of millions (*Bryophyllum delagoensis, Bryophyllum x houghtonii)*	Class 2	Moderate
annual ragweed (*Ambrosia artemisiifolia)*	Class 2	Moderate
groundsel bush (*Baccharis halimifolia)*	Class 2	Low
balloon vine (*Cardiospermum grandiflorum)*	Class 3	Moderate
chinese celtis (*Celtis sinensis)*	Class 3	Low
camphor laurel (*Cinnamomum camphora)*	Class 3	Low
parthenium (*Parthenium hysterophorus)*	Class 2 WONS	High
mesquite (*Prosopis glandulosa* var. *glandulos, Prosopis velutina)*	Class 2 (WONS)	High
willow (*Salix babylonica)*	Class 1	Low
broad leaf pepper tree (*Schinus terebinthifolius)*	Class 3	Low
fireweed (*Senecio madagascariensis)*	Class 2	Low
rubber vine (*Cryptostegia grandiflora)*	Class 2 WONS	Moderate
lippia (*Phyla canescens)*	Not Declared	High
african love grass *(Eragrostis curvula)*	Not Declared	High

6.7.2 Impacts to Pest Fauna Species

Project related activities have the potential to increase pest fauna abundance throughout the life of the project. In particular, pest abundance and distribution may increase due to the following.

- The creation of gas gathering lines and road corridors through existing contiguous vegetation may act as movement conduits (DEWHA 2008b), facilitating pest species spread.
- Surface dams around gas wells and associated with facilities can provide a stable water supply for feral animals increasing their abundance and distribution.
- Putrescible waste dumps associated with increased human inhabitation can become a valuable food resource for a variety of pest species leading to an increase in their abundance.

Pest fauna species may affect existing values, including social, economic and ecological values. Ecological values may be deleteriously impacted through a number of mechanisms including competition (e.g. European wild rabbit, feral goats, Indian myna), predation (e.g. European red fox, feral cat, wild dog), habitat destruction (e.g. cane toad, feral pig, feral horse, European wild rabbit), disease spread (e.g. rodents) and toxic ingestion (e.g. cane toad). These pest species can affect common species within a community as well as have serious impacts on EVNT populations.

Exotic pest species abundance within the study area may vary, as detailed in **Table 29**. This information has been sourced from the Queensland's predictive pest animal maps (Biosecurity Queensland 2008a), annual pest distribution surveys (Biosecurity Queensland 2008b) and WildNet (see **Appendix G**). **Table 29** also briefly notes the potential impacts that each pest vertebrate may have on existing natural values.

Exotic pest species abundance within the Study area may vary, as detailed in **Table 29**. This information has been sourced from the Queensland's predictive pest animal maps (Biosecurity Queensland 2008a), annual pest distribution surveys (Biosecurity Queensland 2008b) and WildNet (see **Appendix G**). **Table 29** also briefly notes the potential impacts that each pest vertebrate may have on existing natural values.

The potential for impact is based upon the suitability of climatic conditions and habitats in the study area to facilate infestation coupled with a range of other considerations including effectiveness of current biological controls. It is ranked according to the following classification.

1. **High Potential for Impact:** Species is highly suited to the climate and habitats within the study area facilitating rapid proliferation of the species (in absence of biological control)
2. **Moderate Potential:** Species is marginally suited to the climate in the study area although is expected to colonise niche habitats without intervention.
3. **Low potential:** Climate and habitats are not suitable for species proliferation

Table 29. Terrestrial pest fauna species with potential for significant ecological impact.

Common Name	Pest Class	Potential For Impact
cane toad (*Rhinella marina*)	Not Declared	Moderate
european red fox (*Vulpes vulpes*)	Class 2	Moderate
european rabbit (*Oryctolagus cuniculus*)	Class 2	Low Moderate in localised areas
feral cat (*Felis catus*)	Class 2	Low Moderate in localised areas
feral deer (*Cervus* spp.)	Class 2	Low
feral donkey (*Equus asinus*)	Not Declared	Low
feral goat (*Capra hircus*)	Class 2	Low
feral horse (*Equus caballus*)	Not Declared	Low
feral pig (*Sus scrofa*)	Class 2	Low Moderate in localised areas
indian mynah (*Acridotheres tristis*)	Class 1	Low Moderate in localised areas
house mouse (*Mus musculus*)	Not Declared	Moderate in localised areas
wild dog (*Canis familiaris*)	Class 2	Low Moderate in localised areas.

This data indicates that those species which have the greatest potential to proliferate due to project related activities, and have the potential to affect native fauna values are:

- Cane Toad (*Rhinella marina*),
- European Red Fox (*Vulpes vulpes*),

- Feral Cat (*Felis catus*).
- Wild Dogs *(Canis lupis familiaris)*
- Feral Pigs (*Sus scrofa)*

6.8 Other Impacts

In addition to the above, several other sources of potential impact warrant consideration, including the following.

- Trapped wildlife in open trenches created while laying pipeline infrastructure.
- Creation of temporary and permanent water bodies through the construction of dams
- Scalding of native vegetation and reduction in biodiversity values through dispersal of saline coal seam associated water from leaking well heads and water storage facilities and use as a dust supressant.
- Secondary salinity resulting from vegetation clearing.
- Temporary and permanent sources of light.
- Termporary and permanent sources of noise.
- Impact of groundwater drawdown on groundwater dependant ecosystems

6.8.1 Wildlife Entrapment

During the construction of gas fields, gathering lines will be buried beneath the ground. This process requires trenches to be open for several nights. The trench poses a significant movement barrier for terrestrial fauna species, particularly frogs, snakes, reptiles and small mammals. Large numbers of these species can become trapped when they fall into the trench. Trapped animals are susceptible to desiccation, predation or even death when the trench is subsequently closed. This has the potential to impact both common and EVNT species.

6.8.2 Creation of Temporary and Permanent Water Bodies

The liberation of coal seam gas from underground coal seams also produces water (coal seam water). Additional water stored at the surface has both positive and negative impacts on local vertebrate communities when valuable watering points are created for a number of species, including some EVNT species (e.g. glossy black-cockatoo). Some water bodies will however contain untreated brine for concentration and will not provide suitable watering points. However, surface water also increases the number of predators and exotic species (e.g. Cane

Toad). Many native mammals are adapted to survive in arid environments and the deleterious effects of addtional water bodies are considered to outweigh benefits.

6.8.3 Impacts of Saline Coal Seam Water on Native Vegetation

Release of saline coal seam water from leaking well heads has the potential, when in significant quatities, to scald native ground covers in remnant vegetation. Impact to ground cover creates an opportunity for weed invasion with resultant decrease in habitat biodiversity values. Wetland ecosystems, particularly in drier seasonal periods may be particularly susceptible to impacts from saline coal seam water release.

6.8.4 Potential for Secondary Salinity Resulting from Land Clearing

The removal of deep rooted vegetation impacts on the amount of groundwater taken up by that vegetation, thereby increasing the volumes of water remaining in the system. These volumes can exceed the ability of groundwater systems to discharge excess water to rivers and watercourses. Excess water may manifest at ground surface increasing salinity of the upper soil profile with ongoing water evaporation at the surface. Areas of surface salinity have been reported in the Chincilla area, although some of these may be related to erosion of sodic soil which increases sodium content in overland flow (Bourke et al, 2000). In all cases however, secondary salinity can be attributed to excessive vegetation clearing.

6.8.5 Temporary and permanent sources of light.and noise.

Temporary and permanent sources of light may affect behaviour of animals, both diurnal and nocturnal. Changes in behavioural patterns may include focusing the foraging activities of insectivorous animals (e.g.bats), changing the movement and migration patterns of nocturnal birds or other nocturnal animals. Nocturnal birds may also become disoriented when they fly within the influence of a bright light source, affecting their a ability to feed and roost. It is also likely that some species will suffer from increased predation. The impacts of extended periods of lighting are not detrimental to all species and some, particularly insectivorous predators are likely to be favoured. There is limited documentation of the effects of noise on fauna assemblages or populations although excessive noise is expected to interfere with communications between some animals. The breeding patterns of frogs and birds in particular may be affected and it may lead to increased predation on some species.

6.8.6 Impact of groundwater drawdown on groundwater dependant ecosystems

Whilst there are no known groundwater dependant ecosystems in the PDA, groundwater may provide an important buffer for maintenance of riparian forest and wetland habitats during periods of prolonged drought. Excessive groundwater drawdown has the potential to extend the period of reduced flow in river systems during drought and facilitate extended dry periods in flood plain wetlands. Draw down may impact a range of ecosystems although the most at risk in the PDA include riparian woodlands (RE11.3.25), associated floodplain woodlands (RE11.3.2, RE11.3.4), and palustrine wetland habitats, in particular RE11.3.27. General impacts may include:

- Loss of canopy vigour in woodland species including canopy dieback and senescence,
- Degredation of wetland habitats through invasion of exotic species into fertile soils that have suffered prolonged periods of drying. Lippia *(Phyla canescens)* has aggressively invaded seasonally wetland habitats held in dry condition for extended periods across large areas of the Condamine River Flood flood plain.

Studies associated with the Surat Gas EIS indicate that shallow aquifers in the Condamine Alluvium are below stream level and streams and rivers discharge surface water to shallow aquifers rather than gain water through groundwater baseflow. This is confirmed in a water budget for the Condamine Alluvium aquifer which indicates significant annual recharge from surface water, but no discharge (SKM 2002, cited in Hillier 2010). Hence the potential for groundwater drawdown to impact to vegetation associated with the Condamine Alluvium is limited.

7. Recommendations for Management/ Mitigation

Project activities and associated vegetation clearing will occur within the PDA. Vegetation removal will occur for discrete permanent footprints (such as facilities) and temporary footprints (such as construction camps) and for linear features (such as gathering lines). This will modify existing landscape patterns, affecting individual species, populations, communities and ecological processes. Managing every individual species and every ecological process is impracticable when final locations of project infrastructure is unknown. However, impacts may be mitigated by considering the problem in two steps. The first is to manage the landscape pattern in a way that simultaneously benefits as many species as possible. The second is to manage individual species and ecological processes to prevent the decline of species and assemblages.

Relevant key conservation principles in **Table 30** have been used as the basis for mitigation measures recommended within this section. Mitigation measures for individual species are included in **Appendix I.** These mitigation measures may be ranked according to effectiveness (refer to **Figure 24**). Avoiding vegetation clearing will always be the most effective method to avoid impacts, although other strategies may assist in alleviating consequences if avoidance is not possible. Less effective strategies, such as ongoing manual weed removal, may be expensive, time consuming, and can have limited success.

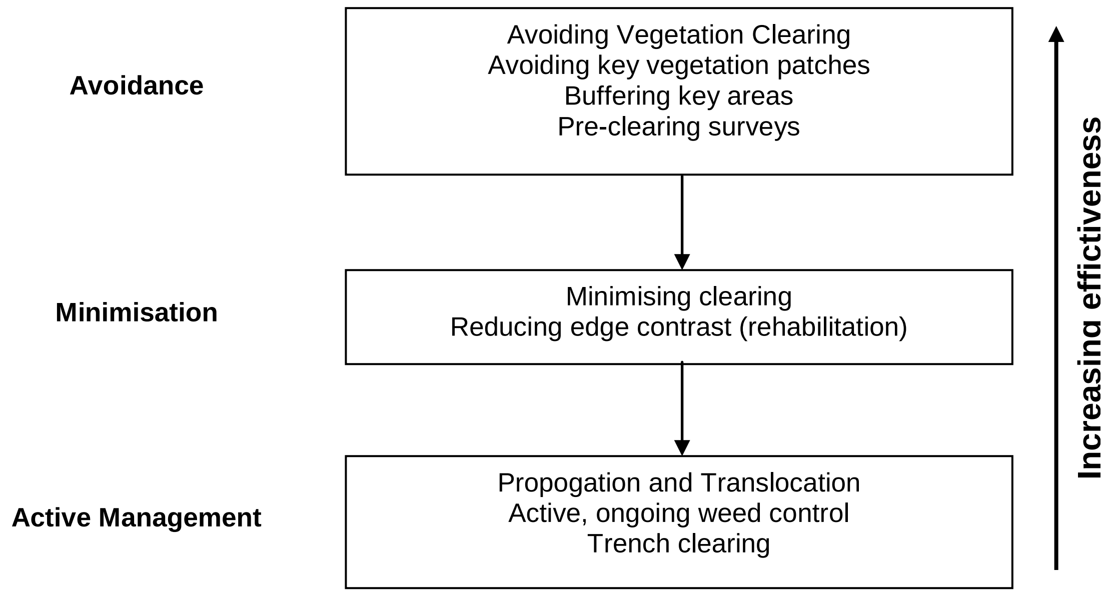


Figure 24. Mitigation hierarchy.

Impacts from land modification accumulate or reinforce, and can lead to cascading consequences on ecological values. Therefore, if clearing of vegetation is unavoidable, a range of mitigation measures from **Table 30** will be required.

Table 30. Key conservation principles (Lindenmayer and Fischer 2006).

Conservation Principle	Rationale
MANAGING LANDSCAPE PATTERNS	
Maintain and/or restore large and structurally complex patches of native vegetation	Larger, more structurally complex vegetation patches tend to support more species. Benefits from retaining these patches include 1) maximizing the overall vegetation cover, reducing losses of species reliant on native vegetation; 2) more types of habitat are conserved; 3) conditions are retained for specialist species; 4) populations of individual taxa are larger and better buffered against extinction pressures; and 5) key ecological processes such as hydrological regimes are retained.
Maintain and/or restore a matrix that is structurally similar to native vegetation	A matrix characterised by vegetation structure similar to native vegetation patches will have numerous benefits for native species including 1) provision of habitat for some species; 2) enhancement of landscape connectivity; and 3) reduced edge effects (e.g., weed invasion).
Maintain and/or restore buffers around sensitive areas	Edge effects can have major deleterious impacts on native ecosystems and are most severe where the structural contrast between the matrix and retained vegetation is pronounced. Retaining or creating buffers that minimise structural contrast will 1) reduce edge effect severity; and 2) in some cases allow species to extend their population into buffer areas.
Maintain and/or restore corridors and stepping stones	Landscape connectivity promotes population connectivity reducing the likelihood of deleterious processes (e.g., inbreeding depression) and allowing recolonisation following an extinction event. Corridors and stepping stones also can provide habitat in themselves.
Maintain and/or restore landscape heterogeneity and capture environmental gradients.	Heterogeneous human-modified landscapes tend to support more species than homogeneous human-modified landscapes. Heterogenity may be improved by maintaining and enhancing vegetation patches ranging in size, shape and level of isolation and using a range of land management practices in the matrix between them.
MANAGING INDIVIDUAL SPECIES AND ECOLOGICAL PROCESSES	
Maintain key species interactions and functional diversity	Landscape modification can alter the composition of ecological communities and therefore affect interactions important for ecosystem function (e.g., predation, pollination, seed dispersal). Retaining key species (keystone species), or functional group diversity, safeguard continued effective ecosystem function.
Maintain or apply appropriate disturbance regimes	Landscape modification typically alters historical disturbance regimes (e.g., through grazing or altered fire regimes). Retaining or returning existing disturbance conditions can avoid cascading deleterious impacts.
Maintain taxa of particular concern	As individual species perceive landscapes patterns differently, individual conservation strategies may be required (e.g., disease control, captive breeding, translocation, reintroduction, predator control, critical habitat protection, etc).
Control aggressive, overabundant and invasive species	Landscape modification favours a small number of native or introduced species. Increased abundance of some species can negatively affect other species via aggression, competition or predation.

Conservation Principle	Rationale
Minimise ecosystem-specific threatening processes	While landscape modification is often the most abundant and severe threatening process, other processes can also be important and warrant mitigation (e.g. hunting, air pollution, water degradation, etc).

7.1 Avoidance and Pre-clearing Surveys

The most effective method to reduce ecological impacts is to avoid key values such as ESAs, endangered communities or core habitats for EVNT species. If these areas can be avoided then few, if any, impacts are likely and the need for further mitigation is reduced.Core habitat for both EVNT flora and fauna species has been mapped as “core habitat known” and “core habitat possible”. Development within “core habitat known” areas will coincide with known populations and should be avoided unless other mitigation measures can adequately reduce impacts (see residual impact assessment **Section 8.0**). “Core habitat possible” areas are those habitats consistent with the species’ requirements and therefore their presence has been assumed. However, a number of species are reliant on habitat values that cannot be assessed through desktop evaluation such as ground strata integrity, soil characteristics and rocky outcrops. Further site specific survey effort in the known area of development is the only method available to determine the presence/absence of these species.While mitigation measures may reduce impacts for resilient and moderately sensitive fauna species (see **Table 27)** avoidance may be the only method with acceptable residual impacts for highly sensitive species. If development is required within the core habitats of highly sensitive species, further survey work should be undertaken. This will allow the impact assessment to be re-evaluated and potentially reduce the impact to acceptable levels if the species is absent or considered less likely to occur based on new field data.

The level of required survey effort will vary between species and be influenced by habitat and behaviour. Initial visual assessment may be suitable for some species, allowing the habitat to be assessed to determine if the species is likely, thereby avoiding further survey effort. However, some species will require effort if suitable habitat components are located.

It should be noted that the need for pre-clearing flora surveys within areas proposed for vegetation clearing is governed by the permit requirements under Section 89 of the NCA Act 1992 as guided by the *Nature Conservation (Protected Plants) Conservation Plan 2000* (PPCP) (Section 29). A licence, permit or authority (issued under the NCA) or an exemption is required to ‘take‘ protected plants. Assessment factors include; the presence of near-threatened and threatened species, whether or not the species is part of a threatened RE, the importance of the individual occurrence, the possibility of translocation, and the presence of critical habitat.

7.2 Management of Land Clearing and Habitat Fragmentation

The extent of vegetation removal should be minimised where ever possible. Impacts related to land clearing may be reduced through sensitive infrastructure design. Use of a qualified ecologist to review conceptual designs may be of considerable benefit to ensure site selection criteria are met. Consideration should be given to the measures listed below.

- Vegetation disturbance should be minimised wherever possible. Corridors for linear infrastructure should be as narrow as possible, particularly when crossing linear corridors of vegetation (e.g., Condamine River, Wilkie Creek, some roadside reserves). Areas cleared for exploration and production wells should be as small as possible.
- *E. tereticornis* and *E. populnea* trees within the Wilkie Creek and Condamine River floodplains should be visually inspected prior to clearing to ensure they are free of koalas. If koalas are located, the tree should be retained overnight. Vegetation surrounding the tree may be cleared. Koalas typically relocate overnight to nearby vegetation, avoiding death or injury.
- Machinery operators should keep vigilant watch for any injured vertebrates (including snakes and lizards) resulting from clearing activities. Injured wildlife should receive veterinary treatment.
- An induction for clearing contractors should be required to inform them of their obligations in regards to the above recommendations.
- Attempt to locate wells, gathering lines and access tracks within previous clearings or non-remnant vegetation if possible. Wells should be located along existing easements wherever possible, and innovative solutions such as non-linear corridors should be investigated (i.e., curves and bends around patches).
- Construct infrastructure within previously disturbed vegetation in preference to areas with higher biodiversity values.
- Design infrastructure to avoid undisturbed tracts of remnant vegetation. Where collection and gathering infrastructure is to be placed within contiguous vegetation, collection networks should be designed to avoid dissection (see **Figure 25**).
- Access track location should avoid the repeated isolation of small parcels of remnant vegetation from more continuous tracts.
- Retain habitat trees as a priority

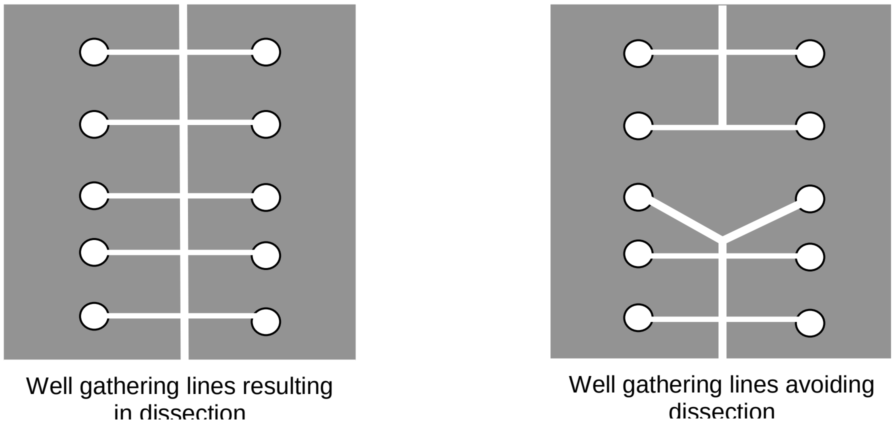


Figure 25. Designing well gathering pipelines to reduce fragmentation.

The long-term impacts of vegetation clearing and fragmentation may also be mitigated by rehabilitation and revegetation. Rehabilitation should aim to return areas to their pre-clearing condition. The success of achieving these aims is often complicated by the level of disturbance between clearing and commencement of rehabilitation efforts. Furthermore, the return of suitable tree hollows, a keystone structure in Australian landscapes, can be prolonged (e.g., 120+ years; Gibbons and Lindenmayer 2002). Rehabilitation will therefore not mitigate short-term habitat loss for a suite of species. However, to assist in project rehabilitation, some rehabilitation effort should be undertaken as soon as possible to avoid soil sterility and reduce weed infestation. Both these processes can reduce long-term rehabilitation success. Suitable rehabilitation methods are outlined in **Section 7.3.**

7.3 Rehabilitation Method - Management of Edge Effects

Some edge effects are unavoidable; however, deleterious edge effects may be substantially reduced if structural differences between cleared areas and adjacent native vegetation are minimised. This might be achieved by sequential rehabilitation in suitable locations. Sequential rehabilitation will involve short-term rehabilitation (referred to hereafter as partial rehabilitation) such as depositing cleared debris and seeding with small native shrubs and grasses whose growth will not affect project operations. Following decommission, larger canopy species may be seeded or allowed to naturally recolonise (final rehabilitation). This type of rehabilitation will also increase fauna movement rates, while providing long-term habitat recovery. Rehabilitation should occur as soon as possible following disturbance to avoid soil sterility and reduce the likelihood of weed infestation.

Photograph 1 & 2. Examples of the use of cleared debris and natural regeneration of low growing vegetation to reduce structural differences between cleared areas and remnant vegetation.

A balanced site rehabilitation plan that utilises suitable native tree and grass species should be prepared and acted upon when developed areas are no longer in use. The rehabilitation program should aim to enhance suitability for wildlife and follow the principles defined by Bennett (2000) for site, block, and landscape levels. These principles are detailed below.

At the site level:

- Areas suitable for rehabilitation should be clearly designated and identified prior to clearing. The type of rehabilitation (long-term, or partial, followed by long-term) should be indicated for each area.
- Woody debris, logs and rocks should be retained for use in rehabilitation. At the very least, these should be piled along the edge of the cleared corridor. However, spreading these features over part or all of the corridor is highly preferred as they will provide refugia for crossing fauna. Systematic removal of surface debris should be avoided and cleared timber should never be burnt. The burning of timber will increase the project's greenhouse gas emissions and reduce the effectiveness of rehabilitation efforts.
- Plant species used for rehabilitation are specific to the original ecosystem and local provenance, wherever possible. For example, the use of readily available sources of *Lomandra longifolia, Carex* spp., *Chrysopogon filipes* and *Arundinella nepalensis* would enhance rehabilitation efforts in riparian ecosystems (RE11.3.4 and RE11.3.25).
- Promote the establishment of vegetation layers (e.g., ground cover, shrub layer, canopy)

- Ground layer component diversity is considered to enhance habitat suitability for wildlife.

At the block level:

- Ensure that the size of the rehabilitated area is commensurate with requirements for particular species.
- Ensure the shape of the rehabilitated area minimises exposure to edge effects.
- Build on natural vegetation in the area of rehabilitation wherever possible.

At the landscape level:

- Revegetate in a manner that enhances connectivity in the landscape.
- Give priority to natural watercourses for rehabilitation corridors.
- Restore remnants of depleted ecosystems governed by assessment of pre-clearing vegetation and suitability of the substrate.

Some locations and vegetation types are particularly sensitive to weed infestation (e.g., brigalow and grasslands). If clearing occurs within or adjacent to these locations, further weed control methods may be required. In particular, regular monitoring of weed occurrence and triggers to initiate weed control should be formulated in line with principles identified in **Section 7.7**. These should be included within the rehabilitation plan. All machinery involved in clearing vegetation and trench construction (including light vehicles) should be thoroughly washed before and after site access to reduce weed spread.

7.4 Impact Management for Environmentally Sensitive Areas

The following general conditions in relation to ESA management should be applied.

No work should be undertaken within Category A and Category B ESAs or within disturbance exclusion zones erected. The following general conditions in relation to ESA management should be applied.

- No work should be undertaken within a Category A or Category B ESA.
- Petroleum activities other than limited petroleum activities (Queensland Government, 2010) are not conducted within 1 km of a Category A or 500 m of a Category B ESA.
- No petroleum activities should be undertaken within 200 m of a Category A, B, or C ESA.

Where there is no feasible alternative, strict management protocols should be implemented detailing how habitat degradation within these areas can be managed. These protocol requirements are listed below, although this list may not consider all conditions that may be applied.

- Develop site induction procedures to ensure that all worksite personnel are made aware of the location of these sensitive habitats and educated in regard to necessary site access protocols and requirements.
- There is a requirement to develop procedures that detail weed hygiene requirements for all vehicles, machinery/equipment and materials brought on to a site.
- Ensure access points and work sites are contained within disturbed areas. Access of workers and equipment outside defined areas should be undertaken by special permit only.
- Undertake weed maintenance within the sensitive areas to limit point sources for exotic species.
- Ensure emergency shutdown protocols are capable of rapidly sealing any saline coal seam water leaks from well head or dam facilities. Stringent design of well head and dam facilities to minimise any uncontrolled releases into the environment; these should be accompanied by emergency shutdown protocols in the event of uncontrolled release.

Generic recommendations made in the ‘Regional Vegetation Management Code for Brigalow Belt bioregion and New England Tableland (DERM, 2009g) require than no clearing be undertaken:

- within 100m of any natural wetland (Long Swamp) within 200m of any natural significant wetland (Lake Broadwater);
- within 50m of a stream of the 1^{st} or 2^{nd} order;
- within 100m of a stream of the 3^{rd} or 4^{th} order, and
- within 200m of a stream of the 5^{th} order or greater.

It should however be noted that the approach to riparian management will adopt the conditions of the Dalby Expansion Area Project EA conditions which specify a ‘ no impact buffer’ of 100m from the high point of all watercourses.

7.5 Management of Impacts to Floristic Values

7.5.1 Management of Impacts to Relevant Vegetation Communities and Regional Ecosystems

Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact. Certified RE mapping (DERM 2009b) for the study area is prepared at 1:100,000 scale and does not consistently provide representation for remnant vegetation polygons of less than 5 Ha. Field survey works determined that the certified RE mapping is unreliable in terms of vegetation classification and often underestimates the extent of remnant vegetation. Reliance on certified RE mapping to identify ecological values in terms of relevant vegetation communities will considerably increase the risk that relevant vegetation will be impacted. Reference to **Appendix J** demonstrates the disparity between certified ecosystem mapping (DERM 2009b) and field verification undertaken during the course of this study to classify EPBC Act significant vegetation communities. Comparison of 36 survey sites established in locations where EPBC Act significant vegetation communities are identified in either certified RE mapping or ground verified project mapping indicates correlation between the two datasets may be as low as 27%. Project scale (1:50, 000) vegetation maps have been prepared during the course of this study to provide a more accurate mapping layer over all PL areas. Submission of revised mapping to the Queensland Herbarium for certification should be undertaken where it differs significantly from existing mapping, particularly where differences involve significant or sensitive vegetation types. Additional recommendations include the following.

- Identification of the location of all EPBC and VMA significant vegetation communities (endangered and of concern) within the vicinity of disturbance areas and avoidance of these areas where alternative pathways are identified.
- Ensuring all workers including contract plant and machinery operators are aware of the location of significant remnant vegetation and are guided by qualified personnel when clearing is undertaken.
- Marking all disturbance areas on the ground prior to clearing to ensure unnecessary or unintended impact is avoided.
- Reduction in the width of gathering line construction easements in the vicinity of significant ecosystem types and riparian corridors (e.g. Wilkie Creek crossing).

The work program should aim to avoid impact to all remnant and advanced regrowth vegetation. Where impact to remnant vegetation is unavoidable, site specific property scale vegetation mapping should be utilised to identify whether this vegetation will trigger requirement for an environmental offset under relevant state or federal policy. Development of an offset plan in consultation with DERM or DSEWPC will be required where impacts to ecosystems requiring offsets are unavoidable. Whilst the project activities are interpreted to be exempt from the vegetation management framework, impacts to high quality regrowth should be avoided wherever possible. Liaison with vegetation management staff from DERM is recommended prior to impacting any areas of high value regrowth vegetation.

7.5.2 Management of Impacts to EVNT Flora Species

Field surveys identified the presence of six EVNT flora species within the PDA with a further 32 species noted to be either known, likely or possibly occuring. Strategies to minimise the project's impacts on EVNT flora should occur according to the hierarchical system outlined in **Section 7.0**. General mitigation measures to avoid or minimise impacts to these species are detailed below.

- Avoid disturbance to all remnant vegetation wherever possible.
- Avoid disturbance to habitats known to support significant flora species wherever possible, in particular palustrine wetlands and derived grassland habitats on alluvial clay soils.
- Adhere to policy and permit requirements relevant to the removal of EVNT flora species. Any proposed vegetation disturbance will be subject to the permit requirements of the NCA in relation to taking (disturbing) protected plants.
- Initiate a 'no net loss' policy in regard to species numbers or sustainability of significant flora species. Note that clearing permit conditions for the taking of protected plants may require application of a 'net conservation gain' for the species.
- Conduct pre-construction/pre-clearing surveys in habitats known or which have the potential for EVNT flora species in order to identify the location of all EPBC and NCA significant species within the vicinity of disturbance areas.
- Conduct surveys for target grass species such as *Digitaria porrecta, Bothriochloa biloba,* and *Homopholis belsonii* to occur in optimum times (in the window following rainfall to allow growth of fertile material for identification).
- Implement environmental protection zones in close proximity to clearing zones for any populations or EVNT habitat by fencing and signage.
- Develop and implement a management plan for the control of invasive weed species including weed hygiene procedures, regular weed monitoring during and after construction and weed control works.
- Implement effective sediment and erosion control systems to minimise impacts on surrounding areas, particularly in riparian habitats and palustrine wetlands. This

includes procedures to control any leaking wells and/or associated water treatment infrastucture to prevent saline coal seam water interacting with sensitive riverine and wetland environments.

- Translocate populations of EVNT flora where disturbance is unavoidable. Translocation should be considered to assist in management and conservation. Principles and protocols are identified in Vallee *et al.* (2004). Establish additional populations if necessary and feasible according to best practise principles. These include:
  - liaison with relevant agencies and experts;
  - commencement of translocation prior to construction into retention areas; and,
  - prior seed collection and propagation to replace individuals that are destroyed as a result of construction or do not survive translocation programs.
- Utilise existing recovery plans and threatened species advice statements.
- Salvage efforts should be made to salvage least concern Type A plants for use in revegetation. Commercial harvesting of these plants should be considered. Typical Type A plants within the PDA are any cycads, orchids, Brachychiton species, and Xanthorrhoea species.

7.6 Management of Impacts to Fauna Values

Strategies to minimise the project's impacts on EVNT fauna should occur according to the hierarchical system outlined in **Section 7.0**. The first mitigation measure that should always be considered is the avoidance of clearing within core habitats. Clearing within "core habitat known" or "core habitat possible" of highly sensitive species should be avoided where possible (see **Figure 21**). Where clearing within these areas is unavoidable, pre-clearing surveys should be undertaken to assess the likely occurrence of EVNT species.

Other, less effective mitigation measures include those outlined in **Section 7.3** and **Section 7.4**. In particular, reducing edge effects and facilitating movement by partial rehabilitation is considered a priority. Furthermore, as many ground-dwelling species are likely to become captured within open trenches, checking these structures is important (see **Section 7.8**).

The main principles for the management of EVNT fauna species are provided below.

- Where possible, avoid clearing EVNT core habitat as mapped for each species.
- Undertake pre-clearing surveys within mapped 'core habitat possible' areas of sensitive fauna to determine the likelihood of the species occurring.
- Undertake partial rehabilitation of gathering lines and other linear infrastructure to reduce edge effects (including weed invasion) and maintain movement rates.

- Undertake rehabilitation of available areas consistent with pre-clearing habitats, to increase the rate of recovery and assist the final trajectory of cleared areas.
- Undertake weed monitoring and targeted weed control measures within sensitive EVNT habitats (particularly brigalow and grassland communities).
- Reduce the impact of trench entrapment for terrestrial species by daily checking of open trenches as well as minimise the time that trenches or excavated areas are left open.
- Reduce the impact of coal seam water on soil structure and aquatic values, by preventing well leaks and not creating dams adjacent to wells (where possible).
- Reduce the incursion of feral predators by partial rehabilitation and reducing introduced water bodies (e.g., dams).
- Design creek crossings to ensure that existing flow regimes are maintained.

Mitigation measures that should be employed when passing through core habitat are detailed in **Table 31** below. These management strategies have been segregated according to the sensitivity of the species affected

Table 31. Management strategies for disturbance within core habitat areas.

Sensitivity	Relevant Map	Mitigation Measures
Low/ Moderate	**Figure 23**	• Disturbance of native vegetation should be minimised whereever possible. This should include consideration of infrastructure locations and reducing clearing during construction. • Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. • Trenches should be checked regularly and trapped animals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by: o Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench; o Placing two sawdust-filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals; o Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

<table>
<tr><th>Sensitivity</th><th>Relevant Map</th><th>Mitigation Measures</th></tr>
<tr><td></td><td></td><td>Details of trapped and released animals should be recorded (e.g., date, GPS location, species, condition) for inclusion into DERM WildNet database and to refine the EVNT mapping.
Coal seam water extracted from gas bores should not be allowed to sit on the surface, risking contamination to surrounding land and water bodies. Rather, this should be piped to dams (or similar) preferably constructed in cleared areas.
Lined low sump drains.</td></tr>
<tr><td>Moderate</td><td>Figure 22</td><td>All strategies suggested above with additional strategies as listed below:
Avoiding disturbance in all “Core habitat known” vegetation.
Preparation of a project rehabilitation plan for clearing within remnant vegetation that is not required during operation, particularly gas gathering lines. The plan should include the following strategies:
Logs and debris (including dirt clods and rocks) that were removed during clearing should be retained and placed back over cleared ground to provide shelter.
clearings should be initially seeded with a sterile cover crop such as Jap Millet or Winter Rye (depending on season) to provide some initial cover and stability to the soils. Partial revegetation by seeding with small native grass and shrub species (e.g., Acacias) should also be considered. Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement. This will also assist in preventing weed incursion and reduce deleterious edge effects that might modify the long-term integrity of uncleared adjacent habitat.
Long-term rehabilitation should be undertaken through seeding canopy species in cleared areas not partially rehabilitated or required for operation. Seed species should be consistent with surrounding vegetation.</td></tr>
<tr><td>Extremely High / High</td><td>Figure 21</td><td>All strategies suggested for Low and Moderately sensitive species with additional strategies as listed below:
300 m management buffer with a 200m work exclusion zone for all areas of “core habitat known”.
Exclusion of operations within “Core habitat possible”. Where this is not possible, the following strategies are required:
Pre-clearing surveys should be undertaken by a qualified ecologist to determine the potential presence/distribution of EVNT species. The duration and survey methods will vary between species.
Establishment of habitat offsets as per guidelines within the Environmental Offsets policy (see Section 7.8).
The Bulloak Jewel butterfly (Hypocrysops piceatus) 1000 m management buffer zone for all works around Bendidee State Forest (encompassing Bendidee National Park) with ‘no impact’ zones within located within 200m of the state forest boundary.</td></tr>
</table>

Specific recommendations for each EVNT species are provided in the EVNT profiles provided in **Appendix I.**

7.7 Management of Pest Species

A Pest Management Plan, integrated into the project EMP, should be developed for all construction, operation and decommission stages of the Project prior to the commencement of activities. The Pest Management Plan should include specific species related control measures, the below pest management principles adapted from the Petroleum Industry - Pest Spread Minimisation Advisory Guide (Biosecurity Queensland 2008d), and monitoring protocols/methods.

<u>Generic Principles</u>

1. **Integration:** Pest management is an integral part of managing natural resources and agricultural systems.

    - Integrate the management of weeds within standard operating procedures for environmentally significant areas, remnant vegetation and agricultural areas.

2. **Awareness:** The awareness and knowledge of pests must be raised to increase the capacity and willingness of individuals to manage pests.

    - Increase the level of awareness of weed and pest fauna species and associated issues within the PDA so that the relevant employees and contractors are able to identify key pest species and have knowledge of issues, impacts and management.
    - Methods may include; incorporating material into project and site inductions; training, preparation of identification guides. Training to include; identification of pests, identifying infestation areas; risk assessment; risk mitigation; control and management of identified pest outbreaks; and legislative requirements.

3. **Commitment:** Effective pest management requires a long-term commitment to pest management.

    - Identify short and long term measures within pest management plans and standard operating procedures.
    - Consider compliance measures for employees and contractors in regard to weed and pest fauna management.

4. **Consultation and partnership:** Establish consultation and partnership arrangements between local communities, industry groups, state government agencies and local governments to achieve a collaborative approach to pest management.

- Establish relationships between key stakeholders such as landholders, catchment management groups, land care groups, local government, and state government agencies towards a consistent approach to weed and pest fauna management and a sense of community ownership of the problem.
- Develop opportunities to contribute to existing or developing pest management projects in the area.
- Liaise with property owners regarding property specific weed hygiene and fauna pest control requirements.

5. **Planning:** Pest management planning must be consistent at local, regional, state and national levels to ensure resources target priorities for pest management identified at each level.

- Prepare practical management plans that are relevant to project issues and consistent with local government pest plans and cognizant of stakeholder interests.
- Note that pest management plans are not a regulatory requirement however, they offer a useful management tool to assist meeting statutory obligations as required by the *Land Protection (Pest and Stock Route Management) Act 2002*.
- Incorporate protocols and procedures into standard operating procedures to ensure prevention and management of pests.
- Identify existing infestations of high-risk weeds and pest fauna species particularly in relation to environmentally significant areas.
- Secure adequate resources (i.e. time, funds, and personnel) to implement actions.

6. **Prevention:** Prevent the spread of pests, and viable parts of pests, by project activities.

- Maintain constant vigilance of weeds and pest fauna species throughout the project life to ensure early detection and intervention.
- Training for field personnel to identify key pest species to enable early detection.
- Identify strategically placed designated wash-down or cleaning areas for vehicles and equipment.

7. **Industry Standards:** Management must be based on ecologically and socially responsible pest management practices that protect the environment and the productive capacity of natural resources.

- Adopt integrated management practices which incorporate a combination of land and habitat rehabilitation, pasture improvement, herbicide use and grazing management.
- Consider soil types, adjoining habitat, and land use when developing land rehabilitation programs and species selection on disturbed sites.
- Set aside containment areas to manage any weed emergence when unsure of the weed status.
- Weed control on access roads, easements and development sites through early detection, targeted control, and monitoring, and use of established unsealed roads/tracks where possible.
- Equipment and vehicles which may be used over large areas, may assist the spread of weeds. When equipment moves out of infected areas the cleaning down and inspection of equipment and vehicles after use may help to contain the spread.
- Minimise vegetation and soil disturbance by consideration of methods such as: minimising clearance areas; slashing using weed free slashers as an alternative to dozing to reduce vegetative ground cover on seismic / pipelines; using appropriate chemical control as an option to remove ground cover.
- Monitoring stockpiles of ground soil to ensure there are no declared or other significant pests - consider sowing suitable plants on stockpiles to reduce risk of weed establishment.
- Monitoring disturbed sites to prevent the establishment of declared and other significant pest plants.
- Consider undertaking operations in low risk areas first, before moving to higher risk areas.

8. **Improvement:** Regular monitoring and evaluation of pest control activities is necessary to improve pest management practices at the project and industry levels.

- Develop and implement monitoring and evaluation system to assess the effectiveness of pest prevention activities. The process should occur on a regular basis and may include measures identified in the industry pest advisory guidelines (Biosecurity Queensland 2008) for example:
- Assessment of effectiveness of training;

- Assessment of effectiveness of inspection procedures e.g. spot checks of vehicles;
- The number of new infestations found and timeliness of management of outbreaks;
- Assess compliance with regulatory requirements (i.e. legislation, regulation and standards) and company policies and guidelines;
- Identify system weaknesses and failures;
- Make recommendations for improvement;
- Contribution of information derived from project monitoring and evaluation into existing or developing local and regional strategies or programs.

7.7.1 Specific Pest Plant Species Management (Weeds)

The management and control of pest plants across the PDA will require a number of methods often particular to the species, the habitat, and the nature of infestation and applicable over the short and long terms. In some instances, land disturbance associated with proposed development activities will occur in areas with pre-existing weed infestations whilst other areas may be relatively weed free. The potential exists for disturbance activities to increase infestations of pre-existing weeds, and to introduce new weeds into previously clean areas. Where disturbance will fragment remnant and non-remnant vegetation there is a potential for pest plants to infiltrate adjoining vegetation. Introduction of certain pest plants across grazing and cropping land may have serious impacts on property management systems and farm economies.

In addition to the principle and guidelines identified above, a number of actions may be considered to manage species considered to have a high risk of proliferation. Thes are provided below.

Lippia (source: Lucy *et al.* 1995, Leigh and Walton 2004)

- When equipment moves out of alluvial and riparian areas where Lippia is already established (into uninfected areas), the cleaning down and inspection of equipment and vehicles after use may help to contain the spread.
- The colonization of lippia on disturbed areas can be reduced by rehabilitation measures particularly planting of improved pastures on grazing land in association with grazing strategies.
- Pasture re-establishment of lippia infested areas on alluvial soils will require preparing a fine moist seed bed with high soil moisture content; timely sowing to avoid effects of residual allelopathic chemicals; accurate seed placement; fertiliser

application and weed and grazing control during early growth periods (Lucy *et al.* 1995).

- Battering down or leveling of deep washouts and gutters in preparation for new pasture will reduce the risk of out-competition by lippia. Sowing of grass seed at up to double the normal planting rate will assist adequate establishment of ground cover to suppress the emergence of lippia seedlings (Leigh and Walton 2004).
- Re-invasion of lippia in regeneration areas must be monitored and can be controlled by herbicide treatment.
- Where river banks are disturbed rehabilitation is likely to be an important way of decreasing reinvasion with lippia as native woody species have been shown to suppress growth of lippia (Lucy *et al.* 1995, Leigh and Walton 2004). Fencing along watercourses is likely to be required to assist in grazing management and vegetation rehabilitation (Leigh and Walton 2004).

African Love Grass (Source: Biosecurity Queensland 2009).

- African love grass currently occurs on roadsides through the study area and has a high-risk potential to invade disturbance areas particularly gathering line corridors, access tracks and roads. On lighter sandy soils, it has the potential to invade pastures with potentially negative consequences to grazing management and farm profitability.
- Excluding African love grass from un-infested areas, via property-level quarantine and early detection is reliant on constant vigilance and a clear means of identification.
- Contractor equipment, which may be used over large areas of land, may assist dispersal. The cleaning down and inspection of equipment and vehicles before entering uninfected areas may help to contain the spread.
- For large infestations, effective long-term management will involve integration of herbicides together with rehabilitation measures such as planting of improved pastures on grazing land and appropriate grazing strategies (Biosecurity Queensland 2009).

Parthenium weed (source: Department of Primary Industries 2004b)

- Ensure relevant employees and contractors are able to identify Parthenium and have knowledge of issues, impacts and management.
- Ongoing liaison with relevant agencies, and landowners regarding Parthenium distribution and threat.

- Maintain constant vigilance throughout the project life to ensure early detection and intervention.
- Identify the extremities of parthenium infestations and monitor areas potentially at risk of new parthenium infestations.
- Develop parthenium management plans where appropriate. Plans to incorporate strict weed hygiene.
- Refer to the national *Parthenium Weed Strategic Plan* and *Parthenium Best Practice Manual* for additional guidance.

Mesquite

- Any infestations of Mesquite within the PDA are likely to small and isolated and therefore eradication by chemical or mechanical means is achievable and important.
- Identify locations of existing mesquite records and maintain awareness and vigilance.
- Control should incorporate strategies that limit the spread of seeds such as strategic fencing, stock quarantine and feral pig management.

7.7.2 Specific Fauna Pest Species Management

In addition to the generic control measures outlined above, specific pest fauna species should be managed. However, the management of pest fauna species can be problematic and expensive. Preliminary assessment suggests that the following three activities pose the greatest threat to increased exotic species proliferation:

- Increased access along access roads and gathering line corridors.
- Creation of artificial and temporaty and permanent water bodies (dams)
- Miss-managed putrescible wastes.

Increased movement along roadways and gathering corridors is unlikely to significantly increase pest species abundance, but may increase the distribution of pest species. Movement of pest fauna species are likely to be more difficult to mitigate during operational phases where permanent infrastructure is in place. However, long-term revegetation should aim to return habitat structure such as shrubs and canopy elements (**Section 7.3)** Once established, these features should assist in reducing movement ease, thereby reducing the ongoing impacts infinitum.

Surface water can be a limiting resource within the Southern Brigalow Belt. Increased surface water bodies as a result of dams resulting from the project may increase exotic pest species abundance. Management should primarily aim to reduce the number of water bodies , especially in association with individual wells. Rather, water should be gathered in large structures, preferable within existing cleared areas where exotic species are most likely to already occur. Where not feasible to collect water in larger containments, access to smaller water bodies can be restricted by the inclusion of fauna exclusion protocols, as detailed in **Section 7.8.2.** In addition, individual dams associated with individual wells would be temporary features, partially rehabilitated when the well is completed and brought into production following its initial installation.

Regular monitoring of each well should be undertaken to ensure that no water is allowed to leak and collect around well heads. Even small quantities of ponding water may be suitable for species such as the European Red Fox and can be used by Cane Toads for breeding.

Putrescible wastes such as food scraps can attract pest species as well as increase their abundance if the food resource is stable. All food scraps should therefore be appropriately disposed in large skips or bins that prevent animal access, particularly around camps and construction areas. These storage devices should be regularly emptied through existing council disposal facilities. No food scraps or general waste should be buried, or disposed in open trenches/waste dumps.

In addition to the above strategies, the final pest management plan should include species specific management protocols.

7.8 Management of Other Impacts

7.8.1 Management of Wildlife Entrapment

Capture of terrestrial animals in open trenches poses a significant impact to both common and EVNT species. Several strategies relevant to construction of gathering lines are often used to avoid these impacts as detailed below.

- Minimising the time trenches are open. Laying and burying of pipes should occur as soon as possible after the trench has been created.
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1 m wide from the bottom of the trench to the surface. Trapped animals (e.g. wallabies, bettongs) may use these to exit the trench.
- Trenches should be checked, and trapped frogs, lizards, snakes, mammals etc removed on a daily basis *prior to* laying pipes and closing trenches (i.e. shortly after

sunrise). Captured animals may be relocated to nearby vegetation. This process will be facilitated by conducting the following:

- Locating two sawdust/wood filing filled hessian bags (to provide shelter for trapped animals) at the base of the trench approximately every 200 m when passing through native vegetation. Bags of surgical cotton should also be added to low points in these areas if significant rainfall is expected. This will provide flotation for any native marsuipial / dasyurid / rodents that are prone to high levels of mortality when trenches become waterlogged.
- Locating the above bags approximately every 400 m when passing through disturbed land.
- Bags may be moved prior to trench closing. Additional bags (and surgical cotton) may be positioned wherever high fauna activity is likely.
- Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist.
- Details of trapped and released animals should be recorded (e.g. date, GPS location, species, condition) for inclusion into DERM WildNet database. This will provide valuable information on the types of animals within the region and may provide additional information for any EVNT species.

7.8.2 Management of Temporary and Permanent Water Bodies

Water derived from gas extraction activities should not be collected in nearby small dams or allowed to pool on the surface if possible; however, it is understood that this will be largely unavoidable when conducting drilling activities in more isolated areas. In this event, the length of time that the dams exist should be limited, and the areas progressively rehabilitated as soon as possible after the completion of works. Water should preferably be transported to large reservoirs in existing cleared areas where it will not facilitate the movement of pest species into native habitats. Large reservoirs will inadvertently attract native aquatic species to locations where they may have previously been absent. However, fewer large dams in existing cleared areas will have less impact on ecological function than many smaller dams.

When dams and ponds cannot be avoided, they should be designed to include a range of animal exclusion controls, particularly focusing on excluding exotic pest species. These controls may include two options:

1) Fauna exclusion fencing. This option would see the construction of a 1.5m high chain-wire fence surrounding the water body to prevent large animal access (e.g. European Red Fox/Wild Dog). Smaller fauna species (e.g. snakes/frogs/Cane

Toads) may be excluded by including a 40cm high metal or smooth plastic barrier attached to the bottom of the exclusion fence. Both the lower smooth barrier and the chain wire fence should be buried to a depth of 10cm and the chain wire folded out to form an apron to prevent animals digging beneath the structure. This option may be best suited for large water bodies.

2) Fauna exclusion covers which would involve covering the pond surface with a highly durable material (e.g. heavy duty shad-cloth). The material should not be allowed to contact the water and no water should be visible. The material should be buried around the edges of the pond to prevent animals digging beneath the structure. This option may be more suited to smaller water bodies and will require some maintenance of the surface material to ensure its integrity and function.

7.8.3 Impacts of saline groundwater discharge on native vegetation.

The following recommendations are made to reduce the risk of impact to native vegetation associated due to uncontrolled saline groundwater discharge:

- Ensure emergency shutdown protocols are capable of rapidly sealing saline groundwater leaks from well head or dam facilities.
- Do not locate production wells within the management management buffers of ESAs, wetlands or riparian systems.
- Ensure that in the event of accidental discharge, drainage is not directed into the local catchments of wetlands or watercourses.

7.8.4 Manangement of permanent or semi-permanent noise and lighting

The impacts of permanent or semi-permanent noise and lighting will be localised and best managed by locating facilities (including Integrated and central processing facilities) away from habitats for highly sensitive fauna species. This includes consideration to buffer zones required around ESAs. Standard industry noise suppression techniques should be employed.

7.8.5 Management of secondary salinity and impacts to groundwater dependent ecosystems

Detailed planning for the management of shallow aquifers is required to minimise aquifer drawdown and prevent impact to habitats dependent on groundwater during extended . Consultation with DERMs ‘salinity risk frameworks (Grundy et al, 2007) is recommended. Some general principles that might be employed by the proponent include:

- Monitoring of groundwater levels and levels of groundwater salinity

- Prevent further loss of deep rooted vegetation
- Avoid building dams at sites where the water table is high

7.9 Environmental/ Habitat Offsets

It is recommended that offset packages be developed in consultation with DERM and DSEWPC to address both State and Commonwealth offsetting requirements. Due to the uncertainty in the degree and nature of the environmental impacts, specific offset requirements should be identified during the course of the project and discussed with regulating authorities.

7.9.1 Environmental offsets for impact on Matters of National Environmental Significance

Environmental offsets for impacts on Matters of National Environmental Significance may be used to maintain or enhance the health, diversity and productivity of the environment as it relates to Matters of National Environmental Significance. The requirement for environmental offset 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:

- environmental offsets should target the matter protected by the EPBC Act that is being impacted;
- 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;
- environmental offsets should deliver a real conservation outcome;
- environmental offsets should be developed as a package of actions, both direct and indirect;
- environmental offsets as a minimum should be commensurate with the magnitude of the impact and deliver outcomes that are like for like;
- environmental offsets should be located in the same general area as the activity;
- environmental offsets should be delivered in a timely manner and be long lasting; and
- environmental impacts should be enforceable, monitored and audited (Department of Environment and Water Resources (DEWR 2007).

7.9.2 Queensland Government Environmental Offsets Policy

The Queensland Government Environmental Offsets Policy (EPA, 2008c) provides a framework for preparation of environmental offsets in Queensland and provides guidelines for the use of environmental offsets and when they should be applied. The policy applies when current legislation triggers assessment of impact on environmental values. The Queensland Government Policy applies to projects under a range of approval mechanisms including the Integrated Planning Act and the EP Act. The policy outlines seven principles that direct the way offsets must be used to contribute to environmentallysustainable development as follows:

- 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;
- environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact;
- offsets must achieve an equivalent or better environmental outcome;
- offsets must provide environmental values as similar as possible to those being lost;
- offset provision should minimise the time-lag between the impact and delivery of the offset;
- offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values, and
- offsets must be legally secured for the duration of the offset requirement.
- These principles should be adhered to throughout all stages of the project.

Due to uncertainty in the location of project impacts, the requirement for environmental offsetting must be determined and regulatory authorities should be notified prior to work commencement.

7.9.3 State Policy for Vegetation Management Offsets

The requirements for offsets under state legislation fall under the subordinate policies of the VMA and NCA, as listed below.

- Regional Vegetation Management Code (DERM, 2009g);
- Policy for Vegetation Management Offsets – Version 2.4 (DERM 2009h); and
- Nature Conservation (Koala) Conservation Plan (2006).

The offsets should be based on the residual impact once alternative measures to avoid impacts have been implemented. Offset requirements must be sufficient to ‘maintain existing extent’ for

REs, essential habitat and conservation status thresholds under the Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands Bioregion (DERM, 2009h).

8. Impact Assessment

The method used to assess impacts is provided in Section 4.5. The following section provides an unmitigated significiance assessment for key environmental values, recommends suitable mitigiation measures, and then provides a residual significance assessment

8.1 Residual Impact Significance Assessment

Due to the requirement to give consideration to an extensive number of ecological factors across a broad PDA, the residual impact significance assessment presented within this report provides a summary only. The summary deals specifically with the significance of residual impact to:

- Threatened ecological communities;
- Environmentally sensitive areas;
- Threatened flora species assemblages;
- Threatened fauna species assemblages; and
- Migratory fauna species.

The assessment provided below relates to the significance of impacts to these ecological values as groups. It is however based on detailed consideration of mitigation measures that have been proven to be effective in the mitigation or management of impacts to individual vegetation communities, ecosystems, flora and fauna species. The assessed impact significance may vary widely between the individual values within these groups and an assessment of individual values is provided in **Appendices C** and **G**. The impact magnitude may also vary for an individual ecological entity dependant on the impact pathway, whether this be through a direct (clearing) or indirect (facilitated weed invasion) impact pathway. Variations in impact significance for individual entities across a range of impact pathways are provided in **Appendix L** with a assessment of entities within groups against impact pathway provided in **Appendix M**.

As detailed in **Section 4.5**, impact significance is based on potential impact to populations rather than individuals. This assessment is particularly targeted toward the identification of those ecological values which may potentially incur impact of extremely high or high significance, as well as identifying those activities which present the greatest risk to significant ecological value.

8.1.1 Significant Ecological Communities and Regional Ecosystems Residual Impact Assessment

A detailed basis for residual impact assessment for all significant ecological communities and ecosystems is provided in **Appendix C**. Assessment of impact is applied to those ecological communities listed as ‘Endangered’ or ‘Critically Endangered’ under the EPBC Act or ‘Endangered’ and ‘Of Concern’ under the VMA. The significance of a number of additional ecosystems included in the assessment is based on landscape function and habitat sensitivity. **Table 32** presents the assessed residual ecological impact posed by project development activities to significant vegetation communities as a whole following implementation of mitigation measures. The range of sensitivities and impact magnitudes are derived from individual assessments provided in **Appendix L** and grouped assessment against impact pathway provided in **Appendix M. Table 33** presents the assessed residual impact to individual ecological communities and regional ecosystems posed by the full range of activities. It is intended that this assessment highlight those ecological communities that require specific attention throughout the life of the project due to particular susceptibility to environmental impact. In some highly sensitive ecosystems, avoidance may not be sufficient to mitigate against indirect impacts and in these communities, management buffers and a range of additional measures may be necessary to reduce the impact to acceptable levels (as low as possible). In reality, across the operational phases of the project, it is likely that a range of mitigation measures will be adopted because avoidance will not be possible in all circumstances. It should be noted that the ‘natural grassland’ and ‘semi-evergreen vine thicket’ ecological communities present a high to moderate impact if avoidance is not implemented as the preferred mitigation measure. In these communities however, avoidance should be readily accommodated due to the limited extent and fragmented nature of these systems.

Table 32. Residual impact assessment for significant ecological communities and ecosystems (* includes management buffers).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Exploration and Appraisal Well Drilling								
Exploration Well Drilling*	Low to Extremely High	Low to Extremely High	Low (5) to Extremely High (25)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (4) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.				
Seismic Data Collection	Low to Extremely High	Low to Extremely High	Low (5) to Extremely High (25)	As for exploration and appraisal Well drilling although including: • Organise survey lines in a formation that minimises habitat dissection.	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (4) to High (20)
Production Well Design and Installation								
Site Preparation*	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure				
Well Site Drilling	Low to Extremely High	Low to Moderate	Low (5) to High (21)	• As for Production Well Design and Installation.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16)
Well Completion	Low to Extremely High	Low to Moderate	Low (5) to High (21)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16)
Gathering Infrastructure Design and Installation								
Gathering line installation and management*	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure				
Electricity Grid (Overhead) Design and Installation								
Installation and Management*	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	As per Gathering Line Installation and Management although including: • Explore alternative means of corridor clearing through selective timber extraction and mulching	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				rather than wholesale clearing. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Organise overhead lines in a formation that minimises habitat dissection. • washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation..				
Integrated Production Facility Design and Installation								
Gas Compression and Processing Facility Design and Installation	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Adhere to management buffers prescribed by regulatory authorities. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				(DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.				
Electricity Generation Design and Installation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Exclusion of all 'non limited' petroleum facilities to outside a 500m buffer from all EPBC significant Ecological Communities and Endangered Regional Ecosystems. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig.(2) to Moderate (16)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.				
Water Storage Treatment Facility Design and Installation	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Exclusion of all 'non limited' petroleum facilities to outside a 500m buffer from all EPBC significant Ecological Communities and Endangered Regional Ecosystems (includes pre-clearance site inspection /survey). • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Ensure dams have sufficient capacity to accommodate significant rainfall events. • Locate dams away from sensitive	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				catchment areas. • Put in place emergency protocols to react to dam breach or spill.				
Sewerage Treatment Plant Design and Installation	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Exclusion of all 'non limited' petroleum facilities to outside a 500m buffer from all EPBC significant Ecological Communities and Endangered Regional Ecosystems (includes pre-clearance site inspection /survey). • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Insig. (2) to High (20)
Operation and Maintenance								

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Well Site Operation and Maintenance	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).
Gathering Infrastructure Operation and Maintenance	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Provide immediate ground stabilisation through placement of cleared debris onto disturbed areas. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).
Electricity Grid Operation and Maintenance	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,				
Electricity Generation Site Operation and Maintenance	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).
Central Gas Processing Facility Design and Operation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures, • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				measures are in place. Particular care should be exercised in proximity to wetland areas. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,				
Export of Gas from Field to Downstream Use								
Clearing of ROW , trenching and access for construction equipment.	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind, • Minimisation of impact footprint. • Organise gathering lines in a formation that minimises habitat dissection. • Ensure weed hygiene protocols	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Preparation of biodiversity offsets (DEWHA 2007; DNRW 2007) for all impacted significant vegetation. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.				
Decommission and Rehabilitation								
Well Site Decommission and Rehabilitation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Gathering Infrastructure Decommision and Rehabilitiation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).
Electricital Grid Decommision and Rehabilitiation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).
Integrated Processing Facility Decommission and Rehabilitation	Low to Extremely High	Low to Moderate	Low (5) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Protocols should be in place to ensure effective management of hazardous waste.				

* Defined as a limited petroleum activity

Table 33. EPBC significant ecological communities and regional ecosystems residual impact assessment.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
					Total Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance	Avoidance[2]	Others[3]	Sensitivity Ranking	Magnitude Ranking	Significance	Sensitivity Ranking	Magnitude Ranking	Significance
EPBC Significant Ecological Community: Brigalow (Acacia harpophylla dominant and co-dominant) (endangered) **Regional Ecosystems:** 11.3.1, 11.4.3, 11.9.5, 11.9.6, 11.4.10										
High	Moderate	High (17)	Totally Effective	Effective	High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)
Ecological Community: : Natural Grasslands of the southern Darling Downs (critically endangered)										

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
					Total Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance	Avoidance[2]	Others[3]	Sensitivity Ranking	Magnitude Ranking	Significance	Sensitivity Ranking	Magnitude Ranking	Significance
Regional Ecosystems :11.3.21, 11.3.24)										
Extremely High	Extremely High	Extremely High (25)	Totally Effective	Not Effective	Extremely High	Extremely Low Magnitude	Moderate (11)	Extremely High	High	Extremely High (23)
Ecological Community: Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (endangered) **Regional Ecosystems:** 11.8.3, 11.9.4a										
High	Moderate	Moderate (17)	Totally Effective	Effective	High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)
Ecological Community: Weeping Myall Woodlands (endangered); Regional Ecosystems: Not Represented										
High	Moderate	Moderate (17)	Totally Effective	Effective	High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)
Ecological Community: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered) **Regional Ecosystems:** 11.8.2a										
Extremely High	High	Extremely High (23)	Totally Effective	Not Effective	Extremely High	Extremely Low Magnitude	Moderate (11)	Extremely High	Moderate	High (20)
Ecological Community: Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered): **Regional Ecosystems:** 11.3.3.										
Moderate	Low	Low (8)	Totally Effective	Mostly Effective	Moderate	Extremely Low Magnitude	Low (4)	Moderate	Extremely Low	Low (4)
RE 11.3.2: Eucalyptus populnea woodland on alluvial plains (of concern)										

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
					Total Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance	Avoidance[2]	Others[3]	Sensitivity Ranking	Magnitude Ranking	Significance	Sensitivity Ranking	Magnitude Ranking	Significance
Moderate	Low	Low (8)	Totally Effective	Effective	Moderate	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)
RE 11.3.4: Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains (of concern)										
Moderate	Low	Low (8)	Totally Effective	Effective	Moderate	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)
RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains (endangered)										
High	Low	Moderate (12)	Totally	Effective	High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)
RE 11.3.25: Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. (of Concern)										
Moderate	Low	Low (8)	Totally	Effective	Moderate	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)
RE 11.3.27: Freshwater wetlands (of Concern)										
Moderate	Moderate	Moderate (13)	Totally	Not Effective	Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)
RE 11.4.12: Eucalyptus populnea woodland on Cainozoic clay plains (endangered)										
High	High	High (21)	Totally	Effective	High	Extremely Low	Low (7)	High	Low	Moderate (12)
RE 11.9.7: Eucalyptus populnea, Eremophila mitchellii shrubby woodland on fine-grained sedimentary rocks (of concern)										
Moderate	Low	Low (8)	Totally	Effective	Moderate	Extremely	Low (4)	Moderate	Low	Low (5)

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
					Total Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance	Avoidance[2]	Others[3]	Sensitivity Ranking	Magnitude Ranking	Significance	Sensitivity Ranking	Magnitude Ranking	Significance
						Low				
RE 11.9.10: Acacia harpophylla, Eucalyptus populnea open forest on fine-grained sedimentary rocks (of concern)										
High	Low	Moderate (12)	Totally	Effective	High	Extremely Low	Low (7)	High	Low	Moderate (12)

1. Mitigation measures where the effectiveness is considered unknown / untested may include mitigation measures which may partially mitigate against an impact.
2. No clearing of vegetation within areas of 'core habitat known'
3. Clearing within areas of 'core habitat known' is unavoidable.

8.1.2 Environmentally Sensitive Areas Residual Impact Assessment

Environmentally Sensitive Areas present some complexity for residual risk assessment as their classification can be based on both tenure in (as for National Parks and State Forests), or specific ecological attributes in the case of Category B ESAs which may be classified according to vegetation type. Included in this impact assessment Category are;

- Category A ESAs (Wondul Range National Park, Bendidee National Park, Lake Broadwater Conservation Park);.
- Category C ESAs (state forests, resources reserves, river improvement areas, regional ecosystems with biodiversity status ‘of concern’).

Regional ecosystems classified as ESAs are not included in this assessment as these have been assessed individually within **Table 33**. Wherever necessary, recommendations pertaining to ESA categories are recorded individually within the assessment and the range of sensitivities for ESAs is derived from **Appendix L** where individual sensitivities to ESAs have been attributed. Potential for environmental impact has been previously described in **Section 6.4** with an assessment of residual impact to ESAs provided in **Table 34.**

Table 34. Environmentally Sensitive Areas(by tenure) Residual Impact Assessment.

Activity	Sensitivity	Unmitigated Impact Assessment		Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Others	
		Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Exploration and Appraisal Well Drilling								
Exploration Well Drilling and Seismic Data Collection*	Moderate to Extremely High	Moderate to Extremely High	Moderate to (13) to Extremely High (25)	No works should be undertaken within Category A ESAs. Additional management measures are: • Exclusion of all petroleum activities with the exception of ‘limited’ petroleum activities (see Glossary) to outside a 1000m management buffer from all Category A ESAs, and 500m from all Category B ESAs. • Exclusion of all petroleum activities to areas outside a 200m impact management buffer around all Category A, B and C ESAs. • Limit areas works to areas outside a 100m buffer from the high bank of all watercourses Generic recommendations for all works undertaken in ESAs and management buffer areas are: • Minimisation of impact footprint. • Location of any works to previously disturbed areas. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.	Extremely Low	Low (4) to Moderate (11)	Low to High	Moderate (12) to Extremely High (23)
Production Well Design and Installation								
Site Preparation*	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for Exploration Well and Seismic Data Collection.	Extremely Low	Low (4) to Moderate (11)	Low to Moderate	Low (8) to Extremely High (20)
Well Site Drilling*	Moderate to	Low to Moderate	Low(8) to Moderate	As for Exploration Well and Seismic Data Collection plus. • Limit access to existing access tracks or points wherever	Extremely Low	Low (4) to Moderate	Extremely Low to	Low (4) to High (20)

Activity	Sensitivity	Unmitigated Impact Assessment		Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Others	
		Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
	Extremely High		(20)	possible. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.		(11)	Moderate	
Well Completion*	Moderate to Extremely High	Extremely Low to Low	Low (4) to Moderate (16)	As for well site drilling.	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Moderate	Low (4) to High (20)
Gathering Infrastructure Design and Installation								
Gathering line installation and management*	Moderate to Extremely High	Low to High	Moderate (13) to Extremely High (23)	As for Exploration Well and Seismic Data	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Electricity Grid (Overhead) Design and Installation								
Installation and Management*	Moderate to Extremely High	Low to High	Moderate (13) to Extremely High (23)	As for Exploration Well and Seismic Data	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Integrated Production Facility Design and Installation								
Gas Compression and Processing Facility Design and Installation	Moderate to Extremely High	Low to High	Moderate (13) to Extremely High (23)	As for exploration well and seismic data collection.	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Electricity Generation Design and Installation	Moderate to Extremely High	Low to High	Moderate (13) to Extremely High (23)	As for exploration well and seismic data collection.	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Water Storage Treatment Facility Design and	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for exploration Well and Seismic Data Collection athough also includes the following additional measures. • Ensure dams have sufficient capacity to accommodate significant rainfall events.	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)

Activity	Sensitivity	Unmitigated Impact Assessment		Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Others	
		Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Installation (where outside IPF footprint)				• Ensure dams constructed do not drain directly into the catchment of wetland areas. • Put in place emergency protocols to react to dam breach or spill. Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind.				
Sewerage Treatment Plant Design and Installation	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (23)	As for exploration well and seismic data collection.	Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Operation and Maintenance								
Well Site Operation and Maintenance	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind.	. Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Gathering Infrastructure Operation and Maintenance	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	As for well site operation and maintenance.	. Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Electricity Grid Operation and Maintenance	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	As for well site operation and maintenance.	. Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Electricity Generation Site Operation and	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	As for well site operation and maintenance.	. Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)

Activity	Sensitivity	Unmitigated Impact Assessment		Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Others	
		Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Maintenance								
Central Gas Processing Facility Design and Operation	Moderate to Extremely High .	Low to Moderate	Low (8) to High (20)	• Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind.	. Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Export of Gas from Field to Downstream Use								
Clearing of ROW , trenching and access for construction equipment.	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for Exploration Well and Seismic Data	. Extremely Low	Low (4) to Moderate (11)	Low to High	Low (8) to Extremely High (23)
Decommission and Rehabilitation								
Well Site Decommission and Rehabilitation	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland ESAs.	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Gathering Infrastructure Decommision and Rehabilitiation	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	As for well site decommission and rehabilitation.	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)
Electricity Grid Decommission and	Moderate to Extremely	Low to Moderate	Low (8) to High (20)	As for well site decommission and rehabilitation.	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)

Activity	Sensitivity	Unmitigated Impact Assessment		Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Others	
		Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Rehabilitation	High							
Integrated Processing Facility Decommission and Rehabilitation	Moderate to Extremely High	Low to Moderate	Low (8) to High (20)	• Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000). • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Protocols should be in place to ensure effective management of hazardous waste.	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Low	Low (4) to Moderate (16)

* Defined as a limited petroleum activity.

8.1.3 Significant Flora Species Residual Impact Assessment

Table 35 provides a combined summary of residual impact to all significant flora species in the PDA posed by the range of project development activities. Whilst this considers EVNT species grouped as a whole, it is based on a detailed assessment of individual species as provided within **Appendix E**. Species that are particularly susceptible or resilient to impact may have an individual impact significance that varies significantly from the combined EVNT flora species assessment. It should be noted that total avoidance of populations of most EVNT species is the measure that in most cases, provides the lowest possible residual impact. In some cases, due to susceptibility to edge effects, habitat avoidance may not mitigate all impacts. For these species, a range of mitigation measures may be implemented. It should also be noted that the assessment considers impacts to core habitats for sensitive species. In areas of general or low suitability habitats, impact magnitudes are in all cases considered to be low to extremely low.

Table 36 considers the significance of impacts posed by all project development activities on individual EVNT species. This table is intended to provide an indication of those species which require particular attention throughout all stages of project development due to their inherent sensitivity to disturbance, highly restricted population distributions, or lack of any known effective means to propagate or translocate individual plants. The risk posed to individual species will vary across the PDA dependant on the species distribution.

Table 35. Summary of residual impact significance to threatened flora species in PDA.

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Asseessment			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Exploration and Appraisal Well Drilling								
Exploration Well Drilling Seismic Data Collection	<u>Core Habitat Possible and Core Habitat Known</u> ***Moderate to Extremely High***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low to Extremely High***	<u>*Core Habitat Possible and Core Habitat Known*</u> ***Low (8) to Extremely High (25)***	<u>Avoidance</u> • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT flora species (including establishment and maintenance of management buffers for highly sensitive species). <u>Other Mitigation Measures</u> *Absence Likely* • Ground inspection to ensure most appropriate siting of infrastructure/ equipment. • Minimisation of impact footprint where possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to drainage lines. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Develop and implement weed hygiene protocols including machinery / equipment washdown procedures. *General habitat* All above measures plus: • Ground survey should be undertaken by a qualified ecologist to identify incidental EVNT species locations. Pre-clearance survey for EVNT flora as determined by compliance with DERM permit conditions for protected plants when clearing vegetation. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow	<u>*Core habitat Possible and Core Habitat Known*</u> ***Extremely Low to Low***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low (4) to Moderate (16)***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low to Extremely High***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low (8) to Extremely High (25)***

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Asseessment			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				adequate impact assessment. Survey effort will vary between species. • Avoidance of any identified EVNT species locations and habitat • Limit access to existing access tracks or points wherever possible and avoid creation of multiple access points. *Core habitat possible* • All measures for general habitat *Core Habitat Known* • All measures for core habitat possible • Detailed on ground survey to determine EVNT population sizes and to confirm ground locations of all EVNT species including specimen tagging. • Consideration of appropriate mitigation measures including translocation and /or propogation. • Establish management buffers around all known EVNT species locations				
Production Well Design and Installation								
Site Preparation Well Site Drilling Well Completion	<u>Core Habitat Possible and Core Habitat Known</u> ***Moderate to Extremely High***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low to Extremely High***	<u>*Core Habitat Possible and Core Habitat Known*</u> ***Low (8) to Extremely High (25)***	As for exploration and appraisal well drilling. Additional requirements include: • Necessity to ensure emergency shut down procedures are fully in place to prevent any uncontrolled release of hazardous substances into the environment (e.g. diesel, saline groundwater)	<u>*Core habitat Possible and Core Habitat Known*</u> ***Extremely Low to Low***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low (4) to Moderate (16)***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low to Extremely High***	<u>*Core habitat Possible and Core Habitat Known*</u> ***Low (8) to Extremely High (25)***
Gathering Infrastructure Design and Installation								
Gathering line				As for exploration and appraisal well drilling.				

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Asseessment			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
installation and management	Core Habitat Possible and Core Habitat Known ***Moderate to Extremely High***	*Core habitat Possible and Core Habitat Known* ***Low to Extremely High***	*Core Habitat Possible and Core Habitat Known* ***Low (8) to Extremely High (25)***	Additional measures include: • Reduction of construction corridors width in areas of general habitat, core habitat possible and core habitat known. • Ensure gathering lines are planned in a manner to prevent dissection of EVNT species habitat to prevent the promotion of edge effects and subsequent degredation of EVNT species habitat. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands)or during periods of high wind	*Core habitat Possible and Core Habitat Known* ***Extremely Low to Low***	*Core habitat Possible and Core Habitat Known* ***Low (4) to Moderate (16)***	*Core habitat Possible and Core Habitat Known* ***Low to Extremely High***	*Core habitat Possible and Core Habitat Known* ***Low (8) to Extremely High (25)***
Electricity Grid (Overhead) Design and Installation								
Electricity Grid installation and management	Core Habitat Possible and Core Habitat Known ***Moderate to Extremely High***	*Core habitat Possible and Core Habitat Known* ***Low to Extremely High***	*Core Habitat Possible and Core Habitat Known* ***Low (8) to Extremely High (25)***	As for exploration and appraisal well drilling. Additional measures include: • Reduction of construction corridors in areas of general habitat, core habitat possible and core habitat known. • Ensure gathering lines are planned in a manner to prevent dissection of EVNT species habitat to prevent the promotion of edge effects and subsequent degredation of EVNT species habitat. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands)or during periods of high wind	*Core habitat Possible and Core Habitat Known* ***Extremely Low to Low***	*Core habitat Possible and Core Habitat Known* ***Low (4) to Moderate (16)***	*Core habitat Possible and Core Habitat Known* ***Low to Extremely High***	*Core habitat Possible and Core Habitat Known* ***Low (8) to Extremely High (25)***
Integrated Production Facility Design and Installation								
Gas Compression and Processing Facility Design and Installation	Core Habitat Possible and Core Habitat Known	*Core habitat Possible and Core Habitat Known*	*Core Habitat Possible and Core Habitat Known*	As for exploration and appraisal well drilling. Additional requirements include: • Necessity to ensure emergency shut down procedures are fully in place to prevent any uncontrolled release of hazardous substances into the environment (e.g. diesel, effluent)	*Core habitat Possible and Core Habitat Known*	*Core habitat Possible and Core Habitat Known*	*Core habitat Possible and Core Habitat Known*	*Core habitat Possible and Core Habitat Known*

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Asseessment			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Electricity Generation Design and Installation Water Storage Treatment Facility Design and Installation Sewerage Treatment Plant Design and Installation	***Moderate to Extremely High***	***Low to Extremely High***	***Low (8) to Extremely High (25)***	• Ensure facilities are not sited in sensitive catchment areas where sedimentation and contaminant release may have a dramatic negative impact on habitat quality (e. g. Lake Broadwater). • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,	***Extremely Low to Low***	***Low (4) to Moderate (16***)	***Low to Extremely High***	***Low (8) to Extremely High (25)***
Operation and Maintenance								
Well Site Operation and Maintenance Gathering Infrastructure Operation and Maintenance Electricity Generation Site Operation and Maintenance Central Gas	Core Habitat Possible and Core Habitat Known ***Moderate to Extremely High***	*Core habitat Possible and Core Habitat Known* ***Low to Moderate***	*Core Habitat Possible and Core Habitat Known* ***Low (8) to High (20)***	As for exploration and appraisal well drilling. Particular attention must be applied to the following mitigation measures: • Ensure site access follows established routes. • Ensure all habitats for sensitive flora species are clearly identified and all staff and contractors are aware of these locations. • Fencing should be considered for sensitive habitats throughout operational phases. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind,	*Not Applicable*	*Not Applicable*	*Core habitat Possible and Core Habitat Known* ***Extremely Low to Low***	*Core habitat Possible and Core Habitat Known* ***Insignificant (2) to Moderate (16)***

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Asseessment			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Processing Facility Design and Operation								
Export of Gas from Field to Downstream Use								
Clearing of ROW, trenching and access for construction equipment.	<u>Core Habitat Possible and Core Habitat Known</u> ***Moderate to Extremely High***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Low to Extremely High***	*<u>Core Habitat Possible and Core Habitat Known</u>* ***Low (8) to Extremely High (25)***	As for gathering infrastructure design and installation.	*<u>Core habitat Possible and Core Habitat Known</u>* ***Extremely Low to Low***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Low (4) to Moderate (16)***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Low to Extremely High***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Low (8) to Extremely High (25)***
Decommission and Rehabilitation								
Well Site Decomm. and Rehab. Gathering Infrastructure Decomm. and Rehab. Electricity Grid Decomm. And Rehab. Integrated Processing Facility Decomm. and Rehab.	<u>Core Habitat Possible and Core Habitat Known</u> ***Moderate to Extremely High***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Low to Moderate***	*<u>Core Habitat Possible and Core Habitat Known</u>* ***Low (8) to High (20)***	As for operation and maintenance. Additional management considerations include: • Rehabilitation which includes the use of EVNT flora species of immediate local provenance, particularly those species impacted during construction phases. • Adequate erosion control to ensure rehabilitated areas retain integrity and sedimentation of sensitive environments does not occur. • Ensure protocols are in place to ensure safe and effective removal of hazardous waste from site. • Ensure long term monitoring programs are in place for rehabilitated areas to measure the effectiveness of these areas as habitat for EVNT flora species.	*<u>Not Applicable</u>*	*<u>Not Applicable</u>*	*<u>Core habitat Possible and Core Habitat Known</u>* ***Extremely Low to Low***	*<u>Core habitat Possible and Core Habitat Known</u>* ***Insignificant (2) to Moderate (16)***

Table 36. Residual impact significance assessment for threatened flora species.

Species	EBPC	NCA	Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
								Avoidance			Others		
			Sensitivity	Impact Magnitude	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Acacia barakulensis	Not listed	V	Mod.	Mod.	Mod. (13)	Completely	Effective	Mod.	Extrem. Low	Low(4)	Mod	Low	Low (8)
Acacia curranii	V	V	High	High	High (21)	Completely	Effective	High	Extrem. Low	Low(7)	High	Mod.	Mod. (17)
Acacia handonis	V	V	High	Mod.	Mod. (17)	Completely	Effective	High.	Extrem. Low	Low(7))	High.	Low	Mod (12)
Acacia tenuinervis	Not listed	NT	Mod.	Mod.	Mod. (13)	Completely	Effective	Mod.	Extrem. Low	Low (4)	Mod.	Low	Low (8)
Acacia wardellii	V	V	High	Low	Mod. (12)	Completely	Unknown	High	Extrem. Low	Low(7)	High	Low	Mod (12)
Apatophyllum teretifolium	Not listed	V	Mod.	Mod.	Mod. (13)	Completely	Unknown	Mod.	Extrem. Low	Low (4)	Mod.	Low	Low (8)
Aristida forsteri	Not listed	NT	Extremely High	Extremely High	Extremely High (25)	Completely	Unknown	Extrem. High	Extrem. Low	Mod(11)	Extrem. High	High	Extrem. High (23)
Bothriochloa biloba	V	Not listed	Mod.	High	Mod. (18)	Completely	Unknown	Mod.	Extrem. Low	Low (4)	Mod.	Mod.	Mod. (13)
Cadellia pentastylis	V	V	High	Mod.	Mod. (17)	Completely	Unknown - untested	High	Extrem. Low	Low (7)	High	Mod.	Mod. (17)

Species	EBPC	NCA	Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
								Avoidance			Others		
			Sensitivity	Impact Magnitude	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Callitris baileyi	Not listed	NT	High	Mod.	Mod. (17)	Completely	Unknown	High	Extrem. Low	Low (7)	High	Mod	Mod. (17)
Calotis glabrescens	Not listed	NT	Mod.	Low	Low (8)	Completely	Unknown	Mod.	Extrem. Low	Low(4)	Mod.	Low	Low (5)
Calytrix gurulmundensis	V	V	Extremely High	High	Extremely High (23)	Completely	Unknown	Extremely High	Extrem. Low	Mod(11)	Extremely High	Mod.	High (20)
Cryptandra ciliata	Not listed	NT	Mod.	Mod.	Mod.(13)	Completely	Unknown	Mod.	Extrem.Low	Low (4)	Mod.	Low	Low (8)
Cyperus clarus	Not listed	V	High	Mod.	Mod. (17)	Completely	Unknown	High	Low	Mod(12)	High	Low	Mod (12)
Denhamia parviflora	V	V	High	Mod.	Mod. (17)	Completely	Requires further testing	High	Extrem.Low	Low(7)	High	Low	Mod (12)
Dichanthium queenslandicum	V	V	High	Low	Mod. (12)	Completely	Requires further Testing	High	Extrem. Low	Low(7)	High	Low	Mod (12)
Digitaria porrecta	E	NT	Mod.	Mod.	Mod. (13)	Completely	Unknown	Mod.	Extrem. Low	Low(4)	Mod.	Low	Low (8)
Eleocharis blakeana	Not Listed	NT	Mod.	Mod.	Mod.(13)	Completely	Effective	Mod.	Extrem. Low	Low(4)	Mod.	Low	Low (8)

Species	EBPC	NCA	Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
								Avoidance			Others		
			Sensitivity	Impact Magnitude	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Eucalyptus curtisii	Not Listed	NT	Mod.	Mod.	Mod. (13)	Completely	Mostly Effective	Mod.	Extrem.Low	Low(4)	Mod.	Low	Low (8)
Fimbristylis vagans	Not Listed	NT	Mod.	High	Mod. (18)	Totally Effective	Mostly Effective	Mod.	Extrem. Low	Low(4)	Mod.	Low	Low (8)
Gonocarpus urceolatus	Not Listed	V	Mod.	High	Mod. (18)	Completely	Unknown	Mod.	Extrem. Low	Low(4)	Mod.	Mod.	Mod. (13)
Homopholis belsonii	V	E	High	High	High (21)	Completely	Unknown/ Untested	High	Extrem.Low	Low(7)	High	Low	Mod(12)
Macrozamia machinii	V	V	Extrem. High	Extrem. High	Extrem. High (25)	Completely	Unknown - Unviable	Extrem. High	Extrem. Low	Mod(11)	Extrem. High	Extrem.High	Extrem.High (25)
Microcarpaea agonis	E	E	Extrem. High	High	Extrem. High (23)	Completely	Unknown	Extrem. High	Extrem.Low	Mod(11)	Extrem. High	Mod.	High. (20)
Micromyrtus carinata	Not Listed	E	High	Extrem. High	Extrem. High (24)	Completely	Unknown - Untested	High	Extrem. Low	Low(7)	High	High	High (21)
Philotheca sporadica	V	V	Extrem. High	Extrem. High	Extrem. High (25)	Completely	Effective	Extrem. High	Extrem. Low	Mod(11)	Extrem. High	Low	Mod(16)
Picris barbarorum	Not Listed	V	High	Moderate	Mod. (17)	Completely	Mostly Effective	High	Extrem. Low	Low(7)	High	Low	Mod (12)

Species	EBPC	NCA	Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
								Avoidance			Others		
			Sensitivity	Impact Magnitude	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Picris evae	V	V	High	Mod.	Mod. (17)	Completely	Effective	High	Extrem. Low	Low(7)	High	Low	Low (5)
Pomaderris coomingalensis	E	Not listed	High	Extrem. High	Extrem. High (24)	Completely	Unknown - Untested	High	Extrem. Low	Low(7)	High	High	High (21)
Prostanthera sp. (Dunmore D.M.Gordon 8A)	V	V	High	Extrem. High	Extrem. High (24)	Completely	Unknown - Untested	High	Extrem. Low	Low(7)	High	High	High (21)
Pterostylis cobarensis	V	Not listed	Mod.	Mod.	Mod.(13)	Completely	Effective	Mod.	Extrem.Low	Low(4)	Mod.	Low	Low (8)
Ptilotis extenuatus	Not listed	NT	High	Mod.	Mod. (17)	Not Feasible	Effective	High	Low	Mod (12)	High	Low	Mod(12)
Rhaponticum australe	V	V	High	Mod.	Mod. (17)	Completely	Effective	High	Extrem. Low	Low (7)	High	Low	Mod(12)
Rutidosus lanata	Not listed	E	High	Mod.	Mod.(17)	Completely	Unknown - untested	High	Extrem.Low	Low (7)	High	Low	Mod(12)
Solanum papaverifolium	Not listed	E	Mod.	Mod.	Mod. (13)	Completely	Unknown	Mod.	Extrem.Low	Low (4)	Mod.	Mod.	Mod(13)
Solanum stenopterum	Not listed	V	High	Extrem. High	Extrem. High (24)	Completely	Unknown - Untested	High	Extrem. Low	Low (7)	High	Mod.	Mod(17)

Species	EBPC	NCA	Unmitigated Impact Assessment			Effectiveness of Mitigation Measures[1]		Residual Impact Assessment					
								Avoidance			Others		
			Sensitivity	Impact Magnitude	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Thesium australe	V	V	High	Mod.	Mod. (17)	Completely	Unknown - Untested	High	Extrem.Low	Low(7)	High	Low	Mod(12)
Xerothamnella herbacea	V	E	Extrem, High	High	Extrem. High (23)	Completely	Unknown - Untested	Extrem, High	Extrem. Low	Mod(11)	Extrem, High	Mod.	High(20)

1. Mitigation measures where the effectiveness is considered 'unknown – untested' may include mitigation measures which may partially mitigate against and impact.
2. No clearing of vegetation within areas of core habitat known or core habitat possible and assumes surveys were carried out in optimal seasonal conditions i.e. flowering period.
3. Clearing of core habitat known and possible is unavoidable.

E = Endangered.
V = Vulnerable.
NT = Near Threatened.

8.1.4 Significant Fauna Species Residual Impact Assessment

Consideration of EVNT species detailed in **Table 37** highlights three broad groups:

1) Those that are highly sensitive to disturbance regimes. Avoiding clearing within core or known habitat for these species is the most successful mitigation measure, with other measures only mildly reducing risks;
2) Species that are moderately sensitive to disturbance, which are best protected by avoiding disturbance within core habitat, but may be managed with moderate success by mitigation measures; and
3) Those species that seem relatively robust to disturbance regimes. While mitigation measures may reduce impacts on these species, there is little overall change between unmitigated impact and residual impacts. In some cases (e.g. spotted-tailed quoll) this may be due to the highly unlikely occurrence of the species within the EIS area, or because those areas of high importance (e.g. Lake Broadwater) to the species has existing exclusion and protection measures (e.g. cotton pygmy-goose, Australian painted snipe etc). Such species need less stringent mitigation.

Accordingly, it is possible to pool species according to the above groups as follows:

- Species resilient to disturbance within the EIS area: *Cyclorana verrucosa*, golden-tailed gecko, grey goshawk, Australian painted snipe, black-necked stork, square-tailed kite, cotton pygmy-goose, freckled duck, black-chinned honeyeater, spotted-tailed quoll and little pied bat.
- Moderately sensitive species: brigalow scaly-foot, yakka skink, common death adder, Dunmall's Snake, grey snake, glossy black-cockatoo, squatter pigeon, turquoise parrot, *N. timoriensis* (sensu lato), and
- Highly sensitive species: *Hypochrysops piceatus, Jalmenus eubulus,* Collared Delma, *Anomalopus mackayi*, *Tympanocryptis cf. tetraporophora*, painted honeyeater, regent honeyeater.

Using these groups, it is possible to undertake a risk evaluation for each project related activity, there by perscribing appropriate mitigation measures according to the type of species and habitat (e.g. 'core habitat known'; 'core habitat likely'; 'absence likely' etc). (i.e., see **Figures 21, 22** and **23**). Species that are particularly susceptible or resilient to impact may have an individual impact significance that varies significantly from the combined EVNT flora species assessment. One species in particular, the bulloak jewel butterfly is highly sensitive and its habitats around Bendidee National Park and State Forest must be avoided if impacts are to be appropriately mitigated.

Impacts to significant fauna species have been individually assessed and are outlined in **Table 38** below. The impact significance assessment considers impacts to core habitat for sensitive species only except where species are habitat generalists. The Table includes a residual impact assessment, which provides some indication of the remaining impact following mitigation measures. Without infrastructure locations, this impact assessment is somewhat subjective. Future assessment may be required throughout the project as plans become available.

Table 37. Residual impact assessment for activities within core habitat known and core habitat possible for EVNT fauna species.

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Exploration and Appraisal Well Drilling								
Exploration Well Drilling	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** +	Resilient Species ***Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***High***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***High* (21)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Ensure earthworks do not hinder existing flow regimes. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Rehabilitation by replacing disturbed timber, rocks and logs over cleared ground. • Initiate pest management plan strategies. *Moderately Sensitive Species* All above measures plus: • Rehabilitation includes reseeding or establishing native flora species consistent with surrounding vegetation. *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insig (2)*** Moderately Sensitive Species ***Low (4)*** Highly Sensitive Species ***Low* (7)**	Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***High***	Resilient Species ***Insig (2)*** Moderate Sensitive Species ***Low (8)*** Highly Sensitive Species ***High* (21)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				the likelihood of the species being present. If absent, impacts will be negligible. If present, sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Seismic Data Collection	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Mod***	Resilient Species ***insig** (2)* Moderately Sensitive Species ***Low** (8)* Highly Sensitive Species ***Mod*** **(17)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing seismic line widths. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Ensure earthworks do not hinder existing flow regimes. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Avoid moving fallen timber (where possible) and/or undertake remedial rehabilitation by replacing disturbed timber, rocks and logs over cleared ground. • Initiate pest management plan strategies. *Moderately Sensitive Species*	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insig (2)*** Moderately Sensitive Species ***Low (4)*** Highly Sensitive Species ***Low*** **(7)**	Resilient Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Mod***	Resilient Species ***insig (2)*** Moderate Sensitive Species ***Low** (8)* Highly Sensitive Species ***Mod*** **(17)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				All above measures plus: • Remedial rehabilitation includes reseeding or establishing native flora species consistent with surrounding vegetation. *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Production Well Design and Installation								
Site Preparation	<u>Resilient Species</u> ***Low*** <u>Moderately Sensitive Species</u> ***Moderate*** <u>Highly Sensitive Species</u> ***High***	<u>Resilient Species</u> ***Low*** <u>Moderately Sensitive Species</u> ***Low*** <u>Highly Sensitive Species</u> ***High***	<u>Resilient Species</u> ***Low*** *(5)* <u>Moderately Sensitive Species</u> ***Low*** *(8)* <u>Highly Sensitive Species</u> ***High*** **(21)**	<u>Avoidance</u> • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). <u>Other Management Options</u> *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous	<u>Resilient Species</u> ***Ext low*** <u>Moderately Sensitive Species</u> ***Ext low*** <u>Highly Sensitive Species</u> ***Ext low***	<u>Resilient Species</u> ***Insig (2)*** <u>Moderately Sensitive Species</u> ***Low (4)*** <u>Highly Sensitive Species</u> ***Low*** **(7)**	<u>Resilient Species</u> ***Ext low*** <u>Moderate Sensitive Species</u> ***Low*** <u>Highly Sensitive Species</u> ***High***	<u>Resilient Species</u> ***Insig (2)*** <u>Moderate Sensitive Species</u> ***Low (8)*** <u>Highly Sensitive Species</u> ***High*** **(21)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				substance in the event of equipment failure. • Replace disturbed timber, rocks and logs over cleared/disturbed ground not required for operation. • Initiate pest management plan strategies. *Moderately Sensitive Species* All above measures plus: • Rehabilitation during both operation and decommission stages (see below). *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Well Site Drilling	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** *+*	Resilient Species ***Ext Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low****+*	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod****+* **(12)**	• Ensure weed hygiene protocols are maintained including machinery/equipment washdown procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Initiate pest management plan strategies.			Resilient Species ***Insig*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext Low***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**

Activity	**Unmitigated Impact Assessment**			**Mitigation Measures**	**Residual Impact Assessment**			
					Total Avoidance		**Other Management Options**	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Well Completion	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** +	Resilient Species ***Ext Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low***+	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod***+ **(12)**	• Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Avoid gathering/storing excess subterranean water in small open ponds adjacent each well. Where not avoidable, undertaken fauna exclusion actions as described in **Section 7.8.2.** • Partial rehabilitation by respreading cleared debris (rocks, logs, trees) and seeding with small shrubs/grasses over areas not required for operation. • Commence pest monitoring as outlined in the Pest Management Plan			Resilient Species ***Insig*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext Low***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**
Gathering Infrastructure Design and Installation								
Gathering line installation and management	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***High***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***High*** **(21)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment washdown procedures, • Ensure earthworks do not hinder existing flow regimes. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.	Resilient Species ***Low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	Resilient Species ***Ext Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Mod***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(17)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance

				• Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.
				• Replace disturbed timber, rocks and logs over cleared ground not required for operation.
				• Trench management including:
				  • Reduce duration and extent of open trenches.
				  • Daily checks of trenches to release trapped animals.
				  • Creation of exit ramps along the open trench.
				• Initiate pest management plan strategies.
				Moderately Sensitive Species
				All measures for resilient species plus:
				• Organise gathering lines in a formation that minimises habitat dissection.
				• Rehabilitation during both operation and decommission stages (see below).
				Highly Sensitive Species
				All measures for moderately sensitive and resilient species plus:
				• Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species.
				• Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				

Electricity Grid (Overhead) Design and Installation								
Electricity Grid Installation and	<u>Resilient Species</u>	<u>Resilient Species</u>	<u>Resilient Species</u>	As for Gathering Line Installation and Maintenance.	<u>Resilient</u>		<u>Resilient</u>	<u>Resilient</u>

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
management	***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	***Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***High***	***Low*** *(5)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***High*** **(21)**		Species ***Low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	Species ***Ext Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Mod***	Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(17)**
Integrated Production Facility Design and Installation								
Gas Compression and Processing Facility Design and Installation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***Ext high***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Mod*** *(13)* Highly Sensitive Species ***Ext high*** **(24)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Replace disturbed timber, rocks and logs over cleared ground not required for operation.	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insig*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species ***Ext high***	Resilient Species ***Low*** *(5)* Moderate Sensitive Species ***Mod*** *(13)* Highly Sensitive Species ***Ext high*** **(24)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• Initiate pest management plan strategies. *Moderately Sensitive Species* All measures for resilient species plus: • Rehabilitation during both operation and decommission stages (see below). *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Electricity Generation Design and Installation.	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***low*** Moderately Sensitive Species ***Mod*** Highly Sensitive Species ***High***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Mod*** *(13)* Highly Sensitive Species ***High*** **(21)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insig*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	Resilient Species ***Low*** Moderately Sensitive Species ***Mod +*** Highly Sensitive Species ***Ext High***	Resilient Species ***Low*** *(5)* Moderate Sensitive Species ***Mod+*** *(13)* Highly Sensitive Species ***Ext High (24)***

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				substance in the event of equipment failure. • Replace disturbed timber, rocks and logs over cleared ground not required for operation. • Initiate pest management plan strategies. *Moderately Sensitive Species* All measures for resilient species plus: • Rehabilitation during both operation and decommission stages (see below). *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Water Storage Treatment Facility Design and Installation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***low*** Moderately Sensitive Species ***High*** Highly Sensitive Species ***Ext High***	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Mod*** *(18)* Highly Sensitive Species ***Ext High* (24)**	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insig*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**	Resilient Species ***Low*** Moderately Sensitive Species ***Mod +*** Highly Sensitive Species ***Ext High***	Resilient Species ***Low*** *(5)* Moderate Sensitive Species ***Mod+*** *(13)* Highly Sensitive Species ***Ext High (24)***

Activity	Unmitigated Impact Assessment – Sensitivity	Unmitigated Impact Assessment – Magnitude	Unmitigated Impact Assessment – Significance	Mitigation Measures	Residual Impact Assessment – Total Avoidance – Magnitude	Residual Impact Assessment – Total Avoidance – Significance	Residual Impact Assessment – Other Management Options – Magnitude	Residual Impact Assessment – Other Management Options – Significance
				are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Positioning facility away from major waterways or catchment areas. • Replace disturbed timber, rocks and logs over cleared ground not required for operation. • Construct fauna exclusion fencing as described in **Section 7.8.2.** • Initiate pest management plan strategies. *Moderately Sensitive Species* All measures for resilient species plus: • Rehabilitation during both operation and decommission stages (see below). *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Sewerage Treatment Plant Design and Installation	Resilient Species ***Low*** Moderate Sensitive	Resilient Species ***low*** Moderately Sensitive	Resilient Species ***Low*** *(5)* Moderately Sensitive	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species).	Resilient Species ***Ext low*** Moderately	Resilient Species ***Insig*** *(2)* Moderately	Resilient Species ***low*** Moderately	Resilient Species ***low*** *(5)* Moderate

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
	Species ***Moderate*** Highly Sensitive Species ***High***	Species ***Mod*** Highly Sensitive Species ***High***	Species ***Mod*** *(13)* Highly Sensitive Species ***High* (21)**	Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery / equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Positioning facility away from major waterways or catchment areas. • Replace disturbed timber, rocks and logs over cleared ground not required for operation. • Construct fauna exclusion fencing around all permanent water bodies as described in **Section 7.8.2.** • Initiate pest management plan strategies. *Moderately Sensitive Species* All measures for resilient species plus: • Rehabilitation during both operation and decommission stages (see below). *Highly Sensitive Species* All measures for moderately sensitive and resilient species plus: • Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species.	Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**	Sensitive Species ***Low+*** Highly Sensitive Species ***High***	Sensitive Species ***Low+*** *(8)* Highly Sensitive Species ***High* (21)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core habitats.				
Operation and Maintenance								
Well Site Operation and Maintenance	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**	• Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Avoid gathering/storing excess subterranean water in small open ponds adjacent each well. • Partial remedial rehabilitation to reduce impacts from edge effects. Partial rehabilitation should include respreading debris (rocks, logs, trees) and reseeding with native species typical of surrounding vegetation in locations not required for ongoing operation. • Regularly inspect fauna exclusion devices to ensure functionality and integrity. • Continue pest management control and monitoring	NA		Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**
Gathering Infrastructure Operation and Maintenance	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species	• Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Avoid gathering/storing excess subterranean water in small open ponds adjacent each well. • Partial remedial rehabilitation to reduce impacts from edge effects and improve fauna movement. Partial rehabilitation	NA		Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
	High	***Ext low***	***Low*** **(7)**	should include respreading debris (rocks, logs, trees) and reseeding with native species typical of surrounding vegetation in locations not required for ongoing operation. Where deep- rooted species may adversely affect infrastructure, small shrubs and grasses should be used. • Continue pest management control and monitoring			Species ***Ext low***	Species ***Low*** **(7)**
	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	As for Gathering Infrastructur Operation and Maintenance.	NA		Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low +***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**
Electricity Generation Site Operation and Maintenance	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**	• Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Partial rehabilitation to reduce impacts from edge effects. Partial rehabilitation should include respreading debris (rocks, logs, trees) and reseeding with native species typical of surrounding vegetation in locations not required for ongoing operation. • Ensure all domestic wastes, including putrescible wastes are appropriately disposed in skips or bins that cannot be accessed by animals. Regular removal of	NA		Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				wastes to existing council infrastructure should occur to ensure sufficient storage is always available. • Continue pest management control and monitoring			***Ext low +***	***Low* (7)**
Central Gas Processing Facility Design and Operation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High***	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**	• Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Partial rehabilitation to reduce impacts from edge effects. Partial rehabilitation should include respreading debris (rocks, logs, trees) and reseeding with native species typical of surrounding vegetation in locations not required for ongoing operation. • Ensure all domestic wastes, including putrescible wastes are appropriately disposed in skips or bins that cannot be accessed by animals. Regular removal of wastes to existing council infrastructure should occur to ensure sufficient storage is always available. • Continue pest management control and monitoring			Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive Species ***Ext low***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low* (7)**
Export of Gas from Field to Downstream Use								
Clearing of ROW, trenching and access for construction equipment.	Resilient Species ***Low*** Moderately Sensitive Species ***Moderate*** Highly Sensitive Species	Resilient Species ***Low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species	Resilient Species ***Low*** *(5)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species	Avoidance • Avoid activities within areas mapped as Core habitat known or Core habitat possible for EVNT fauna species (including maintenance of management buffers for highly sensitive species). Other Management Options *Resilient Species* • Minimise impact footprint by reducing clearing zones. • Ensure weed hygiene protocols are maintained including machinery/equipment	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext low*** Highly Sensitive	Resilient Species ***Insig*** *(2)* Moderately Sensitive Species ***Low*** *(4)* Highly Sensitive	Resilient Species ***Ext Low*** Moderately Sensitive Species ***Low*** Highly Sensitive	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(8)* Highly Sensitive

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		**Other Management Options**	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance

	High	***High***	***High* (21)**	wash-down procedures,
				• Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas.
				• Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure.
				• Replace disturbed timber, rocks and logs over cleared ground not required for operation.
				• Trench management including:
				  • Reduce duration and extent of open trenches.
				  • Daily checks of trenches to release trapped animals.
				  • Creation of exit ramps along the open trench.
				• Initiate pest management protocols
				Moderately Sensitive Species
				All measures for resilient species plus:
				• Organise gathering lines in a formation that minimises habitat dissection.
				• Rehabilitation during both operation and decommission stages (see below).
				Highly Sensitive Species
				All measures for moderately sensitive and resilient species plus:
				• Undertake pre-clearing surveys to determine the likelihood of the species being present. If absent, then impacts will be negligible. If present, then sufficient survey should be completed to allow adequate impact assessment. Survey effort will vary between species.
				• Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted core
					Species
					Ext low
						Species
						***Low* (7)**
							Species
							Mod
								Species
								***Mod* (17)**

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				habitats.				
Decommission and Rehabilitation								
Well Site Decommission and Rehabilitation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** +	Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low+***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(12)**	• Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Rehabilitated cleared areas to compensate long-term habitat loss. Rehabilitation should including ripping and the use of debris and seeding with native shrub and canopy species typical of surrounding vegetation. • Where required, supplementary seeding with canopy species in areas rehabilitated during commission. • Weed suppression activities undertaken to ensure any established weed species are disadvantaged and less likely to overrun native vegetation. • Remove any water storage ponds associated with the well and rehabilitate according to long-term rehabilitation goals.	*Not Applicable*	*Not Applicable*	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext low+***	Resilient Species ***Insig*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**
Gathering Infrastructure Decommission and Rehabilitation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** +	Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low+***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(12)**	• Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Rehabilitated cleared areas to compensate long-term habitat loss. Rehabilitation should including ripping and the use of debris and seeding with native shrub and canopy species typical of surrounding vegetation. • Where required, supplementary seeding with canopy species in areas rehabilitated during commission. • Weed suppression activities undertaken to ensure any established weed species are disadvantaged and less likely to overrun native vegetation.	*Not Applicable*	*Not Applicable*	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext low+***	Resilient Species ***Insig*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**
Electricity Grid	Resilient	Resilient	Resilient	As for Gathering Line Decommission and	*Not Applicable*	*Not Applicable*		

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Assessment			
					Total Avoidance		Other Management Options	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Decommission and Rehabilitation	Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** *+*	Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low+***	Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(12)**	Rehabilitation			Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext low+***	Resilient Species ***Insig*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**
Integrated Processing Facility Decommission and Rehabilitation	Resilient Species ***Low*** Moderate Sensitive Species ***Moderate*** Highly Sensitive Species ***High*** *+*	Resilient Species ***Ext low*** Moderately Sensitive Species ***Low*** Highly Sensitive Species ***Low+***	Resilient Species ***Insign*** *(2)* Moderately Sensitive Species ***Low*** *(8)* Highly Sensitive Species ***Mod*** **(12)**	• Ensure weed hygiene protocols are maintained including machinery/equipment wash-down procedures, • Rehabilitated cleared areas to compensate long-term habitat loss. Rehabilitation should including ripping and the use of debris and seeding with native shrub and canopy species typical of surrounding vegetation. • Where required, supplementary seeding with canopy species in areas rehabilitated during commission. • Weed suppression activities undertaken to ensure any established weed species are disadvantaged and less likely to overrun native vegetation.	*Not Applicable*	*Not Applicable*	Resilient Species ***Ext low*** Moderately Sensitive Species ***Ext Low*** Highly Sensitive Species ***Ext low+***	Resilient Species ***Insign*** *(2)* Moderate Sensitive Species ***Low*** *(4)* Highly Sensitive Species ***Low*** **(7)**

Table 38. Residual impact assessment for individual EVNT fauna species.

Scientific Name **Common Name**	**Status**		**Preliminary Impact Assessment**			**Effectiveness of Mitigation Measures.**[1]		**Residual Impact Assessment**					
								Avoidance			**Others**		
	NCA	**EPBC**	Sensitivity.	Magnitude.	Significance	**Avoidance**[2]	**Others**[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Hypochrysops piceatus bulloak jewel butterfly	E	Not Listed	Ext High	High	Ext High (23)	Completely	Ineffective	Ext. High	Low	Mod (11)	Ext high	High	Ext high (23)
Jalmenus eubulus pale imperial hairsteak	V	Not Listed	High	High	High (21)	Completely	Unknown/ Untested	High	Ext low	Low (7)	Ext.high	Mid	Mod (17)
Cyclorana verrucosa rough collared frog	NT	Not Listed	Mod	Low	Low (9)	Completely	Unknown/ Untested	Mod	Low	Low (9)	Mod	Ext.low	Low (4)
Strophurus taenicauda golden-tailed gecko	NT	Not Listed	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Delma torquata Ccllared delma	V	V	Ext.high	Ext.high	Ext.high (25)	Completely	Ineffective	Ext.high	Ext.low	Mod (11)	Ext.high	High	Ext.high (23)
Paradelma orientalis brigalow scaly-foot	V	V	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Anomalopus mackayi five-clawed worm-skink	E	V	Ext.high	Ext.high	Ext.high (25)	Completely	Ineffective	Ext.high	Ext.low	Mod (11)	Ext.high	High	Ext.high (23)
Egernia rugosa yakka skink	V	V	Mod	High	Mod (18)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (9)

Scientific Name **Common Name**	**Status**		**Preliminary Impact Assessment**			**Effectiveness of Mitigation Measures.**[1]		**Residual Impact Assessment**					
								Avoidance			**Others**		
	NCA	**EPBC**	Sensitivity.	Magnitude.	Significance	**Avoidance**[2]	**Others**[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Tympanocryptis cf. tetraporophora grassland earless dragon	E	E	High	High	High (21)	Completely	Ineffective	High	Ext.low	Low (7)	High	Mod	Mod (18)
Acanthophis antarcticus common death adder	NT	Not Listed	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Mod	Mod (13)
Furina dunmalli Dunmall's snake	V	V	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Hemiaspis damelii grey snake	E	Not Listed	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Accipiter novaehollandiae grey goshawk	NT	Not Listed	Mod	Ext.low	Low (4)	Mostly Effective	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	N/A	N/A
Rostratula australis Australian painted snipe	V	V	Mod	Mod	Mod (13)	Mostly	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Mod	Mod (13)
Calyptorhynchus lathami glossy black-cockatoo	V	Not Listed	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Ephippiorhynchus asiaticus black-necked stork	NT	Not Listed	Mod	Low	Low (8)	Mostly	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)

Scientific Name Common Name	Status		Preliminary Impact Assessment			Effectiveness of Mitigation Measures.[1]		Residual Impact Assessment					
								Avoidance			Others		
	NCA	EPBC	Sensitivity.	Magnitude.	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Geophaps scripta scripta squatter pigeon	V	V	Mod	Low	Low (8)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Grantiella picta painted honeyeater	NT	Not Listed	Mod	High	Mod (18)	Mostly	Ineffective	Mod	Ext.low	Ext.low (4)	Mod	High	Mod (18)
Lophoictinia isura square-tailed kite	NT	Not Listed	Mod	Low	Low (8)	Completely	Ineffective	Mod	Ext.low	Ext.low (4)	Mod	Low	Low (8)
Melithreptus gularis black-chinned honeyeater	NT	Not Listed	Mod	Low	Low (8)	Completely	Ineffective	Mod	Ext.low	Ext.low (4)	Mod	Low	Low (8)
Neophema pulchella turquoise parrot	NT	Not Listed	Mod	Low	Low (8)	Completely	Unknown/ Untested	Mod	Ext.low	Ext.low (4)	Mod	Low	Low (8)
Nettapus coromandelianus cotton pygmy-goose	NT	Not Listed	Mod	Low	Low (8)	Mostly	Unknown/ Untested	Mod	Ext.low	Ext.low (4)	Mod	Low	Low (8)
Anthochaera phrygia regent honeyeater	E	E	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.Low	Low (4)	Mod	Mod	Mod (13)
Stictonetta naevosa freckled duck	NT	Not Listed	Mod	Low	Low (8)	Mostly	Ineffective	Mod	Ext.low	Ext.low (4)	Mod	Low	Low (8)

Scientific Name Common Name	Status		Preliminary Impact Assessment			Effectiveness of Mitigation Measures.[1]		Residual Impact Assessment					
								Avoidance			Others		
	NCA	EPBC	Sensitivity.	Magnitude.	Significance	Avoidance[2]	Others[3]	Sensitivity	Magnitude	Significance	Sensitivity	Magnitude	Significance
Dasyurus maculatus maculatus spotted-tailed quoll	E	V	Mod	High	Mod (18)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)
Chalinolobus picatus little pied bat	NT	Not Listed	Mod	Low	Low (8)	Completely	Mostly Effective	Mod	Ext.low	Low (4)	Mod	Low	Low (4)
Nyctophilus corbeni south-eastern long-eared bat	V	V	Mod	Mod	Mod (13)	Completely	Unknown/ Untested	Mod	Ext.low	Low (4)	Mod	Low	Low (8)

8.1.5 Summary Residual Impact Significance Assessment

A summary of the residual impact that broad project activity groupings pose to ecological values is provided in **Table 39** to **Table 42** below. Residual impact scores provide a derived average of the assessed impact that sub-activities within the seven broader activity groupings pose to ecological values. It should be recognised that considerable variation in the level of residual impact may apply to sub-activities within these activity groupings, and also to specific components contained within grouped ecological values. An assessment of the residual impact posed to individual values is contained within the report body, allowing identification of those values which are particularly susceptible to project development activities and require active management or attention throughout all phases of project development to decommission.

Table 39. Residual impact significance posed by project development activities to significant ecological communities and regional ecosystems.

Activity	**Unmitigated Impacts**	**Residual Impact Significance Through Avoidance**	**Residual Impact Significance Through Other Management Actions**
Exploration and Appraisal Well Drilling	Low (5) to Extremely High (25)	Insignificant (2) to Moderate (11)	Low (4) to High (20)
Production Well Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11	Low (5) to High (20)
Gathering Infrastructure Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Electricity Grid (Overhead) Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Integrated Production Facility Design and Installation	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Operation and Maintenance	Low (5) to High (20)	Insignificant (2) to Moderate (11)	Insignificant (2) to Moderate (16).
Export of Gas from Field to Downstream Use	Low (5) to Extremely High (23)	Insignificant (2) to Moderate (11)	Low (5) to High (20)
Decommission and Rehabilitation	Low (5) to High (20)	Insignificant (2) to Moderate (11)	Insignificant (2) to Moderate (16).

Table 40. Residual impact significance posed by project development activities to Ecologically Sensitive Areas

Activity	**Preliminary Impact**	**Residual Impact Significance Through Avoidance**	**Residual Impact Significance Through Other Management Actions**
Exploration and Appraisal Well Drilling	Moderate to (13) to Extremely High (25)	Low (4) to Moderate (11)	Moderate (12) to Extremely High (23)
Production Well Design and Installation	Low (4) to Extremely High (25)	Low (4) to Moderate (11)	Low (4) to High (20)
Gathering Infrastructure Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Electricity Grid (Overhead) Design and Installation	Low (5) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23
Integrated Production Facility Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Operation and Maintenance	Low (8) to High (20)	Low (4) to Moderate (11)	Low (4) to Moderate (16)
Export of Gas from Field to Downstream Use	Moderate (13) to Extremely High (25)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Decommission and Rehabilitation	Low (8) to High (20)	Low (4) to Moderate (11)	Low (4) to Moderate (16)

Table 41. Residual impact significance posed by project development activities to significant flora species.

Activity	**Preliminary Impact**	**Residual Impact Significance Through Avoidance**	**Residual Impact Significance Through Other Management Actions**
Exploration and Appraisal Well Drilling	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Production Well Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Gathering Infrastructure Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Electricity Grid (Overhead) Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)

Activity	Preliminary Impact	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Integrated Production Facility Design and Installation	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Operation and Maintenance	Low (8) to High (20)	Not Applicable	Insignificant (2) to Moderate (16)
Export of Gas from Field to Downstream Use	Low (8) to Extremely High (25)	Low (4) to Moderate (16)	Low (8) to Extremely High (25)
Decommission and Rehabilitation	Low (8) to High (20)	Not Applicable	Insignificant (2) to Moderate (16)

Table 42. Residual impact significance posed by project development activities to significant fauna species.

Activity	Preliminary Impact	Residual Impact Significance Through Avoidance	Residual Impact Significance Through Other Management Actions
Exploration and Appraisal Well Drilling	Low (5) to High (21)	Insignificant (2) to Low (7)	Insignificant (2) to High (21)
Production Well Design and Installation	Insignificant (2) to Moderate (17)	Insignificant (2) to Low (7)	Insignificant (2) to Moderate (17)
Gathering Infrastructure Design and Installation	Low (5) to High (21)	Low (5) to Low (7)	Insignificant (2) to Moderate (17)
Electricity Grid (Overhead) Design and Installation	Moderate (13) to Extremely High (23)	Low (4) to Moderate (11)	Low (8) to Extremely High (23)
Integrated Production Facility Design and Installation	Low (5) to Extremely High (24)	Low (5) to Low (7)	Insignificant (2) to Extremely High (24)
Operation and Maintenance	Insignificant (2) to Low (7)	Not Applicable	Insignificant (2) to Low (7)
Export of Gas from Field to Downstream Use	Low (5) to High (7)	Insignificant (2) to Low (7)	Insignificant (2) to Moderate (17)
Decommission and Rehabilitation	Insignificant (2) to Moderate (12)	Not Applicable	Insignificant (2) to Low (7)

9. Monitoring and Ongoing Actions

Following the assessment of residual impact (refer to **Section 8.1**) a monitoring program should be implemented to test the effectiveness of mitigation. A monitoring program must include details of management actions, a set of performance criteria, and reporting to document the outcomes of each management action.

Monitoring will be required to ensure compliance with performance criteria as might be necessary to ensure compliance with statutory requirements. Methods must be developed to monitor impacts on threatened species and communities and determine the effectiveness of mitigation measures such as the habitat rehabilitation. Priority for monitoring should be given to the highest risk species in the area of (or in the vicinity of) immediate impact.

Requirements for monitoring will undoubtedly change as infrastructure and exploration planning mature through the life of the project and it is a likely requirement that monitoring be sustained beyond the project's operational phases. A logical scientific framework is required to account for the variability in natural ecosystems with 'Beyond BACI' design (Underwood 1992), a commonly accepted method, relating to the use of multiple control sites. A monitoring program as such should be complemented with more subjective assessments including established photographic points.

The constraints mapping and analysis developed for this assessment relies heavily on a vegetation based GIS package. The accuracy of this package, and hence analysis, is dependant on background data availability and accuracy. Ongoing data collection, particularly of EVNT species identified during pre-clearing surveys, during trench checking or in other project related activities, should be ongoing and used to refine areas of core habitat known and core habitat possible.

Where potential impacts are realised, monitoring programs should focus on those sensitive ecological values at risk of a high to extremely high level of residual impact significance as discussed in **Section 8**, or at high risk of significant cumulative impacts as identified in following sections (**Section 10**). Habitats or ecological values that are particularly vulnerable to disturbance warrant monitoring to ensure rehabilitation is effective and responsive to changing conditions. These include:

- The critically endangered 'Natural Grassland' ecological community. Baseline ecological information has been collected for this habitat and ongoing monitoring on a seasonal / bi-annual basis to detect changes in habitat condition or accelerated invasion of exotic species is warranted.
- Populations of endangered or vulnerable plant species including *Philotheca sporadica, Xerothamnella herbacea, Pomaderris coomingalensis, Microcarpaea agonis, Aristida*

forsteri, Micromyrtus carinata, Calytrix gurulmundensis, Acacia curranii, Solanum papaverifolium have limited baseline information concerning the size and robustness of populations within the project area. Baseline information should be collected for target species and monitored on an annual basis to measure changes in population size, size classes, recruitment and impacts of exotic pest invasion or disease.

- Habitats within environmentally sensitive areas including Bendidee National Park and Lake Broadwater Conservation Reserve should also have permanent monitoring sites placed within to measure the health of habitats and impacts of exotic species on a seasonal basis.

Fauna population are notoriously difficult to monitor. The difficulties in replication of seasonal conditions and the natural transience of some species means fauna monitoring generally takes an effort over many seasons before trends can be detected. The results of monitoring also need to be linked into a much broader regional base than a single set of monitoring plots at any one location. Hence those species at risk of high to extremely high levels of cumulative impact, identified and further discussed in **Section 10**, may be particularly suited to targeted monitoring effort conducted in co-operation with the proponents of impacting projects. Such species include *Anomalopus mackayi* (five clawed worm skink), *Tympanocryptis cf. tetraporpophora* (grassland earless dragon), *Delma torquata* (collared delma) and *Hypochrysops piceatus* (bulloak jewel), the latter having core habitat focused on the Bendidee National Park and State Forest area.

It should also be noted that commitments to monitoring project impacts to sensitive flora and fauna species and sensitive habitats should be extended throughout and beyond project decommissioning phases. The process of landscape recovery may be ongoing well beyond the life of the project and the risk of impact from disease, exotic species or changes to the population dynamics of threatened species will continue until the process of landscape stabilisation is complete.

10. Cumulative Impacts

Cumulative impacts refer to the accumulation of human induced changes in valued environmental components across space and over time; such impacts can occur in an additive or interactive manner (Spaling, 1997). This study focused on impacts at a project level although consideration in the context of the broader utilisation of land resources in the regional area, and the inter-relationship of previous, present and potential future projects, is required to appreciate the scale of impact in a regional, state or national context. The bio-regional context has been utilised within to provide a firm basis for assessment of potential cumulative impacts to ecological values although it should be recognised that the Brigalow Belt South Bioregion contains areas of state or national significance that may be subject to similar threats in other bioregional zones.

The Brigalow Belt South Bioregion has suffered rapid and extensive loss of habitat accompanied by declines in species populations. Approximately 2.2% of the bioregion is reserved in protected areas (Sattler and Williams 1999). The fertile soils are recognised for their productivity, which has resulted in very widespread fragmentation of habitat for agricultural development such as crops and pastures. The impact of this activity has resulted in a landscape in which 30% of the remaining native vegetation exists as fragments and patches of varying extent and size (DNRM 2006). In this context, whilst the remaining continuous tracts of remnant vegetation are critical for maintenance of the region's bio-diversity values, fragmented remnants will be fundamental in any programs that aim for landscape repair. The potential consequence of inadequately managing multiple and varied projects in the area may be detrimental to the bioregion's ecological values with broadscale impacts on wildlife movement corridors, vegetation connectivity and condition, and a range of specific impacts to natural values/species at bioregional, state and national levels. Hence the requirement to manage these values in a framework that recognises the area's current ecological values and identifies measures to protect these values is critical.

10.1 Assessment Criteria and Methods

Whilst historical broad scale development of the Brigalow Belt South Bioregion has resulted in significant degradation of its landscape and inherent ecological values, the assessment of cumulative impacts in this section considers those future projects where there is a recognised serious intent to develop. These projects in general have sufficient data in the form of an IAS or EIS, or in the least a description of ecological values which may potentially be impacted, from which an assessment of potential cumulative impact can be drawn. The major factors considered relevant to the assessment of cumulative impacts are discussed briefly below.

Geographical Location: The geographical location of projects included in the assessment is considered particularly relevant, as is the spatial distribution of projects across the landscape. The cumulative impacts of interacting projects will be greatest when their potential impact footprints are contiguous across the landscape and they are impacting on a geographically and ecologically similar set of values. For this reason, projects located in the Brigalow Belt South Bioregion, particularly those which are adjacent or in near vicinity of one another, have considerable potential to interact cumulatively in respect to ecological impact.

Temporal Scale: The temporal scale of projects must also be considered with those projects developing and operating on a similar timeframe having greatest potential for impacts to interact and re-enforce. Projects which operate on separate temporal scales may facilitate recovery or stability of landscape scale ecological values. These ecological values may otherwise suffer severe, long duration negative impacts if projects interact temporally.

Cumulative Impact Pathways: The mechanisms by which projects interact to facilitate impact accumulation require definition. The major impact pathways identified for the Surat Gas Project are:

1. Clearing of land and vegetation.
2. Fragmentation of vegetation at a landscape scale.
3. Edge effects of land clearing and fragmentation negatively impacting the quality and viability of habitat.
4. Introduction, spread and proliferation of exotic or noxious flora and fauna species.
5. Interaction of natural ecological values with waste products including brine dams, or with altered environmental conditions such as might be facilitated by long term lighting of facilities, noise, or an increase in the volume and intensity of traffic.

These pathways will impact a range of ecological values including ESAs, significant vegetation communities including REs (state) and threatened ecological communities (federal), significant flora species and significant fauna species and species assemblages. Those projects which have greatest similarity in terms of generated impact pathways have the greatest potential to interact cumulatively. These impact pathways may also interact and re-enforce. For example, the fragmentation of vegetation facilitates edge effects within exposed habitats, which in term provides a niche in which exotic species can establish and proliferate.

A number of future projects were identified as having the potential to interact cumulatively. These have been assessed in regard to their potential to interact with the Surat Gas Project in terms of geographic location, temporal scale of development and impact pathway. The potential for cumulative project interactions is subjectively assessed according to the criteria defined in **Table**

43. Individual projects are assessed subjectively against this criteria in **Table 44**. It should be noted that for each project identified, an overall 'cumulative impact relevance' score is assessed as an average of individual scores for bioregional location, temporal scale, and impact pathway. Projects do not necessarily fit neatly into one of the project relevance descriptions given in **Table 46** and the overall relevance ranking is derived from consideration to what may be subtle variations in the full range of possible cumulative impact pathways, bioregional location and temporal scale.

Table 43. Relevance definition for interacting projects

Relevance Ranking	Project Relevance Description
5	**Extremely High Relevance:** Project is in the same bioregional area and project boundaries are contiguous with the Surat Gas Project, the project operates on the same or similar temporal scale, and a large number of common impact pathways are shared.
4	**High Relevance:** Project is in the same bioregional area, temporal scales of development overlap and the project shares a number of common impact pathways.
3	**Moderate Relevance:** Project is in the same bioregional area, temporal scales of projects may overlap and the project generally shares at least one common impact pathway.
2	**Low Relevance:** Project is in the same bioregional area although is developing on a different temporal scale and impact pathways do not correspond to those of the Surat Gas Project.
1	**Not relevant:** Project is outside bioregional influence (including Brigalow Belt North), is developing on a different temporal scale and impact pathways are do not correspond to those of the Arrow Surat Gas Project.

Table 44. Relevance of interacting project to Arrow Surat Gas cumulative impact assessment.

Project	Status	Bioregional Location	Temporal Scale	Impact Pathway	Cumulative Impact Relevance (=total score/3)
Arrow Surat Pipeline (Arrow Energy)	EIS Approved January 2010	4: Passes within Arrow PDA although impacts are spread over a 250km long easement impacting adjacent bioregions).	3: Project EIS has been approved and pipeline is under construction. Major impacts will be incurred in the early stages of Surat Gas project development.	4: Has impact pathways including vegetation clearing and fragmentation that overlap with Arrow Surat Gas project.	4
Australia Pacific LNG (Origin Energy)	Final EIS Approved with conditions in January 2011	5: The project boundaries are contiguous with the Arrow Surat	5: Project development will occur in unison with	5: Impact pathways are identical to those of the	5

Project	Status	Bioregional Location	Temporal Scale	Impact Pathway	Cumulative Impact Relevance (=total score/3)
		Gas Project boundaries.	development of the Arrow Surat Gas Project.	Arrow Surat Gas Project.	
Bloodwood Creek (Carbon Energy)	IAS issued January 2009. EIS not submitted	4: Project is located within 50km of Arrow Surat Gas Project boundary.	3: Major impacts will be incurred in the early stages of the Arrow Surat Gas Project although there will be longer term indirect ecological impacts.	2. Will incur some vegetation clearing although broader landscape fragmentation will not occur.	3
Cameby Downs Expansion Project	Final TOR issued. EIS to be delivered February 2012	5: Contiguous with the Arrow Surat Gas Project tenement boundary.	5: Project timing and duration will overlap with the Arrow Surat Gas Project.	3: Will incur some vegetation clearing although broader landscape fragmentation will not occur.	4
CS Energy – Kogan Creek Solar	Funding for project is available. No other information is available.	5: PDA coincides with Arrow Surat Gas Project tenement.	3: Proposed project timing is likely to overlap with the Arrow Surat Gas PDA.	1: No broadscale vegetation clearing or fragmentation is expected,	3
Elimatta Coal Project (Taroom Coal P/L)	IAS lodged 2009. EIS to be delivered April 2012	4: Occurs in same bioregional area 30km west of the Arrow Surat Gas PDA.	5: Project timing and duration will overlap with the Arrow Surat Gas Project.	3: Will incur some vegetation clearing although broader landscape fragmentation is minimal.	4
Emu Swamp Dam Project	EIS Lodged January 2008	1: Occurs outside the Brigalow Belt South Bioregional Area.	2: Project is currently on hold and timing is unknown.	3: Will incur some vegetation clearing and fragmentation through access track construction.	2
Felton Clean Coal (Ambre Energy)	Final TOR Issued June 2009. EIS in production	4: Occurs in Brigalow Belt South Bioregion 30km east of Arrow Surat Gas Project boundary.	3: Project timing and duration will overlap with the Arrow Surat Gas Project although there is no finalised development	3: Will incur some vegetation clearing although broader landscape fragmentation	3

Project	Status	Bioregional Location	Temporal Scale	Impact Pathway	Cumulative Impact Relevance (=total score/3)
			timescale.	will not occur.	
Gladstone LNG Project (Santos)	Final EIS approval October 2010	4: Occurs in Brigalow Belt South Bioregion up to 100km east of Arrow Surat Gas Project boundary.	5: Project development will occur in unison with development of the Arrow Surat Gas Project.	5: Impact pathways are identical to those of the Arrow Surat Gas Project.	4
Nathan Dam and Nathan Pipeline	IAS lodged March 2008. EIS in preparation.	3: Occurs in Brigalow Belt South Bioregion 50km north of PDA.	3: Finalised development timeframe is not available. Major impacts are likely to be occurred in early stages of Arrow Surat Gas Project development .	3: Will incur some vegetation clearing and fragmentation through access track construction.	3
New Acland Coal Mine – Stage 3 expansion (New Hope Coal Australia)	Amended EIS Lodged August 2008	4: Occurs in Brigalow Belt South Bioregion 30km east of Arrow Surat Gas Project boundary.	3: Project timing and duration will overlap with the Arrow Surat Gas Project although there is no finalised development timescale.	3: Will incur some vegetation clearing although broader landscape fragmentation will not occur.	3
Queensland Curtis LNG (QGC/ BG)	EIS lodged and approved with project financial decision made	5: The project boundaries are contiguous with the Arrow Surat Gas Project boundaries.	5: Project development will occur in unison with development of the Arrow Surat Gas Project.	5: Impact pathways are identical to those of the Arrow Surat Gas Project.	5
Queensland Hunter Gas Pipeline Project (Hunter Gas Pipeline P/L)	QLD Project license issued is April 2007	2: Only minor impacts will occur in Brigalow Belt South Bioregion.	1: Limited impact to vegetation and contribution to landscape fragmentation.	3: Has impact pathways including vegetation clearing and fragmentation that overlap with Arrow Surat Gas project although these are limited in extent.	2
Spring Gully Power Station (Origin Energy)	EIS Completed in 2006	3: Occurs in Brigalow Belt South Bioregion 60km north-west of PDA.	1: Major impacts will be incurred before Arrow Surat Gas Project is commissioned.	2: Will incur some vegetation clearing although broader landscape	2

Project	Status	Bioregional Location	Temporal Scale	Impact Pathway	Cumulative Impact Relevance (=total score/3)
				fragmentation will not occur.	
Surat Basin Rail (Surat Basin Rail Pty Ltd)	EIS Complete	3: Contiguous with the northern portion of the Arrow Surat Gas PDA with impacts spread over a 150km long easement to the north.	3: Project EIS has been approved. Major impacts will be incurred in the early stages of Surat Gas Project development.	3: Has impact pathways that overlap with those of the Arrow Surat Gas project.	3
Wandoan Coal Project (Xstrata Coal)	Approved with conditions March 2010	5: Adjacent to northern portion of Arrow Surat Gas PDA.	3: Project is currently in development stage and there will be some overlap with the Arrow Surat Gas PDA.	3: Will incur some vegetation clearing although broader landscape scale fragmentation will be minimal.	4

Cumulative Impact Significance Assessment: The significance of cumulative impacts is derived from the risk matrix as provided in **Table 45,** which has been adapted from the impact significance assessment undertaken in Sections **8.1.1** and **8.1.2.** The cumulative impact assessment is targeted specifically at identifying those specific ecological values that are at risk of incurring substantial cumulative impact and the interacting projects that pose greatest risk to those values. In this regard, individual ecological values are considered only (i.e. individual significant fauna or flora species or threatened vegetation communities) rather than groups of values. This is because it is unfeasible to compare ecological values as groups between projects which may have a range of different impact sensitivities and magnitudes. It should be noted that the cumulative impact assessment is based on the following assumptions.

- The assessment is relevant only to those ecological values identified in the Surat Gas PDA and does not consider values identified only in other interacting PDAs that have not been identified in the Surat Gas PDA.
- An overall residual impact significance (as a function of impact sensitivity and impact magnitude) as defined in **Section 8.1.2** (**Table 36** and **Table 38** respectively) have already been considered for individual values in the Surat Gas PDA. A similar assessment of impact significance is interpreted for individual values in interacting projects based on available information in EIS and IAS documentation. While this process is considered subjective, it is based on available information and in the context of standard impact assessment processes.

- The assessment assumes that conditions applied to projects will ensure that mitigation measures will be adequately implemented and successful in all cases, particular in projects that involve development of extensive gas fields where project constraints and mitigation measures are likely to be similar.

All cumulative impacts assessed to be either extremely high or high levels warrant particular attention in regards to the monitoring and management of cumulative impacts.

Table 45. Cumulative impact significance matrix.

		Project Relevance				
		Extremely High	**High**	**Moderate**	**Low**	**Not Relevant**
Impact Significance	**Extremely High Significance**	25	24	22	19	15
	High Significance	23	21	18	14	10
	Moderate Significance	20	17	13	9	6
	Low Significance	16	12	8	5	3
	Extremely Low Significance	11	7	4	2	1

Cumulative Impact Significance Ranking	**Extremely High**	**23-25**
	High	**20-22**
	Moderate	**11-19**
	Low significance	**4-10**
	Insignificant	**1-3**

10.2 Tables for Cumulative Impact Assessment

The assessed potential for cumulative impacts on threatened ecological communities and REs, threatened flora species and threatened fauna species is provided in **Tables 46** to **48** respectively. Proposed clearing impacts for individual projects on individual significant REs and threatened ecological communities, as represented in column 2 of the following impact significance tables are summarised in **Appendix L.**

Table 46. Cumulative impact significance for threatened ecological communities and regional ecosystems

Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	**Interacting projects in which habitat is impacted and quantities cleared.**	**Interpreted combined residual impact significance incurred by other projects***	**Relevance of other interaction projects to Arrow Surat Gas Project****	**Potential for cumulative impact.**
EPBC Significant Ecological Community: Brigalow (Acacia harpophylla dominant and co-dominant) (endangered) Regional Ecosystems: **11.3.1, 11.4.3, 11.9.6, 11.4.10, 11.9.6**				
Mod(12)	**1** (2ha), **2** (68.5 ha), **4** (unspecified) , **6** (43ha max), **9** (52 ha worst case) **10** (predicted only) **11** (39 ha max) **12** (73ha max), **15** (9ha – unspecified max) **16** (35.4ha)	Mod(12)	Extremely High	High (20)
Ecological Community: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (critically endangered) Regional Ecosystems: **11.3.21, 11.3.24**				
Extremely High (21) – This is recognised as a N0-GO habitat and true residual impact will be Moderate (11)	**11** (78.5)**, 8** (unspecified), **9** (5.2ha), **10** (predicted only)	Extremely High	High	Extremely High (24)
Ecological Community: Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (endangered)				
Moderate (12)	**2** (13.27), **4** (unspecified) , **9** (0.8 ha) **10** (predicted only) **, 12** (0)	Moderate	Extremely High	High Significance (20)
Ecological Community: Weeping Myall Woodlands (endangered); Regional Ecosystems: Not Represented				
Moderate (12)	No Impact	Insignificant	Not Relevant	Extremely Low (1)

Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which habitat is impacted and quantities cleared.	Interpreted combined residual impact significance incurred by other projects*	Relevance of other interaction projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Ecological Community: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered) Regional Ecosystems: **11.8.2a**				
High(17)	**7** (100ha max potential)	Extremely High (24)	Low Relevence	Moderate (19)
Ecological Community: Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered): Regional Ecosystems: **11.3.3**				
Low (8)	**2** (7.8ha post approval), **9** (2.8ha post approval), **12** (unspecified post approval)	Low (8)	Extremely High	Moderate (16)
RE 11.3.2: Eucalyptus populnea woodland on alluvial plains (of concern)				
Low (8)	**1**(7.55 ha max), **2**(129.13ha), **4** (Unspecified), **9**(108.9), **11** (35.2) **12** (13.26 max)	Low (8)	Extremely High	Moderate (16)
RE 11.3.4: Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains (of concern)				
Low (8)	**1** (7.5ha max), **2** (10.24ha) **4** (Unspecified) **9** (1.99ha), **12** (16.72 ha max),	Extremely Low	Extremely High	Moderate (11)
RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains (Endangered)				
Moderate (12)	**2** (1ha)**, 9** (12.6 ha), **11** (35.7 ha), **12** (11.2 ha max)	Low (5)	Extremely High	Moderate (16)
RE 11.3.25: Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. (not of concern)				

Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	**Interacting projects in which habitat is impacted and quantities cleared.**	**Interpreted combined residual impact significance incurred by other projects***	**Relevance of other interaction projects to Arrow Surat Gas Project****	**Potential for cumulative impact.**
Low (5)	**1** (unspecified), **2** (249 ha), **3** (unspecified), **4** (unspecified), **6** (nspecified)**, 9** (15.97 ha), **10** (unspecified) **12** (15.8 ha) **15** (Unspecified), **16** (446 ha)	Low (5)	Extremely High	Moderate (16)
RE 11.3.27: Freshwater wetlands (not of concern)				
Low (8)	**2** (0.4ha), **12** (9.8 ha max)	Insignificant (4)	Extremely High	Moderate (16)
RE 11.4.12: Eucalyptus populnea woodland on Cainozoic clay plains (endangered)				
Moderate (12)	**2** (12.72 ha), **12** (12.5 ha)	Low (5)	Extremely High	Moderate (16)
RE 11.9.7: Eucalyptus populnea, Eremophila mitchellii shrubby woodland on fine-grained sedimentary rocks (of concern)				
Low (5)	**2** (2.85 ha), **6** (Unspecified), **9** (1.3 ha), **12** (8.9 ha max)	Low (4)	Extremely High	Moderate (16)
RE 11.9.10: Acacia harpophylla, Eucalyptus populnea open forest on fine-grained sedimentary rocks (of concern)				
Low (8)	**2** (19.8 ha), **11** (22.9 ha), **12** (13.4 ha max), **16** (71.6 ha)	Low (4)	Extremely High	Moderate (16)

*Calculated by comparison of the magnitude of combined project impacts with the sensitivity of the impacted ecological element.

** Defaults to the highest level of project relevance where there are multiple interacting projects.

1. Arrow Surat Pipeline (Arrow Energy)
2. Australia Pacific LNG (Origin Energy)-includes gas fields and pipelines
3. Bloodwood Creek (Carbon Energy)
4. Cameby Downs Expansion Project

5. CS Energy – Kogan Creek Solar
6. Elimatta Coal Project (Taroom Coal P/L)
7. Emu Swamp Dam Project
8. Felton Clean Coal (Ambre Energy)
9. Gladstone LNG Project (Santos) –includes gas fields and pipelines
10. Nathan Dam and Nathan Pipeline
11. New Acland Coal Mine – Stage 3 expansion (New Hope Coal Australia)
12. Queensland Curtis LNG (QGC/ BG) – Includes gas fields and pipelines
13. Queensland Hunter Gas Pipeline Project (Hunter Gas Pipeline P/L)
14. Spring Gully Power Station (Origin Energy)
15. Surat Basin Rail (Surat Basin Rail Pty Ltd)
16. Wandoan Coal Project (Xstrata Coal)

Table 47. Potential for cumulative impacts to significant flora species

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Acacia barakulensis	Not listed	V	Low (8)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Acacia curranii	V	V	Moderate (17)	2, 12	High	Extremely High	Extremely High (23)
Acacia handonis	V	V	Mod(12)	4	Low	High	Moderate (12)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Acacia tenuinervis	Not listed	NT	Low (8)	2, 12	Low	Extremely High	Moderate (16)
Acacia wardellii	V	V	Mod(12)	2, 4 (source unspecified) 12,	High	Extremely High	Extremely High (23)
Apatophyllum teretifolium	Not listed	V	Low (8)	9 (source unspecified)	Low	Extremely High	Moderate (16)
Aristida forsteri	Not listed	NT	Extremely High (23)	No Interactions	Extremely Low	Not Relevant	Insignificant (1)
Bothriochloa biloba	V	Not listed	Moderate (13)	11	Moderate	Moderate	Moderate (13)
Cadellia pentastylis	V	V	Moderate (17)	2, 9 (source unspecified), 10 (potential only), 12	High	High	High (21)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Callitris baileyi	Not listed	NT	Moderate (17)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Calotis glabrescens	Not listed	NT	Low (5)	No Interactions	Extremely Low	Not Relevant	Insignificant (1)
Calytrix gurulmundensis	V	V	High (20)	2, 12	High	Extremely High	Extremely High (23)
Cryptandra ciliata	Not listed	NT	Low (8)	2, 12	Moderate	Extremely High	High (20)
Cyperus clarus	Not listed	V	Mod(12)	2	Low	Extremely High	Moderate (16)
Denhamia parviflora	V	V	Mod(12)	4 (source unspecified), 12	Low	Extremely High	Moderate (16)
Dichanthium queenslandicum	V	V	Mod(12)	9 (source unspecified), 16	Low	High	Moderate (12)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Digitaria porrecta	E	NT	Low (8)	9 (source unspecified) 10 (EPBC search), 11, 4 (source unspecified),	Low	High	Moderate (12)
Eloecharis blakeana	Not Listed	NT	Low (8)	2, 4 (source unspecified) 9 (source unspecified), 12	Low	Extremely High	Moderate (16)
Eucalyptus curtisii	Not Listed	NT	Low (8)	9 (source unspecified), 12	Low	Extremely High	Moderate (16)
Fimbristylis vagans	Not Listed	NT	Low (8)	4 (source unspecified), 12	Low	Extremely High	Moderate (16)
Gonocarpus urceolatus	Not Listed	V	Moderate (13)	2, 4 (source unspecified), 12	Moderate	Extremely High	High (20)
Homopholis belsonii	V	E	Mod(12)	2, 4 (source unspecified), 10, 11, 12	Moderate	Extremely High	High (20)
Macrozamia machinii	V	V	Extremely High (25)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Microcarpaea agonis	E	E	Moderate (20)	2	Moderate	Extremely High	High (20)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Micromyrtus carinata	Not Listed	E	High (21)	2, 12	High	Extremely High	Extremely High (23)
Philotheca sporadica	V	V	Mod (16)	2, 12	High	Extremely High	Extremely High (23)
Picris barbarorum	Not Listed	V	Mod(12)	2	Low	Extremely High	Moderate (16)
Picris evae	V	V	Low (5)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Pomaderris coomingalensis	E	Not listed	High (21)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Prostanthera sp. (Dunmore D.M.Gordon 8A)	V	V	High (21)	2	High	Extremely High	Extremely High (23)
Pterostylis cobarensis	V	Not listed	Low (8)	2, 4 (source unspecified)	Low	Extremely High	Moderate (16)
Ptilotis extenuatus	Not listed	NT	Moderate (12)	No Interactions	Extremely Low	Not relevant	Insignificant (1)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Rhaponticum australe	V	V	Mod (12)	11 (stemmacantha australis)	Low	Moderate	Low (8)
Rutidosus lanata	Not listed	E	Low (8)	2, 12	Moderate	Extremely High	High (20)
Solanum papaverifolium	Not listed	E	Mod(13)	12	Low	Low	Extremely High
Solanum stenopterum	Not listed	V	Moderate (17)	2, 12	Moderate	Extremely High	High (20)
Thesium australe	V	V	Mod(12)	No Interactions	Extremely Low	Not relevant	Insignificant (1)
Xerothamnella herbacea	V	E	High (20)	2	Moderate	Extremely High	High (20)

*Calculated by comparison of the magnitude of combined project impacts with the sensitivity of the impacted ecological element.

** Defaults to the highest level of project relevance where there are multiple interacting projects.

NT = not threatened
V = vulnerable
E = endangered

1. Arrow Surat Pipeline (Arrow Energy)
2. Australia Pacific LNG (Origin Energy)-includes gas fields and pipelines
3. Bloodwood Creek (Carbon Energy)
4. Cameby Downs Expansion Project
5. CS Energy – Kogan Creek Solar
6. Elimatta Coal Project (Taroom Coal P/L)
7. Emu Swamp Dam Project
8. Felton Coal to Liquids (ambreCTL)
9. Gladstone LNG Project (Santos) –includes gas fields and pipelines
10. Nathan Dam and Nathan Pipeline
11. New Acland Coal Mine – Stage 3 expansion (New Hope Coal Australia)
12. Queensland Curtis LNG (QGC/ BG) – Includes gas fields and pipelines
13. Queensland Hunter Gas Pipeline Project (Hunter Gas Pipeline P/L)
14. Spring Gully Power Station (Origin Energy)
15. Surat Basin Rail (Surat Basin Rail Pty Ltd)
16. Wandoan Coal Project (Xstrata Coal)

Table 48. Potential for cumulative impacts to significant fauna species.

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Hypochrysops piceatus bulloak jewel butterfly	Not Listed	E	Extremely High (23)	2 (marginal)	Low	Extremely High	Moderate (16)
Jalmenus eubulus pale imperial hairsteak	Not Listed	V	Moderate (17)	2, 12	Moderate	Extremely High	High (20)
Cyclorana verrucosa rough collared frog	Not Listed	NT	Low (4)	2, 11, 4, 9	Low	Extremely High	Moderate (16)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Strophurus taenicauda golden-tailed gecko	Not Listed	NT	Low (8)	2, 4 (source unspecified), 11, 12, 16	Low	Extremely High	Moderate (16)
Delma torquata Ccllared delma	V	V	Extremely High (24)	2, 9, 19	Extremely High	Extremely High	Extremely High (25)
Paradelma orientalis brigalow scaly-foot	V	V	Low (8)	2, 4, 10, 12, 16	Moderate	Extremely High	High (20)
Anomalopus mackayi five-clawed worm-skink	V	E	Extremely High (23)	4 (source unspecified) 11, 12	Moderate	Extremely High	High (20)
Egernia rugosa *yakka skink*	V	V	Low (9)	2, 4 (source unspecified), 9, 10, 12, 16	Low	Extremely High	Moderate (16)
Tympanocryptis cf. tetraporophora grassland earless dragon	E	E	Moderate (18)	12	Moderate	Extremely High	High (20)
Acanthophis antarcticus common death adder	Not Listed	NT	Moderate (13)	2, 9, 16	Moderate	Extremely High	High (20)
Furina dunmalli Dunmall's snake	V	V	Low (8)	2, 4 (source unspecified), 9, 10, 12, 16	Moderate	Extremely High	High (20)
Hemiaspis damelii grey snake	Not Listed	E	Low (8)	2, 4(source unspecified), 11, 16	Moderate	Extremely High	High (20)
Accipiter novaehollandiae grey goshawk	Not Listed	NT	Low (4)	2, 4(source unspecified), 16	Low	Extremely High	Moderate (16)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Rostratula australis Australian painted snipe	V	V	Moderate (13)	2, 4 (source unspecified), 10, 16	Moderate	Extremely High	High (20)
Calyptorhynchus lathami glossy black-cockatoo	Not Listed	V	Low (8)	2, 4 (source unspecified),12, 16	Low	Extremely High	Moderate (16)
Ephippiorhynchus asiaticus black-necked stork	Not Listed	NT	Low (8)	2, 10, 16	Low	Extremely High	Moderate (16)
Geophaps scripta scripta squatter pigeon	V	V	Low (8)	2, 4(source unspecified), 9, 10, 12, 16	Low	Extremely High	Moderate (16)
Grantiella picta painted honeyeater	Not Listed	NT	Moderate (18)	2, 4 (source unspecified), 11,16	Moderate	Extremely High	High (20)
Lophoictinia isura square-tailed kite	Not Listed	NT	Low (5)	2, 4 (source unspecified), 10, 11, 16	Low	Extremely High	Moderate (16)
Melithreptus gularis black-chinned honeyeater	Not Listed	NT	Low (5)	2, 16	Low	Extremely High	Moderate (16)
Neophema pulchella turquoise parrot	Not Listed	NT	Low (8)	2	Low	Extremely High	Moderate (16)
Nettapus coromandelianus cotton pygmy-goose	Not Listed	NT	Low (8)	2, 10, 12	Low	Extremely High	Moderate (16)
Anthochaera phrygia regent honeyeater	E	E	Moderate (13)	4 (source unspecified), 12	Moderate	Extremely High	High (16)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Interacting projects in which species is known to or possibly occurs	Interpreted combined residual impact significance incurred by other projects*	Relevance of other projects to Arrow Surat Gas Project**	Potential for cumulative impact.
Stictonetta naevosa freckled duck	Not Listed	NT	Low (8)	2, 12	Low	Extremely High	Moderate (16)
Dasyurus maculatus maculatus spotted-tailed quoll	E	V	Low (8)	No interactions	Insignificant	Not Relevant	Insignificant (1)
Chalinolobus picatus little pied bat	Not Listed	NT	Low (8)	2, 4 (source unspecified), 6, 9, 11, 12, 16	Low	Extremely High	Moderate (16)
Nyctophilus corbeni south-eastern long-eared bat	V	V	Low (8)	No interactions	Insignificant	Not Relevant	Insignificant (1)

*Calculated by comparison of the magnitude of combined project impacts with the sensitivity of the impacted ecological element.

** Defaults to the highest level of project relevance where there are multiple interacting projects.

NT = not threatened
V = vulnerable
E = endangered

1. Arrow Surat Pipeline (Arrow Energy)
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7. Emu Swamp Dam Project
8. Felton Clean Coal (Ambre Energy)
9. Gladstone LNG Project (Santos) –includes gas fields and pipelines
10. Nathan Dam and Nathan Pipeline
11. New Acland Coal Mine – Stage 3 expansion (New Hope Coal Australia)

12.Queensland Curtis LNG (QGC/ BG) – Includes gas fields and pipelines
13.Queensland Hunter Gas Pipeline Project (Hunter Gas Pipeline P/L)
14.Spring Gully Power Station (Origin Energy)
15.Surat Basin Rail (Surat Basin Rail Pty Ltd)
16. Wandoan Coal Project (Xstrata Coal)

10.3 Cumulative Impact Assessment Summary

Table 49 to **Table 51** provide a summary of significant vegetation communities, flora species and fauna species with high potential for cumulative impact. The communities and species with high potential have a typically restricted distribution and are often endemic to the Brigalow Belt South Bioregion. The potential for cumulative impact is extenuated by the considerable number of contiguous projects with similar impact pathways and temporal scales of operation. Whilst this assessment highlights those habitats which may suffer significant impact from multiple projects, there are also a number of highly restricted endemic species which have limited potential for cumulative impact. These include the flora species Forster Wiregrass (*Aristida forsterii), Macrozamia machinii* and the Bulloak Jewel butterfly (*Hypochrysops piceatus).* Species endemicity in these cases is centred on the Surat Gas PDA which highlights the necessity for effective long term management by the proponent.

Table 49. Summary of significant vegetation communities with high potential for cumulative impact.

Vegetation Community	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Potential for cumulative impact.
EPBC Significant Ecological Community: Brigalow (Acacia harpophylla dominant and co-dominant) (endangered)	Moderate(12)	High(20)
Ecological Community: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (critically endangered)	High (21)	Extremely High (24)
Ecological Community: Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (endangered)	Low (8)	High (20)

Table 50. Summary of significant flora species with high potential for cumulative impact.

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Potential for cumulative impact.
Acacia curranii	V	V	Moderate (17)	Extremely High (23)

Species	**EPBC**	**NCA**	**Residual impact significance – Arrow Surat Gas Project (does not include avoidance)**	**Potential for cumulative impact.**
Acacia wardellii	V	V	Low (5)	Extremely High (23)
Cadellia pentastylis	V	V	Moderate (12)	High (21)
Calytrix gurulmundensis	V	V	Moderate (17)	Extremely High (23)
Cryptandra ciliata	Not Listed	NT	Low (8)	High (20)
Gonocarpus urceolatus	Not Listed	V	Moderate (13)	High (20)
Homopholis belsonii	V	E	Moderate(12)	High (20)
Microcarpaea agonis	E	E	High(20)	High (20)
Micromyrtus carinata	Not Listed	E	High (21)	Extremely High (23)
Philotheca sporadica	V	V	Mod (16)	Extremely High (23)
Prostanthera sp. (Dunmore D.M.Gordon 8A)	V	V	High (21)	Extremely High (23)
Rutidosus lanata	Not listed	E	Moderate (12)	High (20)
Solanum papaverifolium	Not listed	E	Moderate (13)	Extremely High (23)
Solanum stenopterum	Not listed	V	Moderate (17)	High (20)
Xerothamnella herbacea	V	E	High (20)	High (20)

Table 51. Summary of significant fauna species with high potential for cumulative impact.

Species	**EPBC**	**NCA**	**Residual impact significance – Arrow Surat Gas Project (does not include avoidance)**	**Potential for cumulative impact.**
Jalmenus eubulus pale imperial hairsteak	Not Listed	V	Moderate (17)	High (20)
Delma torquata Collared delma	V	V	Extremely High (24)	Extremely High (25)
Paradelma orientalis brigalow scaly-foot	V	V	Low (8)	High (20)
Anomalopus mackayi five-clawed worm-skink	V	E	Extremely High (23)	High (20)
Tympanocryptis cf. tetraporophora grassland earless dragon	E	E	Moderate (18)	High (20)
Acanthophis antarcticus common death adder	Not Listed	NT	Moderate (13)	High (20)
Furina dunmalli Dunmall's snake	V	V	Low (8)	High (20)
Hemiaspis damelii grey snake	Not Listed	E	Low (8)	High (20)

Species	EPBC	NCA	Residual impact significance – Arrow Surat Gas Project (does not include avoidance)	Potential for cumulative impact.
Rostratula australis Australian painted snipe	V	V	Moderate (13)	High (20)
Grantiella picta painted honeyeater	Not Listed	NT	Moderate (18)	High (20)
Anthochaera phrygia regent honeyeater	E	E	Moderate (13)	High (16)

Whilst impacts to those ecological communities, REs and threatened flora and fauna species identified in **Table 49** to **Table 51** can best be managed at the individual project scale, a number of recommendations can be made in respect to the broader scale management of cumulative impacts. These include:

- Research into species ecology and effective impact mitigation techniques to be sponsored collaboratively by the proponents of the projects contributing to the impact.
- Ensuring all interacting projects identified as potentially contributing to a significant cumulative impact are made aware of this potential and their responsibilities towards management of these impacts are identified.
- A collaborative approach between project proponents for the purpose of effective ecological offsetting (e.g. joint funding for management of a specific habitat offset for a species or ecological community that is heavily impacted by a number of projects).

11. Constraints Mapping

Ecological constraints mapping will form the basis for the sensitive location of infrastructure, and decisions regarding the appropriate implementation of site specific management actions. These management measures may be highly customised, dependant on the nature of the ecological constraint at any given location, or a generalised set of SOPs where specific ecological constraints are not identified. The basis for the constraint mapping is a GIS data set which is attributed for each specific level of constraint, as well providing information relevant to measures required to manage the constraint. Proposed constraint zones and recommended management procedures are identified in **Table 52** with rules for pre-clearance survey provided in **Table 53**. **Figure 26** provides representation of the spatial distribution of constraint levels in the detailed mapping area with **Figure 27** representing constraints in the broader PDA.

Table 52. Constraints mapping categories.

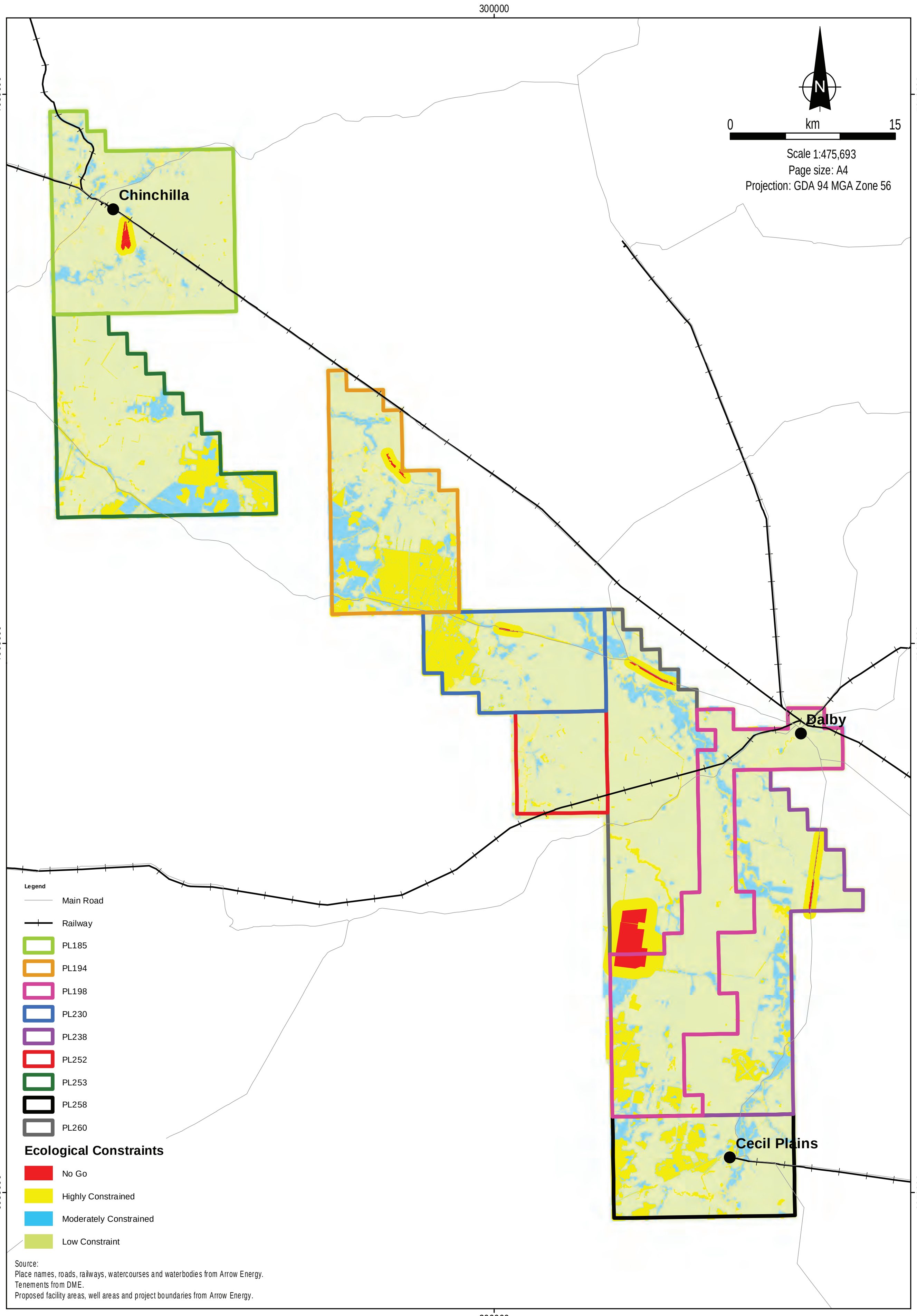
Level of Constraint	Constraint Description	Constraint Attribute	Identified Procedure
No Go	The project could cause considerable adverse impact to the ecological value. No activity permitted.	• Category A ESAs (National Parks); • Chinchilla Sporting Shooters Range; • Bendidee National Park and State Forest • EPBC Critically Endangered EPBC communities (RE11.3.21)	No activity permitted. Seek alternative action
High Constraint	The ecological value is at high risk from the project activities. Stringent control measures will be required and only certain activity types will be permitted.	• Other EPBC significant ecological communities (endangered); • DERM declared Essential Habitat for EVNT flora and fauna species; • Core habitat (known and possible) for highly sensitive EVNT fauna species. • Category B ESAs; • Areas classified 'Core Habitat Known' for EVNT flora and fauna species species; • REs classified as endangered and of concern (biodiversity status); • State Forest Areas. • 1000m buffer zones around Category A ESAs including a 200m 'no-impact' buffer. • 300m buffer zone around Chinchilla Sporting Shooters Club. • Bioregional Wildlife Corridors • Wildflower areas and reserves in state forests.	1). Seek alternative lower risk areas for operation. In absence of viable alternative. 2). General rules include: • Site inspection by a qualified ecologist to identify or confirm the extent and distribution of the constraining value prior to activity**; • Determine if constraining value can be avoided (e.g. sensitive placement of an exploration well to avoid impact).; • Consider species translocation or biodiversity offsets when impact cannot be avoided; • Strict weed hygiene procedures maintained for all equipment. 3). Identify specific ecological value contributing to constraint classification in GIS database (there may be multiple). Once identified: • Reference appropriate specific management strategy for each specific ecological attribute (regional ecosystem, EVNT flora or fauna species etc.) in project EMP; • Implement stringent management controls

Level of Constraint	Constraint Description	Constraint Attribute	Identified Procedure
			suitable to indivual attribute. These controls may include: • Complete avoidance if species or habitat is extremely sensitive (where residual impact for methods other than avoidance are moderate to Extremely High); • Assessment of population size through trapping or flagging of all individual EVNT species locations; • Fencing (permanent or temporary) of highly significant areas as a permanent measure of protection; • Specific translocation procedures for highly sensitive species including collection of viable seed stock; • Thorough planning and precise and highly restricted location of activity to ensure critical habitat factors are avoided (eg. Placement of equipment between trees to avoid canopy disturbance); • Specific requirements for rehabilitation including utilisation of habitat specific grassland species.
Moderate Constraint	The ecological value is at risk from the project although application of additional management measures will ensure risk of environmental harm is minimised.	• Areas classified as core habitat (known or possible) for moderately sensitive EVNT fauna species. • Areas classified as core habitat (known or possible) for resilient EVNT fauna species. • Areas classified as core habitat possible for EVNT flora species. • Areas classified as general habitat for EVNT flora and fauna species. • All other remnant vegetation	1). Seek alternative lower risk areas for operation in all cases. 2). General rules that apply for all activities in moderately constrained areas. • Activity location should be visually inspected by field officer to confirm mapped constraint and identify any obvious ecological values**; • Site access should be limited to clearly located routes; • Strict weed hygiene procedures maintained for all equipment.

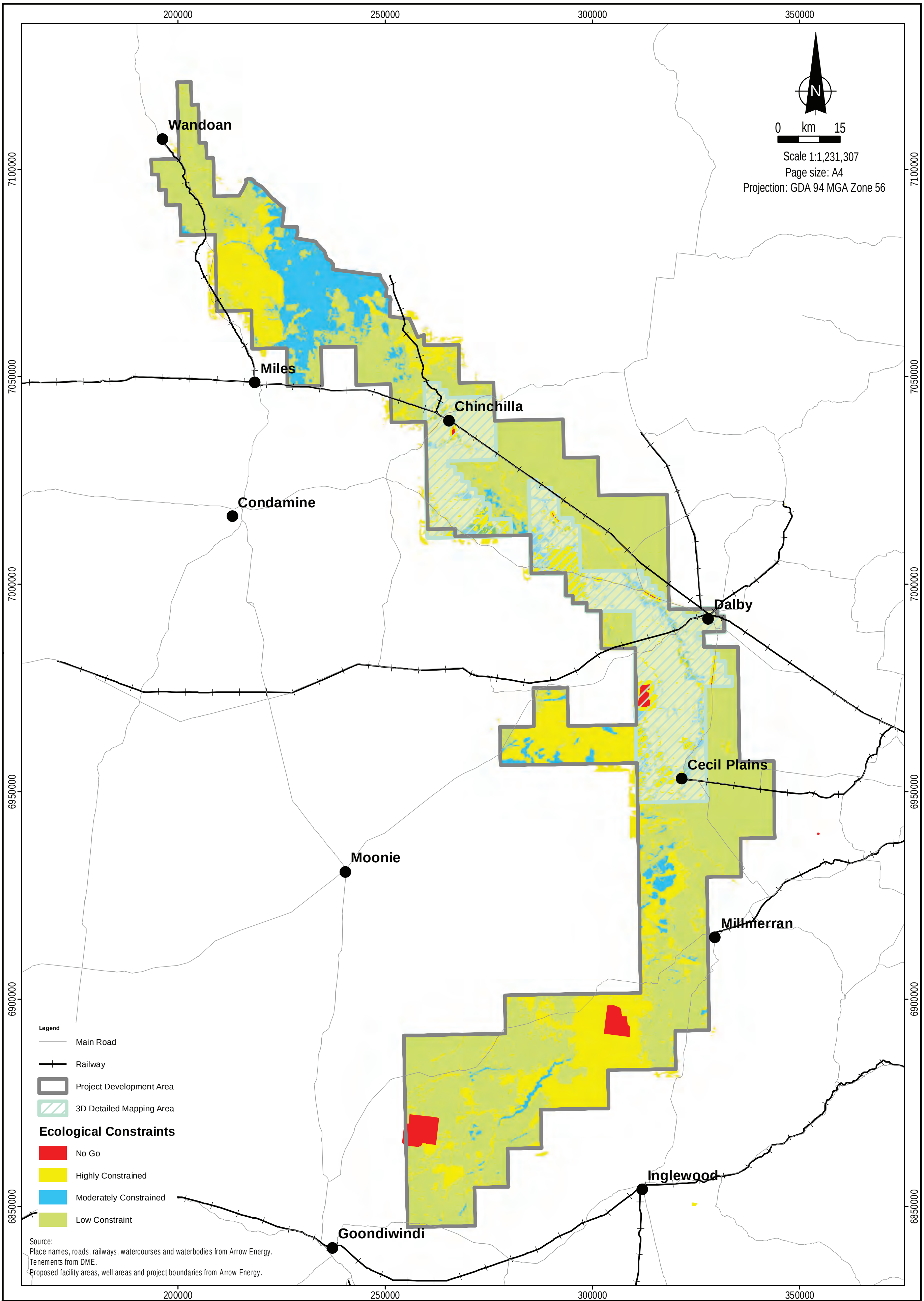
Level of Constraint	Constraint Description	Constraint Attribute	Identified Procedure
		• Derived grassland areas (non-remnant) • 300m buffer zones around Cat B ESAs (not represented in Figures) • Category C ESA's.	• General habitat and diversity management actions (e.g. rehabilitation, trench management) are required. 3). If particular high value or sensitive ecological value is identified during ground assessment, procede with level 3 procedures from highly constrained areas.
Low Constraint	No specific ecological values identified. Project can procede under a standard set of environmental procedures.	All other areas of non-remnant vegetation (cleared areas and cultivated areas).	Procede with SOPs.

Table 53. Recommended procedures for pre-clearance surveys.

Recommended Rules for Pre-clearance Surveys	
Highly constrained areas	Inspection to be carried out by qualified ecologist (Arrow/external): 1). Visual inspection to confirm actual conditions vs mapped conditions; 2). Sampling/trapping if required to confirm key species presence/absence; 3). Undertake specific mitigation procedures.
Moderately constrained areas	Inspection by trained personnel: 1). Visual inspection to confirm actual conditions vs mapped conditions; 2). If actual = mapped and no of concern species observed then proceed under moderate constraint SOPs; 3). If actual does not equal mapped and observations suggest a more sensitive environment, then upgrade the constraint to high and carry out appropriate mitigation procedures as per above.
Low constraint.	1). Ground inspection to identify lowest impact activity site; 2). Proceed with low constraint SOPs.



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: **09-05-2011** MXD: Arrow\DS_Info\Arrow_3D_P_A4_July11.mxd File Name: **3D_F26_GIS**	Arrow Energy Limited Surat Gas Project	arrowenergy go further	Eco-constraints. Detailed Mapping Area	Figure No: **26**



3D Environmental Vegetation Assessment & Mapping Specialists P. O. Box 959 Kenmore, Qld 4069 Phone: (07) 3411 9072 Phone: (07) 3878 4344 Mobile: 0404 577 285 Mobile: 0409 426 916 www.3denvironmental.com.au	Date: 09-05-2011 MXD: Arrow\DS_Info\Arrow_ 3D_P_A4_July11 .mxd File Name: 3D_F27 _GIS	Arrow Energy Limited Surat Gas Project	Ecological Constraints in Project Development Area	Figure No: 27

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13. Appendices

Appendix A. Site Survey Data

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ1	Quaternary	302198	6995765	Open forest (18-22 m) of *Acacia harpophylla* with a sparse T2 of *Eucalyptus populnea.*	Alluvial plain	Non R
AQ2	Quaternary	302211	6995817	Regrowth shrubland (6-10m) of *Casuarina cristata.*	Alluvial plain	Non R
AQ3	Quaternary	301977	6994873	Open forest (18-22 m) dominated by *Eucalyptus tereticornis* and *Angophora floribunda* with a dense groundcover of *Lomandra longifolia.*	Alluvial plain	11.3.14
AQ4	Quaternary	300624	6994956	Woodland (15-20 m) of *Eucalyptus crebra* with associated *Angophora leiocarpa* and a dense T2 of *Callitris glaucophylla*. Heavily disturbed.	Sandstone rises	11.10.1d
AS5	Secondary	301092	6996452	Open forest (18-22 m) of *Angophora floribunda* with minor *Eucalyptus tereticornis.*	Alluvial plain	11.3.14
AQ6	Quaternary	299614	6996752	Woodland to 20 m of *Eucalyptus populnea* with minor *Eucalyptus tereticornis*	Alluvial plain	11.3.2
AS7	Secondary	298413	699684	Open forest (20-26 m) of *Eucalyptus crebra* with minor *Angophora leiocarpa*	Gentle sandstone rises	11.10.1d
AS8	Secondary	296927	6996427	Woodland (18-22m) of *Eucalyptus populnea* and minor *Eucalyptus pilligaensis*	Weathered sandstone rises	11.9.7
AS9	Secondary	302847	6994819	Open forest (18-25m) of *Eucalyptus tereticornis* with codominant *Angophora floribunda*	Alluvial plain	11.3.4
AQ10	Quaternary	302796	6994824	Natural Waterhole/Riverine Wetland	Alluvial plain	11.3.25g
AQ11	Quaternary	303073	6995706	Woodland (22-28m) of *Eucalyptus tereticornis.*	Alluvial plain	11.3.4
AS12	Secondary	304516	6989689	Open forest (22-30m) of *Eucalyptus tereticornis* and Angophora floribunda with minor *Corymbia tessellaris.*	Alluvial plain	11.3.14
AQ13	Quaternary	304635	6989319	Open forest (disturbed) (20-28m) of *Angophora floribunda* with minor *Eucalyptus tereticornis.*	Alluvial plain	11.3.14
AS14	Secondary	304614	6989510	Open forest (18-22m) of *Eucalyptus tereticornis* and *Angophora floribunda* with Callitris glaucophylla dominating subcanopy.	Sandy alluvial rise on floodplain	11.3.14
AS15	Secondary	304382	6989629	Woodland of (22-27m) *Eucalyptus populnea* with minor *Casuarina cristata.*	Alluvial plain	11.3.2
AQ16	Quaternary	304363	6989723	Woodland (18-22m) of *Eucalyptus populnea* (18-22m) with minor *Casuarina cristata* and *Corymbia clarksoniana*	Alluvial plain	11.3.2
AS17	Secondary	303977	6989247	Woodland (13-16m) of *Callitris glaucophylla* with minor *Eucalyptus tereticornis*. Disturbance type.	Sandy rises on alluvial plain	Non R
AS18	Secondary	306261	6988686	Open forest (16-20m) of *Callitris glaucophylla* with scattered *Brachychiton populneus, Eucalyptus tereticornis* and *Angophora floribunda*.	Sandy alluvial plain	11.3.14
AQ19	Quaternary	307334	6989335	Open forest (13-18m) of *Acacia harpophylla*. Restricted to road reserve.	Heavy clay soils	Non R
AQ20	Quaternary	304095	6990258	Open forest (heavily disturbed) of *Casuarina cristata* with *Eucalyptus populnea* and *Acacia* sp. Road reserves.	Heavy clay soils	11.3.17
AQ21	Quaternary	295566	7007819	Riparian open forest (16-20m) of *Eucalyptus tereticornis* and *Angophora floribunda.*	Alluvial channels	11.3.25
AS22	Secondary	295590	7007653	Woodland (16-20m) of *Eucalyptus crebra* with *E. pilligaensis*	Sandstone rises	11.9.9a
AQ23	Quaternary	295414	7007912	Riparian open forest (15-25m) of *Eucalyptus tereticornis* with *Angophora floribunda.*	Alluvial river terrace	11.3.25
AS24	Secondary	292481	7004973	Woodland (16-20m) of *Eucalyptus crebra* with *Lysicarpus angustifolius* and *Callitris glaucophylla*.	Sandstone rises	11.10.1d

Site Code	Site Level	E	N	Site Description	Landform	RE
AS25	Secondary	293080	7004815	Open woodland (12-16m) of *Eucalyptus crebra* with *Callitris glaucophylla* and minor *Allocasuarina luehmannii* and a dense shrub layer of *Allocasuarina leuhmanii.*	Sandstone rises	11.10.1
AS26	Secondary	302639	6990717	Open forest (18-25m) of *Eucalyptus tereticornis* and *Angophora floribunda*.	Alluvial bench	11.3.4
AS27	Secondary	302682	6990399	Open forest of *Angophora floribunda* with *Eucalyptus tereticornis.*	Alluvial bench	11.3.4
AQ28	Quaternary	303261	6991086	Open forest (18-25m) of *Casuarina cristata*.	Alluvial floodplain	11.3.1
AS29	Secondary	305516	6989310	Open forest (20-25m) of *Callitris glaucophylla* with minor *Eucalyptus tereticornis.*	Sandy rises on alluvial plain	11.3.14
AQ30	Quaternary	304905	6991481	Woodland (20-26m) of *Acacia harpophylla* with scattered *Casuarina cristata* and *Melaleuca bracteata*.	Cracking clay gilgai soils	11.3.1
AS31	Secondary	304037	6992441	Open forest (25-30m) of *Eucalyptus tereticornis* and *Angophora floribunda.*	Alluvial benches and overflow channels	11.3.4
AQ32	Quaternary	302847	6988789	Riparian open forest of *Eucalyptus tereticornis* and *Angophora floribunda.*	Alluvial overflow channel	11.3.25
AQ33	Quaternary	302840	6988782	Tall woodland of *Acacia harpophylla* with associated *Casuarina cristata.*	Cracking clay gilgai soils	11.3.1
AQ34	Quaternary	302777	6988861	Riparian open forest of *Eucalyptus tereticornis* and *Angophora floribunda*.	Riverine overflow flood channel	11.3.25
AQ35	Quaternary	302296	6985819	Riparian open forest of *Eucalyptus tereticornis.*	Alluvial channel	11.3.25
AQ36	Quaternary	302989	6985986	Natural Waterhole/Riverine Wetland	Riverine overflow flood channel	11.3.25g
AQ37	Quaternary	302961	6986103	Riparian open forest of *Eucalyptus tereticornis* and *Casuarina cristata.*	Alluvial terrace	11.3.25
AQ38	Quaternary	302992	6986220	Open forest of *Casuarina cristata* and *Eucalyptus populnea*.	Alluvial bench	11.3.17
AQ39	Quaternary	302947	6986559	Woodland of *Eucalyptus populnea* and *Casuarina cristata.*	Alluvial levee margins	11.3.17
AS40	Secondary	311696	6958695	Woodland (15-20m) of *Eucalyptus crebra* with associated *Angophora leiocarpa* + *Corymbia trachyphloia* and a subcanopy/shrub layer of *Callitris glaucophylla.*	Hillsopes and crests of lateritic sandstone	11.7.4
AS41	Secondary	311560	6958766	Open forest (15-20m) of *Eucalyptus crebra* with minor *E. tereticornis* and a subcanopy of *Callitris glaucophylla.*	Remnant tertiary surface	11.5.1
AS42	Secondary	319163	6952384	Woodland (15-18m) of Eucalyptus crebra with understorey of Allocasuarina inophloia and Callitris glaucophylla	Remnant tertiary surface	11.5.1
AQ43	Quaternary	319742	6952772	Woodland (15-18m) of *Eucalyptus populnea* + *E. crebra* + *E. chloroclada* and subcanopy/understorey of *Allocasuarina inophloia.*	Remnant tertiary surface	11.5.1
AQ44	Quaternary	313338	6950023	Woodland (15-18m) of *Eucalyptus populnea* + *E. chloroclada* and sparse understorey of *Callitris glaucophylla.*	Alluvium	11.3.2
AQ45	Quaternary	313770	6949900	Woodland (14-18m) of *Eucalyptus crebra* + minor *Corymbia clarksoniana* and *Callitris glaucophylla.*	Lateritic sandstone rises	11.7.4
AQ46	Quaternary	316304	6953579	Woodland (disturbed) (14-18m) of *Eucalyptus crebra* and associated *E. populnea x E. crebra* + *Corymbia clarksoniana* + *C. trachyphloia*. Secondary tree layer of *Callitris glaucophylla* and *Allocasuarina luehmannii.*	Remnant surface	11.5.1
AQ47	Quaternary	316231	6954036	Woodland of *Eucalyptus populnea* + *E. populnea x E. crebra* and minor *E. tereticornis.*	Alluvial floodplain	11.3.2
AS48	Secondary	314717	6959741	Woodland (15-18m) of *Eucalyptus pilligaensis*.	Alluvial floodplain	11.3.26

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ49	Quaternary	314725	6959674	Open forest (15-20m) of *Acacia harpophylla* with minor *Eucalyptus pilligaensis*.	Alluvial floodplain	11.3.1
AQ50	Quaternary	314604	6959741	Woodland (10-15m) of *Eucalyptus populnea.*	Alluvial floodplain	11.3.2
AQ51	Quaternary	314436	6959828	Riparian woodland of *Eucalyptus populnea* with a dense shrub layer of *Callitris glaucophylla.*	Alluvial floodplain	11.3.18
AS52	Secondary	316140	6958203	Woodland (18-25m) of *Eucalyptus crebra* + *Angophora leiocarpa* and a understorey of *Callitris glaucophylla.*	Lateritic sandstone rises	11.7.4
AS53	Secondary	316157	6957897	Woodland (16-20m) of *Acacia harpophylla*.	Gilgai clays on fine grained sedimentary	11.9.5
AS54	Secondary	316167	6957987	Open grassy woodland (18-26m) of *Eucalyptus crebra.*	Fine grained sedimentary	11.9.9
AQ55	Quaternary	315153	6957349	Woodland (20-25m) of *Eucalyptus crebra* with minor *Corymbia clarksoniana.*	Fine grained sedimentary	11.9.9a
AS56	Secondary	326352	6966932	Riparian woodland of *Eucalyptus tereticornis* and *E. camaldulensis*.	Alluvial channels	11.3.25
AQ57	Quaternary	325893	6966986	Derived native grassland (formerly open *E. populnea* woodland).	Cracking clay alluvial plain	Non-R
AQ58	Quaternary	322456	6969687	Open woodland of *Eucalyptus tereticornis* (road reserve remnant).	Cracking clay alluvial plain	Non-R
AQ59	Quaternary	315879	6964844	Woodland (regrowth 5-8m) of *Eucalyptus pilligaensis*.	Alluvial plain	Non-R
AQ60	Quaternary	315849	6964694	Woodland (15-20m) of *Eucalyptus crebra* with a sparse understorey of *Allocasuarina luehmannii.*	Alluvial plain	11.5.1
AS61	Secondary	312631	6963894	Woodland (16-22m) of *Eucalyptus crebra* + *Angophora leiocarpa* with a subcanopy of *Callitris glaucophylla* + *Allocasuarina luehmannii* + *Lysicarpus angustifolius* + *Corymbia clarksoniana.*	Sandy remnant surface	11.5.1
AQ62	Quaternary	311877	6962398	Woodland (12-15m) of *Allocasuarina luehmannii* + *Callitris glaucophylla* with associated *Eucalyptus crebra, E. chloroclada* & *C. clarksoniana*. (Eucalypts removed from T1 by selective logging and ringbarking).	Sandy colluvium	11.5.1
AT63	Tertiary	311877	6962398	Open forest (15-18m) of *Eucalyptus crebra* with *Angophora leiocarpa, Corymbia trachyphloia* and E. *exserta.*	Lateritic sandstone rises/ scarp retreat	11.7.4
AQ64	Quaternary	311273	6960483	Woodland (heavily disturbed) (18-22m) of *Eucalyptus crebra* with minor *E. pilligaensis, E. crebra & E. populnea*, and a secondary tree layer of *Allocasuarina luehmannii* and *Callitris glaucophylla.*	Sandy remnant surface	11.5.1
AQ65	Quaternary	311230	6958890	Woodland (heavily disturbed) (18-22m) of *Eucalyptus crebra* with subdominant *E. chloroclada*, associated *E. populnea* and a dense subcanopy of *Allocasuarina luehmannii.*	Sandy remnant surface	11.5.1
AQ66	Quaternary	311792	6966177	Woodland (heavily disturbed) (15-20m) of *Eucalyptus populnea* and associated *E. crebra.*	Sandy remnant surface	11.5.1a
AQ67	Quaternary	311814	6967419	Woodland (18-23m) of *Eucalyptus pilligaensis.*	Sandy remnant surface	11.5.20
AQ68	Quaternary	311857	6968465	Woodland (18-22m) of *Eucalyptus pilligaensis* with a dense second tree layer of *Callitris glaucophylla.*	Sandy remnant surface	11.5.20
AS69	Secondary	310890	6974785	Woodland (16-22m) of *Casuarina cristata* and *Acacia harpophylla*.	Cracking clays (gilgai)	11.4.3
AQ70	Quaternary	310916	6975312	Woodland (20-23m) dominated by *E. piligaenensis* with *Callitris sp*. and *A. harpophylla* on margins.	Sandy remnant surface	11.5.20
AT71	Tertiary	313345	6980315	Woodland (18-23m) of *Eucalyptus tereticornis*.	Broad swampy depressions on alluvial	11.3.27d

Site Code	Site Level	E	N	Site Description	Landform	RE
					plain	
AQ72	Quaternary	313372	6980290	Woodland (16-20m) of *Acacia harpophylla*.	Alluvial plain (gilgai soils)	11.3.1
AQ73	Quaternary	312959	6981030	Woodland (16-22m) of *Eucalyptus tereticornis*.	Swampy alluvial depressions	11.3.27d
AQ74	Quaternary	311357	6982267	Sedgeland of *Eleocharis* spp.	Permanent freshwater lagoon on river flood channel	11.3.27d
AS75	Secondary	311283	6982254	Woodland (15-22m) of *Eucalyptus tereticornis.*	Swampy alluvial depressions	11.3.27d
AQ76	Quaternary	311445	6982284	Woodland (15-18m) of *Eucalyptus populnea* with shrubby layer of *Geijera parviflora* and *Citrus glauca.*	Alluvial plain	11.3.17
AS77	Secondary	312363	6985749	Open forest (16-20m) of *Acacia harpophylla* + *Casuarina cristata* with a shrubby layer of *Melaleuca bracteata* and *Elaeodendron australe* var. *integrifolia.*	Cracking clay plain with gilgai	11.3.1
AQ78	Quaternary	312178	6983606	Open forest (13-17m) of *Eucalyptus populnea* + *Casuarina cristata* + *Acacia melvillei.*	Cracking clay plain with gilgai	11.3.17
AS79	Secondary	311607	6975054	Open forest/woodland (18-25m) of *Acacia harpophylla* with subdominant *Casuarina cristata* and associated *Eucalyptus pilligaensis*.	Cracking clay plain with gilgai	11.4.3
AQ80	Quaternary	312113	6979209	Woodland with *Angophora floribunda* + *E. tereticornis* to 23m with dense ground cover of Lomandra.	Sandy alluvial rise	11.3.14
AQ81	Quaternary	312431	6981961	*Eucalyptus populnea* woodland.	Heavy clay soils	11.3.17
AQ82	Quaternary	312694	6983706	*Eucalyptus populnea* + *Casuarina cristata* woodland.	Heavy clay soils	11.3.2
AQ83	Quaternary	314851	6984766	Open forest of *Casuarina cristata* and *Eucalyptus populnea*.	Heavy clay soils	11.3.17
AS84	Secondary	297154	6995693	Woodland (14-18m) of *Eucalyptus pilligaensis* with a sparse shrub layer of *Callitris glaucophylla* and *Allocasuarina luehmannii*.	Gentle sandstone rises	11.9.13
AS85	Secondary	321699	6980929	Woodland (18-22m) of *Eucalyptus tereticornis* with subdominant *Corymbia tessellaris* and a sparse shrub layer of *Acacia salicina.*	Alluvial terrace	11.3.4
AQ86	Quaternary	321625	6980857	Overflow lagoon dominated by **Phyla canescens* fringed with *E. tereticornis.*	Alluvial overflow	11.3.27c
AQ87	Quaternary	321825	6981291	Sparse woodland (15-20m) (heavily thinned) of *Eucalyptus tereticornis* and *E. populnea* subdominant *Corymbia tessellaris* and a sparse shrub layer of *Acacia salicina*.	Alluvial plain	Non- remnant
AQ88	Quaternary	322070	6981308	Derived grassland/heavily disturbed woodland of *E. tereticornis*.	Alluvial plain cracking clay soils	Non-remnant
AQ89	Quaternary	322461	6981042	Woodland (17-23m) of *E. teretcornis*. Heavily disturbed (PCC <20%).	Alluvial plain	Non-remnant
AS90	Secondary	316164	6963325	Tall shrubland (6-8m) of *Allocasuarina luehmanii*.	Loamy plain	Non-remnant
AQ90a	Quaternary	317800	6967734	Brigalow regrowth to 5m (less than 15 years old).	Loamy plain	Non-remnant
AS91	Secondary	318307	6932090	Woodland (15-21m) (disturbed) with dominant *Callitris glaucophylla* and scattered *Eucalyptus crebra, Allocasuarina luehmanii* and A. *inophloia.*	Undulating plain formed on degraded sandstone	11.9.9a.
AQ92	Quaternary	319184	6931192	Woodland (18-23m) of *Eucalyptus crebra* (d) + *Angophora leiocarpa* (sd) +/- *E. fibrosa* subsp. *nubila* with a tall shrub layer of *Acacia leiocalyx.*	Rocky sandstone outcrop with minor induration	11.9.9a

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ93	Quaternary	319960	6930279	Artificial dam surrounded by *E. crebra, Angophora leiocarpa* woodland.	Woodland (15-18m) of Eucalyptus crebra with understorey of Allocasuarina inophloia and Callitris glaucophylla	Non-remnant
AQ94	Quaternary	319867	6930410	Woodland (14-20m) of *Angophora leiocarpa* (d) + *E. tereticornis* (sd) with a subcanopy/understorey of *Callitris glaucocarpa* + *Allocasuarina luehmanii* and a groundcover of *Lomandra longifolia.*	Margins of narrow drainage line dissecting gently undulating sandy colluvial slope	11.3.14
AS95	Secondary	323292	6961319	Woodland (14-18m) of *E. crebra* with a subcanopy and understorey of *Callitris glaucophulla* + *Allocasuarina luehmanii.*	Loamy plain	11.5.1
AQ96	Quaternary	322632	6961389	Woodland (7-23m) (disturbed) of *E. crebra* (d) + *E. chloroclada* (sd) + *Corymbia trachyphloia* (a) with a subcanopy and understorey of *Callitris glaucophylla* + *Allocasuarina luehmanii.*	Loamy plain	11.5.1
AS97	Secondary	322736	6962505	Open grassy woodland of *Eucalyptus populnea*.	margins of alluvial plain	11.3.2
AS98	Secondary	293021	6999746	Open forest (18-25m) of *Eucalyptus fibrosa* subsp. *nubila* (d) + *E. crebra* (a).	Colluvial slope formed on fine grained sandstone	11.7.7
AQ99	Quaternary	392804	6999608	Woodland (12-18m) of *E. crebra* (d) + *E. exserta* (sd) + *Angophora leiocarpa* (a) with a shrubby understorey of *Callitris glaucocarpa* and scattered *Lyscicarpus angustifolius.*	Sandstone rise with capping of pisolitic ironstone gravel	11.7.4
AQ100	Quaternary	294408	7000396	Open forest (18-25m) of *Eucalyptus tereticornis* (d) + *Angophora leiocarpa* (a) with a subcanopy and understorey of *Callitris glaucocarpa* and *Allocasuarina luehmanii.*	Alluvial terrace	11.3.4
AQ101	Quaternary	294388	7000462	Woodland (18-25m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) + *E. fibrosa subsp. nubila* (a) with a subcanopy dominated by *Allocasuarina luehmanii.*	Colluvial slope formed on fine grained sandstone	11.9.9a
AQ102	Quaternary	294571	7000208	Woodland (18-22m) of *Angophora leiocarpa* (d) + *E. crebra* (a) and a sparse shrub layer of *Callitris glaucocarpa* and *Petalostigma pubescens.*	Colluvial slope formed on fine grained sandstone	11.9.9a
AQ103	Quaternary	286831	7003658	Woodland (15-18m) of *E. exserta* (d) + *Corymbia trachyphloia* (sd) + *E. crebra* (a).	Coarse grained sandstone rise/ plateau with minor induration and iron staining	11.7.4
AQ104	Quaternary	286644	7003757	Woodland (16-20m) of *E. fibrosa* subsp. *nubila* (d) + *Callitris glaucophylla* (a) + *Lysicarpus angustifolius* (a).	Colluvial slope formed on fine grained sandstone	11.7.7
AQ105	Quaternary	288197	7004384	Open forest (18-25m) of *Eucalyptus tereticornis* (d) + *Angophora floribunda* (sd) + *E. populnea* (a) with a groundcover of *Lomandra longifolia*.	Alluvial terrace	11.3.4
AS106	Secondary	286017	7003777	Woodland (10-14m) of *Eucalyptus exserta* (d) + *E. crebra* + *Callitris glaucophylla* + *Acacia* sp. + *Corymbia trachyphloia* with a lower shrub layer of *Philotheca sporadica*.	Coarse grained sandstone rise/ plateau with minor induration and iron staining	11.7.4
AQ107	Quaternary	286119	7003556	Shrubland with Acacia tenuissima, Acacia spp., *Calitris glaucophylla* with a	Coarse grained sandstone	11.7.5

Site Code	Site Level	E	N	Site Description	Landform	RE
				groundcover of *Triodia* sp.	rise/ plateau with minor induration and iron staining	
AQ108	Quaternary	385678	7004668	Shrubland (regrowth 6-8m) of *Acacia apprepta* with lower shrub layer of *Philotheca sporadica*.	Woodland (10-14m) of E. exserta (d) + E. crebra + Callitris glaucophylla + Acacia sp. + Corymbia trachyphloia with a lower shrub layer of Philotheca sporadica	Non-remnant
AQ109	Quaternary	285802	7006302	Woodland (10-15m) of *Eucalyptus exserta* (d) + *E. crebra* (cd) + *Acacia apprepta* (a) + *Lysicarpus angustifolius* (a) + *Callitris glaucophylla* (a).	Sandstone rises, plateau with minor induratio	11.7.4
AQ110	Quaternary	289446	7009184	Open forest (18-23m) of *Eucalyptus* tereticornis (d) + Angophora floribunda (sd) with a sub canopy of of *Callitris glaucophylla* and groundcover dominated by *Lomandra longifolia*.	Alluvial terrace	11.3.4
AQ111	Quaternary	389567	7009068	Ephemeral wetland of *Eleocharis plana* + *Fimbristylis littoralis* + *Juncus ustitatus* + *Alternanthera dentata*. Potential habitat of *Aponogeton queenslandicus.*	Alluvial overflow depression	11.3.27c
AQ112	Quaternary	290279	7009657	Woodland (15-18m) of *Eucalyptus crebra* (d) + *Angophora leiocarpa* (sd) with a subcanopy of *Callitris glaucocarpa* + *Allocasuarina luehmanii* with scattered shrubs of *Acacia conferta* + *A. crassa* + *A. montana* + *Allocasuarina luehmanii.*	Low rocky rise on sandstone - minor induration in some outcropping areas	11.9.9a
AQ113	Quaternary	291386	7010480	Woodland (15-18m) (heavily disturbed) of *Eucalyptus pilagaensis* with a dense T2 of *Allocasuarina luehmanii* + *Callitris glaucophylla*.	Colluvial slope formed onsandstone	Non-remnant
AS114	Secondary	286183	7012762	Woodland (18-25m) of *E. fibrosa* subsp. *nubila* (d) with sparse T2 of *Callitris glaucophylla* and a sparse shrub layer of *Acacia conferta* + *A. leiocalyx* + *Callitris glaucophylla* + *Dodonaea triangularis.*	Low rise on fine grained sedimentary rock	11.7.7
AQ115	Quaternary	288776	7017496	Open grassy woodland of *Eucalyptus populnea*.	Alluvial floodplain	11.3.2
AQ116	Quaternary	298418	7017125	Open riverine forest of *Eucalyptus camaldulensis* (d) + *E. coolabah* (sd) + *E. tereticornis* (sd) + *Casuarina cuninghamiana* (a) with a sparse T2 of *Acacia stenophylla* + *Casuarina cunninghamiana*. In some areas the low shrub layer is heavily infested by *Riccinus communis** and *Megathrysus maximus* subsp. *maximus** and *Phyla canescens** in groundcover.	Bank of Condamine River - river channel	11.3.25
AQ117	Quaternary	293863	7013421	Riparian open forest (18-26m) of *E. tereticornis* (d) + *E. camaldulensis* (sd) with *E. coolabah* on margins. Dense groundcover of *Lomandra longifolia* with areas of heavy Lippia infestation.	Lower alluvial terrace of Condamine River	11.3.25 (merging with RE 11.3.4)
AQ118	Quaternary	294176	7013375	Permanent waterhole with *Ludwigia peploides* + *Azolla pinnata* fringed with *E. camaldulensis* and *Acacia stenophylla* on margins.	River oxbow on Condamine River	11.3.27c
AS119	Secondary	292545	7012692	Open forest (10-18m) (disturbed) of *E. camaldulensis* with scattered *E. coolabah* and a degraded groundcover dominated by Lippia.	Lower alluvial flat/ depression adjacent to	11.3.4/11.3.25

Site Code	Site Level	E	N	Site Description	Landform	RE
					stream channel	
AQ120	Quaternary	292824	7012705	Regrowth sapling shrubland (3-6m) of *E. coolabah* with occasional *E. coolabah* emergents (8-10m). Groundcover dominated by Lippa.	Alluvial plain	Non-remnant
AS121	Secondary	291456	7015692	Native species dominant grassland.	Alluvial plain, cracking clay soils	11.3.21
AT122	Tertiary	291445	7015736	Grassy open woodland of E. populnea with a sparse shrub layer of *Acacia stenophylla + A. farnesiana* + Alectryon oleofolia + Eucalyptus coolabah.*	Alluvial plain, cracking clay soils	11.3.2
AQ123	Quaternary	290292	7011936	Woodland (10-15m) (advanced regrowth) of *E. populnea* with shrub layer of *Geijera parviflora + Callitris glaucophylla.*	Alluvial plain, cracking clay soils	Non- remnant
AQ124	Quaternary	291341	7012214	Regrowth *Acacia harpophylla* (10-15m) heavily degraded by stock (+/- 0.25 ha).	Alluvial plain	Non-remnant
AS125	Secondary	291722	7008327	Woodland (17-23m) of *E. crebra* (d) + *Angophora leiocarpa* (a) with T2 of *Callitris glaucophylla + Allocasuarina luehmanii*.	Undulating plain formed on degraded coarse - fine grained sandstone	11.9.9a
AQ126	Quaternary	289092	7005832	Ephemeral wetland with fringing *E. tereticornis* woodland.	Alluvial plain	11.3.27c
AQ127	Quaternary	269012	7006066	Permanent waterhole with *Leersia hexandra + Ludwigia peploides and fringed by E. tereticornis + Angophora floribunda* woodland. Feature has been bunded.	Alluvial overflow	11.3.27c
AQ128	Quaternary	289048	7006065	Open forest (20-30m) of *E. tereticornis + Angophora floribunda* with a T2 of *Callitris glaucophylla* and a groundcover dominated by *Lomandra longifolia* with scattered *Arundinella nepalensis + Aristida ramosus.*	Alluvial margins	11.3.4
AQ129	Quaternary	289173	7006046	Woodland (15-20m) of *E. populnea + Callitris glaucophylla* with a dense S1 of C. *glaucophylla + Allocasuarina luehmanii.*	Sandy wash	11.3.18
AS130	Secondary	290159	7006508	Woodland (18-23m) of *E. fibrosa* subsp. *nubila* (d) + *Angophora leiocarpa* (sd) + *E. crebra* (a) and a T2 of *Callitris glaucophylla + Allocasuarina luehmanii.*	Degraded sandstone - undulating colluvial slope	11.7.7
AQ131	Quaternary	289987	7007058	Woodland (15-22m) of *Callitris glaucophylla* with scattered *E. populnea x E. crebra* and a T2 of *E. populnea*. Past management for Cypress production with removal of *E. crebra* and *Angophora leiocarpa*. Heavy infestations of *Bryophyllum* spp. (Mother of Millions).	Alluvial wash over degraded colluvial terrace	11.5.1a
AQ132	Quaternary	290108	7007730	Woodland of *E. populnea (d) + E. pilaegensis (sd) + Callitris glaucophylla* (a).	Dissected colluvial terrace	11.5.1a
AQ133	Quaternary	290321	7068563	Woodland of *E. populnea* (d) + *Callitris glaucophylla* (a) and T2 of *C. glaucophylla + Allocasuarina luehmanii* scattered shrub layer of *Exocarpos cupressiodes* and *Acacia crassa.*	Gently sloping loamy plain formed on fine grained sediments	11.9.7
AQ134	Quaternary	290493	7008502	Woodland (18-23m) of *E. crebra + Angophora leiocarpa* with shrub layer of *Acacia conferta*.	Sandstone outcrop - flat topped plateau with minor induration	11.7.4
AQ135	Quaternary	297082	6998563	Woodland (18-22m) of *E. crebra* (d) + *Angophora floribunda* (a) + *Corymbia trachyphloia* (a) + *E. exserta* (a) + *C. clarksoniana* (a) with a T2/S1 of *Acacia sp. (AQ135/1).*	Deep sandy soils derived from coarse grained sandstone. Minor induration in some	11.9.9a

Site Code	Site Level	E	N	Site Description	Landform	RE
					outcrops	
AQ136	Quaternary	297697	6998661	Woodland (16-22m) of E. crebra with a dense S1 of *Acacia leiocalyx* + *Allocasuarina luehmanii.*	Sandy colluvium from sandstone	11.5.1
AQ137	Quaternary	297697	6998661	Regrowth *Acacia* spp. in disused gravel pit.	Pisolitic ironstone gravel on ridge top	Non-remnant
AS138	Secondary	299572	6999150	Open forest (18-23m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) and sparse shrub layer of *Geijera parviflora.*	Heavy clay alluvium - gilgaid	11.3.1
AQ139	Quaternary	299727	6999025	Regrowth of *E. populnea* (d) + *Allocasuarina luehmanii* + *Geijera parviflora* + *Acacia melvillei* + *Capparis mitchellii.*	Alluvial plain	Non-remnant
AQ140	Quaternary	234180	7104661	Low woodland/shrubland.	Deep sands over clayey sand profile. Indurated sandstone outcrop on plateau margins	11.7.5
AS141	Secondary	240232	7092969	Woodland (18-24m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) + *Corymbia bloxsomei* (a) and a T2/S1 of *Allocasuarina luehmanii* + *Callitris glaucophylla.*	Old loamy plain	11.5.1
AQ142	Quaternary	239955	7090707	Woodland (18-25m) of *Callitris glaucophylla* with occasional emergents of *Angophora floribunda* with a sparse shrub layer of Callitris and a groundcover of *Lomandra longifolia* + *Aristida calycina* + *Leucopogon muticus*. Managed for Cypress production.	Old loamy plain	11.5.1
AQ143	Quaternary	239856	7090723	Open forest of *E. tereticornis* + *Angophora floribunda.*	Narrow riparian fringe. Incised channel on banks of Dogwood Creek	11.3.25
AS144	Secondary	239595	7067965	Woodland (15-22m) of *Callitris glaucophylla* + *E. crebra* + *Angophora leiocarpa* with a T2 of *Callitris glaucophylla* + *Allocasuarina luehmanii*, and a shrub layer of *Acacia barakulensis*. Past management for Cypress production.	Old loamy plain	11.5.1
AQ145	Quaternary	238874	7082459	Woodland (15-20m) of *E. fibrosa* subsp. *nubila* with a T2 of *Callitris glaucophylla* & a sparse shrub layer of *Callitris glaucophylla* + *Leucopogon* sp. + *Acacia semilunata* + *A. triptera*. *Gahnia aspera* prominent in groundcover.	Shallow skeletal soils over indurated sandstone horizon (exposed in creek incision)	11.7.7
AQ146	Quaternary	326691	6974838	Ephemeral wetland dominated by **Phyla canescens.*	Flood overflow channel (ephemeral)	11.3.27c
AS147	Secondary	326506	6974735	Woodland/open forest (20-28m) of *E. tereticornis* (d) + *C. tessellaris* (sd) + *E. camaldulensis* (a) + *Casuarina cunninghamiana* (a) with a mid-dense shrub layer of *Acacia salicina* and *Pittosporum angustifolium* and a grassy groundcover.	Lower alluvial terrace. Heavy clay soils	11.3.4
AQ148	Quaternary	326554	6974646	Riparian open forest (22-28m) of E. *camaldulensis* (d) with a T2 of *Casuarina cunninghamiana* and sparse shrub layer of *Acacia salicina*. Groundcover dominated by *Lomandra longifolia, Panicum* sp., *Eragrostis* sp. with infestations of **Phyla canescens* to 50%.	River bank	11.3.25
AT149	Tertiary	326270	6975698	Woodland (15-20m) of *E. populnea* (d) + *E. tereticornis* (a) with a sparse shrub	Alluvial plain, cracking	11.3.2

Site Code	Site Level	E	N	Site Description	Landform	RE
				layer of *Acacia stenophylla* and **A. farnesiana.*	clay soils	
AQ150	Quaternary	326554	6974646	Woodland (15-20m) of E*. camaldulensis* + *E. tereticornis* with a shrub layer of *Acacia stenophylla* and *Meulenbeckia florulenta*.	Alluvial plain, drainage depressions	11.3.27d
AQ151	Quaternary	332879	6961968	Native species dominant grassland.	Alluvial plain, cracking clay soils	11.3.21
AQ152	Quaternary	316445	6953099	Woodland (20-25m) of *E. crebra* (d) + E. pilaegensis (cd) + Angophora leiocarpa (a) with a T2 and S1 of *Callitris glaucophylla* + *Allocasuarina luehmanii* and a groundcover domianted by *Aristida caput-medusae.*	Gentle hillslope formed on degraded sedimentary rocks. Shallow sandy soils with minor ironstone gravel	11.9.9a
AQ153	Quaternary	316710	6953553	Woodland (18-25m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) + *E. crebra x E. popunea* (a) with a subcanopy dominated by *Allocasuarina luehmanii* + *Callitris glaucophylla* + *Acacia* sp. and *Aristida* spp. + *Lomandra* spp. dominated groundcover.	Fine sandy soils forming loamy plain. Old alluvial surface	11.5.1 /11.5.4
AQ154	Quaternary	326442	6948067	Derived grassland dominated by tussock grasses, *Marsilea* sp., *Aristida* spp., *Ptilotus* sp. + **Phyla canescens*. Formerly woodland of *E. tereticornis* + *C. tessellaris* (ringbarked by landowners in 1960's).	Low rise on alluvial floodplain. Fringes heavy clay plain.	Non-remnant
AQ155	Quaternary	326202	6949249	Woodland (16-20m) of *E. populnea* (d) + *Corymbia tessellaris* (a) + *E. tereticornis* (a) with scattered **Opuntia tomentosa.*	Sandy rise above alluvial clay plain	11.3.2
AQ156	Quaternary	312037	6989919	Open forest (14-18m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) and a T2 of *A. harpophylla* + *C. cristata.*	Gilgaid alluvial plain - heavy clay soils	11.3.1
AQ157	Quaternary	310495	6990163	Secondary woodland (8-15m) (degraded) of *Acacia harpophylla.*	Alluvial plain, cracking clay soils	Non-remnant
AS158	Secondary	303766	6985442	Open forest (12-16m) of *Acacia harpophylla*. Heavily disturbed comprising predominantly secondary growth.	Alluvial plain, gilgai cracking clays	11.3.1
AQ158a	Quaternary	303690	6985379	Regrowth woodland with *Callitris glaucophylla* + *Eucalyptus populnea* + *Angophora floribunda.*	Alluvial flat	Non-remnant
AQ158b	Quaternary	304062	6985288	Riparian woodland with *E. tereticornis* + *E. populnea* + *Angophora floribunda.*	River bank	11.3.25
AQ159	Quaternary	303442	6985855	Woodland with *Casuarina cristata* + *E. populnea* to 20m. Heavily disturbed with frequent canopy gaps.	Alluvial terrace	11.3.17
AS160	Secondary	364411	7037565	Woodland (15-18m) of *E. populnea* with a sparse T2 of *Casuarina cristata* + *Alectryon oleofolius* + *Citrus glauca* and a S1 of *Geijera parviflora* + *Acacia salicina* + *Atalaya hemiglauca* + *Eremophila mitchellii* + *Grevillea striata.*	Sandy rise above alluvial clay plain	11.4.12
AQ161	Quaternary	264250	7037714	Artificial wetland with *Azolla pinnata* + *Marselia sp.* + *Ludwigia peploides* + *Fimbristylis littoralis* + *Eleocharis* sp.	Old loamy plain	Non-remnant
AS162	Secondary	268033	7020437	Woodland (18-22m) of *Acacia harpophylla* with a T2 of *A. harpophylla* + *Casuarina cristata* and a sparse shrub layer of *Geijera parviflora.*	Shallow drainage depression - gilgaid clay plain	11.4.3
AQ163	Quaternary	268370	7020437	Open woodland with *E. piligaensis* + *Casuarina cristata* to 20m. S1 of groved *Melaleuca bracteata* over grassy ground cover.	Shallow drainage depression	11.4.3a

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ164	Quaternary	255175	7042720	Woodland (15-18m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) with a subcanopy of *Callitris glaucocarpa* and a sparse shrub layer of *Allocasuarina luehmanii* + *Callitris glaucocarpa* + *Acacia conferta* + *A. crassa* + *A. triptera* + *Psydrax oleofolia.*	Skeletal sandy soils exposed over fine grained sedimentary rocks (indurated and iron stained).	11.7.4
AQ165	Quaternary	263343	7040488	Woodland of *E. tereticornnis* + *E. coolabah* + *C. tessellaris.*	Alluvial flood plain. Lower alluvial terrace	11.3.4
AS166	Secondary	260625	7036455	Woodland (15-20m) of *E. populnea* (d) with a T2 of *Acacia melvillei* + *Casuarina cristata* + *Eremophila mitchellii* + *Alectryon oleofolia* and a mid-dense shrub layer of *Geijera parviflora* + *Eremophila mitchellii* + *Pittosporum angustifolia.*	Sandy rise above current flood levels	11.4.12
AQ167	Quaternary	260745	7036613	Woodland of *E. populnea* with scattered copses of *Acacia pendula.*	Sandy rise above current flood levels	11.4.12
AQ168	Quaternary	261336	7037082	Woodland (14-18m) of *E. populnea* (d) + with a T2 of *Acacia melvillei.*	Sandy rise above current flood levels	11.4.12
AQ169	Quaternary	262800	7038632	Open forest (14-18m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) and a T2 of *A. harpophylla* and a sparse shrub layer of *Geijera parviflora*.	Gilgaid clay plain	11.4.3
AS170	Secondary	266299	7037383	Open forest (20-25m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) with a shrubby understorey of *Geijera parviflora* + *Ehretia membranifolia* + *Alectryon oleofolia* + *Carissa ovata.*	Gilgaid clay plain above current flood levels	11.4.3
AQ171	Quaternary	266253	7035747	Riparian open forest (20-26m) of E. *camaldulensis* + *E. tereticornis* + *E. coolabah* with a sparse T2 of *Casuarina cunninghamiana*. Scattered shrubs of *Acacia salicina* + *A. stenophylla.*	River Bank	11.3.25
AS172	Secondary	266281	7035937	Woodland (14-18m) of *E. populnea* with a shrubby understorey of *Eremophila mitchellii* + *Geijera parviflora* + *Pittosporum angustifolium* + *Cassine australianum var. integrifolium* + *Capparis mitchellii.*	Sandy alluvial plain above current flood levels	11.4.12
AQ173	Quaternary	265503	7014615	Open forest (16-22m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) with a T2 of *C. cristata* + *A. harpophylla*. Tall shrub layer of **Opuntia tomentosa* and low shrub layer of *Geijera parviflora.*	Clay plain	11.4.3
AQ173a	Quaternary	265486	7014546	Woodland (15-18m) of *E. populnea* with a T2 of *Casuarina cristata* and a S1 of *Geijera parviflora* + *Eremophila mitchellii.*	Clay plain	11.4.12
AQ174	Quaternary	264814	7015675	Woodland (15-20m) of *E. populnea* with T2 of *Callitris glaucophylla*.	Sandy alluvial soil adjacent to creek line	11.3.18
AQ175	Quaternary	259466	7020618	Woodland (15-18m) of *E. populnea* with T2 of *Acacia* sp. (175/1) and shrub layer of *Eremophila mitchellii* + *Callitris glaucocarpa* + *Acacia burrowii* + *A. microsperma.*	Old loamy plain	11.5.1a
AQ176	Quaternary	260357	7019672	Woodland (15-20m) of *E. populnea* with a T2 of *Callitris glaucophylla* + *Allocasuarina luehmanii*, and a sparse shrub layer of *Geijera parviflora* and *Myoporum acuminata.*	Old loamy plain	11.5.1
AQ177	Quaternary	261765	7018110	Woodland/open forest (18-26m) of *E. tereticornis* (d) + *Angophora floribunda*	Alluvial terrace	11.3.4

Site Code	Site Level	E	N	Site Description	Landform	RE
				(sd).		
AQ178	Quaternary	261805	7018212	Woodland (18-25m) of *Angophora floribunda* + *E. tereticornis* with a mid-dense T2 of *Callitris glaucophylla.*	Broad alluvial flood channel	11.3.4
AQ179	Quaternary	262755	7016996	Woodland (18-25m) *Casuarina cristata* + *Acacia harpophylla* with a sparse undertorey of *Geijera parviflora.*	Gilgai clay plain	11.4.3
AQ180	Quaternary	262593	7017194	Woodland of *E. populnea* with scattered *Casuarina cristata* + *Acacia melvillei.*	Loamy clay plain	11.5.1a
AQ181	Quaternary	266430	7013748	Woodland of E. *populnea* + *E. pilaegensis* + *E. crebra*.	Loamy clay plain	11.5.1a
AQ182	Quaternary	266494	7013641	Open forest of *Acacia harpophylla*.	Gilgaid clay plain	11.4.3
AQ183	Quaternary	267533	7013099	Woodland of *E. crebra* + *Angophora leiocarpa* with T2/S1 of *Allocasuarina luehmanii* + *Callitris glaucophylla.*	Sandy plain	11.5.1
AQ184	Quaternary	285135	6971909	Woodland (15-20m) of *Acacia harpophylla* + *E. populnea x E. crebra* with a T2 of *Casuarina cristata* and a shrubby understorey of *Geijera parviflora* + *Eremophila desertii* + *Santalum lanceolatum* + *A. harpophylla.*	Gilgai clay plain	11.4.3
AQ185	Quaternary	294713	6971063	Woodland (14-18m) of *E. crebra x E. populnea* (d) + *Casuarina cristata* (sd) + *Acacia harpophylla* (a) with T2 of *Callitris glaucophylla*.	Sandy plain	11.5.1
AQ186	Quaternary	284764	6969580	Woodland (15-18m) of *E. crebra* (d) + *Allocasuarina luehmanii* (a) and a sparse T2 of *Callitris glaucophylla*. Mid-dense upper shrub layer of *A. luehmanii* + *C. glaucophylla* with a lower layer dominated by *Dodonaea triangularis.*	Gently undulating fine grained sandstone	11.9.9a
AQ187	Quaternary	264902	6368033	Woodland (14-18m) of *E. fibrosa* subsp. *nubila* (d) + *E. crebra* (a) with a sparse T2 and S1 of *Callitris glaucophylla* + *Allocasuarina luehmanii* and scattered *Exocarpos cupressoides* + *Carissa ovata* + *Acacia confertta* + *Bursaria spinosa Acacia muelleriana* + *Dodonaea triangularis.*	Gently undulating fine grained sandstone	11.7.7
AQ188	Quaternary	286130	6964200	Woodland (18-26m) of *E. tereticornis* (d) + *Angophora floribunda* (a) with scattered shrubs of *Acacia muelleriana* + *A. spectabilis* + *Melaleuca decora* with a groundcover of *Carex* sp. + *Lomandra longifolia* + *Arundinella nepalensis.*	Linear riparian expression dissecting remnant surface	11.3.25
AQ189	Quaternary	286279	6964247	Woodland (18-24m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) + *E. crebra x E. populnea* with a T2/S1 of *Allocasuarina luehmanii* + *Callitris glaucocarpa.*	Gently undulating fine grained sandstone	11.9.9a
AQ190	Quaternary	286995	6960606	Woodland (18-26m) of *Angophora leiocarpa* (d) + *E. chloroclada* (a) + *Callitris glaucophylla* (a) with a T2 of *Allocasuarina luehmanii* + *Callitris glaucophylla* and scattered *Acacia leiocalyx* + *A. spectabilis*. Managed for Cypress production.	Gently undulating fine grained sandstone	11.9.9a
AQ191	Quaternary	286894	6963001	Woodland (14-18m) of *E. crebra* (d) + *E. exserta* (a) with a T2 of *Acacia burrowii.*	Loamy plain	11.5.1
AQ192	Quaternary	297862	6962973	Woodland (10-14m) of *E. pilaegaensis* + *Allocasuarina luehmanii* with a dense shrub layer of *Melaleuca* sp.	Loamy plain	11.5.1
AQ193	Quaternary	287802	6965266	Woodland (18-22m) of *E. crebra* (d) + *E. fibrosa* subsp. *nubila* (sd) with a T2 of *Callitris endlicheri* + *C. glaucophylla.*	Loamy plain	11.5.1
AQ194	Quaternary	289770	6964979	Woodland (18-24m) of *E. pilagaensis* (d) + *E. populnea* (sd) with a sparse	Loamy plain	11.5.20

Site Code	Site Level	E	N	Site Description	Landform	RE
				shrublayer of *Acacia muelleriana* and *A. luehmanii* on margins.		
AQ195	Quaternary	290540	6964845	Woodland (15-25m) of *E. pilagaensis* with a sparse shrub layer of *Eremophila mitchellii* + *Senna coronolloides* + *Acacia muelleriana* + *Atalaya hemiglauca* + *Pittosporum angustifolia* + *Capparis mitchellii.*	On a plain with fine silty clay soils possibly alluvium	11.5.20
AQ196	Quaternary	290942	6963654	Woodland (16-20m) of E. crebra (d) + Angophora leiocarpa (sd) with a T2/S1 of Callitris glaucocarpa + Allocasuarina luehmanii with an lower shrub layer of Acacia spp.	Old loamy plain	11.5.1
AQ197	Quaternary	290769	6962138	Woodland (18-24m) of *E. pilagaensis* (d) with shrub layer of *A. luehmanii.*	Old loamy plain	11.5.20
AQ198	Quaternary	293294	6962148	Woodland (20-25m) of *E. crebra* (d) + *Angophora leiocarpa* (a) with a T2 and S1 of *Allocasuarina luehmanii.*	Old loamy plain	11.5.20
AQ199	Quaternary	294750	6962297	Woodland (18-22m) of *E. tereticornis* + *Angophora floribunda* with a sparse shrub layer dominated by *Leptospermum polygalifolia.*	Alluvial terrace	11.3.4
AQ200	Quaternary	295073	6964176	Woodland (15-24m) of *E. pilagaensis* (d) + *E. populnea* (sd) with a shrub layer domainated by *Allocasuarina leuhmannii*+ minor *C. glaucophylla.*	Old loamy plain	11.5.20
AQ201	Quaternary	296235	6963781	Woodland (29-26m) of *Angophora leiocarpa* (d) + *E. chloroclada* (a) with a T2 of *Callitris glaucophylla* + *Lysicarpus angustifolius* and a sparse shrub layer of *Acacia conferta* + *A. burrowii.*	Old loamy plain	11.5.1
AQ202	Quaternary	303109	6963024	Woodland (16-20m) of *E. crebra* (d) + *Angophora leiocarpa* (sd) with a T2/S1 of *Callitris glaucocarpa* + *Allocasuarina luehmanii* with an lower shrub layer of *Acacia* spp.	Old loamy plain	11.5.1
AQ203	Quaternary	306775	6962459	Woodland of *E. crebra* + *Corymbia trachyphloia* + *Callitris glaucophylla* with a mid dense T2 and S1 of *Callitris* + *Xylomelum cunninghamiana* + *Alphitonia excelsa* + *Lysicarpus angustifolius*.	Old loamy plain	11.5.1
AQ204	Quaternary	309237	6962086	Woodland of (18-23m) *E. crebra* + *C. trachyphloia* with a T2 of *Callitris glaucophylla* + *Alphitonia excelsa* + *Acacia conferta.*	Old loamy plain	11.5.1
AQ205	Quaternary	239050	7051803	Woodland (15-18m) of E. crebra (d) with scattered *Allocasuarina luehmanii and Callitris glaucophylla* and a grassy groundcover of *Gahnia aspera* with *Dodonaea biloba*.	Sandy loam soils derived from sedimentary rocks	11.9.9a
AQ206	Quaternary	239217	7053271	Woodland (18-22m) of *E. fibrosa* subsp. *nubila* (d) + *E. crebra* (a) with a sparse shrub T2 of *Callitris glaucophylla* and a sparse shrub layer of *Acacia muelleriana* + *Dodonaea triangularis* + *Maytenus cunninghamii* + *Jasminum didymum* subsp. *lineare* + **Opuntia tomentosa*. Groundcover dominated by *Gahnia aspera* + *Aristida* spp.	Sandy loam soils derived from sedimentary rocks	11.7.7
AQ207	Quaternary	239405	7054768	Woodland (14-18m) of *E. crebra* (d) + *E. exserta* (sd) + *E. fibrosa* subsp. *nubila* (a) + *Corymbia trachyphloia* (a) with shrub layer of *Callitris glaucophylla* + *Acacia* spp.	Sandstone rise / plateau with minor induration	11.7.4
AQ208	Quaternary	240261	7061789	Woodland (15-18m) of *E. crebra* (d) with a T2 and S1 dominated by *Callitris glaucophylla* and a grassy groundcover of *Gahnia aspera* with *Dodonaea biloba.*	Undulating loamy plain derived from indurated sandstone. Likely indurated hardpan layer	11.7.4

Site Code	Site Level	E	N	Site Description	Landform	RE
					below surface	
AQ209	Quaternary	239634	7062594	Woodland (18-23m) of *E. crebra* (d) + *E. fibrosa* subsp. *nubila* (a) with a T2/S1 of *Callitris glaucocarpa* + *Allocasuarina luehmanii* and a groundcover domaited by *Dodonaea biloba*.	Gently undulating sandstone hills	11.7.7
AQ210	Quaternary	237677	7060965	Woodland (15-20m) of *E. crebra* (d) + *E. populnea* (a) with a shrub layer of *Allocasuarina luehmanii* + *Acacia mulleriana* + *Acacia* sp. Groundcover dominated by *Aristida* spp. + *Gahnia aspera*.	Loamy plain with ironstone gravel at surface. Indurated hardpan likely at depth	11.7.4
AQ211	Quaternary	235818	7060658	Regrowth of *Callitris glaucophylla*.	Old loamy plain woth calcrete hardpan at 1m depth exposed at creek crossing	Non-R
AQ212	Quaternary	232393	7058434	Woodland (14-19m) of *E. crebra* (d) + *E. populnea* (sd) with a understorey of *E. populnea* and *E. crebra* saplings + *Allocasuarina luehmanii* + *Callitris glaucophylla.* Groundcover dominated by *Aristida* spp. + *Dodonaea biloba*.	Gently undulating hills formed on fine grained sandstone with minor iron staining and induration	11.7.4
AQ213	Quaternary	231839	7058502	Open forest (18-25m) of *Eucalyptus* sp. (213/1) + *E. fibrosa* subsp. *nubila* + *E. crebra* with a T2 of *Callitris glaucophylla*.	Old loamy plain formed on fine grained sandstone	11.7.7
AQ214	Quaternary	231336	7058535	Woodland/open forest (15-20m) of *Acacia shirleyi* + *E. fibrosa* subsp. *nubila* + *E. crebra*.	Indurated coarse grained sandstone outcrop	11.7.2
AQ214a	Quaternary	228569	7058460	Low woodland/shrubland with *A.shirleyi* + *E. fibrosa subsp. nubila* emergents. Dense S1 of *Acacia sp.*	Skeletal soils on fine grained sandstone	11.7.2
AQ215	Quaternary	227804	7058423	Woodland/open forest of *E. crebra* (d) + *Callitris glaucophylla* (sd) + *Brachychiton populneus* (a) + *Eucalyptus tenuipes* (a).	Sandstone jump-up. Minor induration and iron staining	11.7.4
AQ216	Quaternary	224984	7058927	Woodland (20-26m) of *E. tereticornis* (d) + *Angophora floribunda* (a) with a shrub layer of *Melaleuca viminalis* + *Leptospermum polygalifolium* and a groundcover of *Lomandra longifolia* + *Imperata cylindrica* + *Arundinella nepalensis.*	Alluvial channels and terraces of Dogwood Creek	11.3.4/11.3.25
AQ217	Quaternary	223697	7060507	Woodland (15-20m) of *Eucalyptus* sp. (218/1) + *E. crebra* + *Angophora leiocarpa* with a shrub layer of *Leptospermum polygalifolium* + *Acacia bancroftii* + *Eucalyptus bloxsomei.*	Gentle hillslope formed on degraded sedimentary rocks. Shallow sandy soils.	11.5.1
AQ218	Quaternary	218153	7065329	Woodland of *E. crebra* + *E. exserta* + *E. tenuipes* with shrub layer of *Aphitonia excelsa.*	Skeletal soils on fine grained sandstone. Minor induration and iron staining	11.7.4
AQ219	Quaternary	259165	7074386	Woodland of *E. crebra* with a T2 of *Callitris glaucophylla* and a shrub layer of *Melaleuca uncinata* + *Acacia* sp. + *A. barakulensis* (219/1).	Deep sandy soils derived from coarse grained sandstone.	11.7.4

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ220	Quaternary	219026	7074441	Shrubland (2-3m) of *Melaleuca uncinata* (d) with emergents of *E. exserta* + *E. bloxsomei*. Diverse shrub layer includes *Hakea pungens, Calytrix tetragona* + *Leucopogon muticus* + *Acaci*a sp. (220/3) + *Boronia bipinnata* + *Acacia* sp. (220/5)	Sandstone rises/plataeu	11.7.5
AQ221	Quaternary	209596	7075800	Shrubland (1-2m) of *Calytrix tetragona* with emergent of *E. exserta* + *E. tenuipes.*	Pavement on indurated sandstone	11.7.5
AQ222	Quaternary	258576	7051194	Woodland (15-18m) of *E. crebra* (d) + *E. populnea* (a) + *E. crebra x E. populnea* (a) + *Angophora leiocarpa* (a) with a T2 of *Callitris glaucophylla* + *Allocasuarina luehmanii* + *Brachychiton populneus*. Sparse groundcover of *Gahnia aspera* + *Dodonaea biloba.*	Undulating plain formed on silty loam soils	11.5.1
AQ222a	Tertiary	259132	7051088	Woodland to 20m with dominant E. crebra + E. populnea + Angophora leiocarpa. Dense S1/T2 of *Allocasuarina leuhmannii* + *Callitris glaucophylla*.	Undulating plain formed on silty loam soils	11.5.1
AQ223	Quaternary	259702	7050730	Riparian woodland (18-25m) of *E. tereticornis* + *Angophora floribunda* with a T2 of *Callitris glaucophylla* and a sparse shrub layer of *Acacia semilunata* and *Leptospermum polygalifolium* (in creek only). Groundcover infested with Mother of Millions.	River bank	11.3.25
AQ224	Quaternary	259863	7050807	Woodland with *E. crebra* + *E. piligaensis* + *E. populnea* to 23m. Dense T2 of *Callitris glaucophylla, Casuarina cristata, Allocasuarina leuhmannii, Acacia spp.*	Sandy soils on residual plain	11.5.1
AQ225	Quaternary	248195	7062105	Advanced regrowth of *Acacia harpophylla* (8-12m).	Clay plain with gilgai development	11.4.3
AQ226	Quaternary	248254	7062074	Open forest/woodland (18-24m) of *E. piligaensis* (d) + *E. populnea* (sd) + *E. tereticornis* (a)(in drainage line) with a shrub layer of *Eremophila desertii* + *Geijera parviflora.*	Silty alluvial plain	11.3.26
AQ227	Quaternary	246142	7061412	Woodland of *E. crebra* (d) + *Angophora leiocarpa* (a) with a sparse T2 of *Callitris glaucophylla* with a shrub layer of *Acacia leiocalyx* + *A. semilunata* + *A. conferta* + *A. muelleriana*. Groundcover dominated by *Dodonaea biloba*.	Undulating plain formed on silty loam soils	11.5.1
AQ228	Quaternary	245196	7061371	Woodland of *E. crebra* (d) + *Angophora leiocarpa* (a) with a sparse T2 of *Callitris glaucophylla* with a shrub layer of *Leucopogon* sp. + *Acacia leiocalyx* + *A. semilunata* + A. sp. (228/1) + *A. tenuissima*. Groundcover dominated by *Dodonaea biloba*.	Undulating plain formed on silty loam soils	11.5.1
AQ229	Quaternary	241694	7062737	Woodland (23m) with dominant E. crebra, E. populnea*.* Sparse S1 of *A. leuhmannii* + *Callitris glaucophylla*. Ground cover of *Dodonaea triangularis*.	Silty loam soils. Residual plain	11.5.1
AQ230	Quaternary	219851	7079034	Woodland (10-15m) of *Corymbia bloxsomei* with a sparse T2 of *Callitris glaucophylla* + *E. tenuipes* + *Allocasuarina inophloia* + *Lysicarpus angustifolius.* Diverse shrub layer of *Hakea pungens* + *Acacia conferta* + *A. barakulensis* + *Leucopogon sp.* + *Grevillea singularis* + *Homoranthus* sp.	Sandstone plateau/ rise	11.7.4
AQ231	Quaternary	220044	7089484	Woodland (18-25m) of *Corymbia variegata* (d) + *E. crebra* (a) with a T2 of *E. exserta* + *Acacia shirleyi* and a sparse shrub layer of *Acacia leiocalyx, A. crassa* + *Petalostigma pubescens* + *Alphitonia excelsa* + *Allocasuarina*	Sandstone plateau	11.7.4

Site Code	Site Level	E	N	Site Description	Landform	RE
				luehmanii.		
AQ232	Quaternary	222616	7093305	Woodland (18-25m) of *Corymbia variegata + E. crebra* with a dense shrub layer of *Alphitonia excelsa + A. crassa.*	Sandstone plateau	11.7.4
AQ233	Quaternary	210233	7096674	Riparian woodland (18-25m) of *E. tereticornis + Angophora floribunda* with *E. populnea* on margins.	Lower alluvial terrace	11.3.4
AQ234	Quaternary	208471	7095222	Woodland/open forest of Acacia harpophylla (d) + Casuarina cristata (sd) + Brachychiton rupestre (a)	Rolling hills formed on fine grained sedimentary rocks	11.9.5
AQ234a	Quaternary	242838	6869357	Woodland (10-15m) (disturbed) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) + *E. populnea* (a) with a shrubby understorey of *Geijera parviflora + A. harpophylla + *Opuntia tomentosa + Eremophila desertii.*	Heavy clay soils with gilgai	11.4.3
AS235	Secondary	255163	6865954	Woodland (18-25m) of *Acacia harpophylla* (d) + *Casuarina cristata* (a) with a T2 of *A. harpophylla + C. cristata*. Shrub layer of *Geijera parviflora + Melaleuca bracteata + Alectryon oleofolia + *Opuntia tomentosa. Groundcover of Paspalidium caespitosum + Atriplex semibaccata*. Bendidee NP	Heavy clay soils with gilgai	11.4.3
AQ236	Quaternary	255538	6868978	Woodland (15-20m) of *E. pilagaensis* (d) + *E. populnea* (sd) + *Acacia excelsa* (a) + *Angophora leiocarpa* (a) with a mid dense T2 of *Allocasuarina luehmanii + Callitris glaucophylla + C. endlicheri*, and a spare shrub layer of *Geijera parviflora + A. luehmanii.*	Old loamy plain	11.5.20
AQ237	Quaternary	256531	6869402	Woodland (15-22m) of *Acacia harpophylla + Casuarina cristata*.	Heavy clay soils with gilgai	11.4.3
AQ238	Quaternary	255596	6869923	Non remnant grassland formerly Brigalow forest.	Heavy clay soils with gilgai	Non-R
AQ239	Quaternary	255711	6870819	Woodland (15-22m) of *Acacia harpophylla + Casuarina cristata*.	Heavy clay soils with gilgai	11.4.3
AQ240	Quaternary	255768	6871334	Woodland (15-18m) of *E. pilaegensis* (d) + *E. crebra* (sd) + *Allocasuarina luehmanii + Callitris glaucophylla* with a shrubby understorey of *Geijera parviflora*.	Sandy plain	11.5.20
AQ241	Quaternary	256557	6872167	Woodland (15-18m) of *Callitris glaucophylla* with scattered *E. chloroclada + Allocasuarina luehmanii + Angophora leiocarpa*. Sparse shrub layer of *Acacia conferta + Leucopogon* sp. Managed for Cypress production, Bendidee State Forest.	Sandy plain	11.5.1
AQ242	Quaternary	257788	6872060	Woodland (14-18m) of *E. piligaensis* (d) + *Angophora leiocarpa* (a) + *Corymbia clarksoniana* (a) with a T2 of mid dense shrubby layer of *Allocasuarina luehmanii + Callitris glaucophylla*, and a spare shrub layer of *Geijera parviflora + A. luehmanii, Callitris + Acacia oswaldii.*	Sandy plain	11.5.20
AQ243	Quaternary	260619	6871719	Woodland (14-20m) of *E. crebra* (d) + *Callitris glaucophylla* (sd) + *Allocasuarina luehmanii* (sd) + *E. chloroclada* (a) + *Angophora leiocarpa* (a).	Sandy plain	11.5.1
AQ244	Quaternary	260367	6870014	Woodland (15-18m) of *E. populnea* (d) + *Casuarina cristata* (sd) with a shrubby understorey of *Geijera parviflora + Eremophila mitchelii.*	Sandy plain	11.5.1a
AQ245	Quaternary	260117	6868060	Woodland (10-15m) of *E. populnea* (d) with a sparse T2 of *Casuarina cristata*	Sandy plain	11.5.1a

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				and a shrubby understorey of *Eremophila mitchellii* (d) + *Callitris glaucophylla* (a) + *Geijera parviflora* + *Dodonaea spathulata* + *Acacia decora* + *Allocasuarina luehmanii.*		
AQ246	Quaternary	259715	6865206	Woodland (15-18m) of *Angophora leiocarpa* with a mid dense T2 of *Allocasuarina luehmanii* + *Callitris glaucophylla* and a sparse shrub layer of *Acacia conferta*.	Sandy plain	11.5.1
AQ247	Quaternary	265023	6863839	Woodland/open forest (18-23m) of *E. populnea* (d) + *Casuarina cristata* (cd) + *E. piligaensis* with a sparse shrub layer of *Geijera parviflora*.	Sandy plain	11.5.1a
AQ248	Quaternary	266154	6862503	Open forest 15-20m of *Casuarina cristata* and scattered *E. populnea*. Mid dense shrub layer of *Geijera parviflora* (d) + **Opuntia tomentosa* + *Eremophila desertii* + *Apophyllum anomalum* + *Capparis canescens* + *Citrus glauca.*	Sandy plain	11.5.1a
AQ249	Quaternary	265699	6859130	Woodland of *E. populnea* (d) + *E. chloroclada* (a) + *C. clarksoniana* (a) with a T2 of *Allocasuarina luehmanii* + *Callitris glaucophylla.*	Sandy plain	11.5.1a
AQ250	Quaternary	266047	6858536	Woodland (14-18m) of *E. populnea* with a T2 of *Allocasuarina luehmanii* + *Callitris glaucophylla.*	Sandy plain	11.5.1a
AQ251	Quaternary	263876	6858107	Woodland (11-15m) of *E. populnea* with a T2 and S1 dominated by *Callitris glaucophylla* and scattered *Geijera parviflora*.	Sandy plain	11.5.1a
AQ252	Quaternary	267834	6856805	Woodland (16-22m) of *E. populnea* (d) + *Acacia harpophylla* (cd) + *Casuarina cristata* (cd) with a shrub layer of *Geijera parviflora* + *Eremophila mitchellii.*	Sandy plain (possibly recent alluvium??)	11.3.17
AQ253	Quaternary	266819	6856008	Open forest/woodland (18-23m) of *Angophora floribunda* (d) + *E. tereticornis* (a) with T2 of *Callitris glaucophylla.*	Sandy plain (possibly recent alluvium??)	11.3.4
AQ254	Quaternary	265143	6855096	Woodland (12-15m) of E. populnea with a T2/S1 of *Callitris glaucophylla.*	Sandy plain	11.5.1
AQ255	Quaternary	308395	6894077	Woodland (15-18m) of *Angophora leiocarpa* (d) + *E. apothalassica* (sd) + *E. terrica* (a) + *E. exserta* (a) with a T2 of A*llocasuarina inophloia* + *Callitris endlicheri* + *Petalostigma pubescens* and a shrub layer of *Jacksonia scoparia* + *Xylomelum cunninghamiana* + *Leucopogon muticus* + *Petrophile canescens*. Wondul Range NP.	Sandy plain	11.5.4
AQ256	Quaternary	307095	6892401	Woodland of *Corymbia trachyphloia* (d) + *E. fibrosa* subsp. *nubila* (sd) with a T2 of *Allocasuarina inophloia* and a shrub layer of *Jacksonia scoparia* + *Acacia conferta* + *Dodonaea triangularis* + *Exocarpos cupressoides+ Acacia crassa.*	Duricrust, lateritic jump up	11.7.4
AQ257	Quaternary	306824	6892544	Woodland (13-16m) of *Corymbia trachyphloia* + *E. decorticans* + *E. terrica* + *Allocasuarina inophloia.* T2/S1 dominated by *A. inophloia* with scatttered low shrubs of *Boronia bipinnata* + *Dodonaea triangularis* + *Styphlea viridis* + *Acacia conferta* + *A. crassa* + *Leucopogon muticus* + *Pomaderris* sp.	Duricrust, lateritic jump up	11.7.4
AQ258	Quaternary	302973	6894077	Woodland (18-22m) of *E. crebra* (d) + *Angophora leiocarpa* (a) with a T2/S1 of *Allocasuarina luehmanii* + *Calitris glaucohylla* with scattered *Acacia neriifolius*.	Sandy plain	11.5.4
AQ259	Quaternary	312590	6953107	Woodland of *E. crebra* + *A. leiocarpa*. T2 of *E. crebra* + *Callitris glaucophylla.*	Scree slope on margins of ironstone jump up	11.7.4
AQ260	Quaternary	313718	6952907	Woodland of *E. populnea* (18m) with S1 of *Eremophila mitchelli* + *Callitris glaucophylla* + *Geijera parviflora.*	Gentle footslope fringing jump-up - loamy plain	11.5.1a

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AQ261	Quaternary	314973	6953247	Regrowth woodland of *E. populnea* + *E. crebra* to 15m.	Dissected plain with silty loam soils	Non-remnant
AQ262	Quaternary	314881	6952562	Woodland of *E. crebra* + *E. populnea x crebra.* Dense S1 of *Callitris glaucophylla* + *Allocasuarina leuhmannii.*	Gently sloping colluvial plain	11.5.1a
AQ263	Quaternary	315699	6952614	Woodland (20m) with *Angophora leiocarpa, E. crebra, C. trachyphloia*. Dense S1/T2 of *Callitris glaucophylla, Allocasuarina leuhmanni, Acacia crassa*.	Gravelly ridge with ironstone	11.7.4
AQ264	Quaternary	316079	6952484	Woodland (20m) with *E. crebra,* and *C. trachyphloia*. Dense S1/T2 of *Allocasuarina leuhmanni, Callitris glaucophylla, Acacia crassa*.	Footlslope - plain formed with silty loam soils	11.5.1
AQ265	Quaternary	316195	6952553	Woodland (20m) with *E. crebra*. S1/ T2 of *Allocasuarina leuhmanni, Acacia conferta, Acacia crassa.*	Loamy plain formed below sandstone scarp	11.5.1
AQ266	Quaternary	316287	6953372	Woodland (20m) with *E. crebra, C. trachyphloia*. Dense S1 of *Callitris glaucophylla, Acacia crassa.*	Gravelly ridge with ironstone	11.7.4
AQ267	Quaternary	316591	6954431	Woodland to 27m with dominant *E. tereticornis*. Dense S1 of *Acacia crassa*.	Incised alluvial plain	11.3.25
AQ268	Quaternary	316264	6955189	Woodland to 18m with dominant *E. crebra*. Site has been heavily thinned/logged.	Gently sloping colluvial plain	11.5.1
AQ269	Quaternary	316761	6955742	Woodland (20m) with *E. crebra*. T2 of *Callitris glaucophylla* + *Allocasuarina leuhmanii.*	Gentle slope fringing ironstone jump-up.	11.9.9a
AQ270	Quaternary	315016	6956654	Woodland (20m) with *E. crebra*. Dense T2 of *Callitris glaucophylla*.	Suppressed rise with capping of ironstone gravel	11.7.4
AQ271	Quaternary	314962	6956319	Regrowth woodland (to 15m) with dominant of *E. crebra* + *Angophora leiocarpa.* Mid-dense S1 of *Callitris glaucophylla* to 15m	Suppressed rise with capping of ironstone gravel	Non-remnant
AQ272	Quaternary	314004	6956860	Woodland of Angophora *leiocarpa* on drainage channel. Heavily disturbed with low S1 of *Callitris glaucophylla*.	Eroded stream channel	11.3.4
AQ273	Quaternary	313195	6956968	Woodland with *E. populnea* + *E. crebra*. Dense T2 of *Callitris glaucophylla*.	Gentle colluvial slope on jump-up margins	11.5.1a
AQ274	Quaternary	312753	6957241	Woodland of *E. crebra* to 20m with T2 of *Callitris glaucophylla, Allocasuarina leuhmanii*	Low rise on sedimentary rock with minor induration and iron staining	11.7.4
AQ275	Quaternary	311267	6957365	Woodland of *E. populnea* (15m) on roadside verge. Narrow fringe < 20m wide.	Plain formed on silty loam soils	Non-remnant
AQ276	Quaternary	311308	6957095	Secondary shrubland/low woodland of *E. populnea* (to 5m) + *E crebra*.	Plain formed on silty loam soils	Non-remnant
AQ277	Quaternary	311872	6957786	Woodland of *E. crebra* + *C. trachyphloia* (to 20m). Dense T2 of *C. glaucophylla*.	Jump-up formed on indurated sandston	11.7.4
AQ278	Quaternary	316920	6956536	Woodland of *E. populnea* to 18m. Narrow roadside verge.	Silty alluvial plain	Non-remnant
AQ279	Quaternary	317088	6956514	Woodland to 15m dominated by E. populnea with S1 of *Allocasuarina leuhmanii, Callitris glaucophylla, Alectryon* sp. + *E. populnea.*	Plain formed on silty loam soils	11.5.1a
AQ280	Quaternary	318090	6957229	Secondary woodland (15m) with dominant *E. populnea* + *C. tessellaris*.	Alluvial flat/ drainage	11.3.2

Site Code	Site Level	E	N	Site Description	Landform	RE
					depression	
AQ281	Quaternary	319502	6956188	Woodland with *Angophora floribunda*. Dense S1 of *Callitris glaucophylla* + *A. leuhmannii.*	Alluvial flat/ drainage depression	11.3.2
AQ282	Quaternary	320004	6956127	Woodland of *Acacia harpophylla* with scattered *E. piligaensis*. Abundant mistletoe.	Alluvial flat with heavy clay soils	11.3.1
AQ283	Quaternary	320936	6955957	Woodland with *E. populnea*. Narrow roadside verge <10m wide.	Alluvial flat	Non-remnant
AQ284	Quaternary	322035	6955108	Regrowth *Acacia harpophylla* to 10m.	Alluvial flat	Non-remnant
AQ285	Quaternary	322554	6952888	Riparian woodland to 25m with dominant *E. camaldulensis* on inner stream banks. Merges with *E. tereticornis* woodland on adjacent river flats.	River Bank	11.3.25
AQ286	Quaternary	321569	6954252	Woodland to 20m with dominant *E. crebra*. Dense T2 of *Callitris glaucophylla*. Heavily disturbed.	Low rise on sedimentary rock with iron-stone gravel	11.7.4
AQ287	Quaternary	323124	6958439	Woodland of *E. populnea* to 18m and S1 dominated by *A. salicinia*. Mixed native/exotic ground cover. Roadside verge > 25m width.	Alluvial flat	11.3.2
AQ288	Quaternary	323795	6959149	Woodland of *E. populnea* + *E. tereticornis* to 23m and S1 dominated by *A. salicinia.* Mostly native grasses forming ground cover. Roadside verge.25m width.	Alluvial flat	11.3.2
AQ289	Quaternary	326724	6963502	Tall woodland to 23m with *E. tereticornis* + *C. tessellaris*. Large portion of canopy trees senescent.	River bank merging into T1 alluvial terrace	8b
AQ290	Quaternary	326029	6962699	Woodland of *E. populnea* to 20m. Heavily disturbed - dominated by secondary growth	T2 alluvial terrace	11.3.2
AQ291	Quaternary	322808	6962874	Woodland with *E. populnea* (18m). Heavily disturbed with major canopy senesence.	Swampy alluvial flat/depression	11.3.2
AQ292	Quaternary	321865	6962341	Woodland with *E. tereticornis* + *E. crebra* + *E. populnea* to 23m. Dense S1 of *Allocasuarina leuhmannii*.	Margins of LZ5 overlapping with alluvial landforms on nth side of access track.	11.5.1
AQ293	Quaternary	321625	6961865	Woodland of *E. tereticornis* + *E. crebra* to 25m. Dense S1 of *A. leuhmannii, Petalostigma pubescens, Callitris glaucophylla.*	Low rise with loamy clay soils	11.5.1
AQ294	Quaternary	320564	6963680	Woodland to 18m with dominant *E. populnea*. Grassy groundcover.	Low alluvial rise	11.3.2
AQ295	Quaternary	320499	6976452	Woodland with *E. populnea* to 20m (heavily disturbed).	Silty alluvial plain - interface between LZ3 and LZ5.	11.3.2
AQ296	Quaternary	316824	69767475	*E. tereticornis* + *E. crebra* woodland.	Low rise - old alluvial surface	11.5.1a
AQ297	Quaternary	262099	7041628	Woodland of *E. populnea* (15m) with T2 of *Eremophila mitchelli, Allocasuarina leuhmannii, Acacia salicinia,* and *Brachychiton populnea.*	T2 alluvial terrace	11.3.2
AQ298	Quaternary	262750	7042686	Brigalow woodland.	Alluvial flat	11.3.1
AQ299	Quaternary	262438	7037737	Regrowth woodland with E. *populnea* + *Allocasuarina leuhmannii* + *Callitris glaucophylla* to 12m.	Low rise above alluvial plain	Non-remnant
AQ300	Quaternary	264361	7041413	Woodland of *E. populnea* + *Casuarina cristata* with S1 of *Eremophila mitchellii*.	Sandy loam soils. Older	11.4.12

Site Code	Site Level	E	N	Site Description	Landform	RE
					alluvial surface sitting above current flood levels	
AQ301	Quaternary	263488	7045397	Woodland of *E. populnea* to 18m with T1 of *Eremophila mitchellii*.	Sandy loam soils. Older alluvial surface sitting above current flood levels	11.4.12
AQ302	Quaternary	262873	7045878	Woodland of *E. populnea* + *Callitris glaucophylla* to 15m. Clay soils derived from sedimentary rock.	Clay loam soils - weathered plain	11.5.1a
AQ303	Quaternary	262598	7046406	Woodland with *E. piligaensis* + *E. populnea*.	Clay loam plain derived from weathered sandstone	11.7.4
AQ304	Quaternary	262237	7046960	Woodland of *E. populnea* to 12m.	Gently sloping alluvial depression	11.3.2
AQ305	Quaternary	261121	7047430	*E. populnea* woodland with grassy groundcover. Scattered shrubs of *Callitris glaucophylla.*	Deeply weathered clay loam plain	11.5.1a
AQ306	Quaternary	260322	7048034	Woodland to 23m with dominant *E. crebra* + *Angophora leiocarpa*. T2 of *Callitris glaucophylla.*	Loamy plain formed above indurated sandstone	11.7.4
AQ307	Quaternary	262557	7042538	Woodland of *E. populnea* to 20m. Heavily disturbed.	Alluvial flat	11.3.2
AQ308	Quaternary	202193	7043500	Regrowth *Callitris glaucophylla* + *Angophora leiocarpa* + *Allocasuarina leuhmannii* to 12m. Scattered remnant emergent trees to 20m.	Stony rise on deeply weathered sandstone.	Non-remnant
AQ309	Quaternary	261855	7044911	Regrowth of *Casuarina cristata* with emergent eucalypts (*E. crebra* + *E. piligaensis*).	Sedentary clay soils	Non-remnant
AQ310	Quaternary	261785	9044755	Regrowth *Acacia harpophylla* to 10m.	Sedentary clay soils	Non-remnant
AQ311	Quaternary	262371	7044574	Woodland of *E. piligaensis* with T2 of *A. harpophylla* + *C. cristata*. S1 dominanted by *Geijera parviflora*. Narrow roadside verge <10m wide.	Silty clay soils.	Non-remnant
AQ312	Quaternary	266777	7042323	Woodland to 25m with E. *tereticornis* + *Angophora floribunda* + occasional *E. coolabah*. S1 of *Acacia salicinia*.	Lower alluvial terrace	11.3.4
AQ313	Quaternary	267967	7043798	Woodland of *E. populnea* to 15m. S1 of *Alectryon* sp. + *Geijera parviflora* + *Acacia salicinia*. Abundant Mistletoe.	Red clay loam soils. Old alluvial plain above current flood levels	Non-remnant
AQ314	Quaternary	269402	7041926	Woodland of *E. populnea* to 15m with T2 of *A. harpophylla* + *C. cristata*. Dense S1 of *Eremophila mitchellii.*	Red clay loam soils. Old alluvial plain above current flood levels	11.4.12
AQ315	Quaternary	267551	7042420	Woodland of *C. tessellaris* + *E. populnea* + *Angophora floribunda* + *E. tereticornis* to 23m.	T2 alluvial terrace	11.3.4
AQ316	Quaternary	267513	7042335	Open forest to 30m with *E. tereticornis* + *Angophora floribunda*. S1 dominated by *A. salicinia.*	T1 alluvial terrace	11.3.4
AQ317	Quaternary	269182	7034080	Open forest (riparian) to 25m with *E. tereticornis* + *E. coolabah* + *Casuarina cunninghamiana*. S1 of *Acacia salicinia.*	River Bank	11.3.25
AQ318	Quaternary	264368	6863943	Open forest with *C. cristata* + *E. populnea* (occasional) to 18m.	Sedentary clay soils with gilgai	11.4.3

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ319	Quaternary	266506	6861933	Woodland to 23m with dominant *C. clarksoniana* + *E. chloroclada* + *Callitris glaucophylla* + *E. populnea* + *C. trachyphloia*. S1 of *Callitris glaucophylla* + *Allocasuarina leuhmannii.*	Loamy clay plain	11.5.4
AQ320	Quaternary	266998	6866859	Woodland with *E. populnea* with sparse T2 of *Casuarina cristata*. S1 of *Eremophila mitchellii.*	Clay loam plain. Gentle rise above alluvial flood plain	11.4.12
AQ321	Quaternary	269031	6969819	Woodland of *Acacia harpophylla* with *Casuarina cristata* to 15m. Scattered *E. piligaensis*. Roadside remnant.	Sedentary clays with gilgai	11.4.3
AQ322	Quaternary	272617	6871952	Woodland with *E. piligaensis* + *E. populnea* + *C. crristata* + *A. harpophylla*. S1 dominated by Geijera salicifolia	Sedentary clays with gilgai	11.4.12
AQ323	Quaternary	276585	6871450	Woodland with E. piligaensis + E. crebra + Angophora leiocarpa to 23m. Dense T2 of *Callitris* + *Allocasuarina leuhmannii.*	Weathered plain formed on clay loam soils	11.5.20
AQ324	Quaternary	270662	6873947	Woodland of *E. populnea* (to 15m) wih dense S1 of *Callitris glaucophylla* + *Eremophila mitchelli* + *Geijera parviflora.*	Clay loam plain on margins of watercourse	11.5.1a
AQ325	Quaternary	270662	6873947	Woodland to 15m with *E. populnea* + *Callitris*. Dense S1 of *Callitris glaucophylla* + *Allocasuarina leuhmannii.*	Gravel scrape exposing indurated fine grained sandstone with minor iron staining	11.7.4??
AQ326	Quaternary	270683	6875127	Woodland to 15m with *E. exserta* + *E. crebra* + *Callitris glaucophylla*. T2 of *Acacia sp.* + *Callitris glaucophylla*. S1 of *Micromyrtus sessilis* + *Philotheca sproradica*	Jump-up formed on indurated sandstone	11.7.4
AQ327	Quaternary	270193	6879702	Open shrubby woodland of E. crebra. T2/S1 of *Callitris glaucophylla* + *Acacia spp.*	Iron stained sandstone jump up	11.7.4
AS343	Secondary	314698	6997036	Grassland (native).	Alluvial plain	11.3.21
AS344	Secondary	315960	6996455	Woodland (12-16m) of *Eucalyptus populnea.*	Alluvial plain	11.3.2
AQ345	Quaternary	316278	6996422	Woodland of *Eucalyptus populnea*.	Alluvial plain	11.3.2
AS346	Secondary	323262	6958112	Open woodland (25-30m) of *Eucalyptus tereticornis* (heavily disturbed with extensive timber extraction. Heavily grazed)	Alluvial plain	Non Remnant
AQ347	Quaternary	323157	6957887	Herbland/grassland dominated by **Phyla canescens* with *Ludwigia peploides*, *Azolla pinnata* and Cyperus sp. Margins of large man made wetland.	Alluvial plain	Non Remnant
AT348	Tertiary	322858	6957742	Woodland (28-32m) of *Eucalyptus tereticornis* with a sparse subcanopy of *Angophora floribunda* and a very sparse shrub layer of *Acacia salicinia*.	Alluvial plain	11.3.25
AS349	Secondary	326778	6963387	Woodland (12-18m) of *Eucalyptus populnea* (d) with *E. tereticornis* (sd) and *Corymbia tessellaris* (a).	Alluvial plain (terrace)	11.3.2
AQ350	Quaternary	326864	6963323	Grassland dominated by **Chloris gayana.*	Alluvial plain	Non Remnant
AS351	Secondary	326636	6964042	Woodland (14-18m) of *Corymbia tessellaris* + *Eucalyptus tereticornis* + *E. populnea.*	Alluvial plain	11.3.4
AQ352	Quaternary	326530	6964056	Tall woodland / Open forest (25-30m) on lower alluvial terrace (T1). Dominant species include *Eucalyptus tereticornis, Corymbia tessellaris, Angophora floribunda.* Ground cover of *Sida retusa, Chloris sp.*, Verbena tenuisecta**	Alluvial plain	11.3.4

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ353	Quaternary	326722	6963945	Derived grassland with scattered *Eucalyptus populnea* emergents, dominated by Poaceae (DGF352/1) with patches of *Salsola kali* and *Atriplex muelleri*.	Alluvial plain	Non Remnant
AQ354	Quaternary	326786	6964029	Remnant wetland billabong dominated by *Eleocharis pallens*, with fringing Eucalyptus tereticonis.	Alluvial plain	11.3.27
AS355	Secondary	328819	6976734	Grassland (native)	Alluvial plain	11.3.21
AS356	Secondary	329067	6977977	Grassland (native)	Alluvial plain	11.3.21
AS357	Secondary	326585	6961405	Riparian open forest (26-30m) of *Eucalyptus tereticornis* (d) + *E. camaldulensis* (cd) + *Angophora floribunda* (a).	Alluvial (river banks and terrace)	11.3.25
AS358	Secondary	326579	6961508	Derived grassland (with exotic species).	Alluvial T2 terrace on level plain with grey silty clay loam.	Non-remnant
AS359	Secondary	326768	6975864	Grassy woodland (15-30m) of *Eucalyptus populnea* with very sparse shrub layer of *Opuntia tomentosa**.	Alluvial plain. Grey silty clays.	11.3.2
AS360	Secondary	323241	6980576	Sedgeland (seasonal freshwater wetland) dominated by *Eleocharis plana* with minor *Tricholglin procera* and *Marselia* sp. Wetland margins lined with *Eucalyptus camaldulensis* and *Acacia stenophylla*.	Alluvial plain	11.3.27
AS361	Secondary	323124	6980436	Woodland (12-15m) of *Eucalyptus tereticornis* (d) + *Corymbia tessellaris* (a). Disturbed by past selective clearing.	Alluvial plain	Non-remnant
AS362	Secondary	323037	6980076	Riparian open forest (20-30m) dominated by *Eucalyptus camaldulensis* and *E. tereticornis.* Heavily degraded.	Alluvial (river banks and T1 terrace)	11.3.25
AQ363	Quaternary	325403	6972057	Grassy wooodland of *Eucalyptus populnea*.	Alluvial plain	11.3.2
AQ364	Quaternary	326179	6971623	Riparian open forest (20-30m) of *Eucalyptus camaldulensis* (d) + *E. tereticornis* (sd) + *Casuarina cunninghamiana* (a) + *Corymbia tessellaris* (a). Very sparse shrub layer of *Acacia stenophylla*. Modified grassy groundcover dominated by *Megathrysus maximus subsp. maximus**, *Sida* sp.* and *Commelina diffusa*.	Alluvial (river banks and terrace)	11.3.25
AS365	Secondary	329151	6979425	Grassland (native)	Alluvial plain with cracking clay soils.	11.3.21
AS366	Secondary	329255	6980164	Grassland (native)	Alluvial plain with cracking clay soils.	11.3.21
AS367	Secondary	317823	6995867	Derived grassland with sparse *Eucalyptus populnea.*	Alluvial plain	Non-remnant
AS368	Secondary	314197	6997287	Grassland (native). *Solanum papaverifolium* common in herb layer.	Alluvial plain with cracking clay soils.	11.3.21
AQ369	Quaternary	310731	6998793	Riparian woodland (25-28m) of *Eucalyptus camaldulensis* (d) + *Casuarina cunninghamiana* (a) and a shrub layer of *Acacia stenophylla*. Groundcover dominated by *Megathrysus maximus subsp. maximus*, Megathyrsus maximus var. pubiglumis*., Lomandra longifolia, Cynodon dactylon** and *Chrysopogon filipes.*	Alluvial (river banks and T1 terrace)	11.3.25
AS370	Secondary	312484	6998252	Grassland with scattered emergents of *Eucalyptus populnea* (possibly derived but can't ascertain with certainty).	Alluvial plain with cracking clay gilgai soils.	11.3.21

Site Code	Site Level	E	N	Site Description	Landform	RE
AS371	Secondary	311830	6998464	Grassy open woodland dominated by *Eucalyptus populnea* with E. tereticornis, and a very sparse shrub layer of *Acacia salicina* (appears heavily disturbed).	Alluvial plain with cracking clay soils.	11.3.2
AS372	Secondary	300682	7001289	Grassland. Possibly derived although comprising native species (requires mapping checks).	Alluvial plain with cracking clay soils.	11.3.21??
AS373	Secondary	303227	7000951	Woodland (15-22m) of *Eucalyptus populnea*. Very sparse shrub layer of *Acacia salicina*.	Alluvial plain. Grey silty clays.	11.3.2
AS374	Secondary	305718	7000271	Grassy open woodland of *Eucalyptus populnea*. Sparse second tree layer of *Grevillea striata*.	Alluvial plain. Grey silty clays.	11.3.2
AQ375	Quaternary	306615	7000021	Woodland of *Eucalyptus populnea*.	Alluvial plain. Grey silty clays.	11.3.2
AQ376	Quaternary	209615	7075751	Low open forest (11-15m) of *Eucalyptus exserta* (d) + *E. crebra* + *Callitris glaucophylla*. Mid dense shrubby understorey dominated by *Micromyrtus sessilis* with *Acacia crassa, Alphitonia excelsa*, and *Petalostigma pubescens*. Grassy groundcover dominated by *Aristida caput-medusae, A. calycina, Dianella sp., Gahnia aspera* and *Xanthorrhoea* sp.	Sandstone with well developed duricrust. LZ7	11.7.6
AQ377	Quaternary	211467	7076181	Woodland (15-22m) of *Eucalyptus crebra* + *Corymbia trachyphloia* + *Corymbia bloxsomii* + *E. rubiginosa* + *C. clarksoniana*. Secondary tree layer of *Acacia crassa, A. sparsisora, Lysicarpus angustifolia*. Shrubby understorey of *Alphitonia excelsa* and *Callitris glaucophylla*.	Fine sandy soils derived from sandstone.	11.9.9
AQ378	Quaternary	211467	7076181	Woodland of *Eucalyptus crebra* (d) + *E. fibrosa subsp. nubila* (a) with a second tree layer of *Allocasuarina leuhmanii* + *Callitris glaucophylla*. Shrub layer of *Acacia podalyriifolia, A. decora, Alstonia constricta.*	Remnant surface (LZ5)	11.5.4
AQ379	Quaternary	218409	7078218	Woodland of *Eucalyptus crebra* (d) + *E. populnea* (a) with a sparse second tree layer of *Allocasuarina leuhmanii* and a shrub layer of *Acacia ixiophylla* and *A. semilunata.*	Remnant surface (LZ5)	11.5.1
AQ380	Quaternary	794360	7089494	Open forest of *Eucalyptus crebra* + *E. poplnea.*	Alluvial sandy flat.	11.5.1
AQ381	Quaternary	795893	7089748	Open forest (18-22m) of *Corymbia variegata* + *Eucalyptus crebra* and a sparse subcanopy of *Callitris glaucophylla*. Sparse shrub layer of *Acacia leiocalyx* and *Callitris glaucophylla*.	Sandstone escarpment.	11.7.6
AQ382	Quaternary	795374	7089514	Open forest (23-28m) of *Corymbia variegata* (d) with *Eucalyptus crebra* (a) and a sparse subcanopy of *Callitris glaucophylla*. Shrub layer of *Acacia leiocalyx*.	Sandstone escarpment.	11.7.6
AQ383	Quaternary	268633	7020736	Woodland of *Eucalyptus piligaensis* with minor *E. tereticornis* (observed from habitat margins - access not allowed).	Alluvial plain. Swampy area associated with drainage depression	11.3.27d
AQ384	Quaternary	268385	7020765	Open forest (20-25m) of *Acacia harpophylla* with minor *Casuarina cristata*.	Cracking clays	11.4.3
AQ385	Quaternary	267374	7020899	Open forest (18-20m) of *Acacia harpophylla* with scattered *Casuarina cristata* and a shrub layer of *Geijera parviflora*.	Sedentary clay plain (LZ4)	11.4.3
AQ386	Quaternary	265640	7020702	Regrowth *Acacia harpophylla* with *Casuarina cristata, Geijera parviflora*, and *Citrus glauca*. Narrow roadside strip of 10m width.	Sedentary clay plain (LZ4)	Non Remnant (EPBC significant)

Site Code	Site Level	E	N	Site Description	Landform	RE
AQ387	Quaternary	265542	7019849	Regrowth *Acacia harpophylla* with *Acacia melvillei* and scattered *Casuarina cristata.*	Alluvial depression on plain.	Non-remnant (EPBC significant)
AQ388	Quaternary	265879	7019945	Open forest patch of *Acacia harpophylla* and *Casuarina cristata*.	Alluvial plain	11.4.3
AQ389	Quaternary	266332	7019244	Regrowth *Acacia harpophylla* with *Melaleuca bracteata* and *Geijera parviflora*. Canopy to 18m, small patch.	Sedentary clay plain (LZ4)	Non-remnant (EPBC significant)
AQ390	Quaternary	267739	7019035	Remnant open forest of *Acacia harpophylla* to 23m.	Sedentary clay plain (LZ4)	11.4.3
AQ391	Quaternary	270373	7018733	Regrowth *Acacia harpophylla* to 10m with scattered *Eucalyptus piligaensis*. High density of Loranthaceae.	Sedentary clay plain (LZ4)	Non-remnant
AQ392	Quaternary	270948	7018693	Non remnant fragment *of E. piligaensis* with *Melaleuca bracteata*.	Swampy black soil plain.	Non-remnant
AQ393	Quaternary	271478	7019597	Open forest (15-20m) of *Acacia harpophylla* with associated *Casuarina cristata.* Remnant strip.		11.4.3
AQ394	Quaternary	271133	7016666	Open forest of *Eucalyptus pilligaensis* with shrubby understorey.	Remnant surface (LZ5)	11.5.20
AQ395	Quaternary	271612	7014850	Woodland of *Eucalyptus populnea* + *E. creba* with minor *Acacia leiocalyx*. Subcanopy and understorey dominated by *Allocasuarina leuhmanii and Callitris glaucophylla* with scattered low shrubs of *Acacia ixiophylla*.	Remnant surface (LZ5)	11.5.1
AQ396	Quaternary	272123	7014491	Regrowth woodland of *Allocasuarina leuhmanii* and *Callitris glaucophylla* on roadside.	Remnant surface (LZ5)	Non-remnant
AQ397	Quaternary	272910	7014421	Tall woodland of *Eucalyptus pilligaensis* with a subcanopy of *Callitris glaucophylla, Allocasuarina leuhmanii* and scattered *Melaleuca decora*.	Remnant surface (LZ5)	11.5.20
AQ398	Quaternary	273791	7014372	Woodland (18-22m) of *E. crebra* with sub-canopy of *Allocasuarina leuhmanii* + *Callitris glaucophylla* + *Melaleuca decora* with a shrub layer dominated by *Acacia ixiophylla*.	Remnant surface (LZ5)	11.5.1
AQ399	Quaternary	285953	7004004	Clearing along roadside vegetation habitat of *Philotheca sporadica*. Bellebee Rd.	Low rise on indurated sandstone	Non-remnant

Appendix B. EPBC MNES Database Search Results

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Protected Matters Search Tool

EPBC Act Protected Matters Report: Coordinates

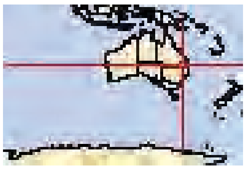
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

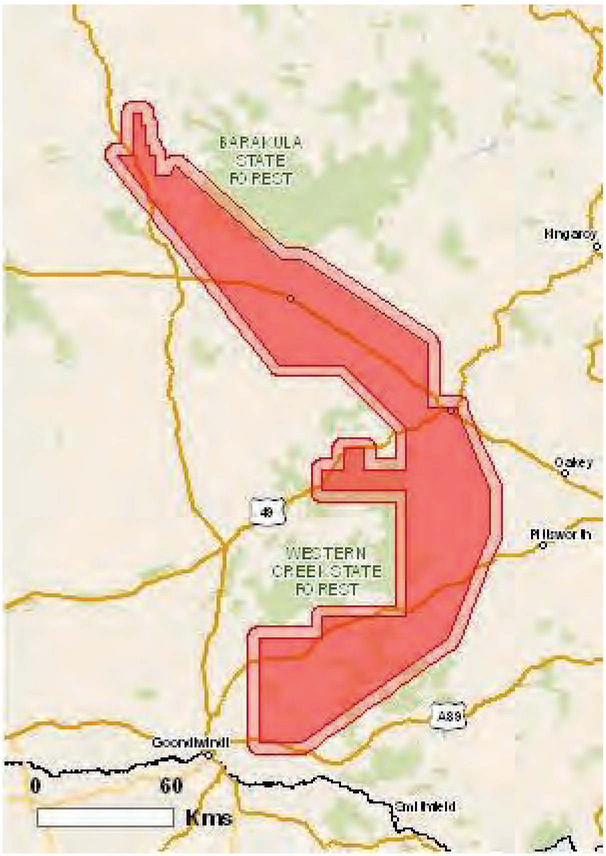
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 21/02/11 11:54:21





Coordinates

Buffer: 5Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	5
Threatened Species:	44
Migratory Species:	18

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	19

Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	10
State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	13
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR Sites) [Resource Information]

Name	Proximity
Narran lake nature reserve	Upstream from Ramsar site

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus		

Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
FISH		
Maccullochella peelii peelii Murray Cod, Cod, Goodoo [68443]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus timoriensis (South-eastern form) Greater Long-eared Bat, South-eastern Long-eared Bat [66888]	Vulnerable	Species or species habitat may occur within area
OTHER		
Macrozamia machinii [64583]	Vulnerable	Species or species habitat likely to occur within area
PLANTS		
Acacia curranii Curly-bark Wattle [3908]	Vulnerable	Species or species habitat likely to occur within area
Acacia handonis Hando's Wattle, Percy Grant Wattle [14928]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area

Calytrix gurulmundensis [24241]	Vulnerable	Species or species habitat likely to occur within area
Commersonia argentea a shrub [82761]	Vulnerable	Species or species habitat likely to occur within area
Denhamia parvifolia [18106]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium queenslandicum King Blue-grass [5481]	Vulnerable	Species or species habitat likely to occur within area
Digitaria porrecta Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
Eucalyptus argophloia Queensland White Gum, Queensland Western White Gum, Lapunyah, Scrub Gum, White Gum [19748]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus virens [10181]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. velutina [16839]	Vulnerable	Species or species habitat likely to occur within area
Homopholis belsonii [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Philotheca sporadica [64944]	Vulnerable	Species or species habitat likely to occur within area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat likely to occur within area
Prostanthera sp. Dunmore (D.M.Gordon 84) [56748]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cobarensis Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
Rhaponticum australe Austral Cornflower, Native Thistle [22647]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area

Westringia parvifolia [4822]	Vulnerable	Species or species habitat likely to occur within area
Xerothamnella herbacea [4146]	Endangered	Species or species habitat likely to occur within area
REPTILES		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area
Delma torquata Collared Delma [1656]	Vulnerable	Species or species habitat known to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area
Elseya belli Bell's Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle [66690]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Paradelma orientalis Brigalow Scaly-foot [59134]	Vulnerable	Species or species habitat likely to occur within area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle [1761]	Vulnerable	Species or species habitat may occur within area
Tympanocryptis pinguicolla Grassland Earless Dragon [66727]	Endangered	Species or species habitat may occur within area

Migratory Species [Resource Information]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Xanthomyza phrygia		

Regent Honeyeater [430]	Species or species habitat may occur within area
Migratory Wetlands Species	
Ardea alba Great Egret, White Egret [59541]	Breeding likely to occur within area
Ardea ibis Cattle Egret [59542]	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Species or species habitat known to occur within area
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose [25979]	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]	Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]	Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Defence - DALBY TRAINING DEPOT

Listed Marine Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose [25979]		Species or species habitat may occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]		Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

Places on the RNE **[Resource Information]**

Note that not all Indigenous sites may be listed.

Name	Status
Natural	
Barakula State Forest Area QLD	Indicative Place
Bendidee National Park QLD	Indicative Place
Dalby / Jandowae Roadside Remnant Grassland	Indicative Place

QLD	
Dalby Cecil Plains Roadside Remnant Dichanthium sericeum Site QLD	Indicative Place
Dalby Radio Tower Remnant Grassland QLD	Indicative Place
Lake Broadwater Environmental Park QLD	Indicative Place
Chinchilla Sands Local Fossil Fauna Site QLD	Registered
Historic	
All Saints Church QLD	Registered
Boonarga Cactoblastis Memorial Hall QLD	Registered
Dalby War Memorial and Memorial Park QLD	Registered

State and Territory Reserves [Resource Information]

Bendidee, QLD
Wondul Range, QLD
Chinchilla Rifle Range, QLD
Lake Broadwater, QLD
Lake Broadwater, QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Bufo marinus		
Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Capra hircus		
Goat [2]		Species or species habitat may occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat may occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Alternanthera philoxeroides		
Alligator Weed [11620]		Species or species habitat may occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered		Species or species habitat may occur within area

Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]	
Lycium ferocissimum	
African Boxthorn, Boxthorn [19235]	Species or species habitat may occur within area
Parthenium hysterophorus	
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]	Species or species habitat likely to occur within area
Pinus radiata	
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]	Species or species habitat may occur within area
Rubus fruticosus aggregate	
Blackberry, European Blackberry [68406]	Species or species habitat may occur within area

Nationally Important Wetlands **[Resource Information]**

Lake Broadwater, QLD

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed

- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:
- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

151.417757 -27.665094,151.251098 -28.081759,150.667775 -28.498424,150.501112 -28.498426,150.501105 -28.081755,150.751101 -28.081754,150.751101 -27.998421,151.084432 -27.998425,151.084433 -27.998425,151.084423 -27.498427,150.751095 -27.498424,150.751092 -27.415092,150.834423 -27.415093,150.834421 -27.331761,150.917752 -27.331761,150.917754 -27.415094,151.08442 -27.415095,151.084417 -27.248429,150.834348 -26.998415,150.584352 -26.998416,149.934426 -26.165101,150.001092 -26.1651,150.001089 -25.998434,150.034422 -25.998433,150.034423 -26.048433,150.05109 -26.048433,150.051091 -26.131766,150.067758 -26.131766,150.067758 -26.165099,150.084425 -26.165099,150.084426 -26.248432,150.14443 -26.248431,150.162573 -26.219997,150.161674 -26.213972,150.168011 -26.21164,150.176038 -26.212632,150.181409 -26.216662,150.182709 -26.220668,150.184012 -26.221424,150.588173 -26.581751,150.66768 -26.581751,151.167675 -26.915079,151.16775 -27.165095,151.284416 -27.165095,151.284416 -27.181761,151.417755 -27.498427,151.417757 -27.665094

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra

-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111 ABN

Appendix C. Significant Vegetation Community Profiles and Residual Impact Significance Assessment

C1. EPBC and VMA significant communities observed– characteristics, distribution, condition and residual impact Assessment

Ecological Community: Brigalow (*Acacia harpophylla* dominant and co-dominant)

Regional Ecosystems: 11.3.1 (*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains), 11.4.3 (*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains), 11.9.5 (*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks), 11.4.10 (*Eucalyptus populnea or E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains), 11.9.6 (A*cacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks).

EPBC Status: Endangered

VMA Status: Endangered

Biodiversity Status: Endangered

No of Survey Sites: RE11.3.1 - 3 Secondary (AS77, AS138, AS158), 8 Quaternary; RE11.4.3 -4 Secondary (AS77, AS138, AS158), 6 Quaternary; RE11.9.5 – 1 Secondary (AS53); BRB – (9 Quaternary).

Non-remnant Ecosystems: Non-remnant brigalow – BRB

Regional Ecosystem 11.3.1: The ecosystem has been highly fragmented throughout its range, generally existing as linear remnants within roadside reserves and stock routes. The most extensive occurrences are located within PL252 and PL260 with scattered occurrences occurring throughout the broader PDA.

Typical canopy heights range from 15 to 23 m in better preserved examples where projected canopy covers range 30 to 60%. Whilst *Acacia harpophylla* generally forms the dominant canopy, *Casuarina cristata* predominates in some locations. Typical sub-canopy trees include *Acacia harpophylla,* and *Casuarina cristata* with shrubby layers often dominated by *Geijera parviflora, Pittosporum angustifolium, Melaleuca bracteata, Alectryon oleofolious* subsp*. elongatus, Alectryon diversifolius, Elaeodendron australe* var*. integrifolium, Ehretia membranifolium,* and *Optuntia stricta*.* Ground cover percentage is variable with typical species being *Paspalidium caespitosum, Ancistrachne uncinulata, Aristida* spp., *Enychleana tomentosa, Rhagodia spinescens, Einadia* *hastata,* and *Solanum parvifolium,* although *Eriocereus martiniii** and *Bryophyllum delagoense** may be typically abundant.

Community condition is typically poor, a testament to edge effects created by massive fragmentation. The class 2 declared weed species *Opuntia stricta* and *O. tomentosa** and *Eriocereus martinii** are highly prominent in shrub and ground layers and frequent canopy gaps, caused by canopy dieback and senescence in the absence of recruitment is a compounding problem.

The spatial representation of the ecosystem provided in the certified RE (DERM 2009b) mapping is often inaccurate, incorporating areas of cypress regrowth and frequently mis-representing RE11.3.17. Updated mapping provided in this exercise is intended to provide a more realistic representation of the ecosystems distribution.

Photograph 1. Tall brigalow woodland on the alluvial plain of Wilkie Creek (Site AS138). This occurrence is represented as RE11.3.17 in DERM (2009b).

Regional Ecosystem 11.4.3: The distinction between RE11.3.1 and RE11.4.3 is based largely on landscape position rather than any recognisable floristic expression. RE11.3.1 by definition, occupies alluvial landforms, and as such is associated with flood plains, river terraces and associated drainage depressions and swamps. The heavy clay soils associated with LZ4 are raised above the influence of current river systems and in the majority cases, this provides the only basis for distinction. Both ecosystems occupy heavy clay soils with shrink and swell properties (vertosols) and gilgai micro-topography.

The productivity of the associated soil types has resulted in extensive fragmentation of this ecosystem and remaining occurrences are generally highly fragmented and isolated. Well preserved examples are found in the southern portion of the PDA within Bendidee National Park and Bringabilly State Forest where the ecosystem is relatively intact. Intact examples may also be associated with stock routes (e.g. within PL253) where the remnants, although linear, are generally continuous with adjacent ecosystems. The Chinchilla Sporting Shooters Club Range hosts one of the better preserved and more extensive examples observed with the PDA In this location *Acacia harpopylla* forms the dominant canopy to 25 m, mixed to varying degrees with *Casuarina cristata* with a predominant canopy cover ranging from 30% to 60% dependant largely on habitat condition. The sub-canopy is typically formed by *Acacia harpophylla* and *Casuarina cristata* mixed with a range of vine thicket shrubs and trees including *Geijera parviflora, Ehretia membranifolia* , *Alectryon oleofolia* subsp*. elongatus* and *Carissa ovata.*

The classification also includes RE11.4.3a, a wetland community formed by *Eucalyptus piligaensis* with a sub-canopy formed by *Melaleuca bracteata* (Site AQ163). A relatively extensive area is mapped within PL 253 (in the Linc-Energy operational area) although this area was assessed remotely and requires ground truthing to confirm the true nature of the habitafor confirmation. The concerned area is currently mapped as RE11.5.1 in certified RE mapping (DERM 2009b).

The community is degraded throughout much of its range with sub-canopy layers often dominated by *Opuntia spp.* and *Eriocereus martinii.* Canopy dieback, although a natural feature of the brigalow community, is severe in some locations. Excessive light penetration through a dramatically reduced canopy cover has further promoted the invasion of exotic species into the ground cover and shrub layers.

Photograph 2. Well developed woodland of *Acacia harpophylla* an *Casuarina cristata* in the Chinchilla Sporting Shooters Club (Site AS 170).

Regional Ecosystem 11.9.5: One small remnant area of approximately 0.75 ha was assessed during the field survey within PL258. Certified mapping provided by DERM (2009b) indicates the community becomes increasingly prominent within ATP 689 to the south and west of Millmerran. Scattered examples are also indicated in the northern portions of the PDA.

Where examined, the community demonstrated structural and floristic similarities to other EPBC communities. *Acacia harpophylla* forms the dominant canopy at 16 to 20 m with up to 50% PCC. Sub-canopy and shrub layers are typically sparse with scattered *Acacia harpophylla* and *Geijera parviflora.* Ground cover is was sparse, degraded by cattle grazing, with *Eriocereus martinii** and

*Opuntia stricta** forming < 5% ground cover. The community occupies the gentle footslope of a low sedimentary rise, forming an isolated pocket amongst more extensive ironbark woodlands. Soils are heavy clays with well developed gilgai.

Regional Ecosystem 11.4.10: The ecosystem was not observed during the study. Certified RE mapping (DERM 2009) represents minor scattered occurrences scattered in the north of the PDA (within ATP 676), and some more extensive occurrences in the south-western portion of the PDA (within ATP 689) in the vicinity of Bendidee National Park. The ecosystem is indicated as occurring on the margins of clay plains (LZ4) in association with REs 11.4.3, 11.3.18, 11.3.14, 11.3.25, 11.5.4 and 11.5.1a. Although unconfirmed, this ecosystem is considered likely to occur in the vicinity of currently mapped locations.

Regional Ecosystem 11.9.6: The ecosystem was not observed during the field survey. Certified RE mapping (DERM 2009b) represents the ecosystem as occurring as numerous scattered fragments across the PDA, almost universally mapped as sub-dominant components of heterogeneous polygons associated with other brigalow ecosystems (RE11.9.5, RE11.3.1).

Advanced Brigalow Regrowth – BRB: The EPBC brigalow ecological community includes advanced brigalow regrowth. The ecological community was defined to include brigalow regrowth with > 60% canopy cover, >0.5 ha in size, a width of > 10 m for linear communities and determined as greater than 15 years old as per guidelines of Environment Australia (2001b). Classification of regrowth is determined through examination of historical aerial photography. The minimum size of 0.5 ha is the minimum area that can be practically delineated on 1:40 000 scale aerial photograph. Patches below this size with linear width of <10 m generally suffer severely from edge effects and structural development is of poor quality. Regrowth brigalow is prominent throughout the heavily utilised portions of the PDA where it commonly manifests as linear fringes along fencelines, and road reserves. The community may include areas dominated by *Casuarina cristata* (belah).

Major Threats and Risks

- Vegetation clearing through failure to correctly identify habitat prior to activity.
- Failure to account for and identify areas of regrowth vegetation developed structurally to a degree that they form EPBC siginificant values.
- Unavoidable impacts to the ecosystem through necessity to clear for infrastructure or facility placement.

Photograph 3. Small non-remnant area of brigalow regrowth of approximately 0.5 ha in size (Site AQ081, PL194).

<u>Project-related Impacts (unmitigated)</u>

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing associated with placement of facilities or infrastructure (e.g. gathering lines for water and gas, IPFs, road widening and road maintenance).
- Edge effects associated with increased habitat and landscape fragmentation including loss of native ground covers, exotic species invasion, changes to surface water flow and sedimentation that affect ecosystem function.

<u>Project-related Impact Consequences</u>

Brigalow also has an extensive root system which is capable of developing adventitious buds in response to disturbance of aerial plant proportions. Hence, disturbance will often result in massive suckering response (Collard 2007). As such, the mechanism to profusely regenerate naturally means that the ability of this ecosystem to recover from disturbance (in the absence of intervening factors such as exotic species invasion) is relatively robust. The susceptibility of the ecosystem to edge effects including invasion of exotic species (in particular *Opuntia* spp.* and *Eriocereus martinii**), the noted tendency for heavily fragmented communities to suffer from canopy dieback in the absence of recruitment, does have implications for the long term integrity and viability of both fragmented and intact remnants. Unmitigated activities in the vicinity of sensitive areas (in the absence of direct impact) do have considerable potential to accelerate edge effects and hence affect the long term viability of the community on a project scale. The sensitivity of this habitat is considered to be ***High.***

An estimated 804 264 Ha of this ecosystem occurs nationally (TSSC2001a) with 586 049 Ha of this ecosystem present in the bio-region and 50394 Ha occurring in Queensland's National Parks based on data provided by Accad *et al*. (2008). Mapping revision by 3d Environmental (in PL areas) in accompaniment with RE mapping provided by DERM (2009b) in ATP areas indicates

9331 ha of the ecological community is mapped as regional ecosystems in the PDA. A further 568 ha is mapped by 3d Environmental in PL areas as regrowth > 15 years age. Individually, the small disturbed fragments that are common across the landscape present poor type examples, although some much better preserved examples are present in the PDA, typically in historic stock routes and National Parks. As this exists mostly as small disturbed fragments, the impact magnitude in terms of direct habitat loss is considered to be ***Moderate*** and the unmitigated impact significance is considered to be ***High***.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk if impact to the Brigalow ecological community and its associated REs.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact including identification of all areas of advanced brigalow regrowth.
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant remnant vegetation and guided by qualified personnel when clearing is undertaken.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 300 m should be established around all remnant communities. Where incursion into these buffer areas is unavoidable,strict weed hygiene protocols and site access protocols should be followed including weed washdown.
- A reduction in the width of construction easements where the brigalow community cannot be avoided. This will be particularly relevant where infrastructure is located on roadside easements, fencelines etc. where high quality regrowth is often located.
- Whist the work program should aim to avoid impact to all remnant and advanced regrowth communities, where impact is unavoidable, VMO's will be required as a compensatory measure under the Draft Policy Statement: Use of environmental offsets under the EPBC Act (DEWR 2007).

Summary Residual Impact Assessment

Whilst avoidance is the only feasible method of avoiding direct impact to the ecosystem, the measure alone will not eliminate impact. The increase in land use and access pressure facilitated by gas construction and production activities will, in the absence of strict management measures, promote edge effects including weed infestation and potential loss of canopy vigour (through dust, weed infestation and hydrological changes). A combination of all measures will be required to completely eliminate the risk of impact. Habitat avoidance in all cases is not likely to be possible and hence it is anticipated that some habitat offset will be required as a mitigation measure. A combination of various measures including habitat avoidance where possible and habitat offset will mostly mitigate against impact and residual impact significance assessment is ***Moderate* (12)**.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	Moderate	High (17)	Totally Effective	Mostly effective

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable.

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<u>Ecological Community: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</u>

Regional Ecosystems: 11.3.21 (*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils): 11.3.24 (*Themeda avenacea* grassland on alluvial plains. Basalt derived soils)

EPBC Status: Critically Endangered

VMA Status: Endangered

Biodiversity Status: Endangered

No of Survey Sites: 8 Secondary (AS121, AS355, AS365, AS366, AS368, AS370, AS372), 1 Quaternary

Native grassland is one of the more difficult communities to map and assess, due largely to the difficulties in determining whether the community is a natural treeless area, or derived from historical clearing of the original woodland. Whilst historical photographs provide some evidence on which to make an assessment, the earliest photography (1960's) may predate settlement by up to 100yrs. Hence landscape context and landuse type (in the absence of historical survey reports) are often the most reliable means on which to base a determination.

In the PDA, field survey determined that naturally grassed areas, with the exception of a few minor occurrences, are confined almost entirely to designated stock routes which have been largely protected from land clearing. The community is largely restricted to narrow linear fragments in the area between Cecil Plains and Dalby (PL238, ATP 683) with scattered examples north in PL194. Heavy clay soils with vertic properties (gilgai) form the underlying substrate in all examples that were examined.

The ecosystem was sampled on a seasonal basis with surveys completed in October/November 2009. Methods utilised in supplementary surveys in May 2010 were consistent with those necassary to determine threshold condition according to the EPBC listing advice. Four sites were placed within grasslands along the Dalby-Kogan Road and another four along the Dalby-Cecil Plains Road. Species were grouped into broad life form categories with calculations of mean cover values and species richness utilised.

On the basis of the data collected in May 2010 the grasslands on the Dalby-Kogan Road exhibit high integrity and are consistent with the 'best quality' EPBC endangered classifcation on the basis that they: a) have a minimum patch size at least 0.5 ha; b) support at least four native perennial grass species from the indicator species list; c) support at least 200 native perennial grass tussocks; d) have a total projected canopy cover of shrubs less than 30%; and e) where perennial non-woody introduced weed species are less than 5% of the total projected crown cover.

Whilst the Dalby-Cecil Plains Road grasslands also meet EPBC criteria they are assessed as ‘good quality’ grasslands under the EPBC threshold criteria. They exhibit a higher incidence of weeds (i.e. perennial non-woody introduced weed species are less than 30% of the total projected crown cover), however this is heaviy influenced by the widespread occurrence of lippia rather than widespread infestations of exotic grasses. Exotic grasses such as rhodes grass (*Chloris gayana*), african love grass (*Eragrostis curvula*), and pasplaum (*Paspalum notatum*) are more prolific on roadside margins and along disturbance associated with drainage works, fence lines and other linear infrastructure.

The results of the condition survey are broadly consistent with the findings of Goodland (2000) who notes the overall high integrity of grasslands within the Dalby-Kogan stockroute, and the lower signficance of the Dalby-Cecil Plains stouck route. Goodland (2000) also notes that the influence of lippia is more pronounced along the Dalby-Cecil Plains sites. It is likely that the widespread flooding events of 2011 will have facilitated its further dispersal of lippia adding to increased modification of the groundcover through displacement of native herbs in inter-tussock spaces.

One EVNT species *Solanum papaverifloium,* was recorded within the Dalby-Kogan Road grasslands. Habitat is suitable for the potential occurrence of *Bothriochloa biloba. Digitaria porrecta, Dichanthium queenslandicum, Picris evae, Rhaponticum australe, Solanum stenopterum,* and *Thesium australe.*

The certified RE mapping (DERM 2009b) does not necessarily present an accurate spatial representation of the community, and includes many areas of derived grassland where the evidence of the original woodland in the form of ringbarked trees, log piles and inappropriate soil types is clearly evident both in field inspection and through stereoscopic examination of recent aerial photography. The best preserved example located within a stock route in PL194 (Site AS121) is not recognised in the certified RE mapping, being represented as a mosaic of RE11.3.2 and 11.3.25. It is intended that the detailed mapping undertaken in this exercise provide a more accurate representation of the community distribution and reduce the risk of direct impact.

It should also be noted that two minor areas of RE 11.3.24 (*Themeda avenacea* grassland on alluvial plains. Basalt derived soils.) are indicated within ATP 683 to the northeast of Cecil Plains. In this location, the ecosystem is represented in association with grassland ecosystem 11.3.21. Access restrictions to private property prevented confirmation although it is considered unlikely however that small areas of basalt derived alluvial soil could be differentiated from within a broader alluvial landform. Hence this ecosystem has been merged with the broader RE11.3.21 ecosystem for the purpose of impact assessment.

Major Threats and Risks

- Vegetation clearing through failure to correctly identify habitat prior to activity.
- Unavoidable impacts to the ecosystem through necessity to clear for infrastructure along roadsides or within stock routes or facility placement.
- Degradation of habitat through habitat fragmentation and facilitation of the invasion of exotic species and other edge effects.

Photograph 6. Remnant native grassland within a stockroute in PL194 (Site AS121). The ecosystem forms a mosaic with woodland RE11.3.2 which is clearly visible in the background.

Photograph 7. Derived grassland at site AQ88 is mapped as RE11.3.21 in certified DERM RE mapping. Log piles from stick raking clearly visible in foreground.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing associated with placement of facilities or infrastructure (e.g. gathering lines for water and gas, IPFs, road widening and road maintenance).

- Accelerated fragmentation of linear habitats adjacent to roadsides or within stock routes through placement of access tracks and petroleum related infrastructure.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers, exotic species invasion, changes to surface water flow and sedimentation that affect ecosystem function.
- Salt scalding through saline groundwater discharge from production well heads.

Project-related Impact Significance

In recognition of the the Critically Endangered EPBC status, the habitat can be considered ***Extremely Sensitive*** to impact. Whilst mechanical disturbance is implicated as a means of effecting the spread of exotic plants, Fensham (1998) indicates that relatively few exotic species have the capacity to displace native species without mechanical disturbance, with the exception of lippia (*Phyla canescens)* a weed which is a pervasive groundcover in many habitats within the PDA. Of the 54 584 ha of this ecosystem present in the bio-region, 990 ha (0.18%) occurs within the PDA as linear fragments within stock routes. The community is poorly represented in the conservation estate with only 150 ha preserved within National Parks (Accad *et al*. 2008). Whilst the potential for direct loss of habitat resulting from this project is relatively low, the listing as a 'critically endangered' ecological community underwrites the historical broadscale habitat loss that has been imparted on this community. Grasslands originally extended for 390 000 ha across the Darling Downs with poplar box (*Eucalyptus populnea*) grassy woodlands making up 100 000 ha of the 920 000 ha. Extensive land use in the form of cropping and grazing of the fertile alluvial soils of the Condamine valley has drastically reduced grasslands to some 1.25% of the original extent (Fensham and Fairfax 1997). In Queensland, natural grassland ecosystems in the Darling Downs have been cleared to less than 1% of their original extent (Butler 2007 cited in TSSC 2008a). In this regard, it is considered important to address the cumulative impacts of similar projects running concurrently in the bioregion which have the potential to result in further incremental loss of habitat. As such, any aspect of habitat loss within the PDA should be considered indicative of processes that are likely to be occurring in the broader bio-regional area and the magnitude of any impact can be considered to be ***Ex*t*remely High***.

Proposed Management/Mitigation Measures

The following mitigation measures should be employed to reduce the risk if impact to the natural grassland ecological community and its associated REs.

- Accurate vegetation mapping and condition assessment at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact including identification of all areas of natural grassland as well as the location of existing access points and previously disturbed areas.

- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- All areas of grassland should be avoided by all activities.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 300 m should be established around all remnant communities with impact risk areas considered within 200m of these habitats. Strict weed hygiene protocols and site access protocols should be followed including weed washdown.
- While mechanical disturbance is implicated as a means of effecting the spread of exotic plants within grassland communities, Fensham (1998) indicates that relatively few exotic species have the capacity to displace native species without mechanical disturbance, with the exception of lippia (*Phyla canescens*). Hence all mechanical disturbance has the potential to promote degradation with potential for long term catastrophic consequences. The condition of the identified communities, determined through survey within an appropriate seasonal window, should be considered a baseline condition assessment prior to project development and used for long term Condition monitoring.

It should be noted that there are no known examples where grassland habitats have been effectively rehabilitated and this is not considered a viable management option.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. This measure alone will not eliminate all impacts. The increase in land use and access pressure facilitated by gas construction and production activities will, in the absence of strict management measures, promote edge effects including weed infestation, changes to the natural composition and floristic structure of grasslands. A combination of all measures will be required to eliminate the risk of impact. In this regard, maintenance of management buffers around identified grassland areas will be particularly important and un-necessary activity within these buffer zones should be avoided.

Without any mitigation,impact significance will be ***Extremely High* (25).** Total habitat avoidance with management buffers in place is the only effective means to manage impact to this habitat and residual impact will be ***Moderate (11).***

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Extremely High	Extremely High	Extremely High (25)	Totally Effective	Not Effective

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Extremely High	Extremely Low Magnitude	Moderate (11)	Extremely High	High	Extremely High (23)

*Includes management buffer implementation
[#] Clearing of core habitat known and possible is unavoidable

References

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Ecological Community: Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Regional Ecosystems: 11.9.4a (Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine grained sedimentary rocks), 11.8.3 (Semi-evergreen vine thicket on Cainozoic igneous rocks).

EPBC Status: Endangered

VMA Status: Endangered (11.9.4a), Least Concern (11.8.3)

Biodiversity Status: Endangered (11.9.4a), Of Concern (11.8.3)

No of Survey Sites: Ecological community was not observed during survey

The ecological community comprises REs 11.11.18, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.13 and 11.9.4 (TSSC 2001b). RE 11.9.4a, and a single mapped occurrence of RE11.8.3 provides the only example of these ecosystems in the PDA in represented in certified ecosystem mapping (DERM 2009b).

RE 11.9.4a occurs to the west of Chinchilla (PL185/ATP747) where it is mapped as a sub-dominant component of heterogeneous polygons (11.9.5/11.9.4a). Examination of a number of these small occurrences of brigalow in the vicinity indicates vine forest elements are generally suppressed and brigalow-belah comprises the dominant canopy. There is some potential for this ecological community to occur in association with small patches of brigalow (RE 11.9.5) and the two ecosystems area likely to merge and be difficult to differentiate. Hence it is possible that small areas of this community are included with mapping of the brigalow ecological community.

One small 1.7ha occurrence of RE11.8.3 is represented by DERM (2009b) in the Captain's Mountain area approximately 15km to the south of Millmerran (within ATP 689). Without field survey, it is not possible to confirm that this ecosystem has been correctly classified. It is however considered likely that small occurrences of this ecosystem will be associated with the basalt landscapes to the south of Millmerran, particularly in association with RE11.8.2a within which small pockets of RE11.8.3 may be present. Occurrences are however likely to be extremely limited in both size and spatial distribution.

It should be noted that no minimum patch size for the ecological community is defined in the EPBC advice listing. Considering that the natural patch size may be extremely small, it is feasible to recognise fragments with intact canopy down to 0.25 ha as being representative. It should be noted that isolated remnants of < 2ha may not be represented in certified ecosystem mapping. As such, it is possible that the presently defined extent is under estimated.

Major Threats and Risks

Fragmentation, lack of connectivity, continued clearing, inappropriate fire regimes, invasion by introduced pasture species and increased grazing by domestic stock and native animals are considered to be general threats to SEVT remnants (EPBC Listing Advice). Within the PDA, major identified threats include:

- Degradation of habitat through fragmentation.
- Edge effects associated with clearing and fragmentation. Of greatest concern is the acceleration of the invasion of exotic species including *Opuntia* spp. Lantana and pasture grasses [buffel grass (*Cenchrus ciliaris*) in particular] which increase sensitivity to fire.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing. No occurrences of the ecosystem are recorded in current PL areas. Major threats are thus associated with exploration related activities (e.g. drill pad, access tracks).
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

Project-related Impact Significance

A total of 141 500 ha (DEWHA 2001b) of this ecological community in the Brigalow Belt bioregion Based on certified ecosystem mapping (DERM 2011) and detailed mapping undertaken during the study, 31 ha is represented in the PDA. These occurrences are represented as small isolated remnants (of <1.7 ha) which, due to the large edge to area ratios, are likely to be severely degraded and provide poor representation of the community. Hence, the sensitivity of this habitat, considered in context of its 'Endangered' conservation status is considered to be ***High***. The potential for direct loss of habitat resulting from this project is relatively low, and due to current fragmentation of the community within the PDA, the loss of high quality examples of the ecosystem is considered unlikely with the impact magnitude considered to be ***Moderate.*** . The project related impact significance is considered to be ***Moderate.***

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact. This is particularly relevant when works are being undertaken in basalt landscapes in the Captains Mountain area (ATP 747).
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 300 m should be established around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown.
- The condition of the any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on-ground protocols designed to manage impacts to the community and prevent further degradation.
- Whist the work program should aim to avoid impact to all remnant and advanced regrowth communities, where impact is unavoidable, biodiversity offsets prepared under the Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act (DEWR 2007) and DERMs Policy for Vegetation Management Offsets (2008) will be required.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. Because the ecosystem comprises small isolated fragments, avoidance of the ecosystem should be easily managed The highly fragmented nature of the habitat suggests the current occurrences will be moderately sensitive to disturbance, inferring that edge effects have already significantly reduced the habitat integrity.The increase in land use and access pressure facilitated by exploration activities has the potential to promote edge effects and management buffers should be implemented to reduce impacts. Total mitigation against impacts will be provided by both avoidance and maintenance of management buffers. Habitat re-construction may be difficult to implement and maintain in the long term. Little detailed information is available on the reproduction of semi-evergreen vine thicket plants and observations suggest that few seedlings and young plants establish in undisturbed thickets although recovery potential for some species could be robust (Kahn and Lawrie, 1987 cited in DEWHA, 2001b). Hence, rehabilitation is likely to be moderately successful. Biodiversity offsets should be considered only in the absence of other mitigation measures.

Without any mitigation, the impact significance will be ***Moderate*** **(17)**. If habitats are not avoided, alternative management measures and well managed rehabilitation to disturbed areas will mostly be able to mitigate impacts and the impact significance will be ***Moderate*** **(12)**. Total habitat avoidance with management buffers in place will totally mitigate against impact and residual impact will be ***Low*** **(7)**.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	Moderate	Moderate (17)	Totally Effective	Mostly Effective

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Department of Environmental Resource Management (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

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Ecological Community: Weeping Myall Woodlands

Regional Ecosystems: Not Represented

EPBC Status: Endangered

VMA Status: Not Represented

Biodiversity Status: Not Represented

No of Survey Sites: Ecological community was not observed during survey.

No occurrence of Weeping Myall Woodland was observed during the field survey. In Queensland, the ecological community is known to occur as small patches within REs 11.3.2 and 11.3.28 (DEWHA, 2009c), although the latter ecosystem is not known to occur in the project acrea. The best preserved examples are typically associated with road reserves and stock routes although the community does not form woodland communities of sufficient extent to be consistently separated as an ecosystem. As such, the community is not recognised as an individual ecosystem within the framework of Queensland's VMA. The patchy nature of the community also makes delineation difficult, hence the community is easily overlooked.

The only occurrence where weeping myall *(Acacia pendula)* was observed to form a dominant canopy was in a small copse (approx. 0.25 ha) within RE 11.4.12 on a stock route to the west of Chinchilla (within PL185). The restricted area is not consistent with the ecological community which has a minimum patch size of 0.5 ha (DEWHA, 2009a). It does however indicate the possibility that small patches may also be associated with RE11.4.12.

Regional distribution mapping provided by DEWHA (2009c) indicates the greatest likelihood for occurence is in a band that stretches from Roma to Blackall, well west of the PDA. The project boundaries cover an area where it is indicated that weeping myall may occur. Considering the extensive field survey undertaken, it is considered unlikely that weeping myall will occur within PL areas. In the context of the broader PDA, the community should be considered as possibly occurring within areas of RE11.3.2.

Major Threats and Risks

DEWHA (2009c) lists the major threats to the community as being land clearing and modification; heavy grazing, lopping for drought fodder; invasive plant species, and; fertiliser and herbicide application. Major threats imposed by the project include:

- Vegetation clearing through failure to correctly identify the ecological community prior to activity.
- Degradation of habitat through fragmentation.
- Edge effects associated with clearing and fragmentation including . Of greatest concern is the acceleration of the invasion of exotic species including *Opuntia* spp., lantana and pasture grasses (buffel grass in particular) which increase sensitivity to fire.
- Particular attention is paid to degradation of the chenopod shrub and forb cover of the ground layer. This is particularly susceptible to displacement by exotic species through heavy grazing and changed fire regimes (DEWHA, 2009c).

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing. No occurrences of the ecosystem are recorded in current PL areas and the community is considered to possibly occur within thr broader PDA. Major threats are thus associated with exploration related activities (e.g. drill pad, access tracks).
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

Project-related Impact Significance

Current indications are that the community is capable of regeneration following removal of disturbance regimes (DEWHA, 2009c) although information relating to the success of rehabilitation efforts from past examples is lacking. The habitat sensitivity is therefore assessed to be ***High.***

A total of 31 000 ha of the community is estimated to occur in Queensland (DEWHA, 2009c). . Based on field survey effort, the community is considered unlikely to occur within PL areas although occurrence is possible in the broader PDA. In the absence of detailed field survey data for the broader PDA, and lack of any quantified indication of the communities spatial distribution, impact magnitude is considered to be ***Moderate*** .

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk if impact to the ecological community.

- Ground survey of all areas of RE11.3.2 to identify any occurrences of the ecosystem prior to any activity that proposes physical disturbance or disruption. Without availablility of high resolution imagery for the entire PDA, it is unlikely that community mapping will be a reliable means spatial delineation.

- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The condition of the any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further degradation.
- Careful weed hygiene measures will be required in the vicinity of all identified occurrences. Consideration should also be given to the application of management buffers in any significant areas.
- Biodiversity Offsets (DEWR 2007) will be required as a compensatory measure under EPBC Act Policy for Biodiversity Offsets. Current indications are that the community is capable of regeneration following removal of disturbance regimes (DEWHA, 2009c).

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. Because the ecosystem comprises small isolated fragments, avoidance of the ecosystem should be easily managed although will require careful on site inspection prior to disturbance activities to ensure the community is accurately indentified. Following removal of disturbance, indications are that community will regenerate successfully (DEWHA, 2009a). It is therefore considered that preparation of compensatory habitat will be mostly mitigate impacts.

Without any mitigation, impact significance will be ***Moderate*** **(17)*.*** Avoidance with strict protocols to manage edge effects will completely mitigate impacts and residual impact will be ***Moderate*** **(12).** A combination of avoidance and other compensatory measures will mostly mitigate impacts and project related residual impact significance will be ***Low (7).***

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	Moderate	Moderate (17)	Totally Effective	Unknown although indications are that regeneration is generally viable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)

*Includes management buffer implementation
[#] Clearing of core habitat known and possible is unavoidable

References

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a). *Weeping Myall Woodlands - EPBC Act policy statement 3.17* - Nationally threatened species and ecological communities. [Online].

Department of the Environment and Water Resources (2007), *Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment and Water Resources, Canberra.

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Threatened Species Scientific Committee (2008c). *Commonwealth Conservation Advice on Weeping Myall Woodlands*. [Online].

Ecological Community: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Regional Ecosystems: 11.8.2a

EPBC Status: Critically Endangered

VMA Status: Least Concern

Biodiversity Status: No Concern at Present

No. of Survey Sites: Ecological community was not observed during survey.

A number of relatively extensive occurrences of RE 11.8.2a (*Eucalyptus tereticornis* + *E. melliodora* woodland) are represented in the certified RE mapping (DERM, 2009b) on steep basalt landforms in the Captains Mountain area to the south of Millmerran (ATP 689). The ecological community forms a primary component of this RE (TSSC, 2006a). These sites could not be accessed during the field survey to allow habitat confirmation, although the occurrence of *Eucalyptus melliodora* in roadside regrowth vegetation suggests that the RE is likely to be accurately represented. However, the nature of the shrub layer requires consideration and only those remnants with a significant cover of native tussock grasses and a patchy shrub layer are consistent with classification of the ecological community. Remnant patches with consistently dense shrub layers are excluded from the classification. In the absence of detailed field survey, it should be assumed that areas of mapped RE11.8.2a provide representation for the ecological community. The community should therefore be considered likely to occur in basalt landscapes to the southern portion of the PDA.

Major Threats and Risks

DEWHA (2006b) indicates major threats to the community as including grazing, land clearing, weed invasion plus a range of other degrading processes including salinity, nutrient enrichment, altered fire regimes and fragmentation. Major threats imposed by the project are likely include:

- Vegetation clearing through failure to correctly identify the ecological community prior to activity.
- Degradation of habitat through fragmentation.
- Edge effects associated with clearing and fragmentation including invasion of exotic weeds. Of particular concern would be those that displace native grass covers such as *Lantana camara*,* a process that might occur relatively rapidly in the long term absence of fire.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing. The most extensive areas currently mapped occur on steep basalt escarpments and hill slopes where access for exploration would be extremely limited.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.
- Interruption of fire regimes which are responsible for maintenance of native grass cover. This would likely occur with increasing fragmentation of the landscape through construction of exploration infrastructure.

Project-related Impact Significance

Given the Critically Endangered status of the ecological community, and the fact that the community is at the northern limit of its ecological range, the sensitivity of this habitat is considered ***Extremely High.*** The Brigalow Belt bioregion hosts of 67 574 ha (16%) of the ecological community out of a total of 416 325 ha at a national level (TSSC, 2006a). Approximately 104 ha of the community is inferred to be present in the PDA, 1.5% of the total bioregional representation. The magnitude of potential unmitigated impact to this habitat is considered ***High.*** Major representations at the project scale are located on relatively inaccessible basaltic escarpments. a total loss of the representation in the PDA would be considered a ***Extremely High (23)*** significance of impact. In consideration to the inaccessible nature of the occurrence, any major loss incurred by direct impact is however unlikely.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Ground survey of basalt landscapes (within ATP 689) prior to any disruptive exploration activity to identify any occurrences of the ecological community and asses factors contribution to degredation.
- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The condition of any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further

degradation. Any potential for loss of habitat through altered fire regimes should be given consideration.

- Careful weed hygiene measures will be required in the vicinity of all identified occurrences. Consideration should also be given to the application of management buffers in any significant areas.
- Where the community is identified and impact is unavoidable, Biodiversity Offsets (DEWR 2007) will be required as a compensatory measure. Focus on rehabilitation in degraded, non-remnant areas where some representation of the original floristic assemblage will only partially mitigate against impacts.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. Because the ecosystem occurs largely on inaccessible terrain, there is unlikely to be any direct impact to the community during exploration activity and avoidance easily managed.

Without any mitigation, impact of ***Extremely High (23)*** significance may occur. Avoidance of the habitat with strict protocols to manage edge effects will completely mitigate impacts and residual impacts will be ***Moderate* (11).** A combination of avoidance and other compensatory measures will moderately mitigate impact and impact significance will be ***High* (20).**

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Extremely High	High	Extremely High (23)	Totally Effective	Unknown although indications are that regeneration is generally viable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Extremely High	Extremely Low Magnitude	Moderate (11)	Extremely High	Moderate	High (20)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Threatened Species Scientific Committee (2006a). *Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. [Online].

DEWHA (2006b). White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands. EPBC Act Policy Statement.

Ecological Community: Coolibah – Black Box woodlands of the Darling Riverine Plains and Bigalow Belt South Bioregions

Regional Ecosystems: 11.3.3

EPBC Status: Endangered (listed March 2011)

VMA Status: Of Concern

Biodiversity Status: Of Concern

No. of Survey Sites: Ecological community was not observed during survey.

The Coolibah woodland ecological community is mapped by DERM (2009b) as occurring in the Chinchilla region (PL185/ATP747) where it is occurrence is focused on the Charlie Creek Flood Plain and other tributaries of the Condamine River occurring in the vicinity. The community is mapped in these areas as a sub-dominant component of flood plain woodland mosaics containing REs 11.3.25 and RE11.3.4. Field survey of flood plain vegetation in the area did not confirm the presence of the ecological community. Although *Eucalyptus coolibah* was identified as a component of riparian open forest vegetation, it was in no case observed to be a dominant species, mixing with *Eucalyptus camaldulensis, Eucalyptus tereticornis* and *Casuarina cunninghamiana* within RE11.3.25. Thresholds for the ecological community, as described by TSSC (2011), require *Eucalyptus coolibah* to be the dominant contributor to the total canopy cover (> 50%). Whilst revised mapping does not indicate its presence, there is potential for the ecological community to occur in flood plain habitats in the PDA, particularly in areas from Chinchilla northwards.

Major Threats and Risks

TSSC (2011) indicates major threats to the community as including land clearing and fragmentation, Hydrological changes to river flow, innappropriate grazing regimes and weed invasion. Major threats imposed by the project are likely to include:

- Vegetation clearing and fragmentation
- Edge effects associated with clearing and fragmentation
- Potential changes to hydrology or water quality associated with gas field development including construction of brine ponds, causeways and river crossings and dams.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing although ensuring that development works adhere to buffers associated with watercoarses and riparian vegetation will alleviate this threat.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

Project-related Impact Significance

Although having an EPBC status of Endangered, the majority of flood plain vegetation in the PDA is heavily degraded and thus sensitivity to disturbance is considered ***Moderate***. The Brigalow Belt South bioregion hosts 181 173 (13%) of the ecological community out of a total of 1 321 103 ha at a national level (TSSC, 2011). Approximately 259 ha of the community is inferred to be present in the PDA, excluding the area of detailed mapping completed by 3d Environmental , 0.14% of the total bioregional representation. The magnitude of potential unmitigated impact to this habitat is considered ***Low.*** The significance of unmitigated impact is therefore considered to be ***Low (8).***

Proposed Management/ Mitigation Measures

Requirements for mitigation are generic in nature. The following measures can be employed to reduce the risk if impact to the ecological community.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact.
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- Rapid rehabilitation of disturbed areas through planting of appropriate native ground cover species should be undertaken. This should be followed long term management and maintenance of rehabilitated areas.
- Construction corridors in riparian areas should be considerably reduced and large remnant trees should be avoided where possible.

Summary Residual Impact Assessment

Without any mitigation, impacts of minor consequence will happen and preliminary impact significance will be ***Low*** **(8)**. Total habitat avoidance will completely mitigate against impact and residual impact will be ***Low*** **(4)'.** Alternative management measures and well managed rehabilitation in disturbed areas will mostly mitigate impacts. The residual impacts in this case will be of ***Low*** **(4)**.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Low	Low (8)	Totally	The potential for rehabilitation of this habitat is unknown.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Extremely Low	Low (4)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J., Wilson, B., A., Neihus, R. A. (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

Threatened Species Scientific Committee (2011). *Commonwealth Listing Advice on Coolibah-Black Box Woodland of Darling Riverine Plains and Brigalow Belt South Bioregion.* Online at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/66-listing-advice.pdf. Accessed 14/2/11.

<u>RE 11.3.2 *Eucalyptus populnea* woodland on alluvial plains</u>

VMA Status: Of Concern

Biodiversity Status: No Concern at Present

No of Survey Sites: 2 Secondary (AS15, AS97); 2 Tertiary (AT22, AT149); 19 Quaternary.

Regional Ecosystem 11.3.2 is widely distributed in the detailed mapping area and extensive in the broader mapping area. The regional ecosystem is largely restricted to the upper alluvial terraces, typically where alluvial soils comprise finer silts and clays where drainage capacity is impeded. Vegetation condition is generally poor, with the siltier soil substrate subject to compaction, and overgrazing. The best preserved examples are typically associated with Stock Routes in the Dalby- Cecil Plains area where the community often mosaics with grassland ecosystem RE11.3.21. The ecosystem also forms mosaics with RE11.3.4 and RE 11.3.27c on better preserved examples of the Condamine River flood plain.

The canopy (T1) is characterised by *Eucalyptus populnea,* often the sole representative species, forming a typical height range of 15 to 23 m with 30 to 50% projected canopy cover (PCC). The sub-canopy is typically dominated by *Eucalyptus populnea* with very occasional *E. tereticornis* and *E. crebra.* The sub-canopy T2 and shrub layer (S1) is typically sparse dominated by *E. populnea* saplings and scattered shrubs of *Acacia salicina, A. farnesiana** and occasional *Opuntia* spp. The species composition and condition of the groundcover is influenced by grazing history. At Site AS15 native groundcover comprised 36% of total cover (28% native perennial grasses, 8% native forbs) with 20% cover of introduced forbs. Groundcover species included *Aristida caput-medusae, Brunonia australis*, *Calotis* sp., *Cheilanthes distans, Chrysocephalum apiculatum, Cyperus* sp*., Dichanthium sericeum, Euphorbia tannensis* subsp*. tannensis, Fimbristylis dichotoma, Ptilotus* sp*., Neptunia gracilis,* and *Wahlenbergia gracilis.* Suitable habitat exists for EVNT flora species *Bothriochloa biloba, Homopholis belsonii, Calotis glabrescens, Digitaria porrecta, Ptilotis extenuatus,* and *Rutidosus lanata.*

The community is over-represented in certified ecosystem mapping for PL areas. An extensive mapped area within PL198 (WW2 airstrip south of Dalby) was reclassified to RE11.5.1 as result of detailed field survey and stereoscopic examination of recent aerial photography.

Photograph 8. *Eucalyptus populnea* woodland on poorly drained alluvial plain within PL238 (Site AS97)

Major Threats and Risks

Major threats imposed by the project are likely to include:

- Vegetation clearing through failure to correctly identify the ecological community prior to activity.
- Degradation of habitat through fragmentation.
- Edge effects associated with clearing and fragmentation including invasion of exotic weeds and pasture grass species. Lippia *(Phyla canescens)* is a prominent weed on the flood plain of the Condamine River, displacing native ground covers.
- The ecosystem appears particularly prone to canopy dieback. Stresses imposed by changing hydrological or land use regimes may have implications for the long term viability of the ecosystem in some locations.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community include:

- Direct impacts due to vegetation clearing.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.
- Changing hydrological flow regimes on major water courses may be a cause of canopy senescence and degradation.

Project-related Impact Significance

The majority of remnant areas exist as narrow, linear fragments on roadside easement, stock routes and disturbed fragments within flood plain woodland mosaics. The condition of remnants observed was generally poor due to canopy senescence an displacement of native ground covers by exotic species.Due to the poorly preserved nature of the majority of this habitat, and the ability of *Eucalyptus populnea* to regenerate from total clearing, the habitat is considered to possess ***Moderate Sensitivity.*** The Brigalow Belt bioregion hosts of 528 081 ha of this ecosystem (Accad *et al*., 2008). Detailed mapping of PL Areas indicates a total of 1187 Ha with a further 4150 Ha indicated in certified ecosystem mapping (DERM, 2009b) in the broader PDA. With consideration to the poor condition of remnants and the limited extent of the ecosystem in the PDA, impacts of ***Low Magnitude*** are predicted. This should be considered in the broader landscape context where residual fragments provide the majority of habitat and biodiversity value in heavily utilised agricultural lands.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Consideration given to detailed mapping of proposed impact areas to identify extent of the ecosystem prior to impact.
- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The condition of the any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further degradation.
- Careful weed hygiene measures will be required in the vicinity of all identified occurrences.
- Avoid stock route areas where the best preserved examples of the ecosystem were observed to occur. Fragmentation of stock routes threatens the integrity of a number of highly significant vegetation communities.
- Where the community is identified and impact is unavoidable, construction corridors should be narrowed. Impacted areas should be immediately seeded with native grass species, and individual canopy trees avoided wherever practical. The wide spacing of individual canopy trees and general suitability of alluvial soils for ground cover rehabilitation means these measure will mostly mitigate against impact.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem although, due to the often wide spacing of canopy trees, it will usually be possible to place infrasture without significant impacts to ecosystem structure. Rapid rehabilitation of native ground covers will be required to prevent further habitat degradation.

Without any mitigation, impacts of significance will be ***Low* (8)**.. A combination of avoidance and other compensatory measures will mostly mitigate against impacts and residual impact significance will also be low ***Low* (8).**. Total avoidance including management buffers will result in an ***Low* (4)** residual impact.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (8)	Totally Effective	*Eucalyptus populnea* has been observed to regenerate readily from total habitat clearing and is considered amenable to site rehabilitation.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderater	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A, Neldner, V. J, Wilson, B., A, Neihus, R. A (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

Department of the Environment and Water Resources (2007), *Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment and Water Resources, Canberra.

<u>RE 11.3.4: *Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains*</u>

VMA Status: Of Concern

Biodiversity Status: Of Concern

No of Survey Sites: 7 Secondary (AS9, AS26, AS27, AS31, AS85, AS119, AS147), 16 Quaternary

An extensive ecosystem associated with lower alluvial terraces of most major watercourses. The ecosystem is often continuous with RE11.3.25 on river banks and mosaics with RE11.3.2 on the outer flood plain margins.

The canopy is generally dominated by *Eucalyptus tereticornis* and *Angophora floribunda* in varying proportions with canopy cover (PCC) ranging from 30 to 60% and heights of up to 30 m. Associated canopy species include *Corymbia tessellaris, Corymbia clarksoniana* and *Eucalyptus populnea* although these species rarely dominate. Sub-canopy layers are generally formed by species typical of the canopy although may occasionally contain *Acacia salicina, Casuarina cristata, Casuarina cuninghamiana, Callitris glaucophylla* and *Acacia harpophylla* in low densities. *Acacia salicina and A. stenophylla* often form the dominant shrub layer at densities rarely exceeding 10% cover.

The condition of these communities is variable across the landscape. Vegetation along the Condamine River is generally in poor condition with a large number of dead and senescing canopy trees and dramatically reduced canopy and foliage cover. Mean groundcover values across all 11.3.4 secondary sites indicate a robust cover of 80% comprising 58% natives (50% native perennial grasses and sedges/8% natives forbs), with exotic species contributing 21% cover (10% exotic grasses/11%exotic forbs). The mean value combining leaf litter, bare soil and logs/branches >5cm diameter was 21%. Typical native ground cover e species include *Lomandra longifolia, Eragrostis parviflora, Imperata cylindrica, Arundinella nepalensis, Chloris divaricata,* and *Carex impressa*. At some locations the exotic grasses giant panic (*Megathyrus maximus* var. *maximus*) and rhodes grass (*Chloris gayana*) tend to dominate with often extensive infestations of lippia, and scattered occurrences of *Opuntia* spp. and *Acacia farnesiana*.

The vegetation on some of the smaller tributaries including Wilkie, Back and Braemar Creeks retain moderate to good condition with well preserved examples was located on the riparian corridor of Wilkie Creek within PL252 (Sites AS26, AS27, AS31). The vegetation in this location attained canopy heights to 28 m with up to 50% PCC. Ground cover is dominated by up to 80% cover of native species including *Lomandra longifolia, Arundinella nepalensis,* and *Carex impressa*.

Photograph 9. Tall open forest of *Eucalyptus tereticornis* and *Angophora floribunda* with dense native ground cover on Wilkie Creek (Site AS31).

Major Threats and Risks

Major threats imposed by the project are likely to include:

- Vegetation clearing through failure to correctly identify the ecological community prior to activity.
- Degradation of habitat through fragmentation, particularly associated with linear crossings of riparian areas.
- Edge effects associated with clearing and fragmentation including invasion of exotic weeds and pasture grass species. Lippia *(Phyla canescens), Opuntia* spp*.* and exotic pasture gasses were all observed to be common causes of groundcover degradation.
- Similar to RE11.3.2, The ecosystem appears particularly prone to canopy dieback. Stresses imposed by changing hydrological or land use regimes may have implications for the long term viability of the riparian ecosystem in some locations.

Project-related Impacts (unmitigated)

Activities and processes which threaten this communityinclude:

- Direct impacts due to vegetation clearing, particularly where associated with crossings on major watercourses.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.
- Changing hydrological flow regimes on major water courses may be a cause of canopy senescence and degradation.

Project-related Impact Significance

The majority of remnant areas are associated with the immediate riparian margins of major river systems and are often in poor condition due to heavy grazing pressure, displacement of native ground covers and canopy dieback. Notable exceptions in the detailed mapping area include Wilkie Creek where it traverses the western fringe of PL252. The ecosystem in this area is in excellent condition with high retention of native ground cover and original canopy trees. Given the generally poor condition of remnants and the limited extent of the ecosystem in the PDA, the habitat sensitivity is considered to be ***Moderate.*** The Brigalow Belt bioregion hosts of 186652 ha of this ecosystem. Detailed mapping of PL Areas indicates a total of 2376 Ha with a further 2544 Ha indicated in certified ecosystem mapping (DERM, 2009b) in the broader PDA. As such the magnitude of impact is ***Low***.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Consideration given to detailed mapping of proposed impact areas to identify extent of the ecosystem prior to impact.
- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The condition of the any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further degradation.
- Avoid traversing riparian forests with linear infrastructure wherever possible.
- Careful weed hygiene measures will be required in the vicinity of all identified occurrences.
- Where the community is identified and impact is unavoidable, construction corridors should be narrowed. Impacted areas should be immediately seeded with native grass species, and individual canopy trees avoided wherever practical. The general suitability of alluvial soils for ground cover rehabilitation means these measures will mostly mitigate against impact.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. The ecosystem is relatively robust and rehabilitation efforts will mostly mitigate impacts, provided total area of impact is small and rehabilitation measures are implemented immediately. Without any mitigation, impacts of ***Low Significance*** **(8)** will occur. A combination of avoidance and other compensatory measures will mostly mitigate against impacts and residual impact will be of ***Low Significance*** **(8).** Total avoidance will result in a residual impact that is ***Low*** **(4).**

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (8)	Totally Effective	The habitat is is considered amenable to site rehabilitation.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A, Neldner, V. J, Wilson, B., A, Neihus, R. A (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

<u>RE 11.3.17: </u>*<u>Eucalyptus populnea</u>* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.

VMA Status: Of Concern

Biodiversity Status: Endangered

No of Survey Sites: 1 Secondary (AS14), 9 Quaternary

The ecosystem occurs largely within PLs 252, 230, 260 and 198 where it often forms mosaics with brigalow communities (RE11.3.1). It is a highly fragmented system with the majority of occurrences confined to narrow, often discontinuous linear strips associated with road reserves and property boundary fencelines. Minor areas are also found on the upper terraces of major watercourses although these have similarly been reduced to narrow, often un-mappable strips.

The canopy is dominated by *Eucalyptus populnea* with *Eucalptus tereticornis* and *Corymbia clarksoniana* being a rare sub-dominant where it was sampled to secondary level in the Strathedon area (Site AS14) within PL252. *Casuarina cristata* is a co-dominant to subdominant canopy species with occasional *Acacia harpophylla.* Typical canopy cover (PCC) ranges from 40 to 60%. The sub-canopy is dominated by *Casuarina cristata* with associated species including *Callitris glaucophylla, Alectryon oleofolius* subsp*. elongatus*, *Melaleuca bracteata,* and *Alphitonia excelsa.* The shrub layer is typically dominated by a sparse cover of *Geijera parviflora, Citurs glauca, Capparis mitchellii,* and *Elaeodendron australe* var*. integrifolium.* Ground cover layers are typically sparse, with infestations of exotic species such as *Opuntia stricta** and *Bryophyllum delagoense** which forms particularly heavy ground covers in some locations, most notably on narrow slivers associated with the riparian margins of Wilkie Creek. In these locations severe disturbance has facilitated invasion well into the inner margins of the community.

The ecosystem is over-represented in the certified RE mapping (DERM, 2009b) with a relatively extensive riparian community along Wilkie Creek revised from the certified classification of RE11.3.17 to RE 11.3.4.

Photograph 10. A dense sub-canopy and shrub layer of *Casuarina cristata* is typical of the ecosystem at Strathedon (Site AS14)

Major Threats and Risks

Major threats imposed by the project are likely to include:

- Vegetation clearing through failure to correctly identify the ecological community prior to activity.
- Degradation of habitat through fragmentation.
- Edge effects associated with clearing, land use pressure and fragmentation including invasion of exotic weeds. *Opuntia spp. a*nd *Harissia martinii** may form prominent ground and shrub covers in the majority of communities examined and *Byophyllum delagoense* m*ay be particularly intrusive in riparian situations.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community include:

- Direct impacts due to vegetation clearing, particularly associated with linear access tracks dissecting roadside remnants.

- Edge effects associated with increased land use pressure, habitat and landscape fragmentation and in particular, loss of the natural diversity of the ground cover an shrub layers through exotic species invasion.

Project-related Impact Significance

The Brigalow Belt bioregion hosts of 36 294 Ha of this ecosystem. Detailed mapping of PL Areas indicates a total of 167 Ha with a further 4245 Ha indicated in certified ecosystem mapping (DERM, 2009b) in the broader PDA. The majority of remnant areas are in poor condition due to to major fragmentation and generally severe infestation of exotic ground cover species, Most examples surveyed are secondary communities where original structural integrity has be severely compromised although the 'endangered' biodiversity status is considered in the assessment of habitat sensitivity which is assessed to be ***High*** . With consideration given to poor condition of remnants and limited extent of the ecosystem in the PDA, impacts of ***Low Magnitude*** are predicted.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Detailed mapping of proposed impact areas within PL areas has been undertaken to reduce risk of impact. Further mapping of ATP areas should be undertaken in those areas subject to intensive exploration activity.
- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The condition of the any identified communities should be examined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further degradation. Consideration should be given to weed eradication where the community occurs on Arrow controlled land.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 300 m should be established around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown.
- Where the community is identified and impact is unavoidable, construction corridors should be narrowed. Regeneration of impacted areas with representative native species should be relatively successful provided ongoing management of rehabilitation is undertaken.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. The ecosystem is relatively robust and rehabilitation efforts will mostly mitigate impacts, provided total areas of impact is small and rehabilitation measures are implemented immediately. Without any mitigation, impacts of ***Moderate Significance*** **(12)** will occur. A combination of avoidance and other compensatory measures will mostly mitigate against impacts and residual impact significance will be ***Moderate (12*****)** and with total avoidance including management buffers, residual impact is ***Low*** **(7).**

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	Low	Moderate (12)	Totally	The component canopy species have been observed to regenerate readily from total habitat clearing and the habitat is considered amenable to site rehabilitation.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
High	Extremely Low Magnitude	Low (7)	High	Low	Moderate (12)

*Includes management buffer implementation
[#] Clearing of core habitat known and possible is unavoidable

References

Accad, A, Neldner, V. J, Wilson, B., A, Neihus, R. A (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

<u>RE 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.</u>

VMA Status: Not of Concern

Biodiversity Status: Of Concern

No of Survey Sites: 3 Secondary (AS56, AS119, AS148), 19 Quaternary

Regional ecosystem 11.3.25 occupies the inner flood channel banks of the majority of larger watercourses. It is difficult to define the true extent of this ecosystem due largely to its tendency to merge with adjacent flood plain vegetation (typically RE11.3.4 or RE11.3.2) with little change in floristics or structure. For this reason, the ecosystem is mapped in complex with RE11.3.4 in the majority of cases, except where it provides a clearly defined aerial photographic signature.

Eucalyptus tereticornis or *Eucalyptus camaldulensis* to 30 m are the dominant canopy species, merging with a range of other *eucalypts* including *Angophora floribunda, Corymbia intermedia* and *Eucalyptus coolabah* in northern areas near Chinchilla. *Casuarina cunninghamiana* is an occasional tree in the majority of riparian environments athough is more typical of the sub-canopy. Sparse shrub layers are typically formed by *Acacia stenophylla*, *Acacia salicinia* and occasional *Alectryon oleofolius* subsp*. elongatus.* Ground cover is typically formed by *Lomandra longifolia* with *Panicum spp., Eragrostis spp., Dichanthium sericeum, Bothriochloa decipiens, Chrysopogon filipes Atriplex muelleri, Salsola kali, Tetragonia tetragonioides, Crinum uniflorum* and *Marselia* spp. Exotic species include *Megathyrsus maximus*, Xanthium occidentale** (sandy river beds), *Ricinus communis*, Verbena bonariensis*,* and *Bidens bippinata*.* Lippia (*Phyla canescens)** and *Bryophyllum delagoense** may form dense cover in heavily disturbed locations.

The ecosystem also includes riverine waterbodies which are mapped as RE11.3.25g. Impounded waterbodies are mapped as non-remnant where they discernable.

The poor condition of this vegetation, particularly along the banks of the Condamine River is noteworthy. The majority of occurrences comprise a considerable proportion of dead or senescing canopy trees, often in the absence of any evidence for mechanical disturbance such as ringbarking. However, mean groundcover values across all 11.3.25 secondary sites indicate a robust cover of 84% comprising 56% natives (52% native perennial grasses and sedges/4% natives forbs), with exotic species contributing 29% cover (4% exotic grasses/25% exotic forbs). Where grazing pressure is evident on the inner river banks, stream bank erosion and exotic species invasion is more prevalent.

Photograph 11. Steep inner banks of the Condamine River at site AS148 with riparian vegetation (RE11.3.25).

<u>Major Threats and Risks</u>

Major threats imposed by the project are likely to include:

- Direct clearing of vegetation through failure to correctly identify remnant areas on watercourses.
- Degradation of habitat through fragmentation.
- Edge effects associated with clearing, land use pressure and fragmentation including invasion of exotic weeds. *Opuntia* spp*. Lippia,* invasive pasture grasses and *Bryophyllum delagoense** may form prominent ground and shrub covers in the majority of communities examined with the latter being particularly intrusive in riparian situations.
- Erosion of stream banks causing habitat loss and decline in habitat condition.
- Changes to river flow regimes resulting in canopy senescence, and condition/composition of ground and shrub layers.

<u>Project-related Impacts (unmitigated)</u>

Activities and processes which threaten this community include:

- Direct impacts due to clearing of linear corridors during river crossings of access tracks, pipelines and gathering lines. This includes loss of habitat trees.
- Erosion of river banks resulting in habitat loss due to poor siting of river crossings or failure to adequately rehabilitate.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation and in particular, loss of the natural diversity of the ground cover and shrub layers through exotic species invasion.

<u>Project-related Impact Significance</u>

Consequences of impact to this community extend beyond direct loss of habitat, affecting a wide range of geomorphic and ecological functions including changes to water quality and associated impacts to aquatic function. These impacts are addressed in other impact sections, and issues discussed here relate to the potential for direct habitat loss. The Brigalow Belt bioregion hosts of 21 472 ha of this ecosystem with detailed mapping of PL areas indicating a total of 2020 Ha with a further 7352 Ha indicated in certified ecosystem mapping (DERM, 2009b) in the broader PDA. The majority of remnant areas are in moderate to poor condition due to loss of canopy vigour and displacement of ground cover by exotic species. High quality examples may be found in state forest areas where riparian fringes are continuous with broader tracts of remnant vegetation. Direct impacts to habitat will be minor and habitat will be affected only where watercourse crossings are necessary. With consideration given to the poor to moderate condition of habitats and unlikelihood that extensive areas of the ecosystem will be affected by direct impact, habitat sensitivity is considered to be ***Moderate*** and the magnitude of potential impact is also considered ***Low.*** This does not consider the potential for more pervasive loss of habitat that might be affected through changes to river hydrology and flow regimes.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Identify high value riparian forest areas and ensure these areas are avoided during activity.
- Assess the geomorphic character of riverine areas prior to habitat incursion to ensure highly erosion prone areas are avoided.
- Construction corridors should be narrowed as far as practically possible and large remnant trees should be avoided.
- All areas subject to trenching or other direct impact should be immediately stabilised to prevent the initiation and acceleration of erosion.
- The ground location of all identified communities should be marked prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- Avoid significant habitat trees where possible.

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem although this is unlikely to be possible in all cases. Unmitigated, impacts of ***Low*** (8) significance will happen. Whilst some impact is expected, dramatically reducing construction corridors followed by rapid stabilisation will mostly mitigate impacts and residual impact will be ***Low***

(8). Total avoidance with management buffers in place will result in a residual impact that is ***Extremely Low* (4)**

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (8)	Totally	The component canopy species have been observed to regenerate readily from total habitat clearing and the habitat is considered amenable to site rehabilitation.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low Magnitude	Low (4)	Moderate	Low	Low (8)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J, Wilson, B.,A., Neihus, R. A (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

RE 11.3.27: Freshwater wetlands

VMA Status: Not of Concern

Biodiversity Status: Of Concern

No of Survey Sites: 2 Secondary (AT71, AT75); 10 Quaternary.

Floodplain wetlands are generally associated with the flood overflow channels characteristic of the flood plains of major river systems throughout the PDA. The wetlands play an important hydrological role, facilitating nutrient exchange between aquatic and terrestrial ecosystems during periods of seasonal overbank flow. The Condamine River floodplain hosts a complex wetland system with RE11.3.27 forming mosaics with RE11.3.25, 11.3.2 and 11.3.4 throughout its entire length within the PDA. A variety of wetland types are recognised within the PDA.

Lake Broadwater, mapped as RE11.3.27a (Freshwater Lake) is a seasonal water feature that was dry at the time of survey. The wetland feature is nationally recognised for its natural values, being significant at a national and state level. The lake is listed on the Directory of Important Wetlands and is recognised as being a rare example of a semi-permanent freshwater lake in the bioregional area (Environment Australian 2001a, Blackman *et al.* 1999). Wetland habitats are known to support two flora species listed as near-threatened under the NCA 1992 i.e. *Eleocharis blakeana* and *Fimbristylis vagans*.

The feature is rimmed by a woodland of *Eucalyptus camaldulensis* which demonstrate concentric rings indicative of variations in seasonal fluctuations in water level. The woodland feature is represented as the palustrine wetland ecosystem sub-type RE11.3.27d. Long Swamp, within PL 260 is a similar vegetated wetland ecosystem that discharges on a seasonal basis into Wilkie Creek. Representation of the feature as RE11.3.2 in Certified RE Mapping (DERM 2009b) is incorrect with field survey confirming features typical of RE11.3.27d (palustrine wetland). Long Swamp is heavily utilised for irrigation purposes which has undoubtedly affected hydrological function, species composition of the ground layers, the vigour of the canopy trees and reduced its overall biodiversity values.

Photograph 12. Lake Broadwater in background (RE11.3.27a) with concentrically zoned *Eucalyptus camaldulensis* woodland and shrubland in foreground.

The most extensive of the wetland types is RE11.3.27c which forms by the extensive floodplain system of channel overflows and anabranches that are seasonally activated during periods of overbank flow. The majority of these overflow channels were dry at the time of survey and heavily degraded with Lippia (*Phyla canescens*).* Those retaining water generally possessed native aquatic macrophytes such as *Ottellia ovalifolia, Damasonium minus, Azolla piñata* and *Ludwigia pepaloides* subsp*. montevidensis.* A large number of these features had been artificially dammed and where site disturbance was clearly evident, have been mapped as non-remnant.

Photograph 13. Overflow channel of the Condamine River (Site AQ146) providing representation of RE11.3.27c. The system was seasonally dry and ground cover was dominated by a dense infestation of Lippia.

Major Threats and Risks

Major threats imposed by the project are likely to include:

- Sedimentation of wetland areas through unmanaged erosion.
- Changes to hydrological regimes affecting seasonal cycles of wetland replenishment.
- Degradation of habitat through invasion of exotic species.
- Direct impacts due to failure to adequately identify the location of wetland habitats prior to construction.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community include:

- Direct impacts due to clearing of linear corridors for gathering lines and pipelines.
- Sedimentation of wetland habitats due to failure to stabilise construction areas or other areas of impact.
- Changes to overland flow paths (during) construction of linear access infrastructure resulting in disruption to replenishment events.

- Edge effects associated with increased land use pressure, habitat and landscape fragmentation and in particular, loss of the natural diversity of the ground cover and shrub layers through exotic species invasion.
- Scorching of natural wetland ecosystems through direct release of saline groundwaters discharged from leaking well heads.

Project-related Impact Significance

Similar to RE11.3.25, consequences of impact to this community extend beyond direct loss of habitat. Approximately 49875 Ha of this ecosystem is represented within the bioregion although it is relatively well represented in the conservation estate with 613 Ha contained within National Parks (Accad *et al.* 2008). The majority of remnant areas associated with the flood plain of the Condamine River are in poor condition with native vegetation almost universally displaced by Lippia (*Phyla canescens).* Lake Broadwater is however a highly significant wetland feature in the bio-regional context which has retained high quality natural values. This feature is considered to be ***Highly Sensitive*** to disturbance although in relation to the broader representation of wetland habitats in the PDA, the habitat sensitivity is considered to be ***Moderate****.* Impact magnitude is considered to be ***Moderate.***

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Identify all wetland areas through mapping and on ground survey prior to activity.
- Ensure all infrastructure is designed to retain natural or existing flow regimes.
- Ensure sediment control measures are in place in all areas where significant ground disturbance has occurred.
- Assess the geomorphic character of flood plain areas prior to incursion to ensure natural flow paths remain unrestricted wherever possible.
- Construction corridors should be narrowed as far as practically possible on flood plain areas and large remnant trees should be avoided to minimise potential for soil loss.
- Lake Broadwater is a Category A ESA and activities in the vicinity will require careful consideration and management. Implementation of a disturbance exclusion buffer of 1km from the boundaries of the conservation reserve should be considered.
- Emergency shut-down procedures for all well heads with potential to discharge groundwater directly into wetland areas should be in place.

Summary Residual Impact Assessment

Unmitigated, impact significance will be ***Moderate*** (with consideration given to the intact nature of Lake Broadwater). Avoidance of this feature through implementation of a management buffers coupled with other mitigation measures will completely mitigate impact and residual impact will be ***Low* (4).** Use of other measures only will result in ***Low (8)*** residual impact significance**.**

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Moderate	Moderate (13)	Totally	Wetland rehabilitation is unlikely to be successful due to prevalence of invasive weeds. rehabilitation.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J., Wilson, B. A., Neihus, R. A. (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

<u>RE 11.4.12: *Eucalyptus populnea woodland on Cainozoic clay plains*</u>

VMA Status: Endangered

Biodiversity Status: Endangered

No of Survey Sites: 3 Secondary (AS160, AS166, AS172), 3 Quaternary.

Mapped occurrences of RE 11.4.12 are restricted to the Chinchilla region within PL 185. The ecosystem occupies low sandy rises which sit above the upper alluvial terrace of the Condamine River flood plain. The ecosystem generally mixes with RE11.4.3 on the outer margins of the sandy rises as soil drainage becomes more impeded.

Similar to all vegetation associated with the Condamine River Flood Plain, the ecosystem has been heavily fragmented, reduced to narrow slivers and isolated remnants on stock routes, roadside easements and occasionally on private land. A well preserved example is located on the Chinchilla Sporting Shooters Club Range where it forms a continuous tract of remnant vegetation mixed with RE11.4.3 and 11.3.25.

The ecosystem is dominated by *Eucalyptus populnea*, generally with canopy cover ranging from 25 to 40% and height range from 15 to 23m. *Casuarina cristata* forms an associated canopy species. The sub-canopy layer (T2) comprises *Acacia melvillei, Casuarina cristata, Eremophila mitchellii, Geijera parviflora, Alectryon oleofolia* and a mid-dense shrub layer is formed by *Geijera parviflora, Acacia pendula, Acacia salicina, Eremophila mitchellii, Citrus glauca, Pittosporum angustifolia, Atalaya hemiglauca, Myoporum acuminata, Piitosporum spinescens, Capparis mitchellii* and *Alectryon diversifolius.*

Mean groundcover values across all 11.4.3 secondary sites indicate an average cover of 30% comprising 25% natives (15% native perennial grasses and sedges/10% natives forbs), with exotic species contributing 5% cover (0% exotic grasses/5% exotic forbs). However, *Opuntia stricta* and *Eriocereus martinii* may be prominent shrub and ground cover species and localised invasion is a major source of habitat degradation. A large proportion of canopy trees were senescing or dead in the some of the communities examined.

Photograph 14. RE11.4.3 in the Chinchilla Sporting Shooters Club Range (AS172).

Major Threats and Risks

The major threats to the ecosystem are;

- Vegetation clearing.
- Degradation of habitat through fragmentation.
- Edge effects associated with fragmentation including invasion of exotic species. Incursion of exotic pasture grasses may promote inappropriate fire regimes resulting in habitat degradation.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing, particularly adjacent to roadside corridors and stock routes.. Major occurrences within the PDA are located within PL185 where they exist as isolated fragments.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

Project-related Impact Significance

A total of 7 526 Ha of this ecological community in the Brigalow Belt bioregion Based on certified ecosystem mapping (Accad *et al.* 2008), with 946 Ha represented in the PDA based on detailed project mapping and certified RE mapping (DERM, 2009). The ecosystem has limited representation in the conservation estate with no examples preserved in the national park system. All remnants examined were in moderate to poor structural condition with a prominence of exotic species in the ground cover and lower shrub layers which, due to the large edge to area ratios. The heavy fragmentation appears consistent with examples of the ecosystem in the broader bioregional and it is rare to find an occurrence which has continuity with well preserved areas of remnant vegetation. Considering the ecosystems ‘Endangered’ status the habitat sensitivity is considered to be ***High.*** With the limited area in secure conservation tenure and relative extensive occurrence of this habitat in the PDA, the magnitude of the unmitigated impact is considered to be ***High***.

Proposed Management/ Mitigation Measures

The following mitigation measures should be employed to reduce the risk of impact to the ecological community.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact. Ecological mapping has already been prepared for PL 185 as a component of this exercise which significantly reduces the risk of direct impact.
- Avoid stock route areas in and the Chinchilla Sporting Shooters Range in ATP 185 where the best preserved examples of the ecosystem are located.
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 500 m should be established around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown.
- The condition of the any identified communities should be determined and factors contributing to degradation should be identified and documented. These factors should be used to revise on ground protocols designed to manage impacts to the community and prevent further degradation.
- Whist the work program should aim to avoid impact to all remnant and advanced regrowth communities, reduction in the width of construction corridors should be applied where all incursions to the ecosystem are unavoidable.
- Rapid rehabilitation of disturbed areas through planting of appropriate native species should be undertaken. This should be followed by intensive long term management and maintenance of rehabilitated areas. Habitat re-construction in disturbed areas should be readily achieved as a large proportion of the constituent species can be regarded as colonisers

Summary Residual Impact Assessment

Avoidance is the only feasible method to mitigate direct impact to the ecosystem. Because the ecosystem is highly fragmented, avoidance of the majority of occurrences should be easily managed. The increase in land use and access pressure facilitated by exploration activities has the potential to promote edge effects and management buffers should be implemented to totally avoid impacts.

Without any mitigation, the significance of impacts will be ***High (21)*** . If habitats are not totally avoided, alternative management measures and well managed rehabilitation to disturbed areas will mostly mitigate impacts with residual impacts of ***Moderate Significance*** **(12)**. Total habitat avoidance with management buffers in place will completely mitigate against impact and residual impact will be ***Low*** **(7)**.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	High	High (21)	Totally	Eucalyptus populnea has been observed to regenerate rapidly following site disturbance.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
High	Extremely Low	Low (7)	Highe	Low	Moderate (12)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J., Wilson, B., A., Neihus, R. A. (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

C2. Other significant ecosystems inferred to be in PDA

The following ecosystems were not observed or sampled during EIS survey works although are inferred to be present within the PDA based on certified RE Mapping (DERM, 2009b). Brief comments regarding the distribution and attributes are provided.

<u>RE 11.9.7: Eucalyptus populnea, Eremophila mitchellii shrubby woodland on fine-grained sedimentary rocks</u>

VMA Status: Of Concern

Biodiversity Status: Of Concern

A minor area was mapped within PL 230 in continuous with the Braemar State Forest to the west. Certified RE mapping (DERM, 2009b) represents the majority of occurrences as heavily fragmented remnants throughout the landscape. Intact examples are also represented within major tracts of remnant vegetation to the west of Millmerran. The ecosystem occurs throughout the PDA although the most extensive occurrences are located in the northern and southern regions, generally within heterogenous polygons where it is associated with a range of ecosystems including RE11.3.2, 11.9.5, 11.3.25 and 11.9.10.

<u>Major Threats and Risks</u>

The major threats to the ecosystem are generic in nature and relate to:

- Vegetation clearing.
- Degradation of habitat through fragmentation.
- Edge effects associated with fragmentation including invasion of exotic species. Incursion of exotic pasture grasses may promote inappropriate fire regimes resulting in habitat degradation.

<u>Project-related Impacts (unmitigated)</u>

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

<u>Project-related Impact Significance</u>

A total of 109286 ha of this ecological community in the Brigalow Belt bioregion based on certified ecosystem mapping (Accad *et al.* 2008), with 704 Ha represented in the PDA based on both certified RE mapping (DERM, 2009b). The ecosystem exists as minor scattered fragments, often on the fringes of more extensive remnant areas. The majority of occurrences are in ATP areas and not subject to immediate plans for exploration activity. Considering the ecosystems 'Of Concern' status and limited extent in the PDA in, the habitat sensitivity is considered to be ***Moderate*** and the magnitude of potential impacts is considered to be ***Low*** .

Proposed Management/ Mitigation Measures

Requirements for mitigation are generic in nature. The following measures can be employed to reduce the risk of impact to the ecological community.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact.
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- Whist the work program should aim to avoid impact to all remnant and advanced regrowth communities, reduction in the width of construction corridors should be applied where all incursions to the ecosystem are unavoidable.
- Rapid rehabilitation of disturbed areas through planting of appropriate native ground cover speciesshould be undertaken. This should be followed long term management and maintenance of rehabilitated areas.

Summary Residual Impact Assessment

Without any mitigation, impacts significance will be ***Low*** **(8)** will happen. Total habitat avoidance will completely mitigate against impact and residual impact will be ***Low*** **(4)**. Alternative management measures and well managed rehabilitation in disturbed areas will mostly mitigate impacts and the significance of the residual impact will be ***Low*** **(5)**.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (8)	Totally	Eucalyptus populnea has been observed to regenerate rapidly following site disturbance.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (5)

*Includes management buffer implementation
[#] Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J., Wilson, B., A., Neihus, R. A. (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

RE 11.9.10: Acacia harpophylla, Eucalyptus populnea open forest on fine-grained sedimentary rocks

VMA Status: Of Concern

Biodiversity Status: Endangered

Certified RE mapping (DERM, 2009b) represents RE11.9.10 as being restricted to the northern portion of the PDA within ATP 747. The ecosystem is shown to be heavily fragmented consisting of narrow slivers that form the sub-dominant component of a number of heterogeneous polygons. The ecosystem is generally associated with the brigalow dominant RE 11.9.5

Major Threats and Risks

In the absence of detailed ecosystem information, the major threats to the ecosystem are generic in nature and relate to:

- Vegetation clearing.
- Degradation of habitat through fragmentation.
- Edge effects associated with fragmentation including invasion of exotic species. Incursion of exotic pasture grasses may promote inappropriate fire regimes resulting in habitat degradation.

Project-related Impacts (unmitigated)

Activities and processes which threaten this community, include:

- Direct impacts due to vegetation clearing.
- Edge effects associated with increased land use pressure, habitat and landscape fragmentation including loss of native ground covers and exotic species invasion.

Project-related Impact Significance

A total of 83 507 Ha of this ecological community in the Brigalow Belt bioregion based on certified ecosystem mapping (Accad *et al*. 2007), with 175 Ha represented in the PDA. The ecosystem exists as minor scattered fragments. The ‘endangered’ biodiversity status is indicative of the ecosystems sensitivity to degradation and it will likely be highly sensitive to habitat fragmentation. ***High*** habitat sensitivity is therefore attributed to this habitat. The majority of occurrences are in ATP areas and not subject to immediate plans for exploration activity. Considering the ecosystems ‘Of Concern’ VMA status and limited extent in the PDA in, potential impacts are considered to be ‘***Low Magnitude***’.

Proposed Management/ Mitigation Measures

Requirements for mitigation are generic in nature. The following measures can be employed to reduce the risk of impact to the ecological community.

- Accurate vegetation mapping at a scale suitable for site specific planning should be prepared over all areas subject to immediate potential impact.
- The ground location of all identified communities should be surveyed prior to activity. All workers including contract plant and machinery operators should be made aware of the location of significant areas.
- Rapid rehabilitation of disturbed areas through planting of appropriate native ground cover speciesshould be undertaken. This should be followed long term management and maintenance of rehabilitated areas.
- The community and component ecosystem are classed as Category B Environmentally Sensitive Areas. Work exclusion buffers to a distance of 300 m should be established around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown.

Summary Residual Impact Assessment

Without any mitigation, impacts of minor consequence will possibly happen and preliminary impact significance will be ***Moderate*** **(12).** Total habitat avoidance will completely mitigate against impact and residual impact will be ***Low*** **(7)**. Alternative management measures and well managed rehabilitation in disturbed areas will mostly mitigate impacts. The residual impact in this case will also be of ***Moderate*** Significance **(12).**

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
High	Low	Moderate (12)	Totally	Mostly

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
High	Extremely Low	Low (7)	High	Low	Moderate (12)

*Includes management buffer implementation
Clearing of core habitat known and possible is unavoidable

References

Accad, A., Neldner, V. J., Wilson, B., A., Neihus, R. A. (2008). *Remnant Vegetation in Queensland. Analysis of remnant vegetation-1997-1998-1999-2000-2001-2002-2005, including regional ecosystem information.* Queensland Herbarium, Environmental Protection Agency.

Department of Environmental Resource Management (DERM) (2009b). *Regional Ecosystem Digital Data, Version 6.0.* Queensland Herbarium, Brisbane.

Appendix D. Flora Species List based on data searches and project field surveys

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Abildgaardia ovata (Burm.f.) Kral		1			
Abildgaardia vaginata R.Br.				1	
Abutilon calliphyllum Domin		1			
Abutilon fraseri (Hook.) Hook. ex Walp. subsp. fraseri			1		
Abutilon malvifolium (Benth.) J.M.Black		1		1	
Abutilon oxycarpum (F.Muell.) F.Muell. ex Benth.		1	1	1	
Abutilon oxycarpum (F.Muell.) F.Muell. ex Benth. var. oxycarpum		1			1
Abutilon oxycarpum var. incanum (Benth.) J.M.Black		1			
Abutilon oxycarpum var. subsagittatum Domin		1			1
Abutilon tubulosum Hook. var. tubulosum		1			
Acacia amblygona A.Cunn. ex Benth.		1		1	
Acacia aneura var. intermedia Pedley		1			1
Acacia aneura var. major Pedley		1			
Acacia aprepta Pedley		1		1	
Acacia bancroftiorum Maiden		1		1	1
Acacia barakulensis (Vulnerable NCA)				1	
Acacia blakei Pedley subsp. blakei		1			1
Acacia burrowii Maiden		1	1	1	1
Acacia buxifolia subsp. pubiflora Pedley		1			
Acacia carolae		1			1
Acacia complanata A.Cunn. ex Benth.		1			1
Acacia conferta A.Cunn. ex Benth.		1	1	1	1
Acacia crassa Pedley		1	1	1	
Acacia crassa Pedley subsp. crassa		1	1	1	1
Acacia crassa subsp. longicoma Pedley		1			
Acacia curranii Maiden (Vulnerable EPBC, NCA)		1			
Acacia deanei (R.T.Baker) M.B.Welch, Coombs & McGlynn subsp. deanei		1	1	1	1
Acacia debilis Tindale		1		1	1
Acacia decora Rchb.		1		1	1
Acacia everistii Pedley		1			
Acacia excelsa Benth. subsp. excelsa		1	1	1	1
Acacia falcata Willd.		1		1	
*Acacia farnesiana (L.) Willd.**	1	1		1	1
Acacia fimbriata A.Cunn. ex G.Don		1			
Acacia hakeoides A.Cunn. ex Benth.		1			
Acacia handonis Pedley (Vulnerable EPBC, NCA)				1	
Acacia harpophylla F.Muell. ex Benth.		1	1	1	1
Acacia implexa Benth.		1			1
Acacia ixiophylla		1		1	
Acacia johnsonii Pedley		1	1		
Acacia jucunda Maiden & Blakely		1	1		
Acacia julifera Benth. subsp. julifera		1			
Acacia juncifolia Benth.		1			
*Acacia karroo Hayne**	1	1			
Acacia leiocalyx (Domin) Pedley subsp. leiocalyx		1	1	1	1
Acacia lineata A.Cunn. ex G.Don		1			
Acacia melvillei Pedley		1		1	1
Acacia montana Benth.		1		1	
Acacia muelleriana Maiden & R.T.Baker		1	1	1	
Acacia neriifolia A.Cunn. ex Benth.		1	1	1	
Acacia omalophylla A.Cunn. ex Benth.		1			1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Acacia oswaldii F.Muell.		1		1	
Acacia pendula A.Cunn. ex G.Don		1		1	1
Acacia penninervis Sieber ex DC. var. penninervis		1			
Acacia polybotrya Benth.		1	1	1	
Acacia pravifolia F.Muell.		1			
Acacia pruinosa A.Cunn. ex Benth.		1			
Acacia pustula Maiden & Blakely		1			
Acacia rigens A.Cunn. ex G.Don		1			
Acacia salicina Lindl.		1	1	1	1
Acacia semilunata Maiden & Blakely		1	1	1	1
Acacia semirigida Maiden & Blakely		1			
Acacia shirleyi Maiden		1	1	1	
Acacia sparsiflora Maiden		1	1		
Acacia spectabilis A.Cunn. ex Benth.		1		1	1
Acacia stenophylla A.Cunn. ex Benth.		1		1	
Acacia striatifolia Pedley		1	1	1	
Acacia tenuinervis Pedley (Near-threatened NCA)		1		1	1
Acacia triptera Benth.		1	1	1	1
Acacia ulicifolia (Salisb.) Court		1			
Acalypha eremorum Muell.Arg.		1		1	1
Acanthospermum hispidum DC.		1		1	
Achyranthes aspera L.		1		1	1
Acianthus fornicatus R.Br.		1			
Actinotus gibbonsii F.Muell.		1			
Adiantum aetheopicum					1
Adiantum hispidulum Sw. var. hispidulum		1			
*Adonis microcarpa DC.**	1	1			
*Aeschynomene indica L.**	1	1		1	1
Agiortia pleiosperma (F.Muell.) Quinn		1			
Ajuga australis R.Br.		1		1	1
Alectryon diversifolius (F.Muell.) S.T.Reynolds		1	1	1	1
Alectryon oleifolius subsp. elongatus S.T.Reynolds		1	1	1	1
Allocasuarina inophloia (F.Muell. & F.M.Bailey) L.A.S.Johnson		1	1	1	1
Allocasuarina littoralis (Salisb.) L.A.S.Johnson		1	1	1	
Allocasuarina luehmannii (R.T.Baker) L.A.S.Johnson		1	1	1	1
Allocasuarina torulosa (Aiton) L.A.S.Johnson		1			
Alloteropsis semialata (R.Br.) Hitchc.		1	1	1	1
Alopecurus geniculatus L.		1			
Alphitonia excelsa (A.Cunn. ex Fenzl) Reissek ex Benth.		1	1	1	1
Alstonia constricta F.Muell.		1		1	1
Alternanthera denticulata R.Br.		1	1	1	1
Alternanthera ficoidea (L.) P.Beauv.		1		1	
Alternanthera micrantha (Benth.) Domin		1		1	
Alternanthera nana R.Br.		1	1	1	1
Alternanthera nodiflora R.Br.		1		1	
*Alternanthera pungens Kunth**	1	1		1	1
Amaranthus macrocarpus Benth.		1			
Amaranthus retroflexus L.		1			
*Amaranthus viridis L.**	1	1		1	1
Ambrosia artemisiifolia L. (Declared Class 2)*	1	1			
Ammannia multiflora Roxb.		1		1	
Amphipogon caricinus F.Muell. var. caricinus		1	1		
Amphipogon caricinus var. scaber Vickery		1	1		
Amyema bifurcata (Benth.) Tiegh.		1		1	1
Amyema cambagei (Blakely) Danser		1		1	1
Amyema congener (Sieber ex Schult. & Schult.f.) Tiegh.		1		1	1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Amyema congener subsp. rotundifolia Barlow		1			
Amyema gaudichaudii (DC.) Tiegh.		1			1
Amyema linophylla subsp. orientalis Barlow		1			1
Amyema maidenii (Blakely) Barlow subsp. maidenii		1		1	
Amyema maidenii subsp. angustifolia Barlow		1			1
Amyema miquelii (Lehm. ex Miq.) Tiegh.		1		1	1
Amyema pendula subsp. longifolia (Hook.) Barlow		1		1	1
Amyema quandang (Lindl.) Tiegh. var. quandang		1		1	1
Amyema quandang var. bancroftii (F.M.Bailey) Barlow		1		1	1
*Anagallis arvensis L.**	1	1			1
Ancistrachne uncinulata (R.Br.) S.T.Blake		1	1	1	1
Angophora floribunda (Sm.) Sweet		1	1	1	1
Angophora leiocarpa (L.A.S.Johnson ex G.J.Leach) K.R.Thiele & Ladiges		1	1	1	1
Anthobolus leptomerioides F.Muell.		1		1	1
Anthosachne scabra				1	
Aotus subglauca var. filiformis Blakely & McKie		1			
Aponogeton queenslandicus H.Bruggen		1		1	1
Apophyllum anomalum F.Muell.		1		1	1
Arabidella eremigena (F.Muell.) E.A.Shaw		1			
*Arctotheca calendula (L.) Levyns**	1	1			
*Arctotis stoechadifolia P.J.Bergius**	1	1			1
*Argemone mexicana L.**	1	1		1	
*Argemone ochroleuca Sweet subsp. ochroleuca**	1	1		1	1
Aristida benthamii var. benthamii		1	1	1	1
Aristida calycina R.Br. var. calycina		1	1	1	1
Aristida calycina var. praealta Domin		1			1
Aristida caput-medusae Domin		1	1	1	1
Aristida echinata Henrard		1	1		
Aristida forsteri B.K.Simon (Endangered NCA)		1			
Aristida gracilipes (Domin) Henrard			1		
Aristida holathera Domin var. holathera		1	1	1	
Aristida jerichoensis (Domin) Henrard var. jerichoensis		1	1	1	1
Aristida jerichoensis var. subspinulifera Henrard		1	1		1
Aristida latifolia Domin		1		1	1
Aristida lazaridis B.K.Simon		1			
Aristida leichhardtiana Domin		1	1		1
Aristida leptopoda Benth.		1		1	
Aristida lignosa B.K.Simon			1		
Aristida obscura Henrard		1			
Aristida personata Henrard		1	1	1	
Aristida psammophila Henrard		1			
Aristida queenslandica Henrard var. queenslandica			1		
Aristida queenslandica var. dissimilis (S.T.Blake) B.K.Simon		1	1		
Aristida ramosa R.Br.		1	1	1	1
Aristida sciuroides Domin		1			
Aristida spuria Domin		1	1		
Aristida vagans Cav.		1	1	1	
Arthropodium strictum R.Br.		1			
Arundinella nepalensis Trin.		1	1	1	1
*Asclepias curassavica L.**	1	1	1		1
Asperula conferta Hook.f.		1		1	1
Asperula cunninghamii Airy Shaw & Turrill		1			
Asperula geminifolia F.Muell.		1			1
*Aster subulatus**	1				1
Astrebla elymoides F.Muell. ex F.M.Bailey		1			1
Astrebla lappacea (Lindl.) Domin		1		1	
Atalaya hemiglauca (F.Muell.) F.Muell. ex Benth.		1		1	1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Atriplex eardleyae Aellen		1			
Atriplex leptocarpa F.Muell.		1			
Atriplex muelleri Benth.		1		1	1
Atriplex semibaccata R.Br.		1		1	1
Atriplex spinibractea R.H.Anderson		1			
Auranticarpa rhombifolia					1
Austrodanthonia bipartita (Link) H.P.Linder		1			1
Austrodanthonia induta (Vickery) H.P.Linder		1			
Austrodanthonia tenuior (Steud.) H.P.Linder		1			1
Austrostipa nodosa (S.T.Blake) S.W.L.Jacobs & J.Everett		1			
Austrostipa ramosissima (Trin.) S.W.L.Jacobs & J.Everett		1		1	1
Austrostipa scabra (Lindl.) S.W.L.Jacobs & J.Everett		1			
Austrostipa setacea (R.Br.) S.W.L.Jacobs & J.Everett		1			1
Austrostipa verticillata (Nees ex Spreng.) S.W.L.Jacobs & J.Everett		1	1	1	
Avena ludoviciana Durieu		1			
Avena sativa L.		1		1	
Azolla filiculoides Lam.		1			1
Azolla pinnata R.Br.		1		1	
Babingtonia densiflora					1
*Baccharis halimifolia L. * (Declared)*	1	1			1
Bacopa monnieri (L.) Pennell		1			
Banksia integrifolia L.f. subsp. integrifolia		1		1	
Banksia integrifolia subsp. compar (R.Br.) K.R.Thiele		1			
*Bidens bipinnata L.**	1	1		1	
*Bidens pilosa L.**	1	1		1	1
Boerhavia dominii Meikle & Hewson		1		1	1
Boerhavia pubescens R.Br.		1			
Bolboschoenus fluviatilis (Torr.) Sojak		1			
Boronia bipinnata Lindl.		1	1	1	
Boronia glabra (Maiden & Betche) Cheel		1			
Boronia occidentalis Duretto		1			
Boronia splendida Duretto		1			
Bossiaea rhombifolia subsp. concolor (Maiden & Betche) A.T.Lee		1			
Bossiaea scortechinii F.Muell.		1			
Bothriochloa biloba S.T.Blake (Vulnerable EPBC)		1		1	
Bothriochloa bladhii (Retz.) S.T.Blake subsp. bladhii		1		1	1
Bothriochloa decipiens (Hack.) C.E.Hubb. var. decipiens		1	1	1	1
Bothriochloa erianthoides (F.Muell.) C.E.Hubb.		1		1	
Bothriochloa ewartiana (Domin) C.E.Hubb.		1		1	
Brachiaria foliosa			1		
Brachyachne convergens (F.Muell.) Stapf		1		1	
Brachychiton australis (Schott & Endl.) A.Terracc.			1		1
Brachychiton populneus (Schott & Endl.) R.Br. subsp. populneus		1	1	1	1
Brachychiton populneus subsp. trilobus Guymer		1			
Brachychiton rupestris				1	1
Brachyloma daphnoides (Sm.) Benth.		1			
Brachyloma daphnoides (Sm.) Benth. subsp. daphnoides		1			
Brachyscome aculeata (Labill.) Less.		1			
Brachyscome basaltica F.Muell. var. basaltica		1			
Brachyscome ciliaris var. subintegrifolia G.L.R.Davis		1			
Brachyscome dentata Gaudich.		1		1	1
Brachyscome diversifolia var. dissecta G.L.R.Davis		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Brachyscome microcarpa F.Muell.		1			
Brachyscome multifida DC. var. multifida		1	1		
Brachyscome multifida var. dilatata Benth.		1			
Brachyscome trachycarpa F.Muell.		1	1	1	1
Brachyscome whitei G.L.R.Davis		1			1
Bracteantha bracteata			1		1
Brassica rapa subsp. campestris (L.) A.R.Clapham		1			
Breynia oblongifolia (Muell.Arg.) Muell.Arg.		1		1	1
*Bromus catharticus Vahl**	1	1			1
*Bromus diandrus Roth**	1	1			
Brunonia australis Sm. ex R.Br.		1		1	1
Brunoniella australis (Cav.) Bremek.		1	1	1	1
*Bryophyllum delagoense (Eckl. & Zeyh.) Schinz * (Declared Class 2)*	1	1		1	1
Bryophyllum x houghtonii (D.B.Ward) P.I.Forst. (Declared Class 2)*	1	1		1	
Buchnera gracilis R.Br.		1			
Buchnera linearis R.Br.		1			
Buchnera ramosissima R.Br.		1			
Bulbine alata Baijnath		1			1
Bulbine bulbosa (R.Br.) Haw.		1			
Bulbine semibarbata (R.Br.) Haw.		1			
Bulbostylis barbata (Rottb.) C.B.Clarke		1		1	
Bulbostylis pyriformis S.T.Blake		1			
Bursaria incana Lindl.		1		1	
Bursaria spinosa Cav. subsp. spinosa		1	1	1	1
Cadellia pentastylis F.Muell. (Vulnerable)		1			
Caesia chlorantha F.Muell.		1			
Caesia parviflora R.Br.		1			
Caesia parviflora R.Br. var. parviflora		1			
Caesia parviflora var. vittata (R.Br.) R.J.F.Hend.		1			
Caladenia caerulea R.Br. var. caerulea		1	1		
Caladenia carnea R.Br. var. carnea		1			
Caladenia fuscata (Rchb.f.) M.A.Clem. & D.L.Jones		1			
Calandrinia balonensis Lindl.		1			
Calandrinia calyptrata Hook.f.		1			
Calandrinia eremaea Ewart		1			
Calandrinia pickeringii A.Gray		1		1	1
Calandrinia pleiopetala F.Muell.		1			
Caleana minor R.Br.		1			
*Calendula arvensis L.**	1	1			
Callitriche sonderi Hegelm.		1			
Callitris baileyi C.T.White (Near-threatened NCA)		1		1	
Callitris endlicheri (Parl.) F.M.Bailey		1	1	1	1
Callitris endlicheri (Parl.) F.M.Bailey - C.glaucophylla Joy Thomps. & L.A.S.Johnson		1			
Callitris glaucophylla Joy Thomps. & L.A.S.Johnson		1	1	1	1
Callitris glaucophylla Joy Thomps. & L.A.S.Johnson x C.verrucosa (A.Cunn. ex Endl.) F.Muell.		1			
Calocephalus citreus Less.		1			
Calochilus robertsonii Benth.		1			
Calostemma luteum Sims		1			1
Calotis cuneata (F.Muell. ex Benth.) G.L.R.Davis		1	1	1	
Calotis cuneifolia R.Br.		1	1	1	1
Calotis dentex R.Br.		1	1		
Calotis glabrescens C.T.White (Near-threatened NCA)		1			
Calotis lappulacea Benth.		1	1		1
Calotis scabiosifolia Sond. & F.Muell. var. scabiosifolia		1			1
Calotis scapigera Hook.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Calyptochloa gracillima C.E.Hubb.		1			1
Calytrix gurulmundensis Craven (Vuln. EPBC, NCA)		1			
Calytrix longiflora (F.Muell.) Benth.		1		1	
Calytrix tetragona Labill.		1	1	1	1
Camptacra barbata N.T.Burb.		1		1	
Capillipedium parviflorum (R.Br.) Stapf		1			1
Capparis arborea (F.Muell.) Maiden		1		1	1
Capparis canescens Banks ex DC.		1		1	1
Capparis lasiantha R.Br. ex DC.		1	1	1	1
Capparis loranthifolia var. bancroftii C.T.White ex M.Jacobs		1		1	1
Capparis mitchellii Lindl.		1		1	1
*Capsella bursapastoris**	1				1
*Cardamine hirsuta**	1				1
Cardiospermum grandiflorum Sw. (Declared Class 3)*	1	1		1	
*Carduus pycnocephalus L.**	1	1			
Carex appressa R.Br.		1		1	1
Carex inversa R.Br.		1		1	1
Carex rhytidocarpa			1		1
Carissa ovata R.Br.		1	1	1	1
Cassinia laevis					1
Cassinia quinquefaria R.Br.		1			
Cassinia uncata A.Cunn. ex DC.		1			
Casuarina cristata Miq.		1	1	1	1
Casuarina cunninghamiana Miq. subsp. cunninghamiana		1		1	
Cayratia clematidea				1	1
Celtis sinensis Pers. (Declared Class 3)*	1	1		1	
*Cenchrus ciliaris**	1		1	1	1
*Cenchrus echinatus L.**	1	1		1	
*Cenchrus incertus M.A.Curtis**	1	1	1		1
*Centaurea melitensis L.**	1	1			
*Centaurea solstitialis L.**	1	1			
Centaurium erythraea Rafn		1			
Centella asiatica (L.) Urb.		1		1	
Centipeda minima (L.) A.Braun & Asch. subsp. minima		1		1	1
Centipeda pleiocephala N.G.Walsh		1			
Centrolepis exserta (R.Br.) Roem. & Schult.		1			
Centrolepis strigosa (R.Br.) Roem. & Schult.		1			
Ceratophyllum emersum					1
*Cestrum parqui L'Her.**	1	1			
Chamaesyce dallachyana (Baill.) D.C.Hassall		1	1	1	
Chamaesyce drummondii (Boiss.) D.C.Hassall		1			1
*Chamaesyce hirta (L.) Millsp.**	1	1			1
*Chamaesyce hyssopifolia (L.) Small**	1	1			
Cheilanthes distans (R.Br.) Mett.		1	1	1	1
Cheilanthes sieberi Kunze subsp. sieberi		1	1	1	1
Cheiranthera borealis (E.M.Benn.) L.Cayzer & Crisp		1			
*Chenopodium ambrosioides**	1				1
Chenopodium carinatum R.Br.		1	1		1
Chionachne cyathopoda (F.Muell.) F.Muell. ex Benth.		1			
Chloris divaricata R.Br. var. divaricata		1	1	1	1
*Chloris gayana Kunth**	1	1		1	1
Chloris truncata R.Br.		1	1	1	1
Chloris ventricosa R.Br.		1	1	1	
*Chloris virgata Sw.**	1	1		1	1
Chondrilla juncea L.		1			
Choretrum candollei F.Muell. ex Benth.		1		1	
Chorizema parviflorum Benth.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Chrysocephalum apiculatum (Labill.) Steetz		1	1	1	1
Chrysopogon fallax S.T.Blake		1	1	1	1
Chrysopogon filipes (Benth.) Reeder		1		1	1
*Cichorium intybus L.**	1	1			1
Cinnamomum camphora (L.) J.Presl (Decl. Class 3)*	1	1			1
*Cirsium vulgare (Savi) Ten.**	1	1		1	1
*Citrullus lanatus**	1				1
Citrus glauca (Lindl.) Burkill		1		1	1
Cleistochloa rigida (S.T.Blake) R.D.Webster		1			
Cleistochloa subjuncea C.E.Hubb.		1	1		
Clematicissus opaca (F.Muell.) Jackes & Rossetto		1	1	1	
Clematis decipiens H.Eichler ex Jeanes		1			
Clematis microphylla var. microphylla					1
Comesperma patentifolium F.Muell.		1			
*Commelina benghalensis L.**	1			1	
Commelina diffusa Burm.f.		1	1	1	1
Commelina ensifolia R.Br.		1		1	
Commelina lanceolata					1
*Conospermum taxifolium C.F.Gaertn.**	1	1			
*Conringia orientalis (L.) Dumort.**	1	1			
*Convolvulus arvensis L.**	1	1			1
Convolvulus clementii Domin		1			
Convolvulus erebescens					1
Convolvulus graminetinus R.W.Johnson		1			
*Conyza bonariensis (L.) Cronquist**	1	1	1	1	1
*Conyza canadensis**	1				1
Conyza primulifolia (Lam.) Cuatrec. & Lourteig		1			
*Conyza sumatrensis**	1			1	1
*Coreopsis lanceolata L.**	1	1		1	
Coronidium lanuginosum (A.Cunn. ex DC.) Paul G.Wilson		1			
Coronidium oxylepis subsp. lanatum Paul G.Wilson		1			
*Coronopus didymus**	1				1
Corymbia bloxsomei (Maiden) K.D.Hill & L.A.S.Johnson		1		1	1
Corymbia bloxsomei (Maiden) K.D.Hill & L.A.S.Johnson x C.citriodora (Hook.) K.D.Hill & L.A.S.Johnson		1			
Corymbia citriodora subsp. variegata (F.Muell.) A.R.Bean & M.W.McDonald		1		1	
Corymbia clarksoniana (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson		1	1	1	1
Corymbia tessellaris (F.Muell.) K.D.Hill & L.A.S.Johnson		1	1	1	1
Corymbia trachyphloia (F.Muell.) K.D.Hill & L.A.S.Johnson subsp. trachyphloia		1	1	1	1
Corymbia watsoniana (F.Muell.) K.D.Hill & L.A.S.Johnson subsp. watsoniana		1			
Cotula australia					1
*Crassocephalum crepidioides (Benth.) S.Moore**	1	1		1	1
Crassula peduncularis (Sm.) F.Meigen		1			
Crassula sieberiana					1
Crassula tetramera (Toelken) A.P.Druce & Sykes		1			
Crinum flaccidum Herb.		1		1	1
*Critesion murinum subsp. glaucum**	1				1
Crotalaria dissitiflora Benth. subsp. dissitiflora		1			
*Crotalaria incana L. subsp. incana**	1	1			
Crotalaria limifolia					1
Crotalaria mitchellii Benth. subsp. mitchellii		1			1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Croton insularis Baill.		1			1
Croton phebalioides					1
Cryptandra amara Sm. var. amara		1			
Cryptandra armata C.T.White & W.D.Francis		1	1		1
Cryptandra ciliata A.R.Bean (Near-threatened NCA)		1			
Cryptandra longistaminea F.Muell.		1			
Cucumis melo L.		1		1	
Cucumis melo subsp. (Manfred D.Davidson 47)		1			
*Cucumis myriocarpus Naudin subsp. myriocarpus**	1	1			1
Cullen australasicum (Schltdl.) J.W.Grimes		1			
Cullen patens (Lindl.) J.W.Grimes		1			
Cullen tenax (Lindl.) J.W.Grimes		1		1	1
*Curcumis melo subsp. agrestis**	1				1
*Cuscuta campestris Yunck.**	1	1			
Cyanthillium cinereum (L.) H.Rob.		1		1	
*Cyclospermum leptophyllum (Pers.) Sprague ex Britton & P.Wilson**	1	1			
Cymbidium canaliculatum R.Br.		1		1	1
Cymbidium suave R.Br.		1		1	
Cymbonotus maidenii (Beauverd) A.E.Holland & V.A.Funk		1			
Cymbopogon bombycinus (R.Br.) Domin		1		1	
Cymbopogon obtectus S.T.Blake		1			
Cymbopogon refractus (R.Br.) A.Camus		1	1	1	1
Cynanchum bowmanii S.T.Blake		1			
*Cynodon dactylon (L.) Pers. var. dactylon**	1	1		1	1
*Cynodon nlemfuensis Vanderyst var. nlemfuensis**	1	1			1
Cynoglossum australe R.Br.		1			1
*Cyperus aggregatus (Willd.) Endl.**	1	1			
Cyperus betchei (Kuek.) S.T.Blake		1	1		1
Cyperus betchei (Kuek.) S.T.Blake subsp. betchei		1			
Cyperus bifax C.B.Clarke		1		1	1
Cyperus bowmannii F.Muell. ex Benth.			1		
*Cyperus brevifolius**	1				1
Cyperus castaneus Willd.		1			
Cyperus clarus S.T.Blake (Vulnerable NCA)		1			
Cyperus concinnus				1	
Cyperus conicus (R.Br.) Boeck. var. conicus		1		1	1
Cyperus dietrichiae var. brevibracteatus (Domin) Kuek.		1			
Cyperus difformis L.		1		1	1
Cyperus exaltatus Retz.		1		1	1
Cyperus flaccidus R.Br.		1			
Cyperus fulvus R.Br.		1	1	1	
Cyperus gracilis R.Br.		1	1	1	1
Cyperus gunnii Hook.f. subsp. gunnii		1			1
Cyperus gymnocaulos Steud.		1			
Cyperus haspan L. subsp. haspan		1		1	
Cyperus iria L.		1		1	1
Cyperus isabellinus K.L.Wilson		1	1		
Cyperus lucidus R.Br.		1			1
Cyperus nervulosus (Kuek.) S.T.Blake		1			
*Cyperus papyrus L.**	1	1			
Cyperus polystachyos Rottb. var. polystachyos					
Cyperus pulchellus R.Br.		1			1
Cyperus pygmaeus Rottb.		1			1
*Cyperus rotundus L.**	1	1		1	
Cyperus sanguinolentus Vahl		1			1
Cyperus sculptus S.T.Blake		1			1
Cyperus squarrosus L.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Cyperus subulatus R.Br.		1			
Cyperus trinervis R.Br.		1			1
Cyperus victoriensis C.B.Clarke		1			1
Dactyloctenium radulans (R.Br.) P.Beauv.		1	1	1	1
Damasonium minus (R.Br.) Buchenau		1		1	1
Dampiera adpressa A.Cunn. ex DC.		1			1
Dampiera discolor (de Vriese) K.Krause		1			
Dampiera ferruginea R.Br.		1			
Dampiera stricta					1
*Datura ferox L.**	1	1			1
*Datura inoxia Mill.**	1	1			
Daucus glochidiatus (Labill.) Fisch., C.A.Mey. & Ave-Lall.		1			
Daviesia acicularis Sm.		1			1
Daviesia filipes Benth.		1			
Daviesia genistifolia A.Cunn. ex Benth.		1			
Daviesia ulicifolia Andrews		1		1	
Daviesia ulicifolia subsp. (Bybera C.T.White 12612)		1			
Daviesia ulicifolia subsp. stenophylla G.Chandler & Crisp		1			
Daviesia umbellulata Sm.		1			
Daviesia villifera A.Cunn. ex Benth.		1			
Deeringia amaranthoides (Lam.) Merr.		1			
Dendrophthoe glabrescens (Blakely) Barlow		1		1	
Denhamia parvifolia L.S.Sm. (Vulnerable EPBC)		1			1
Denhamia pittosporoides subsp. pittosporoides					1
Dentella browniana					1
Dentella repens (L.) J.R.Forst. & G.Forst.		1		1	1
Desmodium brachypodum					1
Desmodium campylocaulon F.Muell. ex Benth.		1			
Desmodium rhytidophyllum F.Muell. ex Benth.		1	1	1	
Desmodium varians (Labill.) G.Don		1	1	1	1
Dianella brevipedunculata R.J.F.Hend.		1	1	1	1
Dianella longifolia R.Br. var. longifolia		1	1	1	1
Dianella longifolia var. stenophylla Domin		1			
Dianella rara R.Br.		1		1	
Dianella revoluta R.Br. var. revoluta		1	1	1	
Dichanthium queenslandicum B.K.Simon (Vulnerable)		1			
Dichanthium sericeum (R.Br.) A.Camus subsp. sericeum		1	1	1	1
Dichondra repens				1	1
Digitaria ammophila (F.Muell.) Hughes		1	1		
Digitaria breviglumis			1		
Digitaria brownii (Roem. & Schult.) Hughes		1		1	
*Digitaria ciliaris (Retz.) Koeler**	1			1	1
*Digitaria didactyla Willd.**	1	1		1	1
Digitaria diffusa Vickery		1	1	1	
Digitaria diminuta Hughes		1			
Digitaria divaricatissima (R.Br.) Hughes		1		1	
Digitaria fumida S.T.Blake		1			
Digitaria hystrichoides Vickery		1			
Digitaria longiflora (Retz.) Pers.		1			
Digitaria porrecta S.T.Blake (Endangered EPBC, Near-threatened NCA))		1			
*Dinebra retroflexa (Vahl) Panz.**	1	1		1	
Diospyros humilis (R.Br.) F.Muell.		1		1	1
*Diplanche fusca**	1				1
Diplatia grandibractea (F.Muell.) Tiegh.		1			
Diplocyclos palmatus (L.) C.Jeffrey subsp. palmatus		1		1	1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Dipteracanthus australasicus subsp. corynothecus (F.Muell. ex Benth.) R.M.Barker		1		1	
Diuris tricolor Fitzg.		1			1
Dodonaea biloba J.G.West		1		1	1
Dodonaea boroniifolia G.Don		1			1
Dodonaea heteromorpha J.G.West		1			1
Dodonaea lanceolata var. subsessilifolia J.G.West		1		1	
Dodonaea macrossanii F.Muell. & Scort.		1			
Dodonaea peduncularis Lindl.		1			
Dodonaea sinuolata J.G.West subsp. sinuolata		1			
Dodonaea stenophylla F.Muell.		1			
Dodonaea triangularis Lindl.		1	1	1	
Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West		1	1	1	
Dodonaea viscosa subsp. spatulata (Sm.) J.G.West		1		1	1
Drosera angustifolia F.Muell.		1			
Drosera auriculata Backh. ex Planch.		1			
Drosera binata					1
Drosera burmanni Vahl		1			1
Drosera glanduligera Lehm.		1			
Drosera indica					1
Drosera peltata Thunb.		1			1
Duboisia leichhardtii (F.Muell.) F.Muell.		1			
Duboisia leichhardtii (F.Muell.) F.Muell. x D.myoporoides R.Br.		1			
Dysphania glomulifera (Nees) Paul G.Wilson subsp. glomulifera		1			
Dysphania melanocarpa (J.M.Black) Paul G.Wilson & K.A.Sheph. forma melanocarpa		1			
*Echinochloa colona (L.) Link**	1	1		1	
*Echinochloa crus-galli (L.) P.Beauv.**	1	1		1	
Echinochloa inundata P.W.Michael & Vickery		1			
Echinopogon caespitosus C.E.Hubb. var. caespitosus		1			
*Echium plantagineum L.**	1	1			1
Eclipta platyglossa F.Muell.		1			1
Eclipta prostrata (L.) L.		1		1	1
Ehretia membranifolia R.Br.		1	1	1	1
Einadia hastata (R.Br.) A.J.Scott		1	1	1	1
Einadia hastata (R.Br.) A.J.Scott x E.trigonos subsp. stellulata (Benth.) Paul G.Wilson		1			
Einadia nutans (R.Br.) A.J.Scott subsp. nutans		1	1	1	1
Einadia nutans subsp. linifolia (R.Br.) Paul G.Wilson		1	1	1	1
Einadia polygonoides (Murr) Paul G.Wilson		1		1	
Einadia trigonos subsp. stellulata (Benth.) Paul G.Wilson		1			
Elaeodendron australe var. integrifolium (Tratt.) DC.		1		1	1
Elatine gratioloides A.Cunn.		1			
Eleocharis acuta R.Br.		1			
Eleocharis atricha R.Br.		1			
Eleocharis blakeana L.A.S.Johnson & O.D.Evans (Near-threatened NCA)		1		1	1
Eleocharis cylindrostachys Boeck.		1			1
Eleocharis pallens S.T.Blake		1		1	1
Eleocharis philippinensis Svenson		1		1	
Eleocharis plana S.T.Blake		1		1	1
Eleocharis pusilla R.Br.		1			
Eleocharis sphacelata R.Br.		1			
*Eleusine indica (L.) Gaertn.**	1	1		1	
Elymus plurinervis (Vickery) Connor		1			
Elymus scaber (R.Br.) A.Love		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Elytrophorus spicatus (Willd.) E.G.Camus & A.Camus		1			
*Emex australis Steinh.**	1	1		1	1
Enchylaena tomentosa R.Br. var. tomentosa		1	1	1	1
Enneapogon gracilis (R.Br.) P.Beauv.		1		1	
Enneapogon intermedius N.T.Burb.		1			
Enneapogon lindleyanus (Domin) C.E.Hubb.		1			
Enneapogon polyphyllus				1	1
Enneapogon robustissimus (Domin) N.T.Burb.		1		1	
Enneapogon truncatus Kakudidi		1			
Enteropogon acicularis (Lindl.) Lazarides		1	1	1	
Enteropogon paucispiceus (Lazarides) B.K.Simon		1			
Enteropogon ramosus B.K.Simon		1	1	1	1
Enteropogon unispiceus (F.Muell.) Clayton		1			
Entolasia marginata (R.Br.) Hughes		1			
Entolasia sp. (Miles S.T.Blake 7709)		1			
Entolasia stricta (R.Br.) Hughes		1	1	1	
Epaltes australis Less.		1	1	1	1
Epilobium billardierianum subsp. cinereum (A.Rich.) P.H.Raven & Engelhorn		1			
Eragrostis alveiformis Lazarides		1			
Eragrostis brownii (Kunth) Nees ex Wight		1	1	1	
*Eragrostis cilianensis (All.) Vignolo ex Janch.**	1	1			1
Eragrostis confertiflora J.M.Black		1			
*Eragrostis curvula (Schrad.) Nees**	1	1		1	1
Eragrostis elongata (Willd.) J.Jacq.		1	1	1	1
Eragrostis lacunaria F.Muell. ex Benth.		1	1	1	1
Eragrostis leptocarpa Benth.		1	1		
Eragrostis leptostachya (R.Br.) Steud.		1			
Eragrostis longipedicellata B.K.Simon		1			
Eragrostis megalosperma F.Muell. ex Benth.		1			1
Eragrostis minor Host		1			
Eragrostis parviflora (R.Br.) Trin.		1	1	1	1
Eragrostis pubescens (R.Br.) Steud.		1			
Eragrostis sororia Domin		1	1	1	
Eragrostis speciosa (Roem. & Schult.) Steud.		1			
Eragrostis tenellula			1	1	
*Eragrostis trichophora Coss. & Durieu**	1	1			
Eragrostis triquetra Lazarides		1			
Eremochloa bimaculata Hack.		1	1		
Eremophila debilis (Andrews) Chinnock		1	1	1	
Eremophila deserti (A.Cunn. ex Benth.) Chinnock		1		1	1
Eremophila glabra (R.Br.) Ostenf. subsp. glabra		1			
Eremophila longifolia (R.Br.) F.Muell.		1		1	1
Eremophila mitchellii Benth.		1	1	1	1
Eriachne mucronata forma (Alpha C.E.Hubbard 7882)		1			
Eriachne mucronata R.Br.		1		1	
Eriachne pallescens R.Br. var. pallescens		1			
Eriochloa crebra S.T.Blake		1		1	
Eriochloa procera (Retz.) C.E.Hubb.		1	1	1	
Eriochloa pseudoacrotricha (Stapf ex Thell.) J.M.Black		1	1		
Erodium crinitum Carolin		1			1
Eryngium plantagineum F.Muell.		1			1
Eucalyptus albens Benth.		1		1	
Eucalyptus apothalassica L.A.S.Johnson & K.D.Hill		1	1	1	
Eucalyptus bakeri Maiden		1	1		
Eucalyptus camaldulensis Dehnh.		1	1	1	1
Eucalyptus chloroclada (Blakely) L.A.S.Johnson & K.D.Hill		1	1	1	1
Eucalyptus conica H.Deane & Maiden		1	1		

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Eucalyptus coolabah Blakely & Jacobs		1	1	1	1
Eucalyptus coolabah Blakely & Jacobs x E.crebra F.Muell.		1		1	
Eucalyptus coolabah Blakely & Jacobs x E.melanophloia F.Muell.		1			
Eucalyptus crebra F.Muell.		1	1	1	1
Eucalyptus crebra F.Muell. x E.decorticans (F.M.Bailey) Maiden		1			
Eucalyptus crebra F.Muell. x E.fibrosa subsp. nubila (Maiden & Blakely) L.A.S.Johnson		1		1	
Eucalyptus crebra F.Muell. x E.microcarpa (Maiden) Maiden		1		1	
Eucalyptus crebra F.Muell. x E.populnea F.Muell.		1	1	1	
Eucalyptus curtisii Blakely & C.T.White (Near-threatened NCA)		1			
Eucalyptus dealbata A.Cunn. ex Schauer		1			
Eucalyptus decorticans (F.M.Bailey) Maiden		1	1	1	
Eucalyptus elegans A.R.Bean		1			
Eucalyptus exserta F.Muell.		1	1	1	1
Eucalyptus fibrosa F.Muell. subsp. fibrosa		1			
Eucalyptus fibrosa subsp. nubila (Maiden & Blakely) L.A.S.Johnson		1	1	1	1
Eucalyptus melanoleuca S.T.Blake		1			
Eucalyptus melliodora A.Cunn. ex Schauer		1	1	1	
Eucalyptus moluccana Roxb.		1	1	1	
Eucalyptus orgadophila Maiden & Blakely		1		1	
Eucalyptus panda S.T.Blake		1		1	
Eucalyptus pilligaensis			1	1	
Eucalyptus populnea F.Muell.		1	1	1	1
Eucalyptus rhombica A.R.Bean & Brooker		1			
Eucalyptus tenuipes (Maiden & Blakely) Blakely & C.T.White		1		1	
Eucalyptus tereticornis Sm. subsp. tereticornis		1	1	1	1
Eucalyptus terrica A.R.Bean		1		1	
Eucalyptus viridis R.T.Baker (Vulnerable EPBC)		1			
Eucalyptus woollsiana R.T.Baker (Syn. E. pilligaensis)		1		1	
Euchiton sphaericus (Willd.) Holub		1			
Eulalia aurea (Bory) Kunth		1	1	1	1
Euphorbia tannensis subsp. eremophila (A.Cunn.) D.C.Hassall		1			1
Eustrephus latifolius R.Br. ex Ker Gawl.		1		1	1
Everistia vacciniifolia S.T.Reynolds & R.J.F.Hend. forma vacciniifolia		1		1	1
Evolvulus alsinoides (L.) L.		1	1	1	1
Exocarpos aphyllus R.Br.		1	1	1	
Exocarpos cupressiformis Labill.		1		1	1
Exocarpos latifolius R.Br.		1			
*Fallopia convolvulus (L.) A.Love**	1	1			
Fimbristylis aestivalis (Retz.) Vahl var. aestivalis		1			1
Fimbristylis dichotoma (L.) Vahl		1	1	1	1
Fimbristylis littoralis Gaudich.		1		1	1
Fimbristylis microcarya F.Muell.		1			
Fimbristylis nuda Boeck.		1			
Fimbristylis oxystachya F.Muell.		1			
Fimbristylis vagans S.T.Blake (Near-threatened NCA)		1			1
Fimbristylis velata R.Br.		1			1
Flindersia australis R.Br.		1			1
Flindersia collima					1
*Froelichia floridana**	1				1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Fuirena incrassata S.T.Blake		1			1
*Fumaria capreolata L.**	1	1			
Gahnia aspera (R.Br.) Spreng.		1	1	1	1
Galactia tenuiflora var. lucida Baker		1			1
*Galinsoga parviflora**	1				1
Galium terrae-reginae					1
*Gamochaeta americana (Mill.) Wedd.**	1	1			
*Gamochaeta calviceps (Fernald) Cabrera**	1	1			
Gaura parviflora Douglas ex Lehm.		1			
Geijera parviflora Lindl.		1	1	1	1
Geranium solanderi Carolin var. solanderi		1			1
Glinus lotoides L.		1			
Glinus oppositifolius					1
Glossocardia bidens (Retz.) Veldkamp		1	1	1	1
Glossostigma diandrum (L.) Kuntze		1			1
Glycine clandestina J.C.Wendl. var. clandestina		1	1	1	1
Glycine clandestina var. sericea Benth.		1			
Glycine latifolia (Benth.) C.Newell & Hymowitz		1			
*Glycine max (L.) Merr.**	1	1			
Glycine stenophita B.E.Pfeil & Tindale		1			
Glycine tabacina (Labill.) Benth.		1	1	1	1
Glycine tomentella Hayata		1		1	1
Glycyrrhiza acanthocarpa (Lindl.) J.M.Black		1			
Gnaphalium sphaericum					1
Gnephosis tenuissima Cass.		1			
*Gomphocarpus fruticosus (L.) W.T.Aiton**	1	1		1	
*Gomphocarpus physocarpus E.Mey.**	1	1		1	1
Gompholobium aspalathoides A.Cunn. ex Benth.		1			
Gompholobium foliolosum Benth.		1			1
*Gomphrena celosioides Mart.**	1	1		1	1
Gonocarpus chinensis subsp. verrucosus (Maiden & Betche) Orchard		1			
Gonocarpus elatus (A.Cunn. ex Fenzl) Orchard		1			
Gonocarpus urceolatus Orchard (Vulnerable)		1			1
Goodenia bellidifolia subsp. argentea Carolin		1			
Goodenia delicata Carolin		1	1		
Goodenia disperma F.Muell.		1			1
Goodenia fascicularis F.Muell. & Tate		1			
Goodenia glabra R.Br.		1			1
Goodenia glauca			1		
Goodenia gracilis R.Br.		1			1
Goodenia hederacea Sm. subsp. hederacea			1		
Goodenia heterochila F.Muell.		1			
Goodenia rosulata Domin		1			
Goodenia rotundifolia R.Br.		1		1	
Grahamia australiana (J.M.Black) G.D.Rowley		1			
Gratiola pedunculata R.Br.		1			1
Grevillea decora Domin subsp. decora		1			
Grevillea floribunda R.Br. subsp. floribunda		1			
Grevillea longistyla Hook.		1			
*Grevillea rosmarinifolia A.Cunn.**	1	1			
Grevillea singuliflora F.Muell.		1		1	
Grevillea striata R.Br.		1		1	1
Grevillea whiteana McGill.		1			
Grewia latifolia F.Muell. ex Benth.		1		1	1
Guilleminea densa (Humb. & Bonpl. ex Schult.) Moq.		1			
*Guilleminea densa**	1				1
Gypsophila australis (Schltdl.) A.Gray		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Haemodorum austroqueenslandicum Domin		1			
Hakea fraseri		1			
Hakea lorea (R.Br.) R.Br. subsp. lorea		1		1	1
Hakea purpurea Hook.		1			
Haloragis aspera Lindl.		1			
Haloragis heterophylla Brongn.		1			1
Haloragis stricta R.Br. ex Benth.		1			1
Harmogia densifolia (Sm.) Schauer		1			
Harmsiodoxa blennodioides (F.Muell.) O.E.Schulz		1			1
Harnieria hygrophiloides (F.Muell.) R.M.Barker		1			
Eriocereus martinii (Labour.) Britton* (Declared Class 2)	1	1		1	1
Eriocereus tortuosa (J.Forbes ex Otto & A.Dietr.) Britton & Rose* (Declared Class 1)	1	1		1	
Hedypnois cretica*	1				1
Helianthus annuus*	1				1
Helianthus debilis Nutt.*	1	1			
Helichrysum collinum			1		1
Heliotropium amplexicaule Vahl*	1	1		1	1
Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult.		1	1	1	1
Hibbertia cistoidea (Hook.) C.T.White		1	1	1	1
Hibbertia linearis R.Br. ex DC.		1			
Hibbertia linearis var. obtusifolia		1	1		
Hibbertia pedunculata R.Br. ex DC.		1			
Hibbertia sp. (Barakula V.Hando 122)		1			
Hibbertia sp. (Girraween NP D.Halford+ Q1611)		1			
Hibbertia stricta (DC.) R.Br. ex F.Muell.		1			
Hibbertia stricta (DC.) R.Br. ex F.Muell. var. stricta		1			
Hibbertia vestita A.Cunn. ex Benth.		1			
Hibiscus divaricatus Graham		1			
Hibiscus sturtii Hook.		1	1	1	1
Hibiscus sturtii Hook. var. sturtii		1			
Hibiscus trionum L. var. trionum*	1	1			1
Homalocalyx polyandrus (F.Muell.) F.Muell. ex Benth.		1			
Homopholis belsonii C.E.Hubb. (Vulnerable EPBC, Endnagered NCA)		1			
Homoranthus melanostictus Craven & S.R.Jones		1			
Homoranthus sp. (Wyaga D.Jermyn+ HM25)		1			
Hordeum glaucum Steud.*	1	1			
Hovea angustissima I.Thomps.		1			
Hovea angustissima I.Thomps. x H.tholiformis I.Thomps.		1			
Hovea lanceolata Sims		1			
Hovea longipes Benth.		1			
Hovea lorata I.Thomps.		1			
Hovea planifolia (Domin) J.H.Ross		1			
Hybanthus monopetalus (Schult.) Domin		1			
Hybanthus stellarioides					1
Hydrilla verticellata					1
Hydrocotyle acutiloba (F.Muell.) N.A.Wakef.		1			
Hydrocotyle laxiflora DC.			1		
Hydrocotyle sp. (Lake Broadwater K.A.Williams AQ230829)		1			
Hypericum gramineum G.Forst.		1		1	1
Hypochaeris albiflora (Kuntze) C.F.Azevedo-Goncalves & Matzenb.*	1	1			
Hypochaeris glabra L.*	1	1			
Hypochaeris microcephala var. albiflora*	1				1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
*Hypochaeris radicata**	1				1
Hypoxis arillacea R.J.F.Hend.		1			
Hypoxis hygrometrica var. villosisepala R.J.F.Hend.		1			
Hypoxis pratensis R.Br. var. pratensis		1			
Hypoxis pratensis var. tuberculata			1		
Imperata cylindrica (L.) Raeusch.		1		1	1
Indigofera brevidens					1
Indigofera hirsuta					1
Indigofera linnaei Ali				1	
Ipomoea lonchophylla J.M.Black		1		1	
Ipomoea plebeia R.Br.		1		1	1
*Ipomoea purpurea (L.) Roth**	1	1			
Iseilema membranaceum (Lindl.) Domin		1			
Isoetes drummondii A.Braun subsp. drummondii		1			
Isoetopsis graminifolia Turcz.		1			
Isopogon petiolaris A.Cunn. ex R.Br.		1			
Jacksonia rhadinoclona F.Muell.		1			
Jacksonia scoparia R.Br.		1	1	1	1
Jasminum didymum subsp. didymum			1		
Jasminum didymum subsp. lineare (R.Br.) P.S.Green		1		1	1
Jasminum didymum subsp. lineare (R.Br.) P.S.Green		3D			
Jasminum didymum subsp. racemosum (F.Muell.) P.S.Green		1			
Jasminum suavissimum Lindl.		1		1	1
Juncus aridicola L.A.S.Johnson		1			
Juncus continuus L.A.S.Johnson				1	
Juncus ochrocoleus L.A.S.Johnson		1			
Juncus polyanthemus Buchenau		1	1		
Juncus psammophilus L.A.S.Johnson		1			
Juncus radula Buchenau		1			
Juncus remotiflorus L.A.S.Johnson		1			
Juncus subglaucus L.A.S.Johnson		1			
Juncus subsecundus N.A.Wakef.		1			
Juncus usitatus L.A.S.Johnson		1		1	1
Kardomia jucunda (S.T.Blake) Peter G.Wilson		1			
Keraudrenia collina Domin		1			
Keraudrenia corollata					1
Keraudrenia hookeriana Walp.		1			
Korthalsella taenioides (Comm. ex DC.) Engl. forma taenioides		1			1
Kunzea opposita F.Muell.		1	1		
Lachnagrostis filiformis (G.Forst.) Trin.		1			
*Lactuca serriola**	1				1
Lagenophora gracilis Steetz		1			
*Lamarckia aurea (L.) Moench**	1	1			
*Lamium amplexicaule L.**	1	1			1
Laxmannia compacta Conran & P.I.Forst.		1			
Laxmannia gracilis R.Br.		1			1
Leersia hexandra Sw.		1		1	1
Leiocarpa brevicompta (F.Muell.) Paul G.Wilson		1		1	
Leiocarpa leptolepis (DC.) Paul G.Wilson		1			
Leiocarpa panaetioides (DC.) Paul G.Wilson		1			
Leiocarpa semicalva (F.Muell.) Paul G.Wilson		1			
Leiocarpa panaetioides				1	
Leiocarpa websteri (S.Moore) Paul G.Wilson		1			
*Lepidium africanum (Burm.f.) DC.**	1	1			
*Lepidium bonariense L.**	1	1			
Lepidium fasciculatum Thell.		1			1
Lepidium hysoppifolium					1

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
*Lepidium virginicum L.**	1	1			
Lepidosperma laterale R.Br. var. laterale			1		
Lepidosperma laterale var. angustum Benth.		1			
Lepironia articulata (Retz.) Domin		1			1
Leptochloa ciliolata					1
Leptochloa decipiens (R.Br.) Stapf ex Maiden subsp. decipiens		1	1		
Leptochloa decipiens subsp. asthenes (Roem. & Schult.) N.Snow		1		1	
Leptochloa decipiens subsp. peacockii (Maiden & Betche) N.Snow		1		1	
Leptochloa digitata (R.Br.) Domin		1		1	
Leptochloa divaricatissima S.T.Blake		1			
Leptochloa fusca (L.) Kunth subsp. fusca		1			
*Leptochloa panicea subsp. brachiata (Steud.) N.Snow**	1	1			
Leptospermum brevipes F.Muell.		1			
Leptospermum lamellatum Joy Thomps.		1			
Leptospermum polygalifolium Salisb.		1	1	1	1
Leptospermum trinervum		1			
Lespedeza juncea subsp. sericea (Thunb.) Steenis		1			
Leucopogon biflorus R.Br.		1	1	1	
Leucopogon blakei Pedley		1			
Leucopogon mitchellii Benth.		1			
Leucopogon muticus R.Br.		1	1	1	
Leucopogon pluriloculatus			1		
Lindernia alsinoides R.Br.		1			
Lindernia sp. (Bribie Island S.T.Blake 7089)		1			
Lindernia sp. (Tingoora A.R.Bean 10311)		1			
Linum marginale A.Cunn. ex Planch.		1			1
Lipocarpha microcephala (R.Br.) Kunth		1			1
Lissanthe pluriloculata (F.Muell.) J.M.Powell, Crayn & E.A.Br.		1			
Lissanthe strigosa subsp. subulata		1	1		
Lobelia stenophylla					1
Logania albiflora (Andrews & Jacks.) Druce		1			
*Lolium perenne L.**	1	1			
*Lolium rigidum Gaudin**	1	1			1
Lomandra confertifolia subsp. confertifolia			1		
Lomandra confertifolia subsp. pallida A.T.Lee			1	1	
Lomandra confertifolia subsp. pallida A.T.Lee					
Lomandra elongata (Benth.) Ewart		1	1	1	
Lomandra filiformis (Thunb.) Britten		1	1	1	
Lomandra filiformis (Thunb.) Britten subsp. filiformis		1			
Lomandra laxa (R.Br.) A.T.Lee		1			
Lomandra leucocephala (R.Br.) Ewart subsp. leucocephala		1	1	1	1
Lomandra longifolia Labill.		1	1	1	1
Lomandra multiflora (R.Br.) Britten subsp. multiflora		1	1	1	1
Lotus australis Andrews		1			1
Lotus cruentus Court		1			
Ludwigia octovalvis (Jacq.) P.H.Raven		1		1	1
Ludwigia peploides subsp. montevidensis (Spreng.) P.H.Raven		1		1	1
*Lycium ferocissimum Miers**	1	1			1
Lysiana exocarpi subsp. tenuis (Blakely) Barlow		1			1
Lysicarpus angustifolius (Hook.) Druce		1	1	1	1
Lysiphyllum hookeri (F.Muell.) Pedley		1			
Lythrum paradoxum Koehne		1			
Macarthuria neocambrica F.Muell.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
*Macroptilium lathyroides (L.) Urb.**	1	1		1	
Macrozamia machinii P.I.Forst. & D.L.Jones (Vuln. EPBC, NCA)		1	1		
Maireana decalvans (Gand.) Paul G.Wilson		1			1
Maireana enchylaenoides (F.Muell.) Paul G.Wilson		1		1	
Maireana microphylla (Moq.) Paul G.Wilson		1	1	1	1
*Malus pumila Mill.**	1	1			
*Malva parviflora**	1				1
*Malvastrum americanum (L.) Torr. var. americanum**	1	1			1
*Malvastrum americanum var. stellatum S.R.Hill**	1	1			
*Malvastrum coromandelianum (L.) Garcke subsp. coromandelianum**	1	1			1
*Marrubium vulgare**	1				1
Marsdenia pleiadenia (F.Muell.) P.I.Forst.		1			
Marsdenia viridiflora R.Br. subsp. viridiflora		1			1
Marsilea angustifolia					1
Marsilea crenata C.Presl		1		1	
Marsilea drummondii A.Braun		1			1
Marsilea mutica Mett.		1			
Maytenus bilocularis					1
Maytenus cunninghamii (Hook.) Loes.		1	1	1	1
Maytenus silvestris Lander & L.A.S.Johnson		1			
*Medicago laciniata (L.) Mill. var. laciniata**	1	1			
*Medicago minima (L.) Bartal. var. minima**	1	1			
*Medicago polymorpha L.**	1	1			1
*Medicago sativa L. subsp. sativa**	1	1			
*Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs var. maximus**	1	1		1	1
*Megathyrsus maximus var. pubiglumis (K.Schum.) B.K.Simon & S.W.L.Jacobs**	1	1		1	1
Melaleuca bracteata F.Muell.		1	1	1	1
Melaleuca decora (Salisb.) Britten		1	1	1	1
Melaleuca densispicata Byrnes		1			
Melaleuca diosmatifolia Dum.Cours.		1			
Melaleuca lanceolata Otto		1	1		1
Melaleuca nodosa (Gaertn.) Sm.		1		1	
Melaleuca pallescens Byrnes		1			
Melaleuca squamophloia (Byrnes) Craven		1		1	
Melaleuca thymifolia Sm.		1			
Melaleuca uncinata R.Br.		1		1	
Melaleuca viminalis (Sol. ex Gaertn.) Byrnes		1		1	
Melichrus adpressus A.Cunn. ex DC.		1		1	
Melichrus erubescens A.Cunn. ex DC.		1			
Melichrus sp. (Inglewood A.R.Bean 1652)		1			
Melichrus urceolatus R.Br.		1	1	1	
*Melilotus indicus (L.) All.**	1	1			1
*Melinis repens (Willd.) Zizka**	1	1		1	1
Mentha satureioides R.Br.		1			
Microcarpaea agonis A.R.Bean (Endangered NCA)		1			
Microlaena stipoides (Labill.) R.Br. var. stipoides		1	1	1	1
Micromyrtus albicans A.R.Bean		1			
Micromyrtus carinata A.R.Bean (Endangered NCA)		1			
Micromyrtus leptocalyx (F.Muell.) Benth.		1			
Micromyrtus sessilis J.W.Green		1		1	
Micromyrtus striata J.W.Green		1			
Microtis parviflora R.Br.		1			
Mimulus gracilis R.Br.		1			1
Minuria integerrima (DC.) Benth.		1			1
Mirbelia aotoides F.Muell.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Mirbelia pungens A.Cunn. ex G.Don		1			
Mirbelia speciosa subsp. ringrosei (F.M.Bailey) Pedley		1			
Mitrasacme alsinoides					1
Mitrasacme paludosa R.Br.		1	1		
*Moluccella laevis L.**	1	1			
Monachather paradoxus Steud.		1			
Monochoria cyanea (F.Muell.) F.Muell.		1			1
Monotoca scoparia (Sm.) R.Br.		1	1	1	
*Moorochloa eruciformis (Sm.) Veldkamp**	1	1			
Morinda jasminoides A.Cunn. ex Hook.		1			
Muehlenbeckia florulenta Meisn.		1		1	
Muellerina bidwillii (Benth.) Barlow		1			1
Murdannia graminea (R.Br.) G.Brueckn.		1		1	1
Myoporum acuminatum R.Br.		1	1	1	1
Myoporum montanum R.Br.			1		
Myriocephalus pluriflorus (J.M.Black) D.A.Cooke		1			
Myriophyllum gracile Benth.		1			
Myriophyllum papillosum Orchard		1			
Myriophyllum striatum Orchard		1			
Myriophyllum variifolium Hook.f.		1			
Myriophyllum verrucosum Lindl.		1			1
Najus tenuiflora					1
Neptunia gracilis Benth. forma gracilis		1		1	1
Newcastelia interrupta Munir		1			
Nicotiana forsteri Roem. & Schult.		1			
Nicotiana megalosiphon Van Heurck & Muell.Arg.		1			
Nicotiana megalosiphon Van Heurck & Muell.Arg. subsp. megalosiphon		1			1
Notelaea linearis Benth.		1		1	
Notelaea longifolia					1
Notelaea microcarpa R.Br. var. microcarpa		1			
Notelaea microcarpa var. velutina (F.M.Bailey) P.S.Green		1			
Notelaea punguns (Near-threatened NCA)					1
Nothoscordum borbonicum Kunth		1			
*Nothoscordum borbonicum**	1				1
Notodanthonia longifolia (R.Br.) Veldkamp		1			
Nymphaea gigantea Hook.		1		1	1
Nymphoides crenata (F.Muell.) Kuntze		1			
Nymphoides geminata					1
Nymphoides indica					1
Nyssanthes erecta R.Br.		1	1	1	
*Oenothera affinis Cambess.**	1	1			1
*Oenothera indecora subsp. bonariensis W.Dietr.**	1	1			
*Oenothera speciosa Nutt.**	1	1			
Oenothera stricta Ledeb. ex Link subsp. stricta		1			
Oldenlandia galioides (F.Muell.) F.Muell.		1			1
Oldenlandia mitrasacmoides			1		
Oldenlandia mitrasacmoides subsp. trachymenoides (F.Muell.) Halford		1			1
Olearia canescens (Benth.) Hutch.		1			1
Olearia elliptica DC. subsp. elliptica		1	1		
Olearia gordonii Lander		1			
Olearia microphylla (Vent.) Maiden & Betche		1			
Olearia pimeleoides (DC.) Benth.		1			
Opercularia diphylla Gaertn.		1			
Operculina aequisepala (Domin) R.W.Johnson		1			
Ophioglossum gramineum Willd.		1			
Ophioglossum lusitanicum L.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Ophioglossum nudicaule					1
Ophioglossum reticulatum L.		1			
Oplismenus hirtellus			1		
Opuntia aurantiaca Lindl. (Declared Class 2)*	1			1	
*Opuntia stricta (Haw.) Haw. * (Declared Class 2)*	1	1	1	1	1
*Opuntia tomentosa Salm-Dyck * (Declared Class 2)*	1	1	1	1	1
Ottelia ovalifolia (R.Br.) Rich.		1		1	1
Owenia acidula F.Muell.		1		1	1
Owenia venosa					1
*Oxalis corniculata var. corniculata**	1	1	1		1
Oxalis perennans Haw.		1	1		
Ozothamnus diosmifolius (Vent.) DC.		1		1	1
Ozothamnus diosmifolius (Vent.) DC. x O.diotophyllus (F.Muell.) Anderb.		1			
Ozothamnus diotophyllus (F.Muell.) Anderb.		1			1
Pandorea pandorana (Andrews) Steenis		1	1	1	1
Panicum buncei F.Muell. ex Benth.		1	1	1	1
Panicum decompositum R.Br.		1	1		1
Panicum decompositum R.Br. var. decompositum		1		1	1
Panicum decompositum var. tenuius F.M.Bailey		1			
Panicum effusum R.Br.		1	1	1	1
Panicum effusum var. effusum				1	
Panicum effusum var. simile			1		
Panicum laevinode Lindl.		1			
Panicum larcomianum Hughes		1		1	
*Panicum miliaceum L.**	1	1			
Panicum queenslandicum Domin var. queenslandicum		1	1	1	
Panicum simile Domin		1			
Panicum subxerophilum			1		
*Papaver setigerum**	1				1
Parsonsia eucalyptophylla F.Muell.		1	1	1	1
Parsonsia lanceolata R.Br.		1		1	1
Parsonsia leichhardtii F.Muell.		1			
Parthenium hysterophorus L. (Declared)*		1			1
Paspalidium albovillosum S.T.Blake		1			
Paspalidium aversum Vickery		1			
Paspalidium caespitosum C.E.Hubb.		1	1	1	1
Paspalidium constrictum (Domin) C.E.Hubb.		1		1	
Paspalidium disjunctum S.T.Blake		1			
Paspalidium distans (Trin.) Hughes		1		1	1
Paspalidium globoideum (Domin) Hughes		1	1	1	
Paspalidium gracile (R.Br.) Hughes		1		1	
Paspalidium jubiflorum (Trin.) Hughes		1		1	
*Paspalum dilatatum Poir.**	1	1		1	
Paspalum distichum L.		1			1
*Paspalum notatum Fluegge**	1	1		1	
Paspalum scrobiculatum L.		1		1	
*Pavonia hastata**	1				1
*Pennisetum ciliare (L.) Link**	1	1		1	
*Pennisetum villosum R.Br. ex Fresen.**	1	1			
Peripleura hispidula (F.Muell. ex A.Gray) G.L.Nesom var. hispidula		1		1	1
Perotis rara R.Br.		1		1	1
Persicaria attenuata (R.Br.) Sojak		1		1	
Persicaria decipiens (R.Br.) K.L.Wilson		1		1	
Persicaria lapathifolia (L.) Gray		1			
Persicaria orientalis (L.) Spach		1		1	1
Persicaria prostrata (R.Br.) Sojak		1			1
Persoonia sericea A.Cunn. ex R.Br.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Persoonia terminalis subsp. recurva L.A.S.Johnson & P.H.Weston		1	1		
Petalostigma pubescens Domin		1	1	1	1
Petrophile canescens A.Cunn. ex R.Br.				1	
*Phalaris canariensis L.**	1	1			
*Phalaris paradoxa L.**	1	1			1
Phebalium nottii (F.Muell.) Maiden & Betche		1			
Phebalium squamulosum subsp. gracile Paul G.Wilson		1			
Philotheca difformis (A.Cunn. ex Endl.) Paul G.Wilson subsp. difformis		1			
Philotheca sporadica (Bayly) Paul G.Wilson (Vuln. EBPC, NCA)		1		1	
Philydrum lanuginosum Banks & Sol. ex Gaertn.		1		1	1
Phragmites australis (Cav.) Trin. ex Steud.		1		1	1
*Phyla canescens (Kunth) Greene**	1	1		1	1
Phyla nodiflora			1		
Phyllanthus fuernrohrii F.Muell.		1		1	1
Phyllanthus gunnii Hook.f.		1			
Phyllanthus maderaspatensis		1	1	1	
*Phyllanthus tenellus**	1				1
Phyllanthus virgatus G.Forst.		1	1	1	
*Physalis angulata L.**	1	1		1	
Picris angustifolia subsp. carolorum-henricorum (Lack) S.Holzapfel		1			
Picris evae (Vulnerable EPBC)					1
Pimelea linifolia Sm. subsp. linifolia		1		1	
Pimelea microcephala R.Br. subsp. microcephala		1			
Pimelea neoanglica Threlfall		1	1	1	1
Pimelea trichostachya Lindl.		1			1
Pistia stratiotes L. (Declared Class 2)*	1	1			
Pittosporum angustifolium Lodd.		1	1	1	1
Pittosporum spinescens (F.Muell.) L.Cayzer, Crisp & I.Telford		1		1	
Planchonella pubescens (P.Royen) Swenson, Bartish & Munzinger		1		1	
Plantago cunninghamii Decne.		1		1	
Plantago debilis R.Br.		1			1
*Plantago lanceolata**	1				1
Platysace ericoides (Sieber ex Spreng.) C.Norman		1	1		
Platyzoma microphyllum R.Br.		1			
Plectranthus parviflorus Willd.		1	1	1	1
Pleurosorus rutifolius (R.Br.) Fee		1			
*Poa annua**	1				1
Poa fordeana F.Muell.		1			
Podolepis arachnoidea (Hook.) Druce		1			
Podolepis longipedata A.Cunn. ex DC.		1			1
Polycarpaea corymbosa (L.) Lam. var. corymbosa		1	1		
Polycarpaea corymbosa var. minor Pedley		1			
Polycarpaea spirostylis subsp. compacta Pedley		1			
*Polycarpon tetraphyllum (L.) L.**	1	1			1
*Polygonum aviculare L.**	1	1			1
*Polygonum bellardii All.**	1	1			
Polygonum plebeium R.Br.		1			1
Polymeria calycina R.Br.		1		1	
Polymeria longifolia Lindl.		1			
Polymeria marginata Benth.		1			
Polymeria pusilla R.Br.		1			
Pomaderris argyrophylla N.A.Wakef.		1			
Pomaderris lanigera (Andrews) Sims		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Pomaderris queenslandica C.T.White		1	1		
Pomax umbellata (Gaertn.) Sol. ex A.Rich.		1	1	1	
Portulaca australis Endl.		1		1	
Portulaca filifolia F.Muell.		1			
Portulaca oleracea L.*	1	1	1	1	
*Portulaca pilosa **	1				1
Potamogeton pectinatus L.		1			
Pratia concolor (R.Br.) Domin		1		1	
*Proboscidea lutea (Lindl.) Stapf**	1	1			
Prosopis glandulosa Torr. var. glandulosa (Declared)*	1	1			
Prosopis velutina Wooton (Declared)*	1	1			
Prostanthera cryptandroides subsp. euphrasioides (Benth.) B.J.Conn		1			
Prostanthera granitica Maiden & Betche		1			
Prostanthera leichhardtii Benth.		1			
Prostanthera parvifolia Domin		1			
Prostanthera ringens Benth.		1			
Prostanthera sp. (Baking Board V.Hando 135)		1			
Prostanthera sp. (Dunmore D.M.Gordon 8A) (Vulnerable NCA))		1	1		
*Prunus munsoniana W.Wight & Hedrick**	1	1			
Pseuderanthemum variabile (R.Br.) Radlk.		1	1	1	1
Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt		1			1
Pseudoraphis paradoxa (R.Br.) Pilg.		1			
Pseudoraphis spinescens (R.Br.) Vickery		1			1
Psydrax johnsonii S.T.Reynolds & R.J.F.Hend.		1			
Psydrax longipes S.T.Reynolds & R.J.F.Hend.		1		1	
Psydrax odorata forma buxifolia (Benth.) S.T.Reynolds & R.J.F.Hend.		1			
Psydrax odorata forma subnitida S.T.Reynolds & R.J.F.Hend.		1		1	
Psydrax oleifolia (Hook.) S.T.Reynolds & R.J.F.Hend.		1		1	
Pterocaulon redolens (Willd.) Fern.-Vill.		1		1	
Pterocaulon spacelatum					1
Pterostylis bicolor M.A.Clem. & D.L.Jones		1			
Pterostylis cobarensis M.A.Clem. (Vulnerable EPBC)		1			
Pterostylis mitchellii Lindl.		1			
Pterostylis mutica R.Br.		1			
Pterostylis rufa R.Br.		1			
Ptilotus extenuatus Benl (Endangered NCA)		1			
Ptilotus macrocephalus (R.Br.) Poir.		1		1	
Ptilotus nobilis subsp. semilanatus (Lindl.) A.R.Bean		1			1
Pultenaea bracteamajor de Kok		1			
Pultenaea bracteaminor de Kok		1			
Pultenaea foliolosa A.Cunn. ex Benth.		1			
Pultenaea microphylla Sieber ex DC.		1	1		
Pultenaea petiolaris A.Cunn. ex Benth.		1			
Pycnosorus chrysanthes (Schltdl.) Sond.		1			
Pycnosorus globosus F.L.Bauer ex Benth.		1			
Ranunculus meristus B.G.Briggs & Makinson		1		1	
Ranunculus pentandrus var. platycarpus					1
Ranunculus plebeius R.Br. ex DC.		1			
Ranunculus sessiliflorus R.Br. ex DC. var. sessiliflorus		1			
Ranunculus sessiliflorus var. pilulifer (Hook.) Melville		1			
*Rapistrum rugosum (L.) All.**	1	1			
Rhagodia spinescens R.Br.		1	1	1	1
*Rhaponticum repens (L.) Hidalgo**	1	1			
Rhodanthe diffusa subsp. leucactina (F.Muell.) Paul G.Wilson		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Rhodanthe polyphylla (F.Muell.) Paul G.Wilson		1			1
Rhyncharrhena linearis (Decne.) K.L.Wilson		1			
Rhynchosia minima (L.) DC. var. minima		1		1	1
Rhynchosia minima var. australis (Benth.) C.Moore		1			
*Richardia brasiliensis Gomes**	1	1		1	1
*Ricinus communis L.**	1	1		1	
Roepera apiculata (F.Muell.) Beier & Thulin		1			
Rorippa eustylis (F.Muell.) L.A.S.Johnson		1			
Rorippa laciniata (F.Muell.) L.A.S.Johnson		1			
*Rorippa palustris (L.) Besser**	1	1			
Rostellularia adscendens (R.Br.) R.M.Barker		1	1		
Rostellularia adscendens (R.Br.) R.M.Barker subsp. adscendens		1		1	1
Rostellularia adscendens var. latifolia (Domin) R.M.Barker		1			
Rotala mexicana Cham. & Schltdl.		1			
Rotala occultiflora Koehne		1			
Rubus parvifolius					1
*Ruellia tweediana Griseb.**	1	1		1	
Rumex brownii Campd.		1			
Rumex dumosus A.Cunn. ex Meisn.		1			
Rumex stenoglottis Rech.f.		1			
Rumex tenax Rech.f.		1			
Rutidosis lanata A.E.Holland (Endangered NCA)		1			
Rutidosis leucantha					1
Rutidosis murchisonii F.Muell.		1			
*Sagina apetala Ard.**	1	1			
*Salix babylonica L. * (Declared Class 1)*	1	1			
Salsola kali L.		1		1	1
Salvia plebeia					1
*Salvia reflexa Hornem.**	1	1		1	1
Salvia verbenaca L.		1			
Salvinia molesta D.S.Mitch. (Declared Class 2)*	1	1			
Santalum lanceolatum R.Br.		1	1	1	1
Santalum obtusifolium R.Br.		1		1	
Sarcostemma viminale subsp. brunonianum (Wight & Arn.) P.I.Forst.		1		1	1
Sarga leiocladum (Hack.) Spangler		1		1	
Scaevola spinescens R.Br.		1	1		
*Schinus terebinthifolius Raddi * (Declared Class 3)*	1	1		1	
Schizachyrium fragile (R.Br.) A.Camus		1		1	
*Schkuhria pinnata (Lam.) Kuntze ex Thell.**	1	1			1
Schoenoplectus dissachanthus (S.T.Blake) J.Raynal		1			1
Schoenoplectus lateriflorus					1
Schoenoplectus mucronatus (L.) Palla ex J.Kern.		1			
Schoenus ericetorum R.Br.		1			
Scleria brownii Kunth				1	
Scleria mackaviensis Boeck.		1		1	
Scleria sphacelata F.Muell.		1	1	1	1
Scleroblitum atriplicinum (F.Muell.) Ulbr.		1			
Sclerolaena anisacanthoides (F.Muell.) Domin		1			
Sclerolaena birchii (F.Muell.) Domin		1	1	1	1
Sclerolaena calcarata (Ising) A.J.Scott		1			
Sclerolaena diacantha (Nees) Benth.		1			
Sclerolaena johnsonii (Ising) A.J.Scott		1			
Sclerolaena muricata (Moq.) Domin var. muricata		1			
Sclerolaena muricata var. semiglabra (Ising) A.J.Scott		1			
Sclerolaena muricata var. villosa					1
Sclerolaena muricata var. villosa (Benth.) Ulbr.		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Sclerolaena tetracuspis (C.T.White) A.J.Scott		1	1	1	
Sclerolaena tricuspis (F.Muell.) Ulbr.		1			
Sehima nervosum (Rottler) Stapf		1			
Senecio brigalowensis I.Thomps.		1			
Senecio distalilobatus I.Thomps.		1			
Senecio lautus					1
*Senecio madagascariensis Poir. * (Declared Class 2)*	1	1			
Senecio pinnatifolius A.Rich. var. pinnatifolius		1			
Senecio quadridentatus					1
Senecio tuberculatus Ali		1			
Senna aciphylla (Benth.) Randell		1			
Senna artemisioides (DC.) Randell		1			1
Senna artemisioides subsp. petiolaris Randell		1			
Senna artemisioides subsp. zygophylla (Benth.) Randell		1			1
Senna barclayana (Sweet) Randell		1		1	1
Senna circinnata (Benth.) Randell		1			
Senna clavigera (Domin) Randell				1	
Senna coronilloides (Benth.) Randell		1	1	1	1
Senna gaudichaudii (Hook. & Arn.) H.S.Irwin & Barneby		1			
*Senna occidentalis**	1				1
Senna phyllodinea (R.Br.) Symon		1			
Senna sophera var. (40Mile Scrub J.R.Clarkson+ 6908)		1			
Seringia corollata Steetz		1			
Sesbania cannabina (Retz.) Poir. var. cannabina		1		1	1
*Setaria italica (L.) P.Beauv.**	1	1			
Setaria parviflora					1
*Setaria parviflora (Poir.) Kerguelen**	1	1			
Setaria paspalidioides Vickery		1			
*Setaria pumila (Poir.) Roem. & Schult. subsp. pumila**	1	1			
Setaria surgens Stapf		1	1	1	1
*Setaria verticillata (L.) P.Beauv.**	1	1			
Sida aprica Domin		1			
*Sida cordifolia L.**	1	1		1	
Sida corrugata Lindl.		1			1
Sida cunninghamii					1
Sida fibulifera Lindl.		1	1	1	
Sida filiformis A.Cunn.		1		1	
Sida pleiantha F.Muell. ex Benth.		1			
*Sida rhombifolia L.**	1			1	1
Sida rohlenae Domin subsp. rohlenae		1		1	1
Sida sp. (Aramac E.J.Thompson+ JER192)		1			
Sida subspicata			1	1	
Sida trichopoda F.Muell.		1	1	1	1
Sigesbeckia orientalis L.				1	1
*Silene gallica L.**	1	1			
*Silybum marianum (L.) Gaertn.**	1	1			
*Sisymbrium irio L.**	1	1			1
*Sisymbrium officinale (L.) Scop.**	1	1			
*Sisymbrium thellungii O.E.Schulz**	1	1			
Sisyrinchium sp. (Peregian P.R.Sharpe 4970)		1			
*Soalnum nigrum**	1			1	1
Solanum coracinum Symon		1			
*Solanum elaeagnifolium Cav.**	1	1			
Solanum ellipticum R.Br.		1	1	1	
Solanum esuriale Lindl.		1	1	1	1
Solanum ferocissimum Lindl.		1		1	

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Solanum jucundum A.R.Bean		1			
Solanum lycopersicum var. cerasiforme (Dunal) D.M.Spooner, G.J.Anderson & R.K.Jansen*	1	1		1	
Solanum mitchellianum Domin		1			
Solanum nemophilum F.Muell.		1			1
Solanum nodiflorum Jacq.*	1	1			
Solanum opacum A.Braun & C.D.Bouche		1			
Solanum papaverifolium Symon (Endangered NCA)		1		1	
Solanum parvifolium R.Br. subsp. parvifolium		1	1	1	
Solanum seaforthiamum*	1				1
Solanum semiarmatum					1
Solanum stelligerum					1
Solanum stenopterum A.R.Bean (Vulnerable NCA))		1			
Soliva sessilis Ruiz & Pav.*	1	1			
Sonchus oleraceus*	1				1
Sorghum bicolor (L.) Moench*	1	1			
Sorghum halepense (L.) Pers.*	1	1		1	
Sparganium subglobosum Morong		1			
Spartothamnella juncea (A.Cunn. ex Walp.) Briq.		1		1	1
Spartothamnella puberula (F.Muell.) Maiden & Betche		1	1		1
Spergularia rubra (L.) J.Presl & C.Presl*	1	1			1
Sporobolus actinocladus (F.Muell.) F.Muell.		1		1	
Sporobolus caroli Mez		1	1	1	1
Sporobolus contiguus S.T.Blake		1			
Sporobolus creber De Nardi		1		1	1
Sporobolus disjunctus R.Mills ex B.K.Simon		1			
Sporobolus elongatus R.Br.		1	1		
Sporobolus scabridus S.T.Blake		1	1		
Stachys arvensis L.*	1	1			1
Stackhousia intermedia F.M.Bailey		1			
Stackhousia viminea Sm.		1	1		1
Stellaria glabella					1
Stellaria media*	1				1
Stenopetalum velutinum F.Muell.		1			
Striga parviflora (R.Br.) Benth.		1			
Stylidium ecorne (F.L.Erickson & J.H.Willis) P.G.Farrell & S.H.James		1			
Stylidium eglandulosum F.Muell.		1	1		1
Styphelia viridis subsp. breviflora (Benth.) J.M.Powell		1	1	1	
Swainsona affinis (A.T.Lee) Joy Thomps.		1			
Swainsona brachycarpa Benth.		1			
Swainsona galegifolia (Andrews) R.Br.		1	1		1
Swainsona luteola F.Muell.		1			1
Swainsona oroboides F.Muell. ex Benth.		1			1
Swainsona phacoides Benth.		1			1
Swainsona procumbens (F.Muell.) F.Muell.		1			
Swainsona queenslandica Joy Thomps.		1			
Swainsona swainsonioides (Benth.) A.T.Lee ex J.M.Black		1			1
Synaptantha tillaeacea (F.Muell.) Hook.f. var. tillaeacea		1			
Synedrella nodiflora (L.) Gaertn.*	1			1	
Tagetes minuta*	1				1
Tephrosia bidwillii					1
Tephrosia dietrichiae Domin		1			
Tetragonia tetragonioides (Pall.) Kuntze		1	1	1	1
Teucrium racemosum R.Br. var. racemosum		1			
Teucrium sp. (Pittsworth A.R.Bean 18338)		1			
Thellungia advena Stapf ex Probst		1			

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Themeda avenacea (F.Muell.) Maiden & Betche		1		1	
Themeda triandra Forssk.		1	1	1	1
Thesium australe R.Br. (Vuln. EPBC, NCA)		1			
Thryptomene parviflora (F.Muell. ex Benth.) Domin		1			
Thyridolepis mitchelliana			1		1
Thyridolepis mitchelliana (Nees) S.T.Blake		1			
Thyridolepis xerophila (Domin) S.T.Blake		1			
Thysanotus tuberosus R.Br. subsp. tuberosus		1			
Tragus australianus S.T.Blake		1		1	1
*Trianthema portulacastrum L.**	1	1		1	1
Trianthema triquetra Rottb. ex Willd.		1		1	1
Tribulus micrococcus Domin		1			
Tribulus terrestris					1
Tricoryne elatior R.Br.		1		1	1
*Trifolium subterraneum L.**	1			1	
Triglochin dubium R.Br.		1			
Triglochin procerum					1
Triodia marginata N.T.Burb.		1			
Triodia mitchellii Benth.		1		1	
Triodia scariosa N.T.Burb.		1			
Triodia vella Lazarides		1		1	
Tripogon loliiformis (F.Muell.) C.E.Hubb.		1	1	1	1
Triraphis mollis R.Br.		1			1
Typha domingensis Pers.		1		1	1
Urochloa foliosa (R.Br.) R.D.Webster		1			
Urochloa gilesii (Benth.) Hughes		1			
*Urochloa mosambicensis (Hack.) Dandy**	1	1		1	
*Urochloa panicoides P.Beauv. var. panicoides**	1	1			
Urochloa piligera (F.Muell. ex Benth.) R.D.Webster		1			
Urochloa praetervisa (Domin) Hughes		1			
*Urochloa subquadripara (Trin.) R.D.Webster**	1	1			
Urochloa whiteana (Domin) R.D.Webster		1			
*Urtica urens L.**	1	1		1	1
Utricularia gibba					1
Utricularia stellaris L.f.		1			
*Vallisneria americana Michx. var. americana**	1	1			
Ventilago viminalis Hook.				1	1
*Verbascum virgatum Stokes**	1	1			1
*Verbena aristigera S.Moore**	1	1		1	1
*Verbena bonariensis L.**	1	1		1	1
Verbena gaudichaudii (Briq.) P.W.Michael		1		1	
*Verbena officinalis**	1			1	1
*Verbena halei**	1			1	
*Verbesina encelioides (Cav.) Benth. & Hook.f. ex A.Gray**	1	1			1
Veronica plebeia R.Br.		1		1	
*Vicia monantha Retz. subsp. monantha**	1	1		1	
*Vicia monantha subsp. triflora (Ten.) B.L.Burtt & P.Lewis**	1	1		1	
Vigna lanceolata Benth. var. lanceolata		1		1	1
Vigna sp. (Jimbour A.R.Bean 12534)		1			
*Vigna unguiculata subsp. cylindrica (L.) Verdc.**	1	1			
Vigna vexillata					1
Viscum articulatum Burm.f.		1			1
Viscum bancroftii Blakely		1			1
Viscum whitei Blakely subsp. whitei		1			1
Vittadinia constricta N.T.Burb.		1			
Vittadinia pustulata N.T.Burb.		1	1		
Vittadinia sulcata N.T.Burb.		1	1	1	

Species	Source				
	Exotic	H'recs	C'veg	3d Env.	CFN
Vittadinia tenuissima (Benth.) J.M.Black		1			
Wahlenbergia communis Carolin		1			
Wahlenbergia fluminalis					1
Wahlenbergia gracilis (G.Forst.) A.DC.		1		1	1
Wahlenbergia graniticola Carolin		1			1
Wahlenbergia stricta (R.Br.) Sweet		1			
Wahlenbergia tumidifructa P.J.Sm.		1			
Walwhalleya subxerophila				1	
Wedelia spilanthoides F.Muell.				1	
Westringia cheelii Maiden & Betche		1		1	
Walwhalleya subxerophila				1	1
Wurmbea dioica					1
*Xanthium occidentale Bertol.**	1	1		1	
*Xanthium pungens**	1			1	1
Xanthorrhoea johnsonii A.T.Lee		1	1	1	1
Xerochrysum bracteatum (Vent.) Tzvelev		1			
Xerothamnella herbacea R.M.Barker (Endangered)		1			1
Xylomelum cunninghamianum Foreman		1	1	1	
Zaleya galericulata (Melville) H.Eichler subsp. galericulata		1			
*Zinnia peruviana (L.) L.**	1	1			1
Zornia dyctiocarpa var. dyctiocarpa				1	1
Zygophyllum apiculatum					1

Appendix E. Flora Profiles

Introduction

The Appendix presents background information and impact assessment of the 38 threatened plants which were either recorded in the PDA during field surveys or identified as being likely to occur, or with a possibility of occurring in the PDA. Information derived from literature and data review, field habitat assessment and expert input is used to identify the habitat, distribution and threats to individual species. It forms the basis of an assessment of the likelihood of occurrence within the PDA. This information is further used to develop rules for habitat mapping.

Principles

The measures to mitigate and manage impacts are based upon a 'no net loss' principle concerning numbers or sustainability of the species where construction and maintenance activities should not adversely impact known core populations. The measures of mitigation and management follow a tiered approach and can be generically applied across the majority of taxa. Where mitigation measures are required which are specific to the taxa they have been identified in the species profiles.

Habitat Avoidance

The avoidance of known and possible habitat is the most effective mitigation measure. However, the requirement for further field survey and assessment to inform habitat avoidance is particularly relevant for locations and habitats identified as "Core habitat known" which are defined by Herbarium records of varying age and precision. The requirement also applies to areas of "Core habitat possible" which have been established to identify habitat within which individuals of the species and/or populations have a potential to occur. Following further field surveys, either parts of, or the entirety of "core habitat possible" areas may be upgraded to "core habitat known" (if species are encountered) or can be downgraded to "absence suspected or known" (where no species are found). Identifying the location and extent of a target species within the development footprint using GPS mapping, flagging and / or barrier fencing will facilitate avoidance measures.

Whilst establishing a buffered avoidance zone around areas confirmed as "Core habitat known" or "Core habitat possible" will completely avoid the direct impact of vegetation clearance, there may be a potential for residual impacts such as weed invasion, changed fire regimes, sediment and erosion, or changes to hydrology to manifest (edge effects). Measures to mitigate and manage these impacts are considered below.

Minimise Disturbance

Where options to avoid individuals, populations and habitat by adjustment of the development footprint are limited, further surveys may be required to identify the location and extent of populations and individuals of EVNT species. This process will inform impact assessment and refine mitigation/management measures. For example, part of an EVNT flora population or core habitat area may be able to be avoided by informed site selection, while parts of the core habitat containing widely scattered individuals peripheral to the core population may remain within a proposed impact area. Identifying the location and extent of individuals impacted by the development footprint will require GPS mapping, flagging and / or barrier fencing. The size and number of individuals impacted will influence the necessity and level of other measures to minimise disturbance such as translocation and rehabilitation.

Translocation

Where removal of an EVNT species is unavoidable, relevant permits, policies and legislative requirements will need to be adhered to. Liaison with DERM and relevant industry experts is required to determine the viability of any proposed translocation and methods. Where translocation is considered viable, the adoption of best practice guidelines (i.e. Vallee *et al.* 2004) and input of specialist professional expertise will be required to develop appropriate methods and ongoing management of monitoring programs. Important factors such as careful selection of translocation sites, seed collection, collection of cutting material, propagation, site maintenance and monitoring should proceed under a threatened species management plan, and should be informed by existing species recovery plans.

Rehabilitation

Following disturbance from construction, the EVNT habitat will require rehabilitation. Replacement of stored topsoil and vegetation debris is likely to result in natural recruitment however may require enhancement by seeding of native seed of local provenance, or native grass seed from other parts of southern inland Queensland if unavailable. The use of exotic pasture species should be limited to previously cleared agricultural land. All rehabilitation efforts of threatened species habitat should proceed using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition. Rehabilitation programs should include effective sediment and erosion control systems to minimise impacts on surrounding areas, particularly in riparian habitats and palustrine wetlands.

Other Measures

This includes procedures to control leaking wells/pumps to prevent saline water interacting with sensitive riverine and wetland environments

Barakula or Waaje Wattle (*Acacia barakulensis*)

Status

NCA: Vulnerable

EPBC: Not Listed

Habit

A shrub 1-3m

Habitat

HERBRECS specimen records indicate habitat in flat gently undulating plain on the crest of the slope on deep yellow loamy sand soil derived from sandstone or laterite. Vegetation is tall shrubland with *Eucalyptus tenuipes, Corymbia trachyphloia, Calytrix gurulmundensis,* and *Triodia mitchellii* (DERM 2009). Habitat is consistent with RE 11.7.4, 11.7.5, 11.7.6, and 11.7.7. Survey records identified the species in woodland of narrow leaf ironbark (*Eucalyptus crebra*) + smooth barked apple (*Angophora leioclada*) + white cypress pine (*Callitris glaucophylla*) with a subcanopy of white cypress and bulloak (*Allocasuarina luehmanii*)on old loamy plains (RE 11.5.1, 11.5.4, 11.5.21).

Distribution

A Queensland and bioregional endemic that is Restricted to Barakula State Forest north of Chinchilla where it grows on sandy soils in eucalypt communities in the Waaje Wildflower Area (Lithgow 1997, Chinchilla Field Naturalists Club 1997, Maslin 2001).

Likelihood of occurrence in PDA

Core habitat known: Literature and data review initially considered the species to be unlikely given known populations occur approximately 15 km NE of PDA in Barakula State Forest. However, field surveys recorded a single population of *A. barakulensis* at Site AQ219 indicating the likelihood of occurrence in suitable tracts of remnant habitat in the north of the PDA in Barakula and Binkey State Forests..

Threats

Information on threats is lacking in the literature. Generic threats are likely to include vegetation clearing, logging, weed invasion, grazing and fire.

Project-related Impacts

Impacts to the species and habitat associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing.
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks.
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.
- Changed fire regimes.

Significance of Project Related Impacts (Unmitigated)

In similarity to many Acacias, there is a possibility that *A. barakulensis* may respond to disturbance, however knowledge of the species biology and response to disturbances such as habitat fragmentation, changed fire regimes and edge effects requires further detailed study. Without mitigation measures project impacts are expected to occur over the life and scope of the project causing changes to local populations although never extinction. The sensitivity of the species is therefore considered to be ***Moderate.***

The species is locally endemic to the Barakula State Forest and data and literature reviews indicate its core population is located in the State Forest to the north of the PDA. Additional populations have the potential to occur in tracts of remnant vegetation and on disturbed roadsides on lateritic duricrusts (land zone 7) and old loamy plains (land zone 5). In the PDA, this suitable habitat occurs to the north of the Leichhardt Highway where the PDA overlaps with continuous remnant vegetation within Barakula and Binkey State Forest. Any population within the northern part of the PDA represents the southern extremities of the species distribution and scattered individuals may occur. In recognition that the core populations exist to the north of the PDA, magnitude of potential impact is considered to be ***Moderate***

Proposed Management/ Mitigation Measures

- Habitat Avoidance
- Minimise Disturbance
- Rehabilitation

- Translocation
- Monitoring

Summary Residual Impact Assessment

No mitigation measures will alleviate clearing of core habitat known and therefore *avoidance is the only feasible mitigation measure* in these situations. If infrastructure avoids core habitat the residual impact will be ***Low* (4)**. A combination of avoidance and other measures will mostly mitigate impacts and residual impact assessment will be ***Low* (8)**.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

*No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records in the northern parts of the EIS area should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records should be treated as "Core Habitat Known". Confirmed records are:
   - Site AQ219 Woodland of *Eucalyptus crebra* with a T2 of *Callitris glaucophylla* and a shrub layer of *Melaleuca uncinata* + *Acacia* sp. + *A. barakulensis* (219/1).
3. The species may occur throughout the northern parts of the EIS area in the Barakula State Forest and adjoining freehold land in suitable remnant vegetation of Land Zones five and seven. Therefore the following regional ecosystems occurring in the Barakula area should be classed as "Core Habitat Possible":
   - RE11.7.5,

- RE 11.7.4,
- RE11.7.6,
- RE11.7.7,
- RE11.5.1, ;
- RE11.5.4,
- RE11.5.21,

4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence Possible”.
5. For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Maslin (2001), Pedley (1999), Orchard & Wilson (2001).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).
- Biodiversity values documented by EPA (2002a).

Curly-Bark Wattle (*Acacia curranii*)

Status

NCA: Vulnerable

EPBC: Vulnerable

Habit

An erect or spreading multi-stemmed shrub with distinctive red curling (minniritchi) bark (Pedley 1978).

Habitat

Plants are known to occur in dry sclerophyll forests and semi-arid woodlands where they may occur as widely scattered thickets in very species-rich heathy scrub with emergent eucalypts (Pickard 1995c, Threatened Species Scientific Committee 2008). Pickard (1995b) suggest soils are deeply weathered sandstone forming red sandy soils. HERBRECS records from the Gurulmundi area concur with Maslin (2001) indicating occurrence on poorly drained sandy clay flats over sandstone. Vegetation types includes Acacia and Melaleuca shrublands with some sites dominated by *Melaleuca uncinata,* and *Triodia* sp. HERBRECS records fall within mapped RE's 11.7.1, 11.7.5, and 11.7.6.

Distribution

The species has a disjunct distribution in western NSW and south-eastern Qld, occurring in three areas each separated by several hundred kilometres. NSW populations occur in the Lake Cargelligo area and on the Gunderbooka Range near Bourke, and single Queensland population is centered in the Gurulmundi area north of Miles (Pickard 1995c, Orchard & Wilson 2001a). The Gurulmundi population represents a highly disjunct northern limit of distribution restricted to an area of less than 20 km across (Pickard 1995c).

Likelihood of occurrence in PDA

Known to be present with a cluster of HERBRECS collections occur in the north west of the PDA to the east of Gurulmundi. The Gurulmundi area is reported to support two populations with approx. 200 individuals (Pickard 1995c). The species was not detected during field surveys.

Threats

Threats are habitat erosion; grazing, browsing and horning of adult and seedling plants by feral goats; grazing by stock, rabbits, and macropods; clearing of vegetation for fire trail widening; quarrying activities at the Shephards Hill and Gurulmundi sites; road widening, gravel extraction, and lack of suitable fire disturbance for seedling establishment (Lithgow 1997, DECC 2005a, Threatened Species Scientific Committee 2008).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones;
- Changed fire regimes.

Significance of Project Related Impacts (Unmitigated)

The sensitivity of populations of *Acacia curranii* to unmitigated impacts within the PDA is considered ***High*** with magnitude of potential unmitigated impact also considered ***High.*** Part of the species only known core habitat in Queensland occurs in a small area in the northern part of the PDA. Core habitat also occurs outside of PDA in Gurulmundi SF, which is known to be contained within non-Arrow petroleum leases. It has a low abundance both locally and regionally. Core habitat within State Forest areas and adjoining land is subject to disturbance by logging. Without mitigation measures, project impacts to restricted areas of core habitat are expected to occur over the life and scope of the project causing changes to local populations such as declining local populations although never extinction. It is unlikely that natural recruitment is able to replace or restore the populations within several generations. However, this is unlikely to affect the long-term integrity of the entire species population as the species also known in NSW from two populations.

Proposed Management/ Mitigation Measures

- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

Unmitigated project related activities may result in impacts of ***High Significance*** **(21)** to *Acacia curranii* populations within the PDA. The known location of the species occurs in a popular wildflower viewing area and supports other EVNT taxa including *Cryptandra ciliaris, Eucalyptus curtisii*, and *Callitris baileyi*. No mitigation measures will alleviate clearing of core habitat known and therefore avoidance is the only feasible mitigation measure in these situations.

Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree to the extent that minor loss in a local population occurs. If infrastructure avoids core habitat, the residual impact to the species would be ***Low (7)***. If other mitigation measures are implemented project activities may result in impacts of ***Moderate*** **(17)** significance.

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	High	High (21)	Totally Effective	Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Moderate	Moderate (17)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as "Core Habitat Known".
3. The following regional ecosystems occurring in the Gurulmundi area should be classed as "Core Habitat Possible":
   - RE11.7.1
   - RE11.7.5
   - RE11.7.6
4. All other remnant vegetation in the PDA should be treated as "Absence suspected".
5. All cleared agricultural and grazing land is classed as "Absence Likely".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A threatened species profile has been prepared by Department of Environment & Climate Change New South Wales (DECC) (2005a);
- *A* Threatened Species Priority Action Statement has been prepared by Department of Environment & Climate Change New South Wales (DECC) (2005b);
- Taxonomic treatments have been prepared by Pedley (1978), Tindale and Kodela (2001), Harden (1991), and Maslin (2001);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).
- Biodiversity values documented by EPA (2002).

Handons Wattle (*Acacia handonis*)

Status

NCA: Vulnerable

EPBC: Vulnerable

Habit

A shrub with resinous leaves and branches to 2 m.

Habitat

Lateritic or sandstone substrates in gently undulating country and crests on stony ridges in eucalypt woodland and open forest (Maslin 2001, Orchard & Wilson 2001). Vegetation is woodland and open forest of *Eucalyptus fibrosa* subsp. *nubila*, *E. watsoniana* subsp. *watsoniana, Lysicarpus angustifolius,* and *Allocasuarina inophloia* (Halford 1995r, DNR 2000). The habitat consistent with RE 11.7.4 and 11.7.7.

Distribution and Ecology

A Queensland and bioregional endemic, known from only one population in Barakula SF, approximately 43 km north of Chinchilla, south east Queensland (Halford 1995r; Orchard & Wilson 2001, Maslin 2001, Lithgow 1997, EPA 2002). The single locality encompasses 28 ha, 5 km east of Chinchilla - Auburn Rd (Halford 1995; Lithgow 1997, DNR 2000). Over the last twenty years, the species is reported to have spread over a greater area (Lithgow 1997). Population of 10 080 individuals comprised of 4200 mature and 5880 juvenile plants distributed over three separate stands (Halford 1995 in DNR 2000). Known to flower in June/July/August with pods maturing in November (Lithgow 1997). Regenerates well from seed following burning, and propagates readily from seed (DNR 2000).

Likelihood of occurrence in PDA

Possible. Current known populations occur in Barakula SF and are located approx 10-20 km north of the PDA northern boundary. The potential for additional populations within the northern part of the PDA in any suitable habitat adjoining Barakula SF and Gurulmundi SF should not be ruled out. The species was not detected during field surveys.

Threats

Inappropriate fire regimes, habitat destruction, disturbance from timber harvesting, inappropriate grazing regime (DNR 2000).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones;
- Changed fire regimes.

Consequence of Project Related Impacts (Unmitigated)

The species is reported to propagate readily from seed and regenerate well from seed following burning and with consideration given to it conservation status, its sensitivity ranking is considered ***High.*** The core habitat of the species habitat is located outside of the PDA however, there remains a low potential for isolated individuals to occur within similar habitat in the northern parts of the PDA principally in Barakula State Forest. Isolated individuals at the southern limit of the species range would therefore be susceptible to impacts. Given the restricted occurrence of the taxon, any isolated individuals should be are significant and the magnitude of potential impact is considered *Moderate.* The consequence of unmitigated impacts to populations of *Acacia handonis* within the PDA is considered as ***Moderate (17)*.**

Proposed Management/ Mitigation Measures

- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

The unmitigated project related a impacts to *Acacia handonis* populations within the PDA are considered ***Moderate*** **(17)**. No mitigation measures will alleviate clearing of core habitat known and therefore avoidance is the only feasible mitigation measure in these situations. Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree to the extent that minor loss in a local population of significant species is affected. This includes seed collection and propagation within rehabilitation programs as the species is reported to propagate readily from seed and regenerate well from seed following burning. If infrastructure avoids core habitat, the resulting impact would be ***Insignificant*** **(2)**. If other mitigation measures are implemented, project activities may result in impacts of ***Low Significance*** **(9)** .

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records should be buffered by a 1km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records should be treated as “Core Habitat Known”.
3. The following regional ecosystems occurring in the Barakula and Gurulmundi area should be classed as “Core Habitat Possible”:
   - RE11.7.4
   - RE11.7.5
   - RE11.7.6
   - RE11.10.1
4. All other remnant vegetation in the PDA should be treated as “Absence suspected”.
5. All cleared agricultural and grazing land is classed as “Absence Likely”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A conservation research statement has been prepared by Halford (1995r).
- A species management pofile has been prepared by DNR (2000).
- Conservation Advice Statement prepared by Commonwealth Threatened Species Scientific Committee (2008gx).
- A threatened species profile has been prepared by Department of the Environment, Water, Heritage and the Arts (2009).
- Taxonomic treatments and descriptive accounts by Pedley (1981), Simmons (1988), Lithgow (1997), Orchard & Wilson (2001), Maslin (2001).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).
- Biodiversity values documented by EPA (2002a).

Acacia tenuinervis

Status

NCA: Near-threatened

EPBC: Not listed

Habit

Tree to 12 m or a suckering shrub to 9m (Lithgow 1997, Maslin 2009, Stanley and Ross 1986).

Habitat

Brigalow scrub or eucalypt woodland, in ironstone gravel (Pedley 1978, Maslin 2001). HERBRECS records (DERM 2009) in the Chinchilla area indicate occurrence on red soil ridges in *Eucalyptus crebra* woodland with shrubby understorey (RE11.5.1), in non-remnant and roadside vegetation on old loamy plains, and on margins of dry vine scrub (Lithgow 1997).

Distribution

Queensland and bioregional endemic restricted to a few localities within the Darling Downs, Burnett and Leichhardt Pastoral Districts of south eastern Queensland from near Glenmorgan, north west to Injune and east to just west of Monto (DNR 2000, Bostock and Holland 2007). Known from localities to the west and north of Chinchilla and approximately 20 km north of PDA boundary in Barakula SF (DERM 2009) where populations are mainly on roadsides (DNR 2000).

Likelihood of occurrence in PDA

Known. This species was recorded in the PDA during the field survey with additional HERBRECS records in proximity of Chinchilla.

Threats

Inappropriate fire regimes, habitat destruction, disturbance from timber harvesting, and inappropriate grazing regime are identified as possible threatening processes by DNR (2000).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks; and

- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

Observations of this species regenerating in dense regrowth stands indicate a tolerance for disturbance although its ecological parameters are not known. Collection of seed for propagation within rehabilitation programs is likely to offset loss of local populations. Considering the species Near- Threatened classification in Queensland, its sensitivity to unmitigated impact is considered ***Moderate.*** This species has a limited and sporadic distribution within the PDA and may be locally common in both remnant and non-remnant vegetation particularly on roadsides. It may be more common than the current records indicate. The core habitat of the species is also located outside of the PDA with records from the Burnett and Leichhardt Pastoral Districts. There remains a potential for isolated individuals to occur within similar habitat in the northern parts of the PDA principally in remnant vegetation north of Chinchilla. Roadside populations are susceptible to impacts from pipelines, and road widening. The magnitude of unmitigated impact is therefore considered ***Monderate.***

Proposed Management/ Mitigation Measures

- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

Project related activities may result in unmitigated impacts of ***Moderate (13)*** significance to *Acacia tenuinervis* populations within the PDA. Where avoidance is not possible, impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree to the extent that minor loss in a local population is expected. Observations of this species regenerating in dense regrowth stands indicate a tolerance for disturbance although its ecological parameters are not known. Collection of seed for propagation within rehabilitation programs is likely to offset loss of local populations.

If infrastructure avoids core habitat, the residual impact would be insignificant ***Low (4)***. If other mitigation measures are implemented, project activities may result in residual impact that is of ***Low* (8)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Effective

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. Confirmed species records should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records should be treated as "Core Habitat Known".
3. The following regional ecosystems occurring in the Chinchilla area and north to Barakula should be classed as "Core Habitat Possible":
   - RE11.5.1
   - RE11.7.6
4. All regrowth non-remnant vegetation within the species range should be treated as "General Habitat Possible".
5. All other remnant vegetation and non remnant and cleared agricultural and grazing land in the PDA should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Taxonomic treatments and descriptive accounts by Pedley (1978), Lithgow (1987).
- Tindale & Kodela (2001), and Maslin (2001).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2009).
- A species management profile has been prepared by DNR (2000).
- Biodiversity values documented by EPA (2002).

Acacia wardellii

Status

NCA: Vulnerable

EPBC: Vulnerable

Habit

A slender shrub or tree 5–7 m high with smooth, silvery-grey or white bark and hairless branchlets with a whitish waxy bloom on the surface (Maslin 2001).

Habitat

Gravelly soils on shallow weathered sandstone in eucalypt woodland (Pedley, 1978). HERBRECS data (DERM 2011) indicates habitat in Condamine State Forest which includes; woodland of *Eucalyptus decorticans*; tall open forest of *Eucalyptus crebra* with occasional *Eucalyptus fibrosa* subsp*. nubila* on yellow-brown sandy soils over laterised sandstone on gentle slopes and rises; and on a hillside with *Acacia jucunda* that was formerly a brigalow-belah formation (DERM 2011).

Distribution

Known from south of Roma, south-west of Chinchilla and the Thomby Range in south-east Queensland (Maslin 2001). In the Thomby Range, the species has been collected near Rocky Glen Homestead, Glenmore in the Silver Springs Gas Field. Recorded in an area ranging from 15 km east-north-east to 15 km east-south-east of Condamine (DEWHA 2009). HERBRECS records indicate habitat 36 km south-west of Chinchilla. Populations have been recorded on a gas pipeline easement east of Condamine (QGC Ltd 2009). Qld Herbarium records in the Condamine State Forest indicate robust populations of 10 to 20 plants at the collection site.

Likelihood of occurrence in PDA

Possible. Known populations occur approx. 20-30 km south south-west of the PDA located to the east of Condamine. The species has potential to occur in suitable remnant and regrowth habitat on the western margins of the PDA south of the Condamine-Kogan Rd. It was not recorded in the field survey.

Known Threats

The main identified threats are clearing for agriculture and grazing (DEWHA 2008).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

The species is attributed to have ***High Sensitivity*** based on the its conservation status and the generall ability of most acacia species to respond to propogation and rehabilitation, although mitigation measures have not been tested specifically on this species. This species is not currently known from the PDA and its core habitat species is located outside of the PDA however, there remains a potential for isolated individuals to occur within similar habitat. The magnitude of potential impact is considered to be ***Low.*** The Significance of unmitigated impacts to populations of *Acacia wardellii* within the PDA are considered to be ***Moderate*** **(12)**.

Proposed Management/ Mitigation Measures

- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

Project related activities may result in unmitigated impacts of ***Moderate*** **(12)** significance to potential *Acacia wardellii* populations within the PDA. Targeted field surveys in the limited area of core possible habitat are required to completely rule out the occurrence of the species. Where avoidance of habitat is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree to the extent that minor loss in a local population of significant species is affected. If infrastructure avoids core habitat the resulting in ***Low*** **(4)** impact. If other mitigation measures are implemented, project activities may result in impacts that are of ***Moderate*** **(12)**.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Low	Moderate (12)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	Low	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems occurring within the PDA south of the Kogan-Condamine Road should be classed as “General Habitat”:
   - RE11.5.1
2. All regrowth non-remnant vegetation within the PDA south of the Kogan-Condamine Road should be treated as “General Habitat”.
3. All other remnant vegetation in the PDA and non-remnant and cleared agricultural and grazing land outside of the species known distribution should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Conservation Advice Statement prepared by Commonwealth Threatened Species Scientific Committee (2009).
- A threatened species profile has been prepared by Department of the Environment, Water, Heritage and the Arts (2009).
- Taxonomic treatments and descriptive accounts by Pedley (1978), Lithgow 1997, Tindale & Kodela (2001), and Maslin (2001).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2009).

- Impact assessment carried out by QGC Ltd (2009).
- Biodiversity values documented by EPA (2002).

Sandstone Prickle Bush (*Apatophyllum teretifolium*)

Status

NCA: Near Threatened

EPBC: Not Listed

Habit

A compact shrub, rounded or prostrate, to 0.4m high with lime green, cylindrical leaves approx 10 mm long and <1 mm wide, in opposite pairs, with pungent apex (Bean and Jessup 2000).

Habitat

Shallow sandy soils among rock or along cliff edges on sandstone ridges (Santos 2007) in Eucalyptus dominated woodlands to low woodland with heathy understorey (Bean and Jessup 2000). A record near Chinichilla in Barakula SF occurs in woodland of *Eucalyptus tenuipes, E. trachyphloia,* and *Lysicarpus angustifolius* with *Triodia* groundcover in shallow sandy soil derived from sandstone (DERM 2009).

Distribution

Qld and bioregional endemic. Known from scattered locations in the Carnarvon and Expedition Range with an additional record from Barakula State Forest near Chinchilla (Bean and Jessup 2000).

Likelihood of occurrence in PDA

Possible. No records are known within the PDA, however a single record from Barakula SF approximately 20 km north of PDA boundary suggests possibility to occur in any lateritic sandstone habitats (RE11.7.5, 11.7.6) in the northern parts of the PDA particularly in the Barakula and Gurulmundi areas. The species was not recorded during the field survey.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Known Threats

No threats are documented in the literature.

Significance of Project Related Impacts (Unmitigated)

This species is not currently known from the PDA however, there remains a low potential for isolated individuals to occur within similar general habitat. Its core habitat is located outside of the PDA. Further surveys in its general habitat in the Gurulmundi and Barakula area east of the Leichhardt highway are required to rule out the possibility of occurrence. On the basis of this potential, the magnitude of unmitigated impacts to populations of *Apatophyllum teretifolium* within the PDA is considered to be ***Low.*** There is limited information concerning the sensitivity of this species to disturbance and its ability to regenerate naturally and its sensitivity ranking is considered ***High*** as a precautionary measure.

Proposed Management/ Mitigation Measures

- Undertake additional surveys in core habitat possible to locate any additional populations and/or occurrences and reassess risk.
- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

Project related activities may result in impacts of ***Moderate*** **(17)** significance to potential *Apatophyllum teretifolium* populations which have the potential to occur within the PDA. No mitigation measures will alleviate clearing of its general habitat and therefore avoidance is the only feasible mitigation measure in these situations. Where avoidance is not possible, the degree to which the identified mitigation measures alleviate impact, particularly translocation and rehabilitation, are unknown and their effectiveness is not certain. If infrastructure avoids core habitat the resulting environmental impact would be ***Low*** **(4)**. If other mitigation measures are implemented, project activities may result in impact of ***Low Significance*** **(8)**.

Unmitigated Significance Assessment	**Effectiveness of Mitigation Measures**

Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems occurring in the Barakula and Gurulmundi area should be classed as “General Habitat”:
   - RE11.7.4
   - RE11.7.5
2. All other remnant vegetation and non-remnant and cleared agricultural and grazing land outside of the species known distribution in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A species profile has been prepared by Santos (2007).
- A taxonomic treatment has been prepared by Bean and Jessup (2000).
- Impact assessment in the Surat Basin has been carried out by QGC Ltd (2009).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Forsters Wiregrass (*Aristida forsteri*)

Status

NCA: Endangered

EPBC: Not Listed

Habit

A perennial grass.

Habitat

Low heathland on shallow soil on laterised sandstone ridges and plateaux dominated by *Triodia vella, Micromyrtus striata,* and *Baeckea* sp. (Sharp and Symons 2002, DERM 2011). This habitat is consistent with RE 11.7.5.

Distribution

A Queensland and bioregional endemic know only from Wondul Range, in south-eastern Queensland (Symons 1994, Sharp and Symons 2002, DERM 2009)

Known Threats

Threats are not known from the available literature.

Likelihood of occurrence in PDA

Possible. Herbarium records are located on the margin of the PDA in the Bringalilly State Forest and Wondul Range areas, which suggest potential habitat exists on laterised sandstone plateaux and ridges. This habitat is consistent with RE 11.7.5.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Habitat edge effects such as promoting conditions for invasion of weeds and exotic grasses which induce altered habitat structure along gathering lines, tracks and clearing zones;
- Direct loss of individuals during habitat clearing; and
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks.

Significance of Project Related Impacts (Unmitigated)

The ecology of this species is poorly known and its amenability to translocation and rehabilitation is untested. In this regard the species has a sensitivity ranking of ***Extreme.*** The known populations occur in remnant vegetation within Bringalilly State Forest on the south west the margins of the

PDA. The species grows in restricted heathland habitats. Any disturbance to low heathlands on shallow soil on laterised sandstone ridges and plateaux could have a *an* impact magnitude that is ***Extremely High*** **(25)**. The species was not recorded in the field survey. Detailed surveys are required within the potential area of distribution to determine the presence of this taxon.

Proposed Management/ Mitigation Measures

- Undertake additional surveys in core habitat possible to locate any additional populations and/or occurrences and reassess risk.
- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation - Rehabilitation of the restricted heathland habitat of *Aristida forsteri* is untested and would require particular attention to the ecology and species composition.
- Translocation – Untested.
- Monitoring.

Summary Residual Impact Assessment

Project related activities may result in preliminary impacts of ***Extremely High*** **(25)** significance. No mitigation measures will alleviate clearing of its core and possible habitat and therefore avoidance is the only feasible mitigation measure in these situations. Where avoidance is not possible, the identified impact management measures are uncertain / untested against an impact preventing long-term indirect impacts. If infrastructure avoids core habitat the resulting environmental impact would be ***Moderate*** **(11)**. If other mitigation measures are implemented, the significance of impacts to project activities is considered ***Extremely High*** **(23).**

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	Extremely High	Extremely High (25)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Mod (11)	Extremely High	High	Extremely High (23)

[*] No clearing of vegetation within areas of core habitat known or core habitat possible.

[#] Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems occurring in the south west of the PDA in the Wondul Range and Bringalilly SF should be classed as “Core Habitat Possible”:
   - RE11.7.5
   - RE11.7.4
2. All other remnant and non-remnant vegetation in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment prepared by Symons (1994), and Sharp and Symons (2002).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Lobed Blue Grass (*Bothriochloa biloba*)

Status

NCA: Not Listed

EPBC: Vulnerable

Habit

An erect or decumbent grass to 1 m high.

Habitat

Cleared eucalypt forests and relict grassland with preference for heavier-textured soils brown or black clay soils (Bean 1999). HERBRECS data (DERM 2011) indicates habitat in: disturbed roadside habitat on Condamine flood plain; River red gum (*Eucalyptus camaldulensis*) woodlands on sandy alluvium over clay; queensland blue grass (*Dichanthium sericeum*) grassland on heavy soil alluvium; and in a grassy rail reserve on heavy soil alluvium. Recorded in baseline surveys in open grassy woodland dominated by queensland blue gum (*Eucalyptus tereticornis*) on an alluvial plain. The woodland structure of the habitat has been heavily disturbed by extensive timber extraction and heavy grazing pressure and is considered non-remnant.

Distribution

Known from the Darling Downs district in south east Queensland, south along the western slopes of the Great Dividing Range into NSW to North Star, Warialda, Bingara and Merriwa (Quinn *et al.* 1995; NSW Scientific Committee 2004). Recorded from Miles (2 km south of Condamine River), and in the Cecil Plains locality; and 10 km north, 14 km NE and 6 km E and at Yelarbon, Yellowbank (DERM 2011). Vouchered survey record from 5 km NNE of Cecil Plains. Documented as common within the bioregion and delisted in Queensland to common status (EPA 2002).

Likelihood of occurrence in PDA

Known. Existing HERBRECS records (DERM 2011) to the south of Miles and Cecil Plains area, and at 5 km NNE of Cecil Plains(project vegetation survey site AS346) strongly suggest the likelihood of other occurrences on alluvial habitats within the PDA along the Condamine River floodplain.

Threats

Threats to Lobed Blue-grass are identified by Fensham (1998, 1999), NSW Scientific Committee, (2004) and Quinn *et al*. (1995) in Threatened Species Scientific Committee (2008jc), and include:

- Competition from exotic species such as coolatai grass (*Hyparrhenia hirta*), nut grass (*Cyperus rotundus*) and lippia (*Phyla nodiflora*); african lovegrass (*Eragrostis curvula*), *Paspalum dilatatum, Megathrysus maximus, Pennisetum villosum,* and *Sorghum halepense*.
- Inappropriate management of roadside grasslands (i.e. spraying, low slashing, heavy grazing) which promotes the spread of weeds and aggressive weedy grasses).
- Heavy ongoing grazing pressure.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Habitat edge effects such as promoting conditions for invasion of weeds and exotic grasses which induce altered habitat structure along gathering lines, tracks and clearing zones;
- Direct loss of individuals during habitat clearing; and
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks.

Significance of Project Related Impacts (Unmitigated)

The known populations of this species occur in the vicinity of roadsides, and on river frontages. Large areas of potential habitat occur in riparian woodlands (11.3.4), grasslands on alluvium (11.3.21), poplar box (*E. populnea*) woodlands on alluvium (11.3.2), (11.3.3) and derived grasslands on alluvium. Whilst the amenability of this species to translocation and rehabilitation is unknown, the ability of the species to occupy disturbed grassland habitats suggests that the species is relatively resilient an impact sensitivity ranking of ***Moderate***. These habitats may occur in road reserves, stock routes and cleared paddocks. The potential for invasion of aggressive grassy weeds along disturbance corridors is high. The species occurs outside of the PDA and the potential impact magnitude is considered to be ***High.***

Proposed Management/ Mitigation Measures

- Undertake additional surveys in core habitat known and possible to locate any additional populations and/or occurrences and reassess risks.
- Habitat Avoidance.
- Minimise Disturbance.
- Rehabilitation.
- Translocation.
- Monitoring.

Summary Residual Impact Assessment

Project related activities may result in impacts of ***Moderate*** **(18)** significance to potential *Bothriochloa biloba* populations within the PDA**.** The avoidance of significant grassland and poplar box woodlands on alluvium will significantly reduce potential impacts. Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree, to the extent that minor loss in a local population of significant species is expected. If infrastructure avoids core habitat the resulting environmental impact significance would be ***Low (4)***. If other mitigation measures are implemented, project activities may result in impacts of ***Moderate*** **(13)** significance.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	High	Moderate (18)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Moderate	Moderate (13)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons (<2000 m precision) with confirmed records should be treated as “Core Habitat Known”.
3. The following regional ecosystems occurring should be classed as “Core Habitat Possible”:
   - RE11.3.2
   - RE11.3.3
   - RE11.3.4
   - RE11.3.21
4. Non-remnant derived grassland on land zone 3 should be classed as “General Habitat”.

5. All other remnant and non-remnant vegetation in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A threatened species profile has been prepared by Department of the Environment, Water, Heritage and the Arts (2009).
- Taxonomic treatment by Sharp & Simon (2002).
- A species profile has been prepared by Queensland Department of Natural Resources (Qld DNR) (2000).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Ooline / Scrub Myrtle (*Cadellia pentastylis*)

NCA: Vulnerable

EPBC: Vulnerable

Habit

Tree to 10 m and rarely to 25 m high.

Habitat

Ooline grows in dry rainforest, semi-evergreen vine thickets and sclerophyll vegetation, where it maybe locally dominant in the canopy layer or occurring as an emergent (Threatened Species Scientific Committee 2008jk). Substrates include clay plains, sandstone and residual ridges in association with vine thickets, brigalow, and belah (Santos 2007). It is known to occur as single isolated trees in cleared non-remnant grazing lands.

Distribution

Ooline is known to occur on the western edge of the NSW north-west slopes, and extending into Queensland to Carnarvon Range and Callide Valley, south-west of Rockhampton (Harden *et al*., 2006). Its habitat is now restricted to a few scattered sites and is conserved within the Tregole National Park (NP), Sundown NP, and Carnarvon Gorge NP (DNR 2000). It is known from the West Gurulmundi area.

Likelihood of occurrence in PDA

Possible. The taxon is represented within the southwestern part of the PDA (on Kindon Station in the Wyaga Creek area) by two Herbarium collections. The records are very low precision (16000 m) and dated from 1919 and 1938, however EPA (2002) identify 'Wyaga-Kindon Ooline' as a Special Biodiversity Area where ooline approaches its eastern limit of distribution. It is possible that the records occurred in habitats associated with part of brigalow/belah forests along Wyaga Creek and further detailed surveys are required. The majority of ooline habitat in this area has been cleared however, there remains a possibility of isolated paddock trees and any vegetation associated with RE11.7.1. Ooline is also recorded in brigalow open forest and fragmented softwood scrub vegetation in the Stones Country Resources Reserve West Gurulmundi area located to the west of the PDA. Steep basaltic scree slopes on Captains Mountain near Millmerran are considered low potential habitat and require further survey.

Known Threats

Threats to Ooline are broad scale tree clearing, inappropriate fire regimes, and inappropriate grazing regimes (DNR 2000). Other threats include localised extinction due to small and scattered populations; inbreeding which threatens genetic diversity in small populations; low seed viability which threatens breeding success; feral goats and pigs; invasion of habitat by weeds; frequent fires; tunnel and sheet erosion; damage to roadside populations during roadworks; and high insect attack (Fletcher, 2002, DECC, 2005a in Threatened Species Scientific Committee (2008jk). Species is undergoing slow decline with occurrences in regrowth threatened by re-clearing and fire (EPA 2002).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing; and
- Habitat edge effects such as promoting conditions for invasion of weeds and exotic grasses which induce altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The sensitivity of the species to project related impacts is considered ***High*** as the species is incapable of rapid regeneration following disturbance and is not resilient to severe habitat disturbance. Project related activities may result in impacts of ***Moderate*** magnitude and the preliminary unmitigated significance is considered ***Moderate*** **(17)**. The possibility of the species occurring in the Wyaga locality is considered low given the age of the Herbarium records (1919, 1938) and the extent of clearing in that area. Any remaining occurrences in the Wyaga locality represent the eastern limit of distribution for the species. These occurrences may occur as scattered individual trees within cleared paddocks and/or non-remnant vegetation. Isolated trees in cleared land have the potential to be cleared by project works. Targeted ground truthing of the development footprint in high-risk locations and avoidance of trees will considerably reduce the risk of impact.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat possible” and areas of previously recorded occurrence should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Undertake surveys in potential habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.

Rehabilitation

- The potential for success of rehabilitation programs is unknown considering limitations of current knowledge regarding seed availability, and propagation success.

Translocation

- It will not be feasible or possible to translocate larger tree specimens.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Project related activities may result in impacts of Moderate (17) significance to potential *Cadellia pentastylis* populations within the PDA. Avoiding habitat and undertaking further survey work within areas of core habitat possible that may require clearing will leave environmental impact ***Low (7)*** **residual impact**. Where avoidance is not possible, the identified impact management measures are considered to be only partially effective with species translocation being untested. If other mitigation measures are implemented, project activities may result in impacts of ***Moderate*** **(13)** significance.

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Unknown - untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Moderate	Moderate (13)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Areas of remnant 11.7.1, non-remnant and regrowth vegetation in the Kindon Station and Wyaga Creek areas (in the vicinity of historic Herbarium records) should be classed as 'Core Habitat Possible' subject to further field survey;
2. Scree slopes on basalt substrates in the Captains Mountain area to the south of Millmerran should be classed as 'General Habitat' subject to further field survey;
3. All other remnant and non-remnant vegetation in the PDA should be treated as "Absence suspected".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment prepared by Harden (2002), Harden *et al.* (2006) and Sharp and Symons (2002).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2009).
- Commonwealth Conservation advice has been prepared by Threatened Species Scientific Committee (2008jk).
- A threatened species profile has been prepared by Department of Environment & Climate Change New South Wales New South Wales (DECC) 2005a, 2005b;
- A species profile has been prepared by Queensland Department of Natural Resources (Qld DNR) (2000);
- Biodiversity values documented by EPA (2002).

Baileys Cypress (*Callitris baileyi*)

NCA: Near-threatened

EPBC: Not Listed

Habit

A tree growing to 18 m tall, with spreading or erect branches and rough greyish bark (Harden 2000).

Habitat

A survey record (Site AS376, 29km NNW of Miles) confirms its presence in low open forest (11-15m) of *Eucalyptus exserta*, *E. crebra* and *Callitris glaucophylla* with a mid dense shrubby understorey dominated by *Micromyrtus sessilis* with *Acacia crassa, Alphitonia excelsa, and Petalostigma pubescens*. Groundcover is grassy and dominated by *Aristida caput-medusae, A. calycina, Dianella sp., Gahnia aspera* and *Xanthorrhoea* sp. This vegetation is consistent with RE11.7.6. DERM (2009a, b), DEC (2005); Stanley & Ross (1983) describe its habitat as eucalypt woodland, with ironbark, blue gum and spotted gum on rocky slopes, hilly or mountainous areas, in shallow and often clay soils. Extensive tracts of habitat featuring narrow leaved ironbark (*E. crebra*) associated woodlands on land zones 7 and 5 occur in the Gurulmundi area.

Distribution

In Queensland, Baileys Cypress occurs from the state border to Goomeri in the north and west to the Bunya Mountains. The distribution is predominantly within the Southeast Queensland bioregion extending into the Brigalow Belt near the bioregional boundary (EPA 2002, DERM 2009b). Occurs into NSW in drier ranges inland from near the Qld border in Koreelah National Park and adjacent private land on the NSW–Queensland border west of Woodenbong (DECC 2005a).

Likelihood of occurrence in PDA

Known to be present from a survey record (AS376) located 29km NNW of Miles, in low open forest of *Eucalyptus exserta, E. crebra* and *Callitris glaucophylla* on sandstone duricrust. Also known from a HERBRECS collection in the Gurulmundi locality east of the Leichhardt highway, in the north west of the PDA. Populations in the PDA represent the northern limit of distribution of the species. Further surveys are required to determine the extent of populations.

Threats

The following threats have been documented by DECC (2009):

- Inappropriate fire regimes as cypress pines are fire sensitive;
- Risk of local extinction because small and isolated population;
- Clearing of habitat for agriculture.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones; and
- Inappropriate fire regimes.

Significance of Project Related Impacts (Unmitigated)

Any disturbance to known and possible habitat in the Gurulmundi area west of the Leichhardt Highway would render the species susceptible to project related impacts. The ecology of the species is not well documented and as such a sensitivity ranking of ***High*** has been applied to the species as a precautionary measure. The magnitude of impacts is considered ***Moderate*** considering the the species is widespread outside the PDAs. Clearing of habitat may result in impacts of ***Moderate (17)*** significance to potential *Callitris baileyi* populations within the PDA. Targeted ground truthing in high-risk habitats is required to determine the extent of populations. Avoidance of potential habitat will considerably reduce the risk of impact.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known and possible” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Undertake additional surveys in potential habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where *Callitris baileyi* occurs do not adversely impact on known core populations.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Erect and maintain buffer areas for isolated trees.

Other Measures

- If removal of *Callitris baileyi* is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- If removal of *Callitris baileyi* is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Avoiding habitat and undertaking further survey work to identify additional populations within areas of core habitat possible that may require clearing are the only feasible mitigation measures for these species. Provided these are followed, impacts are expected to be completely mitigated.

Where avoidance is not possible, the identified impact management measures are considered to be only partially effective considering the limited information on species ecology. If infrastructure avoids core and possible habitat, the resulting impact significance would be ***Low (7)***. If other mitigation measures are implemented, project activities may result in impacts of ***Moderate* (13)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Unknown

Residual Significance Assessment

Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (4)	High	Moderate	Moderate (17)

[*] No clearing of vegetation within areas of core habitat known or core habitat possible.

[#] Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems occurring in the Gurulmundi and Barakula areas in the north of the PDA should be classed as “Core Habitat Possible”:
    - RE11.7.5
    - RE11.7.6
4. All other remnant vegetation and cleared agricultural and grazing land in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A species profile has been prepared by DERM (2009b);
- A threatened species profile has been prepared by Department of Environment & Climate Change New South Wales (DECC) (2005a);
- A Threatened Species Priority Action Statement has been prepared by Department of Environment & Climate Change New South Wales (DECC) (2005b);
- Taxonomic treatments have been prepared by Harden (2000); Harden *et al.* (2006); and Stanley and Ross (1983);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);

Calotis glabrescens

NCA: Near-threatened
EPBC: Not Listed

Habit

A herb with white flowers turning purple on drying (DERM 2009).

Habitat

Vegetation in the locality of the record within the PDA is predominately woodland of narrow leaved ironbark (*E. crebra*), smooth barked apple (*Angophora leiocladа*), white cypress (*Callitris glaucophylla*) and bull oak (*Allocasuarina luehmanii*), (RE11.5.1 and 11.5.4).

Distribution

Restricted to the Darling Downs district of south east Queensland where it is represented by one specimen (Bostock and Holland 2007).

Likelihood of occurrence in PDA

The taxon is suspected to be absent given the only occurrence within the PDA is a low precision HERBRECS collection from 1944, in the Bybera locality approximately 23.5 km WNW of Bendidee NP is. It has not been recollected in the region since 1944.

Threats

No threats are documented in the available literature. Possible threats are assumed to be habitat clearing, overgrazing, and inappropriate fire regimes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones; and
- Inappropriate fire regimes.

Significance of Project Related Impacts (Unmitigated)

Herbarium data indicates that the only record for the taxon occurs in the PDA however, it has not been recollected since 1944. The age of the record suggests that the species occurrence is now unlikely and that changes to its habitat may well have occurred. Nevertheless, its habitat is widespread in the PDA. Information on the extent of populations in the PDA is lacking. Further field surveys are required to determine the presence and extent of populations. As a precautionary approach, the sensitivity of the species to impact is considered ***Moderate*** with an impact magnitude ranking of ***Low***. Project related activities might result in impacts of ***Low (8***) significance to potential populations within the PDA.

Proposed Management/Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat possible” should be avoided. If these areas are avoided, impacts are not expected.

Minimising Disturbance

- Undertake additional surveys in general habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where *Calotis glabresens* occurs do not adversely impact on known core populations.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Erect and maintain buffer areas for isolated populations.

Other Measures

- If removal of *Calotis glabresens* is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- If removal of *Calotis glabresens* is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Avoidance of the total area of general habitat of this species is not practical given the widespread nature of potential habitat and that the species is a groundcover herb that may be difficult to detect over large areas. Undertaking further survey work within the location of the historic record, and in any general habitat that may require clearing, and avoiding populations, will completely mitigate impacts. The amenability of the species to site rehabilitation and translocation is unknown and hence the success of these methods cannot be guaranteed and residual impact utilising these methods will result in an impact significance that is ***Low* (8)**.

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Low	Low (8)	Totally Effective	Unknown

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. As a precautionary measure and based on the age and precision of the confirmed species record it should be buffered by a 1km circumference and treated as "Core Habitat Possible".
2. Regional Ecosystem polygon/s with confirmed record should be treated as "Core Habitat Possible".
3. The following regional ecosystems within the PDA should be classed as "General Habitat":
   - RE11.5.1
   - RE11.5.4
4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

The following points/locations have been modified based on ***.

a. *** Detail any deviations from the above and justify why (i.e. expert input)

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Calytrix gurulmundensis

NCA: Vulnerable
EPBC: Vulnerable

Habit

A shrub to 2 m with crowded leaves, aromatic when crushed (Craven 1997, Stanley and Ross 1988, DNR 2000) with white flowers turning purple on drying (DERM 2009).

Habitat

Occurrence in patches of shrubland on very shallow soils (EPA 2002). Vegetation is predominately Triodia-hummock grassland with scattered shrubs and tall eucalypt, Acacia, Casuarina shrublands on low lateritic and sandstone ridges. Habitat is consistent with RE 11.7.5.

Distribution

Endemic to the Gurulmundi, Barakula and Gulubaba areas of south-eastern Queensland (DNR 2000). This species is endemic to Gurulmundi State Forest.

Likelihood of occurrence in PDA

Possible. No records known from the PDA. Records in the Waaje and Gurulmundi Wildflower areas in Triodia grassland and shrubland suggest a possibility of the species occurring in the northern parts of the PDA. The most likely location is in the Gurulmundi SF east of the Leichhardt highway.

Threats

DNR (2000) indicate that the species and habitat is threatened by gravel extraction. Potential threats include vegetation clearance, timber harvesting, road construction and maintenance, and inappropriate fire regimes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones; and
- Inappropriate fire regimes.

Significance of Project Related Impacts (Unmitigated)

The species biology and response to disturbances such as habitat fragmentation, changed fire regimes and edge effects requires further detailed study and its amenability to translocation and rehabilitation is unknown, Hence the sensitivity ranking for the species is considered to be ***Extremely High*****..** It is locally endemic to the Gurulmundi and Barakula State Forests and literature reviews indicate core populations are located in the State Forest to the west and north of the PDA. Additional populations have the potential to occur in tracts of remnant vegetation and on disturbed roadsides on lateritic duricrusts (land zone 7). In the PDA, suitable habitat occurs to the north of the Leichhardt Highway where the where the PDA overlaps with continuous remnant vegetation particularly within Gurulmundi and Barakula State Forests. The impact magnitude ranking is considered ***High****.* Without mitigation measures, project impacts are expected to occur over the life and scope of the project causing changes to local populations although never species extinction and the unmitigated impact significance is considered ***Extremely High*** **(23).**

Proposed Management/ Mitigation Measures

Principles

- A no net loss policy in regard to numbers or sustainability of the species population.

Habitat Avoidance

- Areas mapped as “Core habitat possible” should be avoided. If these areas are avoided, impacts are not expected.

Minimising Disturbance

- Undertake additional surveys in general habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where *Calytrix gurulmundensis* occurs do not adversely impact on known core populations.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Erect and maintain buffer areas for populations.

Other Measures

- If removal of *Calytrix gurulmundensis* is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- If removal of *Calytrix gurulmundensis* is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.

- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

No mitigation measures will alleviate clearing of possible habitat and therefore avoidance is the only feasible mitigation measure in these situations. The effectiveness of translocation and/or propagation and rehabilitation programs is unknown. If infrastructure avoids core habitat, the resulting environmental impact would be ***Insignificant (2)***. If other mitigation measures are implemented, project activities may result in impacts of ***Moderate* (17)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	High	Extremely High (23)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Mod (11)	Extremely High	Moderate	High (20)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. The following regional ecosystems in the vicinity of Gurulmundi and Barakula in the northern part of the PDA should be classed as “Core Habitat Possible”:
    - RE11.7.5

2. The following regional ecosystems in the vicinity of Gurulmundi and Barakula in the northern part of the PDA should be classed as “General Habitat”:

   - RE11.7.4

3. All other remnant vegetation and cleared agricultural and grazing land in the PDA should be treated as “Absence suspected”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Taxonomic treatments and descriptions have been prepared by Stanley and Ross (1986), Craven (1997) and Chinchilla Field Naturalists Club (1997).
- A species profile has been prepared by Queensland Department of Natural Resources (Qld DNR 2000).
- Commonwealth Conservation Advice has been prepared by Threatened Species Scientific Committee (2008jz).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Cryptandra ciliata

NCA: Near-threatened

EPBC: Not Listed

Habit

A low spreading shrub to 0.6 m with intricate branches (Chinchilla Field Naturalists Club 1997, DNR 2000).

Distribution

Restricted to the Gurulmundi, Barakula and Cracow areas of south-eastern Queensland (Chinchilla Field Naturalists Club 1997, DNR 2000).

Habitat

Vegetation is eucalypt dominated woodland, lancewood (*Acacia shirleyi*) woodland and Triodia grassland on rocky on low lateritic and sandstone ridges. Habitat in the PDA is consistent with RE 11.7.5, 11.7.4, 11.7.6, 11.5.1, 11.5.4, 11.5.21

Likelihood of occurrence in PDA

Known from the northern part of the PDA in the Gurulmundi area east of the Leichhardt highway. Extent of the population is unknown. The possibility of the species occurring in the similar habitats in the locality cannot be discounted.

Known Threats

DNR (2000) indicate that the species and habitat is possibly threatened by clearing associated with gravel extraction. Other potential threats may include road construction and maintenance, and inappropriate fire regimes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones; and
- Inappropriate fire regimes.

Significance of Project Related Impacts (Unmitigated)

Populations have the potential to occur in tracts of remnant vegetation and on disturbed roadsides on lateritic duricrusts (land zone 7) and on old loamy plains (land zone 5). In the PDA, this suitable habitat occurs to the north of the Leichhardt Highway where the PDA overlaps with continuous remnant vegetation particularly within Gurulmundi and Barakula State Forests. The species biology and response to disturbances such as habitat fragmentation, changed fire regimes and edge effects requires further detailed study and hence, a sensitivity ranking of ***Moderate*** is applied in recognition of its Near-Threatened status The distribution of the species within the PDA, as well as extent of populations outside the area requires additional clarification and an impact magnitude ranking of ***Moderate*** is applied giving consideration to the species Near- Threatened status. Without mitigation measures project impacts are expected to occur over the life and scope of the project causing changes to local populations within the PDA.

Proposed Management/ Mitigation Measures

Principles

- A no net loss policy in regard to numbers or sustainability of the species population.

Habitat Avoidance

- Areas mapped as “Core habitat known” and “Core Habitat Possible” should be avoided. If these areas are avoided, impacts are not expected.

Minimising Disturbance

- Undertake additional surveys in “Core habitat “ to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where *Cryptandra ciliaris* occurs do not adversely impact on known core populations.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Erect and maintain buffer areas for isolated trees.

Other Measures

- If removal of *Cryptandra ciliaris* is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- If removal of *Cryptandra ciliaris* is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.

- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Preliminary impact significance assessment for the species is ***Moderate* (13)**. No mitigation measures will alleviate clearing of known and possible habitat and therefore avoidance is the only feasible mitigation measure in these situations. Where avoidance is not possible, the identified impact management measures are considered to be only partially effective and further work is study is required in regard to the viability of translocation. If infrastructure avoids area mapped as core habitat possible, the resulting environmental impact significance would be ***Low* (4)**. If other mitigation measures are implemented, project activities may result in impacts of ***Low* (8)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (< 2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. The following regional ecosystems with confirmed records (< 2000 m precision) in the vicinity of Gurulmundi and Barakula in the northern part of the PDA should be classed as “Core Habitat Known”:
   - RE11.7.5
   - RE11.7.4
3. The following regional ecosystems in the vicinity of Gurulmundi and Barakula in the northern part of the PDA should be classed as “General Habitat”:
   - RE11.7.7
   - RE11.7.6
   - RE11.5.21
4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A plant description has been prepared by Chinchilla Field Naturalists Club (1997);
- A species profile has been prepared by Queensland Department of Natural Resources (Qld DNR) (2000);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Cyperus clarus

NCA: Vulnerable
EPBC: Not Listed

<u>Habit</u>
An erect perennial sedge (Stanley and Ross 1989).

<u>Distribution</u>
Known from south eastern/western Queensland in the Burnett, Darling Downs, Leichhardt, Maranoa districts, and in central and northern Qld in the Mitchell and North Kennedy districts (Bostock and Holland 2007). Known from the Jimbour area on the margin of the PDA approximately 26 km north of Dalby. The extent of the population is unknown. Considered to be once a widespread species and under collected (EPA 2002). Also occurs in the north-west areas of NSW.

<u>Habitat</u>
Known from heavy soils with records from remnant and disturbed *Eucalyptus orgadophila* woodland on basaltic soils and grassland on heavy alluvium.

<u>Likelihood of occurrence in PDA</u>
Likely. While only one record exists within the PDA the possibility of the species occurring in remnant and non remnant woodland and derived grassland on land zones 3 and 4 throughout the PDA cannot be discounted.

<u>Known Threats</u>
No threats are recorded in the literature. Potential threats may include lost habitat through cultivation, cropping activity, road construction and maintenance, inappropriate grazing regimes, and weed infestation.

<u>Project-related Impacts</u>

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

The species is uncommon in the PDA however further survey is required to determine the extent of populations in tracts of remnant vegetation on alluvial soils of land zone 3. It is largely restricted to the brigalow belt bioregion where it is widely distributed. In the PDA, this suitable habitat is widespread. Invasion of exotic pasture grasses following mechanical disturbance to grassland habitats is likely to degrade adjacent habitat and limit the ability to recolonise disturbed areas and the sensitivity ranking of the species is considered ***High***. In recognition of its widespread occurrence, the magnitude of potential impact is considered ***Moderate.***

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "Core habitat known and possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, impact assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

The preliminary impact assessment for the the species is considered ***Moderate*** **(17)**. Areas mapped as core habitat, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding core habitat areas is preferable and will completely mitigate against impacts resulting in a residual impact assessment of ***Mod*** **(12).**

Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree, to the extent that minor loss in a local population may occur and the resulting impact would be ***Mod*** **(12)**. Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion are the most effective means to manage disturbed areas.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Unknown although likely to be amenable to translocation

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Mod (12)	High	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping:

1. The confirmed species record should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. The following regional ecosystems should be classed as "Core Habitat Possible":
   - RE11.3.2
   - RE11.3.21
   - RE11.3.27
   - Non remnant (derived grasslands) on alluvium
3. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Stanley and Ross (1989) and Botanic Gardens Trust (2009);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Small-leaved Denhamia (*Denhamia parvifolia*)

NCA: Vulnerable
EPBC: Vulnerable

Habit

An erect shrub to 3 m with rigid, prominently veined broad obovata to elliptic leaves 0.5-2 cm long and conspicuous mottled white bark (Harden *et al*. 2006, DNR 2000, Chinchilla Field Naturalists Club 1997).

Habitat

Semi-evergreen vine thickets, vine scrubs and brigalow (*Acacia harpophylla*) softwood communities on fertile, red brown sandy clay loam hillslopes and crests (DNR 2000). May occur in non-remnant vine thickets on roadsides and brigalow associations. Vine forest elements are generally suppressed within brigalow-belah assocaiations. Potential also exists for this community within basalt landscapes to the south of Millmerran, particularly in association with RE11.8.2a within which small pockets of RE11.8.3 might be scattered.

Distribution

Restricted to southern Queensland north from Eidsvold to Chinchilla and east of Kingaroy and the Mundubbera district (Jessup 1994, Harden *et al*. 2006). Populations occur in the vicinity of Chinchilla (9 km north and approx 4-5 km south west), (Chinchilla Field Naturalists Club 1997, DNR 2000, DERM 2011).

Likelihood of occurrence in PDA

Known. Two records exist within the PDA. The preferred habitat is remnant brigalow with a softwood species understorey or vine thicket elements (RE11.3.1, 11.4.3, 11.5.16, 11.8.3, 11.9.4a, 11.9.5) although it may occur in non-remnant vine thickets throughout the PDA. Field survey did not locate additional populations.

Threats

The species habitat has been heavily fragmented by clearing for agriculture with remaining habitat threatened by clearing and by degradation by invasive weeds such as *Lantana camara* and invasive grasses and by inappropriate grazing regimes (DNR 2000).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

Scattered individuals of Denhamia are susceptible to disturbance of restricted areas of remnant and non-remnant vegetation, both on freehold land and roadside strips in the Chinchilla area, particularly in the vicinity of existing records. The sensitivity of the species is considered the be ***High.*** The species is uncommon in the PDA and occurrences are on the margin of the species range. It is largely restricted to the Brigalow Belt bioregion where it is widely distributed, hence to magnitude of potential impacts is considered ***Moderate.*** Further survey is required to determine the extent of populations in limited tracts of remnant and non-remnant brigalow vegetation and vine thicket. Invasion of exotic pasture grasses following mechanical disturbance to grassland habitats is likely to degrade adjacent habitat and limit its ability to recolonise disturbed areas.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known and possible” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

Unmitigated impact significance for this species is considered to be ***Moderate*** **(17).** Brigalow associations on Land zones 3, 4 and 9 constitute the optimal habitat for Denhamia. These areas are classed as Category B Environmentally Sensitive Areas where work exclusion buffers to a distance of 300 m are recommended around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown. Where brigalow vegetation cannot be avoided, a reduction in the width of construction easements particularly where infrastructure is located on roadside easements, fencelines etc. where high quality regrowth is often located will be required. Further survey work prior to clearing in an attempt to determine the presence or absence of the species is necessary. Any new locations of Denhamia may further inform the location and width of easements. Avoiding core habitat known and possible areas is preferable and will completely mitigate against impacts and residual impact will be ***Low*** **(7).**

Edge effects in particular the invasion of exotic grasses on habitat margins have the potential to be remediated through rehabilitation programs involving use of native grasses, weed management and erosion and sediment control. Where avoidance is not possible, these impact management measures may provide some level of mitigation although the viability of translocation and re-seeding is not known. The resulting residual impact significance using alternative mitigation measures would be ***Moderate*** **(12)**.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Effective	Reguire further testing

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Mod (12)

[*] No clearing of vegetation within areas of core habitat known or core habitat possible.

[#] Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species record should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. The following regional ecosystems in the Chinchilla area should be classed as "Core Habitat Possible":
   - RE11.3.1
   - RE11.4.3
   - RE11.5.16
   - RE11.8.3
   - RE11.9.4a
   - RE11.9.5
   - Non-remnant brigalow/belah type regrowth on alluvium (land zone 3) and clay plains (land zone 4).
3. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A plant description has been prepared by Chinchilla Field Naturalists Club (1997);
- A taxonomic treatment has been prepared by Stanley and Ross (1989), Jessup (1994), Botanic Gardens Trust (2009) and Harden *et al.* (2006);
- A species profile has been prepared by Queensland Department of Natural Resources (Qld DNR) (2000);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

King blue grass (*Dichanthium queenslandicum*)

NCA: Vulnerable

EPBC: Vulnerable

Habit

A erect perennial grass to 80 cm.

Habitat

Remnant and non-remnant derived grasslands on alluvium, cracking clays, and basalt. Regional ecosystems 11.3.2, 11.3.21, 11.4.4, 11.8.11 and Non-remnant.

Distribution

Known from the Brigalow Belt North and South Bioregions with records from the northern Darling Downs, Burnett, Leichhardt, South Kennedy and Mitchell Pastoral Districts. Fensham (1999) considers the taxon restricted to the Central Highlands following its extinction from southern Queensland (in Fensham 1998). Hill (2000) also considers it extinct on the Darling Downs, however more recently it has been found near Jondaryan (R.G. Silcock, unpublished data) and near Roma (W.J. Scattini, unpublished data) (in Silcock *et al*. 2007). A 1952 low precision record is known from the Jimbour Plain (DERM 2009) Silcock *et al*. (2007) consider that it may always have been near its southern ecological limit on the Darling Downs and in the Maranoa and is considered very rare on Darling Downs (TSSC 2008).

Likelihood of occurrence in PDA

Unlikely. No records in the vicinity. Potential habitats are RE11.3.2, 11.3.21, 11.4.4, and Non-remnant derived grasslands on cracking clays. Not observed during field survey.

Known Threats

The species grassland habitat has been heavily fragmented by clearing for agriculture. Remaining habitat restricted to stock routes and road reserves and threatened by degradation by mechanical disturbance, invasive weeds and inappropriate grazing regimes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and

- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species is highly susceptible to invasion of exotic pasture grasses following mechanical disturbance to grassland habitats which degrades adjacent habitat and limits the ability of the species to recolonise disturbed areas. The sensitivity ranking of the species is considered to be ***High.*** The species is not known from the PDA however potential habitat occurs within remnant grasslands on alluvium. Further survey is required to determine the extent of ppopulations in tracts of remnant vegetation on alluvial soils of land zone 3. It is largely restricted to the brigalow belt bioregion where it is widely distributed. The magnitude of unmitigated impacts to populations within the PDA is ***Low***.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Avoid remnant grasslands and grassy woodlands on land zone 3. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat known and possible, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

The possibility of this species occurring is low, however, areas mapped as core habitat warrant may further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding possible habitat in stock routes and road reserves supporting grasslands and grassy woodlands on alluvium is preferable and will completely mitigate against impacts. Preliminary impact significance for the species is considered ***Moderate*** **(12).**

Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree although the suitability of the species for translocation or re-seeding requires further definition., The significance of impacts after following alternative mitigation measures is ***Moderate*** **(12).** Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion may result in have minor impacts on the species.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Low	Moderate (12)	Totally Effective	Requires further investigation

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems in the should be classed as “Core Habitat Possible”:
    - RE11.3.2
    - RE11.3.21
    - RE11.4.4
    - Non-remnant derived grasslands on land zone 3.
3. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Stanley and Ross (1989).
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009).
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).
- Silcock, R.G. and Scattini, W.J. (2007) The original native pasture ecosystems of the eastern and western Darling Downs - Can they be restored? Tropical Grasslands, 41 (3). pp. 154-163.

Finger Panic Grass (*Digitaria porrecta*)

NCA: Near-threatened

EPBC: Endangered

Habit

An erect perennial grass to 80 cm.

Habitat

Occurs in grasslands, woodlands and open forests with a grassy understorey on heavier black soil plains of the Darling Downs, and lighter textured soils to the west (Goodland 2000, Halford, 1995; Fensham, 1997). It is not restricted to high quality native grasslands, nor restricted to roadsides and can be found in highly disturbed sites (Goodland 2000).

Has been recorded in the PDA in roadside remnant grasslands on dark cracking clay, plains; poplar box (*E. populnea*) open forest and woodland with grassy understorey, on dark cracking clay, plain; and along disturbed railway reserve on dark cracking clay soils (DERM 2011). Regional ecosystems 11.3.2, 11.3.21, 11.4.4, 11.8.11 and Non-remnant.

Distribution

Known from four disjunct areas extending over 1000 km. Queensland distribution includes the Nebo district; the Central Highlands between Springsure and Rolleston; and from Jandowae south to Warwick. Also known from NSW, from near Inverell, south to the Liverpool Plains near Coonabarabran and Werris Creek (Threatened Species Scientific Committee 2008mi).

Likelihood of occurrence in PDA

Known. Ten Herbarium records from the eastern parts of the PDA with a number of records located on the PDA margin. Habitats are RE11.3.2, 11.3.21, 11.8.5 and Non-remnant derived grasslands on cracking clays. It has the potential to occur on disturbed roadsides on heavy clay soils. Not recorded during field survey.

Threats

The species grassland habitat has been heavily fragmented by clearing for agriculture. Remaining habitat mainly restricted to stock routes and road reserves and threatened by degradation by mechanical disturbance, invasive weeds and inappropriate grazing regimes. Goodland (2000) notes that *D. porrecta* has may withstand disturbance, although populations decline where introduced species (e.g. Rhodes grass) become dominant.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

The Magnitude of unmitigated impacts to populations within the PDA is ***Moderate***. The species, which is known from the PDA from a number of herbarium records, is largely restricted to the Brigalow Belt bioregion where it is widely distributed in habitats which are under pressure from clearing, agricultural development, weed invasion and overgrazing. In the PDA, stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands are most susceptible to disturbance associated with linear infrastructure such as pipelines. Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Disturbed areas are often colonised by introduced grasses in particular Rhodes grass and giant panic, and by Lippia in alluvial areas which may experience overland flow. Further survey is required to determine the extent of populations in tracts of suitable habitat. Where habitat is avoided, invasion of exotic pasture grasses following mechanical disturbance is likely to degrade adjacent habitat and limit the recolonisation of disturbed areas. The sensitivity of the species is considered ***Moderate.***

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Avoid remnant grasslands and grassy woodlands on land zone 3. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat known and possible, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

Areas mapped as core habitat, may warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding areas of core habitat is preferable and will mostly mitigate against impacts to the degree that the resulting residual impact significance will be ***Low*** **(4)**. Adjacent habitat may remain vulnerable to edge effects (invasion of exotic pasture grasses).

Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree, to the extent that minor loss in a local population may occur. The resulting impact significance would be ***Low*** **(8).** Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as establishing and maintaining buffers, limiting the width of disturbance corridors, rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion may result in some impact.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Unknown

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low(4)	Moderate	Low	Low (8)

[*] No clearing of vegetation within areas of core habitat known or core habitat possible.

[#] Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as "Core Habitat Known".
3. The following regional ecosystems should be classed as "Core Habitat Possible":
   - RE11.3.2
   - RE11.3.21
   - Non-remnant derived grasslands on land zone 3.
4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Sharp & Simon (2001);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009);
- Management issues in the grassy habitats in the are discussed by Goodland (2000);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Eleocharis blakeana

NCA: Near-threatened
EPBC: Not listed

Habit

A perennial spike rush 30-40 cm.

Habitat

Known to occur in ephemerally wet poorly drained situations, such as gilgais, often associated with brigalow and belah woodland and on clayey soil (Botanic Gardens Trust 2009, DERM 2000). HERBRECS records (DERM 2011) indicate habitat in swampy alluvial situations including melonhole paddocks and artificial dam margins. Records from Lake Broadwater Conservation Park indicate high likelihood of occurrence in palustrine wetlands in woodlands of *Eucalyptus camaldulensis* and/or *E. tereticornis*. Additional records approximately 6 km north of Chinchilla are in drainage depressions in *E. populnea* and Callitris woodland. Also, know to inhabit roadside channels and paddocks (DNR 2000). Collections of an Eleocharis species tentatively assigned to *E. blakeana* were made at Long Swamp (Site AT71, AQ73, and AQ74) within RE 11.3.27d and the identification is awaiting confirmation from the Qld Herbarium.

Distribution

Occurs from southern Queensland to central northern NSW (DNR 2000). Queensland distribution is from Munduberra to near Talwood within the Darling Downs district with records from Leichhardt and Maranoa and Burnett (DNR 2000, DERM 2011). Occurs in NSW from near Yetman and Wee Waa (Botanic Gardens Trust 2009).

Likelihood of occurrence in PDA

Known to occur in the PDA (DERM 2011). Conserved within Lake Broadwater Conservation Park. Potential habitats are RE11.3.27d, 11.3.25, 11.3.4, 11.3.2, 11.3.1, and 11.4.4. May also occur in non-remnant areas on land zone 3 (overflow lagoons along rivers and major creeks) and 4 (associated with regrowth gilgai on heavy gilgai).

Threats

Possible threats identified by DNR (2000) are:

- Habitat destruction by vegetation clearing;
- Habitat disturbance by timber harvesting;
- Modification of drainage patterns.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals and habitat during vegetation clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Changes to drainage patterns;
- Infestation of lippia (*Phyla nodiflora*) on alluvial areas.

Significance of Project Related Impacts (Unmitigated)

Eleocharis blakeana is most commonly associated with seasonally inundated alluvial habitats and heavily gilgai soils which may occur in remnant or in highly modified environments.The species is susceptible to impacts to waterways and drainage lines in particular changes to overland flows, and increased soil salinity. Hence the species is considered to have a ***Moderate*** sensitivity ranking. Potential habitat is widespread across the PDA, and it occurs in other parts of the bioregion and NSW with an impact magnitude ranking of ***Moderate,*** The significance of unmitigated impacts is ***Moderate*** **(13).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- The avoidance of riparian zones, overflow depressions and ephemeral and permanent wetlands and heavily gilgai soils will be the most effective mitigation measure.

Further Survey

- Any disturbance to habitat requires further survey work to determine the presence/absence of the species.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and establish appropriate buffers.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.

Translocation

- If removal is unavoidable, the species would be easily translocated.
- Follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- Install sediment and erosion control measures to prevent sediment input into riparian and wetland habitat.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Other Measures

- Locate well heads away from riparian and wetland habitat and ensure maintenance to prevent potential discharge of saline water into wetland habitats.
- Exclude access to wetland areas

Summary Residual Impact Assessment

The preliminary impact significance assessment for the species is considered ***Moderate*** **(13).** Avoiding any areas of core habitat known and possible and establishment if buffers to riparian and wetland habitats will mostly mitigate against impacts. Brigalow communities which occur on heavily gilgaid soils on land zone 3 and 4 are Category B Environmentally Sensitive Areas which are recommend for avoidance and buffer establishment. Populations within Lake Broadwater are within a Category A ESA.

In situations where lineal infrastructure crosses riparian zones, ground truthing of the alignment will be valuable to determine if Eleocharis is present. Route refinement and limiting the width of the disturbance corridor across riparian zones may be required to avoid any populations. Where avoidance of direct impacts is not possible (particularly in non-remnant agricultural areas where the species may occur in degraded drainage depression or ephemeral wetlands), translocation is considered an effective impact mitigation measure,

Avoided habitat may still be susceptible to indirect impacts from sediment input, alteration to drainage flows (roads and pipelines crossing watercourses), increased salinity (potentially from leaking well heads), and weed invasion (particularly Lippia on alluvial areas). Implementation of other mitigation measures such as installation and maintenance of sediment control fences and erosion control features, rehabilitation of disturbed areas, management of exotic species invasion into riparian and wetland habitats, and ongoing maintenance of well heads, will also be required to minimise environmental impact. Implementation of all mitigation measures will result in a residual impact that is ***Low*** **(8).**

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible and incorporation of buffer zones around wetland habitats. # Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons (<2000 m precision) with confirmed records should be treated as "Habitat Known".
3. The following regional ecosystems should be classed as "Core Habitat Possible":
   - 11.3.27d (associated with overflow lagoons and flood channels);
   - 11.3.25 (associated with overflow lagoons and flood channels);
   - 11.3.4 (associated with overflow lagoons and flood channels);
   - 11.3.2 (associated with overflow lagoons);
   - 11.3.1 (associated with gilgai); and
   - 11.4.4 (associated with gilgai).
4. Farm dams and drainage lines and channels in non-remnant grazing land on land zone 3 and 4 should be classed as "General Habitat";
5. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Harden (1993), and Stanley and Ross (1989);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Plains Picris (*Picris barbarorum*)

NCA: Vulnerable
EPBC: Not Listed

Habit

An erect annual herb, 5-60 cm tall with petiolate narrow obovate to oblanceolate basal leaves, attenuate at the base, 4–30 X 0.4–2.5 cm. Inflorescence a loose terminal corymb, yellow in colour.

Habitat

Known from grassland (12.3.21) of *Dichanthium sericeum* in stock routes, road reserves adjacent to disturbed areas such as cultivated paddocks and road and rail lines on black clay soil (DERM 2011).

Distribution

Occurs from the Darling Downs and Warrego pastoral districts in southern Queensland (Bostock & Holland 2010), to north of the north west plains of NSW. Herbrecs data indicates that in the Darling Downs, it has a restricted distribution but may be locally abundant along roadsides. Known to occur from the Jandowae, Macalister, Norwin locailities and along the Warrego highway west of Dalby.

Likelihood of occurrence in PDA

Known. The species has been recorded 15km west of Dalby within grassland habitat consistent with RE11.3.21. Likely habitats include RE11.3.2, and 11.3.4. May occur along disturbed roadsides and on margins of cultivated areas and grazed paddocks. Occurrences on non-alluvial habitats difficult to predict.

Threats

Vouchered records of Plains Picris suggest that the annual herb may be tolerant of light disturbance. Its known occurrence on roadsides suggest it may be impacted by roadworks. In similarity to *Picris evae* it may well be intolerant of grazing and capable of surviving other forms of disturbance.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The habitat of Plains Picris includes stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands. The habitat is susceptible to mechanical disturbance associated with linear infrastructure such as pipelines and to edge effects such as invasion of introduced grasses and herbs. The species has been recorded in the PDA, and is also known to occur outside of the PDA. Resilience to disturbance is possible. The sensitivity of the species is considered ***High.*** The magnitude of unmitigated impacts to populations within the PDA is considered ***Moderate*** with the significance of unmitigated impact ***Moderate*** **(17).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "core habitat possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat possible and general habitat requires further survey work in optimal seasonal conditions to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Moderate*** **(17)** *significance* will happen. Undertaking further survey work within areas of core habitat possible and general habitat that may require clearing and avoiding populations are expected to mostly mitigate against impacts resulting in a rare impact likelihood. Clear identification of any additional populations will allow adjustment and/or minimising of disturbance areas and establishment of suitable buffer zones. Where avoidance is not possible, the development of a threatened species management plan may be required to guide rehabilitation programs which include propagation from seed or cuttings and the resultant residual impact significance will be ***Moderate*** **(12).** If infrastructure avoids all habitat, the resulting impact would be ***Low (7*****).** Management of edge effects such as weed invasion into grassland and grassy woodland habitats is important to mitigate degradation of any habitat adjacent to disturbance.

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Mostly Effective

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional ecosystems with confirmed records (<2000 m precision) should be classed as "Core Habitat Known":
2. The following should be classed as "General Habitat":

- Non-remnant derived grasslands on land zone 3.

3. All other remnant vegetation in the PDA and cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).
- Species description provided in PlantNet NSW Herbarium.

Plunkett Mallee (*Eucalyptus curtisii*)

NCA: Near-threatened
EPBC: Not listed

Habit

A slender stemmed mallee, 3-10 m with outer bark shedding in thin strips to expose a smooth and shiny gum bark (Chinchilla Field Naturalists Club 1997).

Habitat

Lateritic sandstone and sandstone rises/ridges and slopes often with *Eucalyptus exserta, E. fibrosa* subsp. *nubila, Corymbia trachyphloia,* and *Callitris glaucophylla.*

Distribution

The plant is scattered but nowhere common occurring on coastal hinterland to 80 km north and south of Brisbane and inland over 300 km north west to the Dalby and Miles districts (DNR 2000). Occurs in the Burnett, Leichhardt, Moreton and Darling Downs pastoral districts (Bostock and Holland 2007). Conserved in Expedition Range, Robinson Gorge and Isla Gorge National Parks (Brooker and Kleinig 2004, Bean 1989, DERM 2011).

Likelihood of occurrence in PDA

Known in the vicinity of the PDA from Kogan, Barakula and Gurulmundi (Chinchilla Field Naturalists Club 1997, EPA 2002, DERM 2011). Potential habitats are RE11.7.4, 11.7.5, 11.7.6, 11.7.7, 11.5.1, 11.5.4. not recorded in field surveys.

Threats

Known and possible threats identified by DNR (2000) are:

- Habitat loss by vegetation clearing;
- Habitat disturbance by timber harvesting;
- Inappropriate grazing regime;
- Inappropriate fire regimes; and
- Inappropriate legal collecting practices.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals and habitat during vegetation clearing;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as infestation of grassy weeds, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

There is limited information on the ecology of this species and the ability of the species to regenerate following physical disturbance warrants further investigation. The species is considered to have a sensitivity ranking of ***Moderate.*** Any disturbance to core habitat would render the species susceptible to project related impacts. Clearing of habitat may result in impacts of ***Moderate*** magnitude to populations within the PDA and the preliminary impact of unmitigated impacts is considered ***Moderate*** **(13)**. Targeted ground truthing in high-risk habitats is required to determine presence and extent of populations. The species is well represented outside the PDA within the brigalow belt and south east Queensland bioregion, and is grown in the nursery industry.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Undertake surveys in potential habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Erect and maintain buffer areas for isolated trees.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss and to maintain genetics of disjunct populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods. Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Avoiding known habitat and undertaking further survey work within areas of core habitat possible that may require clearing are expected to mostly mitigate against impacts. Clear identification of any additional populations will allow adjustment and/or minimising of disturbance areas. Where avoidance is not possible, the collection and propagation of seed of local provenance for incorporation into rehabilitation programs may mitigate against impacts to a large degree, to the extent that no net loss in a local population may occur. Where seed is unavailable, translocation of trees or populations should be investigated although has not been demonstrated to be effective. If infrastructure avoids core and possible habitat, the resulting impact would be ***Low*** **(4)**. Implementation of other mitigation measures may result in impacts of ***Low*** **(8)** significance.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Mostly Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low(4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as “Habitat Known”.
3. The following regional ecosystems should be classed as “Habitat Possible”:
    - 11.7.4
    - 11.7.5
    - 11.7.6
    - 11.7.7
4. The following regional ecosystems should be classed as “General Habitat”:
    - 11.5.1
    - 11.5.4
5. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A description has been prepared by Brooker and Kleinig (2004), and the Chinchilla Field Naturalists Club (1997);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011); and
- A species profile has been prepared by DNR (2000).

Pomaderris coomingalensis

NCA: Endangered
EPBC: Not Listed

Habit

Low, upright, shrub to 3.5m tall with discolorous, glabrous above, white hairy below (Stanley and Ross 1986).

Habitat

Occurs in *Eucalyptus* and *Callitris* woodland in shallow sandy soil or *Eucalyptus* woodland on hard sandstone jump ups. Herbarium records (DERM 2011) include woodland of narrow leaved ironbark (*Eucalyptus crebra*) and *E. fibrosa subsp nubila*.

Distribution

A southern Queensland endemic known only from the Port Curtis, Burnett and Darling Downs districts.

Likelihood of occurrence in PDA

Known. One population known from Braemer State Forest SF 4 about 30km W of Dalby boundary of Compartments 15 & 16. (GPS 27 15 31 150 46 35) where it is reported as locally common (DERM 2011). Not recorded in field surveys.

Threats

Habitat disturbance by timber harvesting and inappropriate fire regimes are possible threatening processes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The only know records within the PDA occur in Braemer State Forest SF 4 where it is reported as locally common. However, additional populations have the potential to occur in nearby suitable habitat. The species is considered highly susceptible to any incursions into regional ecosystems of known and potential habitat in the vicinity of existing populations and the sensitivity is assessed as ***High***. The magnitude of unmitigated impacts may be ***Extremely High*** with an unmitigated impact significance of ***Extremely High*** **(24).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "core habitat known" and "core habitat possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat possible and general habitat requires further survey work in optimal seasonal conditions to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Extremely High*** **(24)** significance will happen**.** Avoidance of core and possible habitat in remnant vegetation in the south west of the PDA is the most effective mitigation measure and will completely avoid any direct impacts. Application of buffer zones to Category B Environmentally Sensitive Areas would incorporate known habitat and ensure avoidance of project related impacts reducing level of residual impact to ***Low* (7).** Where avoidance is not possible, further survey of areas designated for disturbance in "core habitat possible" will clearly identify populations and allow opportunity for minimisation of disturbance zones and establishment of adequate buffers. The development of a threatened species management plan may be required to guide rehabilitation programs as propagation and translocation methods are untested. The habitat occurs in undulating to steep topography with scarps and therefore any disturbance would require attention to erosion and sediment control. Residual impact if habitat is not avoided and alternative mitigation measures are employed are likely to be ***High* (21).**

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Extremely High	Extremely High (24)	Totally Effective	Unknown - Untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	High	High (21)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000m precision) should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. Regional ecosystems with confirmed records (<2000m precision) should be classed as "Core Habitat Known":
   - RE11.7.5
   - RE11.7.4
3. The following regional ecosystems in the Braemar SF 4 should be classed as "Core Habitat Possible":
   - RE11.7.5
   - RE11.7.4
4. All other remnant vegetation and cleared agricultural and grazing land in the PDA should be treated as "Absence possible".

References

- A taxonomic description has been prepared by Stanley and Ross (1986);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);

Fimbristylis vagans

NCA: Near-threatened

EPBC: Not listed

Habit

A perennial sedge to 60 cm.

Habitat

Fringing ephemeral watercourses and lagoons on alluvium.

Distribution

A Queensland and bioregional endemic restricted to the Darling Downs district between Lake Broadwater and Nudley Creek area (30 km NE of Chinchilla) (DERM 2011).

Likelihood of occurrence in PDA

Known to occur in the PDA in the Lake Broadwater area and at Chinchilla (DERM 2011). Commonly associated with permanent lagoons and seasonally inundated habitats along margins of rivers and major creeks across the PDA. Potential habitats are RE11.3.25, 11.3.4, 11.3.27.

Threats

Known and possible threats are:

- Habitat destruction by vegetation clearing;
- Habitat disturbance by timber harvesting; and
- Modification of drainage patterns.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals and habitat during vegetation clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Changes to drainage patterns;
- Excessive sedimentation into habitat;
- Infestation of lippia (*Phyla nodiflora*) on alluvial areas.

Significance of Project Related Impacts (Unmitigated)

The species is most susceptible to habitat clearing of waterways and drainage lines, changes to overland flows, and increased soil salinity and the sensitivity of the species is considered to be ***Moderate.*** *Fimbristylis vegans* is most commonly associated with permanent lagoons and seasonally inundated habitats along margins of rivers and major creeks and potential habitat is widespread across the PDA. The magnitude of unmitigated impacts is considered ***High***. Unmitigated project development activities will almost likely result in impact to the species and the residual impact would be ***Moderate*** **(18)**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- The avoidance of riparian zones, overflow depressions and ephemeral and permanent wetlands will be the most effective mitigation measure.

Further Survey

- Any disturbance to habitat requires further survey work to determine the presence/absence of the species.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and establish appropriate buffers.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.

Translocation

- If removal is unavoidable, the species would be easily translocated.
- Follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- Install sediment and erosion control measures to prevent sediment input into riparian and wetland habitat.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Other Measures

- Locate well heads away from riparian and wetland habitat and ensure maintenance to prevent potential discharge of saline water into wetland habitats.
- Exclude access to wetland areas

Summary Residual Impact Assessment

Avoiding any areas of core habitat known and possible and establishment if buffers to riparian and wetland habitats will mostly mitigate against impacts. In situations where lineal infrastructure crosses riparian zones, ground truthing of the alignment will be valuable to determine if *F. vagans* is present. Route refinement and limiting the width of the disturbance corridor across riparian zones may be required to avoid any populations. Where avoidance of direct impacts is not possible (particularly in non-remnant agricultural areas where the species may occur in degraded drainage depression or ephemeral wetlands), translocation is considered the most effective impact management measure.

Avoided habitat may still be susceptible to indirect impacts from sediment input, alteration to drainage flows (roads and pipelines crossing watercourses), increased salinity (potentially from leaking well heads), and weed invasion (particularly Lippia on alluvial areas). Implementation of other mitigation measures such as installation and maintenance of sediment control fences and erosion control features, rehabilitation of disturbed areas, management of exotic species invasion into riparian and wetland habitats, and ongoing maintenance of well heads will be required to minimise the risk of impact. The utilization of all mitigation measures in combination with avoidance will result in a ***Low*** **(8)** level of impact significance.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	High	Moderate (18)	Totally Effective	Mostly Effective

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible and incorporation of buffer zones around wetland habitats.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000 m) should be treated as “Core Habitat Known”.
3. The following regional ecosystems should be classed as “Core Habitat Possible”:

- 11.3.25
- 11.3.4
- 11.3.27

4. Large and established dams and major drainage lines and channels in non-remnant grazing land on land zone 3 should be classed as “General Habitat”;
5. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Gonocarpus urceolatus

NCA: Vulnerable

EPBC: Not listed

<u>Habit</u>

A small erect perennial rhizomatous herb to 30 cm with broad toothed leaves.

<u>Habitat</u>

Known from the following habitats (DERM 2011):

- Open woodland of *Eucalyptus exserta*, with *Acacia triptera* on ridgetop with skeletal soil (11.7.4);
- Woodland of *Eucalyptus citriodora, E. exserta, Callitris glaucophylla, Acacia crassa* on sandy soils (11.5.2);
- Woodland of *Eucalyptus crebra, Callitris sp., Acacia* spp. on sandy soils (11.5.1).
- Woodland of *Eucalyptus chloroclada, Angophora leiocarpa, Casuarina luehmannii, Leptospermum polygalifolium* on sandy creek banks (11.3.25)

<u>Distribution</u>

A Queensland and bioregional endemic restricted to the Darling Downs, Maranoa and Warrego districts.

<u>Likelihood of occurrence in PDA</u>

Known to occur in the PDA in the Baking Board area 12 km west of Chinchilla, and in the Rocky Creek locality north of Chinchilla (DERM 2011, Chinchilla Field Naturalists Club 1997). Potential habitats are RE11.5.1, 11.5.2, 11.7.5, 11.7.7, 11.3.25.

<u>Threats</u>

Possible threats are:

- Habitat destruction by vegetation clearing;
- Inappropriate grazing; and
- Inappropriate fire management.

<u>Project-related Impacts</u>

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals and habitat during vegetation clearing;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as infestation of grassy weeds, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The possible habitat of this species is widespread in the PDA and information on the extent of populations is lacking. Further field surveys are required to determine the presence and extent of populations within areas designated for clearing. The sensitivity ranking of the species is considered to be ***Moderate*** whilst the magnitude of potential impacts is considered to be ***High*** as a precautionary measure. Avoidance of known and potential habitat will considerably reduce the risk of impact. Project related activities might result in ***Moderate*** impacts to potential populations within the PDA.

Proposed Management/ Mitigation Measures

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat known and possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of moderate consequence will possibly happen and the preliminary impact assessment will be ***Moderate* (18)**. Avoidance of the total area of possible habitat of this species is not practical given the widespread nature of potential habitat. Therefore, areas mapped as core habitat known and possible that may require clearing warrant further survey work in an attempt to determine the presence or absence of the species.

The effectiveness of mitigation measures such as propagation into rehabilitation programs and translocation have not been proven. Rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic weed invasion may be provide some mitigation against impact. Total avoidance implies impacts to the species will be ***Low (4)*** whilst implementation of a range of mitigation measures may result in impacts of ***Moderate* (13)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	High	Moderate (18)	Totally Effective	Effectiveness Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low(4)	Moderate	Moderate	Moderate (13)

* No clearing of vegetation within areas of core habitat known or core habitat possible and incorporation of buffer zones around wetland habitats.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as "Core Habitat Known".
3. The following regional ecosystems should be classed as "Core Habitat Possible":
   - 11.5.1
   - 11.5.2
   - 11.7.5
   - 11.7.7
   - 11.3.25
4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A description has been prepared by the Chinchilla Field Naturalists Club (1997); and
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Belsons Panic (*Homopholis belsonii*)

NCA: Endangered
EPBC: Vulnerable

Habit
An erect perennial grass.

Habitat
Generally associated with Poplar Box communities (Fensham and Fairfax, 1997, Goodland, 2000), although also found in brigalow, brigalow/belah and brigalow/belah/poplar box and yarran (*Acacia melvillei*) woodlands on light red/brown earths (Goodland 2000).

Known in the PDA and vicinity from the following habitats (DERM 2011):

- Woodland of poplar box (*Eucalyptus populnea*), silver leaf ironbark (*E. melanophloia*), and brigalow (*Acacia harpophylla*) on fine grained sandstones (RE 11.9.10);
- Disturbed forest of brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) on dark brown clays;
- Woodland of *Acacia melvillei* on grey to black alluvial soil of basalt derivation;
- Woodland of poplar box, belah, and *Acacia melvillei* on flat, slightly flood prone, grey alluvial soil of basalt origin; and
- Open forest of belah (*Casuarina cristata)*, with understorey of wilga (*Geijera parviflora*), scrub boonaree (*Alectryon diversifolius*), *Capparis lasiantha, Rhagodia spinescens*, and grasses on low ridge top clay soils (road reserve).

Occurs on roadsides and among fallen timber at the base of trees or shrubs, among branches and leaves of trees hanging to ground level or along the bottom of netting fences (Trémont & Whalley 1993 in DEWHA 2009).

Distribution
In Queensland, major populations occur on the Darling Downs near Oakey, Jondaryan, Bowenville, Dalby, Acland, Sabine, Quinalow, Goombungee, Gurulmundi and Millmerran, and further west between Miles and Roma (Goodland 2000, DERM 2011). Also known from the north-western slopes and plains of NSW (DEWHA 2009).

Likelihood of occurrence in PDA

Known to occur in the PDA. Known habitats are consistent with Regional ecosystems 11.3.1, 11.3.17, and 11.4.3. A record on the road reserve south of Millmerran on the Inglewood Road in brigalow remnants suggests high likelihood in similar remnant and non-remnant roadside brigalow-belah habitats in the PDA. The species is conserved within Bendidee National Park although was not recorded during field surveys.

Threats

Loss of habitat from vegetation clearing, pasture improvement, and overgrazing is a major threatening process (DEWHA 2009). Homopholis is a grazing intolerant requiring tree cover to survive. Roadside populations are threatened by invasion of pasture grasses such as Green Panic (*Megathyrsus maximus*), and road works (Goodland 2000), however it is known to recolonise disturbed areas if tree cover is available (Menkins 1998 in DEWHA 2009).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The sensitivity of the species to impact is considered ***High*** due to the pervasiveness of exotic grass invasion into its preferred habitats. The Magnitude of unmitigated impacts is considered ***High*** due to the habitat being largely centred on the Brigalow Belt South bioregion with known populations in the PDA. Brigalow and belah associations on Land zones 3 and 4 constitute the optimal habitat for Homophilis which requires maintenance of tree cover and lack of grazing to persist in vegetation remnants. The significance of unmitigated impacts is ***High*** **(21)**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Avoiding core habitat is preferable and will completely mitigate against impacts.
- These areas are mostly within Category B Environmentally Sensitive Areas, where work exclusion buffers to a distance of 500 m are recommended around all remnant communities.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species.
- Any new locations may further inform the location and width of easements.

Minimising Disturbance

- Where habitat cannot be avoided, a reduction in the width of construction easements particularly where infrastructure is located on roadside easements and fencelines where high quality regrowth is often located will be required.
- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.
- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***High (21)*** significance will happen. Avoidance of all core habitat is the most effective mitigation measure, and this can be achieved where the protection of its habitat is within Category B Environmentally Sensitive Areas. Avoidance will limit impact to an ***Low (7)*** level.

Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic weed invasion may provide some mitigation against impact although the success of such measures have not been proven to be effective. Implementation of mitigation measures may limit impacts to those of ***Moderate*** **(12)** significance.

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	High	High (21)	Totally Effective	Unknown/ Untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Moderate (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as “Habitat Known”.
3. The following regional ecosystems should be classed as “Core Habitat Possible”:
    - 11.3.1
    - 11.3.17
    - 11.4.3
4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic treatment has been prepared by Sharp & Simon (2001);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009);
- Management issues in the grassy habitats in the are discussed by Goodland (2000);
- Biodiversity values documented by EPA (2002);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Macrozamia machinii

NCA: Vulnerable
EPBC: Vulnerable

Habit

A cycad with a subterranean trunk often branching to produce up to ten growing points in a clump and with one to eight erect frond-like leaves (Jones and Forster 1994; DEWHA 2009).

Habitat

Woodlands of smooth barked apple (*Angophora leiocarpa*), threadybark she oak (*Allocasuarina inophloia*), white cypress pine (*Callitris glaucophylla*), and budgeroo (*Lysicarpus angustifolius*) on undulating to hilly terrain at 300-500 m with deep sandy soils, and on lateritic ridges with tumbledown ironbark (*Eucalyptus panda*), white mahogany (*E. apothalassica*) and black cypress (*Callitris endlicheri*)(Halford 1997 in DNR 2000, DERM 2011).

Distribution

A Queensland and bioregional endemic known from eight known populations Wondul Range (near Inglewood) to Limevale in the Darling Downs district of south-east Queensland (DEWHA 2009). Some key populations occur in State Forests in areas of remnant vegetation, with several populations on private or leasehold land, and one population along a stock route (DEWHA 2009).

Likelihood of occurrence in PDA

Known to occur in the PDA. The majority of the known population of the species occurs in the south eastern parts in the Wondul Range, north of Inglewood. Known habitats are consistent with Regional ecosystems 11.5.1, 11.5.4, 11.7.5, 11.7.7. Not recorded in field surveys.

Threats

Loss and damage through forestry operations, inappropriate fire regimes (which kills surface seed and young seedlings); failure of the insect pollination mutualism; vulnerability to illegal collecting; trampling of seedlings by stock; and deliberate killing; are considered as the major threats (DEWHA 2009).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;

- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The cycad is considered highly susceptible to any incursions into regional ecosystems of known and potential habitat in the vicinity of existing populations. The ecology of the species is poorly documented and core populations of the species are centred on the Wondul Range National Park in the southern portion of the PDA. The species is considered ***Extremely Sensitive*** to unmitigated impact and magnitude of potential habitat is considered to be ***Extremely High.*** The significance of unmitigated impacts is ***Extremely High*** **(25)**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "Core habitat known" and "core habitat possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.
- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Extremely High Significance*** **(25)** consequence will occur. Avoidance of core habitat in remnant vegetation in the south west of the PDA is the most effective mitigation measure and will completely avoid any direct impacts and resultant residual impact will be ***Moderate (11)*** and this is considered the only viable means of impact mitigation**.** Cycads are amenable to translocation and this measure may be viable, although the population is centred on a Category A ESA which will require avoidance throughout project activities**..**

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	Extremely High	Extremely High (25)	Totally Effective	Unknown - Unviable

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Moderate (11)	Extremely High	Extremely High	Extremely High (25)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000 m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems in the Wondul Range area should be classed as “Core Habitat Possible”:

- 11.5.1
- 11.5.4
- 11.7.5
- 11.7.4
- 11.10.1

4. All other remnant vegetation in the PDA and all cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic description has bee prepared by Jones and Forster (1994);
- A species profile has been prepared by DNR (2000);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Microcarpaea agonis

NCA: Endangered

EPBC: Endangered

Habit

A terrestrial herb to 5 cm high and 10 cm wide with angular, glabrous stems and opposite leaves (DEWHA 2009).

Habitat

Occurs on the margins of an *Eleocharis-Cyperus* dominated seasonal swamp fringed by *Eucalyptus chloroclada* in grey loam soils (DERM 2011, Bean 1997). The wetland habitat is consistent with RE11.3.27.

Distribution

A Queensland and bioregional endemic known only from a small population in State Forest 235 approximately 55 km west of Millmerran, south east Queensland (Bean 1997).

Likelihood of occurrence in PDA

Possible. The only known occurrence is approximately 6 km outside of the PDA. The record occurs within Regional ecosystem 11.3.18 (*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium) surrounded by 11.5.1 (*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces). Not recorded in the field survey.

Threats

Threats to the single population of 10 individuals are grazing, road works and trampling by cattle (Bean 1997).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

Based on known threats, the species is considered *Extremely High* sensitivity to disturbance. The known population of the species occurs outside of the PDA (approx. 6 km). As a precautionary measure, any small ephemeral wetlands in the Yarril and Wyaga Creek catchments within the PDA should be considered as possible habitat. That the only know population occurs outside the PDA, any impact to an identified extant population would be of ***High*** magnitude. Unmitigated impact significance and any impacts would be of ***Extremely High*** **(23)** ***significance***. The species has not been found in areas that have been comprehensively botanised including Lake Broadwater and the Chinchilla district (see Bean 1997).

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Avoid areas of core habitat possible.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. If the species was located a reassessment of risk is recommended. Any occurrences would result in recommending total avoidance of the habitat and establishment of appropriate buffers.

Minimising Disturbance

- Clearly identify species habitat using flagging and / or barrier fencing and establish adequate buffers.

Rehabilitation

- Install sediment and erosion control measures to prevent sediment input into riparian and wetland habitat.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

In the absence of mitigation,impacts of ***Extremely High Significance*** **(23)** will occur. Avoidance of possible habitat is the most effective mitigation measure and will completely avoid any direct impacts resulting in a residual impact that is ***Moderate*** **(11).** Where avoidance is not possible, further survey of possible habitat in areas designated for disturbance will clearly identify populations and allow opportunity for minimisation of disturbance zones and establishment of adequate buffers. Sediment and erosion control will limit sediment input into wetland habitat. Residual impact significance in such cases would be ***High* (20)**.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	High	Extremely High (23)	Totally Effective	Unknown

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Moderate (11)	Extremely High	Moderate	High (20)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems in the Yarril and Wyaga Creek catchments should be classed as "Core Habitat Possible":
   - 11.3.27
2. The following regional ecosystems in the Yarril and Wyaga Creek catchments should be classed as "General Habitat":
   - 11.3.25 (with associated ephemeral swamps);
   - 11.3.4 (with associated ephemeral swamps);
   - 11.3.18 (with associated ephemeral swamps).
3. All other remnant vegetation and non-remnant cleared land in the PDA should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- A taxonomic description has been prepared by Bean (1997);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009);

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Micromyrtus carinata

NCA: Endangered
EPBC: Not listed

<u>Habit</u>
A spreading, slender much branched shrub 1 - 2.5 m high with graceful arching branches and yellow-green flowers (DERM 2011).

<u>Habitat</u>
HERBRECS records indicate the following habitats (DERM 2011);

- Heath dominated by *Micromyrtus carinata, Triodia* sp., *Corymbia trachyphloia* and *E. exserta* also present on rock pavement;
- Woodland-low woodland with *Eucalyptus tenuipes, E. exserta, Corymbia trachyphloia, Allocasuarina inophloia,* and *Alphitonia excelsa* on grey-brown loam with some sand and gravel;
- Callitris and *Eucalyptus exserta* woodland with sparse understorey on pale red-brown sand over hard brown loam; and
- Low open shrubland of *Acacia triptera* on rocky soils.

<u>Distribution</u>
A Queensland, bioregional and local endemic restricted to Darling Downs and Leichhardt district of south-east Queensland (Bostock and Holland 2007). A localised endemic known from the Gurulmundi area (Chinchilla Field Naturalists Club 1997, EPA 2002).

<u>Likelihood of occurrence in PDA</u>
Possible. The species has not been recorded in the PDA. Records in the Gurulmundi locality to the west of the PDA are in woodland and heath on sandstone and lateritic sandstone (RE11.7.4, 11.7.5). Similar habitat occurs in the PDA to the north of the Leichhardt Highway, which suggests a potential for the species to occur. Not recorded in the field survey.

<u>Threats</u>
No threats are documented however, possible threats are gravel extraction, vegetation clearance, timber harvesting, road construction and maintenance, and inappropriate fire regimes.

<u>Project-related Impacts</u>

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species biology and response to disturbances such as habitat fragmentation, changed fire regimes and edge effects requires further detailed study. Without mitigation measures, project impacts are expected to occur over the life and scope of the project causing changes to local populations although never species extinction. The sensitivity of the species to disturbance is considered ***High.*** The magnitude of unmitigated impacts to populations within the PDA is considered ***Extremely High***. It is locally endemic to the Gurulmundi area and literature reviews indicate core populations are located in the State Forest to the west of the PDA. As a precautionary measure any areas of RE11.7.4 and 11.7.5 in the Gurulmundi area to the north and east of the Leichhardt Highway should be considered as possible habitat. The significance of unmitigated impact is considered ***Extremely High*** **(24).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "Core habitat possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Undertake surveys in potential habitat to locate any additional populations and/or occurrences. Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.

Rehabilitation

- The potential for success of rehabilitation programs is limited considering limitations of current knowledge regarding seed availability, and propagation success.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods. Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Avoiding possible habitat and undertaking further survey work within areas of core habitat possible that may require clearing are expected to completely mitigate against impacts. Clear identification of any additional populations will allow adjustment and/or minimising of disturbance areas and establishment of suitable buffer zones. Where avoidance is not possible, the collection and propagation of seed of local provenance for incorporation into rehabilitation programs may mitigate against impacts however, these methods are untested for the species in question. Similarly, translocation of shrubs is untested and would require specialist input to determine viability as a mitigation option. If infrastructure avoids possible habitat, the resulting environmental impact impact would be Low **(7)**. Other mitigation measures provide only moderate mitigation to impacts which may result in impacts of ***High*** **(21)** significance*.*

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Extremely High	Extremely High (24)	Totally Effective	Unknown - Untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	High	High (21)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The following regional ecosystems in the Gurulmundi locality north of the Leichhardt highway should be classed as “Core Habitat Possible”:
   - 11.7.4
   - 11.7.5
2. All other remnant vegetation and cleared non-remnant land in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011); and
- A description has been prepared by the Chinchilla Field Naturalists Club (1997).

Philotheca sporadica

NCA: Vulnerable

EPBC: Vulnerable

Habit

An open to compact shrub to 1.5m high, with numerous branches (DERM 2011).

Habitat

The majority of records are in low open forest and woodland of *Acacia burrowii*, *Eucalyptus exserta*, *E. crebra*, *E. fibrosa* subsp. *nubila* and *Callitris glaucophylla* (Halford 1995 in DEWHA 2009), on residual hills which are remnants of laterised Cretaceous sandstones, where the soils are shallow, uniform sandy loams to clay loams of extremely low fertility and poor condition (Dawson, 1972 in DEWHA 2009). HERBRECS records indicate the following habitats (DERM 2011);

- Woodland of *Eucalyptus fibrosa* subsp. *nubila, E. crebra, E. exserta, Corymbia trachyphloia, Allocasuarina luehmannii, Callitris glaucophylla, Acacia conferta, Dodonaea triangularis* on road edge on rocky lateritic ridge;
- Acacia/Eucalypt forest, on shallow hard setting soil, on sandstone rise;
- Shrubland in natural scald area on lateritic duricrust; mixed eucalypt/Callitris woodland surrounds the scald;
- Woodland of ironbark & *Callitris glaucophylla* on stony rise; and
- Open forest of *Acacia burrowii*, *E. exserta, Callitris endlicheri, C. trachyphloia* on low lateritic sandstone plateau.

Habitats are consistent with RE11.7.4, 11.7.5, and 11.7.7

Distribution

Queensland and bioregional endemic known from south-east Queensland, from just north of Tara, to approximately 12 km east of Kogan (DEWHA 2009). Of the 11 known populations, seven occur on road verges, seven extend onto freehold land (Halford, 1995) and one population within Braemar State Forest (SF 4) (Halford 1995 in DEWHA 2009).

Likelihood of occurrence in PDA

Known. The species has been recorded during field surveys on the western margin of the PDA on the Beelbee Rd north and south of the Dalby-Kogan Rd in woodland *of E. exserta, E. crebra, Callitris glaucophylla, Corymbia trachyphloia* and *Acacia burrowii* consistent with RE11.7.5. Similar habitat occurs in the PDA which suggests a potential for the species to occur in other areas.

Threats

Loss of habitat and lack of secure land tenure is considered a serious risk in the long term as the species is not conserved in any conservation reserve. Roadsides populations are at risk from general road maintenance activities and inappropriate use of sites (DEWHA 2009). Potential threats are grazing, invasive weeds, and inappropriate fire regimes. Populations impacted by the Braemar power plant are known to have been successfully translocated.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

Roadsides populations are at risk from general road maintenance activities and inappropriate use of sites (DEWHA 2009). Potential threats are grazing, invasive weeds, and inappropriate fire regimes. Populations impacted by the Braemar power plant are known to have been successfully translocated. The species is considered to have an ***Extremely High*** sensitivity ranking. A number of discrete population clusters occur on the western margin of the PDA in the Braemar Creek catchment, and a disjunct population occurs approximately five km south of Wyaga Creek off the Wyaga Creek road. Additional populations have the potential to occur in tracts of remnant vegetation and on disturbed roadsides on lateritic duricrusts (land zone 7). The distribution of the species lies mostly within petroleum tenements. Roadside populations along Beelbee Rd to the north and south of the Kogan Rd are susceptible to disturbance. Without mitigation measures, project impacts are expected to occur over the life and scope of the project causing changes to local populations although never species extinction. The magnitude of impact to the species is considered to be ***Extremely High*** with an unmitigated impact significance of ***Extremely High*** **(25).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known and “core habitat possible” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat known and possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements and liaise with DERM and relevant industry experts to determine viability of translocation and methods. Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs. Refer to existing Threatened Species Management Plans (e.g. Threatened Species Management Plan for *Philotheca sporadica* at Darling Downs Power Station Site - HLA 2007).

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Extremely High*** **(24)** *significance* will happen. Avoiding areas identified as core known habitat and undertaking further survey work within areas of core habitat possible that may require clearing are expected to completely mitigate against impacts and resulting residual impact will be ***Moderate (11*****).** Clear identification of any additional populations will allow adjustment and/or minimising of disturbance areas and establishment of suitable buffer zones. Where avoidance is not possible, the development of a threatened species management plan may be required to guide rehabilitation programs which include propagation from seed or cuttings, and translocation. Other mitigation measures mostly mitigate impacts which may result in impacts of ***Moderate*** **(16)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	Extremely High	Extremely High (25)	Totally Effective	Mostly

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Moderate (11)	Extremely High	Low	Moderate (16)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000 m precision) should be buffered by a 1 km circumference and treated as “Core Habitat Known”.
2. Regional ecosystems with confirmed records (<2000 m precision) should be classed as “Core Habitat Known”:
3. The following regional ecosystems (in the Braemar creek catchment) should be classed as “Core Habitat Possible”:
   - RE11.7.5
   - RE11.7.4
   - RE11.7.7
4. All other remnant vegetation and all cleared agricultural and grazing land in the PDA should be treated as “Absence suspected”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009); and
- A description has been prepared by the Chinchilla Field Naturalists Club (1997).

Hawkweed (*Picris evae*)

NCA: Vulnerable

EPBC: Vulnerable

Habit

An annual herb, 50-100 cm tall with yellow flowers.

Habitat

Known from *Eucalyptus* open woodland with a grassy understorey composed of *Dichanthium* spp.(DEWHA 2009), in grassland of *Dichanthium sericeum* adjacent to cultivated paddock on black clay soil (DERM 2011), and in grasslands to woodlands on ridges (Goodland 2000). EPA (2002) note its preference for hillsides rather than flats.

Distribution

Occurs from the Darling Downs and Moreton pastoral districts in south-east Queensland (Bostock & Holland 2007), to north of the Inverell area on the NSW northern tablelands (DECC 2005a). In the Darling Downs, it has a restricted distribution but may be locally abundant along roadsides and is known from many other significant roadside sites (Goodland 2000). The nearest vouchered record is on a roadside approximately 10 km east of the PDA.

Likelihood of occurrence in PDA

Likely. The species has been recorded on the eastern margin of the PDA on the Millmerran-Pittsworth Road Rd. Likely habitats include RE11.3.2, and 11.3.21. Similar habitat occurs in the PDA which suggests a likelihood for the species to occur. May occur along disturbed roadsides and on margins of cultivated areas and grazed paddocks. Occurrences on non-alluvial habitats difficult to predict.

Threats

Hawkweed is a roadside species, which tolerates light disturbance, and may be impacted by roadworks (EPA 2002). In New South Wales, it is threatened by weed invasion, inappropriate fire regimes, habitat fragmentation and clearing of vegetation for cropping and grazing (DECC 2005a in DEWHA 2009). In Queensland, *Picris evae* is intolerant of grazing (Fensham 1997) and Goodland (2000) considers it capable of surviving many other forms of disturbance.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The habitat of Picris includes stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands. The habitat is susceptible to mechanical disturbance associated with linear infrastructure such as pipelines and to edge effects such as invasion of introduced grasses and herbs. ***.*** The species has not been recorded in the PDA, occurs outside of the PDA, and is reported as having some resilience to disturbance. The sensitivity of the species is considered ***High.*** The magnitude of unmitigated impacts to populations within the PDA is considered ***Moderate*** with the significance of unmitigated impact ***Moderate*** **(17).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "core habitat possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat possible and general habitat requires further survey work in optimal seasonal conditions to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Moderate* (17)** *significance* will happen. Undertaking further survey work within areas of core habitat possible and general habitat that may require clearing and avoiding populations are expected to mostly mitigate against impacts resulting in a rare impact likelihood. Clear identification of any additional populations will allow adjustment and/or minimising of disturbance areas and establishment of suitable buffer zones. Where avoidance is not possible, the development of a threatened species management plan may be required to guide rehabilitation programs which include propagation from seed or cuttings and the resultant residual impact will be ***Moderate* (12).** If infrastructure avoids all habitat, the resulting environmental impact would be ***Low* (7).** Management of edge effects such as weed invasion into grassland and grassy woodland habitats is important to mitigate degradation of any habitat adjacent to disturbance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Mostly Effective

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Mod (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. As a precautionary measure the following regional ecosystems should be classed as "Core Habitat Possible":
   - 11.3.2
   - 11.3.21
2. The following should be classed as "General Habitat":

- Non-remnant derived grasslands on land zone 3.

3. All other remnant vegetation in the PDA and cleared agricultural and grazing land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2009);
- A brief description has been prepared by the Chinchilla Field Naturalists Club (1997); and
- A species profile and action statement has been prepared by Department of Environment & Climate Change (DECC) NSW 2005d, e;
- Management issues in the grassy habitats in the are discussed by Goodland (2000);
- Biodiversity values documented by EPA (2002).

***Prostanthera* sp. (Dunmore D.M.Gordon 8A)**

NCA: Vulnerable
EPBC: Vulnerable

Habit

Low, upright, shrub to 1m tall with whorled, sessile linear leaves 0.8–1.2 cm long, and 1–2 mm wide, and mauve to purple-blue flowers about 8 mm long (Stanley and Ross 1986, DEWHA 2010b, DNR 2000).

Habitat

Occurs in *Eucalyptus* and *Callitris* woodland in shallow sandy soil or *Eucalyptus* woodland on hard sandstone ridge tops (DEWHA 2010b). Herbarium records (DERM 2011) include woodland/open forest of gum topped ironbark (*Eucalyptus decorticans*) on stony sandstone ridges; woodland of *Eucalyptus crebra, E. fibrosa,* and *Callitris* on shallow sandy soils.

Distribution

A Queensland and bioregional endemic known only from four locations in a small area west of Millmerran in southern Queensland (DEWHA 2010b). Its extent of occurrence is less than 100 km^2. One population occurs on private land and three in state forest, including one on the border with Wondul Range National Park (Queensland Herbarium 2009a, DEWHA 2010b). Populations are possibly stable (EPA 2002).

Likelihood of occurrence in PDA

Known. One of the four known records occur within the PDA from a herbarium record on boundary between Wondul Range NP and Badgery SF 189, Wondul Range (DERM 2011). Additional populations occur approximately 10-15km to the south west of the PDA. Not recorded in field surveys.

Threats

Habitat disturbance by timber harvesting and inappropriate fire regimes are possible threatening processes (DNR 2000, DEWHA 2010b).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The only know records within the PDA occurs on the boundary of a National Park. However, additional populations have the potential to occur in suitable habitat in State Forest 189 located to the west of Wondul Range National Park. The species is considered highly susceptible to any incursions into regional ecosystems of known and potential habitat in the vicinity of existing populations and the sensitivity is assessed as ***High***. The consequences of unmitigated impacts may be ***Extremely High*** with an unmitigated impact significance of ***Extremely High*** **(24).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “core habitat known” and “core habitat possible” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat possible and general habitat requires further survey work in optimal seasonal conditions to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Extremely High*** **(24)** significance will happen**.** . Avoidance of core and possible habitat in remnant vegetation in the south west of the PDA is the most effective mitigation measure and will completely avoid any direct impacts. Application of buffer zones to Category B Environmentally Sensitive Areas would incorporate known habitat and ensure avoidance of project related impacts reducing level of residual impact to ***Low (7)*****.** Where avoidance is not possible, further survey of areas designated for disturbance in "core habitat possible" will clearly identify populations and allow opportunity for minimisation of disturbance zones and establishment of adequate buffers. The development of a threatened species management plan may be required to guide rehabilitation programs as propagation and translocation methods are untested. The habitat occurs in undulating to steep topography with scarps and therefore any disturbance would require attention to erosion and sediment control. Residual impact if habitat is not avoided and alternative mitigation measures are employed are likely to be ***High*** **(21).**

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Extremely High	Extremely High (24)	Totally Effective	Unknown - Untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	High	High (21)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000m precision) should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. Regional ecosystems with confirmed records (<2000m precision) should be classed as "Core Habitat Known":
   - RE11.7.5
   - RE11.7.4
3. The following regional ecosystems in the Badgery SF 189 (west of the Wondul Range NP) should be classed as "Core Habitat Possible":

- RE11.7.5
- RE11.7.4
- RE11.5.1
- RE11.5.4

4. All other remnant vegetation and cleared agricultural and grazing land in the PDA should be treated as “Absence possible”.

References

- A taxonomic description has been prepared by Stanley and Ross (1986);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2010b);
- Biodiversity values documented by EPA (2002); and
- A species profile has been prepared by DNR (2000).

Cobar Greenhood Orchid (*Pterostylis cobarensis*)

NCA: Not Listed
EPBC: Vulnerable

Habit

A terrestrial orchid with 7–11 narrow-elliptic leaves which form a basal rosette, each 1.5–2.5cm long and 5–8mm wide and transparent flowers with brown and green markings (Jones 1993). Flowering occurs from September to November (DEWHA 2010c).

Habitat

Records from the Barakula and Chinchilla districts occur in woodland of cypress pine (DERM 2011). In NSW, it is known from eucalypt woodland, open mallee, or *Callitris* shrubland on low stony ridges and slopes, among rocks on low hills, and on slopes above streams (DECC 2008a, Jones 1993). Usually occurs in very localised populations.

Distribution

Queensland populations known from limited records in the Darling Downs district with a single collection from the Maranoa (Bostock and Holland 2007). These represent the northern limit of the species distribution. Occurs in the far western of plains of NSW within the Nyngan–Cobar–Bourke district (DEWHA 2010c).

Likelihood of occurrence in PDA

Known within the PDA from a single collection approximately 7 km north of Chinchilla on Auburn Rd, with additional records to the north of the PDA within Barakula State Forest. A difficult to detect taxon likely to occur in cypress pine habitats on sandy loams north of Chinchilla. Not recorded during field surveys.

Threats

Identified threats include habitat damage by feral goats (*Capra hircus*); broad-scale vegetation clearing; grazing pressure changed hydrology increasing salinity; fragmentation; and loss of remnants (DEWHA 2010c). The main potential threats to the species include habitat degradation (granite ridge and rocky slope habitat are particularly vulnerable to erosion caused by feral goats); and weed invasion (DEWHA 2010c).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;

- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

With consideration given to the species known threats, the species sensitivity to disturbance is considered ***Moderate.*** Large areas of potential habitat exist throughout the PDA in cypress pine dominated woodlands (RE11.5.1 and 11.5.4) and the species is known from the bioregion and in NSW. However, the species is poorly collected in Queensland and difficult to detect, requiring intensive surveys in suitable habitat during the flowering season between September to November. Within the PDA, the species is likely to be more common than herbarium records indicate with a distribution extending outside of the PDA and into NSW.

Avoidance of potential habitat will considerably reduce the risk of impact however, this will be impractical given the widespread extent of the habitat and the lack of information on the extent of populations in the PDA. Field surveys within the flowering season of September to November in areas of possible habitat identified for clearing are required to determine the presence and extent of populations. The magnitude of unmitigated potential impacts is considered ***Moderate*** with consideration given to interstate populations***.*** The significance of unmitigated impacts is assessed as ***Moderate*** **(13).**

Proposed Management/ Mitigation Measures

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat known and possible, requires further survey work in the flowering season to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of *moderate* consequence will happen and preliminary impact significance will be ***Moderate* (13)**. Areas mapped as core habitat possible, warrant further survey work within areas proposed for clearing in an attempt to determine the presence or absence of the species. Assuming adequate surveys are carried out in optimal seasonal conditions (i.e. flowering period) avoidance will *completely* mitigate against impacts and residual impact will be ***Low* (4).** Where avoidance is not possible, translocation is considered the most effective risk management measure and will be mostly effective although minor loss in a local population may occur. Implementation of other mitigation measures such as limiting the width of disturbance corridors, establishing and maintaining buffers, rehabilitation of disturbance areas, and management of exotic grass invasion may result in a residual impact significance of Low **(8)** significance.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Totally Effective	Mostly Effective

Residual Impact Assessment

Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species record (<2000m precision) should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. Regional ecosystems with confirmed records (<2000m precision) should be classed as "Core Habitat Known":
   - RE11.5.1
   - RE11.5.4
3. The following regional ecosystems in the Barakula SF north of Chinchilla should be classed as "Core Habitat Possible":
   - RE11.5.1
   - RE11.5.4
4. All other remnant vegetation and cleared agricultural and grazing land in the PDA should be treated as "Absence possible".

References

- A taxonomic description has been prepared by Jones (1993);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2010c).

Ptilotus extenuatus

NCA: Endangered

EPBC: Not Listed

Habit

An erect perennial herb to 30cm with slender pink flowers.

Habitat

Known to occur in poplar box woodlands (EPA 2002). A single herbarium record in the PDA is in open grassland and buffel in light sandy soil (DERM 2011). The low precision record is located in non-remnant vegetation.

Distribution

Known from the Darling Downs and Maranoa district of south eastern Queensland (EPA 2002, DERM 2011, Bostock and Holland 2007). *Ptilotus extenuatus* is listed as 'Presumed Extinct' on the schedules of the NSW *Threatened Species Conservation Act*.

Likelihood of occurrence in PDA

Possible. Known from a single record in non-remnant vegetation within the south western part of the PDA approximately 5km to the north of Bendidee National Park (DERM 2011). Not recorded during field surveys.

Threats

No threats are identified in the literature. The main potential threats to the species are estimated as habitat degradation, weed invasion and inappropriate fire and grazing regimes.

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

Given the absence of data concerning the ecology of the species a sensitivity ranking of ***High*** is applied. The species is poorly collected with large areas of potential habitat throughout the PDA including non-remnant areas. Herbarium data indicates that the only record for the taxon occurs in the PDA however, it is a low precision record that has not been recollected since 1996. The age of the record suggests that the species occurrence may be unlikely and that changes to its habitat may have occurred. Information on the extent of populations in the PDA is lacking. Further field surveys are required to determine the presence and extent of populations. Project related activities might result in impacts of ***Moderate*** magnitude. Unmitigated impacts to populations within the PDA are considered to be of ***Moderate* (17)**. Avoidance of potential habitat will considerably reduce the risk of impact.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “core habitat possible” should be avoided if possible. If these areas are avoided, impacts are not expected.

Further Survey

- Any areas where clearing is proposed in core habitat possible and general habitat requires further survey work in optimal seasonal conditions to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Avoid individuals, populations and habitat by adjustment of development footprint where possible and implementing appropriate buffers.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.

Other Measures

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.
- Manage infestations of exotic weeds under the guidance of a weed management plan.

Summary Residual Impact Assessment

Unmitigated impacts to the species are likely to be of ***Moderate*** **(17)** significance. Avoidance of the total area of general habitat of this species is not practical given the widespread nature of potential habitat and that the species is a groundcover herb that may be difficult to detect over large areas. Undertaking further survey work within the location of the historic record, and in general habitat that may require clearing, and avoiding any new populations, will mostly mitigate impacts. Rehabilitation of adjoining habitat and managing edge effects will be mostly effective and may mitigate against an impact to a large degree, resulting in an ***Moderate*** **(12)** residual impact significance.

Unmitigated Impact Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Not Feasible	Mostly

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Low	Moderate (12)	High	Low	Moderate (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. As a precautionary measure and based on the age and precision of the confirmed species record, the record should be buffered by a 1km circumference and treated as "Core Habitat Possible".
2. The following regional ecosystems within the PDA should be classed as "General Habitat":
   - RE11.3.2
3. Cleared agricultural and grazing land should be treated as "Absence suspected".
4. All other remnant vegetation in the PDA should be treated as "Absence known".

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011).

Austral Cornflower (*Rhaponticum australe*)

NCA: Vulnerable
EPBC: Vulnerable

Habit
An erect, herbaceous perennial growing to 60cm high with stems covered with woolly hairs (DEWHA 2010d).

Habitat
Austral Cornflower grows in eucalypt open forest with grassy understory on roadsides and on road reserves with *Chloris gayana*, *Cirsium vulgare*, *Eucalyptus tereticornis* and *Angophora floribunda* on black clay soil (Goodland 2000). Goodland (2000) reports that in the Darling Downs, Rhaphonticum appears to have no habitat preference or soil preference being located in Mountain Coolibah (*Eucalyptus orgadophila*) grassy open woodlands, on stony red soil ridges and to the deep cracking black clay soils of the floodplains. Populations of the species are virtually restricted to roadsides in the Darling Downs (Goodland 2000).

Distribution
Endemic to eastern Australia but now extinct in Victoria and presumed extinct under the *Threatened Species Conservation Act 1995* (NSW). In Queensland it is known from a large number of sites ranging from Cania Gorge (west of Gladstone), Mount Moffat in the north, to Gatton in the south (Goodland 2000).

Likelihood of occurrence in PDA
Possible. No records are known from the PDA although herbrecs indicates collections in the vicinity of Pittsworth and Aubigny on the Darling Downs. Suitable habitat occurs on road reserves supporting grasslands and poplar box woodlands on alluvium. Not recorded in field survey.

Threats
Mainly found on roadsides or in undisturbed reserves where the species may regenerate after moderate mechanical disturbance, however, road work operations have been known to completely destroy entire sites (EPA 2002, Goodland 2000). Threatened when roadsides become infested by exotics (e.g. Johnson's grass and green panic) (EPA 2002). Population condition is probably related to grazing pressure (EPA 2002). The species has High sensitivity to grazing (Fensham 1997).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks;
- Altered and inappropriate fire regimes; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The unmitigated impact magnitude is considered ***Moderate***. Any remnant and derived grassland and poplar box woodlands on alluvium are potential habitat and susceptible to disturbance. The species, which is not currently known from the PDA, is widely distributed in restricted habitats which are under pressure from clearing, agricultural development, weed invasion and overgrazing. In the PDA, stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands are most susceptible to disturbance associated with linear infrastructure such as pipelines. Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Disturbed areas are often colonised by introduced grasses in particular Rhodes Grass and Giant Panic, and by Lippia in alluvial areas which may experience overland flow. Further survey is required to determine the extent of populations in tracts of possible habitat. Invasion of exotic pasture grasses following mechanical disturbance has the potential to degrade adjacent habitat and limit the recolonisation of disturbed areas. The species sensitivity is considered ***High*** and the unmitigated impact significance is expected to be ***Moderate*** **(17).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Avoid remnant grasslands and grassy woodlands on land zone 3. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat possible, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Moderate*** **(17)** significance will happen. Areas mapped as core habitat possible, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding areas of core habitat possible is preferable and will mostly mitigate against impacts and residual impacts will be ***Low(7).*** Adjacent habitat remains vulnerable to edge effects (invasion of exotic pasture grasses). Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree. Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as establishing and maintaining buffers, limiting the width of disturbance corridors, rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion will manage impacts to a degree that impact significance is ***Mod*** **(12)**.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Mostly

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low(7)	High	Low	Mod(12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. As a precautionary measure the following regional ecosystems should be classed as "Core Habitat Possible":
   - 11.3.2
   - 11.3.21
   - Non-remnant derived grasslands on land zone 3.
2. All other remnant vegetation in the PDA and cleared agricultural and grazing land should be treated as "Absence possible".

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2010d);
- Biodiversity values documented by EPA (2002);
- A species profile and description of management within roadside grasslands of the Darling Downs has been prepared by Goodland (2000).

Rutidosis lanata

NCA: Endangered
EPBC: Not Listed

<u>Habit</u>

Herb 25cm high, flowers yellow.

<u>Habitat</u>

Mainly found in roadside vegetation of Acacia and Eucalypt woodland/open forest on red sandy ridges and clay flats between 280-320m altitude adjacent to cleared or partly cleared grazing and cropping land (DNR 2000). Vegetation includes open grassy woodland of *Eucalyptus populnea* with *Eremophila mitchellii; Acacia harpophylla, Casuarina cristata,* and *Eucalyptus pilligaensis* woodland on reddish-brown loamy clay; remnant *Acacia harpophylla*, *Eucalyptus coolabah*, *Eucalyptus populnea* open forest on alluvium clay loam and gentle sedimentary rises; and in cleared areas along powerlines adjoining *Acacia aprepta* thicket (DERM 2011).

<u>Distribution</u>

Endemic to south central Queensland from near Jackson to Hannaford on the western Darling Downs (DNR 2000).

<u>Likelihood of occurrence in PDA</u>

Known to occur within the PDA 10km SE of Chinchilla, in roadside remnant of brigalow, coolabah, poplar box open forest on clay loam on alluvium (DERM 2011), which falls within RE11.3.4. Suitable habitat may occur on road reserves supporting RE11.3.17 and in poplar box woodlands on alluvium (11.3.2) and sedimentary rises (11.9.7) throughout the PDA.

<u>Threats</u>

The species and habitat are known to be threatened by clearing with possible threats of inappropriate grazing, road verge maintenance, and habitat disturbance by weeds and introduced pastures (DNR 2000).

<u>Project-related Impacts</u>

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and

- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species is only known from the PDA from one site in a road side remnant. The known habitat is therefore susceptible to any disturbance. The species is poorly collected with large areas of potential habitat throughout the PDA including non-remnant areas. Information on the extent of populations in the PDA is lacking. Further field surveys are required to determine the presence and extent of populations. The sensitivity of the species is considered to be ***High*** whilst project related activities might result in impacts of ***Moderate*** magnitude. The significance of unmitigated impacts is considered to be ***Moderate*** **(17)**. Avoidance of potential habitat will considerably reduce the risk of impact.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.
- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Translocation

- Propagation and translocation of this species is untested.
- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Summary Residual Impact Assessment

Avoidance of all known and possible habitat is the most effective mitigation measure and where implemented, residual impact will be ***Low(7).*** Unmitigated activities in the vicinity of sensitive habitats have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic weed invasion may be mostly effective and may mitigate against an impact to a large degree. Propagation and translocation of this species is untested. Implementation of mitigation measures may result in impacts of ***Moderate(12)*** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Unknown - untested

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Moderate (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species record (<2000m precision) should be buffered by a 1km circumference and treated as "Core Habitat Known".
2. Regional Ecosystem polygons with confirmed records (<2000m precision) should be treated as "Core Habitat Known".

3. The following regional ecosystems should be classed as “Core Habitat Possible”:

   - 11.3.4
   - 11.3.2
   - 11.9.7

4. All other remnant vegetation in the PDA and cleared agricultural land should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Taxonomic description prepared by Holland (1994);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Biodiversity values documented by EPA (2002);
- A species profile has been prepared by DNR (2000).

Solanum papaverifolium

NCA: Endangered

EPBC: Not Listed

Habit

Erect or sprawling perennial herb to 0.3m high with deeply lobed glabrous ovate leaves 4–7cm long, 3–5cm wide and 10–12mm diameter berry (Bean 2004).

Habitat

Occurs in wetter (swampy) areas of grasslands or open eucalypt woodland on heavy alluvial soils (Goodland 2000, Bean 2004).

Distribution

Recorded in the Darling Downs from between Jimbour and Warwick, where it is known from three locations (Bean 2004). Known from a number of very old records in the Dalby-Cecil Plains area. Goodland (2000) reports two populations west of Dalby on the Warrego Highway before Kogan Rd), and large populations up to 100m extent off Cecil Plains Rd. Known in NSW north from Inverell to Quirindi and Singleton area and west to Narrabrii and Moree (Bean 2004).

Likelihood of occurrence in PDA

Known to occur. The species was recorded during the survey is remnant grassland habitats (RE11.3.21) to the east of Dalby in an extensive population covering an area of several hectares.

Threats

The species occurs on soils utilised by intensive agriculture and remains on roadside reserves and stock routes. Populations remain threatened by habitat destruction, weed invasion, and roadworks (Goodland 2000, Bean 2004).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species stronghold in Queensland is in roadside grassland remnants within the PDA. It is known from a number of herbarium records and is largely restricted to the Darling Downs where it occurs in restricted habitats which are under pressure from clearing, agricultural development, weed invasion and overgrazing. In the PDA, stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands in the vicinity of Dalby (RE11.3.21, 11.3.2 and specific grassy non-remnant areas) should therefore be considered potential habitat with core habitat recognised within vegetation polygons where the species has been previously recorded. Given the importance of the PDA to the species, the potential magnitude of impacts is ***Extremely high***. Although listed as endangered under state legislation, the ability of the species to inhabit agricultural areas and degraded roadside remnants indicates that the species is relatively resilient to change and is able to adapt to disturbance. The relative sensitivity of the species should therefore be considered ***Moderate***. The significance of unmitigated impact should therefore be considered ***Extremely High* (22).**

In the PDA, stock routes and road reserves supporting grasslands, poplar box woodlands, and derived grasslands are most susceptible to disturbance associated with linear infrastructure such as pipelines and many of these areas are under pressure from clearing, agricultural development, weed invasion and overgrazing. Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Disturbed areas are often colonised by introduced grasses in particular Rhodes Grass and Giant Panic, and by Lippia in alluvial areas which may experience overland flow. Further survey is required to determine the extent of populations in tracts of suitable habitat. Where habitat is avoided, invasion of exotic pasture grasses following mechanical disturbance is likely to degrade adjacent habitat and limit recolonisation of disturbed areas by the species.

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known” should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.
- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

<u>Rehabilitation</u>

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

<u>Translocation</u>

- If plant removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods. Given the ability of the species to colonise disturbed agricultural land, it should be amenable to translocation although this will require testing prior to implementation.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

<u>Summary Residual Impact Significance Assessment</u>

In the absence of mitigation, impacts of ***Extremely High*** **(22)** *significance* will happen. Areas mapped as core habitat known and core habitat possible, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding areas of core habitat known and core habitat possible is the recommended mitigation measure, although to protect adjacent vulnerable habitat to edge effects, strict weed management protocols are required to control invasion of exotic pasture grasses in areas where work is conducted in habitat vicinity. The residual impact assessment where habitat avoidance is the management protocol will be ***Low*** **(4).**

Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as establishing and maintaining buffers, limiting the width of disturbance corridors, rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion will be moderately effective although minor loss in a local population may occur. The assessment of residual impact significance is ***Moderate (13).*.**

Unmitigated Impact Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Extremely High	Extremely High (22)	Totally Effective	Unknown

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Moderate	Moderate (13)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species records (<2000m precision) should be buffered by a 1km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems should be classed as “Core Habitat Possible”:
   - 11.3.21
   - 11.3.24
   - Derived grasslands on alluvium.
4. All stockroute and rail reserve polygons surrounding Dalby (i.e. Dalby-Cecil Plains Rd, and Dalby-Kogan Rd) should be treated as “General Habitat”;
5. All other remnant vegetation and cleared agricultural land in the PDA should be treated as “Absence possible”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Taxonomic description prepared by Bean (2004);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Biodiversity values documented by EPA (2002);
- Management issues in the grassy habitats in the are discussed by Goodland (2000).

Solanum stenopterum

NCA: Vulnerable

EPBC: Not Listed

Habit

A sprawling or erect herbaceous resprouter 0.2-0.4m with linear to ovate entire or shallowly to deeply lobed leaves (Bean 2004).

Habitat

Occurs in disturbed grassland, *Casuarina cristata* forest or *Eucalyptus populnea* woodland on clay soils (Bean 2004).

Distribution

Recorded in Queensland from Gayndah in the Burnett Pastoral district to Moonie and west to Glenmorgan and Yuleba (Bean 2004, Bostock and Holland 2007). Known in NSW from Ashford (Bean 2004).

Likelihood of occurrence in PDA

Known to occur in non-remnant grassland approximately 7.5km south of Dalby; 3.5km east of Cecil Plains in a roadside gravel pit; and approximately 6km south east of Cecil Plains in remnant *Eucalyptus populnea* woodland on alluvium (11.3.2). Not recorded during field survey.

Threats

The species occurs on soils utilised by intensive agriculture and occurs on roadside reserves. Populations remain threatened by habitat destruction from land clearing, agricultural practices, weed invasion, roadworks and roadside maintenance (Bean 2004).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, altered habitat structure along gathering lines, tracks and clearing zones.

Consequence of Project Related Impacts (Unmitigated)

The species has the potential to occur in non-remnant disturbed roadside sites on alluvium and in poplar box woodland remnants (11.3.2) and belah woodland on alluvium (11.3.1 and 11.3.17). It is highly susceptible to any disturbance and the sensitivity is considered ***High.*** The species occurs in restricted habitats which are under pressure from clearing, agricultural development, weed invasion and overgrazing. In the PDA, stock routes and road reserves supporting habitat are most susceptible to disturbance associated with linear infrastructure such as pipelines. Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Disturbed areas are often colonised by introduced grasses in particular Rhodes Grass and Giant Panic, and by Lippia in alluvial areas which may experience overland flow. Further survey is required to determine the extent of populations in tracts of suitable habitat. Where habitat is avoided, invasion of exotic pasture grasses following mechanical disturbance is likely to degrade adjacent habitat and limit the recolonisation of disturbed areas. Three of the five known locations of the species occur in the PDA and the magnitude of potential impact is considered ***Extremely High****.* The significance of unmitigated impact is considered ***Extremely High* (24).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat known” should be avoided. If these areas are avoided, impacts are not expected.
- Areas mapped as “Core habitat possible” should be avoided if possible. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.
- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of *Extremely High* (24) significance consequence will happen. Areas mapped as core habitat possible, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding areas of core habitat known and possible is preferable and will mostly mitigate against impacts. Adjacent habitat remains vulnerable to edge effects (invasion of exotic pasture grasses). Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate to a degree although the effectiveness of translocation and rehabilitation have not been tested. . Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as establishing and maintaining buffers, limiting the width of disturbance corridors, rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion may result in impacts of ***Moderate* (17)** significance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Extremely High	Extremely High (24)	Totally Effective	Unknown - Untested

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
HIgh	Extremely Low	Low (7)	High	Moderate	Moderate (17)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. Confirmed species records (<2000m precision)should be buffered by a 1km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems should be classed as “Habitat Possible”:
    - 11.3.2
    - 11.3.1
    - 11.3.17
    - Derived grasslands on alluvium.
4. Any remnant and non-remnant roadside habitats between Dalby, Cecil Plains and Millmerran should be treated as “General habitat”.
5. All other remnant vegetation and cleared agricultural land in the PDA should be treated as “Absence suspected”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Taxonomic description prepared by Bean (2004);
- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Management issues in the grassy habitats in the Darling Downs are discussed by Goodland (2000).

Austral Toadflax (*Thesium australe*)

NCA: Vulnerable

EPBC: Vulnerable

Habit

A perennial/biennial herb to semi-shrub to 40 cm high with erect, wiry, slender and sparingly branched stems, and alternate, linear yellowish green leaves. Flowers February to March. A root parasite of kangaroo grass and other grasses.

Habitat

Known to occur on sandstones in the Stanthorpe area, and on rocky ridges and deep cracking alluvial clays of the central Darling Downs (Goodland 2000). Herbarium records occur on roadsides, mountain coolibah (*Eucalyptus orgadophila*) grassy open woodlands with kangaroo grass (*Themeda triandra*) and queensland blue grass (*Dichanthium sericeum*), grassy *Eucalyptus populnea* woodland on heavy alluvial soil, and in roadside grasslands (Goodland 2000, DERM 2011).

Distribution

Occurs in eastern NSW along the coast, and from the Northern to Southern Tablelands, and in southern Queensland. Also occurs in Victoria, and considered extinct in Tasmania (Department of Sustainability and Environment, 2003). The majority of southern Queensland collections are from the Darling Downs and Moreton districts (Goodland 2000, Bostock and Holland 2007).

Likelihood of occurrence in PDA

Known to occur in grassland approximately 4km west of Dalby on the Warrego Highway, and in a small remnant of *Eucalyptus populnea* on alluvium (11.3.2) approximately 26km NW of Dalby on the Warrego Highway (DERM 2011). High potential to occur in grassland and poplar box woodlands on alluvium on stock routes and road reserves. Not recorded during field surveys.

Threats

Populations in road reserves are threatened by roadwork and maintenance activities such as spraying, grading, slashing, by inappropriate grazing and burning regimes, and weed infestation (Goodland 2000). Known to be susceptible to rabbit, horse and cattle grazing but able to tolerate light, non-continuous cattle grazing. Populations thought to be declining (EPA 2002).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and
- Habitat edge effects such as weed infestation, changed fore regimes, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species occurs in roadside grassland and poplar box remnants on alluvium within the PDA. It is therefore susceptible to any disturbance to the known habitat. Any habitat consistent with RE11.3.21, 11.3.24 and 11.3.2 is potential habitat and susceptible to disturbance. Thesium occurs in restricted habitats which are under pressure from clearing, agricultural development, weed invasion and overgrazing. In the PDA, stock routes and road reserves supporting habitat are most susceptible to disturbance associated with linear infrastructure such as pipelines. Unmitigated activities in the vicinity of sensitive habitats (in the absence of direct impact) have considerable potential to accelerate edge effects and hence affect the long term viability of the species habitat on a project scale. Disturbed areas are often colonised by introduced grasses in particular Rhodes Grass and Giant Panic, and by Lippia in alluvial areas which may experience overland flow. The species sensitivity is considered to be ***High.*** Further survey is required to determine the extent of populations in tracts of suitable habitat. Where habitat is avoided, invasion of exotic pasture grasses following mechanical disturbance is likely to degrade adjacent habitat and limit the recolonisation of disturbed areas. Considering the relatively broad distribution of the species outside the PDA, the magnitude of potential impact is considered ***Moderate.*** The significance of unmitigated impact is ***Moderate*** **(17).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as “Core habitat possible” should be avoided if possible. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- Any areas where clearing is proposed in core habitat possible, requires further survey work to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken.

Minimising Disturbance

- Clearly identify any individuals and populations using flagging and / or barrier fencing and establish adequate buffers.

- Avoid habitat by adjustment of development footprint where possible.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.
- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of *major* consequence will possibly happen and the resultant impact significance will be ***Moderate*** **(17).** Areas mapped as core habitat possible, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Avoiding areas of core habitat known and possible is preferable and will in general mostly mitigate against impacts and resulting residual impact assessment will be ***Low(7)***. Adjacent habitat remains vulnerable to edge effects (invasion of exotic pasture grasses).

Where avoidance is not possible, the identified impact management measures are considered to be mostly effective and may mitigate against an impact to a large degree, although the effectiveness of translocation is not known to have been demonstrated. The resulting residual impact following employment of a full range of mitigation measures is considered to be ***Moderate*** **(12)**. Grassland and grassy woodland habitats support a number of other EVNT flora species and are particularly vulnerable to mechanical disturbance. Implementation of mitigation measures such as establishing and maintaining buffers, limiting the width of disturbance corridors, rehabilitation of disturbance areas using seeding of native grass seed of local provenance, and management of exotic grass and herb invasion.

Unmitigated Impact Assessment	Effectiveness of Mitigation Measures

Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	Moderate	Moderate (17)	Totally Effective	Unknown - Untested

Residual Impact Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Low	Moderate (12)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species records (<2000m precision) should be buffered by a 1km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with confirmed records (<2000m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems should be classed as “Core Habitat Possible”:
   - 11.3.2
   - 11.3.21
   - 11.3.24
   - Derived grasslands on alluvium.
4. Any remnant and non-remnant roadside habitats between Dalby, Cecil Plains and Millmerran should be treated as “General Habitat”;
5. All other remnant vegetation and cleared agricultural land in the PDA should be treated as “Absence suspected”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);

- Management issues in the grassy habitats in the Darling Downs are discussed by Goodland (2000).
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2010e).
- A recovery plan has been prepared by Griffith (1992).

Xerothamnella herbacea

NCA: Endangered
EPBC: Endangered

Habit

A sparse, sprawling, perennial herb growing to a height of 30cm

Habitat

Occurs in remnant and disturbed brigalow (*Acacia harpophylla*) and belah (*Casuarina cristata*) dominated communities in shaded situations, often in leaf litter and is associated with heavy clays with gilgais (shallow ground depressions of land zones 3 and 4).

Distribution

Known from two sites north east of Chinchilla, a single record from near Theodore and a record near Yelarbon east of Goondiwindi, Queensland (DERM 2011, DEWHA 2010f, Bostock and Holland 2007).

Likelihood of occurrence in PDA

Known from a brigalow roadside remnant on the Millmerran-Goondiwindi road. A record approximately 30km east of Chinchilla is on the eastern boundary of the PDA. A record 32km north east of Chinchilla (DERM 2011, Chinchilla Field Naturalist Club 1997) is located approximately 10-12 km north of the PDA boundary. Potential to occur within any brigalow/belah habitat consistent with 11.3.1 and 11.4.3, and advanced regrowth on roadsides.

Threats

The species is threatened by competition from invasive grasses such as green panic (*Megathyrsus maximus* var. *pubiglumis*) and to a lesser extent buffel grass (*Cenchrus ciliaris*) either by direct competition or by increasing the fuel load and altering fire regimes (DEWHA 2010f). Potential threats include road widening and maintenance activities; surface erosion; and grazing and trampling by cattle and native macropods (DEWHA 2010f).

Project-related Impacts

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during clearing of habitat;
- Direct loss and degradation of habitat for construction of facilities and development and maintenance of access tracks; and

- Habitat edge effects such as weed infestation, changed fore regimes, altered habitat structure along gathering lines, tracks and clearing zones.

Significance of Project Related Impacts (Unmitigated)

The species occurs in brigalow and belah remnants on alluvium within the project development arrea. It is therefore susceptible to any disturbance to the known habitat. RE's 11.3.1 and 11.4.3 and advanced non-remnant brigalow regrowth are potential habitat and susceptible to disturbance.

Further survey is required to determine the extent of populations in the limited tracts of remnant and non-remnant brigalow vegetation. Invasion of exotic pasture grasses following mechanical disturbance to grassland habitats is likely to degrade adjacent habitat and limit the ability to recolonise disturbed areas. The sensitivity of the species is considered ***Extremely High*** and the magnitude of unmitigated impact is considered ***High.*** The significance of unmitigated impact is therefore considered ***Extremely High*** **(23).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

- Areas mapped as "Core habitat known and possible" should be avoided. If these areas are avoided, impacts are not expected.

Further Survey and Assessment

- If clearing is proposed in core habitat possible, further survey work is required to determine the presence/absence of the species. Using the results of the fieldwork, a risk assessment should be undertaken using methods outlined in this document.

Minimising Disturbance

- Avoid individuals, populations and habitat by adjustment of development footprint where possible.
- Clearly identify any individuals and populations using flagging and / or barrier fencing.
- Ensure construction and maintenance activities in areas where the species or population occurs do not adversely impact on known core populations.

Rehabilitation

- If removal is unavoidable, collect seed and propagate plants within rehabilitation programs to minimize the risk of net population loss.
- Following construction, rehabilitate all disturbed habitat by seeding of native seed of local provenance or native grass seed from other parts of southern inland Queensland if unavailable. Limit use of exotic pasture species to previously cleared agricultural land.
- Control weeds under the guidance of a weed management plan.

- Monitor all rehabilitation/revegetation of threatened species habitat by using key performance indicators to achieve measurable benchmarks (as determined from adjacent habitat) for percentage groundcover and species composition.

Translocation

- If removal is unavoidable, identify relevant permits, policies and legislative requirements, and liaise with DERM and relevant industry experts to determine viability of translocation and methods.
- Where translocation is considered viable, follow best practice guidelines (i.e. Vallee *et al.* 2004) and utilise professional expertise to develop appropriate methods and ongoing management of monitoring programs.

Summary Residual Impact Assessment

In the absence of mitigation, impacts of ***Extremely High*** **(23)** significance will**.** Brigalow associations on Land zones 3 and 4 constitute the optimal habitat for Xerothamnella. These areas are classed as Category B Environmentally Sensitive Areas where work exclusion buffers to a distance of 500m are recommended around all remnant communities. Where these buffers cannot be maintained, strict weed hygiene protocols and site access protocols should be followed including weed washdown. Avoiding core habitat known and possible areas is preferable and will completely mitigate against impacts resulting in a residual impact that is ***Moderate*** **(11).**

Where brigalow vegetation cannot be avoided, a reduction in the width of construction easements particularly where infrastructure is located on roadside easements, fencelines etc. where high quality regrowth is often located will be required. Further survey work prior to clearing in an attempt to determine the presence or absence of the species is necessary. Any new locations may further inform the location and width of easements. Edge effects in particular the invasion of exotic grasses on habitat margins have the potential to be remediated through rehabilitation programs involving use of native grasses, weed management and erosion and sediment control. Where avoidance is not possible, these impact management measures may mitigate impact to some degree although the effectiveness of translocation has not been tested. The resulting residual impact significance would be ***High*** **(20).**

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremley High	High	Extremely High (23)	Totally Effective	Unknown - Untested

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Moderate(11)	Extremely High	Moderate	High (20)

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Rule(s) for Habitat Mapping

1. The confirmed species record (<2000m precision) should be buffered by a 1km circumference and treated as “Core Habitat Known”.
2. Regional Ecosystem polygons with the confirmed record (<2000m precision) should be treated as “Core Habitat Known”.
3. The following regional ecosystems should be classed as “Core Habitat Possible”:
    - 11.3.1
    - 11.4.3
4. Advanced brigalow/belah regrowth on gilgai soils of land zones 3 and 4 should be classed as “General Habitat”;
5. All other remnant vegetation in the PDA should be treated as “Absence suspected”.
6. All cleared agricultural land is classed as “Absence Likely”.

For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

References

- Specimen backed data from Qld Herbarium HERBRECS database (DERM 2011);
- Conservation advice has been prepared by Department of the Environment, Water, Heritage and the Arts (2010f);
- Biodiversity values documented by EPA (2002).

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Appendix F. Database Search Results – EVNT Flora Species

Species Name	Conservation Status		Source				
	EPBC Status	NCA Status	H'BRECS	C'VEG	W'NET	CFNC	EPBC Online
Acacia barakulensis	Not listed	V	X	-	X	-	-
Acacia calantha #	Not listed	NT	X	-	-	-	-
Acacia centrinervia #	Not listed	NT	X	-	-	-	-
Acacia curranii	V	V	X	X	X	-	X
Acacia eremophiloides #	V	V	X	-	-	-	-
Acacia handonis	V	V	X	-	-	-	X
Acacia lauta #	V	V	X	-	-	-	-
Acacia porcata #	E	E	X	-	-	-	-
Acacia pubifolia #	V	V	X	-	-	-	-
Acacia tenuinervis	Not listed	NT	X	X	X	X	-
Acacia wardellii #	V	V	X	-	-	-	-
Apatophyllum teretifolium	Not listed	NT	X	-	X	-	-
Aristida forsteri	Not listed	E	X	-	X	-	-
Bertya granitica #	E	E	X	-	-	-	-
Bothriochloa bunyensis #	V	V	X	-	-	-	-
Bothriochloa biloba	V	Not listed	X	X	X	-	-
Cadellia pentastylis	V	V	X	-	X	-	X
Callitris baileyi	Not listed	NT	X	-	X	-	-
Calotis glabrescens	Not listed	NT	X	-	X	-	-
Calytrix gurulmundensis	V	V	X	-	X	-	X
Cerbera dumicola #	Not listed	NT	X	-	-	-	-
Commersonia argentea #	V	Not listed	-	-	-	-	X
Commersonia beeronensis #	Not listed	V	X	-	-	-	-
Corymbia petalophylla #	Not listed	NT	X	-	-	-	-
Cryptandra ciliata	Not listed	NT	X	-	X	-	-
Cyperus clarus	Not listed	V	X	-	X	?	-
Denhamia parvifolia	V	V	X	-	-	X	X
Dichanthium queenslandicum	V	V	X	-	-	-	X
Digitaria porrecta	E	NT	X	X	X	-	X
Diuris parvipetala #	Not listed	NT	X	-	-	-	-
Eleocharis blakeana	Not listed	NT	X	X	X	X	-
Eucalyptus argophloia #	V	V	X	-	-	X	X
Eucalyptus broviniensis #	Not listed	E	X	-	-	-	-

Species Name	Conservation Status		Source				
	EPBC Status	NCA Status	H'BRECS	C'VEG	W'NET	CFNC	EPBC Online
Eucalyptus curtisii	Not listed	NT	X	X	X	-	-
Eucalyptus pachycalyx subsp. *waajensis* #	Not listed	E	X	-	-	-	-
Eucalyptus rubiginosa #	Not listed	NT	X	-	X	-	-
Eucalyptus taurina #	Not listed	V	X	-	-	-	-
Eucalyptus virens	V	V	X	-	-	-	X
Fimbristylis vagans	Not listed	NT	X	X	X	X	-
Gonocarpus urceolatus	Not listed	V	X	-	X	-	-
Haloragis exalata subsp. velutina #	V	V	-	-	-	-	X
Hibbertia monticola #	Not listed	NT	X	-	-	-	-
Homopholis belsonii	V	E	X	X	X	-	X
Homoranthus decumbens #	V	V	X	-	-	-	-
Kunzea bracteolata #	Not listed	NT	X	-	-	-	-
Kunzea flavescens #	Not listed	NT	X	-	-	-	-
Lepidium peregrinum #	E	Not listed	-	-	-	-	X
Leucopogon sp. (Coolmunda D.Halford Q1635) #	E	E	X	-	-	-	X
Macrozamia conferta #	V	V	X	-	-	-	-
Macrozamia crassifolia #	V	V	X	-	-	-	-
Macrozamia machinii	V	V	X	X	X	-	X
Newcastelia velutina #	V	V	X	-	-	-	-
Melaleuca groveana #	Not listed	NT	X	-	-	-	-
Microcarpaea agonis	E	E	X	-	-	-	-
Micromyrtus carinata	Not listed	E	X	X	X	-	-
Micromyrtus patula #	Not listed	E	X	-	X	-	-
Newcastelia velutina #	V	V	X	-	-	-	-
Notelaea pungens #	Not listed	NT	X	-	-	-	-
Peripleura sericea #	Not listed	NT	X	-	-	-	-
Philotheca sporadica	V	V	X	X	X	-	X
Picris barbarorum	Not Listed	V	X	-	-	-	-
Picris evae	V	V	X	-	X	X	X
Polianthion minutiflorum #	V	V	X	-	-	-	-
Pomaderris coomingalensis	Not Listed	E	X	-	-	-	-
Prasophyllum campestre #	Not listed	NT	X	-	-	-	-
***Prostanthera* sp. (Dunmore DM Gordon 84)**	V	V	X	X	X	-	X
Pterostylis cobarensis	V	Not listed	X	-	X	-	X
Ptilotus extenuatus	Not listed	E	X	-	X	-	-

Species Name	Conservation Status		Source				
	EPBC Status	NCA Status	H'BRECS	C'VEG	W'NET	CFNC	EPBC Online
Rhaponticum australe	V	V	X	-	-	-	X
Rutidosis glandulosa #	Not listed	NT	X	-	-	-	-
Rutidosis lanata	Not listed	E	X	-	X	-	-
Senna acclinis #	Not listed	NT	X	-	-	-	-
Solanum papaverifolium	Not listed	E	X	X	X	-	-
Solanum stenopterum	Not listed	V	X	X	X	-	-
Thesium australe	V	V	X	X	X	-	X
Tylophora linearis #	E	E	-	-	-	-	X
Westringia parvifolia #	V	V	X	-	-	-	X
Xerothamnella herbacea	E	E	X	-	X	X	X
Zieria verrucosa #	V	V	X	-	-	-	-
Zornia pallida #	Not listed	NT	X	-	-	-	-

- # denotes species discounted from further assessment due to lack of suitable habitat and absence of records within or in close proximity to the PDA.
- **Bold** indicate those species assessed for project impacts.

Appendix G. Indicative Fauna Species List

Abbreviations

Source:

Current survey:	field surveys undertaken from October – December, 2009 and May 2010.
QM:	Queensland Museum collections database
BA:	Birds Australia Atlas
WN:	DERM WildNet database
Ecosmart:	records from field surveys conducted by Ecosmart Ecology staff
Other:	primary literature, personal communications, etc.

Status:

NCA:	Queensland Nature Conservation Act 1992
EPBC:	Environment Protection and Biodiversity Conservation Act 1999
BBS Priority:	non-EVNT species identified as being of conservation concern by DERM (EPA 2008)
Introduced:	feral species
Migratory:	species listed as Migratory under the EPBC

Butterflies N = 49

Family		Status					Source					
Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Hesperiidae												
Hesperilla malindeva	Two-Spotted Sedge-Skipper									x		
Ocybadistes flavovittata	Narrow-brand Grass-Dart						x			x		
Ocybadistes walkeri sothis	Green Grass-Dart									x		
Toxidia parvulus	Banded Grass-Skipper									x		
Toxidia peron	Dingy Skipper									x		
Trapezites eliena	Orange Ochre									x		
Trapezites petalia	Black-ringed Ochre									x		
Lycaenidae												
Acrodipsas cuprea	Copper Ant-blue									x		
Candalides heathi heathi	Rayed Blue									x		
Hypochrysops cyane	Cyane Jewel									x		
Hypochrysops piceata	Bulloak Jewel	En								x	x	
Jalmenus daemeli	Emerald Hairstreak						x			x	x	
Jalmenus eubulus	Pale Imperial Hairstreak	Vu								x		x
Lampides boeticus	Long-tailed Pea-blue									x		
Lucia limbaria	Grassland Copper									x		
Nacaduba biocellata	Two-Spotted Line-blue									x		
Ogyris aenone	Sapphire Azure									x		
Ogyris amaryllis	Satin Azure									x	x	
Ogyris ianthis	Golden Azure									x		

Family			Status					Source					
	Scientific name	Common name	NCA	EPBC	BBS Priority	Introduced	Migratory	Current survey	QM	BA	WN	Ecosmart	Other
	Theclinesthes miskini	Wattle Blue									x		
	Theclinesthes onycha	Cycad Blue									x	x	
	Theclinesthes serpentata	Salt-bush Blue									x		
	Zizeeria karsandra	Spotted Grass-blue									x		
	Zizina labradus	Common Grass-blue						x			x	x	
Nymphalidae													
	Acraea andromacha	Glasswing									x	x	
	Danaus chrysippus	Lesser Wanderer						x			x	x	
	Danaus plexippus	Wanderer									x	x	
	Euploea core	Common Australian Crow						x			x	x	
	Hypocysta pseudirius	Grey Ringlet						x			x	x	
	Hypolimnas bolina	Common Eggfly						x			x	x	
	Junonia villida	Meadow Argus						x			x	x	
	Polyura sempronius	Tailed Emperor									x		
	Vanessa kershawi	Australian Painted Lady									x	x	
Papilionidae													
	Cressida cressida	Big Greasy						x					
	Papilio aegeus	Orchid Swallowtail						x			x	x	
	Papilio anactus	Dingy Swallowtail						x			x		
	Papilio demoleus	Chequered Swallowtail									x	x	
	Papilio fuscus	Fuscous Swallowtail									x	x	
Pieridae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Belenois java	Caper White						x			x	x	
	Catopsilia pomona	Lemon Migrant									x	x	
	Catopsilia pyranthe crokera	White Migrant									x		
	Delias argenthona	Scarlet Jezebel										x	
	Elodina angulipennis	Southern Pearl-White									x		
	Elodina padusa	Narrow-Winged Pearl-White									x		
	Elodina parthia	Striated Pearl-White						x			x		
	Eurema brigitta australis	No-brand Grass-Yellow									x		
	Eurema herla	Pink Grass-Yellow									x		
	Eurema smilax	Small Grass-Yellow						x			x	x	
	Pieris rapae	Cabbage White									x		
	TOTALS	**49**	**2**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**47**	**20**	**1**

Dragonflies

N = 14

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Coenagrionidae													
	Agriocnemis pygmaea	Pygmy Wasp						x					
	Ischnura aurora	Aurora Bluetail						x					
	Ischnura heterosticta	Common Bluetail						x					
	Xanthagrion erythroneurum	Red & Blue Damsel						x					
Gomphidae													
	Austrogomphus ochraceus	Jade Hunter						x					
Hemicorduliidae													
	Hemicordulia tau	Tau Emerald						x					
Lestidae													
	Austrolestes leda	Wandering Ringtail						x					
Libellulidae													
	Diplacodes bipunctata	Wandering Percher						x					
	Diplacodes haematodes	Scarlet Percher						x					
	Orthetrum caledonicum	Blue Skimmer						x					
	Rhyothemis graphiptera	Graphic Flutterwing						x					
	Tramea loewii	Common Glider						x					
	Ictinogomphus australis	Australian Tiger						x					
Synthemistidae													
	Parasynthemis regina	Royal Tigertail						x					
	TOTALS	**14**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**

Amphibians N = 29

Family		Status					Source					
Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Bufonidae												
Rhinella marina	Cane Toad				I					x		
Hylidae												
Cyclorana alboguttata	Green-Striped Burrowing Frog							x		x	x	
Cyclorana brevipes	Short-footed Frog							x		x	x	
Cyclorana novaehollandiae	Eastern Snapping Frog						x	x		x	x	
Cyclorana platycephala	Water-Holding Frog							x		x		
Cyclorana verrucosa	Rough Collared Frog	Ra					x	x		x	x	x
Litoria caerulea	Green Tree Frog						x	x		x	x	
Litoria fallax	Eastern Sedge Frog						x	x		x	x	
Litoria inermis	Bumpy Rocket Frog										x	
Litoria latopalmata	Broad-Palmed Rocket Frog						x	x		x	x	
Litoria nasuta	Striped Rocket Frog									x		
Litoria peronii	Emerald-Spotted Tree Frog						x	x		x	x	
Litoria rubella	Desert Tree Frog						x			x	x	
Litoria wilcoxii	Wilcox's Frog									x		
Limnodynastidae												
Limnodynastes fletcheri	Long-thumbed Frog							x		x	x	
Limnodynastes peronii	Striped Marsh Frog									x		
Limnodynastes salmini	Salmon-Striped Frog			Y				x		x	x	
Limnodynastes tasmaniensis	Spotted Marsh Frog							x		x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Limnodynastes terraereginae	Scarlet-Sided Pobblebonk						x	x		x	x	
	Neobatrachus sudelli	Sudell's Frog							x		x	x	
	Notaden bennettii	Holy Cross Toad							x		x	x	
	Platyplectrum ornatum	Ornate Burrowing Frog							x		x	x	
Myobatrachidae													
	Crinia deserticola	Desert Froglet							x		x		
	Crinia parinsignifera	Beeping Froglet							x		x	x	
	Crinia signifera	Clicking Froglet									x		
	Pseudophryne major	Major Toadlet									x	x	
	Uperoleia fusca	Sandy Gungan			Y				x		x		
	Uperoleia laevigata	Eastern Gungan							x		x		
	Uperoleia rugosa	Chubby Gungan							x		x	x	
	TOTALS	**29**	**1**	**0**	**2**	**1**	**0**	**8**	**21**	**0**	**28**	**20**	**1**

Reptiles N = 96

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Cheluidae													
	Chelodina expansa	Broad-Shelled River Turtle			Y			x			x		
	Chelodina longicollis	Long-necked Turtle									x	x	
	Emydura macquarii	Murray Short-necked Turtle			Y			x	x		x		
Gekkonidae													
	Diplodactylus tessellatus	Tessellated Gecko									x		
	Diplodactylus vittatus	Stone Gecko						x	x		x	x	
	Gehyra dubia	Dubious Dtella						x	x		x	x	x
	Gehyra variegata	Variegated Dtella							x		x	x	
	Heteronotia binoei	Bynoe's Gecko						x	x		x	x	x
	Lucasium steindachneri	Box-Patterned Gecko						x	x		x	x	
	Oedura robusta	Robust Velvet Gecko							x		x	x	
	Oedura monilis	Ocellated Velvet Gecko							x				
	Oedura tryoni	Southern Spotted Velvet Gecko						x	x		x		
	Strophurus taenicauda	Golden-tailed Gecko	NT						x		x	x	x
	Strophurus williamsi	Eastern Spiny-tailed Gecko									x	x	
	Underwoodisaurus milii	Thick-tailed Gecko							x				
Pygopodidae													
	Delma inornata	Patternless Delma			Y						x		
	Delma plebeia	Common Delma			Y				x		x		
	Delma tincta	Excitable Delma							x		x		

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Delma torquata	Collared Delma	Vu	Vu					x		x		
	Lialis burtonis	Burton's Snake Lizard						x	x		x		
	Paradelma orientalis	Brigalow Scaly-foot	Vu	Vu					x		x	x	x
	Pygopus lepidopodus	Common Scaly-foot									x		
	Pygopus schraderi	Eastern Hooded Scaly-foot										x	
Scincidae													
	Anomalopus leuckartii	Two-Clawed Worm-Skink							x		x		
	Anomalopus mackayi	Five-Clawed Worm-Skink	En	Vu					x		x		
	Anomalopus verreauxii	Verreaux's Skink							x		x		
	Carlia foliorum							x	x		x	x	x
	Carlia munda								x				
	Carlia mundivensis								x				
	Carlia pectoralis							x	x		x	x	
	Carlia schmeltzii	Robust Rainbow-Skink							x				
	Carlia tetradactyla								x		x		
	Carlia vivax								x		x	x	
	Cryptoblepharus pannosus										x	x	
	Cryptoblepharus pulcher							x	x		x	x	x
	Ctenotus allotropis										x		
	Ctenotus ingrami	Ingram’s Ctenotus			Y						x		
	Ctenotus robustus	Eastern Striped Skink						x	x		x	x	
	Ctenotus taeniolatus	Copper-tailed Skink									x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Cyclodomorphus gerrardii	Pink-tongued Skink			Y				x		x		
	Egernia rugosa	Yakka Skink	Vu	Vu							x		x
	Egernia striolata	Tree Skink						x	x		x	x	
	Eremiascincus richardsonii	Broad-banded Sand-Swimmer							x		x	x	
	Eulamprus martinii								x				
	Lampropholis delicata										x		
	Lampropholis guichenoti										x		
	Lerista fragilis								x		x	x	
	Lerista punctatovittata							x	x		x	x	
	Lerista timida							x	x		x	x	
	Liopholis modesta								x		x		
	Menetia greyii								x		x	x	
	Menetia timlowi	Dwarf Litter-Skink							x		x	x	
	Morethia boulengeri							x	x		x	x	
	Morethia taeniopleura	Fire-tailed Skink									x		
	Saiphos equalis	Three-toed Skink							x				
	Tiliqua rugosa	Shingleback			Y			x			x	x	
	Tiliqua scincoides	Eastern Blue-tongued Lizard									x		
Agamidae													
	Amphibolurus burnsi	Burns' Dragon						x	x		x	x	
	Amphibolurus gilberti	Ta Ta Lizard							x		x		
	Amphibolurus muricatus	Jacky Lizard			Y						x		

Family		Status					Source					
Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Amphibolurus nobbi	Nobbi Dragon							x		x		
Diporiphora australis	Tommy Round-Head							x		x		
Physignathus lesueurii	Eastern Water Dragon			Y			x			x		
Pogona barbata	Common Bearded Dragon						x	x		x	x	
Tympanocryptis cf. tetraporophora	Grassland Earless Dragon	En	En								x	
Varanidae												
Varanus gouldii	Sand Monitor						x			x	x	
Varanus panoptes	Yellow-Spotted Monitor			Y			x			x	x	
Varanus tristis	Freckled Monitor									x		
Varanus varius	Lace Monitor						x			x	x	
Typhlopidae												
Ramphotyphlops ligatus								x		x	x	
Ramphotyphlops nigrescens										x		
Ramphotyphlops proximus								x				
Ramphotyphlops wiedii										x		
Boidae												
Antaresia maculosa	Spotted Python									x		
Morelia spilota	Coastal Carpet Python									x	x	
Colubridae												
Boiga irregularis	Brown Tree Snake							x				
Dendrelaphis punctulatus	Green Tree Snake							x		x	x	
Tropidonophis mairii	Freshwater Snake							x				

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Elapidae													
	Acanthophis antarcticus	Common Death Adder	Ra								x		
	Brachyurophis australis	Australian Coral Snake							x		x		
	Cacophis harriettae	White-Crowned Snake							x		x		
	Cryptophis boschmai	Carpentaria Snake			Y			x	x				
	Cryptophis nigrescens	Small-eyed Snake							x		x		
	Demansia psammophis	Yellow-faced Whip Snake							x		x		
	Denisonia devisi	De Vis' Banded Snake							x		x	x	
	Furina diadema	Red-naped Snake						x	x		x	x	x
	Furina dunmalli	Dunmall's Snake	Vu	Vu					x		x		
	Hemiaspis damelii	Grey Snake	En						x		x	x	x
	Hoplocephalus bitorquatus	Pale-Headed Snake			Y				x		x	x	
	Parasuta dwyeri	Dwyer's Snake						x	x		x	x	
	Pseudechis australis	Mulga Snake							x		x		
	Pseudechis guttatus	Spotted Black Snake			Y			x	x		x		
	Pseudechis porphyriacus	Red-bellied Black Snake						x	x		x	x	
	Pseudonaja textilis	Eastern Brown Snake						x	x		x	x	
	Suta suta	Curl Snake							x		x		
	Vermicella annulata	Bandy Bandy							x		x		
	TOTALS	**96**	**9**	**6**	**13**	**0**	**0**	**29**	**67**	**0**	**83**	**43**	**9**

Birds N = 307

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Acanthizidae													
	Acanthiza apicalis	Inland Thornbill						x		x	x	x	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill						x		x	x	x	
	Acanthiza lineata	Striated Thornbill								x	x	x	
	Acanthiza nana	Little Thornbill						x		x	x	x	
	Acanthiza pusilla	Brown Thornbill						x		x	x	x	
	Acanthiza reguloides	Buff-rumped Thornbill						x		x	x	x	x
	Acanthiza uropygialis	Chestnut-rumped Thornbill						x		x	x	x	x
	Aphelocephala leucopsis	Southern Whiteface								x			
	Chthonicola sagittata	Speckled Warbler			Y			x		x	x	x	
	Gerygone albogularis	White-throated Gerygone						x		x	x	x	
	Gerygone fusca	Western Gerygone								x	x		
	Gerygone mouki	Brown Gerygone								x			
	Sericornis citreogularis	Yellow-throated Scrubwren								x	x		
	Sericornis frontalis	White-browed Scrubwren								x	x		
	Sericornis magnirostra	Large-billed Scrubwren								x			
	Smicrornis brevirostris	Weebill						x		x	x	x	x

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Accipitridae													
	Accipiter cirrocephalus	Collared Sparrowhawk						x		x	x	x	
	Accipiter fasciatus	Brown Goshawk						x	x	x	x	x	
	Accipiter novaehollandiae	Grey Goshawk	Ra							x	x		x
	Aquila audax	Wedge-tailed Eagle						x		x	x	x	
	Aviceda subcristata	Pacific Baza								x	x		
	Circus approximans	Swamp Harrier								x	x		
	Circus assimilis	Spotted Harrier								x	x		
	Elanus axillaris	Black-Shouldered Kite						x		x	x	x	
	Elanus scriptus	Letter-Winged Kite									x		
	Erythrotriorchis radiatus	Red Goshawk	En	Vu							x		x
	Haliaeetus leucogaster	White-bellied Sea-eagle					Mig			x	x		
	Haliastur sphenurus	Whistling Kite						x		x	x	x	
	Hamirostra melanosternon	Black-breasted Buzzard									x		
	Hieraaetus morphnoides	Little Eagle						x		x	x		
	Lophoictinia isura	Square-tailed Kite	Ra					x		x	x	x	x
	Milvus migrans	Black Kite								x	x		
	Pandion cristatus	Eastern Osprey									x		
Acrocephalidae													
	Acrocephalus australis	Australian Reed-Warbler						x		x	x		

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Aegothelidae													
	Aegotheles cristatus	Australian Owlet Nightjar								x	x	x	
Alaudidae													
	Mirafra javanica	Horsfield’s Bushlark						x		x	x		
Alcedinidae													
	Ceyx azureus	Azure Kingfisher									x		
Anatidae													
	Anas castanea	Chestnut Teal								x	x		
	Anas gracilis	Grey Teal						x		x	x	x	
	Anas platyrhynchos	Northern Mallard				I				x	x		
	Anas rhynchotis	Blue-Winged Shoveller							x	x	x		
	Anas superciliosa	Black Duck						x		x	x	x	
	Aythya australis	Hardhead								x	x	x	
	Biziura lobata	Musk Duck								x	x		
	Cairina moschata	Muscovy Duck				I				x			
	Chenonetta jubata	Wood Duck						x	x	x	x	x	
	Cygnus atratus	Black Swan								x	x	x	
	Dendrocygna arcuata	Wandering Whistling Duck							x	x	x		
	Dendrocygna eytoni	Plumed Whistling Duck						x	x	x	x	x	
	Malacorhynchus membranaceus	Pink-eared Duck								x	x		
	Nettapus coromandelianus	Cotton Pygmy-Goose	Ra				Mig			x	x		
	Oxyura australis	Blue-billed Duck								x	x		

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Stictonetta naevosa	Freckled Duck	Ra							x	x		
Anhingidae													
	Anhinga novaehollandiae	Australasian Darter						x	x	x	x	x	
Anseranatidae													
	Anseranas semipalmata	Magpie Goose								x	x	x	
Apodidae													
	Apus pacificus	Fork-tailed Swift					Mig			x	x		
	Hirundapus caudacutus	White-throated Needletail					Mig	x	x	x	x	x	
Ardeidae													
	Ardea ibis	Cattle Egret					Mig			x	x		
	Ardea intermedia	Intermediate Egret						x		x	x	x	
	Ardea modesta	Eastern Great Egret					Mig*	x		x	x	x	
	Ardea pacifica	White-necked Heron						x		x	x	x	
	Egretta garzetta	Little Egret								x	x		
	Egretta novaehollandiae	White-faced Heron						x	x	x	x	x	
	Ixobrychus dubius	Australian Little Bittern									x		
	Ixobrychus flavicollis	Black Bittern								x	x		
	Nycticorax caledonicus	Nankeen Night-Heron						x		x	x	x	
Artamidae													
	Artamus cinereus	Black-faced Woodswallow								x	x	x	
	Artamus cyanopterus	Dusky Woodswallow								x	x		
	Artamus leucorynchus	White-breasted Woodswallow						x		x	x	x	
	Artamus minor	Little Woodswallow						x		x	x		
	Artamus personatus	Masked Woodswallow								x	x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Artamus superciliosus	White-browed Woodswallow								x	x	x	
	Cracticus nigrogularis	Pied Butcherbird						x	x	x	x	x	
	Cracticus tibicen	Australian Magpie						x	x	x	x	x	
	Cracticus torquatus	Grey Butcherbird						x		x	x	x	x
	Strepera graculina	Pied Currawong						x		x	x	x	
Burhinidae													
	Burhinus grallarius	Bush Stone-Curlew			Y					x	x		
Cacatuidae													
	Cacatua galerita	Sulphur-crested Cockatoo						x		x	x	x	
	Cacatua sanguinea	Little Corella						x		x	x	x	
	Cacatua tenuirostris	Long-billed Corella								x			
	Calyptorhynchus banksii	Red-tailed Black-Cockatoo								x	x	x	
	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo								x	x	x	
	Calyptorhynchus lathami	Glossy Black Cockatoo	Vu					x		x	x	x	x
	Eolophus roseicapillus	Galah						x		x	x	x	x
	Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vu								x		
	Nymphicus hollandicus	Cockatiel						x	x	x	x	x	x
Campephagidae													
	Coracina lineata	Barred Cuckoo-Shrike								x			
	Coracina maxima	Ground Cuckoo-Shrike						x	x	x	x		
	Coracina novaehollandiae	Black-faced Cuckoo-Shrike						x		x	x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Coracina papuensis	Little Cuckoo-Shrike						x		x	x	x	x
	Coracina tenuirostris	Cicadabird						x		x	x	x	
	Lalage leucomela	Varied Triller						x					
	Lalage sueurii	White-Winged Triller						x		x	x	x	
Casuariidae													
	Dromaius novaehollandiae	Emu						x		x	x	x	
Charadriidae													
	Charadrius ruficapillus	Red-Capped Plover								x	x		
	Elseyornis melanops	Black-fronted Dotterel						x		x	x	x	
	Erythrogonys cinctus	Red-kneed Dotterel								x	x		
	Pluvialis fulva	Pacific Golden Plover					Mig				x		
	Vanellus miles	Masked Plover						x	x	x	x	x	
	Vanellus tricolor	Banded Lapwing								x	x		
Ciconiidae													
	Ephippiorhynchus asiaticus	Black-necked Stork	Ra					x		x	x		x
Cisticolidae													
	Cisticola exilis	Golden-headed Cisticola						x		x	x		
Climacteridae													
	Climacteris picumnus	Brown Treecreeper			Y					x	x	x	
	Cormobates leucophaea	White-throated Treecreeper						x	x	x	x	x	
Columbidae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Columba leucomela	White-headed Pigeon								x			
	Columba livia	Feral Pigeon				I		x		x	x		
	Geopelia cuneata	Diamond Dove								x	x		
	Geopelia humeralis	Bar-shouldered Dove						x	x	x	x	x	
	Geopelia striata	Peaceful Dove						x	x	x	x	x	
	Geophaps scripta	Squatter Pigeon	Vu	Vu						x	x		
	Leucosarcia picata	Wonga Pigeon								x	x		
	Lopholaimus antarcticus	Topknot Pigeon								x			
	Macropygia amboinensis	Brown Cuckoo-Dove								x			
	Ocyphaps lophotes	Crested Pigeon						x		x	x	x	x
	Phaps chalcoptera	Common Bronzewing						x		x	x	x	
	Ptilinopus magnificus	Wompoo Pigeon							x				
	Streptopelia chinensis	Spotted Turtle-Dove				I				x	x		
Coraciidae													
	Eurystomus orientalis	Dollarbird						x		x	x	x	
Corcoracidae													
	Corcorax melanorhamphos	White-Winged Chough						x		x	x	x	
	Struthidea cinerea	Apostlebird						x	x	x	x	x	
Corvidae													
	Corvus bennetti	Little Crow								x	x		
	Corvus coronoides	Australian Raven						x		x	x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Corvus orru	Australian Crow						x		x	x	x	x
Cuculidae													
	Cacomantis flabelliformis	Fan-tailed Cuckoo								x	x		
	Cacomantis pallidus	Pallid Cuckoo							x	x	x	x	
	Cacomantis variolosus	Brush Cuckoo						x		x	x		
	Centropus phasianinus	Pheasant Coucal						x		x	x		
	Chalcites basalis	Horsfield's Bronze-Cuckoo						x		x	x	x	
	Chalcites lucidus	Shining Bronze-Cuckoo						x		x	x		
	Chalcites minutillus	Little Bronze-Cuckoo						x			x	x	
	Chalcites osculans	Black-eared Cuckoo								x	x		
	Eudynamys orientalis	Eastern Koel						x	x	x	x		
	Scythrops novaehollandiae	Channel-billed Cuckoo						x		x	x		
Dicruridae													
	Dicrurus bracteatus	Spangled Drongo								x	x	x	
Estrildidae													
	Lonchura castaneothorax	Chestnut-breasted Mannikin								x	x		
	Neochmia modesta	Plum-headed Finch						x		x	x	x	
	Neochmia temporalis	Red-browed Finch							x	x	x	x	
	Stagonopleura guttata	Diamond Firetail			Y				x	x	x		
	Taeniopygia bichenovii	Double-barred Finch						x	x	x	x	x	
	Taeniopygia guttata	Zebra Finch						x		x	x		

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Eupetidae													
	Psophodes olivaceus	Eastern Whipbird								x			
Eurostopodidae													
	Eurostopodus argus	Spotted Nightjar										x	
	Eurostopodus mystacalis	White-throated Nightjar						x		x	x	x	
Falconidae													
	Falco berigora	Brown Falcon						x		x	x	x	
	Falco cenchroides	Nankeen Kestrel						x	x	x	x	x	
	Falco longipennis	Little Falcon								x	x		
	Falco peregrinus	Peregrine Falcon								x	x		
	Falco subniger	Black Falcon								x	x		
Glareolidae													
	Stiltia isabella	Australian Pratincole							x		x		
Gruidae													
	Grus rubicunda	Brolga								x	x		
Halcyonidae													
	Dacelo novaeguineae	Laughing Kookaburra						x		x	x	x	
	Todiramphus macleayii	Forest Kingfisher							x	x	x		
	Todiramphus pyrrhopygius	Red-backed Kingfisher								x	x		
	Todiramphus sanctus	Sacred Kingfisher						x		x	x	x	
Hirundinidae													
	Cheramoeca leucosterna	White-backed Swallow							x	x	x		
	Hirundo neoxena	Welcome Swallow						x		x	x		

Family			Status					Source					
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	Petrochelidon ariel	Fairy Martin						x	x	x	x		
	Petrochelidon nigricans	Tree Martin								x	x		
Jacanidae													
	Irediparra gallinacea	Comb-crested Jacana								x	x		
Laridae													
	Chlidonias hybrida	Marsh Tern								x	x		
	Chlidonias leucopterus	White-winged Black Tern					Mig			x			
	Chroicocephalus novaehollandiae	Silver Gull								x	x		
	Gelochelidon nilotica	Gull-billed Tern								x	x		
	Hydroprogne caspia	Caspian Tern					Mig			x	x		
Maluridae													
	Malurus cyaneus	Superb Fairy-Wren						x	x	x	x	x	
	Malurus lamberti	Variegated Fairy-Wren						x		x	x	x	
	Malurus leucopterus	White-winged Fairy-Wren						x		x	x		
	Malurus melanocephalus	Red-backed Fairy-Wren						x		x	x		
Megaluridae													
	Cincloramphus cruralis	Brown Songlark								x	x	x	
	Cincloramphus mathewsi	Rufous Songlark						x		x	x	x	
	Megalurus gramineus	Little Grassbird									x		
	Megalurus timoriensis	Tawny Grassbird									x		
Meliphagidae													
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater						x		x	x	x	x
	Acanthorhynchus tenuirostris	Eastern Spinebill								x			

Family			Status					Source					
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	Anthochaera carunculata	Red Wattlebird								x			
	Anthochaera phrygia	Regent Honeyeater	En	En			Mig			x	x		x
	Entomyzon cyanotis	Blue-faced Honeyeater						x	x	x	x	x	
	Epthianura tricolor	Crimson Chat								x			
	Grantiella picta	Painted Honeyeater	Ra							x	x		x
	Lichenostomus chrysops	Yellow-faced Honeyeater						x		x	x	x	x
	Lichenostomus fuscus	Fuscous Honeyeater						x		x	x	x	
	Lichenostomus leucotis	White-eared Honeyeater						x		x	x	x	
	Lichenostomus melanops	Yellow-tufted Honeyeater								x	x	x	
	Lichenostomus penicillatus	White-plumed Honeyeater						x		x	x	x	
	Lichenostomus virescens	Singing Honeyeater								x	x		
	Lichmera indistincta	Brown Honeyeater						x		x	x	x	
	Manorina flavigula	Yellow-throated Miner						x		x	x		x
	Manorina melanocephala	Noisy Miner						x	x	x	x	x	x
	Manorina melanophrys	Bell Miner								x			
	Meliphaga lewinii	Lewin's Honeyeater								x	x		
	Melithreptus albogularis	White-throated Honeyeater								x	x	x	
	Melithreptus brevirostris	Brown-headed Honeyeater						x		x	x	x	
	Melithreptus gularis	Black-chinned Honeyeater	Ra							x	x		x
	Melithreptus lunatus	White-naped Honeyeater								x	x		
	Myzomela sanguinolenta	Scarlet Honeyeater								x	x	x	

Family			Status					Source					
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	Philemon citreogularis	Little Friarbird						x		x	x	x	
	Philemon corniculatus	Noisy Friarbird						x	x	x	x	x	x
	Plectorhyncha lanceolata	Striped Honeyeater						x	x	x	x	x	x
	Sugomel niger	Black Honeyeater								x	x		
Meropidae													
	Merops ornatus	Rainbow Bee-eater					Mig	x		x	x	x	
Monarchidae													
	Grallina cyanoleuca	Magpie-lark						x	x	x	x	x	
	Monarcha melanopsis	Black-faced Monarch					Mig			x	x		
	Myiagra cyanoleuca	Satin Flycatcher					Mig				x		
	Myiagra inquieta	Restless Flycatcher						x		x	x	x	
	Myiagra rubecula	Leaden Flycatcher						x		x	x	x	
	Symposiarchus trivirgatus	Spectacled Monarch					Mig	x					
Motacillidae													
	Anthus novaeseelandiae	Australian Pipit								x	x	x	
Nectariniidae													
	Dicaeum hirundinaceum	Mistletoebird						x		x	x	x	x
Neosittidae													
	Daphoenositta chrysoptera	Varied Sittella						x		x	x	x	
Odontophoridae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Oriolus sagittatus	Olive-backed Oriole						x		x	x	x	
	Sphecotheres vieilloti	Australasian Figbird						x		x	x		
Otididae													
	Ardeotis australis	Australian Bustard						x		x	x		
Pachycephalidae													
	Colluricincla harmonica	Grey Shrike-Thrush						x		x	x	x	
	Falcunculus frontatus	Crested Shrike-Tit								x			
	Oreoica gutturalis	Crested Bellbird									x		
	Pachycephala pectoralis	Golden Whistler							x	x	x		
	Pachycephala rufiventris	Rufous Whistler						x		x	x	x	
Paradisaeidae													
	Ptiloris paradiseus	Paradise Riflebird								x			
Pardalotidae													
	Pardalotus punctatus	Spotted Pardalote						x		x	x	x	
	Pardalotus rubricatus	Red-browed Pardalote								x	x		
	Pardalotus striatus	Striated Pardalote						x		x	x	x	
Passeridae													
	Passer domesticus	House Sparrow				I		x		x	x		
Pedionomidae													
	Pedionomus torquatus	Plains-Wanderer	Vu	Vu							x		x
Pelecanidae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Pelecanus conspicillatus	Australian Pelican						x		x	x	x	
Petroicidae													
	Eopsaltria australis	Eastern Yellow Robin						x		x	x	x	
	Melanodryas cucullata	Hooded Robin			Y			x		x	x		
	Microeca fascinans	Jacky Winter						x	x	x	x	x	
	Petroica goodenovii	Red-capped Robin						x		x	x	x	
	Petroica rosea	Rose Robin								x	x		
Phalacrocoracidae													
	Microcarbo melanoleucos	Little Pied Cormorant						x		x	x	x	
	Phalacrocorax carbo	Great Cormorant								x	x		
	Phalacrocorax sulcirostris	Little Black Cormorant						x		x	x		
	Phalacrocorax varius	Pied Cormorant								x	x		
Phasianidae													
	Coturnix pectoralis	Stubble Quail								x	x		
	Coturnix ypsilophora	Brown Quail						x	x	x	x		
	Excalfactoria chinensis	King Quail									x		
	Pavo cristatus	Indian Peafowl				I				x	x		
Pittidae													
	Pitta versicolor	Noisy Pitta									x		
Podargidae													
	Podargus strigoides	Tawny Frogmouth						x	x	x	x	x	

Family			Status					Source					
	Scientific name	Common name	NCA	EPBC	BBS Priority	Introduced	Migratory	Current survey	QM	BA	WN	Ecosmart	Other
Podicipedidae													
	Podiceps cristatus	Great-crested Grebe								x	x		
	Poliocephalus poliocephalus	Hoary-headed Grebe								x	x		
	Tachybaptus novaehollandiae	Australian Grebe						x	x	x	x	x	
Pomatostomidae													
	Pomatostomus superciliosus	White-browed Babbler			Y				x				
	Pomatostomus temporalis	Grey-crowned Babbler			Y			x	x	x	x	x	x
Procellariidae													
	Ardenna pacifica	Wedge-tailed Shearwater							x		x		
Psittacidae													
	Alisterus scapularis	Australian King-Parrot						x		x	x	x	
	Aprosmictus erythropterus	Red-winged Parrot						x		x	x	x	
	Barnardius zonarius	Australian Ringneck						x		x	x		
	Glossopsitta concinna	Musk Lorikeet								x	x	x	
	Glossopsitta pusilla	Little Lorikeet						x		x	x	x	
	Melopsittacus undulatus	Budgerigar								x	x		
	Neophema pulchella	Turquoise Parrot	Ra							x	x		x
	Northiella haematogaster	Blue Bonnet						x		x	x		
	Platycercus adscitus	Pale-headed Rosella						x	x	x	x	x	x
	Platycercus elegans	Crimson Rosella								x	x		
	Platycercus eximius	Eastern Rosella								x	x		

Family			Status					Source					
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	Psephotus haematonotus	Red-rumped Parrot						x	x	x	x	x	x
	Psephotus varius	Mulga Parrot								x			
	Psittacula krameri	Ring-necked Parakeet				I				x			
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet						x	x	x	x	x	x
	Trichoglossus haematodus	Rainbow Lorikeet								x	x	x	
Ptilonorhychidae													
	Ailuroedus crassirostris	Green Catbird								x			
	Ptilonorhynchus maculatus	Spotted Bowerbird						x		x	x		
	Ptilonorhynchus violaceus	Satin Bowerbird								x	x		
Rallidae													
	Fulica atra	Eurasian Coot								x	x	x	
	Gallinula tenebrosa	Dusky Moorhen						x		x	x	x	
	Gallirallus philippensis	Buff-banded Rail							x	x	x		
	Porphyrio porphyrio	Purple Swamphen								x	x	x	
	Porzana fluminea	Australian Spotted Crake									x		
	Porzana pusilla	Baillon's Crake									x		
	Tribonyx ventralis	Black-tailed Native-Hen								x	x		
Recurvirostridae													
	Himantopus himantopus	Pied Stilt								x	x	x	
	Recurvirostra novaehollandiae	Red-necked Avocet								x	x		
Rhipiduridae													

Family			Status					Source					
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	Rhipidura albiscapa	Grey Fantail						x		x	x	x	x
	Rhipidura leucophrys	Willie Wagtail						x		x	x	x	
	Rhipidura rufifrons	Rufous Fantail					Mig	x		x	x		
Rostratulidae													
	Rostratula australis	Australian Painted Snipe	Vu	Vu			Mig			x	x		
Scolopacidae													
	Actitis hypoleucos	Common Sandpiper					Mig				x		
	Calidris acuminata	Sharp-tailed Sandpiper					Mig			x	x		
	Calidris ferruginea	Curlew Sandpiper					Mig			x	x		
	Calidris ruficollis	Red-necked Stint					Mig				x		
	Gallinago hardwickii	Latham's Snipe					Mig	x	x	x	x	x	
	Limosa lapponica	Bar-tailed Godwit					Mig				x		
	Limosa limosa	Black-tailed Godwit					Mig			x	x		
	Numenius minutus	Little Curlew					Mig				x		
	Numenius phaeopus	Whimbrel					Mig				x		
	Philomachus pugnax	Ruff					Mig				x		
	Tringa glareola	Wood Sandpiper					Mig			x	x		
	Tringa nebularia	Common Greenshank					Mig			x	x		
	Tringa stagnatilis	Marsh Sandpiper					Mig			x	x		
Strigidae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Ninox connivens	Barking Owl			Y					x	x		
	Ninox novaeseelandiae	Boobook Owl						x	x	x	x	x	
	Ninox strenua	Powerful Owl	Vu						x		x		x
Struthionidae													
	Struthio camelus	Ostrich				I					x		
Sturnidae													
	Sturnus tristis	Common Myna				I		x		x	x	x	
	Sturnus vulgaris	Common Starling				I				x	x		
Threskiornithidae													
	Platalea flavipes	Yellow-billed Spoonbill						x		x	x	x	
	Platalea regia	Royal Spoonbill								x	x	x	
	Plegadis falcinellus	Glossy Ibis						x	x	x	x	x	
	Threskiornis molucca	Australian White Ibis						x		x	x	x	
	Threskiornis spinicollis	Straw-necked Ibis						x		x	x	x	
Timaliidae													
	Zosterops lateralis	Silvereye						x	x	x	x	x	
Turnicidae													
	Turnix pyrrhothorax	Red-chested Button-Quail						x			x	x	
	Turnix varius	Painted Button-Quail						x		x	x		x
	Turnix velox	Little Button-Quail								x	x		
Tytonidae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Tyto javanica	Barn Owl							x	x	x	x	
	Tyto novaehollandiae	Masked Owl			Y					x			
	TOTALS	**307**	**16**	**5**	**9**	**10**	**29**	**146**	**52**	**273**	**281**	**141**	**33**

*The eastern great egret is listed as migratory under the name *Ardea alba*.

Mammals N = 63

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Ornithorhynchidae													
	Ornithorhynchus anatinus	Platypus			Y						x		
Tachyglossidae													
	Tachyglossus aculeatus	Short-beaked Echidna						x			x	x	
Acrobatidae													
	Acrobates pygmaeus	Feathertail Glider									x		
Macropodidae													
	Macropus dorsalis	Black-Striped Wallaby			Y			x			x	x	

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Macropus giganteus	Eastern Grey Kangaroo						x			x	x	
	Macropus parryi	Whiptail Wallaby							x		x		
	Macropus robustus	Common Wallaroo						x			x		
	Macropus rufogriseus	Red-necked Wallaby						x			x	x	
	Macropus rufus	Red Kangaroo						x			x		
	Petrogale penicillata	Brush-tailed Rock-Wallaby	Vu	Vu							x		
	Wallabia bicolor	Swamp Wallaby						x			x	x	
Peramelidae													
	Isoodon macrourus	Northern Brown Bandicoot			Y						x		
Petauridae													
	Petaurus breviceps	Sugar Glider									x	x	
	Petaurus norfolcensis	Squirrel Glider			Y						x	x	
Phalangeridae													
	Trichosurus caninus	Mountain Brushtail Possum									x		
	Trichosurus vulpecula	Common Brushtail Possum			Y			x	x		x	x	
Phascolarctidae													
	Phascolarctos cinereus	Koala			Y			x	x		x	x	
Potoroidae													
	Aepyprymnus rufescens	Rufous Bettong			Y			x			x	x	x
Pseudocheiridae													
	Petauroides volans	Greater Glider			Y			x			x	x	
	Pseudocheirus peregrinus	Common Ringtail Possum			Y				x				

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
Dasyuridae													
	Antechinus flavipes	Yellow-footed Antechinus							x		x		
	Dasyurus maculatus	Spotted-tailed Quoll (sthn ssp.)	Vu	En							x		
	Phascogale tapoatafa	Brush-tailed Phascogale			Y						x		
	Planigale tenuirostris	Narrow-nosed Planigale			Y						x		
	Sminthopsis crassicaudata	Fat-tailed Dunnart							x				
	Sminthopsis macroura	Stripe-faced Dunnart							x		x		
	Sminthopsis murina	Common Dunnart							x		x	x	
Pteropodidae													
	Pteropus alecto	Black Flying-fox									x		
	Pteropus scapulatus	Little Red Flying-fox							x		x	x	
Emballonuridae													
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat							x		x		
Molossidae													
	Mormopterus beccarii	Beccari's Freetail Bat									x		
	Mormopterus planiceps	Little Mastiff-bat							x				
	Mormopterus sp. 2	Eastern Freetail Bat									x		
	Mormopterus sp. 3	Inland Freetail Bat									x		
	Tadarida australis	White-Striped Freetail Bat									x		
Vespertilionidae													
	Chalinolobus gouldii	Gould's Wattled Bat									x		
	Chalinolobus morio	Chocolate Wattled Bat									x		

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Chalinolobus picatus	Little Pied Bat	Ra								x	x	x
	Nyctophilus geoffroyi	Lesser Long-eared Bat							x		x	x	
	Nyctophilus gouldi	Gould's Long-eared Bat						x	x		x	x	
	Nyctophilus corbeni (= N. timoriensis)	South-eastern Long-eared Bat	Vu	Vu							x	x	x
	Scoteanax rueppellii	Greater Broad-nosed Bat									x		
	Scotorepens balstoni	Western Broad-nosed Bat							x		x	x	
	Scotorepens greyii	Little Broad-nosed Bat							x		x	x	
	Scotorepens orion	South-eastern Broad-nosed Bat									x		
	Scotorepens sp. (Parnaby)	Central-eastern Broad-nosed Bat			Y						x		
	Vespadelus darlingtoni	Large Forest Bat									x		
	Vespadelus troughtoni	Eastern Cave Bat									x		
	Vespadelus vulturnus	Little Forest Bat							x		x	x	
Muridae													
	Hydromys chrysogaster	Water Rat									x	x	
	Mus musculus	House Mouse				I			x		x	x	
	Pseudomys delicatulus	Delicate Mouse							x		x	x	
	Rattus rattus	Black Rat				I					x		
	Rattus tunneyi	Pale Field Rat							x		x		
Bovidae													
	Bos taurus	European Cattle				I					x		
	Capra hircus	Goat				I					x		
Equidae													

Family			Status					Source					
	Scientific name	**Common name**	**NCA**	**EPBC**	**BBS Priority**	**Introduced**	**Migratory**	**Current survey**	**QM**	**BA**	**WN**	**Ecosmart**	**Other**
	Equus caballus	Brumby				I			x				
Leporidae													
	Lepus capensis	European Hare				I		x			x		
	Oryctolagus cuniculus	Rabbit				I		x			x		
Suidae													
	Sus scrofa	Feral Pig				I		x			x		
Canidae													
	Canis lupus	Dog/Dingo				I		x			x	x	
	Vulpes vulpes	European Fox				I		x			x		
Felidae													
	Felis catus	Feral Cat				I		x			x		
	TOTALS	**63**	**4**	**3**	**12**	**11**	**0**	**18**	**20**	**0**	**59**	**24**	**3**

Appendix H. Excluded Fauna Species

The table below lists 18 EVNT fauna species that have been recorded from, or flagged as potentially occurring within, the broad PDA, but that have been excluded from the assessment process. Briefly, most of these species have been dismissed due to a lack of recent records and a lack of suitable habitat within the PDA.

Species	NCA	EPBC	Source	Notes
Giant barred Frog *Mixophyes iteratus*	En	En	EPBC Online	Within the bioregion, this species is known only from the Bunya Mountains. The project area does not encompass this location, or other areas of suitable habitat.
Bell's Turtle *Elseya belli*	Not Listed	Vu	EPBC Online	In Queensland, known only from Bald Rock Creek. The project area does not encompass this location.
Fitzroy River Turtle *Rheodytes leukops*	Vu	Vu	EPBC Online	This species does not occur as far south as the project area.
Border Thick-tailed Gecko *Underwoodisaurus sphyrurus*	Ra	Vu	EPBC Online	Located south of the project area. No specimen or sightings to suggest this species might occur.
Long-nosed Potoroo *Potorous tridactylus*	Vu	Vu	EPBC Online	EPBC predictive results. No specimen or observation records. Habitat within the project area is poor for this species.
Northern Quoll *Dasyurus hallucatus*	Not Listed	En	EPBC Online	EPBC predictive results. No specimen or observation records.
Brush-tailed Rock-wallaby *Petrogale penicillata*	Vu	Vu	W'Net	Three post-1980 records from project area. In the project area, this species is known only from Wondul Range. As of 2008, this population was thought to be extinct (EPA 2008).
Grey-headed Flying-fox *Pteropus poliocephalus*	Not Listed	Vu	EPBC Online	EPBC predictive results. Unusual/vagrant west of the range. No specimen or observation records.
Major Mitchell Cockatoo *Lophochroa leadbeateri*	Vu	Not Listed	W'Net	Seven pre-1980 records and one post-1980 record from project area. Typically observed well west of the project area. Vagrant records do not reflect permanent populations or regular habitat use.
Powerful Owl *Ninox strenua*	Vu	Not Listed	W'Net QM	One post-1980 record from project area within close proximity to the Bunya Mountains. Little suitable habitat within the project area. Two pre-1980 records, including one 1885 record of low spatial precision from Chinchilla region.
Red Goshawk *Erythrotriorchis radiatus*	En	Vu	W'Net	Two pre-1979 records of low spatial precision from the general area. A vagrant species.
Black-throated Finch *Poephila cincta*	En	En	W'Net QM	One 1885 record from project area. Locally extinct.
Plains-wanderer *Pedionomus torquatus*	Vu	Vu	W'Net	One undated (so probably pre-1980) record from project area. Little suitable habitat. Vagrant.
Swift Parrot *Lathamus discolor*	En	En	W'Net	Three pre-1965 records of low spatial precision from the general area. Vagrant.

Species	NCA	EPBC	Source	Notes
Southern Star Finch *Neochmia r. ruficauda*	En	En	EPBC Online	Species unlikely to occur as far south as project area. Locally extinct or always vagrant.
Black-breasted Button-quail *Turnix melanogaster*	Vu	Vu	EPBC Online	Known from State Forests north (but connected to) Barakula. Little suitable habitat within the project area and no confirmed records from the project area.
Superb Parrot *Polytelis swainsonii*	Not Listed	Vu	EPBC Online	No known records from project site. The only Queensland records of this species appear to be of vagrants (DEHWA 2009)

Key:-
En = Endangered; Vu = Vulnerable; W'Net = WildNet; WM = Queensland Museum; EPBC Online = EPBC Protected Matters search tool;

References

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Appendix I. Fauna Species Profiles

BUTTERFLIES

Bulloak Jewel Butterfly (Hypochrysops piceatus)

Status

NCA: endangered; EPBC: not listed

Sands and New (2002 p331) consider the species to be nationally Endangered.

Distribution and habitat

The bulloak jewel butterfly is known from three isolated locations west of the Darling Downs, near Millmerran, Leyburn and Goondiwindi. The largest population appears to centre around Leyburn, where about 11 meta-populations were found between 1998 and 2000 over an area of approximately 8 x 1.5km (Sands and New 2002). In 2001 an additional locality at Bendidee National Park was validated by the collection of a specimen (Sands and New 2002). Subsequent surveys around Bendidee located the species within the adjacent State Forest and on nearby private land (Sands 2003). Near Millmerran at Mount Emlyn, the butterfly is known from only one specimen collected in 1967 (Sands and New 2002). This population is now thought to be extinct (Lundie-Jenkins and Payne 2000).

Anectodal sightings have also been recorded from Dunmore state Forest, Kumbarilla State Forest, Braemar State Forest and within northern NSW (Sands and New 2002; Sands 2003; D. Sands *pers. comm*). However, specimen verification of these areas has not occurred.

Bulloak Jewel Butterflies occur in vegetation containing old-growth (approx 100+ years old) bulloak (*Allocasuarina luehmannii*) trees. Senescing trees with several hollow horizontal branches appear to be necessary for the species to complete its life-cycle. Larvae are attended by a small black ant, *Anonychomyrma* sp. (*itinerans* group), which is absent from burnt vegetation, young or regrowth bulloak and which prefers abundant dead or fallen debris (e.g., branches and logs) (Sands and New 2002). It has also been suggested that the butterfly may depend on eriococcid scale insects which are attended by the ant and therefore concentrate ant activity. This relationship is yet to be proven (Lundie-Jenkins and Payne 2000).

Ecology

Bulloak Jewel larvae feed exclusively on bulloak (*Allocasuarina luehmannii*). Eggs are deposited on twigs of old growth bulloaks, typically greater than 30cm DBH (diameter at breast height). These trees often are senescing and usually have numerous hollow branches in which larvae shelter during the day. The larvae are also attended by small black ants (*Anonychomyrma* sp.

itinerans group), which are likely to provide some protection from natural enemies (Eastwood and Fraser 1999).

Adults fly between late September and October, but may be sporadically located until December. A second adult generation may begin emerging in early to mid January, with peak emergence occurring in February. Most adults cease activity in March (Sands and New 2002).

Adults patrol through the canopy during the middle of the day, particularly between 1430h and 1730h when territorial behaviour seems to peak. When not flying, adults settle for extended periods on exposed sunny branches. Males generally fly higher (8-10m) than females (4-7m), the latter often settling to oviposit (Lundie-Jenkins and Payne 2000; Sands and New 2002). This high activity and their rapid flight make identification from other *Hypochrysop* species difficult in the field.

Adult butterflies feed on nearby flowers including Mistletoe (*Amyema linophyllum*) and *Jacksonia scoparia*. Other species of mistletoe and eucalypts may also be utilised (Lundie-Jenkins and Payne 2000).

<u>Threats</u>

A number of activities threaten this species, including:

- Clearing of old-growth bulloak communities, particularly through road widening or road maintenance.
- The loss of individual old-growth bulloak trees for use in fence or building construction.
- Loss of ground surface structure including fallen debris necessary for the attendant ant species through processes such as fire or fire wood collection.
- Changes in habitat and ground components causing increased ant competition and/or the loss of *Anonychomyrma* ants.

<u>Project-related Impacts (unmitigated)</u>

Activities associated with gas acquisition that could threaten this species include:

- Direct loss of habitat and breeding locations for the construction of facilities, gas gathering lines and access tracks. In some situations, entire meta-populations could be lost by the clearing of very small isolated Bulloak stands.
- Edge effects, particularly weed invasion, altering the ground structure rendering habitat unsuitable for the symbiotic ant species.

<u>Significance of Project Related Impacts (Unmitigated)</u>

This species is highly localised, currently verified from only three populations at Millmerran (Mount Emlyn), Goondiwindi (centred around Bendidee National Park) and Leyburn. It now appears extinct at Millmerran. Given its limited distribution, all known populations are extremely important to the survival of the species.

One of the three currently known populations is located within the EIS area. This population is centred on Bendidee National Park, but several meta-populations may occur nearby. These meta-populations may occur in very minor fragments, insufficient in size to be identified in remnant vegetation mapping. The minor extent of known populations makes them highly susceptible to habitat loss, which could occur if infrastructure planning does not avoid suitable or known habitats.

In addition, potential habitat for the species may also occur in Dunmore State Forest and around Cecil Plains, where unconfirmed sightings have been recorded. Due to the lack of knowledge surrounding the species distribution, it is feasible that the project may inadvertently affect unknown populations.

Existing or potential habitat may also be adversely affected by weed invasion. Incursions of exotic grasses will alter the ground strata structure. Current data suggests that the symbiotic and upon which the butterfly relies is highly selective in its habitat . Weed invasion could therefore lead to the loss of existing populations, even if direct clearing of habitat is avoided.

These factors suggest that the bulloak jewel is **Extremely Sensitive** to impacts and that the magnitute of these impacts could be **High**. Accordingly, the unmitigated significance of impacts is **Extremely High** (23).

<u>Proposed Management/ Mitigation Measures</u>

Habitat Avoidance

Areas mapped as “Core habitat known” or “Core habitat possible” should be buffered with a 300m management buffer and a 200m impact avoidance zone. No impacts are not expected if buffers are maintained. Due to the highly sensitive nature of this species, any clearance within core habitat known cannot be adequately mitigated.

Further Survey and Assessment

Should clearing within "Core habitat possible" be required, further survey work is necessary prior to clearing to determine the presence/absence of this species. If present, then an assessment is required to determine the extent and potential impact of proposed clearing activities on the population using the risk assessment methods detained in this report.

Surveys should only be undertaken by specialists familiar with the species and involve two stages:

1) initial visual inspection to ensure that *Allocasuarina leuhmanii* trees are of sufficient size and age and that other habitat characteristics are suitable. If unsuitable, clearing is possible without any expected impacts on this species.

2) If suitable habitat is located, field surveys are required during February when activity peaks. It may be necessary to undertake two survey events if conditions are unsuitable or the initial survey finds evidence of the species (e.g., the appropriate ants are present) but fails to locate individuals.

Other Measures

A 1000m management buffer zone should be erected around Bendidee National Park and a 300m management buffer zone maintained around Bendidee State Forest. A 200m 'no impact zone should be maintained around the state forest boundary which encompasses the Bendidee National Park. If clearing is required within 1000m of the Bendidee National Park or 300m of the state forest boundary, a stringent weed control plan must be developed prior to clearing. The plan should include weed control measures including rehabilitation and seeding with native species, wash-down, sediment capture (which could transport weed propagules) and direct weed removal techniques. The plan should include all exotic species that might affect habitat integrity (e.g., pastoral grasses), not just those listed under legislation. The plan should also include monitoring methods, trigger events which initiate specific removal actions and methods/strategies that are implemented to ensure weed infestation is controlled following closure.

Summary Residual Impact Assessment

The unmitigated impact significance for this species is Extremely High (23). With the exception of avoidance, no mitigation measures will alleviate clearing of core habitat known. *Avoidance is therefore the only feasible mitigation measure*. Successful revegetation is often difficult; the species only selects old-growth vegetation (100+ years) and is restricted by the presence of a symbiotic ant whose ability to colonise rehabilitated land is unknown.

Core Habitat Possible needs to be sterilised before no impacts can be guaranteed. Hence, further survey work and subsequent amendments to the habitat maps are the only mitigation measure that will relieve possible impacts in core habitat possible areas.

Clearing within 500m of a known population runs the risk of introducing weeds into important habitat areas. It is therefore not advisable, but impacts may be reduced if a stringent weed control strategy is designed and implemented.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	High	Extremely High (23)	Effective	largely ineffective

* No clearing of vegetation within areas of core habitat known.

Clearing of core habitat possible unavoidable.

Residual Significance Assessment

Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Ext. High	Extremely low	Moderate (11)	Extremely. High	High	Extremely. High (23)

Rule(s) for Habitat Mapping:

1. The species may occur anywhere within the EIS area south of Chinchilla.
2. Within the area, communities with a canopy or subcanopy of Bulloak (e.g. 11.5.1, 11.5.1a, 11.5.4, 11.5.21, 11.9.9, 11.10.1d) that have never been cleared (passed on available aerial photos) are classed as “Core Habitat Possible”. Visual inspection or survey is required for further discernment of suitability (e.g., ground strata condition and bulloak size).
3. Due to the lack of known populations in the north of the PDA, Core habitat possible north of Kumbarilla should be downgraded to “general habitat”.
4. All remnant vegetation within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”. This allows for the species’ mobility.
5. Remaining regional ecosystems are classed as “Absence Likely”.
6. Land used for cropping purposes is classed as “Absence Likely”.
7. Land used for grazing purposes is classed as “Absence Possible”. Within these areas, isolated fragments of suitable bulloak habitat may occur in sizes too small to be mapped.
8. For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.
9. Two vegetation patches consistent with this species’ habitat preferences were located during the surveys and should be the subject of further investigation if potentially affected by infrastructure. These two patches (“Core habitat possible – particular interest”) centre on AS25 (S27.06220^{o}; E150.91284^{o}) and AS42 (S27.53984^{o}; E151.16907^{o}).

Mapping Confidence

While the habitat requirements of this species are well documented, it is difficult to consider the size and age of Bulloak stands without detailed field inspection. As the precautionary principle has been followed, all uncleared Bulloak has been mapped and therefore large areas of unsuitable habitat may be included.

Furthermore, the species may inhabit patches of old-growth Bulloak that are very minor in extent. These may be insufficient in size to show on remnant vegetation maps and therefore suitable habitat may have been omitted.

The habitat map for this species is considered to be of MODERATE accuracy.

References

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Pale Imperial Hairstreak (*Jalmenus eubulus*)

Alternative Nomenclature

Eastwood *et al.* (2008) reviewed the taxonomy of *Jalmenus evagoras* and elevated the subspecies *J. evagoras eubulus* to species level based on differences in morphology, ecology and genetics. The species is referred to in previous publications as *Jalmenus evagoras eubulus*.

Status

NCA: vulnerable; EPBC: not listed

Eastwood *et al*. (2008) suggested that approximately 95% of the species' original habitat may have been lost due to land clearing. With less than 2,700km^2 of original habitat remaining, the local extinction of four populations (Millmerran, Rockhampton, Theodore and Dalby) and less than 10% of the extant population protected in reserves, Eastwood *et al*. (2008) suggested that the species should be considered as Vulnerable nationally. This status is not currently recognised in federal legislation.

Distribution and habitat

Jalmenus eubulus is restricted to the eastern Brigalow Belt Bioregion. The northern limit of its distribution appears to be around the latitude of Mackay and ranges south to around Boggabilla in northern NSW. The eastern limit of its distribution is roughly designated by the Great Dividing Range, being found near Kroombit Tops, Binjour Plateau, Bunya Mountains and Jondaryan (Eastwood *et al*. 2008). It may be found as far west as Carnarvon (Sands and New 2002 pp254-255).

Jalmenus eubulus is restricted to brigalow (*Acacia harpophylla*)-dominated woodlands and open-forests. Its core habitat is old-growth brigalow, particularly those areas with belah (*Casuarina cristata*), emergent eucalypts such as *Eucalyptus populnea* and understorey shrubs (Breitfuss and Hill 2003; Eastwood *et al*. 2008). Individuals may also be seen in regrowth brigalow communities (C. Eddie pers. comm.)

Ecology

Jalmenus eubulus feeds exclusively on brigalow (*A. harpophylla*) shrubs ranging in height from 0.5-5m (Braby 2000 p725; Breitfuss and Hill 2003; Eastwood *et al*. 2008). The species has also been documented as feeding on other Acacia species (Sands and New 2002 p254), but this has been discarded as erroneous in recent reviews (Eastwood *et al*. 2008).

It is likely that eggs enter diapause shortly after being laid. Emergence is triggered by summer rainfall, which may fall irregularly throughout the species' range, resulting in apparent different activity patterns between populations and years. Adults have been recorded between October and

April, with peak activity in February and March. Peak activity appears to occur approximately two months after the wettest months of the year (December and January) (Eastwood *et al*. 2008 p414).

Larvae feed singly, or occasionally in small groups of up to three individuals (Braby 2000 p726). As in many lycaenid butterflies, the larvae are always attended by ants of the *Iridomyrmex* group, on which they are likely to be reliant for survival (Braby 2000 p725; Sands and New 2002 p254; Eastwood *et al*. 2008 p414).

<u>Threats</u>

This species is threatened by clearing of suitably sized stands of old-growth brigalow woodland (Sands and New 2000 pp254-255).

<u>Project-related Impacts (unmitigated)</u>

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of habitat and breeding locations due to construction of facilities, gas gathering lines and access tracks.
- Edge effects reducing the viability of brigalow habitat, thereby reducing potential breeding locations.

<u>Significance of Project Related Impacts (Unmitigated)</u>

The EIS area occurs within the south-eastern boundary of the species' distribution, which continues a considerable distance to the north and west. However, there is a concentration of records within the Dalby region suggesting that habitats within the EIS area may be of long-term importance to the species.

The pale imperial hairstreak is a highly mobile species and activities are unlikely to create movement barriers. However, the species is reliant on old-growth brigalow remnants, which are often restricted to isolated fragments or linear corridors (e.g., roadside and stock reserves). Clearing of vegetation will have the most severe impact, rendering cleared areas unsuitable and promoting deleterious impacts on remaining vegetation. In particular, weed infestation and the tendency of fragmented brigalow to suffer dieback, may impact retained vegetation.

The severity of clearing impacts will therefore depend on the portion of suitable habitat lost. Linear corridors and gas acquisition pipelines are less likely to remove entire patches of habitat as they only require small clearing zones. Larger infrastructure such as ponding dams and power plants require larger clearing zones and could result in the loss of small populations.

Indirect impacts that may result from the proposed activities include weed infestation and other related edge effects, reducing the viability and health of brigalow stands. Brigalow in particular seems to be vulnerable to weed infestation and edge effects. Signs of habitat degredation such as senescing trees and lack of recruitment is not uncommon in isolated brigalow fragments. These impacts may not affect the short-term survival of populations, but may have deleterious consequences for long-term survival.

These factors suggest that the species has a **High** Sensitivity to impacts and that project related impacts could have a **High** mangnitude. The unmitigated impact significance is **High (21).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

Areas mapped as “Core habitat known” or “Core habitat possible” should be buffered by a 100m avoidance zone. If these areas are avoided, impacts on this species are not expected.

Further Survey and Assessment

If "Core habitat possible" cannot be avoided, further survey work should be undertaken once proposed disturbance zones are known. The purpose of surveys should be to evaluate habitat suitability and the presence/absence of the species. Surveys should be undertaken during suitable conditions when peak adult activity is likely. Once completed, impacts should be re-assessed using risk analysis methods outlined in this report. The analysis should consider the likelihood of the species occurring and the extent of impacts.

Minimising Disturbance

Where not possible, clearing of core habitat should be restricted to <10% of the patch extent. This will still result in the loss of extent and abundance within the population and is therefore still considered a HIGH consequence.

Habitat offsets should be sort using guidelines within the Queensland Environmental Offsets Policy (2008).

Other Measures

Brigalow is susceptible to weed infestation and hence clearing should ideally not occur within 100m of remnant patches. If clearing is required, impacts may be reduced by implementing a stringent weed control plan developed prior to clearing. The plan should detail weed control measures including rehabilitation using native species, wash-down, sediment capture (which could transport weed propagules) and direct weed removal techniques. The plan should include all exotic species that might affect habitat integrity (e.g., pastoral grasses), not just those listed under legislation. The plan should also include monitoring methods, trigger events that initiate specific removal actions and methods/strategies that are implemented to ensure weed infestation is controlled following closure.

Summary Residual Impact Assessment

Project related unmitigated impact significance to this species is **High (21).** No mitigation measures will alleviate clearing of an entire patch of core habitat known and therefore *avoidance is the only* *feasible mitigation measure* in these situations. If infrastructure avoids remnant brigalow, the resulting environmental impact would be LOW. Reducing the amount of clearing to only include a fraction of the patch may alleviate impacts, but are largely ineffective.

The species is highly mobile and can appear in suitable habitat without warning. Accordingly, all core habitat possible should be treated as core habitat known, regardless of survey effort.

Clearing within 50m of a known population runs the risk of introducing weeds into important habitat areas. It is therefore not advisable, but impacts may be reduced if a stringent weed control strategy is designed and implemented. Avoiding habitat but clearing within 50m with the implementation of a weed control plan would have a Moderate effect on impact consequence.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	High	High	Effective	Reguire further testing

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Moderate	Moderate (17)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. Within the area, all areas of remnant brigalow (11.3.1, 11.4.3, 11.9.1, 11.9.4b, 11.9.5, 11.9.6, 11.9.10) are classed as “Core Habitat Possible”.
3. All remnant and regrowth vegetation within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”. This allows for the species’ mobility.
4. Remaining regional ecosystems are classed as “Absence Possible”.
5. Cleared agricultural and grazing land is classed as “Absence Likely”.
6. For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. However, due to the species’ mobility, the habitat value category should refer to the entire polygon.

Mapping Confidence

The habitat requirements of this species are well documented and easily assigned to regional ecosystems. Core Habitat Possible designations are considered to be accurate. The number of Core Habitat Known areas is likely to increase with further survey effort. As the species is highly mobile and may turn up in suitable habitat previously unoccupied, all areas of Core Habitat Possible should be treated as Core Habitat Known unless habitat characteristics are absent.

The habitat map for this species is considered to be HIGHLY accurate.

References

Braby, M. F. (2000). The butterflies of Australia: their identification, biology and distribution. CSIRO Publishing, Collingwood.

Breitfuss, M. J. and Hill, C. J. (2003). Field observations on the life history and behaviour of *Jalmenus evagoras eubulus* Miskin (Lepidoptera: Lycaenidae) in the Brigalow Belt South of Queensland. *Australian Entomologist* 30. 135–138.

Eastwood, R., Braby, M. F., Schmidt, D. J. and Hughes, J. M. (2008). Taxonomy, ecology, genetics and conservation status of the pale imperial hairstreak (*Jalmenus eubulus*) (Lepidoptera : Lycaenidae): a threatened butterfly from the Brigalow Belt, Australia. *Invertebrate Systematics* 22. 407-423.

Sands, D. P. A and New, T. R. (2002). The action plan for Australian butterflies. Environment Australia, Canberra. pp254-5

FROGS

Rough Collared Frog (*Cyclorana verrucosa*)

Status

NCA: Near-threatened; EPBC: not listed

Despite its listing as near-threatened under the NCA, this species is often recorded in the Brigalow Belt South and has been described as 'locally common' (EPA 2003 p11). WildNet results indicate that *Cyclorana verrucosa* is the seventh-most regularly recorded frog species within the PDA (total number of recorded species = 28).

The species is not listed as a conservation priority or as an 'insufficiently known species that may be of concern' in the Action Plan for Australian Frogs (Tyler 1997).

Distribution and habitat

Cyclorana verrucosa is found in a variety of habitat types ranging from open grassland and woodlands on clay soils (Barker *et al*. 1995 p170; Anstis 2002 p93; Hero *et al*. 2004). This may include highly modified grazing lands and roadside reserves, which may provide significant habitat for this species (Hero *et al*. 2004). The species is abundant at Lake Broadwater (EPA 2003 p11).

Ecology

The species is a burrowing frog, spending large periods of time underground during dry spells and emerging to breed after heavy spring/summer rains. Males may start calling in July, but peak calling occurs between September and February (Lemckert & Mahony 2008). Eggs are laid in shallow water (Hero *et al*. 2004). As with many ephemeral water breeding species, tadpoles develop quickly, particularly during warmer months (Anstis 2002 p94).

Threats

Documented threats include loss and degradation of habitat due to farming and mining (Hero *et al*. 2004). However, the species is often recorded in modified landscapes and is considered to be locally abundant in the Brigalow Belt South Bioregion (EPA 2003 p11).

Project-related Impacts (unmitigated)

Impacts associated with the proposed gas extraction activities could include:

- Direct death or injury of individuals during habitat clearing;
- Direct loss of habitat for the construction of facilities and access tracks;
- Death of individuals captured in open trenches;
- Temporary movement barriers created by open trenches.

Significance of Project Related Impacts (Unmitigated)

The EIS area represents the eastern extent of *C. verrucosa*'s distribution, which extends much further to the west. Within the eastern portion of its range, the species is relatively common and may occur in a variety of habitat types including artificial habitat. Its presence within artificial habitats suggests that it is resilient to land disturbance and habitat clearing. Furthermore, the species is able to quickly recover population numbers within a few generations.

While some individuals may be lost during clearing activities, disturbance in core habitat known and core habitat possible areas is likely to have short-term impacts with few long-lasting consequences. Considering the species Near Threatened status in Queensland, it must be considered **Moderately** sensitive to iimpacts,

These frogs are quite mobile and often observed crossing roadways and tracks. Cleared areas for gas gathering lines are unlikely to affect their movement. However, they are likely to regularly fall into open trenches, particularly if these trenches are open during or shortly following rainfall events. As the frogs can be locally common, the number of captured animals could be high and may have localised short-term impacts if not mitigated. Accordingly, impacts may have a **Low** magnitude. Unmitigated, the species has **Low (8)** significance of impacts.

Proposed Management/ Mitigation Measures

Habitat Avoidance

Due to the wide distribution and broad habitat preferences of this species, avoidance of core habitat possible is unlikely to be feasible. However, clearing of core habitat possible will have Minor consequences and therefore does not warrant special mitigation measures.

Minimise Disturbance

Avoidance of core habitat known is preferable, particularly when in association with remnant vegetation.

Other Measures

Open trenches pose a short-term threat to local populations but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;

- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;
- Details of trapped and released animals should be recorded (e.g., date, GPS location, species, condition) for inclusion into DERM WildNet database.
- Groundwater extracted from gas bores should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

Summary Residual Impact Assessment

This species is likely to be resilient to habitat disturbance and has a **Low (8)** unmitigated impact significance. Habitat avoidance is therefore unlikely to significantly reduce the already low impact significance. Furthermore, it is not anticipated that avoidance of this species, with its wide distribution and broad habitat preferences, will be possible. Controlling impacts of open trenches will be more effective than avoidance.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Low	Low (9)	Ineffective	Largely effective

* No clearing of vegetation within areas of core habitat known or core habitat possible.

\# Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Low	Low (9)	Moderate	Extremely Low	Low (4)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. Within the area, the species may occur in any area where ephemeral surface water collects, particularly in association with clay plains or waterways. The species is not reliant on remnant vegetation. Remnant and non-remnant lands on landzone 3, 4 and 5 are particularly prone to flooding and should be classed as “Core Habitat Possible”.
3. Regional ecosystems 11.9.6, 11.9.5 and 11.9.10 may also contain clay or gilgaied soils which are very suitable for this species. These should be mapped as “Core Habitat Possible”.
4. Remnant communities 11.7.4, 11.7.7, 11.9.7, 11.9.9 11.9.9a, and 11.10.1 are classed as “General Habitat”.
5. Core Habitat Possible and General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
6. Cleared agricultural land subject to tilling is classed as “Absence Likely”.

Mapping Confidence

The occurrence of this species is somewhat difficult to predict. It may be common in some locations, even within modified landscapes, while apparently absent in similar habitats. The map is considered to have Low accuracy.

References

Barker, J, Grigg, G. C and Tyler, M. J. (1995). A field guide to Australian frogs. Surrey Beatty and Sons, Sydney. pp170-172

EPA (2003). BPA BRB South Fauna Expert Panel in Brigalow Belt South Biodiversity Planning Assessment. EPA. Brisbane.

Hero, J-., Clarke, J. and Meyer, E. (2004). *Litoria verrucosa*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <www.iucnredlist.org>. Downloaded on 06 August 2009.

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REPTILES

Golden-tailed Gecko (Strophurus taenicauda)
Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Golden-tailed geckos are found from the western slopes of the Great Dividing Range to Carnarvon, and from Emerald in the north to Inglewood/Millmerran in the south. The EIS area therefore encompasses a sizable portion of the species' range. Furthermore, the area around Barakula may represent a stronghold for this species (Richardson 2006 p15).

Golden-tailed geckos are a Brigalow Belt endemic. They are found mainly in association with brigalow (*Acacia harpophylla*), cypress (*Callitris* spp.) and ironbark (*Eucalyptus* spp.). Ground cover, tree hollows and loose or peeling bark on standing trees may be important shelter sites for this species (Richardson 2006 pp13-14).

Ecology

During the daytime, golden-tailed geckos shelter under loose bark and in tree hollows (Wilson 2005 p60). They may also bask during the daytime. In Spring/Summer, females lay a clutch of two eggs. Females may lay more than one clutch in a season.

Movement patterns of the species have not been documented. However, individuals have been recorded crossing dual lane roads during warm summer nights.

Threats

Habitat loss and degradation including inappropriate roadside management, inappropriate fire regimes, clearing and thinning of vegetation for agriculture appear to be the main threats faced by this species (Richardson 2006 p21). Deaths on roads and predation from introduced carnivores (e.g., foxes and cats) may also affect populations.

Project-related Impacts (unmitigated)

Impacts associated with the proposed gas extraction activities could include:

- Direct loss of individuals during habitat clearing;
- Direct loss of habitat for construction of facilities, gas acquisition pipelines and access tracks;
- Fragmentation and creation of movement barriers in existing habitats by gas gathering lines and tracks;
- Death of individuals trapped in open trenches;

- Edge effects (including weed infestation) altering habitat structure and causing long-term habitat degradation along gathering lines, tracks and clearing zones;

Significance of Project Related Impacts (Unmitigated)

The species is widely distributed, occurring well north and west of the PDA with high abundance around Barakula west to north of Roma. Large patches of suitable habitat occur within state forests and connected land in the PDA.

The species is known to occur in logged forests and is often observed crossing roads at night. This suggests that the species has some resilience to habitat fragmentation and minor habitat loss. It therefore seems unlikely that the type of fragmentation and clearing associated with gas gathering activities will significantly affect the species. Furthermore, clearing within large contiguous patches of vegetation for the construction of facilities is unlikely to significantly reduce resident populations or lead to long-term deleterious effects on these populations.

As the species is known to cross tracks and roads, individuals are likely to fall into open trenches. While it is feasible that considerable numbers could be captured on warm wet nights when activity is at its peak, these impacts are still likely to be relatively localised and short-term.

Considering the species Near Threatened status, it is ranked as **Moderately** sensitive to impacts. Unmitigated, impacts are likely to have a **Moderate** magnitute. Consequently, unmitigated the project impact significance is **Moderate (13).**

Proposed Management/ Mitigation Measures

Habitat Avoidance

Due to the wide distribution and broad habitat preferences of this species, avoidance of core habitat possible is unlikely to be feasible. However, clearing within large patches of core habitat possible vegetation will have Minor consequences and therefore does not warrant special mitigation measures. Habitat avoidance will significantly alleviate impacts on populations occurring in minor fragments (<20ha) where clearing would significantly reduce the population's extent.

Minimise Disturbance

While clearing of large patches of suitable habitat is unlikely to produce severe impacts, clearing should be minimised through careful planning of infrastructure locations. This will further reduce any long-term deleterious effects and recognises the value of this species' habitat.

Rehabilitation

While the species is known to cross open land, movements may be reduced by open habitats associated with gas acquisition pipelines and maintenance tracks. Where possible, clearings should be rehabilitated using the following methods:

- Logs and debris (including dirt clods and rocks) that were removed during clearing should be retained and placed back over cleared ground to provide shelter for crossing golden-tailed geckos;
- After the initial clearing and construction, clearings should be partially revegetated by seeding with small native grass and shrub species (e.g., acacias). Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement. This will also assist in preventing weed incursion and reduce deleteriously edge effects that might modify the long-term integrity of uncleared adjacent habitat.

Long-term loss of habitat may be mitigated by seeding partially rehabilitated areas with canopy species following decommission. Cleared areas not already partially rehabilitated should be ripped and seeded with native flora species typical of surrounding habitats as described in a rehabilitation plan.

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Placing the above sacks approximately every 400m when passing through disturbed land;
    - Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

This species has some resilience to habitat disturbance and therefore clearing within habitat areas is likely to have minor impacts. Furthermore, it is not anticipated that total avoidance of this species, with its wide distribution and broad habitat preferences, will be possible, although minimising clearing should be a priority. Controlling impacts through rehabilitation and trench clearing will be beneficial and substantially reduce short-term and long-term impacts.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	effective

* No clearing of vegetation within areas of core habitat known.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Ext Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. Within the PDA, the REs provided in the table below are classed as “Core Habitat Possible”.
3. Within the PDA, REs provided in the table below are classed as “General Habitat”.

Habitat Category	**REs**
Core habitat possible	11.3.1, 11.3.17, 11.4.3, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.1, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.9a, 11.9.10, 11.9.13, 11.10.1, 11.10.1a and 11.10.1d,.
General habitat	11.3.4, 11.3.14, 11.3.18, 11.3.19, 11.4.12

4. Patches of Core habitat Possible less than 10ha in extent *and* not within 100m of a larger area of remnant vegetation, are classed as "General Habitat".
5. Core Habitat Possible and General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
6. All areas of advanced regrowth (10+) should be treated as remnant vegetation and classed according to the above rules.
7. Regrowth areas <10 years are classed as "Absence Suspected".
8. Cleared agricultural and grazing land is classed as "Absence Likely".
9. For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

Mapping Confidence

This species occurs in a wide variety of habitats. It can be very abundant and common in some locations, while scarce in others. The map is considered to have a Moderate accuracy.

References

Richardson, R. (2006). Queensland Brigalow Belt Reptile Recovery Plan 2008 – 2012. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. WWF-Australia, Brisbane.

Wilson, S (2005). A field guide to reptiles of Queensland. Reed New Holland, Sydney.

Drury, W. and Lesic, S. (2003). Reptiles of the Brigalow Belt South. WWF Australia, Sydney.

Collared Delma (Delma torquata)

Status

NCA: vulnerable; EPBC: vulnerable

Distribution and habitat

While predominantly known from South-east Queensland, this species ranges from Rockhampton in the north, south to Kenmore and inland to the Bunya Mountains (Wilson 2005 p66). A small number of individuals have been collected from Roma and one from State Forest 189 (Queensland Museum record, 1998), approximately 12km west of Wondul Range National Park. This latter record represents the only record of this species within the EIS area.

Recorded from rocky areas associated with dry open eucalypt forests, although the species has also been recorded from semi-evergreen vine thickets (Wilson 2005 p66; Ryan 2006). Individuals typically shelter under fallen debris (e.g., rocks, fallen timber) but may also be found below the ground surface or in soil cracks (Cogger 2000 p292; Richardson 2006 p13; Wilson and Swan 2008 p128). Records from the Roma area have been recorded from forest river gum (*Eucalyptus tereticornis*) woodlands (Wilson 2005 p66) and habitat notes from State Forest 189 document grey cracking clay with brigalow woodland. Both these habitat associations are atypical.

Ecology

Poorly known. Predominantly diurnal, the Collared Delma feeds on small arthropods, and in captivity favours small cockroaches (S. Peck pers. comm.). It is also possible that subterranean termites may fill a portion of the species' diet (Peck 2003).

Movements are not well documented, but limited recapture data suggest that the species is highly sedentary, often repeatedly using the same rock shelter, but will abandon these shelter sites if they are disturbed (Porter 1998). It may therefore be possible for populations to be restricted to very small areas and be very vulnerable to disturbance.

Threats

The loss of populations has occurred in western Brisbane due to housing development and inappropriate roadside management (Richardson 2006 p21). Other threats may also include inappropriate fire regimes and predation from native fauna (e.g., White-crowned Snake). A significant threat to existing populations is modification of habitat from exotic weed species, particularly *Lantana mundivensis* (BCC 2006).

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Loss of individuals during vegetation clearing.

- Collared Delma populations can be restricted to very minor areas, smaller than the minimum width required for gas gathering lines and access tracks. It is possible, therefore, that clearing activities could cause the local extinction of populations.
- The species appears to move only small distances, being largely sedentary. There are no records of the species crossing artificial or disturbed surfaces and therefore gas gathering lines are likely to present a considerable barrier for Collared Delma movements.
- It is possible, although unlikely due to the above point, that some individuals could become trapped in open trenches, resulting in mortality.
- Edge effects, particularly weed invasion, could significantly modify existing habitats and render them unsuitable for this species. Considering the small extent of some populations, even small weed infestations could cause local extinctions.

Significance of Project Related Impacts (Unmitigated)

The bulk of Collared Delma records occur outside the EIS area in the South-east Queensland Bioregion. The species often occurs occurring in very small, restricted populations. Even minor disturbance such as road widening can have serious effects and therefore any clearing activity may have catastrophic consequences on local populations. However, as the species is more common outside the bioregion, Project related impacts will not cause the widespread loss of this species.

This may be compounded by the lack of knowledge about the species' occurrence and habitat use within the Brigalow Belt. Three known populations occur in habitats not typical to the species making predictions regarding its distribution difficult. It is therefore feasible that unknown populations could be severely and unknowingly impacted. Sensitivity criteria, which are based on population impacts, suggest that the species is **Extremely** Sensitive and that the impact magnitude could be **Extremely High**. The impact significance for this species is therefore **Extremely High** (25).

Proposed Management/Mitigation Measures

Habitat Avoidance

The species' distribution within the PDA is almost impossible to predict based on current knowledge. Determining which habitat types or areas should be avoided is therefore difficult. Avoidance, including a 100m buffer, around core habitat known should ensure no deleterious impacts on these populations.

Further Survey and Assessment

Some attempt has been made to predict possible habitat of the species within the EIS area. These areas, mapped as core habitat possible, warrant further survey work prior to clearing in an attempt to determine the presence or absence of the species. Further work should involve an initial visual assessment to determine if the appropriate habitat features are presence possibly followed by two trapping events. Avoiding core habitat possible areas is preferable.

Other mitigation measures such as trench clearing, rehabilitation and minimising clearing are likely to have only limited success in further reducing possible impacts.

Summary Residual Impact Assessment

Avoiding habitat and undertaking further survey work within areas of core habitat possible that may require clearing are the only feasible mitigation measures for this species. Provided these are followed, impacts are expected to be completely mitigated.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	Extremely High	Extremely High (25)	Effective	Moderate

* No clearing of vegetation within areas of core habitat known and pre-surveys of core habitat possible.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely High	Extremely Low	Moderate (11)	Extremely High	High	Extremely High (23)

Rule(s) for Habitat Mapping:

1. Restrict the occurrence of the species to within 20km of the only known record within the EIS area.
2. Within the area, regional ecosystems typically occurring on stony and rocky substrates (i.e., 11.7.2, 11.7.4, 11.7.7, 11.8.2, 11.8.3, 11.9.1) 2, are classed as “Core Habitat Possible”. This represents the species’ *typical* habitat preferences within south-east Queensland.
3. Within the area, regional ecosystems on dark cracking clays with brigalow are classed as “Core Habitat Possible” (11.3.1, 11.4.3, 11.9.5). This represents the species’ habitat based on the only known record within the EIS area.
4. All remnant vegetation within 1km of the only known record is classed as “Core Habitat Known”.
5. Remaining regional ecosystems should be classed as “Absence suspected”.
6. Cleared agricultural and grazing land is classed as “Absence Likely”.

7. For heterogeneous polygons, the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.
8. For both homogeneous and heterogeneous polygons with stony and rocky substrates, the habitat value refers only to those parts of the polygon that contain surface rocks.

Mapping Confidence

Records from within the EIS PDA occur well outside the species' normal distribution. However, the species is known to occur in isolated populations, often hundreds of kilometres from its core distribution. Furthermore, these isolated populations often occur in atypical habitats. This makes predicting the species' distribution and habitat *extremely* difficult.

The map is considered to have a LOW predictive accuracy.

References

Peck, S. (2003). Conservation Status Review and Management Recommendations for the Collared Delma Delma torquata in Brisbane City. Report prepared for Brisbane City Council, Feb 2003.

Richardson, R. (2006). Queensland Brigalow Belt Reptile Recovery Plan 2008 – 2012. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. WWF-Australia, Brisbane.

Ryan, S. (2006). Conservation Management Profile: Collared Delma *Delma torquata*. Ecosystem Conservation Branch, Environment Protection Agency.

Porter, R. (1998). Observations on a large population of the vulnerable pygopodid, *Delma torquata*. *Memoirs of the Queensland Museum.* Vol. 42. 565-572

Brisbane City Council (2006). Collared Delma Conservation Action Statement. Prepared by Brisbane City Council.

Brigalow Scaly-foot (*Paradelma orientalis*)

Status

NCA: vulnerable; EPBC: vulnerable

Distribution and habitat

Largely restricted to the Brigalow Belt bioregion, this species extends from approximately 200km south-west of Charters Towers (Carnarvon Ranges) in the north, south to Bendidee National Park and Eena State Forest (35km north-west of Goondiwindi) (Schulz and Eyre 1997; Kutt *et al*. 2003; DEWHA 2009). The species is at its most easterly extent at Boyne Island (near Gladstone) and can be found as far west as Morven (Eyre *et al*. 1997; Schulz and Eyre 1997; Tremul 2000).

The brigalow scaly-foot can be found in a number of remnant communities including sparse tussock grasslands on grey, cracking soils (Shea 1987); *Acacia falciformis* woodland; *A. cambagei* woodland; *Eucalyptus* woodland; sandstone rises in dry sclerophyll forests; *Corymbia maculata* and *E. crebra* dominated forest; and mixed open woodland with *Triodia mitchelli* (Schulz and Eyre 1997; Kutt *et al*. 2003). Being fossorial in habit, they seem to be more prevalent in habitats that have few weeds and that consist of undisturbed ground surfaces with ground cracks and/or fallen debris and/or native tussock grasses. Most records occur in remnant habitats, but the species can also occur in young regrowth (two to three years old) (Kutt *et al*. 2003; M. Sanders pers. obs.) and in modified habitats, including those dominated by buffel grass (M. Sanders pers. obs.).

Ecology

Invertebrates such as crickets and spiders are regular eaten, although plant material has been located in the scats of at least one individual (Tremul 2000). In addition, sap, particularly from *Acacia* species, constitutes a significant proportion of this species' diet in at least one population (Tremul 2000).

Breeding occurs in spring/summer when two eggs are laid (Tremul 2000).

Threats

The brigalow scaly-foot is threatened by clearing and habitat fragmentation for agriculture and pastoral purposes. Uncleared areas can also be degraded by stock grazing and inappropriate fire regimes. Both of these activities reduce ground layer complexity and therefore reduce potential shelter sites for this species.

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during vegetation clearing. Depending on the extent of clearing, displaced animals forced into nearby habitats are unlikely to persist due to increased competition with resident animals.
- While the species is known to cross roadways and tracks, gas gathering and access tracks are likely to be less frequently crossed, reducing dispersal and movement.
- As the species is known to cross artificial corridors, it is highly probable that individuals could become trapped and perish in open trenches.
- Edge effects, particularly weed invasion, could significantly modify existing habitats and render them unsuitable for the species. As weed invasion resulting from clearing can extend some distance into previously unmodified habitats, this threat has the potential to alter large areas of potential or known habitat, reducing the abundance or extent of the species.

Significance of Project Related Impacts (Unmitigated)

The brigalow scaly-foot may be found in a variety of habitats. While it may be found in small fragments and areas with heavy weed infestation, it is typically located in larger remnant patches with an intact ground surface structure. Clearing within large tracts of habitat will result in the loss of some habitat, but is unlikely to significantly affect the long-term survival of populations in these areas.

The brigalow scaly-foot is a mobile species and has been recorded crossing open roads, suggesting that, while movement may be reduced, some movements are likely to occur across clearings. Gas acquisition pipelines and associated roadways may therefore have a moderate effect on movements.

While clearing may be minor in the context of available habitat, weed invasion associated with disturbance has the potential to alter much larger tracts of vegetation. Weed invasion and other edge effects reducing the integrity of existing habitats do pose a threat to populations.

As the species may cross open gas acquisition pipelines, they are susceptible to trench death. This short-term impact may result in the capture of a number of individuals but is likely to be restricted in extent. The species is likely to be **Moderately** sensitive to disturbance.

Due largely to the potential for weed invasion and short-term impacts, project-related impacts are likely to be Moderate in severity. Impact magnitude associated with gas works is likely to be **Moderate**. The overall impact significance is therefore **Moderate** (13).

Proposed Management/ Mitigation Measures

Habitat Avoidance

Due to the wide distribution and broad habitat preferences of this species, avoidance of core habitat possible by the project is unlikely to be feasible. The clearing of these areas in the context of surrounding habitat may have only localised short-term impacts, especially if other mitigation measures follow. Efforts to avoid core habitat known will mitigate some clearing impacts.

Minimise Disturbance

While clearing of large patches of suitable habitat is unlikely to produce severe impacts, clearing should be minimised through careful planning of infrastructure. Minimising disturbance will reduce habitat loss and therefore reduce long-term deleterious effects.

Rehabilitation

While the species is known to cross open land, movements may be reduced by open habitats associated with gas acquisition pipelines and maintenance tracks. Where possible, clearings should be rehabilitated using the following methods:

- Logs and debris (including dirt clods and rocks) that were removed during clearing should be retained and placed back over cleared ground to provide shelter for crossing golden-tailed geckos;
- After the initial clearing and construction, clearings should be partially revegetated by seeding with small native grass and shrub species (e.g., acacias). Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement. This will also assist in preventing weed incursion and reduce deleteriously edge effects that might modify the long-term integrity of uncleared adjacent habitat.

Long-term loss of habitat may be mitigated by seeding partially rehabilitated areas with canopy species following decommission. Cleared areas not already partially rehabilitated should be ripped and seeded with native flora species typical of surrounding habitats as described in a rehabilitation plan. Seeding with exotic species, particularly grasses, should be avoided at all costs, as these will only exacerbate edge effects and habitat degradation.

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after

sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:

- o Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
- o Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

This species has broad habitat preferences and is widespread. Populations will therefore have some resilience to habitat disturbance. It is not anticipated that complete avoidance of suitable habitat will be possible, although minimising clearing should be a priority. Controlling impacts through rehabilitation and trench clearing will be beneficial and substantially reduce short-term and long-term impacts.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	Largely effective

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species has the potential to occur throughout the entire EIS area.
2. Within the area, the REs provided in the below Table are classed as “Core Habitat Possible” with the exception of small remnant patches that are less than 10ha in extent and greater than 200m from an area of larger remnant vegetation.
3. Within the area, RE’s provided in the below Table are classes as “General Habitat”.

Habitat Category	RE's
Core habitat possible	11.3.1, 11.3.17, 11.3.18, 11.3.19, 11.4.3, 11.4.3b, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.9.1, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.9a, 11.9.10, 11.9.13, 11.10.1 11.10.1a and 11.10.1d.
General habitat	11.3.4, 11.3.14, 11.3.25, 11.3.26, 11.3.27

4. Core Habitat Possible and General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
5. Regrowth vegetation (3+ years) within 200m of remnant vegetation is considered to be "General Habitat".
6. Cleared agricultural and grazing land is classed as "Absence Likely".

Mapping Confidence

This species has very broad habitat requirements and may be found in a large number of regional ecosystems. As the species' distribution is more easily predicted based on *ground strata condition*, prediction based only on aerial mapping is difficult. Unless evidence suggests otherwise, most areas of remnant vegetation should be considered as possible habitat.

The map is considered to have a Moderate predictive accuracy.

References

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Long-legged Worm-skink (*Anomalopus mackayi*)

Status

NCA: endangered; EPBC: vulnerable

Distribution and habitat

Anomalopus mackayi is distributed throughout a relatively small area abutting the western edge of the Great Dividing Range in north-eastern New South Wales and south-eastern Queensland (NSW NPWS 1999). Records in the past 20 years have come only from Oakey and the Dalby regions of Queensland, and from the Wallangra, Mungindi and Wee Waa regions of New South Wales. The Wallangra specimens link what were previously thought to be disjunct Queensland and New South Wales populations. The total range appears to have contracted eastwards. Localities for museum specimens collected prior to 1970 include a number on the plains south and west of Moree, and as far west as Goodooga, New South Wales (DEWHA 2009).

Anomalopus mackayi occurs in low (typically <40cm) native grasslands with or without sparse trees and can include derived native grasslands created by land clearing. It seems to be particularly fond of grasslands on cracking soils. Suitable habitats within the Darling Downs remain a stronghold (Hobson 2002; EPA 2003 p17; Fitzgerald 1996), although these are restricted to linear relicts along road and stock route reserves (Wilson 2005 p75).

Ecology

Little is known of this near-threatened skink's biology, but it is adapted to burrowing and can be found under rocks, fallen timber and clipped grass within areas of suitable habitat. Nothing is known of its breeding biology, except that it is an egg-laying species.

Its diet is assumed to consist of small arthropods (e.g., insects, spiders). Captive animals remained beneath the upper surfaces of soil during the day, emerging only to capture mealworms from the surface.

No movement data have been recorded. The species has not been recorded crossing roadways or tracks; however, related species are known to occasionally cross open artificial surfaces. This suggests that the species, while very reluctant, may cross open ground for short distances.

Threats

The reason for the species' past decline probably involves a combination of factors, including overgrazing by stock, clearing of habitat for agriculture (crop production) and grazing, soil compaction and erosion, loss of ground litter, irrigation and possibly soil and water pollution (Cogger *et al.* 1993; NSW NPWS 1999). Very little pristine native grassland now remains within its known range, and much of the area is heavily modified and regularly cropped (Fitzgerald 1996). A threatening process of ploughing bluegrass has been noted (EPA 2003).

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during vegetation clearing. Depending on the extent of clearing, displaced animals forced into nearby habitats are unlikely to persist due to increased competition with resident animals.
- Loss of suitable habitat, reducing the extent of populations. In cases where disturbance is extensive, local extinctions may occur.
- Fragmentation and isolation of previous contiguous or connected populations by gas gathering lines and access tracks.
- Increased mortality due to captured individuals in open trenches passing through or adjacent to existing habitats.
- Edge effects, particularly weed invasion, pose a significant threat to grasslands dominated by native species. Exotic species alter habitat structure, potentially rendering large areas unsuitable.

Significance of Project Related Impacts (Unmitigated)

Darling Downs Grasslands remain the stronghold for this species in Queensland. However, remaining populations are restricted to minor fragments such as roadside reserves. Due to the minor extent and linear nature of these areas, even small clearing actions can have serious impacts. Remaining populations are highly important.

Remnant grasslands are fragile communities and highly susceptible to disturbance and modification. Clearing, fragmentation, increased mortality due to trench deaths and weed invasion pose significant threats to *Anomalopus mackayi*. The species is Extremely sensitive and impacts could be Extremely High. The impact significance to this species is Extremely High (25) as populations may be lost and populations are unlikely to recover through remedial actions.

Proposed Management/ Mitigation Measures

Habitat Avoidance

Imposing a 100m non-disturbance buffer around all core habitat known and core habitat possible will dramatically reduce impacts. Deaths during clearing, reduced habitat extent, movement barriers, trench deaths and impacts on habitats from edge effects would be largely neutralised. This management strategy is the only strategy considered to be highly effective, although other strategies may lessen impacts.

Further Survey and Assessment

If clearing is required in core habitat possible, further survey work is required to determine the presence/absence of the species and determine the level of impact. Field surveys for this species can only involve trapping, and are best undertaken in suitable conditions (i.e., after rainfall when deep soil cracks are absent). Following field work, disturbance zones should be compared with survey results to determine the decrease in habitat extent. A risk assessment should be undertaken using methods outlined in this document.

Minimise Disturbance

If avoidance is not possible, planning and infrastructure locations should be positioned to minimise disturbance. While this strategy might reduce the extent of habitat loss, it will increase the risk of edge effects (e.g., weed invasion) deleteriously affecting habitats.

Habitat offsets should be sort using guidelines within the Queensland Environmental Offsets Policy (2008).

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Placing the above sacks approximately every 400m when passing through disturbed land;
    - Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

This species has a narrow distribution in Queensland and remaining stronghold populations within the Brigalow Belt are centred on grasslands in the Darling Downs. Imposing a 100m buffer around all core habitat known or core habitat possible is the most effective and efficient impact mitigation measure.

Other measures such as minimising disturbance, trench checking and weed control may be met with limited success as grassland communities are fragile.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Extremely High	Extremely High	Extremely High (25)	Effective	Low

* No clearing of vegetation within areas of core habitat known or core habitat possible.
# Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Extremely high	Extremely Low	Moderate (11)	Extremely High	High	Extremely High (23)

Rule(s) for Habitat Mapping:

1. The species will not occur in the very northern portions of the EIS area. It is therefore restricted to habitats south of 26^0 40’ (26.666^0).
2. Remnant grasslands and woodlands with native ground cover on dark cracking clays (11.3.2, 11.3.3, 11.3.21, 11.3.24), and derived non-remnant native grasslands (veg code ARG) classed as “Core Habitat Possible”.
3. Core Habitat Possible within 1km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
4. Remaining regional ecosystems are considered to be “Absence Likely”.

Mapping Confidence

This species’ habitat requirements are relatively well understood and form discrete regional ecosystems. Additional areas of Core Habitat Known are likely to be located with increased survey effort and regional understanding. The habitat map for this species is considered to be HIGHLY accurate.

References

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Yakka skink (Egernia rugosa)

Status

NCA: vulnerable; EPBC: vulnerable

Distribution and habitat

The yakka skink has a disjunct distribution, with isolated populations occuring from St George, north to Coen on Cape York Peninsula. In 2002, new populations were discovered in Culgoa Floodplain and Thrushton National Parks, and the species extends further west to Chesterton Range National Park (Richardson 2006). yakka skinks are found in a variety of dry forests and woodlands (usually on well-drained, coarse, gritty soils in the vicinity of low ranges, foothills and undulating terrain) including poplar box alluvial soils, low ridges, cypress on sands, belah, mulga and *Eucalyptus intertexta* (Richardson 2006; Wilson 2005; Drury 2001; Cogger 2000; Ehmann 1992).

Ecology

The yakka skink is a robust skink that lives communally in burrows, hollows in timber and rock crevices (Wilson and Swan 2008). They may live in disused rabbit warrens, or less often excavate and occupy their own burrow system. These burrows are often constructed under solid structures, such as concrete slabs and piles of felled timber. The species may be more common than previously thought (EPA 2003), but no detailed studies on the distribution and ecology of this species have been published. They are secretive animals, retreating to their burrows when disturbed. Their presence is often indicated by their defecation sites near their burrow entrances.

Threats

Threats include loss of habitat, loss of shelter sites through agricultural practices, too-frequent fire, trampling of burrows by livestock, and predation by foxes and cats (Drury 2001).

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Loss of individuals during vegetation clearing.
- Individuals may become trapped in open trenches, resulting in mortality.
- Edge effects, particularly weed invasion, could significantly modify existing habitats and render them unsuitable for this species. Considering the small extent of some populations, even small weed infestations could have significant impacts.

Significance of Project Related Impacts (Unmitigated)

The bulk of yakka skink records occur outside the PDA, represented by one record in 1987 within the EIS area. This record has a low degree of accuracy (approximately 1.5km) and is situated in a cleared paddock. Its persistence within the EIS area is therefore unclear.

The species is communal, meaning that the animals in any given area are likely to be concentrated in one location. Minor disturbance such as road widening can have substantial impacts on a local population. The species is tolerate of some disturbance and provided adequate alternative habitat is available, capable of recovery. The species is considered to be **Moderately** sensitive and impact magnitudes could be **High**. This species has a impact significance of **Moderate** (18)..

Proposed Management/Mitigation Measures

Habitat Avoidance

Avoiding the one location from which recent records are known will ensure that this population, if it still exists, will not be impacted upon by the project.

Further Survey and Assessment

There is only one recent (1987) record of this species from the project site. The geospatial accuracy of this location is approximately 1.5km, centred on a cleared area. One large patch of remnant vegetation is near this location. Further survey work is needed if this patch is to be disturbed.

Habitat Modification

yakka skinks construct burrows underneath piles of timber. Any trees cleared for the project should not be burnt. Rather, they should be left in piles until the site is ready to be rehabilitated. Log piles in yakka skink habitat should first be checked for the species. If the species is not found, the log piles should be raked back over the cleared area as per outlined in a rehabilitation plan.

Other mitigation measures such as trench clearing are likely to have only limited success in further reducing possible impacts.

Summary Residual Impact Assessment

Avoiding habitat is the most effective mitigation measure for this species. Where core habitat cannot be avoided, further survey work should be undertaken to ascertain their presence and/or distribution. This will allow the level of impact to be clarified.

Other mitigation measures such as rehabilitation may have limited success.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	High	Moderate (18)	Effective	moderate

* No clearing of vegetation within areas of core habitat known and pre-surveys of core habitat possible.
# Clearing of core habitat known is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (9)

Rule(s) for Habitat Mapping:

1. Map remnant and regrowth vegetation within 2km of the only known record as "core habitat possible".

Mapping Confidence

This species is poorly represented within the EIS area, restricted to one old record (1987). It is unlikely that the species will occur with any regularity and the map is considered to be moderately accurate.

References

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Grassland Earless Dragon (*Tympanocryptis cf. tetraporophora*)

Status

NCA: endangered; EPBC: endangered

Distribution and habitat

Until 2001, the Grassland Earless Dragon was known only from native grasslands around Cooma and Canberra. Historically, the species was also known from grasslands near Canberra and on the Darling Downs, Queensland. Undetected for more than 30 years despite survey efforts (Covacevich *et al.* 1998), the Darling Downs population was rediscovered in 2001 (Melville *et al.* 2007). It is now known from a handful of locations on the Darling Downs, all approximately between Dalby, Toowoomba, Millmerran and Cecil Plains (Hobson 2002).

Unlike southern populations, Queensland populations are regularly recorded in sorghum crops, usually adjacent to native grassland verges that may be only minor in extent (Starr and Leung 2006). These minor grassland areas may act as vital refugia when active farming of sorghum prevents inhabitation.

Despite the above, native grasslands (RE 11.3.2 and 11.3.21) are listed as Essential Habitat for *T. cf. tetraporophora* (EPA 2003 p18). Native grasslands within the Darling Downs have been reduced to 1.34% of their original extent by 1993 (Fensham 1997). Remaining areas are typically located in stock routes and road reserves.

Ecology

The few ecological studies undertaken on *T. cf. tetraporophora* in Queensland suggest that they are more prevalent in sorghum crops (average of 8.686 individuals per 100 trap-days) than grass verges (0.725/100 trap-days) or native grasslands (0.572/100 trap-days). Individuals predominantly shelter beneath sorghum litter (85.7%), but soil cracks are also used (9.5%) (Starr and Leung 2006).

Threats

The main reasons behind the decline of the grassland earless dragon is habitat loss caused by agricultural and urban development. This is still a major threat to existing populations.

Other processes that modify and degrade remaining habitat are also likely to threaten the species including irrigation, changed fire regimes, changed grazing regimes, invasion of weeds and introduced animals (Brereton & Backhouse 2003; Cogger *et al*. 1993; Robertson & Evans 2006).

These dragons occur in crop paddocks on private property. In the absence of further information, existing cropping practices should be continued.

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during construction. Depending on the extent of clearing, displaced animals are unlikely to persist due to increased competition with existing resident animals.
- Loss of habitat reducing the extent of populations, or in the cases where disturbance is extensive, causing local extinctions.
- Fragmentation and isolation of previous contiguous or connected populations by gas gathering lines and access tracks.
- Increased mortality due to captured individuals in open trenches passing through or adjacent to existing habitats.
- Increased surface water leaking from gas bores may alter the soil structure, closing ground cracks and facilitating weed or exotic grass growth.
- Edge effects, particularly weed invasion, pose a significant threat to grasslands dominated by native species. Exotic species alter habitat structure, potentially rendering large areas unsuitable.

<u>Significance of Project Related Impacts (Unmitigated)</u>

This species only occurs within the Darling Downs in Queensland. The EIS area includes a large portion of the western Darling Downs and the loss of populations within the EIS area could have significant deleterious ipmacts on the overall survival of *T. cf. tetraporophora* in Queensland. The species occurs in small isolated populations making them susceptible to clearing.

Movement of the species over artificial surfaces is not documented. However, the species inhabits modified sorghum fields suggesting that narrow gas gathering lines or access tracks are unlikely to create significant movement barriers. However, the ability to move over disturbed ground places them at risk of becoming captured in trenches. Given the small extent of some populations, open trenches adjacent or through communities may affect a significant number of individuals.

Native grasslands are particularly prone to weed infestation. Weed infestations can alter habitat structure, rendering previously suitable areas unsuitable.

These factors indicate that the species may be **Highly** sensitive to impacts and those impacts could have a **High** magnitude. The species has an impact significance of **High** (21).

<u>Proposed Management/ Mitigation Measures</u>

Habitat Avoidance

Imposing a 100m non-disturbance buffer around all core habitat known and core habitat possible will dramatically reduce impacts. Deaths during clearing, reduced habitat extent, movement barriers, trench deaths and impacts on habitats from edge effects would be largely neutralised. This management strategy is the only strategy considered to be highly effective, although other strategies may lessen impacts.

Further Survey and Assessment

If clearing is required in core habitat possible, further survey work is required to determine the presence/absence of the species and determine the level of impact. Following field work, disturbance zones should be compared with survey results to determine the decrease in habitat extent. A risk assessment should be undertaken using methods outlined in this document.

Minimise Disturbance

If avoidance is not possible, planning and infrastructure locations should be positioned to minimise disturbance. While this strategy might reduce the extent of habitat loss, it will increase the risk of edge effects (e.g., weed invasion) deleteriously affecting habitats.

Habitat offsets should be sort using guidelines within the Queensland Environmental Offsets Policy (2008).

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Placing the above sacks approximately every 400m when passing through disturbed land;

- o Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

Imposing a 100m buffer around all core habitat known or core habitat possible is the most effective and efficient impact mitigation measure. Other measures such as minimising disturbance, trench checking and weed control may be met with limited success.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
High	High	High (21)	Effective	Reguire further testing

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
High	Extremely Low	Low (7)	High	Moderate	Moderate (18)

Rule(s) for Habitat Mapping:

1. The species will only occur within the Darling Downs regions associated with the Condamine Floodplain (-27.00° to -28.00°; 151.18° to 151.90°).

2. All remnant grasslands and woodlands with native ground cover (11.3.2, 11.3.21, 11.3.24), and derived non-remnant grasslands dominated by native grasses are classed as “Core Habitat Possible”. A 100m buffer around these communities regardless of land-use should be included as “Core habitat Possible” to account for the species ability to occur in tilled crops (e.g., sorghum).

3. All cleared land within 2km of the above grasslands is classed as “Core Habitat Possible”. This accounts for the species’ propensity to use tilled land.

4. Core Habitat Possible within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".

5. All remaining areas are considered to be "Absence Possible".

Mapping Confidence

The species is known to inhabit artificial land causing difficulties in using remnant ecosystems to predict its occurrence. Remaining populations are isolated and fragmented, further compounding predictions. However, survey work to identify remaining populations of this species has been undertaken by DERM within the Darling Downs. These surveys have added to the overall knowledge of the species' distribution.

The habitat map for this species is considered to be MODERATELY accurate.

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Common Death Adder (*Acanthophis antarcticus*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

This species is widespread throughout Queensland with the exception of Cape York Peninsula and the Mulga Lands in the south-west (Wilson 2005). It also occurs in all other mainland states and territories. Once abundant in the Brigalow Belt, it is now rarely observed. State forests around Inglewood and Southwood National Park may represent strongholds.

It is found in a wide variety of habitats, including rainforest, open woodland, shrubland and heath (Wilson and Swan 2003; Ehmann 1992).

Ecology

The common death adder is a slow-moving, sedentary snake that lies motionless while partially buried in leaf litter, vegetation or soil. Breeding takes place in spring and autumn (Ehmann 1992).

This snake's diet consists of lizards and small mammals, and to a lesser extent, birds and frogs. However, diet changes with age, young animals consuming more reptiles and frogs, whilst adults feed predominantly on small mammals and birds (Shine 1980).

Threats

Threats to this species are poorly known. Land clearing and fragmentation are likely to have extensively affected the occurrence of this species in the Brigalow Belt. Alteration to microhabitats is also likely to have detrimentally affected ambush snakes such as death adders, as they require ground cover such as thick leaf litter from which they can ambush their prey. Grazing, agriculture, urbanisation and inappropriate fire regimes modify this ground cover considerably, reducing potential ambush sites (Ehmann 1992; Reed and Shine 2002, EPA 2003). Similar patterns of decline have been seen in other ambush hunting snake species (Shine 1994).

Common death adders are also at risk from Cane Toad ingestion in areas where toad abundance is high.

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during construction. Those animals that are displaced are unlikely to survive due to increased competition with existing resident animals.
- Loss of habitat, which may reduce population extent.

- While the species is known to cross roads and tracks, it is not known if movement frequency is reduced by these structures. It is possible that the construction of gas gathering lines and access tracks could affect movement.
- Increased mortality due to capture of individuals in open trenches passing through or adjacent to existing habitats.
- Increased surface water (e.g., leaking from gas bores, small water reservoirs) is likely to increase the abundance of Cane Toads, increasing the risk of toxic ingestion.
- Edge effects, particularly weed invasion, may alter the ground surface structure of existing habitats, rendering large areas unsuitable.
- Increased fire frequency related to increased human presence.
- Decreased wildlife extent due to gas gathering lines and access tracks forming fire breaks in otherwise contiguous habitat.

Significance of Project Related Impacts (Unmitigated)

This species is widely distributed and the EIS area forms only a small portion of its distribution. However, the species' population has declined within the Brigalow Belt and stronghold locations near Inglewood and Southwood are close to the EIS area. These populations may be importance to nearby metapopulations, allowing recolonisation and genetic flow.

Death Adders are reluctant to move making them susceptible to death during clearing activities. They seem to be absent from small fragments, restricted to large vegetation patches. Minor clearing within these areas for gas acquisition routes is unlikely to significantly reduce the extent of habitat. Clearing will, however, increase fragmentation, which may have contributed to historical declines of Death Adders.

The species has been recorded crossing roads and tracks, suggesting that short open areas do not represent movement barriers. Their capacity to move over disturbed land does suggest that they are likely to fall into open trenches, particularly on warm humid nights when activity peaks. While trench captures are likely to be localised, the species is scarce even in suitable habitats and a large number of captures has the potential to moderately affect populations.

Clearing activities through remnant vegetation also expose populations to edge effects and invasive species. Weed invasion, particularly from exotic grasses, can alter large areas of habitat, rendering it unsuitable. Rehabilitation using exotics only exacerbates this threat. Cane Toads readily move along tracks and the creation of pathways through existing vegetation increases the risk of Cane Toad-Death Adder interaction. Both these threats are difficult to mitigate.

The threat of trench deaths, fragmentation of existing habitats, weed invasion and increase Cane Toad/Adder interaction suggest that the species is **Moderately** sensitive to project-related impacts and these impacts could have have a **Moderate** magnitude. The species has a impact significance of **Moderate** (13).

Proposed Management/ Mitigation Measures

Habitat Avoidance

Death Adders are typically absent from small patches of vegetation, with existing populations restricted to large contiguous habitats. The physical loss of habitat from project-related activities is unlikely to be significant in the local area context. However, clearing activities expose populations to a number of indirect impacts (e.g., weed invasion, Cane Toad ingestion). Mitigation of these indirect impacts may have moderate effects, but the most effective and efficient protection measure is the avoidance of the remaining large habitats. Avoidance would completely alleviate impacts.

Further Survey and Assessment

This species is difficult to detect due to its cryptic nature. However, survey efforts prior to clearing are warranted and may provide valuable information regarding the presence/absence and distribution/abundance of the species. Surveys should only be undertaken during summer (Oct-Mar) and are likely to be most profitable if conducted during warm, wet periods (i.e., following summer rains). Results from the field study will allow the risks associated with disturbance to be re-evaluated.

Minimise Disturbance

Avoidance of large vegetation patches may not be a viable option. If unavoidable, infrastructure locations should be positioned to minimise clearing and fragmentation. Gas acquisition pipelines in particular should avoid dissecting existing habitats by entering areas from multiple directions.

Minimising clearing will reduce impacts, but still exposes populations to weed infestations and Cane Toad ingestion.

Rehabilitation

While the species is known to cross open land, impacts on movements may be reduced by rehabilitation efforts along acquisition lines. Rehabilitation should aim to restore as much habitat structure as possible, while still allowing for project operation. Rehabilitation of gas acquisition pipelines should include preliminary efforts and final rehabilitation following decommission. Preliminary rehabilitation should include:

- Logs and debris (including dirt clods and rocks) removed during clearing should be retained and placed back over cleared ground to provide shelter;
- Partial revegetation using small native grass and shrub species (e.g., acacias) that will not affect operations. Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement.

Partial rehabilitation will assist in preventing weed incursion and reduce deleterious edge effects that might modify the long-term integrity of uncleared adjacent habitat. Partial rehabilitation may also reduce Cane Toad incursion along disturbed conduits, although this is untested.

Long-term loss of habitat may be mitigated by seeding partially rehabilitated areas with canopy species following decommission. Cleared areas not already partially rehabilitated should be ripped and seeded with native flora species typical of surrounding habitats as described in a rehabilitation plan.

Rehabilitation methods, recommended seed mixes and monitoring should be documented in a project rehabilitation plan.

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Placing the above sacks approximately every 400m when passing through disturbed land;
    - Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;
- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

<u>Summary Residual Impact Assessment</u>

This species has broad habitat preferences and is widespread. Populations will therefore have some resilience to habitat disturbance. It is not anticipated that complete avoidance of suitable habitat will be possible, although minimising clearing should be a priority. Controlling impacts through rehabilitation and trench clearing will be beneficial and substantially reduce short-term and long-term impacts.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	Low

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Moderate	moderate (13)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. All remnant vegetation >100ha in extent or within 500m of a larger vegetation patch should be classed as “Core Habitat Possible” with the exception of grasslands (RE 11.3.21 and 11.3.24).
3. Core Habitat Possible within 2km of a recent (1980+), accurate (±500m) record is classed as “Core Habitat Known”.
4. Regrowth should is classed “Absence Possible”.
5. Cleared farmland or tilled crops are classed “Absence Likely”.

Mapping Confidence

Habitat use by Death Adders is difficult to predict. They may occur in any remnant habitat, yet are absent from seemingly good habitats within their range. This may reflect historic land use or events that have affected ground structure. Historical fires, for example, may have reduced ground cover and resulted in local extinctions. Following fire, recolonisation may only occur if remaining patches are large or well connected to nearby populations. Due to these difficulties, the habitat map for this species is considered to have a LOW accuracy.

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Dunmall’s Snake (*Furina dunmalli*)

Status

NCA: vulnerable; EPBC: vulnerable

Distribution and habitat

The species has been recorded from around Emerald in central Queensland, south to northern NSW (Wilson 2005). Most records of this species are from open forests and woodlands, particularly brigalow and woodlands growing on cracking black clay and clay loams (Cogger *et al*. 1993). The species has also been recorded from dry eucalypt forests and anecdotal evidence suggests it may occur in vine thickets.

Ecology

Dunmall’s snake is a cryptic, secretive species that is possibly genuinely scarce (Wilson 2005). Little is known of its ecology, but it reportedly preys on lizards and geckos (Gow and Swanson 1977; Shine 1981). Nothing is known of its breeding biology other than that it lays eggs (Wilson and Swan 2008).

Threats

Threats to this species are not well understood. They are likely to be affected by altered land practices, particularly land clearing, but the impacts of other activities such as weed invasion and cattle grazing cannot be estimated without a better understanding of the ecology of the species.

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during construction. Those displaced by clearing are less likely to survive due to increased competition with nearby existing resident animals.
- Loss of habitat, which may reduce population extent.
- While the species is known to cross roads and tracks, it is not known if movement frequency is reduced by these structures. The construction of gas gathering lines and access tracks could affect movement.
- Increased mortality due to captured individuals in open trenches passing through or adjacent to existing habitats.
- Edge effects, particularly weed invasion, may alter the ground surface structure of existing habitats, rendering large areas unsuitable.

Significance of Project Related Impacts (Unmitigated)

This species is widely distributed and the EIS area forms only a portion of its distribution. However, the species is very uncommon and encountered only sporadically. As a consequence, the death and loss of individuals from populations may affect this species more than those that are locally common. Death resulting from clearing and trench capture will have short-term consequences, but the species' ability to recover population numbers is unclear.

Clearing native vegetation will promote edge effects, including weed invasion. The response of this species to habitat modification is unclear, but most records occur in large natural areas, or patches that have not been historically disturbed. Edge effects and subsequent weed invasion has the potential to produce long-term impacts over a large area.

The sensitivity of this species this poorly known and difficult to assess, but has been estimated as **Moderate**. The magnitude has also been estimated as **Moderate**, giving an overall impact significance of **Moderate** (13)..

<u>Proposed Management/ Mitigation Measures</u>

Habitat Avoidance

Loss of habitat from project-related activities is unlikely to be significant in the context of surrounding habitat. However, clearing activities expose populations to increased mortality (from clearing or trench capture) and long-term indirect impacts (e.g., weed invasion). Mitigation of these indirect impacts may have moderate effects, but the most effective and efficient protection measure is the avoidance of core habitats. Avoidance would completely alleviate impacts.

Further Survey and Assessment

This species is difficult to detect due to its cryptic nature. However, survey efforts prior to clearing are warranted and may provide valuable information regarding the presence/absence and distribution/abundance of the species. Surveys should only be undertaken during summer (Oct-Mar) and are likely to be most profitable if conducted during warm, wet periods (i.e., following rainfall). Results from the field study will allow the risks associated with disturbance to be re-evaluated.

Minimise Disturbance

Avoidance of large vegetation patches may not be a viable option. If unavoidable, infrastructure locations should be positioned to minimise clearing and fragmentation. Gas acquisition pipelines in particular should avoid dissecting existing habitats by entering areas from multiple directions.

Minimising clearing will reduce the loss of habitat, but death of individuals during clearing cannot be appropriately mitigated.

Rehabilitation

While the species is known to cross open land, movements may be reduced by rehabilitation efforts along acquisition lines. Rehabilitation should aim to restore as much habitat structure as possible, while allow project operation. Rehabilitation of gas acquisition pipelines should include preliminary efforts and final rehabilitation following decommission. Preliminary rehabilitation should include

- Logs and debris (including dirt clods and rocks) removed during clearing should be retained and placed back over cleared ground to provide shelter;
- Partial revegetation using small native grass and shrub species (e.g. acacias) that will not affect operation. Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement.

Partial rehabilitation will assist in preventing weed incursion and reduce deleteriously edge effects that might modify the long-term integrity of uncleared adjacent habitat. Long-term loss of habitat may be mitigated by seeding partially rehabilitated areas with canopy species following decommission. Cleared areas not already partially rehabilitated should be ripped and seeded with native flora species typical of surrounding habitats as described in a rehabilitation plan.

Rehabilitation methods, recommended seed mixes and monitoring should be documented in a project rehabilitation plan.

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;
- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;

- o Placing the above sacks approximately every 400m when passing through disturbed land;
- o Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

This species has broad habitat preferences and is widespread. It is therefore anticipated that complete avoidance of suitable habitat will not be possible, although minimising clearing should be a priority. Deaths associated with vegetation clearing remain unavoidable. Consequences from the loss of individuals from existing populations remain unclear, but would be dependent on the number of animals removed.

Controlling indirect impacts through rehabilitation, trench clearing and weed suppression will be beneficial and assist in reducing short-term and long-term impacts.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	Reguire further testing

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. All remnant vegetation >50ha in extent or within 500m of a larger vegetation patch should be classed as “Core Habitat Possible”.

3. Core Habitat Possible within 1km of a recent (1980+), accurate (±500m) record is classed as “Core Habitat Known”.
4. Regrowth should is classed “Absence Possible”.
5. Cleared farmland or tilled crops are classed “Absence Likely”.

Mapping Confidence

This species is very poorly understood and records are scarce. Predicting its occurrence or gaining an understanding of its habitat preferences are accordingly hampered. The habitat map for this species is considered to be LOW in accuracy.

References

Cogger, H. G., Cameron, E. E., Sadlier, R. A. and Eggler, P. (1993). The action plan for Australian reptiles. Australian Nature Conservation Agency, Canberra. p153-155

Gow, G. R. and Swanson, S. (1977). Snakes and Lizards of Australia. Angus and Robertson Publishers, Sydney. P 69.

Shine, R. (1981). Ecology of Australian Elapid Snakes of the Genera Furina and Glyphodon. *Journal of Herpetology.* 15. 219-224.

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Grey Snake (*Hemiaspis damelii*)

Status

NCA: endangered; EPBC: not listed

Distribution and habitat

Grey snakes occur throughout the Brigalow Belt, from coastal districts near Rockhampton, south-east to the Lockyer Valley in South East Queensland (Wilson 2005).

Grey snakes inhabit dry eucalypt forest and occasionally pasture (Covacevich and Wilson 1995). Favoured areas are cracking, flood-prone soils along floodplains and near watercourses within the Brigalow Belt (Hobson 2000; Wilson 2005).

Ecology

Grey snakes are weakly venomous nocturnal frog specialists (Wilson and Swan 2003), sheltering during the day under fallen logs, within soil cracks and down animal burrows.

They are known to give birth to up to 10 live young (Covacevich and Wilson 1995), but little else is recorded of their breeding biology.

Threats

This species is threatened by habitat loss, habitat degradation and fragmentation. Existing habitats and populations are under threat from agriculture and urban development (Eyre *et al*. 1997), as well as mining activities and the loss of waterways or wetlands. In addition, ingestion of cane toads and subsequent death from poisoning pose a threat to the species.

Project-related Impacts (unmitigated)

Potential impacts associated with the gas developments include:

- Death or injury of individuals during construction. Those not directly affected, but displaced, are unlikely to survive due to increased competition with existing resident animals.
- Loss of habitat, which may reduce population extent.
- While the species is known to cross roads and tracks, it is not known if movement frequency is reduced by these structures. It is possible that the construction of gas gathering lines and access tracks could affect movement.
- Increased mortality due to captured individuals in open trenches passing through or adjacent to existing habitats.
- Increased surface water (e.g., leaking gas bores, small water reservoirs) is likely to increase the abundance of Cane Toads, increasing the risk of toxic ingestion.

Significance of Project Related Impacts (Unmitigated)

This species is widely distributed and may occur in a variety of habitat types, particularly those on soils/landforms subject to ephemeral flooding. Suitable habitat is common and the physical loss of habitat for construction is unlikely to be significant in the context of remaining vegetation. However, vegetation clearing will result in the loss of some individuals from populations. Recruitment in subsequent generations is likely to replace lost individuals where sufficient habitat remains.

The species can be recorded crossing roads and tracks, suggesting that open exposed ground will not pose a significant movement barrier for individuals. However, as the species may move across open areas, open trenches may result in capture and subsequent death. This impact is likely to be short-term and effects localised to individuals in close proximity to clearing.

Clearing activities through previously intact vegetation may expose habitats to edge effects and populations to invasive species. Weed invasion, particularly from exotic grasses, can alter large areas of habitat, rendering it unsuitable. This is particularly relevant in fragile habitats such as those occurring on Landzones 3 and 4 (e.g., 11.3.1, 11.3.21). Rehabilitation using exotic species greatly exacerbates this threat. Cane Toads readily move along tracks and the creation of pathways through existing vegetation increases the risk of Cane Toad interaction and digestion. Both these threats are difficult to mitigate and have the potential for long-term consequences.

The species sensitivity to impacts has been estimated as **Moderate**, while unmitigated impact magnitude is conservatively estimated as **Moderate**. The impact significance for this species is **Moderate** (13).

Proposed Management/ Mitigation Measures

Habitat Avoidance

Loss of habitat from project-related activities is unlikely to be significant in the context of surrounding habitat. However, clearing activities expose populations to increased mortality (from clearing) and long-term indirect impacts (e.g. weed invasion). Mitigation of these impacts may have moderate results, but the most effective and efficient protection measure is the avoidance of core habitats. Avoidance would mostly alleviate impacts.

Further Survey and Assessment

This species is difficult to detect due to its cryptic nature. However, survey efforts prior to clearing are warranted and may provide valuable information regarding habitat suitability, the presence/absence of the species and its potential distribution/abundance. Surveys should only be undertaken during summer (Oct-Mar) and are likely to be most profitable if conducted during warm wet periods (i.e., following rainfall). Results from the field study will allow the risks associated with disturbance to be re-evaluated.

Minimise Disturbance

Avoidance of large vegetation patches may not be a viable option. If unavoidable, infrastructure locations should be positioned to minimise clearing and fragmentation. Gas acquisition pipelines in particular should avoid dissecting existing habitats by entering areas from multiple directions.

Minimising clearing will reduce the loss of habitat, but death of individuals during clearing cannot be appropriately mitigated.

Rehabilitation

While the species is known to cross open land, movements may be reduced by rehabilitation efforts along acquisition lines. Rehabilitation should aim to restore as much habitat structure as possible, while still allowing project operation. Rehabilitation of gas acquisition pipelines should include preliminary efforts and final rehabilitation following decommission. Preliminary rehabilitation should include:

- Logs and debris (including dirt clods and rocks) removed during clearing should be retained and placed back over cleared ground to provide shelter;
- Partial revegetation using small native grass and shrub species (e.g., acacias) that will not affect operation. Some vegetative cover will reduce the difference between surrounding vegetation and cleared areas, facilitating movement.

Partial rehabilitation will assist in preventing weed incursion and reduce deleterious edge effects that might modify the long-term integrity of uncleared adjacent habitat. Long-term loss of habitat may be mitigated by seeding partially rehabilitated areas with canopy species following decommissioning. Cleared areas not already partially rehabilitated should be ripped and seeded with native flora species typical of surrounding habitats as described in a rehabilitation plan. Rehabilitation methods, recommended seed mixes and monitoring should be documented in a project rehabilitation plan.

Groundwater extracted from gas wells should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

Other Measures

Open trenches pose a short-term threat to local populations, but this may be mitigated by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide

from the bottom of the trench to the surface. Trapped animals (e.g., wallabies, bettongs) may use these to exit the trench;

- Trenches should be checked regularly and trapped frogs, lizards, snakes, mammals removed prior to laying pipes and closing trenches. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation. This process will be facilitated by:
    - Placing two sawdust filled hessian sacks at the bottom of the trench approximately every 200m when passing through native vegetation. These will provide shelter for small trapped animals;
    - Placing the above sacks approximately every 400m when passing through disturbed land;
    - Removing these sacks prior to trench closing. Additional bags may be positioned wherever high fauna activity is likely. Clearing of trenches should be undertaken by a suitably qualified animal handler or ecologist;
- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Summary Residual Impact Assessment

This species has broad habitat preferences and is widespread. Furthermore, the species may on occasion appear in modified landscapes, confounding efforts to predict where populations might occur. It is therefore anticipated that complete avoidance of suitable habitat will not be possible, although minimising clearing should be a priority. Deaths associated with vegetation clearing remain unavoidable. Controlling indirect impacts through rehabilitation, trench clearing and weed suppression will be beneficial and assist in reducing short-term and long-term impacts.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	moderate

* No clearing of vegetation within areas of core habitat known or core habitat possible.

Clearing of core habitat known and possible is unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. All remnant vegetation where surface water could collect provides potential habitat for these species. In particular, vegetation on Landzones 3, 4, and 5 should be classed as “Core Habitat Possible”. In addition, the following RE’s have clay soils, gilgai’s or are likely to be subject to temporal ponding and should also be “Core Habitat Possible”; 11.9.5, 11.9.6 and 11.9.10.
3. Remaining remnant vegetation within 50m of a creekline, stream or other waterway should be classed “General Habitat”.
4. Core Habitat Possible or General Habitat within 1km of a recent (1980+), accurate (±500m) record is classed as “Core Habitat Known”.
5. Regrowth be classed according to its parent regional ecosystem.
6. Cleared farmland or tilled crops are classed “Absence possible”. While the species can occur within grazing land, it is unlikely that these habitats are vital for the species survival and records may reflect transient individuals.

Mapping Confidence

This species may occur in a number of habitats, including artificial grazing land. Predicting its habitat is therefore difficult. The habitat map for this species is considered to be LOW in accuracy.

References

Covacevich, J. and Wilson, S. (1995). Land Snakes. In: M Ryan (ed.), Wildlife of Greater Brisbane. Queensland Museum, Brisbane. p209

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BIRDS

Grey Goshawk (*Accipiter novaehollandiae*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Grey goshawks occur in temperate, sub-tropical and tropical rainforest, tall open forests, woodlands, wooded gorges, dense timber along watercourses, usually in the 760+ mm rainfall zone (Marchant and Higgins 1993). They appear to avoid open forest, preferring heavier forests, particularly in hilly and mountainous terrain (Burton and Olsen 2000; Beruldsen 2003). Individuals can, however, be found in other habitats including farmland and heath; these are most likely young birds dispersing from natal territories (Olsen and Olsen 1985; Marchant and Higgins 1993).

Grey goshawks occur in all Australian states and the Northern Territory, though never far inland. They are absent from the dry western portions of Cape York Peninsula and the Gulf of Carpentaria (Marchant and Higgins 1993).

Ecology

The grey goshawk is a solitary, secretive species that forages by ambushing prey from a concealed perch in the tree canopy or by low, fast flight (Debus 1998). Prey is taken from in trees or on the ground rather than in the air (Olsen and Olsen 1985) and principally includes mammals such as rabbits, possums and bats. These are supplemented by birds, nestlings, snakes, lizards, frogs, insects and occasionally carrion (Marchant and Higgins 1993).

Breeding occurs once per year, usually from August to December. The nest is placed either in an upright fork or on top of a clump of mistletoe, usually in the topmost branches of a tall tree (Beruldsen 2003 p202). Mature forests are important for this species as large habitat trees provide the best nesting sites. Regrowth forest less than 30 years old is seldom used (Marchant and Higgins 1993).

Threats

There has been a slight decrease in the population size of grey goshawks since European settlement, probably due to habitat loss and persecution (Olsen 1998). However, the species is not nationally threatened and is still common in the tropics and subtropics (Debus 1998). The species is still threatened by habitat loss, particularly in south-eastern Australia (Debus 1998).

Project-related Impacts (unmitigated)

Grey goshawks inhabit mesic habitats in high rainfall areas and are resident within the Carnarvon Ranges of the Brigalow Belt South (EPA 2003). Little suitable habitat occurs within the EIS area and records probably reflect nomadic individuals or vagrants. Inspection of records with GPS data (Birds Australia records) indicate that all except one occur in open pastoral land, supporting this conjecture. Without large areas of suitable habitat, resident populations are highly unlikely and hence there can be no project-related impacts on grey goshawk populations.

Significance of Project Related Impacts (Unmitigated)

Typical habitat for this species is limited within the PDA and records are likely to reflect transient individuals. It is therefore unlikely that any resident populations occur within the PDA.

The species is highly mobile. Clearing or other project related activities are unlikely to result in direct deaths or impose movement barriers. The species has a **Low** sensitivity to impacts and impacts are likely to be **Extremely Low** in magnitude. The unimtigated impact significance of this species is therefore **Insignificant** (2).

Proposed Management/ Mitigation Measures

As impacts will be Insignificant, no specific mitigation measures are considered necessary for this species. However, consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible. Rehabilitation of cleared land following decommission with vegetation typical of surrounding habitats should also be undertaken.

Summary Residual Impact Assessment

Project-related impacts are expected to be insignificant. Avoidance of any core habitat within the project are will ensure that no impacts occur. However, when clearing occurs, the minor effects may be reduced through minimising habitat clearance and rehabilitating disturbed areas.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Extremely Low	Low (4))	Effective	N/A

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	N/A	N/A

Rule(s) for Habitat Mapping:

- The species could occur throughout the entire PDA.

- Regional Ecosystems 11.8.3 and 11.9.4a are suitable for this species and should be mapped as “Core Habitat Possible”.
- All areas of remnant vegetation should be mapped as “Absence Possible”.
- All areas of non-remnant vegetation and cleared land should be mapped as “Absence Likely”.

Where GPS data is available, grey goshawk records are indicated on the map. These are likely to reflect vagrant records.

Mapping Confidence

With the exception of vagrant records, the grey goshawk habitat map is considered to be HIGHLY accurate.

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Australian Painted Snipe (*Rostratula australis*)

Alternative Nomenclature

Rostratula australis was considered to be a subspecies of *Rostratula bengalensis* until Baker *et al*. (2007) raised it to species level. The Australian painted snipe (*R. australis*) is now restricted to Australia. It is often referred to in previous literature as *R. bengalensis* (*sensu lato*).

Status

NCA: vulnerable; EPBC: Vulnerable (*R. benghalensis* [*sensu lato*] listed as Migratory)

Estimations of Australian painted snipe population trends have been confounded by its nomadic nature. The species may become absent from historical locations, only to re-appear after decades. Nevertheless, there has been a substantial reduction in the reporting rate for the species (Johnstone and Storr 1998; Lane and Rogers 2000; Rogers *et al.* 2005).

Distribution and habitat

Most records of the Australian painted snipe occur east of a line between Eyre Peninsula and the Gulf of Carpentaria, excluding Cape York where they appear to be absent (Marchant and Higgins 1993). However, scattered individuals occur west as far as Western Australia, where they may have once been common in the Kimberley and Swan Coastal Plain (Johnstone and Storr 1998). Recent records mostly centre on the Murray-Darling basin of eastern Queensland and NSW (Marchant and Higgins 1993; Rogers *et al.* 2005). Lake Broadwater is considered to be important habitat for this species within the Brigalow Belt South, although there are no breeding records from this location (EPA 2003).

Birds may be recorded singly or in small groups in freshwater marshes. They are extremely nomadic, coming and going in response to local rainfall and flooding. Breeding only occurs in swamps with temporary water regimes and complex shorelines forming islands, shallow water, exposed wet mud and dense low fringing vegetation (Roger *et al.* 2005; Geering *et al.* 2007). During non-breeding periods they may be found in a wider range of habitats including dams, rice paddocks, waterlogged grasslands, roadside drains and even brackish waterways (Marchant and Higgins 1993)

Ecology

The Painted Snipe appears to be crepuscular and nocturnal, feeding on mudflats or in shallow water during the morning and evening and throughout the night (Geering *et al.* 2007). A variety of dietary items are ingested including vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates including beetles (Marchant and Higgins 1993; Johnstone and Storr 1998).

Nesting occurs in spring and summer in southern Australia and during the wet season in northern Australia (Geering *et al.* 2007). Nests consist of a simple scrap in the ground lined by dry grasses, fine twigs and other vegetation. These nests are located in specific positions such as on a small island surrounded by shallow water, or occasionally on small mounds of purpose-built vegetation surrounded by water (Berudlsen 2003; Rogers *et al.* 2005). Breeding occurs only in suitable temporary wetlands with low relief and complex shorelines after an influx of water (Rogers *et al.* 2005).

Movement and dispersal of the Australian painted snipe is poorly understood. Individuals and small groups may appear irregularly and infrequently, even in locations where they have been previously recorded breeding. It is possible that such movements are due to local conditions, moving to flooded areas from drying wetlands (DEWHA 2009).

<u>Threats</u>

The primary factor in the decline of the Australian painted snipe has been the loss or alteration of wetland habitats and their water regimes, particularly areas of breeding habitat. This loss has occurred through drainage of wetlands, diversion of floodwaters for agricultural and irrigation purposes. Remaining areas have often been flooded, or now contain permanent water allowing the growth of continuous reedbeds, unsuitable habitat for the species (Garnett and Crowley 2000; Rogers *et al.* 2005).

Other processes that may be affected the recovery of this species is the degradation of existing wetlands through cattle trampling and weed infestation. For example, Parkinsonia aculeata is regularly associated with waterways and wetlands where it forms tall dense thickets unsuitable for Australian painted snipe and a range of other wetland species (DEWHA 2009).

<u>Project-related Impacts (unmitigated)</u>

It is probable that this species will be restricted to Lake Broadwater, Long Swamp and any large farm dams (>5ha). Current development plans do not include direct impacts on Lake Broadwater. Impacts are therefore likely to be restricted to impacts at Long-swamp and indirect impacts including:

- The temporary loss of vegetation and hence habitat within Long Swamp for the construction of gas gathering lines.
- Alterations in surface water flow impacting flood frequency and intensity of Lake Broadwater and Long Swamp.
- Deterioration of water quality within Long Swamp and Lake Broadwater through processes such as increased sedimentation and/or increased salinity from activities upstream of these values.
- Increased weed invasion of Long Swamp and Lake Broadwater affecting the composition and structure of bank vegetation. Weed propagules may be transported either directly through clearing practices (Long Swamp) or by surface water flow in Broadwater and Surveyors Gully.

Significance of Project Related Impacts (Unmitigated)

The use of suitable habitats by this species within the EIS area is unclear. It is possible that breeding could occur during prolonged wet periods; however, it seems more probable that records represent transient individuals taking advantage of suitable foraging habitat. No known resident population occurs within the PDA and the importance of potential habitat for the Australian painted snipe is difficult to predict.

While the species can use temporary flooded areas (locations of which are difficult to predict), the best (and known) habitat is located at Lake Broadwater. Habitat might also occur along Long Swamp during periods of inundation. A 500m exclusion zone has been established around Lake Broadwater and hence direct impacts are not expected. Unmitigated indirect impacts predominantly relate to alterations in water quality, the most severe of which could be salination due to ground water intrusion into surface waterways. Water quality could also be affected by increased sedimentation, although this is likely to be short-term as vegetation should return to stabilise disturbed surfaces.

Unlike Lake Broadwater, no exclusion zone has been established around Long Swamp. Disturbance within this area is likely to be restricted to gas gathering lines and infrastructure cannot be placed in flood prone areas. The construction of gas gathering lines through Long Swamp will result in the loss of some vegetation and increased ground disturbance. These impacts will be short-term and probably minor in severity given the existing condition of the swamp and surrounding vegetation. Long-term impacts to Long Swamp might occur if weeds are transported during construction or if saline groundwater is allowed to flow from bores into the swamp. Weed invasions can be difficult to control in low-lying areas where water collects. Given the above uncertainties, it is difficult to estimate the species sensitivity, or impact magnitude. For the purpose of this report both are rated **Moderate** based on a conservative approach. The overall impact significance is therefore **Moderate** (13)

Proposed Management/ Mitigation Measures

Habitat Avoidance

The most important habitat for this species within the PDA (i.e., Lake Broadwater) will be avoided. No plans have been provided for developments at Long Swamp. Avoiding placing infrastructure within this area will further avoid any potential direct impacts and reduce indirect impacts. However, it is recognised that Long Swamp may not be as important to the species and therefore avoidance is preferred, but not necessary.

Minimise Disturbance

While some disturbance of Long Swamp may not have significant impacts, disturbance should be minimised. Gas wells, dams or other large infrastructure should not be placed in Long Swamp, or within 100m. Gas gathering lines will cause limited and minor disturbance to existing habitats, but do increase the risk of habitat modification through weed invasion (therefore requiring stringent weed control mitigation).

Rehabilitation

Following any disturbance within Long Swamp, rehabilitation efforts should follow. These should aim to stabilise the ground surface minimising the risk of increased sedimentation. Native species typical of the habitat should be used to reduce weed infestation. Rehabilitation may require initial seeding if undertaken while the swamp is dry, followed by subsequent planting of aquatic species when in flood.

Other Measures

A stringent weed control strategy should be developed for the project. This should include targeted weed control strategies and monitoring for any disturbance within the vicinity of Long Swamp. Weed species may quickly and rapidly spread along waterways, taking advantage of surface water movements to spread and favourable growing conditions. Weed control within the swamp should therefore be a priority. Groundwater extracted from gas wells should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

Summary Residual Impact Assessment

The most suitable habitat within the PDA around Lake Broadwater is unlikely to be affected. Impacts may occur if avoidance is not possible within less suitable habitat at Long Swamp. Indirect impacts, particularly weed invasion, are extremely difficult to control even with mitigation measures.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Moderate	Moderate (13)	Effective	Low

* Complete avoidance of Long Swamp.

based on the only disturbance in Long Swamp from gas gathering lines.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Moderate	Moderate (13)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. The water containment area of Lake Broadwater and a buffer of 50m should be considered "Core Habitat Known".
3. Areas within Long Swamp where water collection might occur following surface flow should be considered "Core Habitat Possible".
4. All remnant vegetation where surface water could collect within the Condamine and Wilkie Creek Catchments (e.g., RE 11.3.27d and vegetation communities WA, WA1 and WA2) should be classed as "General Habitat".
5. Remaining REs, cleared farmland or tilled crops are classed "Absence Likely".

Mapping Confidence

This species is associated with aquatic and semi-aquatic vegetation, which may be clearly indicated in vegetation maps. However, the species' occurrence is sporadic and may therefore not occur within all areas of Core Habitat Possible. The species may also occur in minor wetlands and flooded non-native grasslands, suggesting that it might occur in areas not indicated on the habitat map. However, these occurrences are likely to be rare at best. The habitat map for this species is considered to be MODERATE in accuracy.

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Glossy Black-Cockatoo (*Calyptorhynchus lathami*)

Status

NCA: vulnerable; EPBC: not listed

Distribution and habitat

Glossy black-cockatoos have a patchy distribution along the east coast and ranges south from near the Paluma Range to the Gippsland region in Victoria. An isolated population is located on Kangaroo Island in South Australia. They are uncommon and declining, especially in the south-western parts of its range, and are now extinct in mainland South Australia (Garnett and Crowley 2000). There has been concern for the status of glossy black-cockatoos in the Southern Downs due to the loss of feeding and nesting resources (EPA 2003).

Birds inhabit woodlands and forests that have abundant Allocasuarina trees and abundant large hollows suitable for nesting. Many populations are restricted to remnant vegetation within hills and gullies surrounded by agricultural land (Higgins 1999); however, some populations move through artificial landscapes such as semi-urban parks, gardens and golf courses to access favoured food resources (Higgins 1999, M. Sanders pers. obs.). Groups are never far from waterbodies, which are visited daily.

Ecology

Typically encountered in small family parties, glossy black-cockatoos are dietary specialists, feeding exclusively on the seeds in Allocasuarina and Casuaninas. Favoured species include *A. torulosa, A. littoralis, A. luehmannii, A. distyla, A. diminuta, A. Gymnanthera* and *A. verticillata* (Chapman 2007). It is poorly documented, but glossy black-cockatoos also feed on *A. inophloia* in and around the Kumbarilla to Inglewood area (M. Sanders pers. obs.).

Observations of the species feeding on other resources (e.g., Callitris and Banksia) are likely to represent food switching during periods of poor Allocasuarina cone production (Chapman 2007). It is unclear if the use of *A. inophloia* by local populations reflect food switching, or if local populations rely on stands of *A. inophloia*. However, given the abundance of orts (feeding signs) in some locations, and their repeated observation over consecutive years, the later seems feasible.

Birds show a preference for productive trees (e.g., higher seed/cone weight ratio), notwithstanding the influence of other factors such as distance from water or breeding hollows (Clout 1989; Pepper *et al.* 2000; Crowley and Garnett 2001; Cameron and Cunningham 2006; Chapman and Paton 2006; Chapman 2007). Stands of Allocasuarina are therefore not of uniform value, and the loss of individual stands or trees may have disproportionate impacts.

The production of cones by Allocasuarina trees closely tracks rainfall (Cameron 2006a), and hence the availability of resources for resident glossy black-cockatoos fluctuate between years. While resources may be sufficient to support existing birds, drought is likely to reduce breeding success (Cameron 2009).

Pairs breed during winter, mainly from April to July, although breeding has been recorded as late as August or as early as March (Beruldsen 2003). Nests are located in a large vertical hollow extending one or two meters deep. Hollows may be reused over many years (Beruldsen 2003). Females incubate and care for the young alone, but are regularly attended and fed by the male. Only one egg is produced, which hatches in about 30 days. Once hatched the chick fledges in around 60 days, but remains with its parents and is fed for another three months (Garnett *et al.* 1999).

Threats

Threats to glossy black-cockatoo populations include:

- Clearing of habitat remains a serious threat. Previous clearing has reduced the species' range in the south and west of the Great Divide (Garnett and Crowley 2000).
- Fire can reduce or remove suitable feed trees from large areas for several years and, if followed by grazing, prevent regeneration of previous habitats.
- Fragmentation of habitats may also result in an increase in predation of nestlings and eggs or alternatively result in higher competition for hollows (Downes *et al*. 1997). This threat may be particularly severe where species adapted to altered or open habitats are abundant. These 'edge' species may include Common Brushtail Possums (*Trichosurus vulpecula*), Little Corellas (*Cacatua sanguinea*) and Galahs (*Eolophus roseicapilla*). By out-competing cockatoos for nest hollows, these predators and/or competitors can significantly reduce recruitment of glossy black-cockatoos (Garnett *et al*. 1999).
- Prolonged and severe drought can significantly reduce Allocasuarina cone production, reducing feeding resources and therefore breeding success. Global climate change may therefore negatively impact the species on a broad scale, particularly on the western slopes of the Great Divide (Cameron 2009).
- The loss of suitable hollow-bearing trees through processes such as fire or logging (Cameron 2006b).

Project-related Impacts (unmitigated)

Glossy black-cockatoos are highly mobile and able to easily cover large distances over modified land. It is unlikely, therefore, that dispersal or movement patterns will be affected by gas field activities. However, in fragmented landscapes, resources can be depleted and remaining stands could be vital for local populations. These remaining stands could be very minor in extent. Potential project-related impacts could include:

- Loss of foraging resources. Construction of gas gathering lines, access tracks, ponds, power plants and associated infrastructure could result in the loss of both small and large patches of forage trees. Furthermore, the disproportionate use of resources means that even minor clearing of individual *Allocasuarina* could severely affect populations.
- Salination of existing water points critical to local populations
- Increased availability of surface water associated with de-watering ponds, increasing access to previously distant and hence unavailable resources. This may be beneficial to glossy black-cockatoos, or it may encourage more competitive species into the area.

Significance of Project Related Impacts (Unmitigated)

Project-related impacts on local glossy black-cockatoo populations are difficult to quantify as the species does not use resources uniformly, selecting individual trees or stands disproportionately. Without knowing exact resource utilisation, it is difficult to quantify impact severity. Furthermore, resource utilisation patterns may change from year to year. Accordingly, all resources need to be considered as highly important, particularly in regions where resources have been depleted (e.g., Dalby and surrounds). The species sensitivity to impacts has been estimated as **Moderate**.

Impact magnitude is also difficult to estimate without proposed infrastructure locations, allowing the extent of resource removal to be estimated. Remaining resources are often contained within roadside or stock reserves, which have been protected from clearing. Unfortunately, these are also the most likely routes for gas acquisition due to fewer landholder issues. Accordingly, it is foreseeable that unmitigated removal of resources could potential affect a sizable portion of remaining habitat. This could have **Moderate** impacts on those populations at most risk.

The species therefore has an unmitigated impact significance of Moderate (13).

Proposed Management/ Mitigation Measures

Habitat Avoidance

Habitat avoidance will ensure that impacts are adequately mitigated. Avoidance should include both core habitat known and core habitat possible, as the species' resource requirements are relatively well known.

Further Survey and Assessment

Clearing in core habitat possible should be preceded by field surveys with the aim of identifying key resource areas. These can be identified as core habitat known areas. The impact of clearing core habitat areas should be assessed once development plans have been released, allowing the loss to be quantified. While this might be effective in identifying resource use at the time of survey, it does not account for seasonal or temporal variations and may therefore not adequately alleviate long-term impacts.

Minimise Disturbance

Should habitat avoidance not be feasible, clearing should be minimised wherever possible by the careful planning of infrastructure and construction. This will reduce the loss of resources for the local population.

Rehabilitation

Although rehabilitation of *Casuarina cristata* is difficult, it is not impossible. Rehabilitation on cleared land has the potential to offset habitats, although rehabilitated areas may not provide sufficient resources for local populations until clearing impacts have already taken effect. Rehabilitation does have the potential to improve overall regional value for glossy black-cockatoos if undertaken in existing cleared areas, thereby alleviating existing pressures on local populations. Rehabilitation could occur on any dark cracking clay areas (particularly landzone 3 and 4) and need not be connected to existing vegetation (although this is preferable) as the species is highly mobile and can easily move to isolated patches.   Weed invasion can be problematic on dark cracking clays and has the potential to adversely affect rehabilitation efforts.

Other Measures

Weeds have the potential to reduce the long-term integrity of existing resource communities, and affect rehabilitation efforts. In particular, soil disturbance in or near resource areas may introduce exotic species. A weed control plan should be developed prior to disturbance and outline weed control strategies to be undertaken during construction (e.g., controlling run-off, vehicle/machinery washdown) and operation. The plan should also include monitoring and trigger mechanism to initiate follow-up weed removal methods.

Summary Residual Impact Assessment

Avoidance of all core habitat would ameliorate foreseeable risks and is the most effective and efficient strategy. Should some clearing be required, further survey work to quantity impacts would be required along with a number of other mitigation measures such as rehabilitation and weed control. These later methods are less effective in reducing impacts.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Moderate	Moderate (13)	Effective	Moderate

* avoidance of core habitat known and core habitat possible

impacts of clearing would need further assessment.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. Regional Ecosystems containing *Casuarina cristata* (11.3.1. 11.3.17, 11.4.3, 11.4.3a, 11.4.3b, 11.4.10, 11.4.12, 11.8.3, 11.9.4b, 11.9.5) throughout the EIS area are classed as "Core Habitat Possible".
3. The species will utilise regrowth *Casuarina cristata* and hence regrowth of the above communities should be classed "Core Habitat Possible".
4. Regional Ecosystems south of the Core Highway containing *Allocasuarina inophloia* (11.5.1, 11.5.4, 11.7.4, 11.9.9, 11.10.1) are classed as "Core Habitat Possible" to account for foraging on these resources in southern areas.
5. Regional Ecosystems containing *Allocasuarina inophloia* in the remaining EIS areas are classed as "General Habitat"
6. Core Habitat Possible and General Habitat within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
7. All remaining Regional Ecosystems are classed "Absence Possible".
8. Non-remnant and agricultural land is classed "Absence Likely".
9. For heterogeneous polygons the above rules were applied where the relevant regional ecosystems were found in the polygon descriptions. The habitat value category refers only to that part of the polygon where suitable habitat is present.

Mapping Confidence

This species' close association with vegetation characteristics allows it to be accurately assigned to Regional Ecosystem Descriptions. The resulting habitat map is therefore considered to be HIGHLY accurate. Additional Core Habitat Known is likely to be discovered with further survey effort.

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Black-necked Stork (*Ephippiorhynchus asiaticus*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

The black-necked stork is widespread in northern and eastern Australia and occurs through much of Queensland, absent only from south-western portions of the state. It may also be found outside of Australia from Pakistan and India through south-east Asia to New Guinea (Marchant and Higgins 1990).

Black-necked storks occur predominantly in terrestrial wetlands, but may also be recorded in estuaries, littoral habitats and grasslands. They occur in both fresh and saline wetlands but prefer open fresh waters such as shallow swamps, billabongs and pools on floodplains (Marchant and Higgins 1990; Johnstone and Storr 1998). They can often be observed around the edges of artificial waterbodies, including occasionally on smaller farm dams. Most activity is restricted to shallow waters less than 0.5m in depth. Recent studies have suggested that not all wetlands within an individual's home range are of equal value. The loss of important wetlands may therefore disproportionately impact resident populations (Dorfman *et al.* 2001).

Ecology

Black-necked storks are typically observed individually or in pairs throughout the range, although flocks of up to 15 birds have been recorded (Sundar *et al.* 2006). It is likely that pairs require large home ranges with abundant freshwater swamp areas. Nesting typically occurs in tall trees, both live and dead, in or near freshwater swamps (Marchant and Higgins 1990). Occasionally nests may be located in small bushes on stumps and even large rock outcrops. Rarely the nest may be located away from water (Johnstone and Storr 1998; Beruldsen 2003).

Largely sedentary, pairs may remain in an area for many years, though some birds will move long distances (Marchant and Higgins 1990 pg 1066).

The species feeds on a variety of aquatic prey items including insects, crustaceans, fish, amphibians and reptiles (Marchant and Higgins 1990; Dorfman *et al.* 2001). Prey items are located through tactile techniques, but birds may also visually locate food (Sundar *et al.* 2006). They have been occasionally recorded feeding on carrion (Johnstone and Storr 1998).

Threats

The species is threatened by collision with powerlines; the use of herbicides, insecticides and other chemicals near wetlands; the loss of suitable nesting trees; disturbance by livestock; ingestion of cane toads; and loss of wetlands due to agriculture and development (Garnett and Crowley 2000; Dorfman *et al.* 2001).

Project-related Impacts (unmitigated)

Black-necked storks are highly mobile and able to easily cover large distances over modified land. It is unlikely that dispersal or movement patterns will be affected by gas field activities.

The species is most likely to occur around existing waterbodies, or areas where ephemeral water may occur. Best habitat therefore occurs at Lake Broadwater, Long Swamp, larger farm dams and waterbodies associated with the Condamine River and major tributaries (e.g., Wilkie and Charlie Creeks). Impacts on these habitats could include:

- The temporary loss of habitat within Long Swamp, the Condamine River and major tributaries for the construction of gas gathering lines.
- Alterations in surface water flow impacting flood frequency and intensity at Lake Broadwater, Long Swamp and the Condamine River.
- Deterioration of water quality within Lake Broadwater, Long Swamp, the Condamine River and its major tributaries through processes such as increased sedimentation and/or increased salinity in upstream catchment areas.
- Increased weed invasion of waterways affecting the composition and structure of bank vegetation. Weed propagules may be transported either directly through clearing practices (e.g., Long Swamp) or by surface water flow (e.g., into Lake Broadwater via Broadwater and Surveyors Gully).

Significance of Project Related Impacts (Unmitigated)

This species is widely distributed throughout the majority of northern Australia and into southern Asia. More common in northern Australia, it is only sporadically observed within the upper Condamine River Catchment and EIS area. Most records are associated with Lake Broadwater, but the species is opportunistic and may turn up in unusual locations (e.g., the current survey recorded a young bird in a temporarily flooded paddock). The occurrence of these transient individuals in unusual locations is unlikely to reflect habitat critical to the survival of the species, and hence they have not been mapped. As this species is listed as Near Threatened, the lowest sensitivity criteria applicable is moderate.

Current plans include a 800m limited-disturbance buffer around Lake Broadwater. Clearing activities within other waterways are also likely to be minor in extent. The species is therefore unlikely to be significantly affected by activities associated with the project and impact magnitude is estimated as **Low**.

The species has a **Low** (5) impact significance.

the species is

Proposed Management/ Mitigation Measures

Habitat Avoidance

Potentially the most important habitat for this species within the PDA around Lake Broadwater will be avoided. Avoiding other habitats such as large farm dams, natural billabongs and Long Swamp will further avoid any potential direct impacts and reduce indirect impacts. However, it is recognised that Long Swamp may not be as important to the species and therefore avoidance is preferred, but not necessary.

Minimise Disturbance

While some disturbance of Long Swamp may not have significant impacts, disturbance should be minimised. Gas wells, dams or other large infrastructure should not be placed in Long Swamp, or within 100m. Gas gathering lines will produce limited and minor disturbance to existing habitats, but will increase the risk of habitat modification through weed invasion (therefore requiring stringent weed control mitigation).

Rehabilitation

Following any disturbance within Long Swamp, rehabilitation efforts should follow. These should aim to stabilise the ground surface minimising the risk of increased sedimentation. Native species typical of the habitat should be used to reduce weed infestation. Rehabilitation may require initial seeding if undertaken while the swamp is dry, followed by subsequent planting of aquatic species when in flood.

Other Measures

A stringent weed control strategy should be developed for the project. This should include targeted weed control strategies and monitoring for any disturbance within the vicinity of Long Swamp. Weed species may rapidly spread along waterways, taking advantage of surface water movements and favourable growing conditions. Weed control within the swamp should therefore be a priority.

Groundwater extracted from gas wells should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

<u>Summary Residual Impact Assessment</u>

The most suitable habitat within the PDA around Lake Broadwater is unlikely to be affected. Impacts may occur if avoidance is not possible within less suitable habitat at Long Swamp. Indirect impacts, particularly weed invasion, are extremely difficult to control even with mitigation measures.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Mod	Low	Low (8)	Effective	Low

* Complete avoidance of Long Swamp.

based on the only disturbance in Long Swamp from gas gathering lines.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Mod	Extremely Low	Low (4)	moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. The water containment area of Lake Broadwater and a buffer of 100m should be considered "Core Habitat Known".
3. Areas within Long Swamp where water collection might occur following surface flow should be considered "Core Habitat Possible".
4. Large artificial dams (e.g., >10ha; vegetation community WA2) should be classed as "Core Habitat Possible".
5. Waterbodies (RE 11.3.4, 11.3.25, 11.3.27d and vegetation communities WA and WA1) along the Condamine River and its major tributaries (e.g., Wilkie and Charleys Creek) are classed as "Core Habitat Possible"
6. Remaining regional ecosystems, cleared farmland or tilled crops are classed as "Absence Likely".
7. Records of this species in modified landscapes (e.g., farming) away from any large dams are considered to be incidental occurrences by transient individuals. These reflect opportunistic foraging and do not indicate important habitat values. Consequently, no Core Habitat Known buffer should be included around the records -S27.13154 and E151.19791.

Mapping Confidence

This species is associated with aquatic habitats and waterbodies, which may be clearly indicated in vegetation maps. It can therefore be relatively accurately predicted. Black-necked storks are opportunistic in nature and may therefore appear in unusual locations outside of predicted areas. However, these are unlikely to reflect important habitat.

The habitat map for this species is considered to be HIGHLY accurate.

References

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Squatter Pigeon – southern subspecies (Geophaps scripta scripta)

Status

NCA: vulnerable; EPBC: vulnerable

Distribution and habitat

Records of squatter pigeons occur along the inland slopes of the Great Dividing Range west to Longreach and Charleville. Historically, it was found as far south as the Dubbo region, NSW, and extended north to the base of Cape York Peninsula (Garnett and Crowley 2000; Pizzey and Knight 2003). The southern subspecies (*Geophaps scripta scripta*) inhabits the southern portion of this range, interbreeding with *G. s. peninsulae* around the Burdekin Divide (Ford 1986).

The species has declined dramatically in the south, and no confirmed records have been recorded from NSW since the 1970s (Garnett and Crowley 2000). While the subspecies may still be commonly seen around the Bowen Basin and north of Injune (M. Sanders pers. obs.), it has disappeared from the regions of Inglewood, Leyburn, Chinchilla and the Lockyer Valley (EPA 2003).

Squatter pigeons occur in open dry sclerophyll woodland with grassy understorey, nearly always near permanent water (Pizzey and Knight 2003; Higgins and Davies 1996). Birds may occasionally feed in sown grasslands and pastures.

Ecology

Squatter pigeons are largely terrestrial, foraging and breeding on the ground. Seeds make up the bulk of their diet and can include grass, legume, herb, tree and shrub seeds. Occasionally insects may be taken (Higgins and Davies 1996). Items are predominantly gleaned from the ground, but may be occasionally taken directly from low seed heads (M. Sanders pers. obs.).

This feeding strategy is most effective in grass areas that have a mosaic of vegetation and open areas. As a result, the species is absent from thick rank grasslands (e.g., areas dominated by exotic grasses), which also restricts surface movement. However, individuals and small groups are often located along roads and tracks surrounded by thick grasslands.

Breeding is poorly known but does appear to be greatly influenced by rainfall. Nests are constructed on the ground and consist of a shallow scrape lined with dry grasses. Often nests are located beside or beneath a tuft of grass, log or low bush (Frith 1982; Beruldsen 2003).

Movements are poorly documented, but birds appear to be locally nomadic (Frith 1982; Higgins and Davies 1996).

Threats

Large areas of historical habitat for the squatter pigeons have been lost due to clearing for agricultural purposes. Remaining habitats are often modified through deleterious processes such as weed invasion, particularly by exotic grass species that are not favourable (e.g., buffel grass), and overgrazing. Predations of nests by cats, foxes and dogs may also reduce reproductive success, reducing the species' ability to recover (Frith 1982; Garnett and Crowley 2000).

Project-related Impacts (unmitigated)

Squatter pigeons are highly mobile and able to easily cover large distances over modified land. It is unlikely that dispersal or movement patterns will be affected by gas field activities. Project-related impacts are therefore restricted to:

- The loss of habitat associated with the clearing of woodland vegetation for the construction of infrastructure.
- Decreased habitat quality due to invading exotic grasses associated with inappropriate revegetation or surface soil disturbance.
- Increased surface water may reduce distance to permanent water from foraging habitats, thereby increasing the use of areas. As squatter pigeons are highly mobile and able to cover large distances, this benefit is likely to be minor or negligible.

Significance of Project Related Impacts (Unmitigated)

Historically the southern subspecies of the squatter pigeon ranged south from the Burdekin River to northern central NSW. While encompassing only a portion of this range, the EIS area is in an area of decline and any populations (if present) are of importance. The species is not regularly recorded within the PDA and permanent populations seem unlikely. Existing records probably reflect either historical observations prior to declines or transient individuals that have not taken residence.

Suitable squatter pigeon habitat has been substantially reduced or modified by agriculture and areas of open woodlands with native understories are restricted to minor remnants. In many cases, even these minor fragments have been affected by grazing and altered fire regimes.

. The species has been estimated to have a **Moderate** sensitivyt to disturbance and disturbance magnitude is **Low**. The unmitigated impact significane is therefore **Low** (8).

Proposed Management/ Mitigation Measures

Habitat Avoidance

Most suitable habitat for this species occurs within woodland communities along waterways (landzone 3). Avoiding these areas will ensure no deleterious impacts on habitats. However, the species is very uncommon and resident populations are unlikely, reducing the importance of avoiding habitat modification.

Minimise Disturbance

Despite the fact that the species is unlikely to occur, even within suitable habitats, disturbance should be minimised wherever possible through careful infrastructure planning.

Rehabilitation

Disturbance within core habitat possible should be followed by rehabilitation efforts. Disturbance areas may require partial rehabilitation using native grasses to ensure that gas acquisition pipelines are serviceable. However, once decommissioned, all areas should be planted or seeded with tree species typical of surrounding habitats.

Other Measures

Waterways and surrounding flood plains (landzone 3) are highly susceptible to weeds. Furthermore, weed incursions upstream have the potential to be transported downstream during flood events. While direct loss of grassy woodlands may be minor in extent, subsequent weed invasion has the potential to modify significantly larger areas. Weed control strategies should therefore be developed for the operation. Strategies should be clearly documented in a weed control plan that includes rehabilitation of disturbed land, weed control methods specific to individual weed species, monitoring protocols and trigger events that initiate follow-up weed control actions.

Summary Residual Impact Assessment

Project-related impacts have the potential to affect squatter pigeon habitat, particularly through weed infestations. The severity of these impacts must be tempered by the fact that squatter pigeons are probably locally extinct, negating high importance to existing habitats. Nevertheless, habitats should be protected were possible and mitigation measures may have moderate success.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Low	Low (8)	Effective	Moderate

* No clearing of vegetation within areas of core habitat known.

\# Clearing of core habitat possible unavoidable.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. Woodlands, native grasslands and derived native grasslands (11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.21, 11.3.25, 11.3.26, 11.4.12, 11.5.1, 11.5.20, 11.8.2, 11.9.9, 11.9.10) are considered to be "Core Habitat Possible".
3. "General Habitat" that might be used by this species includes RE 11.3.18, 11.7.4, 11.7.7, 11.7.9 and 11.10.1.
4. All remaining regional ecosystems are "Absence Possible"
5. All land (remnant or non-remnant) within 1km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".

Mapping Confidence

This species' occurrence within the region is highly sporadic and it may not occur within all areas of designated Core Habitat Possible. Furthermore, where this species is still relatively common (e.g., Bowen Basin), it may occur in artificial habitats including areas dominated by exotic grasses. It could therefore occur within the EIS area outside of mapped habitat. Consequently, the habitat map for this species is considered to have LOW accuracy.

References

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Painted Honeyeater (*Grantiella picta*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Endemic to Australia, the painted honeyeater may be found from the eastern Northern Territory to Victoria and southern regions of South Australia (Pizzey and Knight 2003). Rare in the Northern Territory, they are widespread throughout Queensland, absent only from Cape York and high rainfall areas.

Painted honeyeaters occur mainly in dry open woodlands and forests, particularly box-ironbark woodlands. They may also be located in riparian forest, on plains with scattered eucalypts and in remnant trees on farmland. Their occurrence is strongly associated with mistletoe, on which they feed (Higgins *et al.* 2001).

Ecology

Painted honeyeaters feed almost exclusively on mistletoe fruit, but may also collect nectar and invertebrates (Oliver *et al.* 2003). Most foraging is undertaken within the canopy of trees (Higgins *et al.* 2001).

Nesting occurs during spring-summer (Sept.-Feb.), predominantly in rgw south-east of its range north to around Brisbane. The breeding season is determined by photoperiod to coincide with warmer summer months, but actual breeding is cued in relation to the progression of mistletoe fruiting. This ensures that breeding is matched by peak resource availability, avoiding temporal variation inherent in unpredictable environments (Barea and Watson 2007).

Small, frail cup-shape nests with narrow sides are constructed in the outer foliage and branchlets of eucalypts, casuarinas and acacias. However, a disproportionately large number of nests are placed in mistletoe clumps in taller trees (Whitemore and Eller 1983; Beruldsen 2003; Barea 2008).

While not well understood, movement patterns are generally described as a north-south migration (Keast 1968). Populations move north during winter and return south of approximately 26^{o} during spring-summer to breed (Higgins *et al.* 2001)

Threats

Large areas of suitable woodland habitat have been extensively cleared throughout this species' range. However, increased mistletoe abundance in degraded woodlands and roadside reserves may have benefited the species and alleviated somewhat the impacts of broad-scale habitat loss (Higgins *et al.* 2001; Bowen *et al.* 2009).

Project-related Impacts (unmitigated)

Painted honeyeaters are highly mobile and individuals are unlikely to be injured or killed during clearing activities. Furthermore, it is unlikely that any project-related activities will deleteriously affect dispersal or movement patterns. Rather, project-related impacts are likely to be restricted to:

- The loss of habitat and food sources associated with the clearing of vegetation rich in mistletoe. Often areas of abundant mistletoe are associated with linear fragments such as roadside reserves. They may therefore be minor in extent, and possibly unmapped.

Significance of Project Related Impacts (Unmitigated)

The painted honeyeater is widely distributed and the EIS area forms only a small fraction of its range. However, it is quite uncommon throughout its range, including within the PDA, and remaining populations and breeding areas are important to ensuring the long-term survival of the species. Habitats in which the species occur are difficult to recreate and once lost are unlikely to be available long-term. These factors suggest the species has a **Moderate** sensitivity to disturbance.

While it may occur in large patches of vegetation, it is regularly recorded from small or linear fragments. Due to their diminutive size, these fragments are susceptible to clearing and hence any resident populations could be severely impacted. Unmitigated impacts could lead to the loss of breeding habitat. Accordingly, impact magnitude could be **High**.

Unmitigated impact significance for this species is **Moderate** (18).

Proposed Management/ Mitigation Measures

Habitat Avoidance

A number of core habitat known areas have become apparent during this study. Avoiding clearing in these areas will ensure that these habitats and populations are unaffected by the proposed activities. It is likely, however, that additional populations and records are present within the PDA. Avoiding core habitat possible should ensure that most of these locations are also protected. However, the ability to map mistletoe, upon which this species relies, is limited and some areas may be overlooked. Retaining core habitat known and core habitat possible is the most effective mitigation measure, but does not ensure that all impacts will be avoided.

Further Survey and Assessment

Habitat maps for this species have attempted to predict its distribution based on REs most likely to contain mistletoe. However, not all mapped core habitat possible will contain abundant mistletoe. Accordingly, further assessment of any core habitat possible vegetation that might require disturbance should be undertaken prior to clearing. Surveys should assess habitat suitability and may recommend subsequent surveys during suitable periods (summer months).

Minimise Disturbance

Many locations where this species occurs are linear fragments. Resources in linear fragments are spatially spread, making foraging less effective. If unavoidable, minimising clearing should be a high priority.

Rehabilitation

Once not required for operation, all affected core habitat areas should be rehabilitated using previously present flora species. Rehabilitation of key regional ecosystems utilised by this species on suitable existing cleared land may provide long-term habitat replacement, thereby offsetting historical habitat loss. This would improve regional values for the painted honeyeater.

However, it should be noted that regional ecosystems regularly used by this species (i.e., brigalow communities) are extremely difficult to rehabilitate or establish. Furthermore, the species generally only selects those patches with abundant mistletoe, something that cannot be seeded or planted but must self-colonise. Rehabilitation is therefore likely to be limited in success.

Summary Residual Impact Assessment

Mitigation measures such as rehabilitation and weed control will have limited success in mitigation project-related impacts. The most effective mitigation measures will be to ensure that habitat is not affected.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	High	Moderate (18)	Effective	Low

* No clearing of vegetation within areas of core habitat known.

Clearing of core habitat possible unavoidable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Extremely Low (4)	Moderate	High	Moderate (18)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.

2. Likely habitat coincides with mistletoe, which is most prevalent in RE 11.3.1, 11.3.17, 11.4.3, 11.4.10, 11.9.5 and 11.9.10. These areas should be mapped as “Core Habitat Possible”.

3. Mistletoe is also prevalent in linear roadside fragments of Acacia regrowth (veg comm BRB) and should be mapped as “Core Habitat Possible” even if not considered remnant vegetation.

4. All land (remnant or non-remnant) within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.

5. All remaining regional ecosystems are “Absence Possible”

Mapping Confidence

Painted honeyeater habitat is primarily determined by the presence of abundant mistletoe resources. As these resources are extremely difficult to predict, so is the species’ distribution. The habitat map is considered to have a LOW accuracy.

References

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Square-tailed Kite (*Lophoictinia isura*)

<u>Status</u>

NCA: Near-threatened; EPBC: not listed

<u>Distribution and habitat</u>

Square-tailed kites are widely distributed throughout Australia in coastal and sub-coastal regions. While they may be recorded well inland, they are absent from drier deserts and treeless plains. Most records occur from eastern and northern Australia, although records from the south-west of WA are not uncommon (Marchant and Higgins 1993; Pizzey and Knight 2003). Migratory throughout much of its range, the Square-tailed kite is a spring-summer resident in the south and dry season resident in the north (Debus 1998).

A variety of habitats may be used including heathlands, woodlands, forests, tropical and subtropical rainforests, timbered watercourses, hills and gorges (Pizzey and Knight 200). However most records are from woodlands and forests, particularly those on fertile soils with abundant small birds (Marchant and Higgins 1993).

<u>Ecology</u>

Square-tailed kites feed mostly on small birds, eggs or their nestlings. These are supplemented by foliage insects and occasionally small mammals and lizards. Birds hunt by soaring slowly above or through the canopy, which may be done in a random fashion or along relatively straight lines (Marchant and Higgins 1993; Debus 1998).

Nests are usually located in large trees within woodland areas, particularly along watercourses. Isolated trees are seldom selected as suitable nest sites (Marchant and Higgins 1993; Beruldsen 2003).

<u>Threats</u>

Extensive areas of suitable woodland and forest habitats have been cleared throughout the species' range, particularly in the south. While this is still probably the major threat to the species, egg collecting, shooting and the species' slow recruitment rate hinder recovery.

Other threats may include the loss of woodland bird prey species through processes such as grazing and too-frequent fires (Debus 1998; Garnett and Crowley 2000).

<u>Project-related Impacts (unmitigated)</u>

Square-tailed kite is highly vagile, able to cover large distances and cross artificial landscapes including agriculture and rural development (M. Sanders pers. obs.). No project-related developments are likely to affect the movement or dispersal of this species. Project-related impacts could include:

- The loss of habitat associated with the clearing of woodland vegetation for the construction of infrastructure.
- A reduction in prey abundance or populations (e.g., small birds) resulting from fragmentation of previously continuous habitats.

Significance of Project Related Impacts (Unmitigated)

The Square-tailed kite is widely distributed in Australia, but is never common. The EIS area represents only a small portion of its range, and is not critical to the species' survival.

Highly mobile in nature, it seems unlikely that the species will be significantly affected unless broad-scale clearing occurs. Development plans do not include extensive clearing activities and hence impact magnitude is considered **Low**. As the species is listed as Near Threatened, the lowest applicable sensitivity criteria is **Moderate**. The impact significance for this species is **Low** (8).

Proposed Management/ Mitigation Measures

Project-related impacts upon this species are unlikely and hence specific mitigation measures are not considered necessary. However, consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible. Rehabilitation of cleared land following decommission with plant species typical of surrounding habitats should also be undertaken.

Summary Residual Impact Assessment

Project-related impacts are this species are considered to be insignificant and therefore mitigation will have little effect.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance	Others*
Low	Low	Low (5)	Effective	Limited

* Impacts will be insignificant and hence mitigation measures will have limited success.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Low	Extremely Low	Insignificant (2)	Low	Low	Low (5)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.

2. The species has very broad habitat requirements, potentially using all woodland and forested areas. However, square-tailed kites will more frequently use riparian vegetation. All remnant vegetation within 100m of a creekline or waterway should be mapped as “Core Habitat Possible”.
3. The species is more likely to occur within large contiguous patches of vegetation greater in extent than 500ha. These patches, and any patches within 500m of another patch whose accumulative total approximates 500m, should be mapped as “Core Habitat Possible”.
4. All remaining remnant ecosystems should be mapped as “General Habitat”.
5. Patches of vegetation smaller in extent than 10ha and separated by more than 1km from adjacent vegetation should be mapped as “Absence Possible”.
6. All Core Habitat Possible and General Habitat within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
7. Open pasture, crops and urban landscapes are classed as “Absence Likely”.

Mapping Confidence

This species’ occurrence is sporadic within the EIS area and it may not occur within all areas of designated Core Habitat Possible. There is a chance that it could occur in artificial habitats, although these records are unlikely to reflect habitat values. The habitat map for this species is considered to be MODERATELY accurate.

References

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Black-chinned Honeyeater (*Melithreptus gularis*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Black-chinned honeyeaters are widely distributed from south-east South Australia through central Victoria, eastern NSW, eastern and northern Queensland, most of the Northern Territory and into the Pilbara region of Western Australia (Pizzey and Knight 2003). They have declined in South Australia, Victoria and western NSW, a trend that seems to be continuing (Garnett and Crowley 2000; Lollback *et al.* 2008).

This species occupies dry eucalypt woodland and forests, particularly those containing selected ironbark and box species. Favourite eucalypt associations are typically dominated by *Eucalyptus sideroxylon* (mugga ironbark), *E. microcarpa* (western grey box), *E. melliodora* (yellow box), *E. leucoxylon* (yellow gum), *E. moluccana* (grey box), *E. tereticornis* (forest red gum) and *E. albens* (white box). They also favour riparian vegetation, particularly in arid or semi-arid regions where *E. camaldulensis* (river red gum) may be abundant (Ford and Paton 1975; Gosper 1986, 1992; Higgins *et al.* 2001).

Ecology

Birds are usually observed in pairs or small groups of up to around 12 birds. They feed from the canopy, spending the bulk of time gleaning prey from amongst foliage and small twigs (Keast 1968; Ford and Paton 1977). Potential dietary components include nectar and invertebrates, although seeds are occasionally taken (Woinarski and Tidemann 1991; Turner 1992; Higgins *et al.* 2001). Collection of insects, particularly caterpillars, by prying apart leaves is an important and regular feeding strategy (Lollbeck *et al.* 2008). These resources are less common than surface invertebrates and could explain why the black-chinned honeyeater is near-threatened.

Conjecture surrounds their movements, with some authors describing them as resident and others describing them as nomadic (Higgins *et al.* 2001). It is possible that nomadic references refer to local movements associated with flowering trees. No long-distant movements have been verified (Higgins *et al.* 2001).

Little data has been collected on the breeding behaviour of the black-chinned honeyeater. Pairs have been found nesting in all months of the year, although most occur in spring and summer. Nests are constructed from fibrous bark, hair, wool or fur. Usually two eggs are laid per clutch (Higgins *et al.* 2001; Beruldsen 2003).

Threats

Most declines have been attributed to loss of habitat. Areas of remaining habitat are fragmented, but the mobility of the species suggests that this should not be a significant factor. Reasons for its absence from smaller fragments are unknown (Garnett and Crowley 2000).

Project-related Impacts (unmitigated)

Black-chinned honeyeaters are highly mobile, able to cover large distances and cross artificial landscapes including agriculture. No project-related developments are likely to affect the movement or dispersal of this species. Furthermore, the species is not reliant on ground strata, feeding in the tops of suitable trees. Project-related impacts are therefore likely to be restricted to the loss of habitat associated with the clearing of vegetation for the construction of infrastructure.

Significance of Project Related Impacts (Unmitigated)

Black-chinned honeyeaters occur throughout eastern Australia, but are never common in eastern or southern portions of their range. The EIS area represents only a small portion of its range, and is therefore unlikely to be critical to the species' survival. Furthermore, the species has only been sporadically recorded within the EIS, suggesting that observations may represent transient individuals. Their nomadic and sporadic nature makes estimating impacts extremely difficult.

It seems unlikely that the species will be significantly affected unless broad-scale clearing occurs, although minor impacts might occur where riparian vegetation or suitable woodland vegetation is cleared for infrastructure. The species is listed as near Threatened, and hence the lowest sensitivity criteria applicable to the species is **Moderate**. The Impact magnitude has been estimated as **Low**, resulting in an overal impact significance of L**ow** (8)

Proposed Management/ Mitigation Measures

Project-related impacts to this species are likely to be Minor. Effective mitigation measures are difficult to prescribe and likely to be limited in success. However, consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible. Rehabilitation of cleared land following decommission with species typical of surrounding habitats should also be undertaken.

Summary Residual Impact Assessment

Project-related impacts on this species are considered to be Minor and therefore mitigation will have little effect.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance	Others*
Low	Low	Low (5)	Effective	Low

* Impacts will be Minor and hence mitigation measures will have limited success.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Low	Extremely Low	Insignificant (2)	Low	Low	Low (5)

Rule(s) for Habitat Mapping:

1. The species could occur throughout the entire EIS area.
2. Vegetation communities dominated by *Eucalyptus* species (11.3.4, 11.3.14, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.3.27a, 11.3.27b, 11.4.3a, 11.4.10, 11.4.12, 11.5.1, 11.5.4, 11.5.4a, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.8.2a, 11.9.1, 11.9.7, 11.9.9, 11.9.9a, 11.9.10, 11.9.13, 11.10.1, 11.10.1a, 11.10.1b) are classed as “Core Habitat Possible”.
3. All Core Habitat Possible within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
4. Open pasture, crops and urban landscapes are classed as “Absence Possible”.

Mapping Confidence

This species is sporadic within the EIS area and may not occur within all areas of designated Core Habitat Possible. Furthermore, the species can occur in urban parks (Higgins *et al.* 2001) or collect at individual trees in otherwise artificial landscapes. These possibilities prevent mapping confidence being higher than MODERATE.

References

Beruldsen, G. (2003). Australian Birds their Nests and Eggs. Phoenix Offset, China. pp314-315.

Ford, H. A. and Paton, D. C. (1977). The comparative ecology of ten species of honeyeaters in South Australia. *Australian Journal of Ecology* 2. 399-407.

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Keast, A. (1968). Competitive interactions and the evolution of ecological niches as illustrated by the Australian honeyeater genus *Melithreptus* (Meliphagidae). *Evolution* **22**. 762–784.

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Turquoise Parrot (*Neophema pulchella*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Turquoise parrots are restricted to south-east Australia, historically occurring from inland Mackay south to the Gippsland area of Victoria. While patchily distributed, mostly records occur in open woodlands on the western slopes and ranges of the Great Divide. In Queensland the species is regularly recorded in the Granite Belt Bioregion, north to around Millmerran, becoming increasingly uncommon further north, rarely seen above Chinchilla and no longer recorded north of Maryborough (Higgins 1999; Garnett and Crowley 2000).

Birds occur in eucalypt woodlands and open forests with grassy ground cover or a low shrub understorey. They are also commonly found on forest edges, in clearings, remnant trees in farmland, orchards and golf courses (Higgins 1999; NPWS 2003).

While known to forage in areas with exotic weeds, birds are absent from habitats heavily infested by exotic grasses (e.g., Buffel grass) that alter habitat structure.

The species suffered dramatic population declines throughout its distribution during the 19th century, and by 1915 was thought to be extinct in the wild (Higgins 1999). During the 1920s populations began to recover and, although still much reduced from its former distribution, the species is expanding in range, including in southeast Queensland (Higgins 1999; Garnett and Crowley 2000).

Ecology

Turquoise parrots forage on the ground, in pairs or small flocks sometimes reaching numbers of up to 50 birds. Foraging typically takes place in the morning and evening, with birds finding shelter in foliage of nearby trees during the middle of the day. Favoured dietary items include seeds from grasses, herbaceous plants and shrubs. However, they may occasionally feed on flowers, nectar, fruit, leaves and scale insects (Higgins 1999).

In Queensland, birds commence nesting around October, and young are typically fledged within seven weeks (NPWS 1999; Higgins 1999). Nests are constructed in vertical hollows such as in a limb, stump or trunk. Living trees are favoured, but dead trees are regularly used and some pairs have been recorded nesting in fence posts (Higgins 1999; Beruldsen 2003).

Threats

The dramatic decline of the species at the turn of the century is difficult to explain. Sheep grazing, which was more prevalent in the early 1900s, has a more deleterious effect on native grasslands than other grazing uses. The reduction of this activity and the turquoise parrot's ability to feed on exotic grass species may have assisted in its recovery.

However, the species is absent from heavily modified land (e.g., cropping areas) and grasslands infested by thick exotic grasses. The continued clearing of existing woodlands, pasture improvement and overgrazing still pose a significant threat (NPWS 1999; Garnett and Crowley 2000).

Other threats that may reduce the species' ability to recover in local areas include altered fire regimes affecting grasslands, the loss of hollow-bearing trees with suitable nest sites and predation from feral cats and foxes (Garnett and Crowley 2000).

Project-related Impacts (unmitigated)

Project-related impacts might include:

- The loss of habitat through clearing activities associated with the construction of gas gathering lines, access tracks and other infrastructure.
- The introduction of invasive exotic grasses into previously native grassy woodlands reducing the value of habitats for turquoise parrots.
- Increased exotic predator abundance associated with the creation of surface water points, increasing the risk of predation and nest failure.

Significance of Project Related Impacts (Unmitigated)

Turquoise parrots are highly vagile, able to traverse large distances over artificial landscapes. It is unlikely that the proposed activities will affect movement or dispersal patterns.

Within Queensland, the species' stronghold is now restricted to regions in the Granite Belt. Located to the north of the Granite Belt, the EIS area is unlikely to be essential for the species' survival. However, any resident populations within the EIS area may be of conservation significance due to their location in the species distribution (towards the northern limit where historical declines have occurred). The sparse records in databases suggest that records represent transient individuals and no permanent population exists. Despite this, the lowest applicable sensitivity criteria is **Moderate** due to its status.

Broadscale clearing of habitats is not likely to be associated with the project, and hence only minor areas of habitat may be directly lost. However, the species may also be impacted by exotic grass invasion into native woodlands, reducing habitat suitability. Impacts on this species are likely to have a **Low** magnitude. The overall unmitigated impact significance is **Low** (5)

Proposed Management/ Mitigation Measures

Due to the sporadic nature of this species' distribution within the PDA, appropriate mitigation measures are difficult to prescribe. However, consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible and rehabilitation of cleared land following decommissioning should be undertaken with species typical of surrounding habitats.

Further Survey and Assessment

Not all areas mapped as core habitat possible may be suitable for turquoise parrots. Some areas may be heavily grazed or be dominated by exotic ground covers reducing habitat values. Consequently, further survey work should occur wherever disturbance is planned within core habitat possible. Based on field investigations and disturbance zones, the magnitude and likelihood of the impact can be reassessed according to methods outlined in this study.

Other Measures

Disturbance within grassy woodland communities may introduce exotic species, particularly grasses, which may alter the structure and composition of existing habitats rendering them less valuable. Accordingly, a weed control plan should be developed for the project and include weed control methods used during construction (e.g., sediment traps, vehicle washdown) and operation phases. The plan should also include targeted control methods for individual species, monitoring protocols and triggers to initiate further weed control. The weed management plan should not be restricted to weed species listed as such under legislation, as many unlisted exotic pasture grasses can have serious deleterious effects on native habitats.

Summary Residual Impact Assessment

Mitigation measures are difficult to prescribe due to the species' erratic occurrence and habitat use within the EIS area. Assuming this species presence in mapped Core habitat areas may be mis-leading if solely used for assessing impact likelihood. Accordingly, the impact likelihood has been adjaced to account for this species sporatic occurence.

Minimising disturbance and weed control in existing habitat will be meet with the greatest success

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (8)	Effective	Low

* No clearing of vegetation within areas of core habitat known.

Clearing of core habitat possible unavoidable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. Turquoise parrot records north of Cecil Plains are very uncommon.
2. Turquoise parrots prefer grassy woodlands (11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.3.27, 11.8.2, 11.9.9, 11.9.9a) and these should be mapped as “Core Habitat Possible”.
3. Forest and woodlands with denser understories can also be used by this species, but with less frequency. These habitats (RE 11.4.12, 11.5.1, 11.7.4, 11.7.6, 11.7.7, 11.9.7, 11.9.10, and 11.9.13) should be mapped as “General Habitat”.
4. All Core Habitat Possible and General Habitat within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
5. Remaining remnant vegetation should be mapped as “Absence possible”.
6. Open pasture, crops and urban landscapes are classed as “Absence Likely”.

Mapping Confidence

This species is sporadic within the EIS area and may not occur within all areas of designated Core Habitat Possible. This prevents accurate mapping and the species map is likely to only be MODERATELY accurate.

References

Beruldsen, G. (2003). Australian Birds their Nests and Eggs. Phoenix Offset, China. pp314-315.

Garnett, S. T. and Crowley, G. M. (2000). The action plan for Australian birds. Environment Australia, Canberra. pp345.

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Cotton pygmy-goose (*Nettapus coromandelianus*)

Status

NCA: Near-threatened; EPBC: migratory

Distribution and habitat

Cotton Pygmy-geese occur along eastern Queensland from Princess Charlotte Bay (southern Cape York Peninsula) south to Brisbane. Previously it occurred south to the Hunter River in New South Wales but it is now a vagrant in Australia outside of Queensland. Its stronghold appears to be from Rockhampton to Ingham, with greatest numbers in Ayr, Townsville and Charters Towers districts (Frith 1982; Marchant and Higgins 1990; Garnett and Crowley 2000; Pizzey and Knight 2008).The cotton pygmy-goose is almost entirely aquatic, preferring deep freshwater lagoons, lakes and dams with abundant floating and submerged aquatic vegetation, interspersed with patches of open water (Pizzey and Knight 2008; Marchant and Higgins 1990). Within the Brigalow Belt South, important habitats are found at Lake Broadwater, Lake Nuga Nuga, Lake Murphy and lagoons around Taroom (EPA 2003).

Ecology

The cotton pygmy-goose feeds almost entirely on aquatic vegetation, including flowers and seeds (Marchant and Higgins 1990).Little is known of the species' breeding in Australia, which appears to occur in predominantly in late spring and summer (Nov-Mar) when swamps are full after the wet season (Frith 1982). All known nests have been located in hollows of dead trees in or next to swamps (Beruldsen 2003; Marchant and Higgins 1990). Movements appear to be largely local, with individuals congregating on permanent water during the dry season, and dispersing to breed on less permanent water during the wet season (Marchant and Higgins 1990).

Threats

The species is threatened by drainage of wetlands or their invasion by aquatic weeds (especially water hyacinth *Eichhornia crassipes* and ponded-pasture species). Grazing of native wetlands by livestock, removal of standing dead trees, and the use of herbicides and insecticides near wetlands may also affect populations (Garnett and Crowley 2000).

Project-related Impacts (unmitigated)

It is not expected that the project will directly affect large waterways, billabongs, lakes (e.g., Lake Broadwater) or dams. Consequently, project-related impacts are likely to be restricted to indirect impacts such as:

- Deterioration of water quality affecting aquatic macrophyte growth and abundance. These impacts may occur through upstream earthworks or surface flow carrying saline water.

- Increased weed infestation within waterways and waterbodies.

Significance of Project Related Impacts (Unmitigated)

Records of this species are concentrated around Lake Broadwater, which is likely to represent the best habitat for this species within the PDA. Other large farm dams and large natural or artificially created billabongs may also be sporadically used. The sporadic use of these waterways and the ephemeral nature of Lake Broadwater suggest that no permanent populations occur. Despite this, the species is listed under legislation and hence the lowest applicable sensitivity criteria is **Moderate.** A disturbance exclusion zone has been established around Lake Broadwater, and other suitable waterways are unlikely to be directly affected. Hence, impacts will be restricted to indirect impacts such as salination from groundwater run-off or weed infestation. Both these impacts may have a **Low** magnitude. The species has a **Low** (5) impact signifance rating.

Proposed Management/ Mitigation Measures

Habitat Avoidance

A disturbance exclusion zone has been established around Lake Broadwater and few impacts are expected on this habitat. Similar exclusions around other semi-permanent and permanent waterbodies that may be used by this species should be included in infrastructure planning. This will ensure that impacts are both Unlikely to occur and Minor in consequence.

Other Measures

Groundwater extracted from gas wells should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

Summary Residual Impact Assessment

Exclusion of infrastructure from core habitat will be the most effective control methods. Indirect impacts due to increased saline run-off from groundwater may also be easily mitigated.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others#
Moderate	Low	Low (8)	Effective	Low

* No clearing of vegetation within areas of core habitat known.

\# Clearing of core habitat possible unavoidable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. Lake Broadwater should be mapped as "Essential Habitat Known".
3. Large lakes, artificial dams and wetlands on the Condamine River (and its major tributaries) greater than 10ha in extent should be classed as "Essential Habitat Possible".
4. All Essential Habitat Possible within 1km of a known recent (1980+) record should be "Essential Habitat Known".
5. All remaining terrestrial habitats should be classed as "Absence Likely".

Mapping Confidence

This species is confined to waterways. While it may not occur in all mapped habitat, the map is still considered to be a HIGHLY accurate reflection of its possible occurrence.

References

Beruldsen, G. (2003). Australian birds, their nests and eggs. Phoenix Offset, China. pp165.

EPA (2003). BPA BRB South Fauna Expert Panel in Brigalow Belt South Biodiversity Planning Assessment. EPA. Brisbane.

Frith, H. J. (1982). Waterfowl in Australia. Angus & Robertson Publishers, Sydney. pp284-294.

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Marchant, S. and Higgins, P. J. (eds) (1990). Handbook of Australian, New Zealand and Antarctic birds, Vol 1, Ratites to Ducks, Part B Australian pelican to ducks. Oxford University Press, Melbourne. pp1234-1239.

Pizzey, G. and Knight, F. (2008). The Field Guide to the Birds of Australia. HarperCollins Publishers, Sydney. pp34.

Regent Honeyeater (*Anthochaera phrygia*)

Alternative nomenclature

Changed from the genus *Xanthomyza* to *Anthochaera* by Christides and Boles (2008).

Status

NCA: endangered; EPBC: endangered and migratory

Distribution and habitat

The regent honeyeater is restricted to south-eastern Australia where it is widespread but very sparse, mostly restricted to the inland slopes of the Great Dividing Range. Historically, regent honeyeaters were distributed from Wilmington in South Australia north to Rockhampton/Byfield in Queensland. However, their range has contracted considerably. They are thought to be extinct in South Australia (last recorded in 1977) and are rarely recorded in western Victoria (DEWHA 2009). Most records now occur north of the Great Divide in Victoria and south of Pomona in Queensland. They may still be observed within their historical distribution in NSW, extending inland to Narrabri, Parkes and Warrumbungle National Park. However, reporting frequency and numbers have declined significantly since the 1940s (Higgins *et al.* 2001; NPWS 1999; Garnett and Crowley 2000).

Small numbers and individuals are occasionally reported in south-east Queensland from locations such as Pomona, Bribie Island, the Granite Belt, Sundown National Park and around Gore-Karara (e.g., Durikai State Forest). A small breeding population around Gore-Karara may represent the only breeding population in Queensland (Higgins *et al.* 2001; DEWHA 2009).

Although occasionally found in agricultural land with only partial tree cover or in city parks and gardens, the regent honeyeater occurs mainly in dry box-ironbark eucalypt woodland and dry sclerophyll forest (Higgins *et al.* 2001). They are particularly fond of vegetation associations that reliably produce nectar such as *Eucalyptus sideroxylon* (mugga ironbark), *E. melliodora* (yellow box), *E. albens* (white box) and *E. leucoxylon* (yellow gum). However when nectar is scarce they can also be observed in association with *E. microcarpa* (grey box), *E. polyanthemus* (red box), *E. blakelyi* (Blakely's red gum), *E. camaldulensis* (river red gum), *E. melanophloia* (silver-leaved ironbark), *E. caleyi* (Caley's ironbark) and *E. robusta* (swamp mahogany) (Franklin *et al.* 1989; Geering and French 1998). Within these vegetation associations they are most regularly recorded from the wettest, most fertile sites (Garnett and Crowley 2000).

Ecology

Regent honeyeaters feed predominantly on nectar and insects (including exudates such as lerp and honeydew). Nectar is taken mainly from eucalypts and often mistletoes (Higgins et al. 2001), which when scarce may be substituted by lerps and insects. These resources can become a major component of their diet (up to 90%) when nectar is near-threatened (Menkhorst 1997; Oliver 2000). Regent honeyeaters actively select larger trees for foraging (Oliver 2000; DEWHA 2009).

Breeding typically coincides with peak flowering in local tree populations, May to March but with a peak from September to November (Franklin *et al*. 1989; Higgins *et al*. 2001 pg 590-591). Cup-shaped nests, constructed from strips of bark and dry grass, are usually placed towards the end of large horizontal branches in the crowns of taller trees (Geering and French 1998; Oliver *et al.* 1998; Higgins *et al.* 2001).

Studies have found that nesting success is very low, typically less than 50%, but ranging from 14.3% to 73.3% (DEWHA 2009). Predation and adverse weather conditions (hot weather, strong winds, storms, etc) have been suggested as the primary causes of nesting failure (Geering and French 1998; Higgins *et al.* 2001).

Regent honeyeaters are highly vagile and may be nomadic, eruptive or show some migratory patterns. This makes their movements difficult to predict; however, the population drifts north from southern and high alpine areas of southern Australia to northern NSW and south-east Queensland during late autumn/early spring. This is followed by a influx of birds into core breeding areas on the inland slopes of the Great Divide (DEWHA 2009).

Threats

The disappearance of the regent honeyeater from many former sites is probably primarily due to vegetation clearing and fragmentation (Garnett and Crowley 2000 p493), which may reinforce other deleterious processes such as:

- Nest failure due to predation and parasitism (Lindenmayer and Fischer 2006; DEWHA 2009);
- Increased adverse abiotic conditions (e.g., temperature/wind) (Lindenmayer and Fischer);
- Reduced foraging resources leading to lowered reproductive success; and
- Resulted in an influx of aggressive species (e.g., Friarbirds and Miners) increasing competition (Ford *et al.* 1993; Franklin *et. al.* 1989)

Silviculture removes the larger trees that regent honeyeaters favour for foraging and nesting and may therefore reduce resource availability and breeding success.

Project-related Impacts (unmitigated)

Project-related impacts might include:

- The loss of habitat through clearing activities associated with the construction of gas gathering lines, access tracks and other infrastructure.
- Increased edge effects impacting habitat viability, reproductive success and deleterious species interactions.

Significance of Project Related Impacts (Unmitigated)

No known breeding populations of the regent honeyeater occur within the EIS area. However, a breeding population is approximately 35-40km to the south-east of ATP 689. Dispersing and nomadic individuals may occur within southern portions of the EIS area. Although suitable habitats within the EIS area do not support resident populations, the areas could be important for the recovery of the species. Assuming that no new populations establish, or are located within the EIS area, this species has a **Moderate** sensitivity to project related impacts

Should a population occur within the EIS area, the impact magnitude could be considerably high, however as none are know the impact magnitude has been estimated as **Moderate**. This species impact significance is therefore **Moderate** (13).

Proposed Management/ Mitigation Measures

Mitigation measures for species that do not reside within the PDA, such as the regent honeyeater, are difficult to prescribe and evaluate. Consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible. No impacts would be expected if disturbance of any core habitat is avoided.

Systematic survey of all possibly suitable REs was not undertaken during the current study. Rather, this study identified areas that might represent potential habitat for the species (core habitat possible). Pre-clearing surveys of core habitat possible which may be affected by project related activities should be undertaken. Based on the field assessment and project infrastructure plans, further risk assessment using methods outlined in this report should be undertaken. Additional mitigation measures may be recommended thereafter.

Rehabilitation of regent honeyeater habitat has been undertaken in other statesand presents an opportunity for this project to improve regional biological values. Rehabilitation should focus on returning *E. sideroxylon*, *E. albens* and *E. melliodora* communities to suitable landzones within the southern portions of the PDA.

Summary Residual Impact Assessment

No known populations occur within the PDA and the species occurs sporadically. Therefore, impact likelihood should not be based only on the disturbance of core habitats. Avoiding all core habitat will largely negate any impacts. Pre-clearing surveys of core habitat possible are required to ensure that mapped REs are accurate. Rehabilitation provides some opportunity for environmental value improvement.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Moderate	Moderate (13)	Effective	low

* No clearing of vegetation within areas of core habitat known.

\# Clearing of core habitat possible unavoidable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Moderate	Moderate (13)

Rule(s) for Habitat Mapping:

1. The species is highly unlikely to occur north of Dalby (approximate latitude -27.15). All vegetation north of this latitude should be classes as “Absence Possible”.
2. The species may occur, albeit sporadically, between Millmerran and Dalby (-27.15 south to -27.8). Within this region, Core Habitat Possible should be downgraded to General Habitat and General Habitat downgraded to Absence Possible.
3. The species is most probably within proximity to known populations south of Millmerran (south of -27.8).
4. Within the above areas, vegetation communities with *E. melliodora* (yellow box) and *E. albens* (white box) (11.8.2a, 11.9.9a) are classed “Core Habitat Possible”.
5. Communities with other dominant Eucalypts such as *E. moluccana* (grey box), *E. tereticornis* (forest red gum) (11.3.4, 11.3.14), *E. camaldulensis* (river red gum) (11.3.25, 11.3.26, 11.3.27a, 11.3.27b) and *E. microcarpa* (western grey box) (11.4.10, 11.5.20) are classed “General Habitat”.
6. All Core Habitat Possible and General Habitat within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
7. All remaining remnant communities are considered “Absence Possible”.
8. Open pasture, crops and urban landscapes are classed as “Absence Likely”.

Mapping Confidence

This species is associated with aquatic habitats, which can be readily distinguished in vegetation maps. The resulting habitat map is considered to have a HIGH accuracy.

References

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Freckled Duck (*Stictonetta naevosa*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Freckled ducks are nomadic and eruptive. They can be found throughout southern and western Queensland south into eastern South Australia, Victoria and NSW. They also occur in Western Australia. While they can occur throughout their range at any time, breeding typically takes place in inland lignum swamps that are irregularly flooded (Pizzey and Knight 2008). They tend to congregate more in coastal areas during periods of inland drought (Marchant and Higgins 1990). Important habitats identified within the Brigalow Belt South include Jandowae Dam on Diamond Road, Coolmunda Dam, Lake Murphy, Lake Nuga Nuga and Lake Broadwater (EPA 2003).

Freckled ducks can be observed in small or large groups on terrestrial wetlands. They prefer large, well-vegetated swamps and creeks for breeding, but disperse to open water after breeding or in dry periods (Marchant and Higgins 1990).

Ecology

Freckled ducks are generally secretive during the day, resting in dense cover and usually remaining inconspicuous. When in open water without cover, they tend to roost on the tops of fence-posts and stumps protruding a small distance above the water (Frith 1982). Feeding occurs at dusk or well into the night in shallow water by filter-feeding for aquatic plants and crustaceans (Frith 1982; Johnstone and Storr 1998; Marchant and Higgins 1990).

Breeding can occur in well vegetated freshwater swamps, whether permanent or erratically flooded; however, erratically flooded lignum swamps within the Lake Eyre and Murray-Darling basins are preferred (Frith 1982; Marchant and Higgins 1990). Breeding typically occurs from September to December, but breeding can be stimulated by exceptional rainfall events (Frith 1982). Nests are constructed from sticks (particularly lignum) and placed in bushes at, or just above (0.3-1m), water level. There is one reported nesting in an old Eurasian Coot nest (Johnstone and Storr 1998). Five to ten eggs are laid in a clutch (Frith 1982; Johnstone and Storr 1998; Beruldsen 2003).

During the dry season, freckled duck movement is extensive and vagrants can turn up throughout their range. However, it is probable that the species is sedentary when possible, moving large distances only to exploit newly formed habitat or escape drought conditions (Frith 1982).

Threats

Destruction or modification of suitable breeding wetlands due to alterations in drainage, land clearing, grazing and increased inundation are major threats to the species (Garnett and Crowley

2000; Marchant and Higgins 1990). High mortality can also result from hunting during drier years when populations congregate on the coast, as the species has a tendency to circle repeatedly at low altitude when disturbed, making them easy targets (Marchant and Higgins 1990). However, with recent hunting bans and other protective measures, the key to their long-term security is habitat protection rather than protection from hunting.

Observations and research also suggests that prolonged drought may negatively impact populations (Frith 1982; Kingsford *et al.* 1999). Global warming and altered rainfall patterns may therefore also threaten the long-term survival of the species.

Project-related Impacts (unmitigated)

Project-related impacts might include:

- The loss of habitat through clearing activities associated with the construction of gas gathering lines, access tracks and other infrastructure.
- Increased edge effects impacting habitat viability, reproductive success and deleterious species interactions.

Significance of Project Related Impacts (Unmitigated)

Within the PDA, this species is probably restricted to habitat within Lake Broadwater. Surrounding land practices are likely to have already influenced water quality and contributed to weed infestations. The project has implemented an activity exclusion zone around Lake Broadwater and therefore additional impacts are limited. Despite the exclusion of this area and the unlikelihood of this species occuring in alternative habitats, the lowest applicable sensitivity criteria due to its Near Threatened listing is **Moderate**.

Saline water around extraction wells could potentially enter existing freshwater systems following rainfall. These may slightly modify water quality levels within the lake, but the likelihood of this occurring is low and the impact mangitude is **Low**.

Proposed Management/ Mitigation Measures

Other Measures

Groundwater extracted from gas wells should not be allowed to sit on the surface, risking contamination of existing waterbodies. Rather, this should be piped to large evaporation ponds (or similar) constructed in cleared areas. Small ponds near each bore introduce other environmental risks that might affect other values and are not advised.

Summary Residual Impact Assessment

Exclusion of infrastructure from core habitat will be the most effective control methods. Indirect impacts due to increased saline run-off from groundwater may also be easily mitigated.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Avoidance*	Others*
Low	Low	Low (5)	Effective	Low

* An exclusion zone has already been established around Lake Broadwater. No additional avoidance of habitat is possible.

Residual Significance Assessment					
Avoidance			Others		
Sensitivity Ranking	Magnitude Ranking	Significance Ranking	Sensitivity Ranking	Magnitude Ranking	Significance Ranking
Mod	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. Lake Broadwater should be mapped as “Essential Habitat Known”.
3. All remaining terrestrial habitats should be classed as “Absence Likely”.

Mapping Confidence

This species is associated with aquatic habitats, which can be readily distinguished in vegetation maps. The resulting habitat map is considered to have a HIGH accuracy.

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MAMMALS

Spotted-tailed quoll (Dasyurus maculatus maculatus)

<u>Status</u> (south-eastern population)

NCA: vulnerable; EPBC: endangered

<u>Distribution and habitat</u>

The south-east mainland sub-species of the freckled duck was historically distributed along Australia's south-east from Bundaberg and Chinchilla through eastern NSW, Victoria to Kangaroo Island in South Australia. It is also known from Tasmania (Maxwell *et al.* 1996; Van Dyck and Strahan 2008). It has undergone a significant range retraction and is now absent from South Australia (Eyre *et al.* 1997) and from large areas of Victoria (Menkhorst 1995). In Queensland it now appears to be predominantly restricted to the Blackall/Conondale Ranges, southern Darling Downs (Stanthorpe to Wallangarra), Main Range (Goomburra to Spicers Gap) and the MacPherson/Border Ranges (Springbrook to Mt Lindsay) (Maxwell *et al.* 1996; Eyre *et al.* 1997). The species is threatened by fragmentation, feral predators and human activities and hence tends to be mostly recorded from large contiguous tracts of vegetation.

Spotted-tailed quolls inhabit a variety of forested habitats including subtropical and temperate rainforests, vine thickets, wet and dry sclerophyll forests, woodland and coastal scrub. They are found from sea-level to sub-alpine regions (Menkhorst and Knight 2004; Van Dyck and Strahan 2008).

<u>Ecology</u>

Spotted-tailed quolls are capable climbers and are equally at home on the ground or in trees. They are also voracious predators, feeding on a variety of invertebrates, reptiles, birds, mammals and carrion. Juvenile quolls are more dependent on invertebrates, small mammals and birds, while about 70 percent of an adult's diet consists of larger prey such as possums, gliders, rabbits and bandicoots (Belcher 1995; Jones and Barmuta 1998, 2000; Van Dyck and Strahan 2008).

Quolls shelter in 'dens' located in rock crevices, caves, fallen hollow logs and tree hollows (Menkhorst 1995). While females are territorial, males are not. Male home ranges are larger (2000-3000ha) and can overlap several smaller (180-1000ha) female territories (Belcher and Darrant 2004; Körtner *et al.* 2004).

Spotted-tailed quolls are highly mobile, often traversing several kilometres in one night. Furthermore, wandering individuals can sporadically appear in farmland or semi-rural areas away from remnant vegetation (Menkhorst 1995).

Mating occurs from April to August (Belcher 2003; Menkhorst and Knight 2004) and one litter of up to six young can be produced per year. Young remain in the pouch for several weeks and are independent after about 18-20 weeks (Menkhorst 1995; Van Dyck and Strahan 2008). Females achieve adult size after about two years, while most males take three years. Most individuals do not survive more than five years in the wild (Belcher 2003; Van Dyck and Strahan 2008).

Threats

Spotted-tailed quolls inhabit large territories and have been significantly impacted by habitat loss and fragmentation. Remaining populations may be isolated physically and genetically (Maxwell *et al.* 1996). Other threats include competition with foxes and feral cats, predation by foxes and dogs, and death by ingestion of 1080 or strychnine intended for wild dogs (Mcillroy 1982; Maxwell *et al.* 1996; Belcher 1998).

Illegal shooting may still also contribute to localised declines in some areas. Finally, anecdotal evidence suggests that mortality may increase from Cane Toad ingestion, but probably only affects young animals (Burnett 1997).

Project-related Impacts (unmitigated)

Spotted-tailed quolls are highly mobile and can easily cross roads and tracks. Impacts to dispersal and movement patters are therefore unlikely. Project related impacts could include:

- Loss of habitat from vegetation clearing.
- Increased fragmentation of existing habitats.
- Increased edge effects such as weed invasion leading to a reduction in prey populations.
- Increased predator (fox and dog) abundance due to the incursion of track and gas acquisition lines into previously contiguous habitats and increased surface water. These exotic pests compete for resources and can prey upon adult quolls.
- Increased mortality from Cane Toad ingestion due to a potential increase of Cane Toads associated with increased water storage/ponds.
- Capture and ultimate death in open trenches.

Significance of Project Related Impacts (Unmitigated)

This species is exceedingly uncommon within the PDA. Only two post-1980 records were located within databases, both from WildNet, which provides little additional information for vetting/evaluation purposes. It appears that both these records occur from within the Kumbarilla/Dunmore State Forest area. Without further information, it seems unlikely that resident populations current remain within this area. Until further evidence of a resident population becomes apparent, the lowest sensitivity criteria applicable to this species is **Moderate**. However the unlikelihood of this species occuring should be noted.

The project-related impacts could have serious impacts on local populations. In particular, increased predator abundance associated with fragmentation could lead to long-term deleterious impacts. Impact magnitude could therefore be **High** for an overal impact significance of **Moderate** (18).

Proposed Management/ Mitigation Measures

Avoidance

Avoiding vegetation removal in core habitat areas will be the most effective mitigation measure. While gas acquisition pipelines and bore holes will have a minor impact on vegetation extent, these activities will significantly increase fragmentation leading to other deleterious impacts (e.g., increased exotic predator and Cane Toad abundance). These secondary impacts are very difficult to mitigate.

Minimising Disturbance

Consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible.

Rehabilitation

Rehabilitation of all cleared land following decommissioning with species typical of surrounding habitats should also be undertaken to reduce long-term habitat loss.

Other measures

Efforts should be made to reduce the value of fragmented habitats for exotic predators and Cane Toads:

- Groundwater extracted from gas bores should not be allowed to sit on the surface. Rather, water should be piped to large evaporation ponds (or similar) constructed in cleared areas.

Trench deaths may be minimised by:

- Minimising the duration for which trenches are open. The laying and burying of pipes should occur as soon as possible after the trench has been created. This point should be given considerable weight;
- Construction of exit points along the trench when it passes through or is within 1km of native vegetation. Exit points may be created by digging a sloped ramp approximately 0.5-1m wide from the bottom of the trench to the surface. Trapped animals may use these to exit the trench;
- Trenches should be checked regularly and for trapped animals. Trench checking should take place shortly after sunrise. Captured animals should be relocated to nearby vegetation.

- Details (e.g., date, GPS location, species, condition) of trapped and released animals should be recorded for inclusion in DERM WildNet database.

Monitoring

Throughout the construction and operation, records and observations of Spotted-tailed quolls should be recorded. An education program for all staff should include identification notes and the importance of reporting this species.

Any observations or records should be followed by a targeted survey. Subject to the results of this survey, mitigation further measures may be recommended. The targeted survey should be undertaken by a qualified ecologist.

Summary Residual Impact Assessment

Secondary threats resulting from vegetation clearing (e.g., increased exotic predator abundance) are very difficult to mitigate. Hence, if clearing occurs, the mitigation measures will have limited success. However, it should be noted that the likelihood of this species occurring in the area is low.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Mod	High	Moderate (18)	Effective	moderate

* avoidance of habitats will ensure limited impacts, but is not unlikely to be an option for this project.

minimising clearing, rehabilitation, avoiding surface water and trench checking.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. All remaining remnant vegetation (except very open communities; 11.3.2, 11.3.21) greater in extent than 5000ha (including accumulative area where patches are separated by less than 100m) should be considered “Core Habitat Possible”.
3. All Core Habitat Possible within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.

4. All remaining remnant vegetation patches greater in extent than 200ha should be mapped as “General habitat”.
5. Remnant vegetation patches less than 200ha in extent are mapped as “Absence possible”.
6. Cleared and non-remnant areas are classed as “Absence Likely”.

Mapping Confidence

Habitat requirements for this species are relatively well understood. However, the species is highly susceptible to land modification and associated secondary impacts and can therefore be absent from areas of apparently suitable habitat. Hence, while suitable habitat may be present, estimating its occurrence is difficult. The map is considered to have a Moderate accuracy.

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Little Pied Bat (*Chalinolobus picatus*)

Status

NCA: Near-threatened; EPBC: not listed

Distribution and habitat

Little pied bats are most common west of the Great Dividing Range in semi-arid regions from the mallee region of South Australia/Victoria to the tropic of Capricorn. However, individuals have also been located in scattered areas closer to the coast (Churchill 2008).

Little pied bats are typically found in dry habitats including open forests, woodland, mulga woodlands, chenopod scrublands, Callitris forest and mallee (Churchill 2008). However, recent surveys have also located the species in notophyll vine forest gullies (Eyre *et al.* 1997). In drier parts of its range, populations probably depend heavily on riparian areas (EPA 2003).

Ecology

Historically, the species was thought to roost exclusively in caves, tunnels and similar subterranean structures (Hall and Richards 1979). However recent observations and studies have found that hollow-bearing trees are more regularly used (Van Dyck and Strahan 2008). A wide variety of roost trees may be used, including *Casuarina pauper*, mulga, bloodwoods and large eucalypts. A range of hollow sizes are selected, but favoured locations open into large cavities midway up the trunk (Churchill 2008). Occasionally the species has been located roosting in human-made structures such as woolsheds and abandoned buildings (Van Dyck and Strahan 2008).

Unlike many other microchiropteran bats, little pied bats do not seem to roost in large numbers, although groups up to 50 have been located. Most roosts include ten or fewer individuals (Churchill 2008; Van Dyck and Strahan 2008).

Little pied bats in flight are fast and highly manoeuvrable, often changing direction. Insects, predominantly moths, are taken from close to vegetation or gleaned from substrates. Limited tracking studies suggest that these bats are capable of traversing large distances (e.g., 17km one way) from favoured roosts to foraging areas (Churchill 2008; Van Dyck and Strahan 2008).

Females have been observed pregnant in mid-September with young born in late spring (November) (Menkhorst and Knight 2004; Van Dyck and Strahan 2008).

Threats

Threats to the little pied bat include habitat clearance, fragmentation and loss of potentially important roosting locations such as tunnels, caves and mine shafts.

Project-related Impacts (unmitigated)

Little pied bats are highly mobile and are known to use tracks and canopy openings as hunting grounds. Impacts to dispersal and movement patters are therefore unlikely. Project related impacts could include:

- The loss of unknown roosts associated with rock outcrops and jump-ups in locations such as Wondul Range and in the very north of the EIS area.
- The loss of hollow tree roosts to facilitate the construction of gas gathering lines, access tracks and associated infrastructure, particularly from riparian vegetation.
- Potential death or injury of roosting bats caused by diurnal clearing of unknown roost trees/structures.
- The creation of additional foraging opportunities along gas gathering lines, access tracks and any other linear canopy gaps caused by clearing;
- Increased watering points by the creation of surface ponds around gas wells. Flying insect abundance may also be increased around these waterbodies.

Significance of Project Related Impacts (Unmitigated)

The EIS area forms a small portion of this species' range. Furthermore, it is highly mobile and tolerant of some habitat fragmentation (M. Sanders pers. obs.). Due to this species listing as Near Threatened, the most applicable sensitivity criteria is **Moderate**. Impact magnitude likely to be L**ow**. The species has an impact significance of **Low** (8)

Proposed Management/ Mitigation Measures

Minor project-related impacts are likely and hence particular mitigation measures are not considered necessary, or likely to produce significant success. However, consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible. Rehabilitation of cleared land following decommissioning with species typical of surrounding habitats should also be undertaken to reduce long-term habitat loss.

Summary Residual Impact Assessment

Project-related impacts on this species are considered to be Minor and therefore mitigation will have limited results.

Unmitigated Significance Assessment			Effectiveness of Mitigation Measures	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Low	Low (9)	Effective	Low

* avoidance of habitats will ensure limited impacts, but is not unlikely to be an option for this project.

minimising clearing and rehabilitation

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.
2. All remnant vegetation with the exception of grasslands without canopy trees (11.3.21, 11.3.24) is considered "Core Habitat Possible". However, it is noted that within these areas the species is most likely to occur along waterways.
3. All Core Habitat Possible within 2km of a recent (1980+), accurate (± 500m) record is classed as "Core Habitat Known".
4. All remaining areas are mapped as "Absence Likely".

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South-eastern long-eared Bat (*Nyctophilus corbeni*)

Alternative nomenclature

Taxonomic revision of *Nyctophilus timoriensis* has revealed four geographically separated forms (Parnaby 2009). The south-eastern form has been called *Nyctophilus corbeni* (south-eastern long-eared bat) and is protected under legislation as *N. timoriensis sensu lato* (south-eastern form).

Status

NCA: vulnerable; EPBC: vulnerable (as *Nyctophilus timoriensis sensu lato*)

Distribution and habitat

The distribution of this species approximates the Murray-Darling Basin, south from near Taroom in central Queensland through inland NSW into northern Victoria and the corner of South Australia (Danggali Conservation Park) around the Murray River (Churchill 2008; Van Dyck and Strahan 2008; Parnaby 2009). The species' stronghold appears to be within the Pilliga forests of central NSW (Turbill and Ellis 2006).

It inhabits dry forest and woodland vegetation types including mallee, brigalow, bulloak, box and belah dominated communities. South-eastern long-eared bats appear to be more common in woodlands dominated by box/ironbark and bulloak/cypress on sandy soils (Turbill and Ellis 2006; Churchill 2008; Van Dyck and Strahan 2008). However, they have also been recorded from semi-evergreen vine thicket and inland dry sclerophyll forests with *Corymbia citriodora*, mixed eucalypt forest, poplar box open forest and brigalow/belah vegetation (Churchill 2008). Most records are from large tracts of vegetation of approximately 5000+ha (e.g., Southwood National Park) (EPA 2008), although the species can be recorded from smaller tracks of 600ha (e.g., Erringibba National Park; M. Sanders unpub. data).

Ecology

Little is known about the ecology of this species. Roosting has been documented in hollows of live trees such as *Casuarina pauper*, *Myoporum platycarpum* and Mallee (Churchill 2008). They are also likely to use fissures in branches and exfoliating bark (Van Dyck and Strahan 2008).

With broad, short wings, the south-eastern long-eared bat is highly manoeuvrable and well-adapted to its cluttered habitat. They fly close to vegetation, often through the canopy and can drop suddenly to almost ground level after prey. Foraging movements probably extend no more than 3km from roosts (Churchill 2008).

Mating occurs in autumn and winter. Females are able to store spermatozoa until ovulation and conception in early spring. Two young are usually birthed in late October to November and lactation continues until January (Van Dyck and Strahan 2008).

Threats

Survey data suggest that large, intact remnants of suitable habitat are required to support populations (Turbill and Ellis 2006; Van Dyck and Strahan 2008). With more than 75% of habitat cleared in some parts of its range, land clearing and fragmentation continues to threaten this species (Duncan *et al.* 1999).

Degradation of habitat from grazing and the loss of hollows and larger trees from logging and fires may also threaten existing populations (Van Dyck and Strahan 2008).

Project-related Impacts (unmitigated)

Evidence suggests that this species is absent from small patches, occuring only in patches equal to or larger than Southwood National Park in extent (approximately 5,000ha) (EPA 2008). However, the effect of fragmentation and disturbance associated with the construction of tracks and linear clearing is uncertain. Possible project-related impacts include:

- Potential death or injury of roosting bats caused by diurnal clearing of roosts.
- The loss of foraging and roosting habitat due to the construction of infrastructure.
- Fragmentation of existing large, intact and contiguous habitats. The species does occur in large forests that are traversed by management tracks, suggesting that they could be tolerant of some disturbance.
- Increased fire frequency associated with increased human activity and machinery.
- Decreased wildfire extent due to fire breaks along gas gathering lines in otherwise continuous vegetation.
- Increased watering points by the creation of surface ponds around gas wells. Flying insect abundance may also be increased around these waterbodies.

Significance of Project Related Impacts (Unmitigated)

The EIS area forms a small portion of this species' range. Furthermore, it is highly mobile and likely to be tolerant of small-scale disturbance associated with activities such as gas acquisition pipelines and bores.

More substantial clearing of vegetation associated with larger infrastructure (e.g., power generation plants, groundwater dams, etc) will have greater impacts. While it seems improbable that these activities will result in the extinction of a population, it may reduce available habitat and affect roosting opportunities.

Based on these factors, both the species senstivity and impact magnitude are evaluated as **Moderate** for an overall impact significance of **Moderate** (13).

Proposed Management/ Mitigation Measures

Avoidance

Avoiding vegetation removal in core habitat areas will be the most effective mitigation measure. However, gas acquisition pipelines and bore holes will have only a minor impact on vegetation extent. By contrast, clearing of vegetation for larger infrastructure should be avoided.

Further Surveys and Assessment

If vegetation clearing is required for power generation plants, dams or other large, further surveys should be undertaken. These surveys should aim to identify the presence/absence of *N. corbeni* and reassess project-related impacts. Further survey effort should include targeted trapping methods as this species cannot be adequately identified using remote detection equipment.

Minimising Disturbance

Consistent with broad biodiversity conservation principles, habitat clearance should be minimised wherever possible.

Rehabilitation

Rehabilitation of all cleared land following decommissioning with species typical of surrounding habitats should also be undertaken to reduce long-term habitat loss.

Summary Residual Impact Assessment

Project-related impacts on this species are considered to be Minor and therefore mitigation will have limited results.

Unmitigated Significance Assessment			**Effectiveness of Mitigation Measures**	
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Avoidance***	**Others#**
Moderate	Moderate	Moderate (13)	Effective	low

* avoiding clearing for power generation plants and larger infrastructure

clearing unavoidable.

Residual Significance Assessment					
Avoidance			**Others**		
Sensitivity Ranking	**Magnitude Ranking**	**Significance Ranking**	**Sensitivity Ranking**	**Magnitude Ranking**	**Significance Ranking**
Moderate	Extremely Low	Low (4)	Moderate	Low	Low (8)

Rule(s) for Habitat Mapping:

1. The species may occur throughout the entire EIS area.

2. All remaining remnant vegetation (except very open communities; 11.3.2, 11.3.21) greater in extent than 5000ha (including accumulative area where patches are separated by less than 100m) should be considered “Core Habitat Possible”.
3. All Core Habitat Possible within 2km of a recent (1980+), accurate (± 500m) record is classed as “Core Habitat Known”.
4. All remaining remnant vegetation is mapped as “Absence Possible”.
5. Cleared non-remnant areas are classed as “Absence Likely”.

Mapping Confidence

Important habitats for this species is reasonably well understood and can be matched to regional ecosystem descriptions. While highest abundance is located within these habitats, the species can occur in other habitats and hence may occur outside of mapped habitats. Consequently, the map is considered to be MODERATELY accurate.

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Appendix J. Site Vegetation Classification Comparisons

A comparison between site verified Regional Ecosystems and Version 6.0 RE mapping (DERM, 2009b).

Site No	Field Verified RE	EPA RE Mapping (Version 6.0, 2009)
AS12	11.3.14	11.3.1
AQ13	11.3.14	11.3.1
AS14	11.3.17	11.3.1
AS15	11.3.17	11.3.1
AQ16	11.3.17	11.3.1
AS18	11.3.14	11.3.1
AQ28	11.3.1	11.3.17
AS29	11.3.14	11.3.1
AQ30	11.3.1	Non-remnant
AS31	11.3.4	11.3.17
AQ33	11.3.1	11.3.17
AS48	11.3.26	11.3.1
AQ49	11.3.1	11.3.1
AS53	11.9.5	Non-remnant
AS69	11.4.3	11.4.3
AQ70	11.5.20	11.4.3
AQ72	11.3.1	11.3.2
AS77	11.3.1	11.3.1
AS79	11.4.3	11.5.20
AQ87	Non-remnant	11.3.21
AQ88	Non-remnant	11.3.21
AQ89	Non-remnant	11.3.21
AQ120	Non-remnant	11.3.1/11.3.25
AS121	11.3.21	11.3.2
AS138	11.3.1	11.3.17
AQ154	Non-remnant	11.3.21
AQ156	11.3.1	11.3.1
AS158	11.3.1	11.3.1
AS162	11.4.3	11.4.3
AQ163	11.4.3a	11.4.3
AQ173	11.4.3	11.3.4/11.3.1
AQ179	11.4.3	11.4.3
AQ182	11.4.3	11.4.3
AQ184	11.4.3	11.9.7
AS235	11.4.3	11.4.3
AS346	Non-remnant	11.3.21
AS347	Non-remnant	11.3.21
AS355	11.3.21	11.3.21
AS356	11.3.21	11.3.21
AS365	11.3.21	11.3.21
AS366	11.3.21	11.3.21
AS370	11.3.21	11.3.21
AS372	11.3.21	11.3.21
AQ384	11.4.3	Non-remnant
AQ385	11.4.3	Non-remnant
AQ386	11.4.3(regrowth)	Non-remnant
AQ387	11.4.3(regrowth)	Non-remnant
AQ388	11.4.3	Non-remnant
AQ389	11.4.3(regrowth)	Non-remnant
AQ390	11.4.3	11.4.3
AQ391	11.4.3	11.4.3
AQ393	11.4.3	11.4.3

EPBC Signficant Community	Colour Code
Non-significant	
Endangered	
Critically Endangered	

Appendix K. Cover values for sites located in significant grasslands within PDA.

Site #	RE	Total Veg. G/C %	Total Native Cover %	Total Native Grasses %	Total Native Herbs %	Total Exotic %	Total Exotic Grass %	Total Exotic Herb %	Inter tussock (If litt – bare gr) %	Total Sp.	Total Native Sp. %	Total Exotic %
Dalby-Kogan Rd												
343	11.3.2	100	92	47	45	8	0	8	0	31	61	39
368	11.3.21	94	89	55	34	0	0	0	6	31	84	16
370	11.3.21	90	85	65	20	5	0	5	10	24	75	25
372	11.3.21	91	76	66	10	7	2	5	9	28	68	32
Mean		**94**	**83**	**56**	**27**	**5**	**<1**	**5**	**6**	**29**	**72**	**28**
Dalby-Cecil Plains Rd												
355	11.3.21	80	28	20	8	52	10	51	10	30	77	23
356	11.3.21	93	83	74	9	8	1	9	7	24	71	29
366	11.3.21	74	65	61	4	13	0	13	22	24	71	29
365	11.3.21	95	88	85	3	7	2	5	5	30	63	37
Mean		**88**	**66**	**60**	**6**	**20**	**3**	**20**	**10**	**27**	**73**	**29**

Appendix L. Summary Impact Assessments for Ecological Values and Impact Pathway in the PDA

Appendix L-1. Overall sensitivities and impact magnitudes associated with activities involving direct Clearing.

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
Sensitivities and impact magnitudes associated with direct clearing								
EPBC Communities including component REs	Natural Grasslands (RE11.3.21, RE11.3.24)	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (RE11.8.2a)	Extremely High	High	Extremely High (23)	Extremely Low	Moderate (11)	Moderate	High (20)
	Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Weeping myall woodlands	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Coolibah – Black Box Woodlands (RE 11.3.3)	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
Other REs (of non-EPBC significance)	11.3.17	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.4.12	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	11.9.10	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.3.2	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.4	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.9.7	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.27	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.3.25	Low	Low	Low (8)	Extremely Low	Insignificant (2)	Low	Low (5)
ESA Category A	Wondul Range National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Bendidee National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Lake Broadwater Conservation Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
Additional Areas	Dalby-Kogan Road	Extremely High	Extremely	Extremely High	Extremely Low	Moderate (11)	High	Extremely

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
of Special Ecological Value	reserve		High	(25)				High (23)
	Dalby- Cecil Plains Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Dalby – St George Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Chinchilla Sporting Shooters Range	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
ESA Category B	Endangered Biodiversity Status REs.	Refer to individual assessments for REs 11.3.1, 11.3.17, 11.3.21, 11.3.24, 11.4.3, 11.4.10, 11.4.12, 11.9.5, 11.9.6, 11.9.10.						
Other Areas of Ecological Value	State/ Bioregional Wildlife Corridors	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Stock routes (Other than Dalby St. George Road Reserve, Dalby Cecil Plains Road Reserve, Dalby-Kogan Road Reserve)	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Essential Habitat	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Wyaga-Kindon Ooline populations	High	Extremely High	Extremely High (23)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Vine Thickets	Refer to EPBC Assessment - Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)						
	Riparian Vegetation	Refer to assessment for REs 11.3.25, 11.3.27						
	High D2 Criterion	Refer to assessment for Cat C ESAs (tenure), Bioregional wildlife corridors						
	Large Vegetation Tracts	Refer to assessment for Cat C ESAs, Bioregional wildlife corridors						
	Vegetation Intersecting Rivers	Refer to assessment for RE 11.3.25						
Category C ESAs by Tenure (State Forests and Timber Reserves)	Bendidee State Forest	High	High	High (21)	Extremely Low	Low (7)	High	High (21)
	Gurulmundi State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Binkey State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Barakula State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Other state forest and timber reserve areas	Moderate	Moderate	Moderate (13)	Extremely Low	Low (7)	Low	Moderate (12)
Category C ESAs by biodiversity status	Regional Ecosystems with 'Of Concern' biodiversity status.	Refer to individual Assessments for REs (including those of EPBC significance) 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.27, 11.9.7, 11.8.3, 11.8.2a						

Appendix L-2. Overall sensitivities and impact magnitudes associated with habitat fragmentation.

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
Sensitivity to activities associated with fragmentation								
EPBC Communities including component REs	Natural Grasslands (RE11.3.21, RE11.3.24)	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (RE11.8.2a)	Extremely High	High	Extremely High (23)	Extremely Low	Moderate (11)	Moderate	High (20)
	Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Weeping myall woodlands	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Coolibah – Black Box Woodlands (RE 11.3.3)	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
Other REs (of non-EPBC significance)	11.3.17	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.4.12	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	11.9.10	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.3.2	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.4	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.9.7	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.27	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.3.25	Low	Low	Low (8)	Extremely Low	Insignificant (2)	Low	Low (5)
ESA Category A	Wondul Range National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Bendidee National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Lake Broadwater Conservation Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
Additional Areas of Special	Dalby-Kogan Road reserve	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
Ecological Value	Dalby- Cecil Plains Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
	Dalby – St George Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
	Chinchilla Sporting Shooters Range	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
ESA Category B	Endangered Biodiversity Status REs.	Refer to individual assessments for REs 11.3.1, 11.3.17, 11.3.21, 11.3.24, 11.4.3, 11.4.10, 11.4.12, , 11.9.5, 11.9.6, 11.9.10.						
Other Areas of Ecological Value	State/ Bioregional Wildlife Corridors	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Stock routes (Other than Dalby St. George Road Reserve, Dalby Cecil Plains Road Reserve, Dalby-Kogan Road Reserve)	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Essential Habitat	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Wyaga-Kindon Ooline populations	High	Extremely High	Extremely High (23)	Extremely Low	Low (7)	Moderate	Moderate (17)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Vine Thickets	Refer to EPBC Assessment - Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)						
	Riparian Vegetation	Refer to assessment for REs 11.3.25, 11.3.27						
	High D2 Criterion	Refer to assessment for Cat C ESAs (tenure), Bioregional wildlife corridors						
	Large Vegetation Tracts	Refer to assessment for Cat C ESAs, Bioregional wildlife corridors						
	Vegetation Intersecting Rivers	Refer to assessment for RE 11.3.25						
Category C ESAs by Tenure (State Forests and Timber Reserves)	Bendidee State Forest	High	High	High (21)	Extremely Low	Low (7)	High	High (21)
	Gurulmundi State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Binkey State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Moderate	Moderate (17)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Barakula State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Other state forest and timber reserve areas	Moderate	Moderate	Moderate (13)	Extremely Low	Low (7)	Low	Moderate (12)
Category C ESAs by biodiversity status	Regional Ecosystems with 'Of Concern' biodiversity status.	Refer to individual Assessments for REs (including those of EPBC significance) 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.27, 11.9.7, 11.8.3, 11.8.2a						

Appendix L-3. Overall sensitivities and impact magnitudes associated with edge effects, the loss or modification of habitat important for threatened flora and fauna species.

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
Activities associated with edge effects, the loss or modification of habitat important for threatened flora and fauna species								
EPBC Communities including component REs	Natural Grasslands (RE11.3.21, RE11.3.24)	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (RE11.8.2a)	Extremely High	Moderate	High (18)	Extremely Low	Moderate (11)	Low	Moderate (16)
	Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Weeping myall woodlands	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Coolibah – Black Box Woodlands (RE 11.3.3)	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
Other REs (of non-EPBC significance)	11.3.17	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.4.12	High	High	High (21)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.9.10	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.3.2	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.3.4	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.9.7	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.27	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Extremely Low	Low (4)
	11.3.25	Low	Moderate	Moderate (11)	Extremely Low	Insignificant (2)	Low	Low (5)
ESA Category A	Wondul Range National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Bendidee National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
	Lake Broadwater Conservation Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	High	Extremely High (23)
Additional Areas	Dalby-Kogan Road	Extremely High	Extremely	Extremely High	Extremely Low	Moderate (11)	Low	Moderate (16)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
of Special Ecological Value	reserve		High	(25)				
	Dalby- Cecil Plains Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Low	Moderate (16)
	Dalby – St George Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Low	Moderate (16)
	Chinchilla Sporting Shooters Range	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Low	Moderate (16)
ESA Category B	Endangered Biodiversity Status REs.	Refer to individual assessments for REs 11.3.1, 11.3.17, 11.3.21, 11.3.24, 11.4.3, 11.4.10, 11.4.12, , 11.9.5, 11.9.6, 11.9.10.						
Other Areas of Ecological Value	State/ Bioregional Wildlife Corridors	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Stock routes (Other than Dalby St. George Road Reserve, Dalby Cecil Plains Road Reserve, Dalby-Kogan Road Reserve)	High	High	High (21)	Extremely Low	Low (7)	Moderate	Moderate (17)
	Essential Habitat	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Wyaga-Kindon Ooline populations	High	Extremely High	Extremely High (23)	Extremely Low	Low (7)	Low	Moderate (12)
	Vine Thickets	Refer to EPBC Assessment - Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)						
	Riparian Vegetation	Refer to assessment for REs 11.3.25, 11.3.27						
	High D2 Criterion	Refer to assessment for Cat C ESAs (tenure), Bioregional wildlife corridors						
	Large Vegetation Tracts	Refer to assessment for Cat C ESAs, Bioregional wildlife corridors						
	Vegetation Intersecting Rivers	Refer to assessment for RE 11.3.25						
Category C ESAs by Tenure (State Forests and Timber Reserves)	Bendidee State Forest	High	High	High (21)	Extremely Low	Low (7)	High	High (21)
	Gurulmundi State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Binkey State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Barakula State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Other state forest and timber reserve areas	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Moderate (12)
Category C ESAs by biodiversity status	Regional Ecosystems with 'Of Concern' biodiversity status.	Refer to individual Assessments for REs (including those of EPBC significance) 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.27, 11.9.7, 11.8.3, 11.8.2a						

Appendix L-4. Overall sensitivities and impact magnitudes associated Activities causing changes to other ecological processes, such as fire frequency, fire extent.

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
Activities causing changes to other ecological processes, such as fire frequency, fire extent.								
EPBC Communities including component REs	Natural Grasslands (RE11.3.21, RE11.3.24)	Extremely High	Moderate	High (20)	Extremely Low	Moderate (11)	Low	Moderate (16)
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (RE11.8.2a)	Extremely High	Moderate	High (20)	Extremely Low	Moderate (11)	Low	Moderate (16)
	Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6)	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)	High	High	High (21)	Low	Moderate (12)	Low	Moderate (12)
	Weeping myall woodlands	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Extremely Low	Low (7)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Coolibah – Black Box Woodlands (RE 11.3.3)	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
Other REs (of non-EPBC significance)	11.3.17	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.4.12	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	11.9.10	High	Low	Moderate (12)	Extremely Low	Low (7)	Low	Moderate (12)
	11.3.2	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.3.4	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.9.7	Moderate	Low	Low (8)	Extremely Low	Low (4)	Low	Low (8)
	11.3.27	Moderate	High	Moderate (18)	Extremely Low	Low (4)	Low	Low (8)
	11.3.25	Low	High	Moderate (14)	Extremely Low	Insignificant (2)	Low	Low (5)
ESA Category A	Wondul Range National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
	Bendidee National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
	Lake Broadwater Conservation Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	High (20)
Additional Areas	Dalby-Kogan Road	Extremely High	Extremely	Extremely High	Extremely Low	Moderate (11)	Moderate	Moderate (20)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
of Special Ecological Value	reserve		High	(25)				
	Dalby- Cecil Plains Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	Moderate (20)
	Dalby – St George Road Reserve.	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	Moderate (20)
	Chinchilla Sporting Shooters Range	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Moderate	Moderate (20)
ESA Category B	Endangered Biodiversity Status REs.	Refer to individual assessments for REs 11.3.1, 11.3.17, 11.3.21, 11.3.24, 11.4.3, 11.4.10, 11.4.12, , 11.9.5, 11.9.6, 11.9.10.						
Other Areas of Ecological Value	State/ Bioregional Wildlife Corridors	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Stock routes (Other than Dalby St. George Road Reserve, Dalby Cecil Plains Road Reserve, Dalby-Kogan Road Reserve)	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Essential Habitat	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Wyaga-Kindon Ooline populations	High	Extremely High	Extremely High (23)	Extremely Low	Low (7)	Low	Moderate (12)
	Vine Thickets	Refer to EPBC Assessment - Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)						
	Riparian Vegetation	Refer to assessment for REs 11.3.25, 11.3.27						
	High D2 Criterion	Refer to assessment for Cat C ESAs (tenure), Bioregional wildlife corridors						
	Large Vegetation Tracts	Refer to assessment for Cat C ESAs, Bioregional wildlife corridors						
	Vegetation Intersecting Rivers	Refer to assessment for RE 11.3.25						
Category C ESAs by Tenure (State Forests and Timber Reserves)	Bendidee State Forest	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Gurulmundi State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Binkey State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Barakula State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Low	Moderate (12)
	Other state forest and timber reserve areas	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Extremely Low	Low (4)
Category C ESAs by biodiversity status	Regional Ecosystems with 'Of Concern' biodiversity status.	Refer to individual Assessments for REs (including those of EPBC significance) 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.27, 11.9.7, 11.8.3, 11.8.2a						

Appendix L-5. Overall sensitivities and impact magnitudes associated with activities causing changes to other ecological processes, such as fire frequency, fire extent.

	Existing Environment	**Values Sensitivity**	**Pre Mitigated Impact**		**Residual Impact - Total Avoidance**		**Residual Impact - Other Measures**	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
Activities affecting surface water availability, and surface water flow and potential discharge of saline waters into vegetation and/or wetland areas.								
EPBC Communities including component REs	Natural Grasslands (RE11.3.21, RE11.3.24)	Extremely High	High	Extremely High (23)	Extremely Low	Moderate (11)	Low	Moderate (16)
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (RE11.8.2a)	Extremely High	Low	Moderate (16)	Extremely Low	Moderate (11)	Extremely Low	Moderate (11)
	Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6)	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Weeping myall woodlands	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Coolibah – Black Box Woodlands (RE 11.3.3)	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
Other REs (of non-EPBC significance)	11.3.17	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.4.12	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.9.10	High	Low	Moderate (12)	Extremely Low	Low (7)	Extremely Low	Low (7)
	11.3.2	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.3.4	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Low	Low (8)
	11.9.7	Moderate	Low	Low (8)	Extremely Low	Low (4)	Extremely Low	Low (4)
	11.3.27	Moderate	High	Moderate (18)	Extremely Low	Low (4)	Low	Low (8)
	11.3.25	Low	High	Moderate (14)	Extremely Low	Insignificant (2)	Low	Low (5)
ESA Category A	Wondul Range National Park	Extremely High	Low	Moderate (16)	Extremely Low	Moderate (11)	Extremely Low	Moderate (11)
	Bendidee National Park	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Extremely Low	Moderate (11)
	Lake Broadwater Conservation Park	Extremely High	Extremely High	Extremely High (25)	Low	Moderate (16)	Low	Moderate (16)
Additional Areas	Dalby-Kogan Road	Extremely High	High	Extremely High	Extremely Low	Moderate (11)	Low	Moderate (16)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
of Special Ecological Value	reserve			(23)				
	Dalby- Cecil Plains Road Reserve.	Extremely High	High	Extremely High (23)	Extremely Low	Moderate (11)	Low	Moderate (16)
	Dalby – St George Road Reserve.	Extremely High	High	Extremely High (23)	Extremely Low	Moderate (11)	Extremely Low	Moderate (11)
	Chinchilla Sporting Shooters Range	Extremely High	Extremely High	Extremely High (25)	Extremely Low	Moderate (11)	Extremely Low	Moderate (11)
ESA Category B	Endangered Biodiversity Status REs.	Refer to individual assessments for REs 11.3.1, 11.3.17, 11.3.21, 11.3.24, 11.4.3, 11.4.10, 11.4.12, , 11.9.5, 11.9.6, 11.9.10.						
Other Areas of Ecological Value	State/ Bioregional Wildlife Corridors	High	High	High (21)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Stock routes (Other than Dalby St. George Road Reserve, Dalby Cecil Plains Road Reserve, Dalby- Kogan Road Reserve)	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)
	Essential Habitat	High	High	High (21)	Extremely Low	Low (7)	Low	Moderate (12)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
	Wyaga-Kindon Ooline populations	High	Extremely High	Extremely High (23)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Vine Thickets	Refer to EPBC Assessment - Semi-evergreen vine thickets (RE11.9.4a, 11.8.3)						
	Riparian Vegetation	Refer to assessment for REs 11.3.25, 11.3.27						
	High D2 Criterion	Refer to assessment for Cat C ESAs (tenure), Bioregional wildlife corridors						
	Large Vegetation Tracts	Refer to assessment for Cat C ESAs, Bioregional wildlife corridors						
	Vegetation Intersecting Rivers	Refer to assessment for RE 11.3.25						
Category C ESAs by Tenure (State Forests and Timber Reserves)	Bendidee State Forest	High	High	High (21)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Gurulmundi State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Extremely Low	Low (7)

	Existing Environment	Values Sensitivity	Pre Mitigated Impact		Residual Impact - Total Avoidance		Residual Impact - Other Measures	
			Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
	Binkey State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Barakula State Forest	High	Moderate	Moderate (17)	Extremely Low	Low (7)	Extremely Low	Low (7)
	Other state forest and timber reserve areas	Moderate	Moderate	Moderate (13)	Extremely Low	Low (4)	Extremely Low	Low (4)
Category C ESAs by biodiversity status	Regional Ecosystems with 'Of Concern' biodiversity status.	Refer to individual Assessments for REs (including those of EPBC significance) 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.27, 11.9.7, 11.8.3, 11.8.2a						

Appendix M. Summary Impact Assessments for Grouped Ecological Values Against Impact Pathway in the PDA.

Appendix M-1. Threatened ecological communities and regional ecosystems impact assessment against impact pathway.

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Activities Associated with Direct Clearing of Sensitive Vegetation and Habitat								
Exploration and Appraisal Well Drilling* ▪ Seismic Data Collection **Production Well Design and Installation** ▪ Site Preparation* ▪ Well Site Drilling **Gathering Infrastructure Design and Installation** **Electricity Grid (Overhead) Design and Installation** **Integrated Production Facility Design and Installation** ▪ Gas compression and Processing Facility Design and Installation	Low to Extremely High	Low to Extremely High	Low (5) to Extremely High (25)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems • Minimisation of impact footprint. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation.	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (4) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
▪ Electricity Generation Design and Installation ▪ Water Storage Treatment Facility Design and Installation ▪ Sewerage Treatment Plant Design and Installation **Export of Gas from Field to Downstream Use** ▪ Clearing of ROW , trenching and access for construction equipment.								
Activities Associated with Dissection and Fragmentation of Sensitive Vegetation and Habitat								
As for activities associated with direct clearing	Low to Extremely High	Low to High	Low (5) to Extremely High (23)	• Avoidance of significant ecological communities including maintenance of management buffers (includes pre-clearance site inspection /survey). • Avoidance of bioregional and state wildlife corridors. • Management buffers should be established around all EPBC significant ecological communities and endangered and of concern regional ecosystems • No-impact zones of 300m should be established from which non-linear infrastructure is excluded	Extremely Low	Insig. (2) to Moderate (11)	Low to Moderate	Low (5) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				• A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Minimisation of impact footprint. • Organise survey lines in a formation that minimises habitat dissection. Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation. • Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000).				
Activities associated with edge effects, the loss or modification of habitat important for threatened flora and fauna species								

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
All Activities Plus: **Operation and Maintenance** ▪ Well Site Operation and Maintenance ▪ Electricity Grid Operation and Maintenance ▪ Electricity Generation Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation **Decommission and Rehabilitation** ▪ Well Site Decommission and Rehabilitation ▪ Gathering Infrastructure Decommision and Rehabilitiation ▪ Electricital Grid Decommision and Rehabilitiation ▪ Integrated Processing Facility Decommission and Rehabilitation	Low to Extremely High	Low to Moderate	Low (5) to High (21)	As for activites associated with direct clearing as well as: • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind. • Adhere to management buffers prescribed by regulatory authorities. • Rehabilitation should utilise native species of local provenance and follow recommendations made by	Extremely Low	Insig. (2) to Moderate (11)	Extremely Low to Low	Insig. (2) to Moderate (16)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				Bennett (2000).				
Activities Associated with Changes to other ecological processes, such as fire frequency, fire extent.								
All Activities Plus: **Operation and Maintenance** ▪ Well Site Operation and Maintenance ▪ Electricity Grid Operation and Maintenance ▪ Electricity Generation	Low to Extremely High	Low to High	Low (8) to High (21)	As for activites associated with direct clearing as well as: • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Ensure weed hygiene protocols are maintained including	Extremely Low to Low	Insignificant (2) to Moderate (12)	Extremely Low to Low	Low (5) to Moderate (12)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation **Decommission and Rehabilitation** ▪ Well Site Decommission and Rehabilitation ▪ Gathering Infrastructure Decommision and Rehabilitiation ▪ Electricital Grid Decommision and Rehabilitiation ▪ Integrated Processing Facility Decommission and Rehabilitation				machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Adhere to management buffers prescribed by regulatory authorities. • Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000).				
Activities affecting Surface water availability, and surface water flow and potential discharge of saline waters into vegetation and/or wetland areas.								
Production Well Design and Installation ▪ Well Site Drilling **Operation and Maintenance** ▪ Well Site Operation and Maintenance	Low to Extremely High	Low to High	Low (8) to Extremely High (23)	• Adhere to management buffers prescribed by regulatory authorities. • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Ensure effective erosion control	Extremely Low	Insignificant (2) to Moderate (11)		Low (5) to Moderate (16)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
▪ Electricity Generation Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation ▪ Water Storage Treatment Facility Design and Installation ▪ Sewerage Treatment Plant Design and Installation				measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind.				

Appendix M-2. Environmentally sensitive areas impact assessment against impact pathway (excludes ESAs assigned to RE Biodiversity Status).

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Activities Associated with Direct Clearing of Sensitive Vegetation and Habitat								
Exploration and Appraisal Well Drilling* ▪ Seismic Data Collection **Production Well Design and Installation** ▪ Site Preparation* ▪ Well Site Drilling **Gathering Infrastructure Design and Installation** **Electricity Grid (Overhead) Design and Installation** **Integrated Production Facility Design and Installation** ▪ Gas compression and	Moderate to Extremely High	Low to Extremely High	Moderate (13) to Extremely High (25)	• Avoidance of significant ESAs including maintenance of management buffers (includes pre-clearance site inspection /survey). • 1000m buffer zones around Category A ESAs including a 200m 'no-impact' buffer. • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Minimisation of impact footprint. • Preparation of biodiversity offsets (DEWR 2007; DNRW 2007) for all impacted significant vegetation.	Extremely Low	Low (7) to Moderate (11)	Low to High	Moderate (12) Extremely High (25)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Processing Facility Design and Installation ▪ Electricity Generation Design and Installation ▪ Water Storage Treatment Facility Design and Installation ▪ Sewerage Treatment Plant Design and Installation **Export of Gas from Field to Downstream Use** ▪ Clearing of ROW , trenching and access for construction equipment.								
Activities Associated with Dissection and Fragmentation of Sensitive Vegetation and Habitat								
As for activities associated with direct clearing	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for activities associated with direct clearing as well as: • Avoidance of significant ESA including maintenance of management buffers (includes pre-clearance site inspection /survey). • 1000m buffer zones around Category A ESAs including a 200m 'no-impact' buffer. • No-impact zones of 300m should	Extremely Low	Low (7) to Moderate (11)	Low to High	Moderate (12) to Extremely High (23)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
				be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Avoidance of bioregional and state wildlife corridors. • Minimisation of impact footprint. • Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000).				
Activities associated with edge effects, the loss or modification of habitat important for threatened flora and fauna species								

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
All Activities Plus: **Operation and Maintenance** ▪ Well Site Operation and Maintenance ▪ Electricity Grid Operation and Maintenance ▪ Electricity Generation Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation **Decommission and Rehabilitation** ▪ Well Site Decommission and Rehabilitation ▪ Gathering Infrastructure Decommision and Rehabilitiation ▪ Electricital Grid Decommision and Rehabilitiation ▪ Integrated Processing Facility Decommission and Rehabilitation	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for activities associated with direct clearing as well as: • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • Ensure weed hygiene protocols are maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind. • Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000).	Extremely Low	Low (4) to Moderate (11)	Low to High	Moderate (12) to Extremely High (23)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Activities Associated with Changes to other ecological processes, such as fire frequency, fire extent.								
All Activities Plus: **Operation and Maintenance** ▪ Well Site Operation and Maintenance ▪ Electricity Grid Operation and Maintenance ▪ Electricity Generation Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation **Decommission and Rehabilitation** ▪ Well Site Decommissio n and Rehabilitation ▪ Gathering Infrastructure Decommision and Rehabilitiation ▪ Electricital Grid Decommision and Rehabilitiation ▪ Integrated Processing Facility Decommissio n and	Low to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	• Avoidance of significant ESAs including maintenance of management buffers (includes pre-clearance site inspection /survey). • 1000m buffer zones around Category A ESAs including a 200m 'no-impact' buffer. • No-impact zones of 300m should be established from which non-linear infrastructure is excluded • A 200m impact risk zone is defined around the habitat from which linear infrastructure is excluded. • maintained including machinery / equipment washdown procedures. • Limit access to existing access tracks or points wherever possible. • Ensure effective erosion control • Rehabilitation should utilise native species of local provenance and follow recommendations made by Bennett (2000).	Extremely Low	Low (4) to Moderate (11)	Extremely Low to Moderate	Low (4) to High (20)

Activity	Unmitigated Impact Assessment			Mitigation Measures	Residual Impact Significance			
					Total Avoidance		Others	
	Sensitivity	Magnitude	Significance		Magnitude	Significance	Magnitude	Significance
Rehabilitation								
Activities affecting surface water availability, and surface water flow and potential discharge of saline waters into vegetation and/or wetland areas.								
Production Well Design and Installation ▪ Well Site Drilling **Operation and Maintenance** ▪ Well Site Operation and Maintenance ▪ Electricity Generation Site Operation and Maintenance ▪ Central Gas Processing Facility Design and Operation ▪ Water Storage Treatment Facility Design and Installation ▪ Sewerage Treatment Plant Design and Installation	Moderate to Extremely High	Moderate to Extremely High	Moderate (13) to Extremely High (25)	As for activities associated with direct clearing as well as: . • Ensure effective erosion control measures are in place. Particular care should be exercised in proximity to wetland areas. • Have emergency shutdown procedures in place to prevent release of hazardous substance in the event of equipment failure. • Dust suppression activity utilising saline water should not be undertaken within management buffers of sensitive ecosystems (including wetlands) or during periods of high wind. .	Extremely Low to Low	Low (4) to Moderate (20)	Extremely Low to Low	Low (4) to Moderate (20)

Appendix N. Vegetation Clearing Impacts Associated With Interacting Projects.

Maximum Clearing Limits (ha) For Individual Projects*																
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Totals**
EPBC Significant Ecological Community: Brigalow (Acacia harpophylla dominant and co-dominant) (endangered)**Regional Ecosystems:** 11.3.1, 11.4.3, 11.9.6, 11.4.10, 11.9.6																
2	68.5	-	-	-	43	-	-	52	-	39	73	-	-	9	35	**322**
Ecological Community: <u>Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</u> (critically endangered) **Regional Ecosystems:** 11.3.21, 11.3.24																
-	-	-	-	-	-	-	-	5.2	-	78.5	-	-	-	-	-	**84**
Ecological Community: <u>Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions</u> (endangered) **Regional Ecosystems:** 11.8.3, 119.4a																
-	13.2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**13**
Ecological Community: <u>Weeping Myall Woodlands</u> (endangered); Regional Ecosystems: Not Represented																
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Ecological Community: <u>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</u> (critically endangered) **Regional Ecosystems:** 11.8.2a																
-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	**100**
Ecological Community: Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered): **Regional Ecosystems:** 11.3.3																
-	7.8	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	**11**
RE 11.3.2: Eucalyptus populnea woodland on alluvial plains (of concern)																
7.6	129	-	-	-	-	-	-	109	-	35.2	13.6	-	-	-	-	**296**
RE 11.3.4: Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains (of concern)																
7.5	10.2	-	-	-	-	-	-	2	-	-	16.7	-	-	-	-	**36**
RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains (Endangered)																
-	1	-	-	-	-	-	-	12.6	-	35.7	11.2	-	-	-	-	**61**
RE 11.3.25: Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines. (not of concern)																
-	249	-	-	-	-	-	-	16	-	15.8	-	-	-	-	446	**727**
RE 11.3.27: Freshwater wetlands (not of concern)																
-	0.4	-	-	-	-	-	-	-	-		9.8	-	-	-	-	**10**
RE 11.4.12: Eucalyptus populnea woodland on Cainozoic clay plains (endangered)																
-	12.7	-	-	-	-	-	-	-	-	-	12.5	-	-	-	-	**25**
RE 11.9.7: Eucalyptus populnea, Eremophila mitchellii shrubby woodland on fine-grained sedimentary rocks (of concern)																
-	2.8	-	-	-	-	-	-	1.3	-	-	8.9	-	-	-	-	**13**
RE 11.9.10: Acacia harpophylla, Eucalyptus populnea open forest on fine-grained sedimentary rocks (of concern)																
	19.8									22.9	13.4				76.1	**132**

* Derived from project conditions imposed by Department of SEWPAC, Co-ordinator generals reports for individual EIS projects, and EIS and IAS documentation. All areas indicate maximum clearing limits imposed as a project condition.

<u>Projects</u>

1. Arrow Surat Pipeline (Arrow Energy)
2. Australia Pacific LNG (Origin Energy)-includes gas fields and pipelines
3. Bloodwood Creek (Carbon Energy)
4. Cameby Downs Expansion Project
5. CS Energy – Kogan Creek Solar
6. Elimatta Coal Project (Taroom Coal P/L)
7. Emu Swamp Dam Project
8. Felton Clean Coal (Ambre Energy)
9. Gladstone LNG Project (Santos) –includes gas fields and pipelines
10. Nathan Dam and Nathan Pipeline

11.New Acland Coal Mine – Stage 3 expansion (New Hope Coal Australia)
12.Queensland Curtis LNG (QGC/ BG) – Includes gas fields and pipelines
13.Queensland Hunter Gas Pipeline Project (Hunter Gas Pipeline P/L)
14.Spring Gully Power Station (Origin Energy)
15.Surat Basin Rail (Surat Basin Rail Pty Ltd)
16. Wandoan Coal Project (Xstrata Coal)en