Australia Pacific LNG Project

Volume 5: Attachments

Attachment 14: Terrestrial Ecology – Gas Fields

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
Hirundapus caudacutus	White-throated Needletail	M	S		all
Apus pacificus	Fork-tailed Swift	M	S		all
Ephippiorhynchus asiaticus	Black-necked Stork		R		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Ardea modesta	Eastern Great Egret	M	S		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Ardea ibis	Cattle Egret	M	S		nil
Plegadis falcinellus	Glossy Ibis	M	S		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Pandion cristatus	Eastern Osprey	M	S		nil
Lophoictinia isura	Square-tailed Kite		R		11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.19, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.1, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.3, 11.10.7, 11.10.11, 11.10.13
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	S		11.3.25, 11.3.27b
Accipiter novaehollandiae	Grey Goshawk		R		11.3.25, 11.3.27b, 11.8.3
Erythrotriorchis radiatus	Red Goshawk3	V	E		11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.5.1, 11.5.4, 11.5.4a, 11.5.511.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.9, 11.10.1, 11.10.1d, 11.10.7, 11.10.11, 11.10.13
Lewinia pectoralis	Lewin's Rail		R		11.3.25, 11.3.27b
Burhinus grallarius	Bush Stone-curlew		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.18, 11.3.25, 11.3.26, 11.3.39, 11.4.12, 11.9.7, 11.10.1,

Biodiversity Value Impacted	Potential Area Affected for each Value[1]	Environmental Outcome Sought	Potential Offset Descriptions				Offset Trigger	Offset timing
			Values	Location (in order of preference)	Offset type and characteristics	Ratio of impact to offset		
	and / or Belah (*Casuarina cristata*) on alluvial plains - RE 11.3.17 (also listed as Endangered Biodiversity Status under the VM Act) Coolibah (*Eucalyptus coolabah*) woodland on alluvial plains - RE 11.3.3 Queensland Blue Gum (*Eucalyptus tereticornis*) and/ or Eucalyptus spp. tall woodland on alluvial plains - RE 11.3.4 Poplar Box (*Eucalyptus populne*a), False sandalwood (*Eremophila mitchellii*) shrubby woodland on fine-grained sedimentary rocks - RE 11.9.7 Brigalow (*Acacia harpophylla*) and Poplar Box (*Eucalyptus populnea*) open forest on fine-grained sedimentary rocks - RE 11.9.10	rehabilitation of existing degraded REs; or Re-establishing REs.						Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.
Species:								
EPBC Listed Species for which the Project Area provides important habitat and for which residual impacts are "Moderate" or higher (may also be listed as **Endangered or *Vulnerable under the NC Act)	5568 ha potential habitat for Brigalow Scaly-foot* 3614 ha potential habitat for Dunmall's Snake 5272 ha potential habitat for Yakka Skink	Long-term protection of existing habitat – most likely through arrangements on private land; Restoration or rehabilitation of existing degraded habitat; or Re-establishing habitat.	Environmental offsets commensurate with the magnitude of the impacts of the development and deliver outcomes that are 'like for like'.	1. within the meta-population 2. within the sub-region 3. In an adjacent sub-region in the same bioregion where it is demonstrated that the environmental outcome will be met.	Environmental offsets to be developed as a package of actions –including both direct and indirect offsets. Direct offsets are aimed at on-ground maintenance and improvement of habitat or landscape values. Indirect offsets are the range of other actions that improve knowledge, understanding and management leading to improved conservation outcomes.	Offset ratios to be developed in consultation with DNRW and DEWHA..	Clearing within REs: 11.3.1, 11.3.2, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.9, 11.10.11	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.
NC Act Endangered Species for which the Project Area provides important habitat and for which residual impacts are "Moderate" or higher (may also be listed under EPBC Act*)	674 ha potential habitat for Grey Snake	Long-term protection of existing habitat – most likely through arrangements on private land; Restoration or rehabilitation of existing degraded habitat; or Re-establishing habitat.	Environmental offsets commensurate with the magnitude of the impacts of the development and deliver outcomes that are 'like for like'.	1. within the meta-population 2. within the sub-region 3. in an adjacent sub-region in the same bioregion where it is demonstrated that the environmental outcome will be met.	Direct offsets preferred, but may be supplemented with indirect offsets.	Offset ratios to be developed in consultation with DNRW and DEWHA..	Clearing within REs: 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.25, 11.3.26, 11.3.27b, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.9.111.9.5	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.
NC Act Vulnerable Species for which the Project Area provides important habitat (may also be listed under EPBC Act*)	5568 ha potential habitat for Brigalow Scaly-foot* 3614 ha potential habitat for Dunmall's Snake 5272 ha potential habitat for	Improve population viability of the relevant species in the wild.	Same RE or REs that constitute habitat with similar carrying capacity for the species.	1. within the meta-population 2. within the sub-region 3. in an adjacent sub-region in the same bioregion where it is	Direct offsets preferred, but may be supplemented with indirect offsets.	Offset ratios to be developed in consultation with DNRW and DEWHA..	Clearing within REs: 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a,	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based

Downs region, incorporating the Talinga/Orana, Kainama, Condabri, Woleebee, Combabula/ Ramyard, Corinya, Dalwogan and Gilbert Gully tenements. The entire study area considered for this assessment includes areas outside of the tenements where service infrastructure is required. The total study area is approximately 1,470,000ha or 14,700km2 (Figure 1.1).

Australia Pacific LNG's development plan is to install up to 10,000 gas wells over a 30 year project lifespan. Gas and water gathering systems will be developed for delivery to gas processing facilities and water treatment facilities. Associated infrastructure includes roads, access tracks, storage ponds, camps, communication infrastructure and other logistics support areas. Figure 1.2 shows the proposed Project footprint within the main gas fields study area. This excludes gas wells and associated infrastructure, the total area of which has been considered as part of the Impact Assessment in Section 3.0, but for which precise locations have yet to be determined. Figure 1.2 also excludes a number of proposed telecommunications infrastructure locations and the far north-western extent of the high pressure gas pipeline network, which are assessed separately in a stand-alone Appendix to this report (see introduction to Section 2.0).

Biodiversity Value Impacted	Potential Area Affected for each Value[1]	Environmental Outcome Sought	Potential Offset Descriptions				Offset Trigger	Offset timing
			Values	Location (in order of preference)	Offset type and characteristics	Ratio of impact to offset		
	Yakka Skink 2728 ha potential habitat for Glossy Black-Cockatoo			demonstrated that the environmental outcome will be met.			11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.9, 11.10.11	offsets on maintenance twelve (12) months prior to clearing within listed REs.
NC Act Rare or near-threatened species for which the Project Area provides important habitat	5432 ha potential habitat for Golden-tailed Gecko 5828 ha potential habitat for Little Pied Bat 5244 ha potential habitat for Square-tailed Kite 458 ha potential habitat for Rough Frog 5409 ha potential habitat for Woma	Improve population viability of the relevant species in the wild.	Same RE or REs that constitute habitat with similar carrying capacity for the species.	1. within the meta-population 2. within the sub-region 3. in an adjacent sub-region in the same bioregion where it is demonstrated that the environmental outcome will be met.	Direct offsets preferred, but may be supplemented with indirect offsets.	Offset ratios to be developed in consultation with DNRW.	Clearing within REs: 11.3.1, 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, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.9, 11.10.11	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.

[1] As many of the offset ratios are common to a number of values, the total vegetation communities (REs) and habitat requiring offset are provided in **Table 3.6.**

Tables O.2 (Flora) and O.3 (Flora) (Appendix O) provide breakdowns of offset opportunities, providing estimated clearing figures derived from overlaying the proposed Project infrastructure with the RE mapping (as revised for this report). The REs allocated to each

conservation significant flora and fauna species are derived from the Environmental Sensitivity Mapping process described in Appendix A. Clearing of any EPBC Listed Endangered Communities, and Endangered and Of Concern REs (biodiversity status) will require offsetting. In addition, those species for which recommended mitigation measures cannot adequately ameliorate potential impacts (that is, reduce potential impacts to 'negligible' or 'minor' at most) have been identified for offsetting.

The tables also include recommendations for indirect offsets where relevant.

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

The optimal approach for offsetting will be to offset as much as possible within regrowth inside bioregional corridors, with the next highest priority being rehabilitation of cleared land inside bioregional corridors, and lastly to offset outside of biodiversity corridors using only regrowth vegetation.

Figure 3.3 shows the spatial distribution of regrowth and cleared areas as they currently occur within the bioregional corridors inside the tenement boundaries.

As the construction of the Project is proposed to be staged over a period of approximately six years, with a proposed lifespan of approximately 30 years, it is assumed that delivery of the offset package would also be staged as the development progresses.

2.7 Matters of National Environmental Significance

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

Matters of national environmental significance have been addressed throughout this report as part of the impact assessment process.

The recommended self-assessment process of addressing significant impact criteria as identified by DEWHA has been completed (Appendix P).

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

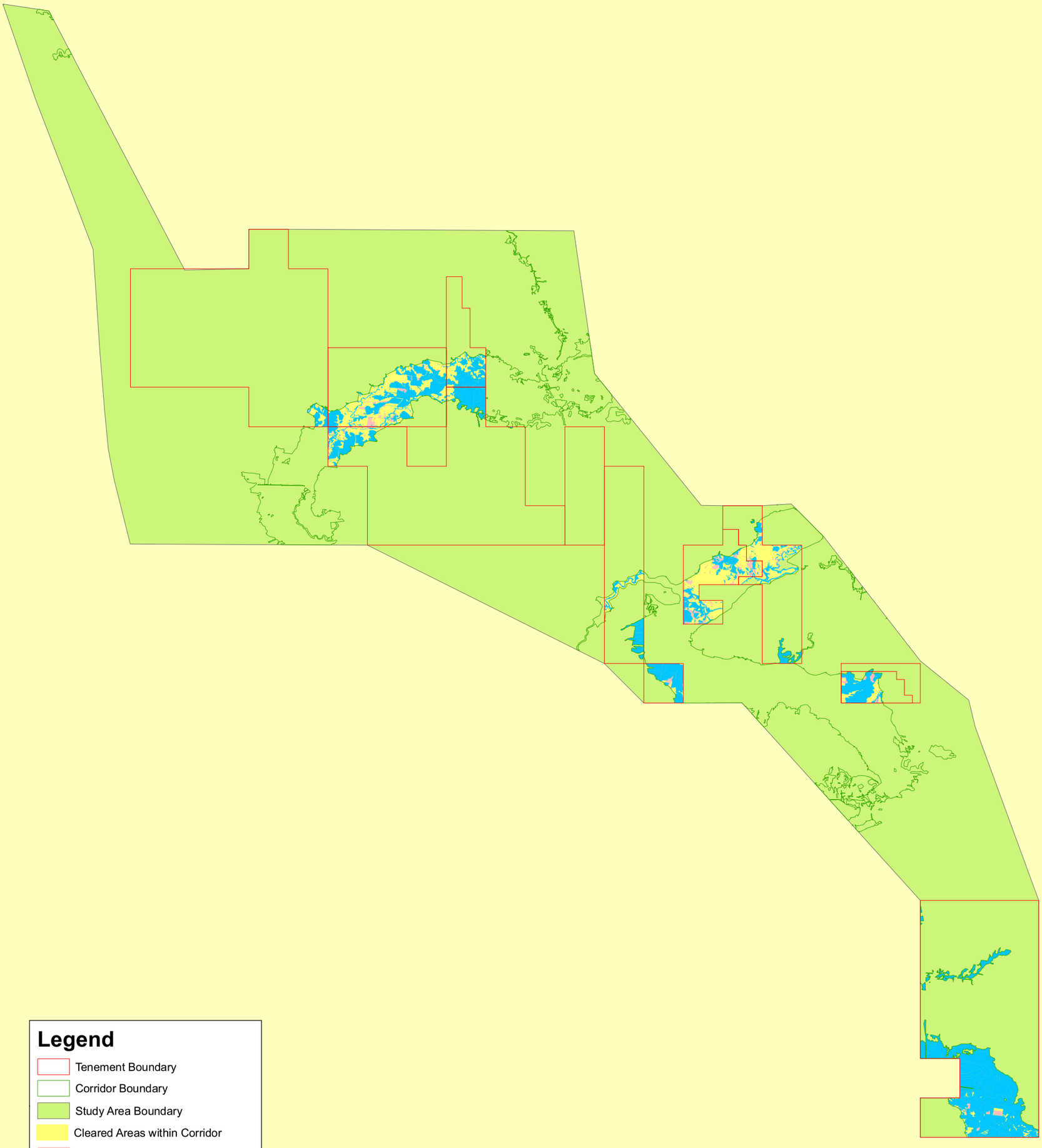
2.8 Cumulative Impacts

An assessment of terrestrial ecological cumulative impacts must take into account not only the potential impacts of the subject Project, but its effects in combination with the impacts of other proposed projects that may have a significant potential to affect regional terrestrial biodiversity.

This process is often confounded by a lack of information regarding the proposed impacts of other projects, and in this case is particularly confounded by the approach taken by other gas field development proponents where impacts are proposed to be assessed on a case by case basis as the development of the

project progresses. Existing reporting for these projects provides with no real estimates of how much habitat will be lost, which habitat types will be affected, the resulting severity of impact, and mitigation and offset measures.

To compensate for a lack of solid information on which to base cumulative impact assessment, the other gas field tenements known to be subject to development applications have been mapped in conjunction with the Australia Pacific LNG tenements, as well as sites of other projects in the approval or early development stage, where they occur within the bioregional provinces affected by the Australia Pacific LNG project.



Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 3.3
Refined Bioregional Corridor Mapping (adapted from EPA 2008a,b,c)

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

Figure 3.4 shows the areas of known proposed development projects over the biodiversity status remnant vegetation. A total of approximately 2,000,000ha of remnant vegetation falls within the boundaries of these project areas.

There are several REs in the bioregion which are present within the relevant provinces that are near increasing VM Act remnant status from 'least concern' to 'of concern' (that is, REs 11.3.19 – 39.97%, 11.3.26 – 37.57%, 11.5.5 – 35.21% and 11.7.1 – 39.94%) by way of the total bioregional extent nearing <30% of the preclearing extent. There are also two REs in the bioregion which are present within the Relevant Provinces that are on the cusp of increasing VM Act remnant status from 'of concern' to 'endangered' (that is, REs 11.3.17 – 13.74% and 11.9.10 – 16.82%) by way of the total bioregional extent being close to <10% of the preclearing extent.

Clearing for the proposed Project would not reduce the extent of these REs within the brigalow belt bioregion such that their remnant status would be altered, and in fact represents a very small extent (that is, no greater than 0.5%) of the preclearing extent of any REs within the relevant provinces. However the cumulative effects of clearing for all projects within the bioregion need to be considered for the borderline REs. At present, there is insufficient data from other projects to allow such an assessment.

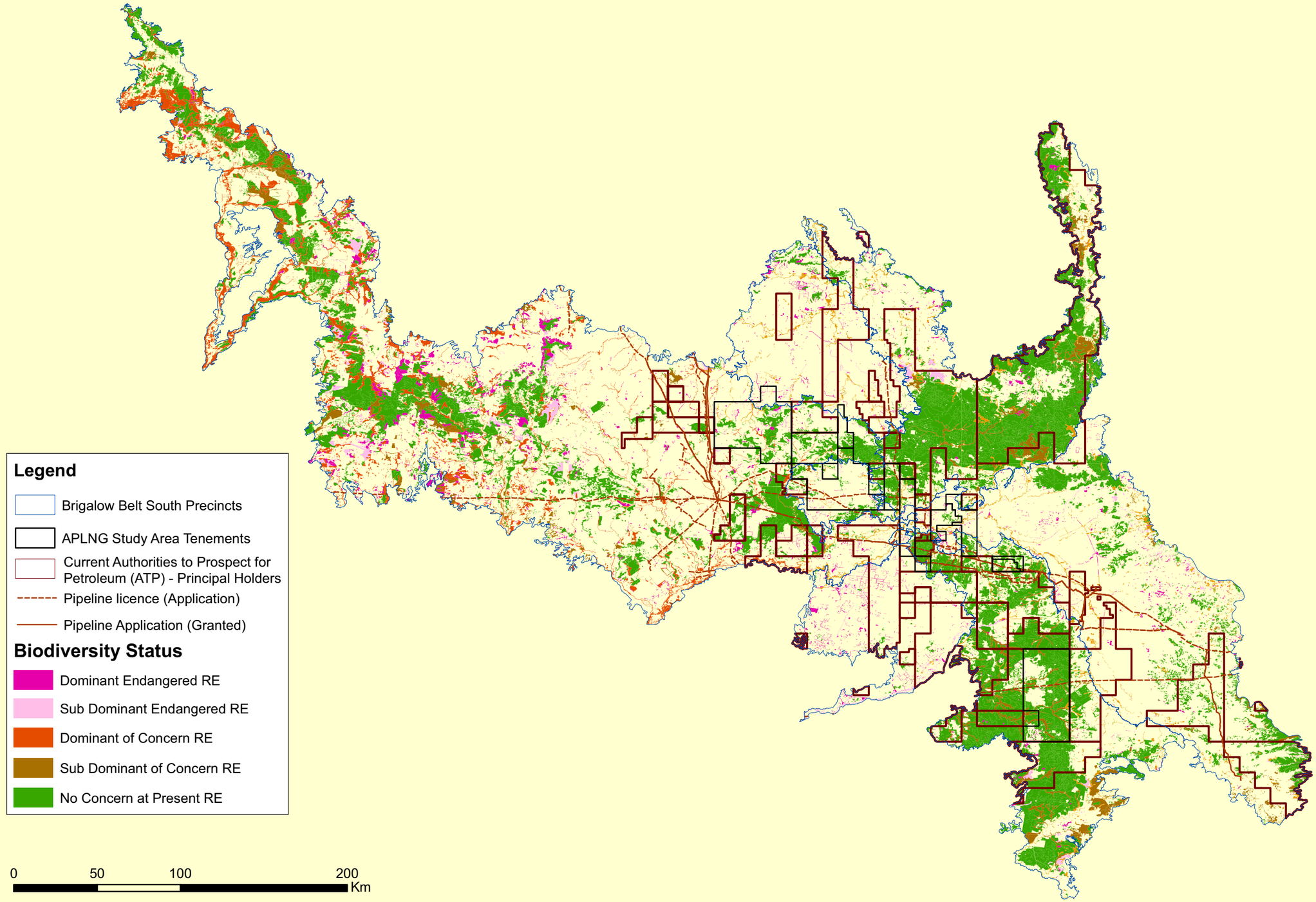
Figure 3.5 shows these projects over the bioregional corridors identified by the BBS BPA process. Maintenance and enhancement of these corridors have been identified as key recommended mitigation actions for the Australia Pacific LNG Project. The treatment of these corridors by neighbouring developments would significantly influence the success of these actions to maintain and improve landscape connectivity.

While the total amount of clearing by all proponents for gas field development is relatively small compared with the overall tenement sizes, the need to establish gas wells in a grid format, connected by access tracks and pipelines, has a significant capacity to fragment remnant vegetation. Regardless of the conservation status of that vegetation, the activities must be carefully managed to avoid severing landscape linkages for flora and fauna.

Such widespread fragmentation also has the capacity to degrade the quality of significant areas of adjacent habitat over time. Vigilance in weed and pest animal species control for the duration of these projects is vital for the protection of the significant number of species of conservation significance present within both remnant and non-remnant vegetation in the region.

Without diligent and cooperative management of terrestrial ecological impacts by all proponents which also actively involves the regional community, and without a broad-scale and integrated planning approach to rehabilitation and offset locations, the combination of the development projects currently proposed for the relevant provinces has the potential to result in long term degradation of habitats for a number of conservation significant flora and fauna species. Those species most at risk are those which are endemic to the region and rely specifically on connected, large tracts of intact, remnant vegetation.

Concentration of rehabilitation efforts within the bioregional corridors recommended for the Australia Pacific LNG project will have positive ecological benefits. However coordination of habitat rehabilitation efforts for all of the proposed gas field projects is outside of the authority of any of the individual proponents and will require government input to ensure that all of the projects adequately compensate for the potentially significant cumulative ecological impacts of fragmentation by cooperating to achieve long term landscape-scale ecological benefits.



Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 3.4
Current Known Proposed Development Projects and Current DERM certified vegetation Mapping (Biodiversity Status)

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

Legend

- Brigalow Belt Precincts
- APLNG Gas Field Tenements
- Current Authorities to Prospect for Petroleum (ATP) - Principal Holders
- Pipeline licence (Application)
- Pipeline Application (Granted)

Biodiversity Planning Assessment Corridors (J Rating)

- Regional
- State

N

0 50 100 200 Km

Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 3.5

Current Known Proposed Development Projects and BPA Corridors (J Rating)

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

3.0 References
References

Adair, RJ and Groves, RH (1998). 'Impact of environmental weeds on biodiversity: a review and development of a methodology.' Biodiversity Group, Environment Australia, Canberra.

Alexiou, PN (1983). 'Effect of feral pigs (*Sus scrofa*) on subalpine vegetation at Smokers Gap, Australian Capital Territory.' *Proceedings of the Ecological Society of Australia*, **12**: 135–142.

Anstis, M (2002). *Tadpoles of south-eastern Australia: A guide with keys*. Reed New Holland, Sydney.

Barker, J, Grigg, GC and Tyler, MJ (1995). *A field guide to Australian frogs*. Surrey Beatty & Sons, Chipping Norton.

Barrett, GW, Ford, HA and Recher, HF (1994). 'Conservation of woodland birds in a fragmented rural landscape.' *Pacific Conservation Biology*, **1**: 245-256.

Bayley, CP (1978). 'A comparison of the diets of the red fox and feral cat in an arid environment.' *South Australian Naturalist*, **53**: 20-28.

Bennett, A, Kimber, S and Ryan, P (2000). 'Revegetation and wildlife: A guide to enhancing revegetated habitats for wildlife conservation in rural environments.' Environment Australia, Canberra.

Bentley, JM and Catterall, CP (1997). 'The use of bushland, corridors, and linear remnants by birds in southeastern Queensland, Australia *Conservation Biology*, **11**: 1173-1189.

Birds Australia (2009). 'New atlas database.' Birds Australia, Melbourne. Accessed 16 July 2009.

Blakers, M, Davies, SJJ F and Reilly, PN (1984). *The atlas of Australian birds*. Melbourne University Press, Melbourne.

Bloomer, JP and Bester, MN (1992). 'Control of feral cats on sub-Antarctic Marion Island, Indian Ocean.' *Biological Conservation*, **60**: 221-219.

Bostock, PD and Holland, AE (eds.) (2007). *Census of the Queensland flora 2007.* Queensland Herbarium, Brisbane.

Bowen, ME, McAlpine, CA, House, APN and Smith, GC (2007). 'Regrowth forests on abandoned agricultural land: A review of their habitat values for recovering forest fauna.' *Biological Conservation*, **140**: 273-296.

Bowen, ME, McAlpine, CA, House, APN and Smith, GC (2009a). 'Agricultural landscape modification increases the abundance of an important food resource: Mistletoes, birds and brigalow.' *Biological Conservation,* **142**: 122-133.

Bowen, ME, McAlpine, CA, Seabrook, LM, House, APN and Smith, GC (2009b). 'The age and amount of regrowth forest in fragmented brigalow landscapes are both important for woodland dependent birds.' *Biological Conservation*, **142**: 3051-3059.

Braby, MF (2000). The butterflies of Australia: their identification, biology and distribution. CSIRO Publishing, Collingwood.

Braby, MF (2004). The complete field guide to butterflies of Australia. CSIRO Publishing, Collingwood.

Brown, GP, Phillips, BL, Webb, JK and Shine, R (2006). 'Toad on the road: Use of roads as dispersal corridors by cane toads (Bufo marinus) at an invasion front in tropical Australia.' Biological Conservation, 133: 88-94.

Burnett, S (1997). 'Colonizing cane toads cause population declines in native predators: reliable anecdotal information and management implications.' *Pacific Conservation Biology*, **3**: 65-72.

Calaby, JH (1969). 'Australian mammals since 1770.' *Australian Natural History*, **16**: 271-275.

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
					11.10.7, 11.10.9, 11.10.11
Rostratula australis	Australian Painted Snipe9	V, M	V		11.3.2, 11.3.3,11.3.25, 11.3.27b, 11.4.3, 11.4.7, 11.9.5
Gallinago hardwickii	Latham's Snipe	M	S		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Limosa limosa	Black-tailed Godwit	M	S		nil
Actitis hypoleucos	Common Sandpiper	M	S		nil
Tringa nebularia	Common Greenshank	M	S		11.3.27b
Tringa stagnatilis	Marsh Sandpiper	M	S		11.3.27b
Tringa glareola	Wood Sandpiper	M	S		11.3.27b
Calidris ruficollis	Red-necked Stint	M	S		nil
Calidris acuminata	Sharp-tailed Sandpiper	M	S		11.3.27b
Calidris ferruginea	Curlew Sandpiper	M	S		11.3.27b
Turnix melanogaster	Black-breasted Button-quail3	V	V		11.8.3, 11.9.4a, 11.9.4b, 11.9.5
Calyptorhynchus lathami	Glossy Black-Cockatoo3		V		11.3.1, 11.3.3, 11.3.4, 11.3.17, 11.3.25, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.5.1, 11.7.1, 11.8.3, 11.9.4a, 11.9.4b, 11.9.5, 11.9.10
Lathamus discolor	Swift Parrot	E	E		11.3.4, 11.3.25, 11.7.7
Neophema pulchella	Turquoise Parrot		R		11.3.2, 11.3.3, 11.3.4,11.3.25, 11.3.27b
Ninox connivens	Barking Owl		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.4.10, 11.4.12, 11.5.1, 11.5.4, 11.5.5, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.10.1, 11.10.7, 11.10.9, 11.10.13

Catling, PC (1988). 'Similarities and contrasts in the diets of foxes, *Vulpes vulpes*, and cats, *Felis catus*, relative to fluctuating prey populations and drought.' *Australian Wildlife Research*, **15**: 307-317.

Choquenot, D, Kilgour, RJ and Lukins, BS (1993). 'An evaluation of feral pig trapping.' *Wildlife Research*, **20**: 15–22.

Churchill, S (2008). *Australian bats*. Second edition. Allen & Unwin, Crows Nest.

Cogger, HG (2000). *Reptiles and amphibians of Australia*. Reed New Holland, Sydney.

Cooke, BD (1987). 'The effects of rabbit grazing on regeneration of she-oaks, *Allocasuarina verticilliata* and saltwater ti-trees, *Melaleuca halmaturorum*, in the Coorong National Park, South Australia.' *Australian Journal of Ecology*, **13**: 11-20.

Corbett, LK (2008). 'Dingo' In: S Van Dyck and R Strahan (eds.), *The Mammals of Australia*. Third Edition. Reed New Holland, Sydney. pp. 737-739.

Covacevich, JA, and Couper, PJ (1996). '*Aspidites ramsayi* (Boidae) in the brigalow biogeographical region of Queensland: occurrence, conservation status, and possible bilby associations.' *Memoirs of the Queensland Museum*, **39**: 243-246.

CRC for Australian Weed Management (2003). 'Athel pine or tamarisk (Tamarix aphylla).' Weed Management Guide, Natural Heritage Trust. **http://www.weeds.gov.au/publications/guidelines/wons/pubs/t-aphylla.pdf**

Crome, F and Shields, J (1992). *Parrots and pigeons of Australia: the National Photographic Index of Australian Wildlife*. Angus and Robertson, Pymble.

Dawson, TJ and Ellis, BA (1979). 'Comparison of the diets of yellow-footed rock-wallabies and sympatric herbivores in western New South Wales.' *Australian Wildlife Research*, **6**: 245-254.

Debus, S (1998). *The birds of prey of Australia: A field guide*. Oxford University Press, Melbourne.

DERM (2009a). 'Regional Ecosystem Mapping.' Version 6.0, Queensland Herbarium, Queensland Department of Environment and Resource Management, Brisbane.

DERM (2009b). 'Regional Vegetation Management Code for Brigalow Belt and New England Tablelands Bioregions.' Queensland Department of Environment and Resource Management, Brisbane.

DERM (2009c). 'WildNet Database.' Queensland Department of Environment and Resource Management, Brisbane. Species locality records accessed via DERM staff, 14 July 2009 and 11 August 2009.

DERM (2009d). 'WildNet Database.' Queensland Department of Environment and Resource Management, Brisbane. Accessed via Wildlife Online, 14 August 2009. http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife_online/

DEWHA (2009a). 'EPBC Act Online Protected Matters Search Tool.' Commonwealth Department of Environment, Water, Heritage and the Arts, Canberra. Accessed 25 September 2009. http://www.environment.gov.au/erin/ert/epbc/index.html

DEWHA (2009b)**.** 'Australian Faunal Directory.' Department of the Environment, Water, Heritage and the Arts, Canberra. http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/

DEWHA (2009c). 'Species Profile and Threats Database.' Department of the Environment, Water, Heritage and the Arts, Canberra. **http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl**

DEWR (2007a). 'Draft Policy Statement: Use of Environmental Offsets Under the Environment Protection and Biodiversity Conservation Act 1999'. Department of

Environment and Water Resources, Canberra.

DEWR (2007b). 'Use of Environmental Offsets Under the Environment Protection and Biodiversity Conservation Act 1999 (Discussion Paper)'. Department of Environment and Water Resources, Canberra.

Dickman, C (1996). 'Overview of the impacts of feral cats on Australian native fauna.' Australian Nature Conservation Agency, Canberra.

Dickman, CR, Pressey, CL, Lim, L Parnaby, HE (1993). 'Mammals of particular conservation concern in the Western Division of New South Wales.' *Biological Conservation*, **65**: 219-248.

Dorricott, K, Lawrie, B and Voller, P (1997). 'Balancing productivity and conservation in southern inland Queensland: a case study at the grass-roots.' In: P Hale and D Lamb (eds.), *Conservation outside nature reserves.* Centre for Conservation Biology, University of Queensland, Brisbane. pp. 233-240.

Drury, W (2001). 'Reptiles under threat in Queensland's Southern Brigalow Belt.' World Wide Fund for Nature, Brisbane.

Duncan, A, Barker, GB and Montgomery, N (1999). The action plan for Australian bats. Environment Australia, Canberra.

Eastwood, R, Braby, MF, Schmidt, DJ and Hughes, JM (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.

Ehmann, H (1992). Encyclopedia of Australian animals: Reptiles. Angus and Robertson, Sydney.

EPA (2002a). 'Biodiversity Assessment and Mapping Methodology.' Environmental Protection Agency Biodiversity Planning Unit, Biodiversity Branch Version 2.1, July 2002. Brisbane.

EPA (2002b). 'Biodiversity Planning Assessment: Brigalow Belt South Fauna Expert Panel Report.' Environmental Protection Agency, Brisbane.

EPA (2003). 'BPA BRB South Fauna Expert Panel in Brigalow Belt South Biodiversity Planning Assessment.' Environmental Protection Agency, Brisbane.

EPA (2007). 'Regional Ecosystem Description Database (REDD).' Version 5.2. Queensland Herbarium, Environmental Protection Agency, Brisbane. Updated November 2007.

EPA (2008a). 'Brigalow Belt South Fauna Expert Panel Report.' Environmental Protection Agency, Brisbane. Revised and updated June 2008.

EPA (2008b). 'Brigalow Belt South Flora Expert Panel Report.' Environmental Protection Agency, Brisbane. October 2002. Revised and updated June 2008.

EPA (2008c). 'Brigalow Belt South Landscape Expert Panel Report.' Environmental Protection Agency, Brisbane. August 2002. Revised and updated June 2008.

EPA (2008d). 'Table 01 – Regional Ecosystems by Subregion.' Unpublished data of pre-clear extent and remnant extent up to 2005. Queensland Herbarium, Environmental Protection Agency, Brisbane.

EPA (2008e). 'Policy for Biodiversity Offsets (Consultation Draft).' Environmental Protection Agency, Brisbane.

EPA (2008f). 'Environmental Offsets Policy'. Enviornmental Protection Agency. Brisbane.

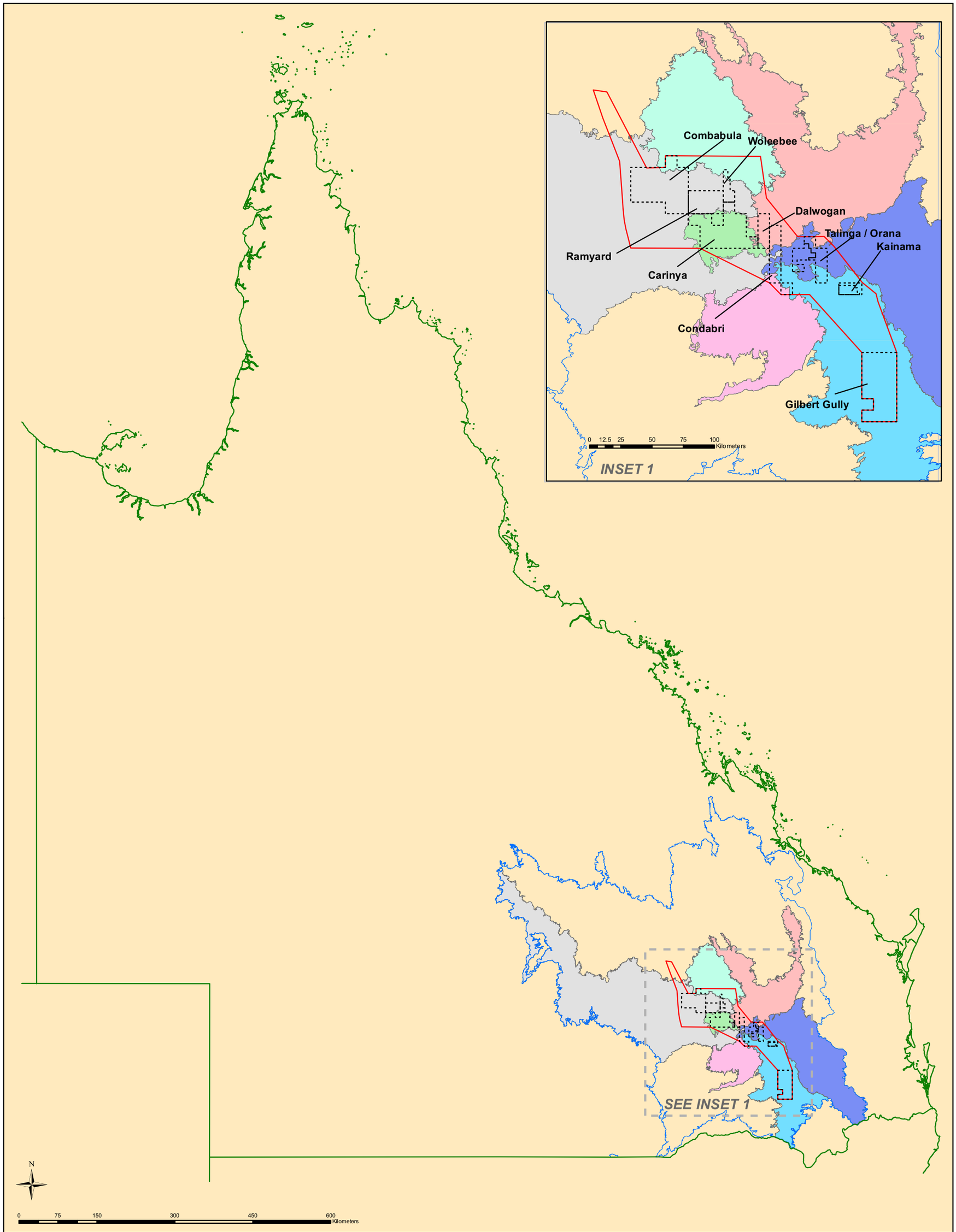
Exelby, A and Melzer, A (eds.) (2001). *Remnant vegetation in the Brigalow Belt: Management and conservation.* Centre for Environmental Management, Central Queensland University, Gladstone.

Fischer, J and Lindenmayer, DB (2002). 'Small patches can be valuable for

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Australia Pacific LNG Pty Limited, and is subject to and issued in accordance with the agreement between Australia Pacific LNG Pty Limited and WorleyParsons Services Pty Ltd. WorleyParsons Services Pty Ltd accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

Copying this report without the permission of Australia Pacific LNG Pty Limited or WorleyParsons is not permitted.



Biodiversity Assessment AND MANAGEMENT PTY LTD

Legend

- Study Area Boundary
- Tenement Boundary
- State Boundary of Queensland
- Brigalow Belt South Bioregional Boundary

Provinces

- 27 Barakula
- 28 Dulacca Downs
- 31 Eastern Darling Downs
- 32 Inglewood Sandstones
- 26 Southern Downs
- 30 Tara Downs
- 25 Taroom Downs

Figure 1.1

Study Area Locality

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

biodiversity conservation: two cases studies on birds in southeastern Australia.' *Biological Conservation*, **106**: 129-136.

Foster, DR, Motzkin, G and Slater, B (1998). 'Land-use history as long-term Broad-scale disturbance: regional forest dynamics in central New England.' *Ecosystems*, **1**: 96-119.

Frith, HJ (1982). Pigeons and doves of Australia. Rigby, Adelaide.

Garnett, ST and Crowley, GM (2000). The action plan for Australian birds. Environment Australia, Canberra.

Geering, A, Agnew, L and Harding, S (2007). Shorebirds of Australia. CSIRO Publishing, Collingwood.

Glen, AS, Dickman, CR, Soulé and Mackey, BG (2007). 'Evaluating the role of the dingo as a trophic regulator in Australian ecosystems.' *Austral Ecology*, **32**: 492-501.

Grey, MJ, Clarke, MF and Loyn, RH (1998). 'Influence of the noisy miner *Manorina melaNCephala* on avian diversity and abundance in remnant grey box woodland.' *Pacific Conservation Biology*, **4**: 55-69.

Griffin, AS, Evans, CS and Blumstein, DT (2001). 'Learning specificity in acquired predator recognition.' *Animal Behaviour*, **62**: 577-589.

Hancock, CN, Ladd, PG and Froend, RH (1996). 'Biodiversity and management of riparian vegetation in Western Australia.' *Forest Ecology and Management*, **85**: 239-250.

Hando, R and Hando, V (1997). *Going bush with Chinchilla Nats*. Second Edition. Chinchilla Field Naturalist's Club Inc., Chinchilla.

Hannah D and Thurgate, N (2001). 'Lands of strips and patches.' *Wildlife Australia*, **autumn 2001**: 38-39.

Hannah, D, Woinarski, JCZ, Catterall, CP, McCosker, JC, Thurgate, NY and Fensham, RJ (2007). 'Impacts of clearing, fragmentation and disturbance on the bird fauna of eucalypt savanna woodlands in central Queensland, Australia.' Austral Ecology, 32: 261-276.

Heise-Pavlov, PM (2008). 'Pig.' In: S Van Dyck and R Strahan (eds.), The mammals of Australia. Third Edition. Reed New Holland, Sydney. pp. 755-757.

Henzell, R (2008). 'Goat.' In: S Van Dyck and R Strahan (eds.), The mammals of Australia. Third Edition. Reed New Holland, Sydney. pp. 768-769.

Higgins, PJ (ed.) (1999). Handbook of Australian, New Zealand & Antarctic Birds. Volume 4: Parrots to dollarbird. Oxford University Press, Melbourne.

Higgins, PJ and Davies, SJJF (eds.) (1996). Handbook of Australian, New Zealand & Antarctic birds, Volume 3, Snipe to pigeons. Oxford University Press, Melbourne.

Higgins, PJ and Peter, JM (eds.) (2002). Handbook of Australian, New Zealand & Antarctic Birds. Volume 6: Pardalotes to shrike-thrushes. Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM and Cowling, SJ (eds.) (2006a). Handbook of Australian, New Zealand & Antarctic Birds, Volume 7, Boatbills to starlings, Part A, boatbill to larks. Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM and Cowling, SJ (eds.) (2006b). Handbook of Australian, New Zealand & Antarctic Birds Volume 7, Boatbills to starlings, Part B, dunNCk to starlings. Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM and Steele, WK (eds.) (2001). Handbook of Australian, New Zealand & Antarctic Birds. Volume 5: Tyrant-flycatchers to chats. Oxford University Press, Melbourne.

Hobbs, RJ (2001). 'Synergisms among habitat fragmentation, livestock grazing, and biotic invasions in southwestern Australia.' Conservation Biology, 15: 1522-1528.

Hollands, D (2008). Owls, frogmouths and nightjars of Australia. Bloomings Books, Melbourne.

Hone, J (1995). 'Spatial and temporal aspects of vertebrate pest damage with emphasis on feral pigs.' Journal of Applied Ecology, 32: 311–319.

Jacquemyn, H, Butaye, J and Hermy, M (2001). 'Forest plant species richness in small, fragmented mixed deciduous forest patches: the role of area, time and dispersal limitation.' Journal of Biogeography, 28: 801-812.

James, CD (2003). 'Response of vertebrates to fenceline contrasts in grazing intensity in semi-arid woodlands of eastern Australia.' Austral Ecology, 28: 137-151.

Jansen, A and Robertson, AI (2001). 'Relationships between livestock management and the ecological condition of riparian habitats along an Australian floodplain river.' Journal of Applied Ecology, 38: 63-75.

Kanowski, J, Catterall, CP, Reis, T and Wardell-Johnson, G (2004). 'Animal-plant interactions in rainforest restoration in tropical and subtropical Australia.' In *Animal-plant interactions in rainforest conservation and restoration.* J Kanowski, CP Catterall, AJ Dennis and DA Westcott. (eds.) Cooperative Research Centre for Tropical Rainforest Ecology and Management (Rainforest CRC), Cairns. pp. 20-24.

Kingsford, RT (2000). 'Ecological impacts of dams, water diversions and river management on floodplain wetlands in Australia.' *Austral Ecology*, **25**: 109-127.

Kutt, AS (1996). 'Bird populations density in thinned, unthinned and old lowland regrowth forest, East Gippsland, Victoria.' *Emu*, **96**: 280-284.

Landsberg, J, James, CD, Morton, SR, Hobbs, TJ, Stol, J, Drew, A and Tongway, H (1997). 'The effects of artificial sources of water on rangeland biodiversity: final report to the Biodiversity Convention and Strategy Section of the Biodiversity Group, Environment Australia.' Environment Australia and CSIRO, Canberra.

Lange, RT and Graham, CR (1983). 'Rabbits and the failure of regeneration in Australian arid zone acacia.' Australian Journal of Ecology, 8: 377-381.

Laurance, WF, Williamson, GB, Delamônica, P, Oliveira, A, Lovejoy, TE, Gascon, C and Pohl, L (2001). 'Effects of a strong drought on Amazonian forest fragments and edges.' Journal of Tropical Ecology, 17: 771-785.

Letnic, M and Koch, F (2009). 'Are dingoes a trophic regulator in arid Australia? A comparison of mammal communities on either side of the dingo fence.' Austral Ecology, doi:10.1111/j.1442-9993.2009.02022.x

Longcore, T and Rich, C (2004). 'Ecological light pollution.' Frontiers in Ecology and the Environment, 2: 191-198.

Loyn, RH (1987). 'Effects of patch area and habitat on bird abundances, species numbers and tree health in fragmented Victorian forests.' In: D Saunders, G Arnold, A Burbidge and A Hopkins (eds.), Nature conservation: the role of remnants of native vegetation. Surrey Beatty & Sons, Chipping Norton, pp 65–77.

Marchant, S and Higgins, PJ (eds.) (1990). Handbook of Australian, New Zealand & Antarctic Birds, Volume 1, Ratites to ducks, Part B Australian Pelican to ducks. Oxford University Press, Melbourne.

Marchant, S and Higgins, PJ (eds.) (1993). Handbook of Australian, New Zealand & Antarctic Birds, Volume 2, Raptors to lapwings. Oxford University Press, Melbourne.

Maron, M (2009). 'Nesting, foraging and aggression of noisy miners relative to road edges in an extensive Queensland forest.' Emu, 109: 75-81.

Maron, M and Lill, A (2005). 'The influence of livestock grazing and weed invasion on habitat use by birds in grassy woodland remnants.' Biological Conservation, 124: 439-450.

Martin, TG and McIntyre, S (2007). 'Impacts of livestock grazing and tree clearing on birds of woodland and riparian habitats.' Conservation Biology, 21: 504-514.

Martin, TG, McIntyre, S, Catterall, CP and Possingham, HP (2006). 'Is landscape context important for riparian conservation? Birds in grassy woodland.' *Biological Conservation*, **127**: 201-214.

Maxwell, S, Burbidge, AA and Morris, K (1996). *The action plan for Australian marsupials and monotremes.* Wildlife Australia, Canberra.

McFarland, D, Venz, M and Reis, T (1999). 'Priority species summaries. An attachment to the report: Terrestrial vertebrate fauna of the Brigalow Belt South Bioregion: Assessment and analysis for conservation planning.' Queensland Environmental Protection Agency, Brisbane.

McIntyre, S (1994). 'Integrating agricultural land-use and management for conservation of a native grassland flora in a variegated landscape.' Pacific Conservation Biology, 1: 236-244.

Mesquita, RCG, Delamônica, P and Laurance, WF (1999). 'Effect of surrounding vegetation on edge-related tree mortality in Amazonian forest fragments.' Biological Conservation, 91: 129-134.

Mitchell, J (1993). 'Systematic assessment of feral pig damage and recommended pig control methods in the wet tropics World Heritage Area.' Final Report to the Wet Tropics Management Agency. Department of Lands, Charters Towers, Queensland.

Moran, C, Catterall, CP, Green, RJ and Olsen, MF (2004). 'Functional variation among frugivorous birds: implications for rainforest seed dispersal in a fragmented subtropical landscape.' Oecologia, 141: 584-595.

Murcia, C (1995). 'Edge effects in fragmented forests: implications for conservation.' Trends in Ecology & Evolution, 10: 58-62.

Naiman, RJ, Décamps, H and Pollock, M (1993). 'The role of riparian corridors in maintaining regional biodiversity.' Ecological Applications, 3: 209-212.

Neldner, VJ, Wilson, BA, Thompson, EJ and Dillewaard, HA (2005). 'Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 3.1.' Queensland Herbarium, Environmental Protection Agency, Brisbane.

Norman, FI (1988). 'Long-term effects of rabbit reduction on Rabbit Island Wilson's Promontory Victoria.' Victorian Naturalist, 105: 136-141.

Norton, DA, Hobbs, RJ and Atkins, L (1995). 'Fragmentation, disturbance, and plant distribution: mistletoes in woodland remnants in the Western Australian Wheatbelt.' Conservation Biology, 9: 426-438.

Olsen, P (1998). 'Australia's raptors: diurnal birds of prey and owls.' Wingspan, 8: supplement I-XVI.

Parnaby, HE (2009). 'A taxonomic review of Australian greater long-eared bats previously known as Nyctophilus timoriensis (Chiroptera: Vespertilionidae) and some associated taxa.' Australian Zoologist, 35: 39-81.

Parsons, W and Cuthbertson, EG (1992). *Noxious weeds of Australia*. Inkata Press, Melbourne.

Parsons, W and Cuthbertson, EG (2001). *Noxious weeds of Australia*. CSIRO Publishing, Melbourne.

Phillips, BL, Brown, GP, Greenless, M, Webb, JK and Shine, R (2007). 'Rapid expansion of the cane toad (*Bufo marinus*) invasion front in tropical Australia.' *Austral Ecology*, **32**: 169-176.

Phillips, BL, Brown, GP and Shine, R (2003). 'Assessing the potential impact of cane toads on Australian snakes.' *Conservation Biology*, **17**: 1738-1747.

Piper, SD and Catterall, CP (2004). 'Effects of edge type and nest height on predation of artificial nests within subtropical Australian eucalypt forests.' *Forest Ecology and Management*, **203**: 361-372.

Priddel, D, Carlile, N, Davey, C, and Fullagar, P (1995). 'The status of Gould's petrel, *Pterodroma leucoptera leucoptera*, on Cabbage Tree Island, New South Wales.' *Wildlife Research*, **22**: 601-610.

Pringle, JD (1985). The waterbirds of Australia: the National Photographic Index of Australian Wildlife. Angus and Robertson, North Ryde.

Pringle, JD (1987). The shorebirds of Australia: the National Photographic Index of Australian Wildlife. Angus and Robertson, North Ryde.

Queensland Museum (2009). 'Fauna Database.' Queensland Museum, Brisbane. Accessed 15 July 2009.

Recher, HF (1999). 'The state of Australia's avifauna: a personal opinion and prediction for the new millennium.' *Australian Zoologist*, **31**: 11-27.

Richardson, R (2006). 'Queensland Brigalow Belt Reptile Recovery Plan.' Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. WWF-Australia, Brisbane.

Roberts, A, Klomp, N and Birkhead, J (1996). 'Monitoring marine and terrestrial hunting in an Aboriginal community in north Queensland.' In: M Bomford and J Caughley (eds.), *Sustainable use of wildlife by Aboriginal peoples and Torres Strait Islanders*. Bureau of Resource Sciences, Australian Government Printing Service, Canberra. pp 152-164.

Robley, A, Reddiex, B, Arthur, T, Pech, R and Forsyth, D (2004). 'Interactions between feral cats, foxes, native carnivores, and rabbits in Australia.' Final report for the Australian Government Department of Environment and Heritage.

Sattler, P (1999). 'Introduction.' In: P Sattler and R Williams (eds.), *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane. pp. I/1-I/19.

Saunders, DA and Hobbs, RJ (1991). 'The role of corridors in conservation: what do we know and where do we go?' In: DA Saunders and RJ Hobbs (eds.), *Nature conservation 2: The role of corridors*. Surrey Beatty & Sons, Chipping Norton. pp. 421-27.

Saunders, G, Berghout, M, Kay, B, Triggs, B, van de Van, R and Winstanely, R (2004). 'The diet of foxes (*Vulpes vulpes*) in south-eastern Australian and the potential effects of rabbit haemorrhagic disease.' *Wildlife Research*, **31**: 13-18.

Seabrook, WA and Dettmann, EB (1996). Roads as activity corridors for cane toads in Australia. *Journal of Wildlife Management*, **60**: 363-368.

Seidman, VM and Zabel, CJ (2001). 'Bat activity along intermittent streams in northwestern California.' *Journal of Mammalogy*, **82**: 738-747.

Short, J, Turner, B and Risbey, D (2002). Control of feral cats for nature conservation. III Trapping. *Wildlife Research*, **29**: 475-487.

Soulé, ME and Gilpin, ME (1991). 'The theory of wildlife corridor capability.' In: DA Saunders and RJ Hobbs (eds.), *Nature conservation 2: The role of corridors*. Surrey Beatty & Sons, Chipping Norton. pp. 3-8.

Stanisic, J, Shea, M, Potter, D and Griffiths, O (in preparation). *Australian land snails: Volume 1. A field guide to eastern Australian species.* Publisher unknown, Singapore.

Statham, M and Middleton, M (1987). 'Feral pigs on Flinders Island.' *Papers and Proceedings of the Royal Society of Tasmania*, **121**: 121–124.

Sutherst, B, Szabo, J and Cleland, E (2007). 'The stock routes and road network – strengthening the biodiversity links.' *Wingspan*, **14**: supplement 23.

Taylor, R, Duckworth, P, Johns, T and Warren, B (1997). 'Succession in bird assemblages over a seven-year period in regrowth dry sclerophyll forest in south-east Tasmania.' *Emu*, **97**: 220-230.

Thompson, KT (1992). 'Prickly acacia infestation of the Mitchell grasslands. Final Report: National Soil Conservation Programme.' Richmond Landcare Group.

Turbill, C, Lumsden, LF and Ford, GI (2008). 'South-eastern & Tasmanian Long-eared Bats.' In: S Van Dyck and R Strahan (eds.) *The mammals of Australia*. Third Edition. Reed New Holland, Sydney. pp. 527-528.

Turner, IM, Wong YK, Chew, PT, and bin Ibrahim, A (1997). 'Tree species richness in primary and old secondary tropical forest in Singapore.' *Biodiver*. *Conserv*. **6**: 537–543.

Urban, MC, Phillips, BL, Skelly, DK and Shine, R (2007). 'The cane toad's (*Chaunus* [*Bufo*] *marinus*) increasing ability to invade Australia is revealed by a dynamically updated range model.' *Proceedings of the Royal Society B*, **274**: 1413-1419.

Vallee, L., Hogbin, T., Monks, L. Makinson, B. Matthes, M. and Rossetto, M. (2004). Guidelines for the Translocation of Threatened Plants in Australia. Second Edition. Australian Network for Plant Conservation. Canberra.

Van Dyck, S. and Strahan, R. (eds.) (2008). *The mammals of Australia*. Third Edition. Reed New Holland, Sydney.

Venz, M, Mathieson, M and Schulz, M (2002). 'Fauna of the Dawson River Floodplain.' Queensland Parks and Wildlife Service, Brisbane.

Williams, CK and Myers, K (2008). 'Rabbit.' In: S Van Dyck and R Strahan (eds.), *The mammals of Australia*. Third Edition. Reed New Holland, Sydney. pp. 745-747.

Wilson, S (2005). *A field guide to reptiles of Queensland*. Reed New Holland, Sydney.

Wilson, S and Swan, G (2008). *A complete guide to reptiles of Australia*. Second Edition. New Holland, Sydney.

Woinarski, JCZ and Ash, AJ (2002). 'Responses of vertebrates to pastoralism, military land use and landscape position in an Australian tropical savanna.' *Austral Ecology*, **27**: 311-323.

Woinarski, JCZ, Brock, C, Armstrong, M, Hempel, C, Cheal, D and Brennan, K (2000). 'Bird distribution in riparian vegetation in the extensive natural landscape of Australia's tropical savanna: a broad-scale survey and analysis of a distributional data base.' *Journal of Biogeography,* ***27***: 843-868.

Woinarski, JCZ, McCosker, JC, Gordon, G, Lawrie, B, James, C, Augusteyn, J, Slated, L and Danvers, T (2006). 'Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002.' *Wildlife Ecology*, **33**:263–274.

Young, PAR, Wilson, BA, McCosker, JC, Fensham, RJ, Morgan, G and Taylor, PM (1999). 'Brigalow Belt.' In: P Sattler and R Williams (eds.), *The conservation status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane. pp. 11/1-11/81.

Appendix A:
Existing Values Assessment Methodology

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
Tyto novaehollandiae	Masked Owl		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.9.7, 11.9.9
Tyto longimembris	Eastern Grass Owl		C	x	nil
Merops ornatus	Rainbow Bee-eater	M	S		all
Climacteris picumnus	Brown Treecreeper		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.3.26, 11.3.27b, 11.3.39
Chthonicola sagittata	Speckled Warbler		C	x	11.3.1, 11.3.3, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.9.1, 11.9.4b, 11.9.5, 11.9.7, 11.9.10, 11.10.1, 11.10.3, 11.10.7
Melithreptus gularis	Black-chinned Honeyeater		R		11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.3.39, 11.4.10, 11.5.1, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.1, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.7, 11.10.9, 11.10.11, 11.10.13
Grantiella picta	Painted Honeyeater3		R		11.3.1, 11.3.2, 11.3.3, 11.3.17, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.7.1, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.10
Pomatostomus temporalis	Grey-crowned Babbler		C	x	11.3.1, 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, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.1, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.3, 11.10.7, 11.10.9, 11.10.11, 11.10.13
Pomatostomus superciliosus	White-browed Babbler		C	x	11.3.14, 11.3.17, 11.3.18, 11.4.3, 11.4.7, 11.4.10, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.7.1, 11.7.6, 11.7.7, 11.9.4b, 11.9.5, 11.9.6, 11.9.7
Rhipidura rufifrons	Rufous Fantail	M	S		11.3.25, 11.3.27b, 11.4.3a, 11.8.3, 11.9.4a, 11.9.4b, 11.9.5
Melanodryas cucullata	Hooded Robin3		C	x	11.3.1, 11.3.3, 11.3.17, 11.4.3, 11.4.7, 11.4.12, 11.7.1, 11.7.2, 11.9.1, 11.9.5, 11.9.6,

APPENDIX A

TERRESTRIAL ECOLOGY ASSESSMENT AND SENSITIVITY MAPPING METHODOLOGY

TERRESTRIAL ECOLOGY AND IMPACT ASSESSMENT REPORT – GAS FIELDS COMPONENT AUSTRALIA PACIFIC LNG PROJECT EIS

Table of contents

List of Figures

List of Attachments

A.1 PRELIMINARY DESK TOP STUDY

In order to summarise currently recognised terrestrial ecological values within the Study Area and inform subsequent ground surveys and terrestrial ecology sensitivity assessment, a preliminary desktop exercise was undertaken for which a number of relevant and publicly available data sources were accessed and reviewed, including:

- The Commonwealth Department of Environment, Water, Heritage and the Arts' (DEWHA's) online Protected Matters Search Tool, which lists Matters of National Environmental Significance (MNES) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that may occur within the area of interest;
- The Queensland Department of Environment and Resource Management's (DERM's) mapping of Environmentally Sensitive Areas as defined under the Queensland *Environment Protection Act 1994* (EP Act);
- DERM's Regional Biodiversity Planning Assessment (BPA) for the Brigalow Belt South Bioregion, which uses the Biodiversity Assessment and Mapping Methodology (BAMM) to determine the relative biodiversity significance of habitats and landscapes in relation to a number of key criteria;
- Current DERM-certified mapping of remnant Regional Ecosystems (REs), High-value Regrowth vegetation and associated Essential Habitat as defined under the Queensland *Vegetation Management Act 1999* (VM Act);
- DERM mapping of important wetlands;
- The Queensland Department of Employment, Economic Development and Innovation's (DEEDI's) mapping of pest distributions; and
- Publicly available species record databases, including DERM's WildNet and Herbrecs databases, the Queensland Museum's fauna database and Birds Australia's Atlas database, which provide background information regarding flora and fauna species previously recorded from the region and local area.

Where available, unpublished locality data for significant species and environmental weeds (e.g. from recent surveys within the Study Area) were also acquired and reviewed for consideration as part of the assessment, with certain records overlaid on vegetation mapping to assist in determining potential species distributions and habitat preferences within the Study Area.

The preliminary desktop exercise also involved a comprehensive review of available literature relevant to the terrestrial ecology of the Study Area, in terms of:

- The pre-European landscape, including vegetation and the terrestrial vertebrate assemblage;
- Land use post European settlement, including the history of vegetation clearing and other threatening processes;
- The current situation within the Southern Brigalow Belt Bioregion, including vegetation community condition, threatened species and communities and areas protected under relevant legislation; and
- The conservation of biodiversity and ecosystem function, including landscape elements and vegetation community condition, landscape perspective and species recovery.

A.2 2009 TERRESTRIAL FLORA AND FAUNA GROUND SURVEYS

A.2.1 PRIORITY SITE SELECTION

The 2009 terrestrial flora and fauna ground surveys comprised a combination of targeted species searches, general habitat assessments and verification of current DERM-certified RE mapping, with the primary aims of producing project-specific vegetation/habitat mapping and enabling the prioritisation of terrestrial ecological values to inform the subsequent terrestrial ecology sensitivity analysis and impact assessment for the project.

Given the significant size of the Study Area and the limited timeframe available for the ground survey component, targeted assessments were undertaken whereby priority sites to be surveyed were selected from RE polygon mapping (DERM

2009) and associated BPA for the Brigalow Belt South bioregion EPA (2008a, b, c), respectively, based on the following considerations:

- RE status under the Queensland *Vegetation Management Act 1999* (VM Act), with greater emphasis placed on REs listed as Endangered (dominant or sub-dominant) or Of Concern;
- Polygon size, with preference given to relatively large polygons (as a possible indicator of community condition and associated habitat quality);
- Size of the tract of remnant vegetation within which the polygon is located (as above);
- Connectivity at a landscape scale; and
- Riparian corridors.

In addition, a representative sample of RE types within each gas field tenement was targeted, regardless of VM Act status, in order to gather information on species that characterise these vegetation communities and factors affecting their general condition.

The eventual inclusion of each of the priority sites within the ground survey activities was subject to logistical constraints, particularly in regards to obtaining permission to enter private land.

The locations of the sites eventually assessed during the surveys are shown on **Figure A.1**.

A.2.2 PRELIMINARY FIELDWORK (1ST ROUND)

REs within the Study Area listed as Endangered or Of Concern under the VM Act, particularly those that include Brigalow *Acacia harpophylla*, provide resources for many fauna species listed under the NC Act and/or EPBC Act (as well as regionally significant species listed by DERM), particularly herpetofauna (i.e. reptiles and frogs). In addition, riparian vegetation often contains large hollow-bearing trees that provide important habitat for a range of arboreal mammals and reptiles, micro-bats and bird species, including many conservation significant species.

Consequently, the preliminary ground surveys, undertaken between 22nd April and 8th May 2009, were targeted primarily towards the detection of significant flora species and herpetofauna, with incidental data collected for birds and mammals. This included supplementary nocturnal surveys during which an ANABAT II ultrasonic bat call detection unit and associated ZCAIM interface module was used to capture the calls of micro-bat species. Typically, this was conducted simultaneously with spotlighting, using a combination of high-powered spotlights and head torches, to sample nocturnal mammals, birds, reptiles and frogs.

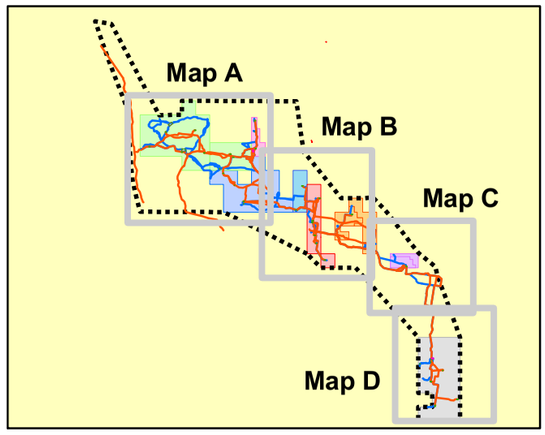
All species data recorded during the surveys was provided to DERM for inclusion into the WildNet database.

At each fauna survey location, general habitat values were also assessed, based largely on structural components, while at each flora survey location (86 in total), data equivalent to a Quaternary site (Neldner *et al*. 2005) was also collected.

A.2.3 REGIONAL ECOSYSTEM AND FAUNA AND FLORA HABITAT VALUE ASSESSMENT (2ND ROUND)

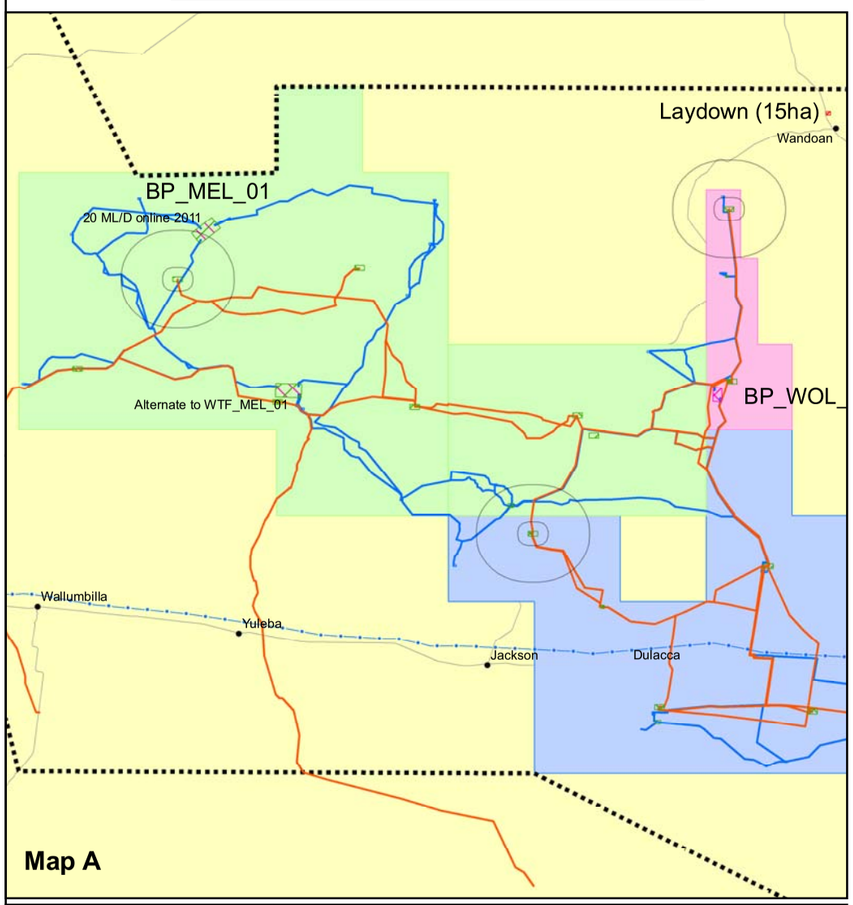
During the subsequent round of ground surveys undertaken during the period 27th July to 28th September 2009, inclusive, RE verification/mapping was conducted concurrently with general and significant fauna species-specific habitat assessments throughout the Study Area. There were five survey periods each of between six and eight days duration. Sites were generally inspected by both a flora and fauna team simultaneously, although some additional sites were established only for RE verification/mapping purposes where sufficient fauna habitat assessment had already been undertaken for the subject community in nearby locations.

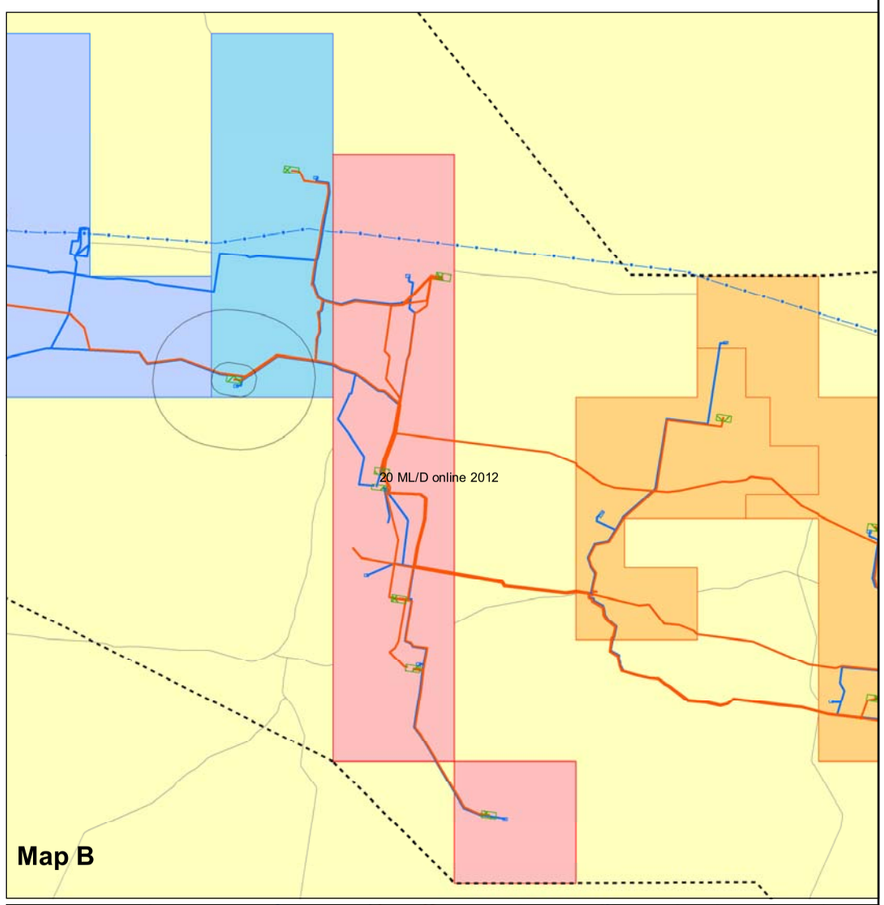
The surveys were conducted after early winter rain (40 mm in June 2009), however, the months of July to September were generally dry. Although late winter/early spring is not ideal for the detection of many flora and fauna species of special conservation significance, the major aim of the surveys was to verify existing vegetation and habitat values such that the potential presence of these species across the landscape could be determined.

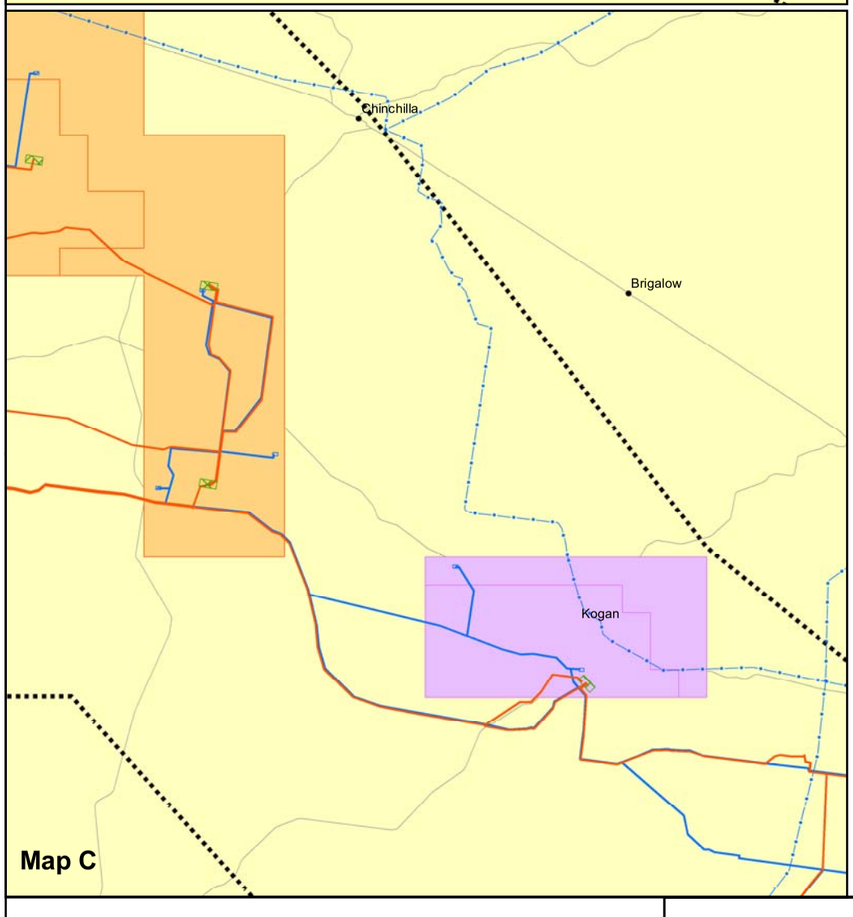


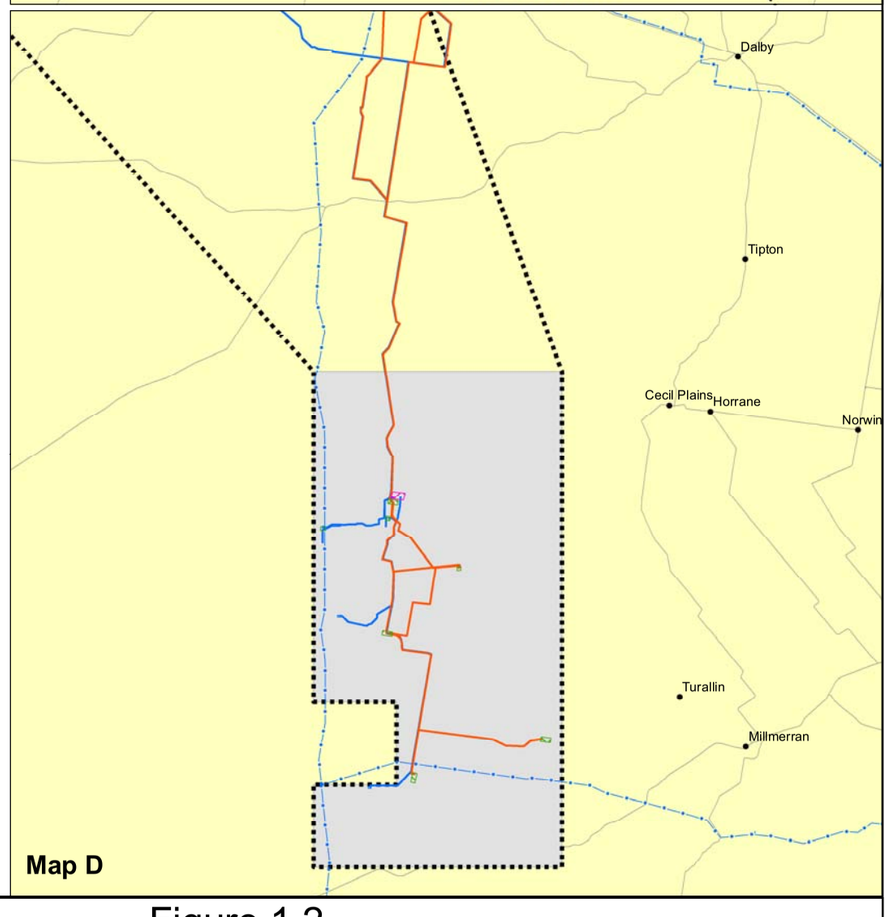
Legend

- Town
- Roads
- Drainage Lines
- Water Treatment Facility
- Water Treatment Station
- Brine Pond
- Indicative Location of Gas Processing Facility
- Camp Laydown Compressor
- Gas Processing Facility
- High Pressure Gas Network
- Powerlines
- Water Network
- Kainama
- Condabri
- Gilbert Gully
- Dalwogan
- Talinga/Orana
- Combabula / Ramyard
- Woleebee
- Carinya
- Project Area Boundary







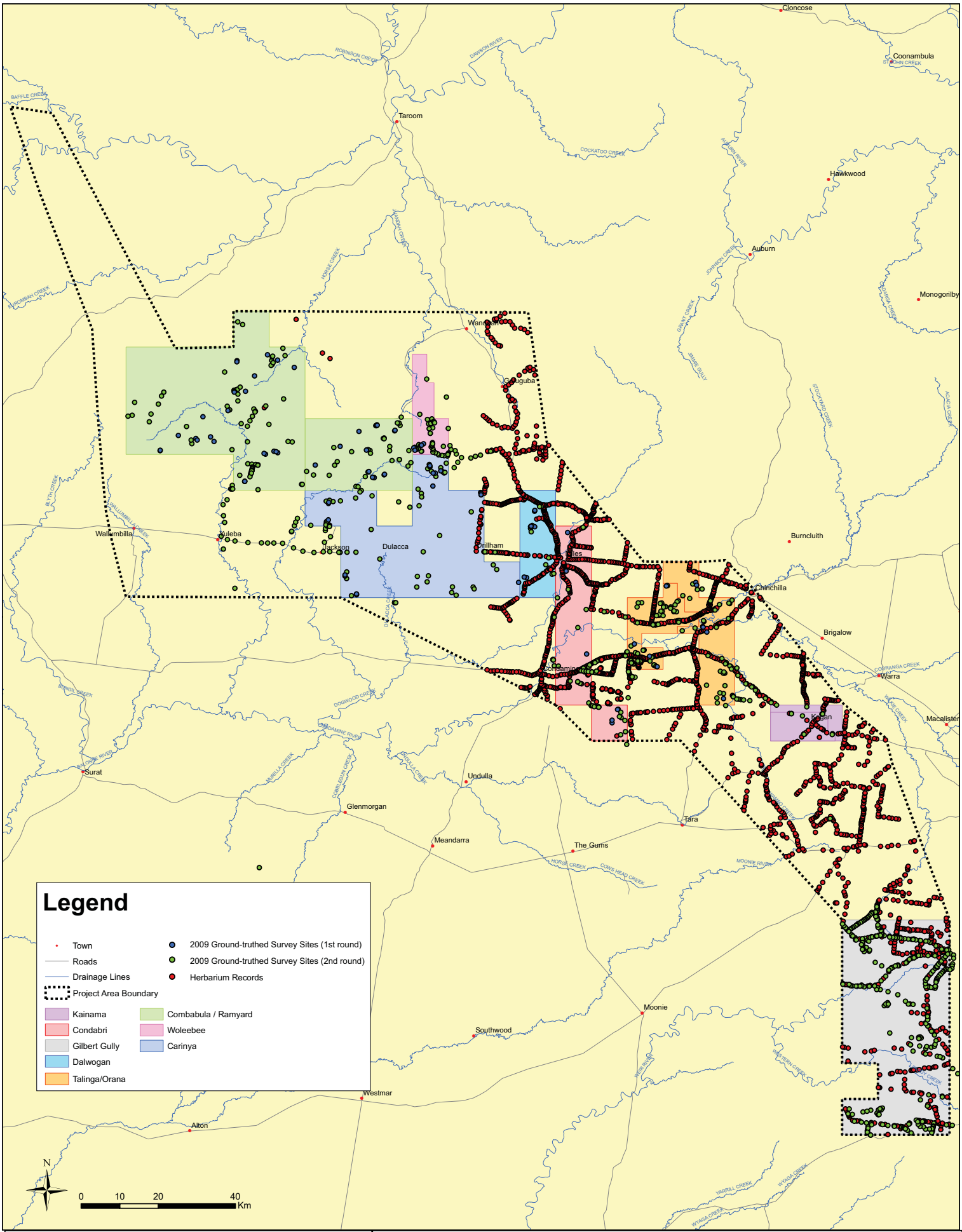


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 1.2

Proposed Project Footprint (excluding Gas Wells, Communications Towers and Access Road infrastructure)

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Biodiversity Assessment

Figure A.1

Location of Ground-truthed Data Collection Sites

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

Regional Ecosystem Assessment

The physiognomy of representative vegetation communities was gathered by obtaining Tertiary or Quaternary site data (modified from Neldner *et al*. 2005, **Attachment 1**), collected at 180 and 697 sites, respectively. Tertiary site data was collected in areas where the vegetation did not match the DERM-certified RE mapping for that polygon or as a representative site for that particular RE. Quaternary site data was collected to verify existing RE classifications and polygon boundary areas. Where RE type varied within a polygon, multiple data collection events were undertaken.

Fauna Habitat Assessment

General fauna habitat assessments, based largely on structural components (**Attachment 1**), were conducted at 283 sites. Two hundred and fifty four of these sites were also assessed on a conservation significant fauna species-specific basis (**Attachment 1**).

Habitat assessments were also partly based on characteristics derived from Queensland Herbarium datasheets, as well as qualitative and quantitative descriptions of habitat factors considered important for the presence of native fauna (e.g. tree hollows, exfoliating bark, fallen timber on ground, leaf litter, caves and crevices).

Species-specific habitat assessment datasheets featured a list of the conservation significant fauna species considered likely to occur within the overall Study Area (excluding some habitat generalists) and habitat features considered influential for the likelihood of each species occurring at a survey site. At each survey site a quantitative rank from zero to five was assigned for each habitat characteristic for each species, as well as an overall habitat suitability rank for each species.

In addition to preselected survey sites, flora and/or fauna surveys were also carried out opportunistically at sites deemed suitable when in the field. This typically included areas within State Forests, road reserves and stock reserves.

All species data incidentally recorded during the habitat assessments was provided to DERM for inclusion into the WildNet database.

Condition Assessment

RE condition was assessed visually using methods based on Eyre *et al*. (2000). This assessment used the following surrogates for condition:

- Percentage of native grasses in ground cover;
- Depth and cover of litter;
- Percentage of exposed earth;
- Percentage and size of coarse woody debris;
- Number of hollows;
- Percentage of weed cover;
- Presence of native shrub layer (if normally present as described in RE description);
- Evidence of fire;
- Past logging;
- Erosion and clearing; and
- Presence of 'increaser' species.

The combination of these parameters was used to place patches into Poor, Average or Good condition categories. Visual observation of these condition surrogates within any given RE across the Study Area was used to apply a general condition category to each RE.

The predominance of factors influencing condition for each category is defined below:

Poor Condition – REs found to be in poor condition were those occurring on more fertile soils. Heavy grazing, trampling and browsing and invasion by exotic weeds has prevented natural generation leading to poor shrub layer complexity and lack of juvenile canopy tree recruitment. Exotic grasses predominating in the ground layer out-compete native species and increase fire intensity, further reducing shrub and tree layer health and the amount of coarse woody debris.

In the case of some riparian REs, altered water regimes brought about by water extraction or clearing of surrounding vegetation have caused canopy die-back.

Average Condition – REs occurring on lightly grazed, relatively weed free shallow infertile soils. Selective logging of commercial timbers or thickening of shrub and lower tree layers through

altered fire regimes have degraded the condition of these communities.

Good Condition – REs occurring on lightly grazed, relatively weed free shallow infertile soils. Cattle using these communities for shelter cause some trampling and light browsing damage but do not prevent natural regeneration. Exotic grasses are rare and fire is infrequent.

A.3 REVISED VEGETATION MAPPING

Vegetation mapping was conducted within the ArcGIS (version 9.3), platform. Layers used to inform the mapping process included:

- Regional Ecosystem polygons supplied in shape file format by the Queensland Herbarium (Version 5; 2003);
- Pre-clear polygons supplied in shape file format by the Queensland Herbarium (15/09/2006);
- Recent aerial photography captured on 9-19 June 2009, 4 July 2009 and 6 September 2009 (1/2m GSD digital orthophotos using DTM and 2.5 metre contour mapping for correction, provided in ecw format and mapinfo tab files by AAMHatch Pty Ltd).
- 10 metre interval contour mapping derived from aerial photography (AAMHatch Pty Ltd);
- Location of EVR flora and data from 54 quaternary level sites (Craig Eddie pers. comm. 2009);
- Data from 2317 Corveg and Quaternary sites for the Study Area supplied by the Queensland Herbarium (**Figure A.1**);
- Moratorium and High-value Regrowth mapping supplied in shape file format by the Queensland Herbarium (2009);
- Tertiary and Quaternary site data collected during recent field survey work (**Section A.2.3**).

A copy of the Queensland Herbarium Regional Ecosystem mapping (Version 5; 2003) was edited as a base layer for mapping updates. The recent aerial photography (2009) was viewed at approximately 1:15,000 and additional vegetation polygons were drawn onto the existing mapping. Specifically areas that had been cleared since 2003 were removed, areas currently vegetated but not previously mapped were added as either regrowth or remnant and line work refined on some existing polygons.

Initially, new polygons were attributed with the pre-clear REs as a default attribution. These attributes were then updated using site data. Finally, polygons were interrogated by field botanists for correctly ascribed REs using specific site knowledge and expert interpretation of photo-pattern and colour within similar landscape position.

Accuracy estimates were made for all polygons according to the following rules:

- Polygon with site data or specific information from one of the field botanists, were ascribed 'High' status;
- Polygons that immediately extend existing mapped vegetation were attributed a similar accuracy as the neighbouring polygon;
- Adjusted Herbarium mapping was ascribed a medium accuracy;
- Polygons isolated and of indistinctive photo pattern and where pre-clear shows more than two REs within a heterogenous polygon were attributed low accuracy.

Regrowth vegetation was also delineated and assigned a final RE using Herbarium pre-clear mapping, with regrowth occurring within State and Regional corridors (as identified under the BPA - **Appendix D**) identified for future rehabilitation areas to offset potential impacts of the Project (**Section 3.0** of the main report).

The capture of aerial photography immediately after rain events (flown 09/06/09 – 19/06/09 and 04/07/09 and 06/09/09) also increased the opportunity for identifying wetlands and creek systems during the mapping process. This increased the likelihood that habitat for threatened flora and fauna species associated with aquatic and semi-aquatic systems were captured.

As wetlands and riparian corridors are valuable ecological elements within the landscape, it is also important to map their location and distribution. The capture of aerial photography immediately after rain events (flown 09/06/09 – 19/06/09 and 04/07/09 and 06/09/09) is considered to representative a 'wet scene' and increased the

opportunity for identifying wetlands and creek systems during the mapping process.

Wetlands were mapped according to their landscape context and size. Landscape context included factors such as proximity to remnant terrestrial vegetation, proximity to drainage lines and position within catchment as these factors are known to influence the periodicity of wetting – drying cycles and utilisation by fauna species. Wetlands were classified according to the following definitions.

Flooded paddock – predominantly restricted to the flood plain for the Condamine River, these are paddocks that remain flooded for periods long enough to show scaring on aerial photography. Although intermittent, these areas can provide ideal habitat for many aquatic flora species and specialist fauna species.

Natural in-stream waterbody – the majority of these waterbodies occur within the bed and banks of the Condamine and Balonne Rivers and Wilkie Creek. These water-bodies provide refugia for aquatic species during drought conditions and are very important to the persistence of some flora and fauna species within the landscape.

In-stream waterbody – These waterbodies, although man-made by blocking natural water courses, have been mapped because they are thought to function as facsimiles for natural in-stream waterbodies.

Large man-made waterbody– These waterbodies, although man-made, by blocking overland water flows have been mapped because they are thought to function as facsimiles for natural large waterbodies in so far as they contain permanent /semi-permanent surface water and are to a large extent surrounded by trees or are in close proximity to large patches of remnant vegetation.

Riparian communities were mapped according to the presence of remnant and non-remnant native vegetation on alluvial soils where they were associated with defined water courses.

A.4 SENSITIVITY MAPPING METHODOLOGY

A.4.1 OVERALL MAPPING METHODOLOGY DESCRIPTION

Figure A.2 illustrates the process applied to derive terrestrial ecology sensitivity mapping for the Study Area. This methodology has been developed specifically for the Project to take into account the landscape-level values of the area subject to the proposal and the diversity and conservation status of terrestrial flora and fauna species occurring within the Southern Brigalow Belt Bioregion.

The following sections describe the methodology in detail.

A.4.2 ECOLOGICAL IMPORTANCE MAPPING

The REs relevant to the Study Area were identified from mapping provided by the Queensland Herbarium and refined on the basis of field assessment and mapping from 2009 aerial photography. To generate a map indicating the ecological importance of patches of vegetation within the Study Area these REs were assessed in terms of their habitat value to conservation significant flora and fauna.

A list of the relevant flora and fauna species was generated through interrogation of the Herbrecs, WildNet, Queensland Museum and Birds Australia databases, and well as from field investigations and a review of relevant literature. These species are listed in **Table A.1**. This excludes certain communities at limit of their known distribution (such as 11.3.16) and species with very restricted, known distributions within the Study Area (such as *Micromyrtus carinata* and *Calytrix gurulmundensis*) that are mapped using additional layers of sensitivity, as discussed in **Section A.4.3**.

Flora

Table A.2 shows the relative weightings applied to each RE to reflect conservation status under the VM Act in descending order of Dominant Endangered, Sub-dominant Endangered, Dominant Of Concern, Sub-dominant Of Concern and Least Concern.

Those Endangered, Vulnerable, Rare and Near Threatened flora species listed under the EPBC Act and/or the Queensland *Nature Conservation Act 1992* (NC Act), and non-EVR priority species for the Brigalow Belt South bioregion (from the Biodiversity Assessment and Mapping Methodology (EPA 2002a)), were reviewed by a panel of experts brought together specifically for the project. The panel included Mr Craig Eddie (Managing Director of Boobook and contractor to Australia Pacific LNG), Mr Paul Grimshaw (Principal Botanist of BAAM), Mr Tim Low (Principal Ecologist and subconsultant to BAAM), Dr Andrew Daniel (Director and Principal Ecologist of BAAM) and Derek Johnson (Managing Director of QTree and subconsultant to BAAM).. Species thought unlikely to occur were discarded for this stage of the mapping process.

A weighting was allocated to each selected flora species to reflect conservation status in descending order of Endangered, Vulnerable, Rare/Near Threatened and non-EVR priority species. For those species listed under both the EPBC Act and NC Act, the higher status is allocated rather than the two listings being combined.

The likelihood that an RE provided suitable habitat for a particular conservation significant flora species was determined through literature review and the local knowledge of distribution and micro-habitat requirements of the expert panel. REs were then categorized as optimal or sub-optimal habitat for each flora species considered likely to occur, and weighted accordingly.

endangered, vulnerable, rare and near threatened species are still predicted to be subject to moderate impacts despite the recommended mitigation measures. Where direct offsets are unable to adequately mitigate potential impacts, such as the potential impacts of Cane Toads on reptiles of conservation significance, indirect offsets such as research to determine the most effective design of the artificial water bodies necessary for the project to discourage toad breeding have been recommended.

Bioregional Corridors

State and regional bioregional corridors traverse the study area and a number of the individual gas field tenements. The creation of further barriers to fauna movement within the corridors, such as clearing for project infrastructure and the construction of roads, tracks and pipelines would have a potentially significant and long term negative impact on regional biodiversity. The impacts would be countered by offsetting habitat losses for the Project within the bioregional corridors occurring within Australia Pacific LNG tenement boundaries. This would include protection and enhancement of regrowth vegetation, replanting and re-establishing preclearing REs within currently cleared areas of the corridors, and rehabilitating infrastructure locations following decommissioning as part of the Offset Package.

Reconnecting currently fragmented habitat within these corridor areas over the life of the Project is predicted to result in a significant, long term positive impact on regional biodiversity.

Habitat Management Guidelines

Outlines are provided to formulate habitat management guidelines designed to manage and mitigate impacts and thereby prevent or restrict their effects on flora and fauna. These impacts include habitat loss and fragmentation; introduction and/or spread of weeds; erosion and sedimentation; soil and water contamination from oil, fuel or chemicals; noise, dust and vibration; construction, operating and decommissioning traffic within fauna movement areas; and establishment of stockpile areas, camps, offices, spoil dumps and refuse areas.

Habitat Management Guidelines form an overarching terrestrial ecology management document, setting out the relationship of the individual ecological management guidelines with the overall goal of minimising, mitigating and offsetting ecological impacts arising from the construction, operation and decommissioning of the Project. In addition, individual management guidelines are to be prepared for the Project that address:

- threatened species, including individual (or like groups of) threatened species,
- clearing,
- weeds,
- feral animals,
- rehabilitation and revegetation, and
- ecological fire.

The habitat management guidelines would be incorporated into the overall Environmental Management Plan for the Project.

Offsets

The Queensland Government Environmental Offsets Policy outlines the needs and guidelines for offsets in Queensland under circumstances where clearing of remnant vegetation is unavoidable. A draft Queensland Government Policy for Biodiversity Offsets is currently in the consultation stage. In this document biodiversity offsets are described as actions to be undertaken to counterbalance an impact that causes a loss of biodiversity values. The draft Policy defines biodiversity as 'the natural diversity of native wildlife, together with the environmental conditions necessary for their survival'.

FIGURE A.2. ECOLOGICAL IMPORTANCE "HEAT MAPPING" AND SENSITIVITY MAPPING METHODOLOGY PROCESS DIAGRAM

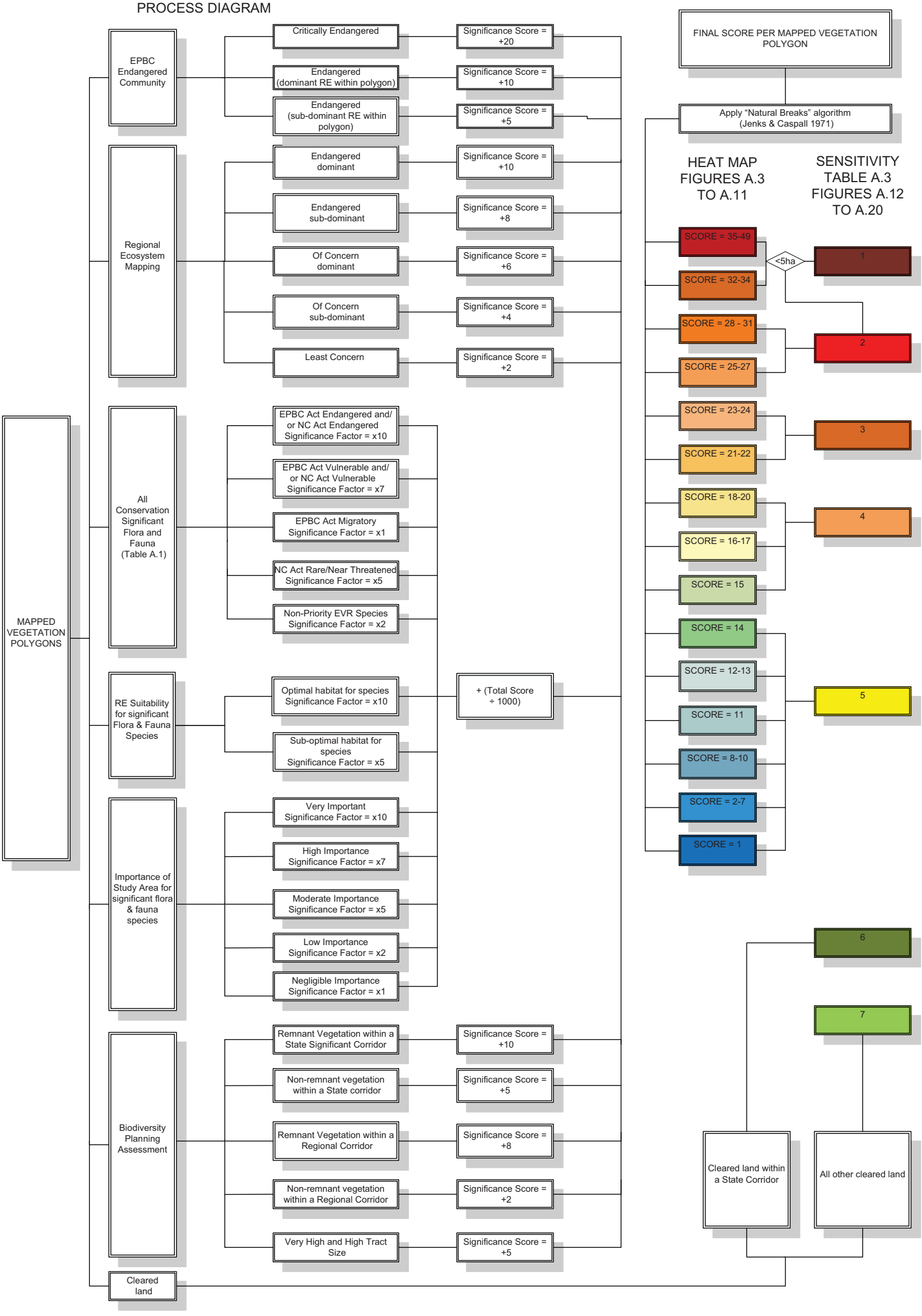


Table A.1. Conservation significant flora and fauna used to determine ecological importance of habitat patches

Scientific Name	Common Name	EPBC Act	NC Act	Non-EVR Priority Species[1]
FLORA				
Acacia chinchillensis	Chinchilla Wattle	V	NT	
Acacia curranii	Curly-bark Wattle	V	V	
Acacia lauta	Tara Wattle	V	V	
Acacia melvillei	Yarran		LC	x
Acacia microsperma	Bowyakka		LC	x
Acacia omalophylla	Yarran		LC	x
Acacia spania	Western Rosewood		R	
Acacia tenuinervis	None Known		R	
Acacia wardellii	Wardel's Wattle	V	V	
Cadellia pentastylis	Ooline	V	V	
Calytrix gurulmundensis	None Known	V	V	
Cryptandra ciliata	None Known		R	
Diuris tricolor	Painted Diuris	V	LC	
Eleocharis blakeana	None Known		R	
Eucalyptus curtisii	Plunkett Mallee		LC	x
Eucalyptus rhombica	None Known		LC	
Eucalyptus viridis	Green Mallee		LC	x
Fimbristylis vagans	None Known		R	
Gonocarpus urceolatus	None Known		V	
Homopholis belsonii	Belson's Panic		E	
Microcarpaea agonis	None Known	E	E	
Micromyrtus carinata	None Known		E	
Philotheca sporadica	None Known	V	V	
Picris barbarorum	Plains Picris		LC	x
Prostanthera sp. Dunmore	None Known	V	LC	
Pterostylis cobarensis	Cobar Greenhood Orchid	V	LC	
Rutidosis lanata	None Known		E	
Senna acclinis	Brush Senna		R	
Solanum stenopterum	None Known		V	
Tylophora linearis	None Known	E	E	
Xerothamnella herbacea	None Known	E	E	
FAUNA				
Limnodynastes salmini	Salmon-striped Frog		LC	x
Cyclorana verrucosa	Rough Frog		R	
Emydura macquarii	Macquarie Turtle		LC	x
Macrochelodina expansa	Broad-shelled River Turtle		LC	x
Strophurus taenicauda	Golden-tailed Gecko		NT	
Paradelma orientalis	Brigalow Scaly-foot	V	V	
Cyclodomorphus gerrardii	Pink-tongued Lizard		LC	x
Egernia rugosa	Yakka Skink	V	V	
Acanthophis antarcticus	Common Death Adder		R	
Furina dunmalli	Dunmall's Snake	V	V	
Hemiaspis damelii	Grey Snake		E	
Stictonetta naevosa	Freckled Duck		R	
Nettapus coromandelianus	Cotton Pygmy-goose	M	R	
Geophaps scripta scripta	Squatter Pigeon (southern	V	V	

Scientific Name	Common Name	EPBC Act	NC Act	Non-EVR Priority Species[1]
	subspecies)			
Ephippiorhynchus asiaticus	Black-necked Stork		R	
Lophoictinia isura	Square-tailed Kite		R	
Accipiter novaehollandiae	Grey Goshawk		R	
Erythrotriorchis radiatus	Red Goshawk	V	E	
Turnix melanogaster	Black-breasted Button-quail	V	V	
Rostratula australis	Australian Painted Snipe	V	V	
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	
Lathamus discolor	Swift Parrot	E	E	
Neophema pulchella	Turquoise Parrot		R	
Melithreptus gularis	Black-chinned Honeyeater		R	
Grantiella picta	Painted Honeyeater		R	
Ornithorhynchus anatinus	Platypus		LC	x
Planigale tenuirostris	Narrow-nosed Planigale		LC	x
Macropus dorsalis	Black-striped Wallaby		LC	x
Petaurus australis australis	Yellow-bellied Glider (southern subspecies)		LC	x
Phascolarctos cinereus	Koala		LC	x
Petauroides volans	Greater Glider		LC	x
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	
Chalinolobus picatus	Little Pied Bat		R	
Nyctophilus species 2 *formerly N. timoriensis*	South-eastern Long-eared Bat	V	V	

[1] Non-EVR Priority species for the Southern Brigalow Belt (EPA 2008a, b).
E = Endangered, V = Vulnerable, R = Rare, NT = Near Threatened, LC = Least Concern, M = Migratory.

Table A.2. Ranking and Weighting Methods for Prioritisation of Remnant and Regrowth Vegetation Values for Conservation Significant Flora and Fauna Species

Factor	Ranking/ Weighting	Definition
Conservation status of RE VM Act	10	Dominant Endangered
	8	Sub-dominant Endangered
	6	Dominant Of Concern
	4	Sub-dominant Of Concern
	2	Least Concern
Conservation status of flora and fauna species EPBC Act and/or NC Act	10	Endangered
	7	Vulnerable
	5	Rare/Near Threatened
	2	Non-EVR priority species in bioregion.
	1	Migratory (fauna)
RE suitability for flora and fauna species	10	RE is optimal habitat within the study area.
	5	RE is sub-optimal habitat within the study area.
Importance of Study Area to flora and fauna species	10	Very important
	7	High importance
	5	Moderate importance
	2	Low importance
	1	Negligible importance
Corridor (remnant) BPA mapping	10	State
	8	Regional
	5	Local
Corridor (regrowth) BPA mapping	5	State
	2	Regional
	1	Local or not part of a corridor
Tract size BPA mapping	5	Very High or High
	0	Medium or Low
Environmentally sensitive Areas [1] (areas protected under the NC Act or *Forestry Act 1959*)	10	e.g., National Park, Conservation Parks, Forest Reserve
	5	e.g., Coordinated Conservation Area, Qld Heritage Register Place, Special Forestry Area
	0	e.g., Nature Refuge, State Forest, Timber Reserve
EPBC Act threatened ecological community	20	Critically Endangered
	10	Endangered – 1st or 2nd RE listed in heterogeneous polygon
	5	Endangered – 3rd or 4th RE listed in heterogeneous polygon

[1] As defined under the EP Act.

An additional weighting was applied in regard to the importance of the Study Area to each species. This was determined by identifying the proportion the Study Area is of the species' overall Australian distribution, the proportion of the Study Area in which the species is known or expected to occur and how much of that known/expected range may be considered as 'core' habitat for the species.

The likelihood that an RE provided suitable habitat for a particular flora species of significance was determined through literature review and the local knowledge of distribution and micro-habitat requirements of the expert panel. REs were then categorised as optimum or sub-optimum habitat for each flora species, and weighted accordingly.

An additional weighting was applied in regards to the importance of the Study Area to each species. This was determined by identifying (a) what proportion of the species' overall Australian distribution is represented by the Study Area, (b) the proportion of the Study Area in which the species is known or expected to occur, and (c) how much of that known/expected range may be considered as 'core' habitat for the species.

Fauna

Not all conservation significant species, EVR or Migratory under either the EPBC Act or NC Act or non-EVR priority species, that possibly, or are known to, occur within the Study Area were included in this exercise. Rather a representative selection was considered. The 34 species selected are listed in **Table A.1**. This excludes certain species with very restricted, known distributions within the Study Area (such as Brigalow Woodland Snail and Dulacca Woodland Snail) that are mapped using additional layers of sensitivity, as discussed in **Section A.4.3**.

Those species excluded are only known from the Study Area from historical records, are vagrants, have a very marginal or even doubtful distribution, have no particular habitat preference, are largely associated with non-remnant vegetation, mainly occur on artificial waterbodies or are migratory species whose passage through the area is not habitat specific.

Non-EVR priority species were selected on the basis of their habitat requirements reflecting particular components of the landscape such as substrate, particularly sandstone and cracking clays/gilgais; rivers and wetlands and their fringing vegetation on alluvial plains; hollow-bearing trees; tree species that are important food resources and habitat structure features such as understorey density and composition.

The likelihood of a species utilising an RE can be determined in part from the description of the RE (Young *et al*. 1999; EPA 2007) and the known distribution and resource requirements of the species in question. Those REs considered important to a species were ranked, in two categories, in terms of resource value. The identification of a particular RE as being important to a fauna species involved extensive literature review, especially of literature specific to the Brigalow Belt bioregion and/or parts of the Study Area (e.g., McFarland *et al*. 1999a, b; EPA 2002b, 2008a, b, c; Venz *et al*. 2002; Richardson 2006; Eddie 2008), and by discussion of a panel of experts brought together specifically for the project. The panel includeed Mr Craig Eddie (Managing Director of Boobook and contractor to Australia Pacific LNG), Mr Steve Wilson (Herpetologist with the Queensland Museum and subconsultant to BAAM), Mr Tim Low (Principal Ecologist and subconsultant to BAAM), Mr Terry Reis (Director and Principal Ecologist of BAAM), Dr John Stanisic (Malacologist, Director and Principal Biodiversity Scientist of BAAM) and Mr Adrian Caneris (Managing Director and Principal Wildlife Expert of BAAM).

The exclusion of an RE in relation to a particular species does not mean that it may not at times occur there, especially for migratory species. Rather, the REs have been chosen to represent the habitats of greatest likelihood of regular occurrence. Waterbirds and wetland species, such as those associated with rank vegetation fringing waterbodies, may use many REs beyond those listed should appropriate waterbodies exist within the area in question. The habitat requirements of some species such White-throated Needletail *Hirundapus caudacutus* and Rainbow Bee-eater *Merops ornatus* are so broad that they could occur in, or above, all REs.

Existing Terrestrial Ecological Values

Documentation of existing terrestrial ecological values of the study area has drawn strongly upon those values recognised under the relevant State and Commonwealth legislation (Appendix B), as well as taking account of regional planning instruments.

Legislation takes into consideration those species most at risk, which within the study area is primarily a function of past and ongoing threats associated with habitat clearing and degradation by livestock and grazing practices. Those species that are widespread in their distribution and/or more capable of adapting to fragmented landscapes are considered less sensitive to the specific effects of habitat disturbance. They do, however, remain significant in terms of biodiversity and ecosystem function.

The persistence of both threatened and non-threatened species within the landscape is addressed through the consideration of 'environmentally sensitive areas', 'regional ecosystems' (RE), habitat tract size, and habitat connectivity through bioregional wildlife corridors.

This section draws together results of existing terrestrial ecology information for the study area, and findings from field investigations aimed at identifying those species for which the study area is significant, verifying Regional Ecosystem mapping, and defining habitat type and quality.

The overall picture that emerges is one of a highly modified landscape, through which large remnant tracts of vegetation persist. These larger remnant areas are primarily associated with higher altitude, less fertile lands supporting ecosystems which are well-represented regionally and are mostly incorporated within the state forest network. The more fertile, lower altitude lands are intensively grazed, with smaller, isolated patches of remnant vegetation remaining. This is a pattern repeated throughout the bioregion and is largely responsible for the endangered status of brigalow vegetation communities that formerly occupied now cleared and grazed lands. Those patches that remain are subject to grazing and frequent fire, facilitated by their invasion from introduced pasture grasses. Species that are reliant on these ecosystems are also affected by their degradation and fragmentation, cattle damage and fire regimes. As a result, many of these species share the threatened status of the vegetation communities.

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

It should be noted that, where relevant, information is provided in the context of the provinces (or sub-regions) of the Brigalow Belt South (BBS) bioregion within which the study area occurs (Young et al. 1999) (herein referred to as the 'Relevant Provinces'). It is considered that providing such information in the context of the Relevant Provinces rather than the bioregion as a whole enables a more accurate understanding of the study area's relative importance in supporting terrestrial ecological values within the local landscape, and thereby provides a more relevant basis for assessing impacts.

In this case, the 'Relevant Provinces' for the majority of the study area include provinces 25 ('Taroom Downs'), 26 ('Southern Downs'), 27 ('Barakula'), 28 ('Dulacca Downs'), 30 ('Tara Downs'), 31 ('Eastern Darling Downs'), and 32 ('Inglewood Sandstones') (Figure 1.1). As shown on Figure 1.1, however, the far north-western extent of the study area occurs outside of these provinces– that is, within province 24 ('Carnarvon Ranges'). Proposed infrastructure within this location is limited to a section of the high pressure gas network pipeline – there is no gas field tenement

This exercise was also conducted with the knowledge that non-remnant vegetation may provide significant resources for many conservation significant species. It is also noted that species do not typically occur in all available and apparently suitable habitat due to a variety of patch characteristics including connectivity and habitat condition. An area mapped as remnant may be highly degraded, particularly in terms of its ground cover, and may not be suitable for ground-dwelling species, especially herpetofauna and ground-nesting birds. An actual habitat assessment is required to accurately identify the likelihood of a species occurring in a habitat patch.

A weighting was given to each fauna species to reflect their conservation status in descending order of Endangered, Vulnerable, Rare/Near Threatened, non-EVR priority and Migratory. For those species listed under both the EPBC Act and NC Act the higher status is allocated rather than the two listings being combined.

A further weighting was applied in regards to the importance of the Study Area to each fauna species. This was determined by identifying what proportion the Study Area is of the species' overall Australian distribution, the proportion of the Study Area in which the species is known or expected to occur and how much of that known/expected range may be considered as 'core' habitat for the species.

This weighting captures the importance of the Study Area to species such as Golden-tailed Gecko (which is endemic to the bioregion), Rough Frog and Brigalow Scalyfoot and facilitates more accurate assessment of marginal species such as Red and Grey Goshawks and Swift Parrot.

Landscape Ecology

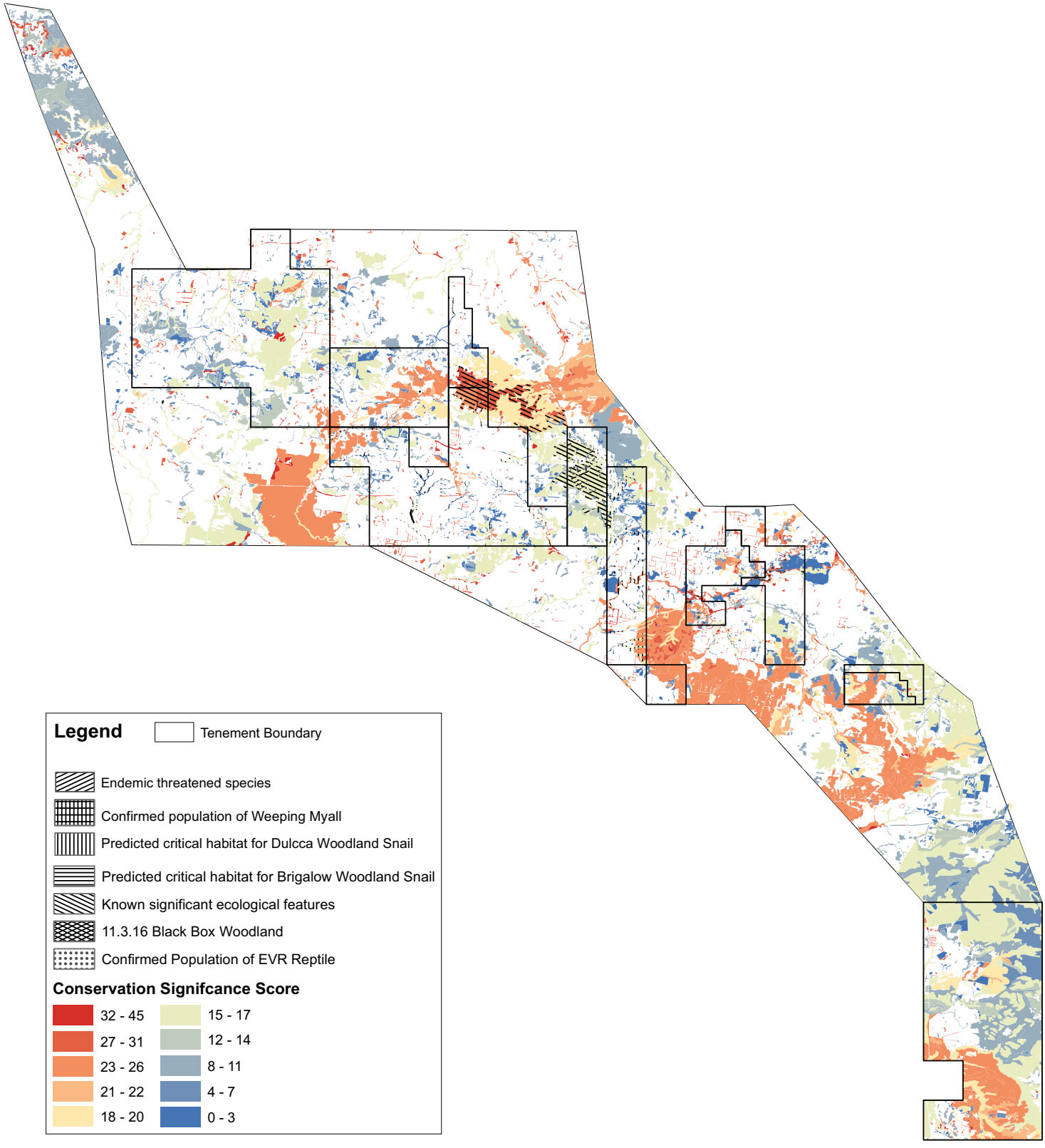
A number of landscape elements were incorporated into the mapping. DERM has prepared BPAs that provide broadscale ecological data to advise a range of planning and decision-making processes.

Included in this mapping exercise is the BPA mapping of vegetation within corridors, for remnant and regrowth vegetation. Both are categorised and weighted as of State, Regional or Local significance.

Weighting has also been applied to areas mapped as High or Very High Tract Size under the BPA, Environmentally Sensitive Areas as identified by the EP Act and ecological community status under the EPBC Act. Threatened ecological communities are ranked in descending order as Critically Endangered, Endangered (1st or 2nd RE) and Endangered (3rd and 4th RE). The numerical order of RE refers to heterogeneous polygons where not all polygons are listed as Endangered.

All factors and their ranking or weighting are listed in **Table A.2**.

The final scores were allocated to 15 categories based on natural groupings inherent in the data identified by ArcMap through an algorithm (Jenks and Caspall 1971) that maximises the differences between data classes. That is, it identifies natural breaks in the data. The numeric results are shown in **Figure A.2** and the spatial results are shown on **Figure A.3** (entire Study Area) and **Figures A.4-A.5-A.13** (individual tenements).

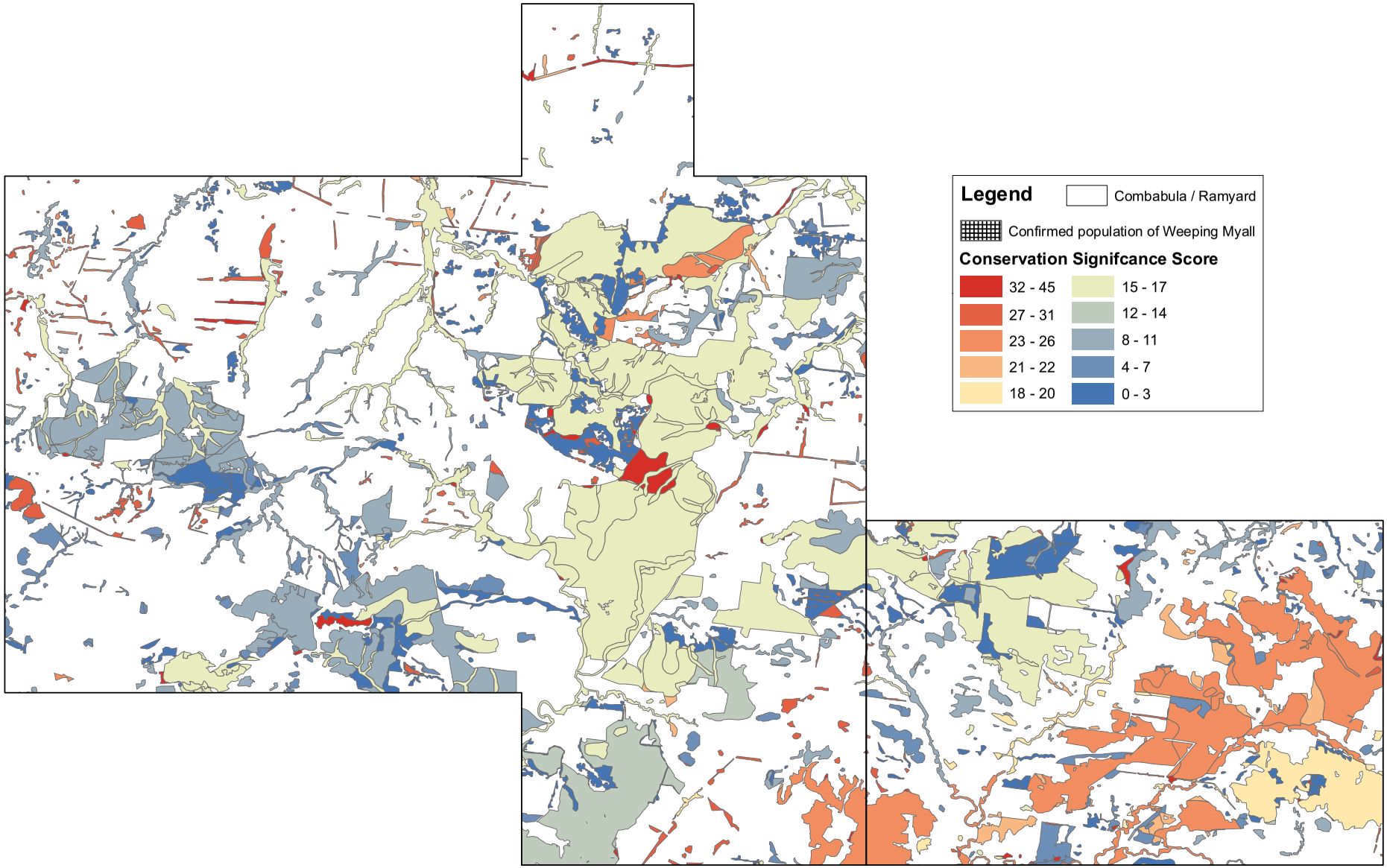


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.3

Subject Area Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

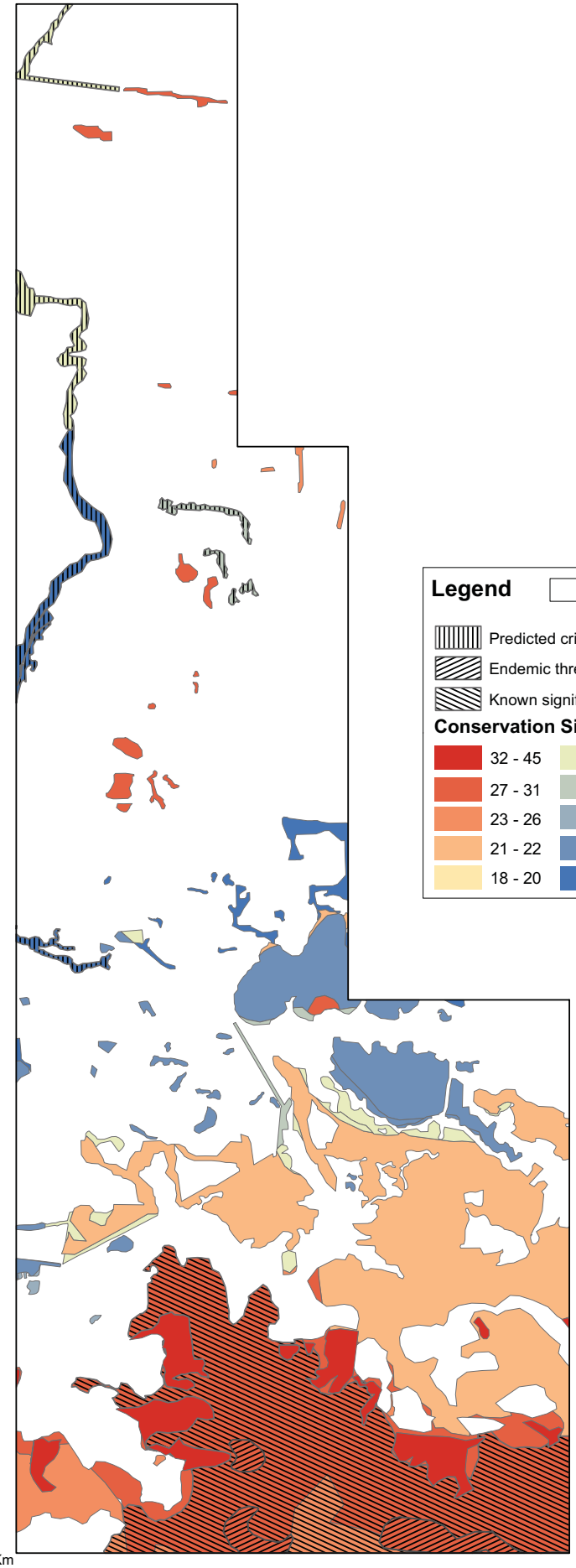


Biodiversity Assessment

Figure A.4

Combabula / Ramyard Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact
Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



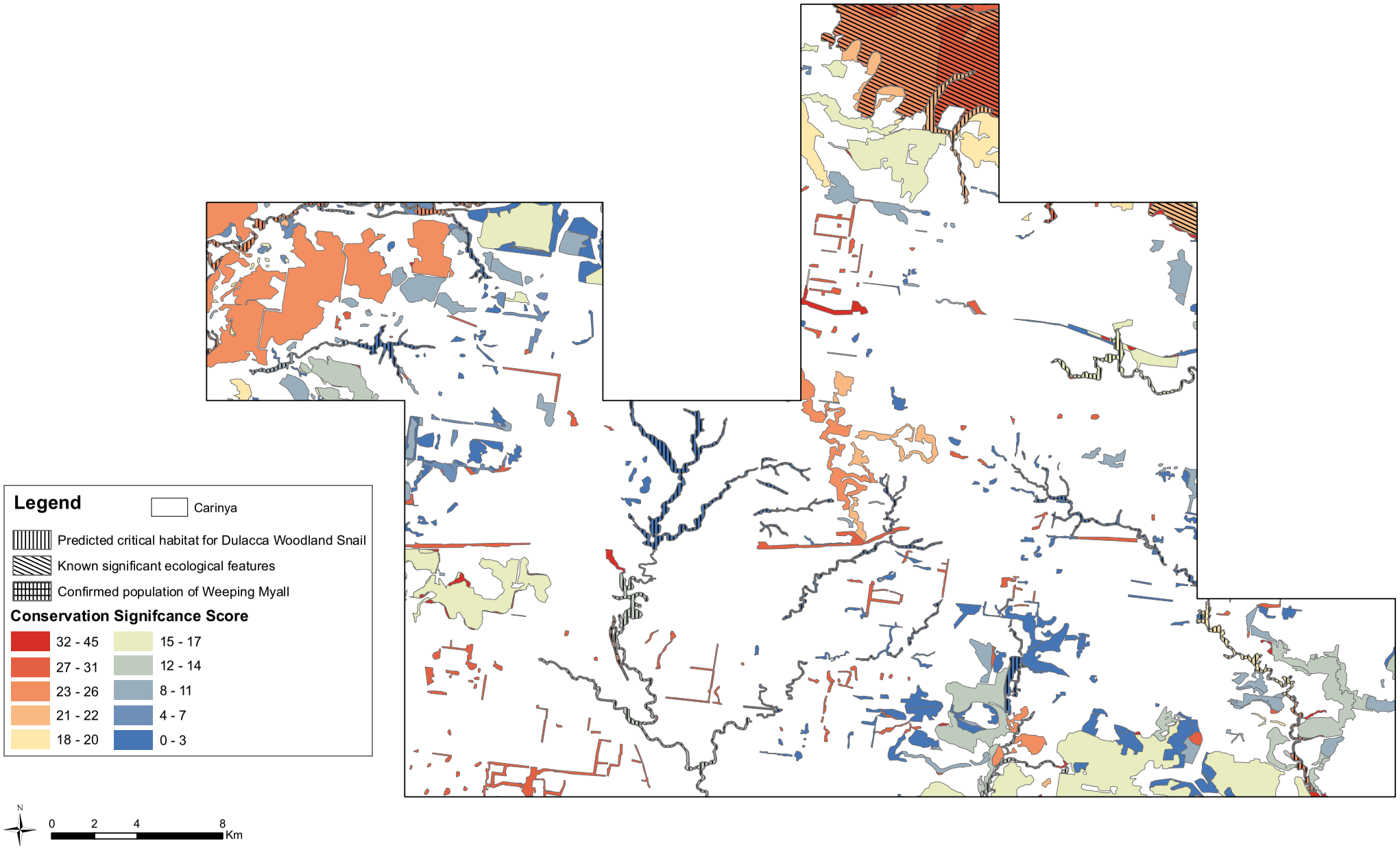
Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.5

Woleebee Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
					11.9.10
Acrocephalus australis	Australian Reed-Warbler	M	S		11.3.27b
Stagonopleura guttata	Diamond Firetail3		C	x	11.3.3, 11.3.4, 11.3.14, 11.3.19, 11.3.25, 11.3.27b, 11.9.5
Ornithorhynchus anatinus	Platypus		C	x	11.3.25, 11.3.27b
Phascogale tapoatafa	Brush-tailed Phascogale		C	x	11.3.2, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.3.39, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.4, 11.5.5, 11.5.20, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.7, 11.9.9, 11.10.1d, 11.10.7, 11.10.11, 11.10.13
Planigale tenuirostris	Narrow-nosed Planigale		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.25, 11.4.3, 11.4.4, 11.4.7, 11.9.1, 11.9.3, 11.9.5
Isoodon macrourus	Northern Brown Bandicoot		C	x	11.3.2, 11.3.25, 11.5.1
Perameles nasuta	Long-nosed Bandicoot		C	x	11.8.3, 11.9.4a
Phascolarctos cinereus	Koala		C	x	11.3.1, 11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.4.3, 11.4.10, 11.5.1, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.7.5, 11.9.7, 11.9.10, 11.10.7, 11.10.11, 11.10.13
Petaurus australis	Yellow-bellied Glider3		C	x	11.3.4, 11.3.14, 11.3.18, 11.3.25, 11.3.26, 11.3.39, 11.5.1, 11.5.4, 11.5.20, 11.7.6, 11.7.7, 11.9.9, 11.10.1, 11.10.7, 11.10.13
Petaurus norfolcensis	Squirrel Glider		C	x	11.3.4, 11.3.25, 11.3.27, 11.10.1, 11.10.7, 11.10.13
Petauroides volans	Greater Glider		C	x	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, 11.3.27b, 11.3.39, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.5, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.7, 11.10.9, 11.10.11, 11.10.13

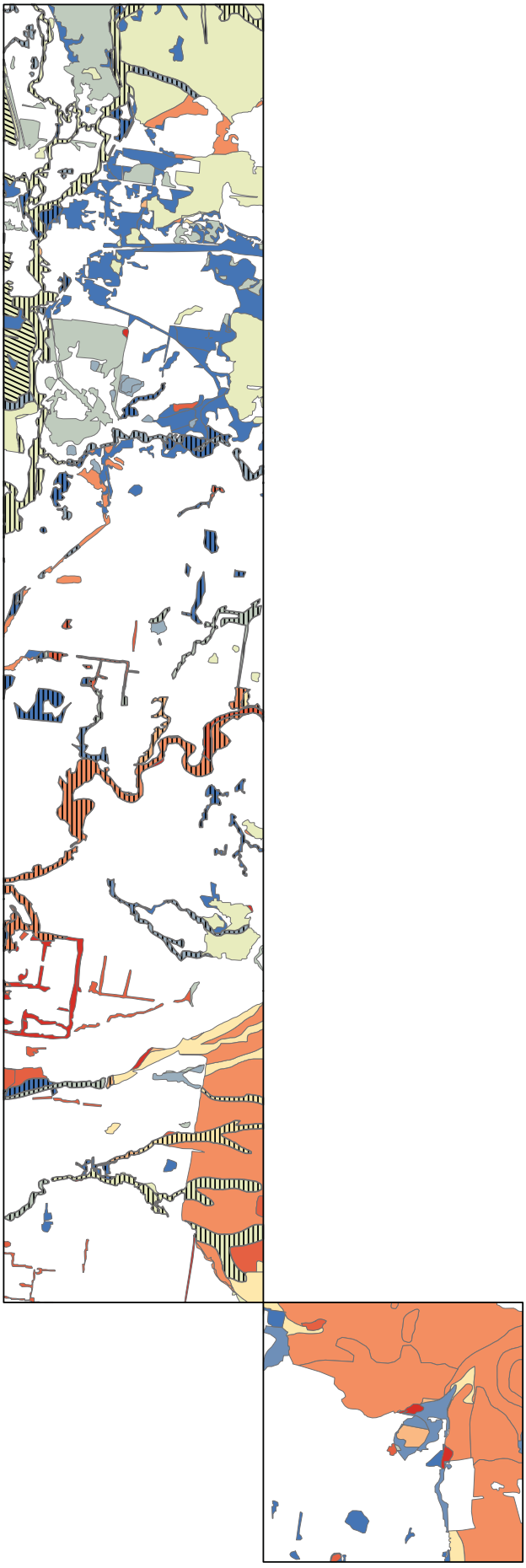


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.6

Carinya Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact
Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

- Condabri
- Predicted critical habitat for Dulacca Woodland Snail
- Known significant ecological features

Conservation Signifcance Score

32 - 45	15 - 17
27 - 31	12 - 14
23 - 26	8 - 11
21 - 22	4 - 7
18 - 20	0 - 3

N

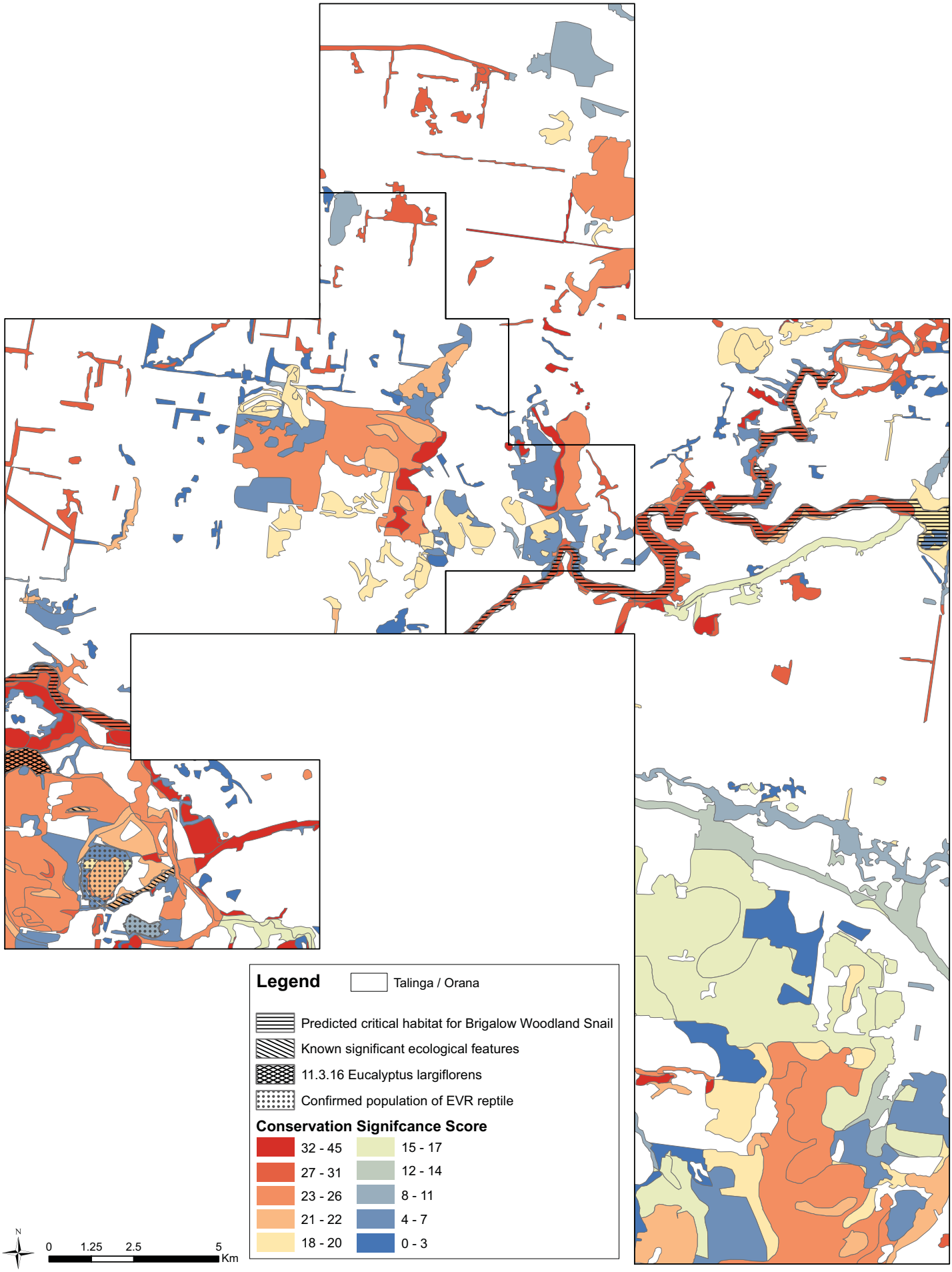
0 2 4 8 Km

Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.7

Condabri Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

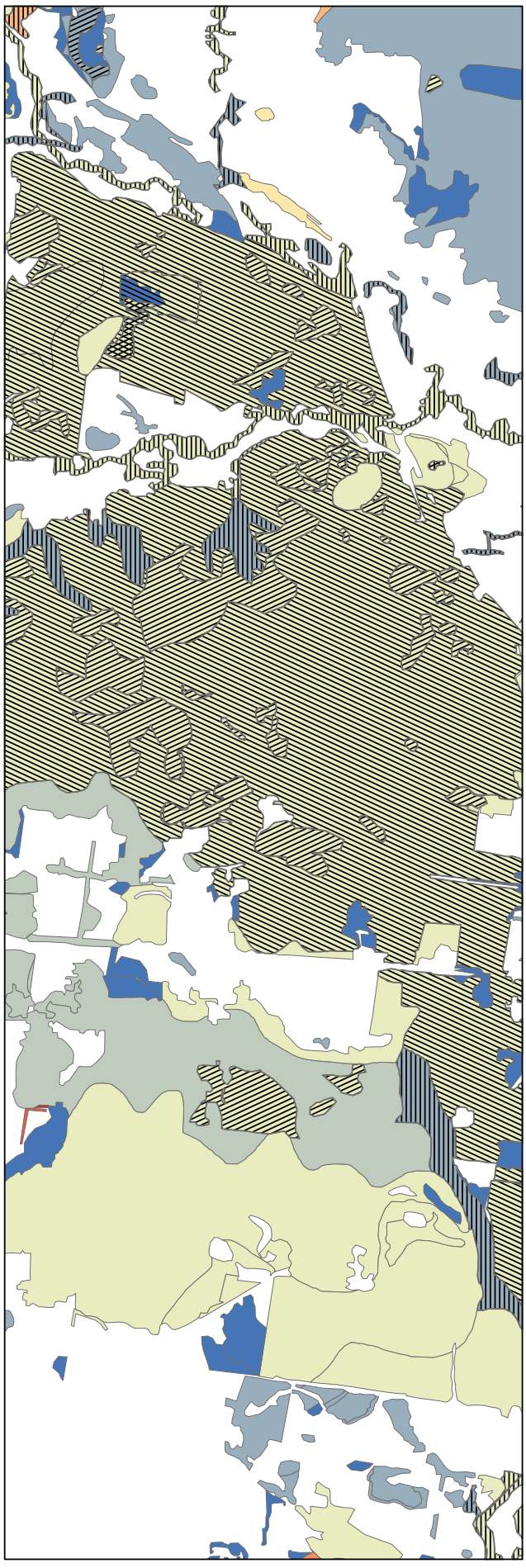


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.8

Talinga / Orana Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

Dalwogan

Predicted critical habitat for Dulacca Woodland Snail

Endemic threatened species

Known significant ecological features

Conservation Signifcance Score

32 - 45	15 - 17
27 - 31	12 - 14
23 - 26	8 - 11
21 - 22	4 - 7
18 - 20	0 - 3

N

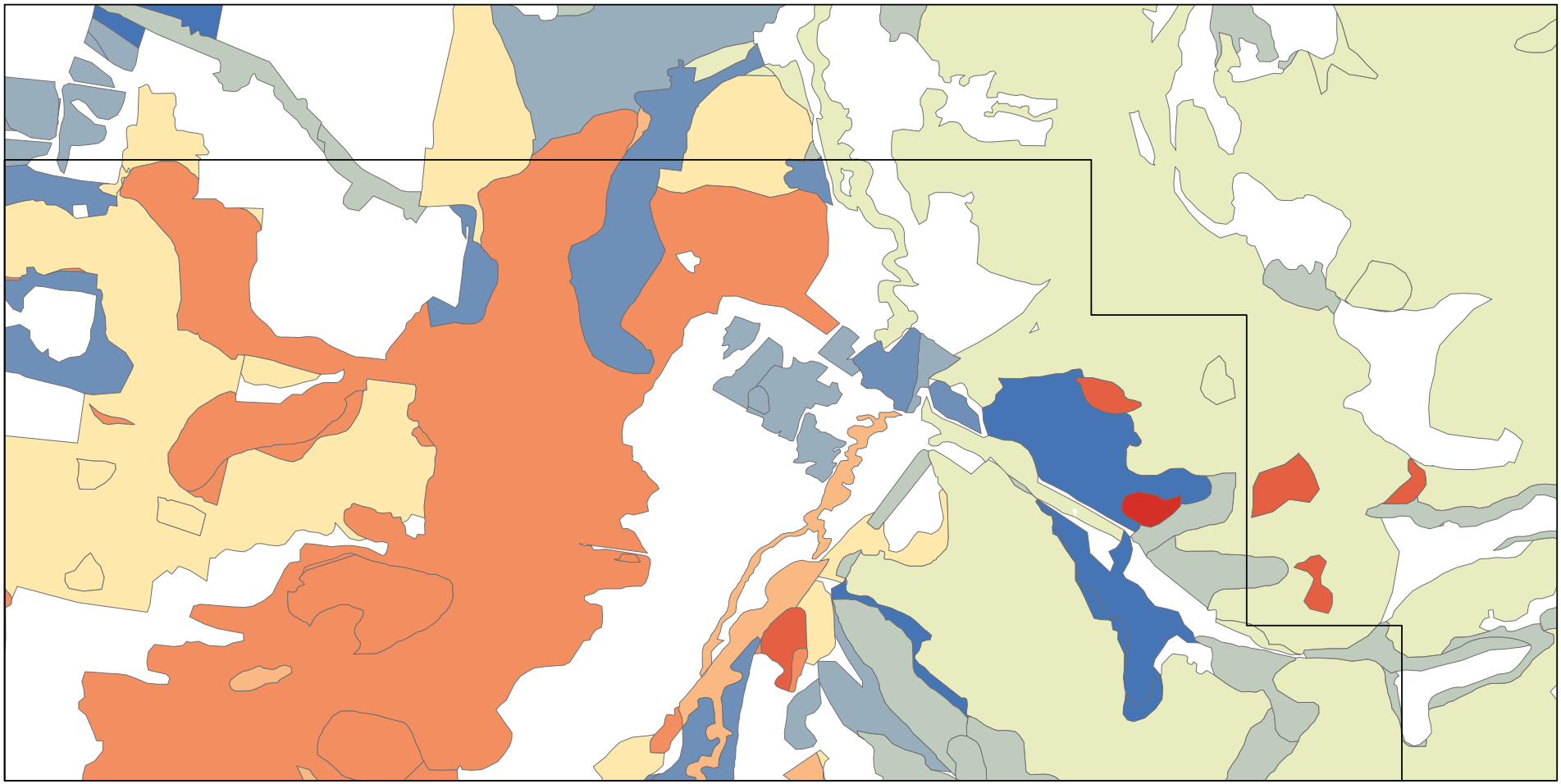
0 1 2 4 Km

Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.9

Dalwogan Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

Kainama

Conservation Signifcance Score

32 - 45	15 - 17
27 - 31	12 - 14
23 - 26	8 - 11
21 - 22	4 - 7
18 - 20	0 - 3

N

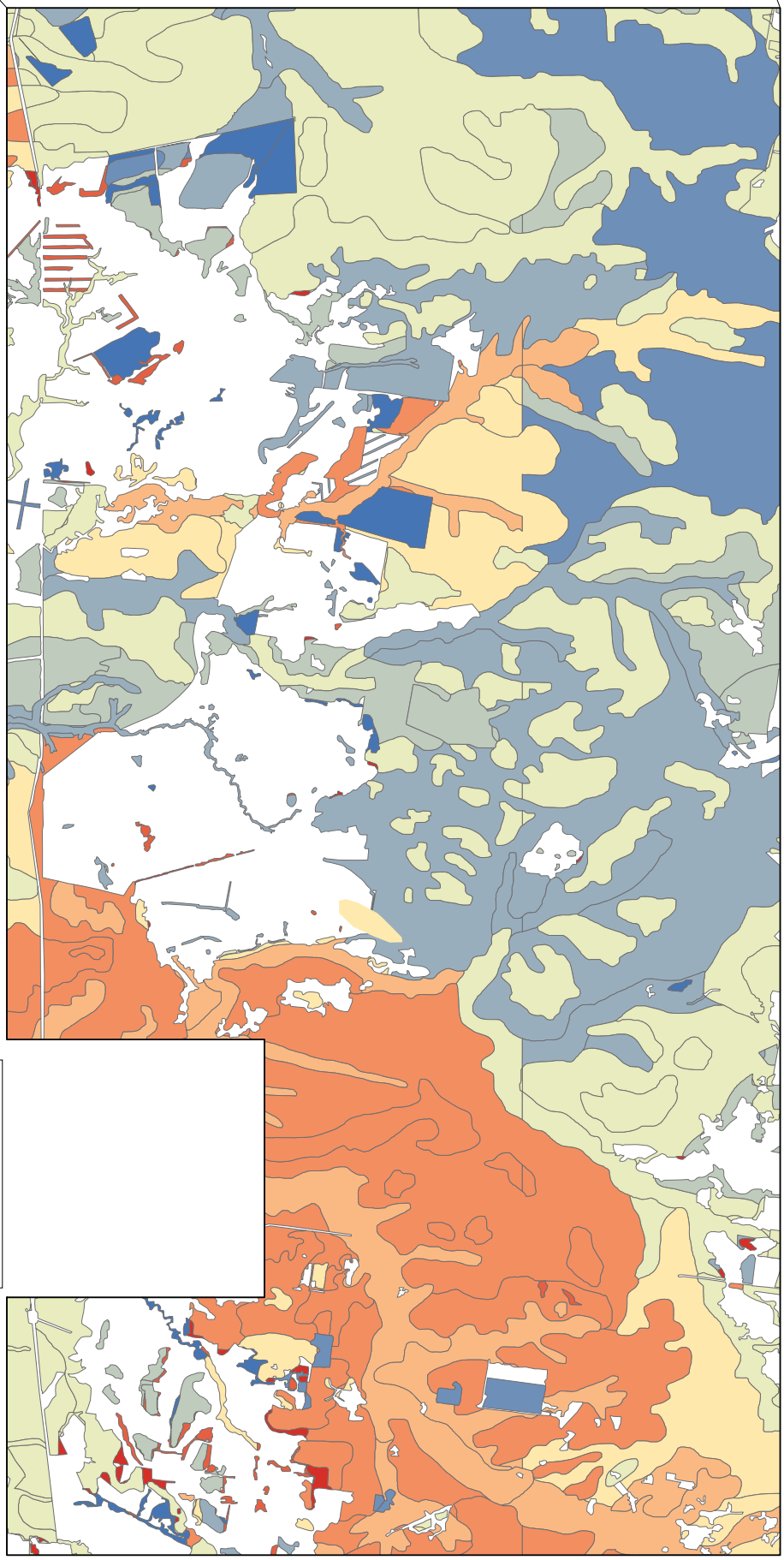
0 1 2 4 Km

Biodiversity Assessment

Figure A.10

Kainama Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact
Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

Gilbert Gully

Conservation Signifcance Score

32 - 45	15 - 17
27 - 31	12 - 14
23 - 26	8 - 11
21 - 22	4 - 7
18 - 20	0 - 3

N

0 2 4 8 Km

Biodiversity Assessment

Figure A.11

Gilbert Gully Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

associated with the Project within province 24. The characteristic features of province 24 include sandstone ranges with deep valleys and gorges (Young et al. 1999), which are atypical of the vast majority of the study area. There are also a number of National Parks within this province, including Carnarvon, Expedition Range, Isla Gorge and Precipice National Parks. Consequently, province 24 has been excluded from the primary group of Relevant Provinces and associated data analyses due to its potential to result in misleading conclusions from the data. The exceptions are the corresponding data analyses for those REs that only occur in province 24 within the study area. For these particular REs, province 24 represents the one and only 'Relevant Province'.

It should also be noted that the following assessment excludes a number of proposed telecommunications infrastructure locations that, due to their occurrence outside of the main gas fields study area, are subject to a stand-alone desktop assessment presented in an appendix to this report.

1.3 Environmentally Sensitive Areas

Environmentally Sensitive Areas relevant to the study area include:

- significant areas proclaimed under the Queensland Nature Conservation Act 1992 (NC Act) (for example, National Parks), Queensland Forestry Act 1959 (Forestry Act) (for example, State Forests) and international treaties/agreements (for example, Ramsar wetlands)
- 'ecological communities' listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- 'remnant vegetation' listed under the Queensland Vegetation Management Act 1999 (VM Act) and considered under the Queensland Environmental Protection Act 1994 (EP Act)
- wetlands and riparian vegetation
- important habitats for endangered, vulnerable, rare and near threatened flora and fauna species (including corridors), and
- important areas of regrowth vegetation.

Figure 2.1 and finer scale mapping provided in Appendix C shows the locations of currently recognised environmentally sensitive areas within the study area as mapped by the Queensland Department of Environment and Resource Management (DERM) and significant areas proclaimed under the NC Act or Forestry Act. The study area includes a number of State Forests and Reserves, as listed in Table 2.1.

Other areas that would be regarded as sensitive with respect to terrestrial flora and fauna are addressed in more detail in the following sections of this report:

- **Section 2.2** discusses areas of high biodiversity value under DERM's Regional Biodiversity Planning Assessment (BPA) for the Brigalow Belt South (BBS) bioregion, including important habitat corridors
- **Section 2.3** identifies endangered Ecological Communities listed under the EPBC Act, REs listed under the VM Act and considered under the EP Act, important wetlands, important habitats for endangered, vulnerable, rare and near threatened flora species and important areas of regrowth vegetation, and
- **Section 2.4** presents information on important habitats for endangered, vulnerable, rare and near threatened fauna species.

A.4.3 SENSITIVITY MAPPING

The results of the Ecological Importance mapping were used as a basis for the formulation of a Terrestrial Ecology Sensitivity Map shown on **Figure A.12** (entire Study Area) and **Figures A.13-A.20** (individual tenements).

The Study Area is mapped under five levels of terrestrial ecological sensitivity for remnant and important regrowth vegetation plus two additional categories for remaining regrowth and existing cleared lands, as listed in **Table A.3**.

The Ecological Importance Scores were grouped into Sensitivity Categories. Sensitivity Category 1 only includes polygons of 5 ha or more within Scores 32 – 34 and 35 – 49. Categories 6 and 7 are for existing cleared lands.

Small polygons of less sensitive Categories contained within large polygons of Sensitivity Categories 1 and 2 may be mapped as the higher level of sensitivity.

There are additional layers of sensitivity applied to the Study Area regardless of the Sensitivity Category of any relevant polygons. Areas known, or having high potential, to support any of two flora species, *Micromyrtus carinata* and *Calytrix gurulmundensis*, and two undescribed snail species, Brigalow Woodland Snail and Dulacca Woodland Snail (**Section 2.4** of main report), are subject to targeted searches for the species in question. These species are conservation significant, with very restricted distributions. If located, Threatened Species Management Guidelines must be applied prior to any disturbance (**Section 3.0** of main report).

The area identified as supporting the two flora species is within an area of 12500 ha around Gurulmundi State Forest that is recommended to be declared as the Gurulmundi High Nature Conservation Area and managed under specialised conditions to be negotiated with affected landholders (SBRVMC 2003).

There are also areas within Talinga tenement known to support populations of Yakka Skink or Painted Diuris (both Vulnerable under the EPBC Act), or which contain habitat features such as caves and overhangs that are important to a number of conservation significant species. The Sensitivity mapping identifies these areas as possessing Known Significant Ecological features. Waterbodies, due to their very high resource value, are included in this category.

The area of 11.3.16 has also been identified as it represents the northernmost known population of this community in Australia.

Certain areas of cleared land within floodplains are subject to inundation during or subsequent to rainfall events. These areas may provide valuable resources for conservation significant fauna species such as Rough Frog *Cyclorana verrucosa* and Grey Snake *Hemiaspis damelii* when flooded. Such flood-prone paddocks are not subject to additional infrastructure restrictions but it is necessary to restore current hydrological conditions to pre-development state following decommissioning.

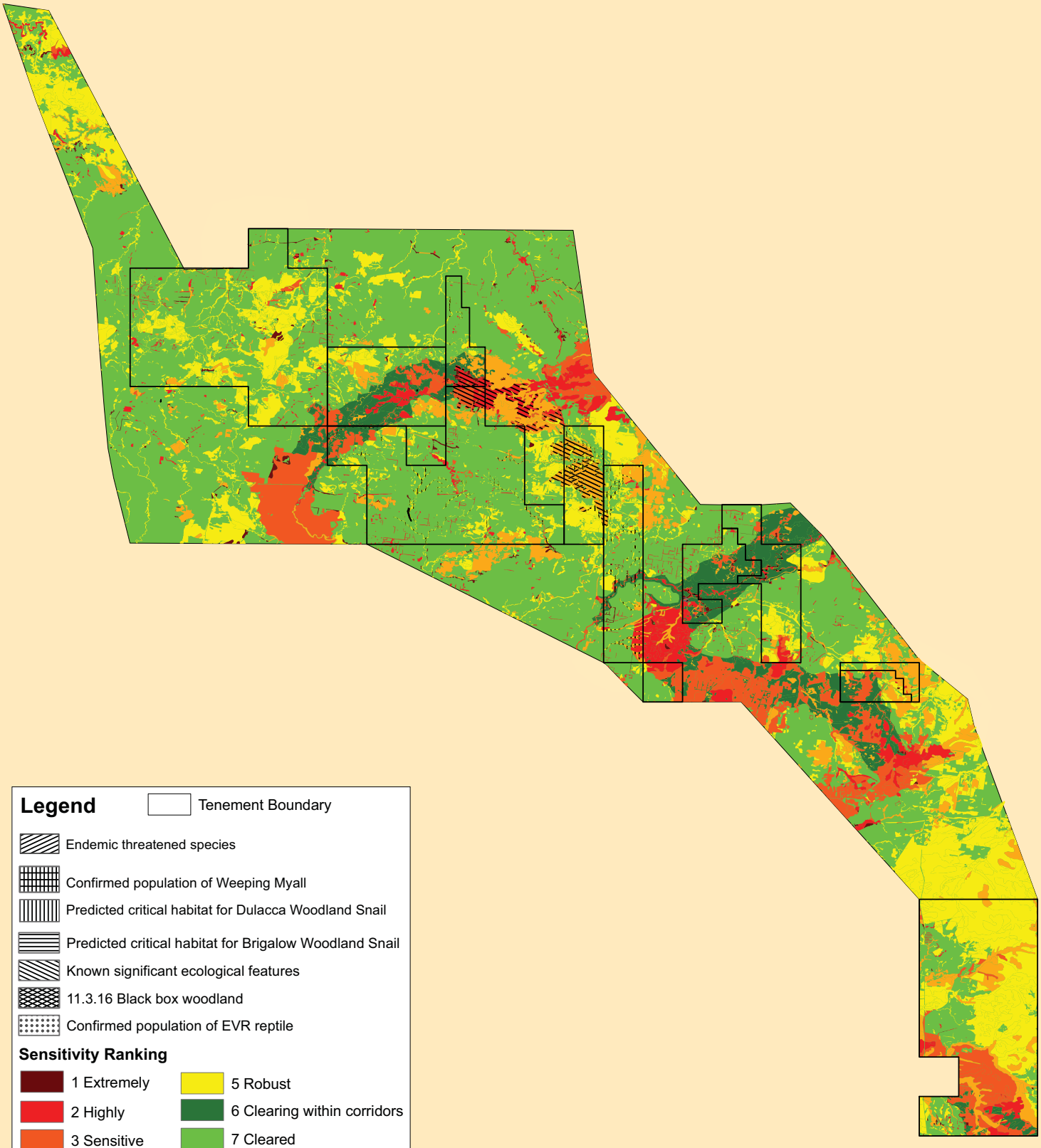
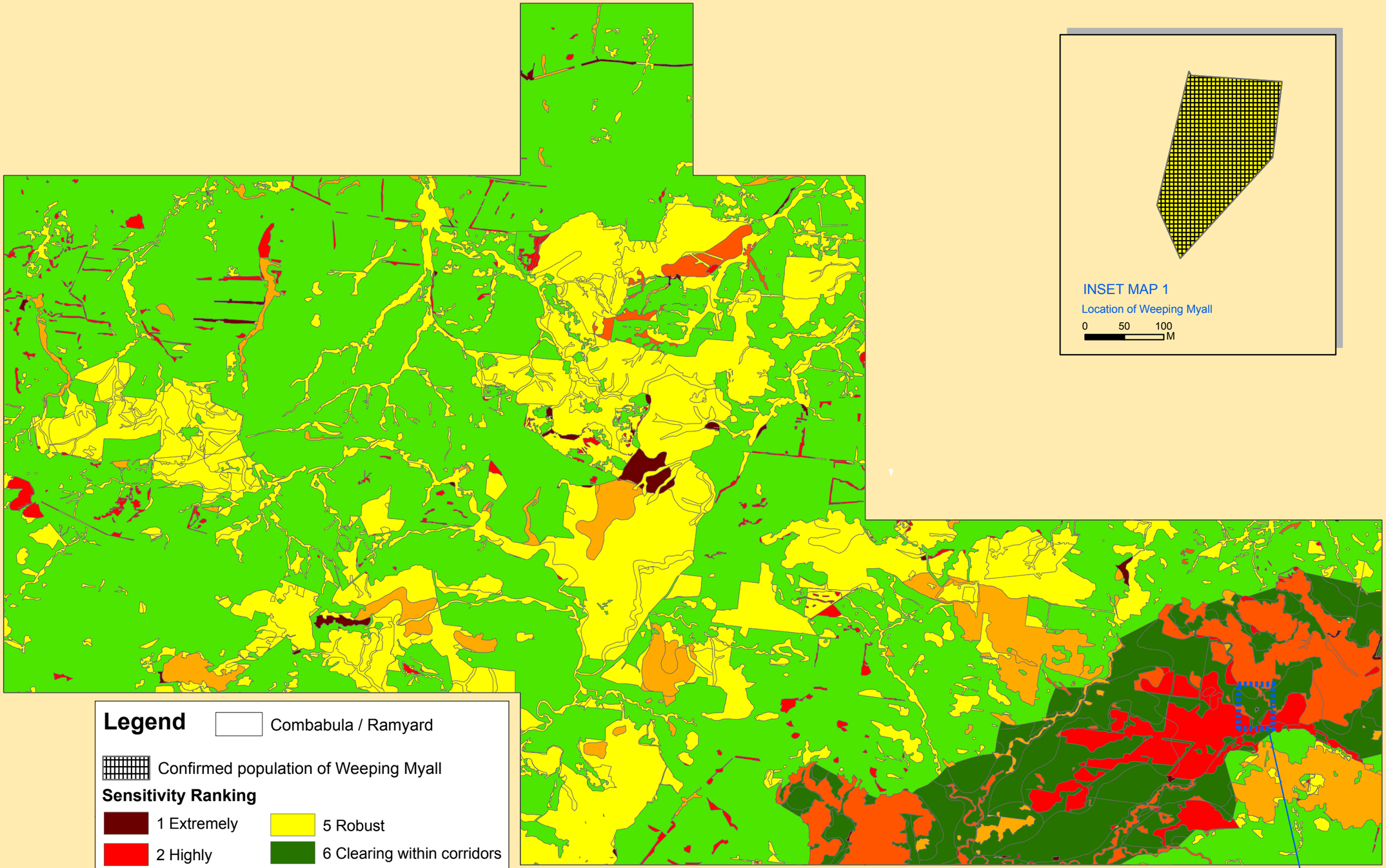


Figure A.12

Subject Area Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



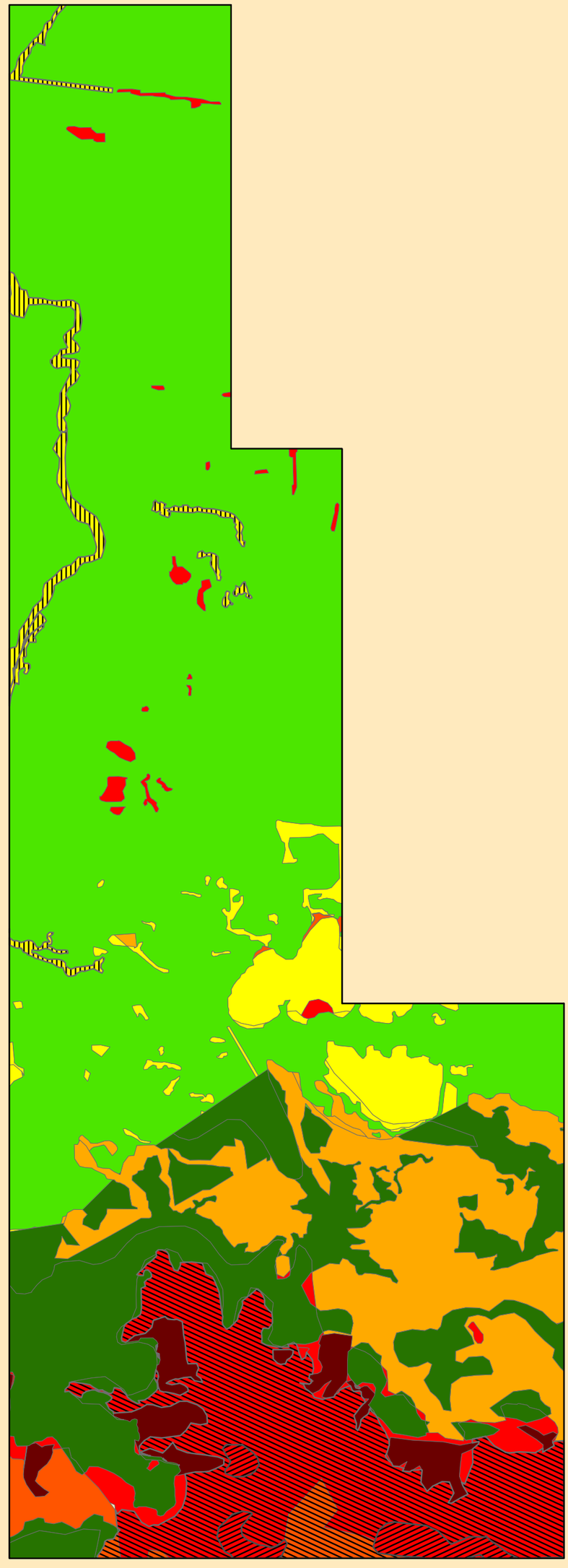
Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.13

Combabula / Ramyard Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
Pseudocheirus peregrinus	Common Ringtail Possum		C	x	11.9.4a, 11.9.4b
Trichosurus vulpecula	Common Brushtail Possum		C	x	11.3.1, 11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.4.3, 11.4.10, 11.5.1, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.7.5, 11.9.7, 11.9.10, 11.10.7, 11.10.11, 11.10.13
Aepyprymnus rufescens	Rufous Bettong		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.39, 11.3.25, 11.7.6, 11.9.711.9.9, 11.10.1, 11.10.1d, 11.10.7
Macropus dorsalis	Black-striped Wallaby		C	x	11.3.1, 11.3.17, 11.4.3, 11.4.7, 11.4.10, 11.7.1, 11.7.2, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.10, 11.10.9
Pteropus poliocephalus	Grey-headed Flying-fox	V	C		11.3.3, 11.3.4, 11.3.18, 11.3.19, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.5.1, 11.5.4, 11.5.5, 11.5.20, 11.5.21, 11.9.9.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V		11.3.14, 11.3.18, 11.7.5, 11.9.4a, 11.10.1, 11.10.3, 11.10.7, 11.10.9, 11.10.13
Chalinolobus picatus	Little Pied Bat		R		11.3.1, 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, 11.3.39, 11.4.3, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.3, 11.10.7, 11.10.9, 11.10.11, 11.10.13
Miniopterus orianae oceanensis	Eastern Bentwing-bat		C	x	11.10.1
Nyctophilus corbeni (formerly timoriensis)10	South-eastern Long-eared Bat	V	V		11.3.1, 11.3.2, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.26, 11.4.3, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.7, 11.9.10, 11.10.1, 11.10.3, 11.10.7, 11.10.9, 11.10.11



Legend

- Woleebee
- Predicted critical habitat for Dulacca Woodland Snail
- Endemic threatened species
- Known significant ecological features

Sensitivity Ranking

- 1 Extremely
- 2 Highly
- 3 Sensitive
- 4 Neutral
- 5 Robust
- 6 Clearing within corridors
- 7 Cleared

N

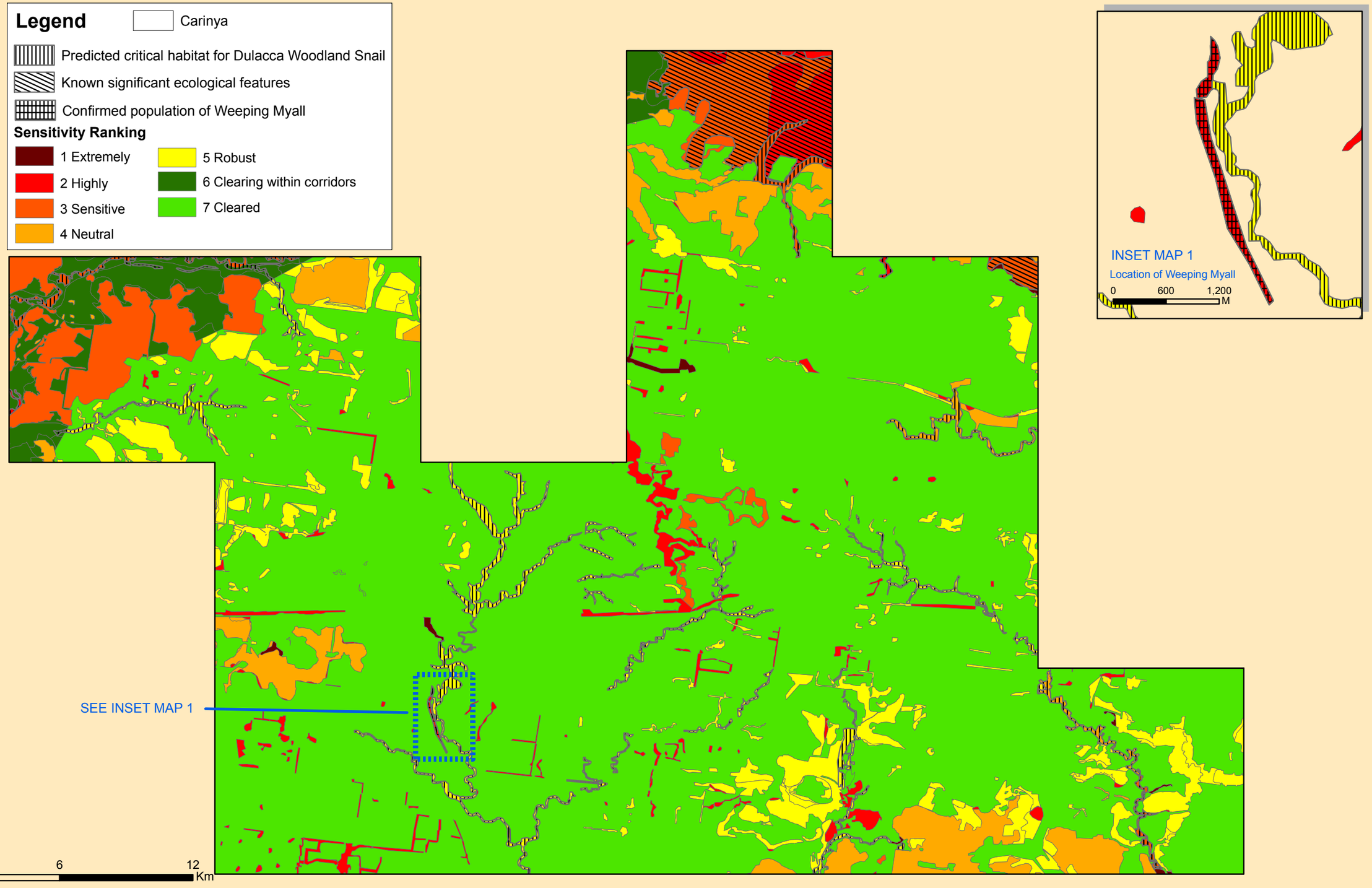
0 1.25 2.5 5 Km

Biodiversity Assessment

Figure A.14

Woleebee Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact
Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

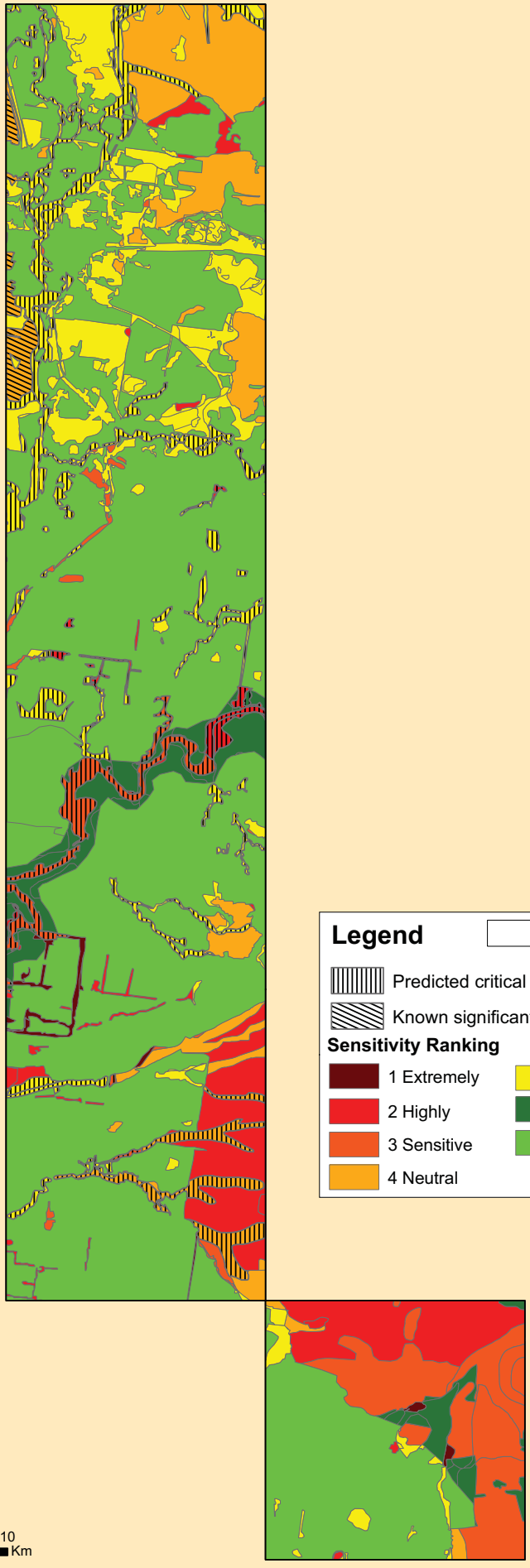


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.15

CarinyaTerrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact
Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Biodiversity Assessment and Management

Figure A.16

Condabri Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

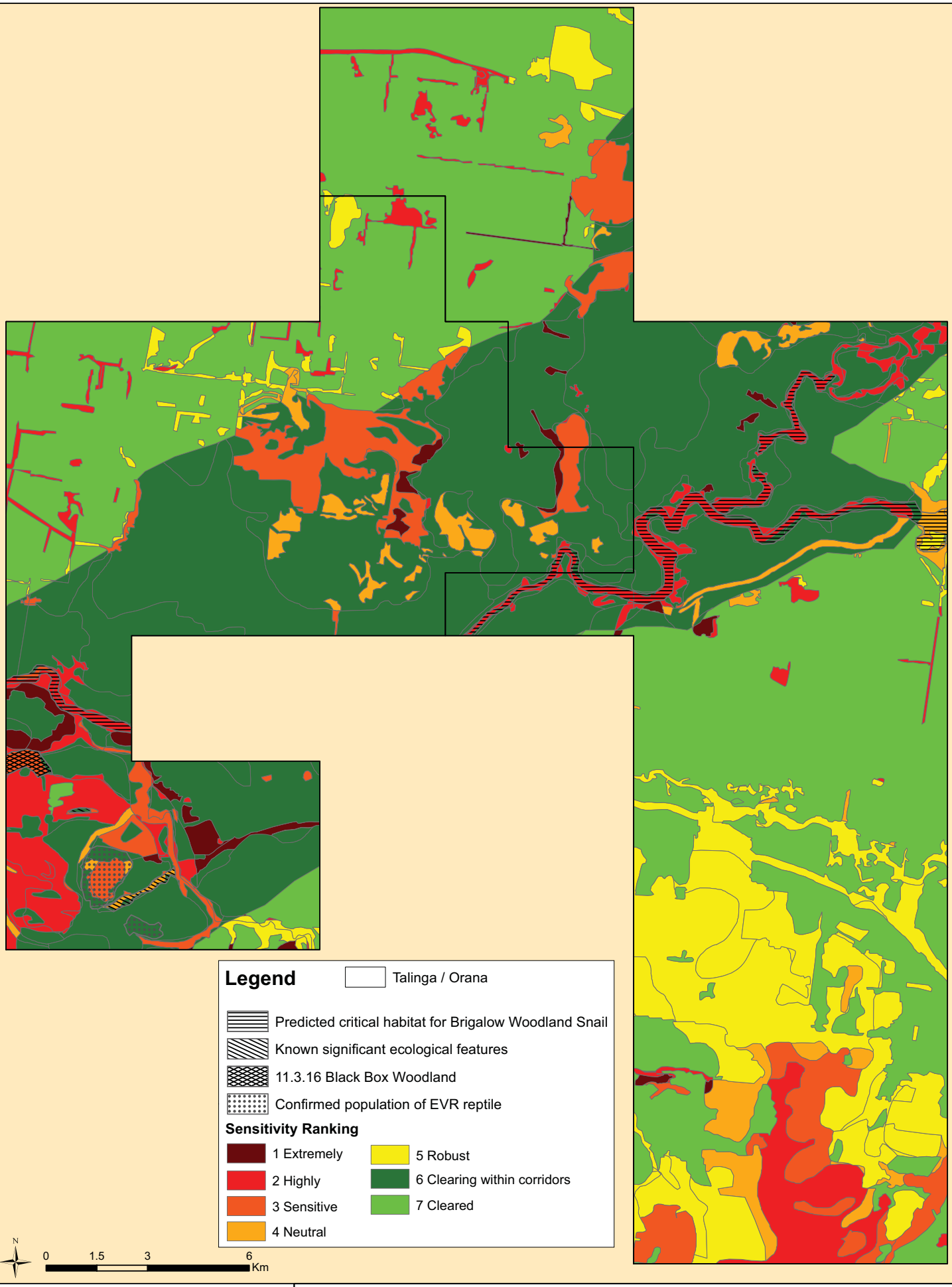
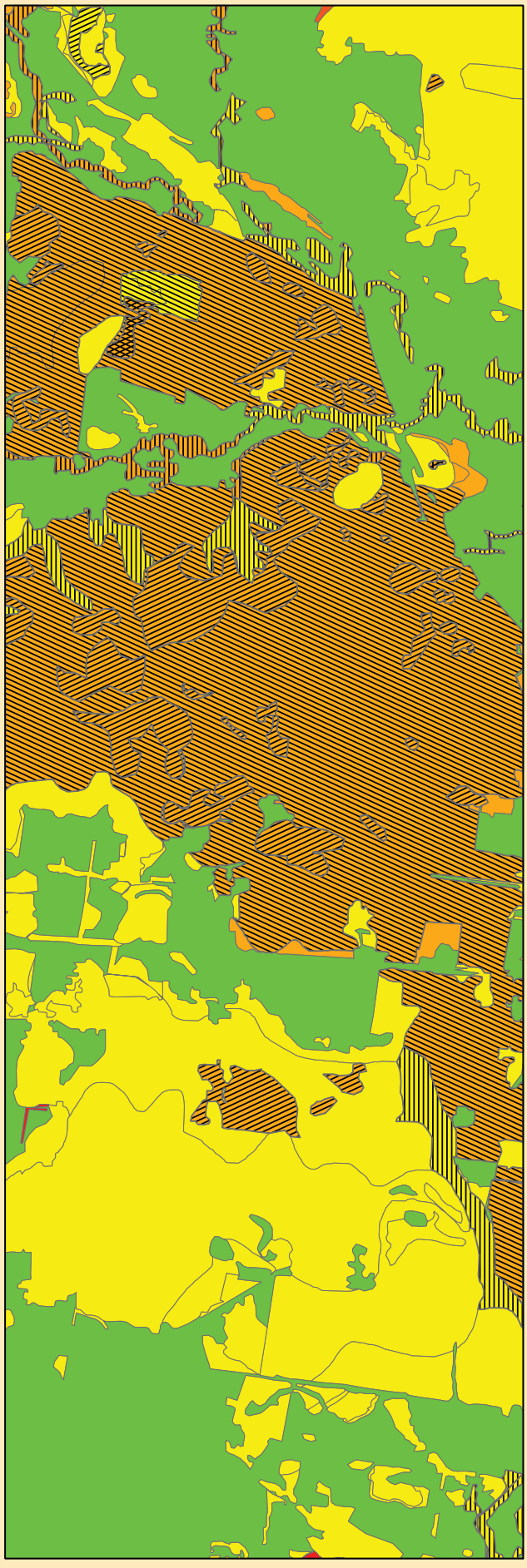


Figure A.17

Talinga / Orana Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

- Dalwogan
- Predicted critical habitat for Dulacca Woodland Snail
- Known significant ecological features
- Endemic threatened species

Sensitivity Ranking

- 1 Extremely
- 2 Highly
- 3 Sensitive
- 4 Neutral
- 5 Robust
- 6 Clearing within corridors
- 7 Cleared

N

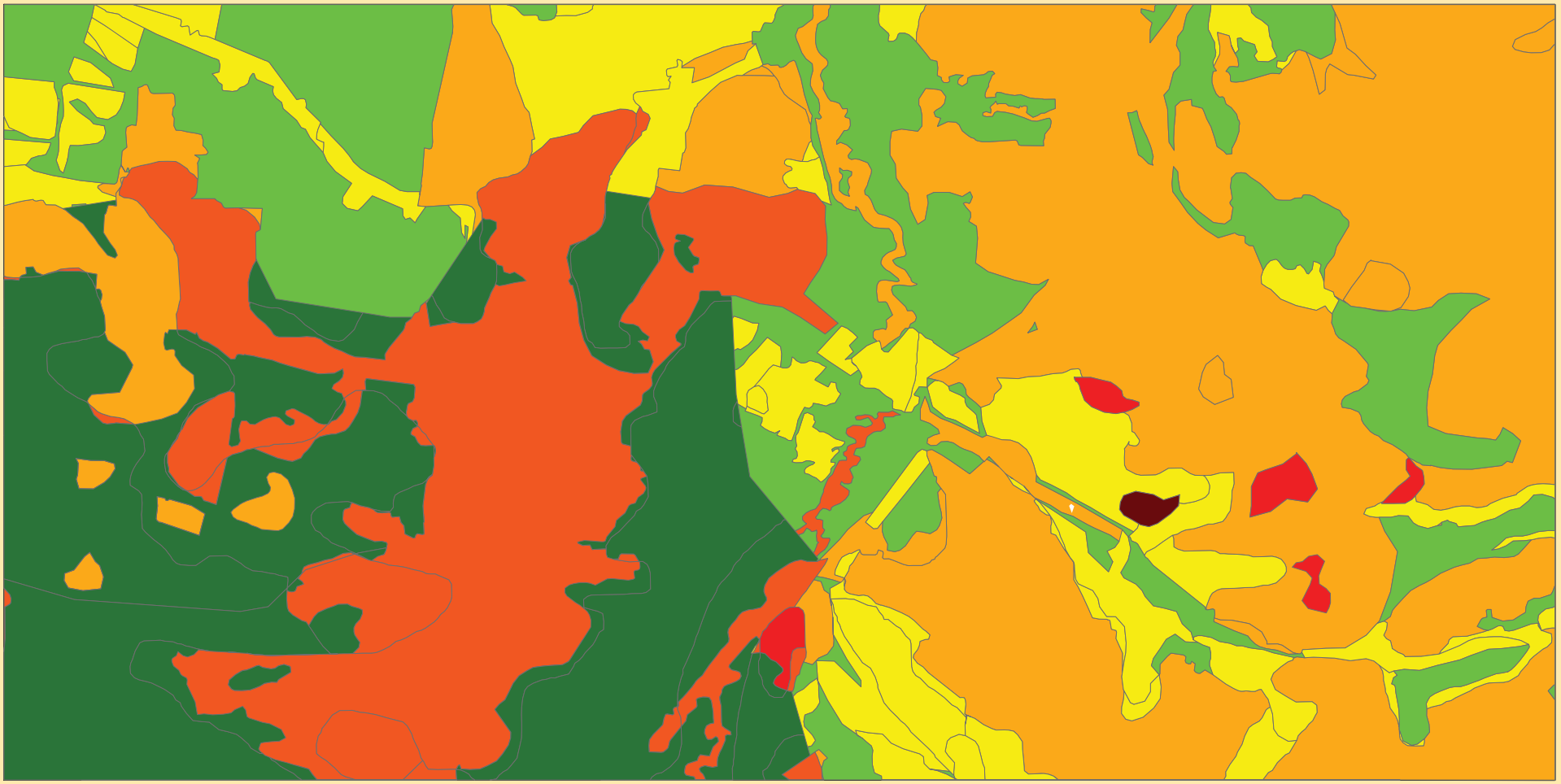
0 1.25 2.5 5 Km

Biodiversity Assessment and Management Pty Ltd

Figure A.18

Dalwogan Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

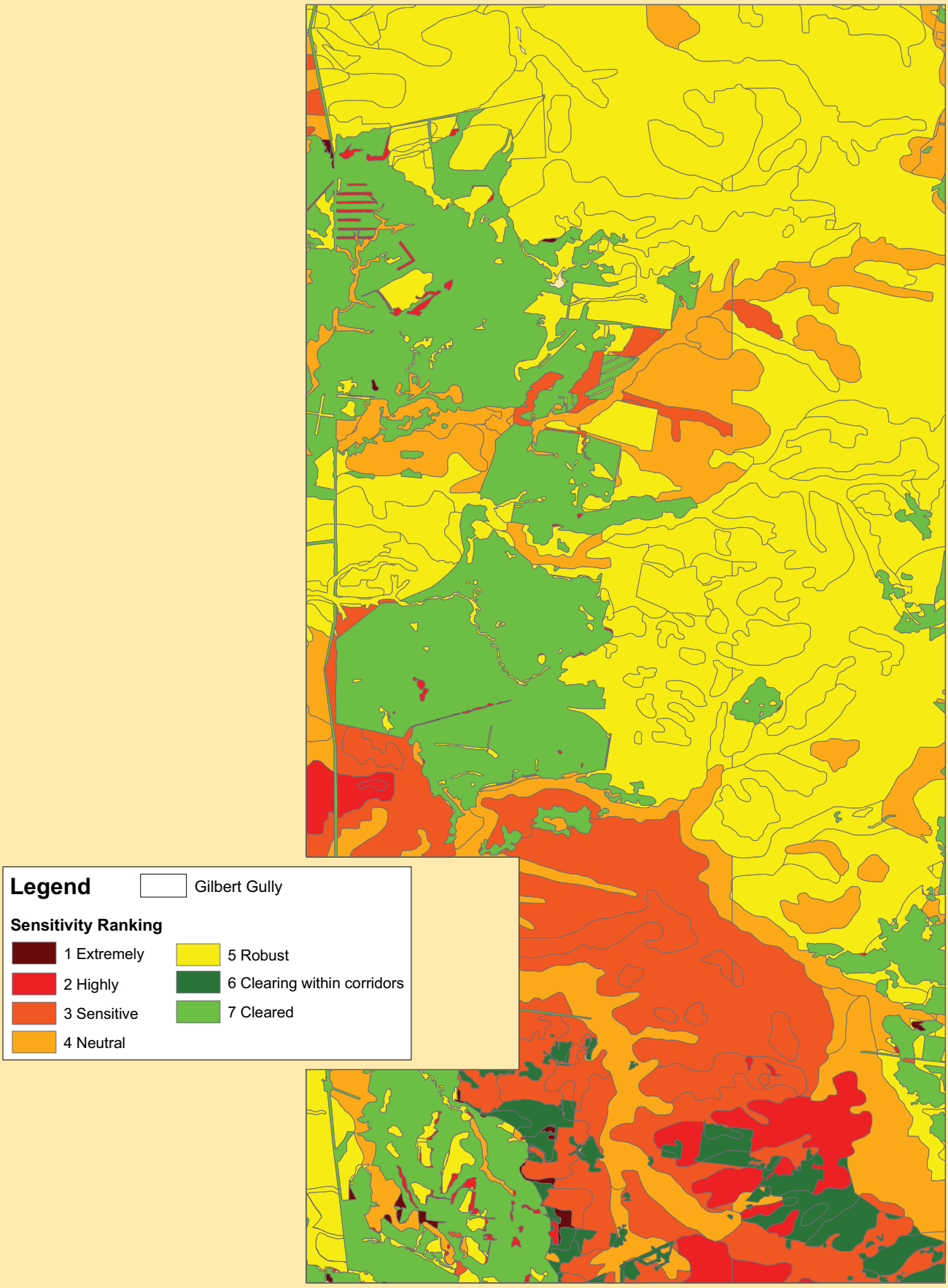


Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure A.19

Kainama Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS



Biodiversity Assessment

Figure A.20

Gibert Gully Terrestrial Ecology "Sensitivity" Map
Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

1.4 Biodiversity Planning Assessment

The study area falls within the BBS bioregion, for which a Biodiversity Planning Assessment (BPA) was initially prepared in 2002, and revised and updated in 2008 (EPA 2008a, b, c). Each BPA uses the Biodiversity Assessment and Mapping Methodology (BAMM) (EPA 2002a) as a consistent approach for assessing biodiversity values at the landscape scale in Queensland using vegetation mapping data generated or approved by the Queensland Herbarium as a fundamental basis (EPA 2008a, b, c). Initially, seven diagnostic criteria are created based on existing data. The results are then refined by expert panels, particularly in terms of habitat for significant species, bioregional corridors, other special biodiversity values and key threatening processes in the bioregion of interest.

Results and relevant information from expert panel reports applicable to the study area are provided in Appendix D, along with mapping of overall biodiversity significance and corridors. As noted in Appendix A, all BPA results were used in the first instance to help prioritise sites included in the 2009 ground surveys, as well as determine the relative importance of terrestrial ecological values across the study area.

As RE mapping provides the basis for much of the BPA criteria and associated mapping, the project-scale assessment of REs (as undertaken for this report and provided in Section 2.3) replaces the need to examine the broad-scale results of the BPA. Exceptions are those criteria that provide useful information about broad-scale habitat value and movement opportunities for native fauna that cannot necessarily be obtained from other sources. These include:

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

corridors, which provides particularly useful information on broad-scale wildlife habitat, movement and dispersal opportunities.

Table 2.2 and Figure 2.2 provide a summary of the results of these criteria for the study area. More detailed analyses for each of the gas field tenements are provided in Appendix D.

Table A.3. Terrestrial Ecology Sensitivity Categories

"Heat" Score (Grouping)	Category	Polygon Attributes	Sensitivity
35 – 49 32 – 34	1	• All are Endangered EPBC listed communities. • 98% are Endangered under the VM Act, including biodiversity status. • 86% have Very High habitat values. • 40% are in a State of Regional Corridor. • 82% have Very High or High values for Tract Size. • All are 5 ha or more in size.	**Extremely sensitive** Habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region and are likely to be in good condition due to minimal impacts of edge effects and located where they enhance ecological functions at a landscape level.
28 – 31 25 - 27	2	• 82% are Endangered EPBC listed communities. • 81% are Endangered under the VM Act, including biodiversity status. • 80% have High or Very High habitat values • All that have low habitat values are in State Corridors and have Very High or High values for Tract Size. • 24% are in a State or Regional Corridor. • 36% have Very High or High values for Tract Size. • Includes polygons of less than 5 ha that scored 32 – 49 for Ecological Importance.	**Highly Sensitive** The majority of habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region. In comparison to those patches in Category 1, these patches have a reduced chance of being in good condition due to increased impacts of edge effects and are less likely to be located where they enhance ecological functions at a landscape level. Those patches that are of less importance at a National and State level or that possess lower habitat values are more likely to be in good condition and located where they enhance ecological functions at a landscape level.
23 – 24 21 – 22	3	• 12% are Endangered EPBC listed communities. • 5% are Endangered under the VM Act, including biodiversity status. • 71% are Least Concern under the VM Act. • 18% have High or Very High habitat values. • 88% are in a State or Regional Corridor. • 71% have Very High or High values for Tract Size.	**Sensitive** Biodiversity characteristics of these habitat patches are mostly unique at a sub-regional level. These patches are more likely to be in good condition due to their size and located where they enhance ecological functions at a landscape level.
18 – 20 16 – 17 15	4	• 6% are Endangered EPBC listed communities. • 8% are Endangered under the VM Act, including biodiversity status. • 22% are Of Concern under the VM Act, the remainder are Least Concern. • 28% have High or Very High habitat values. • 40% are in a State or Regional Corridor. • 56% have Very High or High values for Tract Size.	**Neutral** Habitat patches within this category have a low chance of possessing biodiversity characteristics unique and threatened at a National or State level. These patches contribute little to ecological functions at a landscape scale and are likely to be in poor condition due to edge effects. Also includes patches that are either large in size or within recognised corridors and possess biodiversity values that are

"Heat" Score (Grouping)	Category	Polygon Attributes	Sensitivity
		• None of the EPBC listed communities is within a State or Regional Corridor.	common within the bioregion.
14 12 – 13 11 8 – 10 2 – 7 1	5	• <1% are Endangered EPBC listed communities, sub-dominant in heterogeneous polygons. • <1% are Endangered under the VM Act, including biodiversity status. • 60% are Least Concern under the VM Act. • 32% are regrowth. • 6% have High or Very High habitat values. • 95% are not in a State, Regional or Local corridor. • 27% have Very High or High values for Tract Size.	**Robust** Biodiversity values within this category are generally common within the bioregion, patches are isolated from other remnant vegetation or likely to be in poor condition due to edge effects. The majority of species within these patches are either increaser species that proliferate in agro-ecosystems or unable to persist in the long-term as resources in the patch degrade.
n/a	6	• 100% cleared areas in State or Regional corridors.	**Cleared** These areas are currently devoid of vegetation or other habitat features and do not provide important habitat for many native species. Where such areas occur within a recognised corridor, they are afforded a higher category (6) due to the opportunity for enhancing landscape connectivity through rehabilitation of the pre-clearing vegetation community.
n/a	7	• 100% cleared areas no in State or Regional corridors.	

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
Pseudomys patrius	Eastern Pebble-mouse		C	x	11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.7, 11.10.1, 11.10.1d, 11.10.3, 11.10.7, 11.10.11, 11.10.13

1 Vagrant or marginal species that could occur in any Regional Ecosystem, would only occur in non-remnant vegetation or would occur on artificial waterbodies are excluded.

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

3 'Back on Track' species http://www.epa.qld.gov.au/nature_conservation/wildlife/back_on_track_species_prioritisation_framework/

4 Core habitat is not identified for those species whose life history is insufficiently known or for some species whose distribution is marginal within the study area.

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

6 Undescribed species with no common name, alpha-numeric code is as cited in Queensland Museum database.

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

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

9 Listed as Migratory under the EPBC Act as Painted Snipe Rostratula benghalensis s. lat.

10 Very recently described as Nyctophilus corbeni (Parnaby 2009).

A.5 REFERENCES

DERM (2009). 'Regional Ecosystem Mapping.' Version 5.0, Queensland Herbarium, Queensland Department of Environment and Resource Management, Brisbane.

Eddie, C (2008). 'Fauna and flora of 'Rockwood', Talinga Development Area, southern inland Queensland: historical summary.' Report to Origin Energy and Golder Associates, BOOBOOK Wildlife Consulting, Roma.

EPA (2002a). 'Biodiversity Assessment and Mapping Methodology.' Environmental Protection Agency Biodiversity Planning Unit, Biodiversity Branch Version 2.1, July 2002. Brisbane.

EPA (2002b). 'Biodiversity Planning Assessment: Brigalow Belt South Fauna Expert Panel Report.' Environmental Protection Agency, Brisbane.

EPA (2007). 'Regional Ecosystem Description Database (REDD).' Version 5.2. Queensland Herbarium, Environmental Protection Agency, Brisbane. Updated November 2007.

EPA (2008a). 'Brigalow Belt South Fauna Expert Panel Report.' Environmental Protection Agency, Brisbane. Revised and updated June 2008.

EPA (2008b). 'Brigalow Belt South Flora Expert Panel Report.' Environmental Protection Agency, Brisbane. October 2002. Revised and updated June 2008.

EPA (2008c). 'Brigalow Belt South Landscape Expert Panel Report.' Environmental Protection Agency, Brisbane. August 2002. Revised and updated June 2008.

Eyre, TJ, Jermyn, D and Kelly, AL (2000). 'Forest Condition and Habitat Assessment in Queensland.' Forest Ecosystem Research and Assessment Standards for Forest Assessment Technical Report 02/00. Department of Natural Resources, Brisbane.

Jenks GF and Caspall FC (1971). 'Error on choroplethic maps: Definition, measurement, reduction.' *Annals of the Association of American Geographers*, **61**:217-244.

McFarland, D, Haseler, M, Venz, M, Reis, T, Ford, G and Hines, B (1999a). 'Terrestrial vertebrate fauna of the Brigalow Belt South Bioregion: Assessment and analysis for conservation planning.' Queensland Environmental Protection Agency, Brisbane.

McFarland, D, Venz, M and Reis, T (1999b). 'Priority species summaries. An attachment to the report: Terrestrial vertebrate fauna of the Brigalow Belt South Bioregion: Assessment and analysis for conservation planning.' Queensland Environmental Protection Agency, Brisbane.

Neldner, VJ, Wilson, BA, Thompson, EJ and Dillewaard, HA (2005). 'Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 3.1.' Queensland Herbarium, Environmental Protection Agency, Brisbane.

Richardson, R (2006). 'Queensland Brigalow Belt Reptile Recovery Plan.' Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. WWF-Australia, Brisbane.

SBRVMC (2003). 'Southern Brigalow Region draft regional vegetation management plan.' Southern Brigalow Regional Vegetation Management Committee, location unknown.

Venz, M, Mathieson, M and Schulz, M (2002). 'Fauna of the Dawson River Floodplain.' Queensland Parks and Wildlife Service, Brisbane.

Young, PAR, Wilson, BA, McCosker, JC, Fensham, RJ, Morgan, G and Taylor, PM (1999). 'Brigalow Belt.' In: P Sattler and R Williams (eds.), *The conservation status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane. pp. 11/1-11/81.

ATTACHMENT 1

FIELD DATA SHEETS

Walloons Quaternary Site Proforma Botanist Date

Waypoint		Latitude / Easting:……	Longitude / Northing: ……
Slope:	Crest; Ridge; Hillock; Simple slope; Upper slope; Midslope; Lower slope; Flat; Open / Closed depression		
Total Vegetation Area:; < 1ha; 1-5ha; 5-20ha; 20-50ha; >50ha			
Regional Ecosystem:			
Geology/soils/Landzone			

Dominant Species Observable D = dominant C = Co-dominant A = Associated S = Suppressed

Botanical Species	Dom	Average Height (m)							Dense/mid-dense/sparse/very sparse						
		E	T1	T2	T3	S1	S2	G	E	T1	T2	T3	S1	S2	G

Visible canopy recruitment	none	some	strong	
% weeds observable	< 5	5 - 25	25 - 50	> 50
% disturbance observable	< 5	5 - 25	25 - 50	> 50

D = Dense MD = Mid-Dense S = Sparse V = Very Sparse

Waypoint		Latitude / Easting:……	Longitude / Northing: ……
Slope:	Crest; Ridge; Hillock; Simple slope; Upper slope; Midslope; Lower slope; Flat; Open / Closed depression		
Total Vegetation Area:; < 1ha; 1-5ha; 5-20ha; 20-50ha; >50ha			
Regional Ecosystem:			
Geology/soils/Landzone			

Dominant Species Observable D = dominant C = Co-dominant A = Associated S = Suppressed

Botanical Species	Dom	Average Height (m)							Dense/mid-dense/sparse/very sparse						
		E	T1	T2	T3	S1	S2	G	E	T1	T2	T3	S1	S2	G

Visible canopy recruitment	none	some	strong	
% weeds observable	< 5	5 - 25	25 - 50	> 50
% disturbance observable	< 5	5 - 25	25 - 50	> 50

D = Dense MD = Mid-Dense S = Sparse V = Very Sparse

VEGETATION ASSESSMENT – TERTIARY SURVEY SITE

Project Number: …					Recorder/s: …….		
Site Number: ……					Date / Time: ……../……./…… …….		
Location: ……							
GPS Location:	Latitude / Easting:……				Longitude / Northing: …….		
Altitude:	0	0 - 50	50 - 100	100 - 250	250 - 500	500 - 1000	> 1000
Slope:	Crest; Ridge; Hillock; Simple slope; Upper slope; Midslope; Lower slope; Flat; Open / Closed depression						
Soils:	Map; Cutting; Core; Surface observation						
Reliability:	Low, Medium, High						
Soil Colour:	Whitish, Grayish, Mottled, Yellow, Orange, Red; Brown; Grey; Black; Dark; Pale						
Soil Texture:	Clay; Clay loam; Silty loam; Loam; Sandy loam; Sand; Stony; Silty clay; Sandy clay; Silty clay loam; Sandy clay loam; Loam sand						
Geology:	Inferred; Vertical Exposure; Auger Boring; Outcrop						
Reliability:	Low, Medium, High						
Code:	Unconsolidated; Weathered; Sedimentary; Metamorphosed; Igneous						
RE Width: <35m; 35-75m; 75-150m; 150-300m; >300m; not linear							
Total Vegetation Area: Does not extend beyond site; < 1ha; 1-5ha; 5-20ha; 20-50ha; >50ha							
DNRW Mapped as: RE ……							
Confirmed on Ground to be: RE …… EPBC: E VMA: EN / OC / NOC/ non-remnant							

Dominant and EVR Species in 50 m x 10 m Plot

Botanical Species	Status*	Average Height (m)							Abundance (Basal Area – m^2/ha)						
		E	T1	T2	T3	S1	S2	G	E	T1	T2	T3	S1	S2	G
% Rock															
% Bare ground															
% Leaf litter															
% Cryptogram															

Status: EVR = significant species, # = weed, ## = declared plant

VEGETATION ASSESSMENT – TERTIARY SURVEY SITE

Potential EVR flora species habitat: Y / N	EVR flora species collected: Y / N

Weed species: ……...

……

% Weed cover: < 5 5 - 25 25 - 50 > 50

Disturbance:……

……

% Disturbance: < 5 5 - 25 25 - 50 > 50

Overall Health: Pristine / Excellent / Very Good / Good / Average / Degraded / Completely degraded (no natives)

Landform situation:

PLAIN	HILLS & TABLELANDS	DUNES	STREAMS	WATER
▪ Not specified	▪ Not specified	▪ Not specified	▪ Not specified	▪ Not specified
▪ Downs	▪ Cliff, rocky ledge, outcrop, scarp, crevice	▪ Fossil coastal dune, high dune	▪ Lakes, banks of water-course - permanent	▪ Freshwater lake, lagoon, spring, stream
▪ Alluvial plain, floodplain	▪ Coastal rocky headland	▪ Inland dune, inland sandhill	▪ Gully, drainage line – intermittently wet	▪ Freshwater swamp, marsh, soak, seepage
▪ Inland claypan, saltpan	▪ Top, crest of mountain or ridge		▪ Channel bed – intermittently flooded	▪ Gilgai, melon hole, sinkhole
▪ Tidal flat, salt flat	▪ Jump-up, mesa, tableland, plateau			▪ Saltwater, sea, saltwater swamp

Erosional Landform Patterns:

SLOPE CLASS	Level	Very Gently Inclined	Gently Inclined	Moderately Inclined	Steep	Very Steep	Precipitous
Degree	< 1	1 - 3	3 - 10	10 - 32	32 - 56	56 - 100	> 45
RELIEF	Erosional Landform Pattern						
Very High > 300 m	---	---	---	Rolling mountains	Steep mountains	V. steep mountains	Precipitous
High 90 – 300 m	---	---	Undulating hills	Rolling hills	Steep hills	V. steep hills	Precipitous hills
Low 30 – 90 m	---	---	Undulating low hills	Rolling low hills	Steep low hills	V. steep low hills	Badlands
Very Low 9 – 30 m	---	Gently undulating rises	Undulating rises	Rolling rises	Steep rises	Badlands	Badlands
Extremely Low < 9 m	Level plain	Gently undulating plain	Undulating plain	Rolling plain	Badlands	Badlands	Badlands

Notes: ……

……

……

……

……

……

……

……

……

……

……

Potential Impacts of Proposed Activity:……

……

……

……

……

……

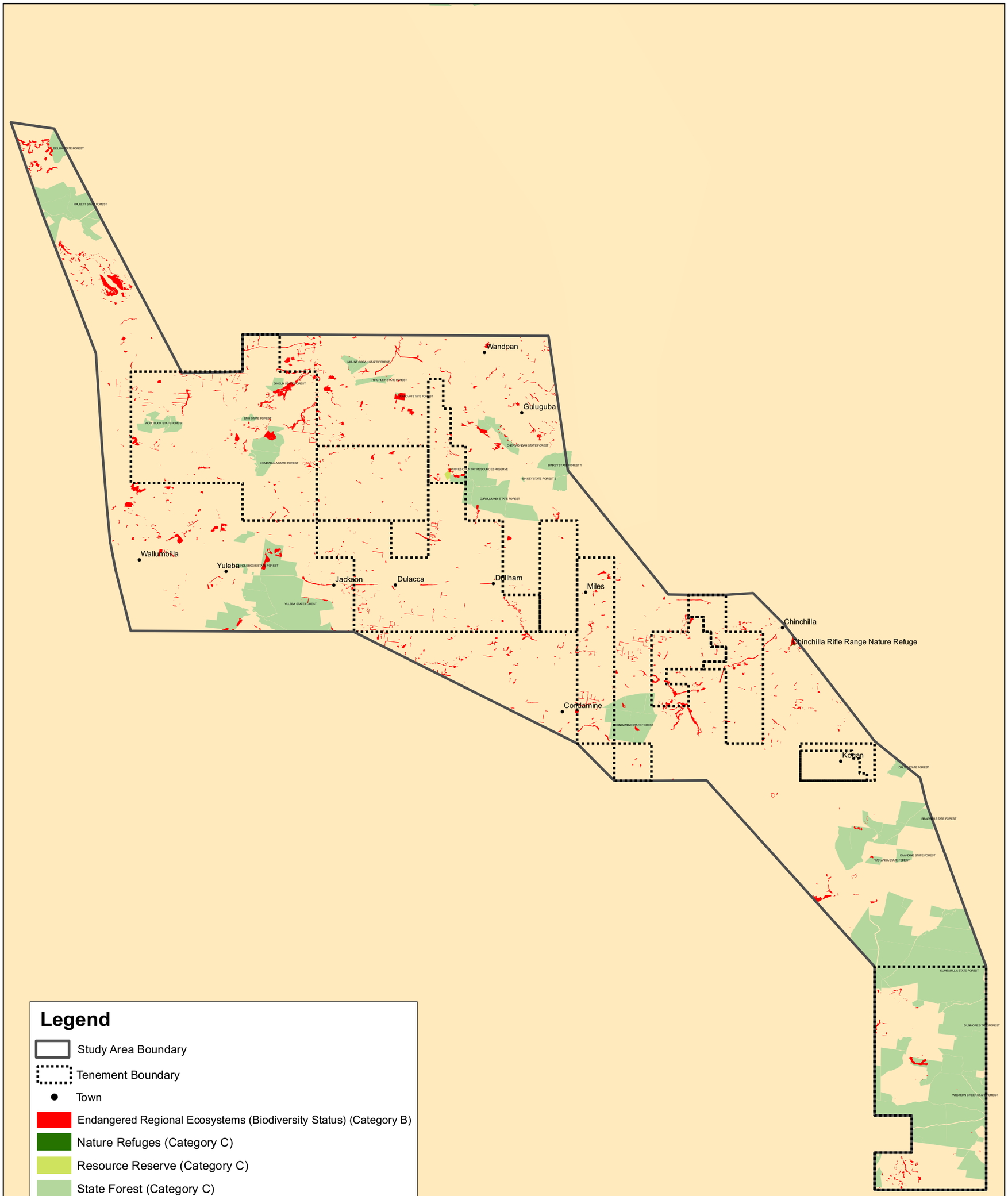
……

……

Site Name		Recorder's Name				Date			Rank 0-5; 0 = no habitat, 1 = very little habitat value, 5 = very good habitat											
Cyclorana verrucosa	**Cracking Clay**		**Gilgai**		Dam		**Overall**													
Limnodynastes salmini	River/Creek/ Billabong		Dam		Gilgai		Cracking Clay		Coarse Woody Debris		Exfoliating Bark (fallen)		Fringing Vegetation		**Overall**					
Emydura macquarii	River/Creek/ Billabong																			
Macrochelodina expansa	River/Creek/ Billabong		Dam																	
Strophurus taenicauda	Exfoliating Bark (standing)		Coarse Woody Debris		**Overall**															
Delma plebeia	Ground Cover		Coarse Woody Debris		Leaf Litter		Loose Rock		**Overall**											
Delma torquata	Ground Cover		Rock Outcrops		Loose Rock		Leaf Litter		Coarse Woody Debris		Exfoliating Bark (fallen)		Canopy Cover		Shrub layer					
Paradelma orientalis	Ground Cover		Coarse Woody Debris		Exfoliating Bark (fallen)		Leaf Litter		Rock Outcrops		Shrub layer		Sandstone		**Overall**					
Anomalopus brevicollis	Canopy Cover		Leaf Litter		Loose Soil		Coarse Woody Debris		Exfoliating Bark (fallen)		Rock Outcrops		Loose Rock		Sandstone					
Ctenotus ingrami	Ground Cover		Shrub layer		Burrows		**Overall**													
Cyclodomorphus gerrardii	**River/Creek/ Billabong**		Tree Hollows		Exfoliating Bark (standing)		Exfoliating Bark (fallen)		Leaf Litter		Caves & Crevices		**Overall**							
Egernia rugosa	Coarse Woody Debris		Hollow Logs		Burrows		Rock Outcrops		Coarse Soil		**Overall**									
Tiliqua rugosus	Ground Cover		Coarse Woody Debris		Leaf Litter		**Overall**													
Chlamydosaurus kingii	Ground Cover		Canopy Height		Tree Hollows		**Overall**													
Physignathus lesueurii	**River/Creek/ Billabong**		Fringing Vegetation		**Overall**															
Tympanocryptis pinguicolla	Cracking Clay		Native Grasses		Canopy Cover		Ground Cover		Spider Holes		**Overall**									
Varanus panoptes	Burrows		**Overall**																	
Aspidites ramsayi	Sand		Cracking Clay		Spinifex		Coarse Woody Debris		Hollow Logs		Rock Outcrops		Burrows		**Overall**					
Acanthophis antarcticus	Leaf Litter		Ground Cover		Shrub layer		Cattle Activity		**Overall**											

Cryptophis boschmai	Cracking Clay		Coarse Woody Debris		Hollow Logs		Exfoliating Bark (fallen)		Leaf Litter		Loose Rock		**Overall**					
Furina dunmalli	Coarse Woody Debris		Hollow Logs		Exfoliating Bark (fallen)		Leaf Litter		**Overall**									
Hemiaspis damelii	**Cracking Clay**		**Gilgai**		River/Creek/ Billabong		Dam		Coarse Woody Debris		Hollow Logs		Exfoliating Bark (fallen)		**Overall**			
Hoplocephalus bitorquatus	Tree Hollows		Exfoliating Bark (standing)		**Overall**													
Pseudechis guttatus	Cracking Clay		Gilgai		River/Creek/ Billabong		Dam		Coarse Woody Debris		Hollow Logs		Exfoliating Bark (fallen)		Burrows			
Freckled Duck	River/Creek/ Billabong		Dam															
Cotton Pygmy-goose	**River/Creek/ Billabong**		**Dam**		Tree Hollows		**Overall**											
Squatter Pigeon	Shrub layer		Ground Cover		River/Creek/ Billabong		Dam		Native Grasses		Sand		**Overall**					
Black-necked Stork	River/Creek/ Billabong		Dam															
Square-tailed Kite	Canopy Height		Canopy Cover		**Overall**													
Grey Goshawk	Canopy Height		Canopy Cover		**Overall**													
Black-breasted Button-quail	**Canopy Cover**		Leaf Litter		**Overall**													
Bush Stone-curlew	Canopy Cover		Shrub layer		Ground Cover		**Overall**											
Australian Painted Snipe, Latham's Snipe	**River/Creek/ Billabong**		**Dam**		Fringing Vegetation		**Overall**											
Glossy Black-Cockatoo	Belah		Other casuarinas		Tree Hollows		River/Creek/ Billabong		Dam		**Overall**							
Turquoise Parrot	Canopy Cover		Shrub layer		Ground Cover		Tree Hollows		River/Creek/ Billabong		Dam		Native Grasses		**Overall**			
Powerful Owl	Canopy Height		Canopy Cover		Tree Hollows		River/Creek/ Billabong		Shrub layer		**Overall**							
Barking Owl	Canopy Height		Canopy Cover		Tree Hollows		River/Creek/ Billabong		**Overall**									

Masked Owl	Canopy Height		Canopy Cover		Tree Hollows		**Overall**										
Eastern Grass Owl	**Canopy Cover**		Ground Cover		**Overall**												
Brown Treecreeper	River/Creek/ Billabong		Coarse Woody Debris		Large Stags		Tree Hollows		Canopy Height		Canopy Cover		Shrub layer		Ground Cover		
Speckled Warbler	Canopy Cover		Shrub layer		Ground Cover		**Overall**										
Black-chinned Honeyeater	Canopy Height		Canopy Cover		**Overall**												
Painted Honeyeater	Mistletoe		**Overall**														
Grey-crowned Babbler	Shrub layer		Ground Cover		**Overall**												
White-browed Babbler	Shrub layer		Ground Cover		**Overall**												
Hooded Robin	Canopy Cover		Shrub layer		Ground Cover		Coarse Woody Debris		**Overall**								
Diamond Firetail	Canopy Cover		Shrub layer		Ground Cover		**Overall**										
Platypus	River/Creek/ Billabong																
Brush-tailed Phascogale	Ground Cover		Tree Hollows		**Overall**												
Narrow-nosed Planigale	**Cracking Clay**		Ground Cover		Coarse Woody Debris		Hollow Logs		**Overall**								
Northern Brown Bandicoot	Shrub layer		Ground Cover		Coarse Woody Debris		Hollow Logs		**Overall**								
Long-nosed Bandicoot	Canopy Cover		Ground Cover		River/Creek/ Billabong		**Overall**										
Koala	Food trees		Canopy Height		Canopy Cover		River/Creek/ Billabong		**Overall**								
Yellow-bellied Glider	Feeding Scars		Canopy Height		Canopy Cover		Tree Hollows		**Overall**								
Squirrel Glider	Canopy Height		Canopy Cover		Tree Hollows		**Overall**										
Greater Glider	Canopy Height		Canopy Cover		Tree Hollows		River/Creek/ Billabong		**Overall**								
Common Brushtail Possum	Canopy Height		Canopy Cover		Tree Hollows		River/Creek/ Billabong		**Overall**								
Rufous Bettong	Canopy Cover		Shrub layer		Ground Cover		Native Grasses		**Overall**								



Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 2.1

Study Area DERM Environmentally Sensitive Areas Mapping:Terrestrial Ecology

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

Brush-tailed Rock-wallaby	Rock Outcrops		Sandstone		Caves & Crevices		**Overall**							
Grey-headed Flying-fox		River/Creek/ Billabong												
South-eastern Long-eared Bat	Tree Hollows		Exfoliating Bark (standing)		Shrub layer		Sand		**Overall**					
Large-eared Pied Bat, Eastern Bentwing Bat	Sandstone		Caves & Crevices		**Overall**									
Little Pied Bat		Tree Hollows			Caves & Crevices		**Overall**							
Eastern Pebble-mouse	Loose Rock		Ground Cover		**Overall**									
Eastern Great Egret		River/Creek/ Billabong			Dam		**Overall**							
Glossy Ibis	River/Creek/ Billabong		Dam		**Overall**									
Eastern Osprey, White-bellied Sea-Eagle		**River/Creek/ Billabong**			**Dam**		Large Stags		**Overall**					
Pacific Golden Plover, Little Curlew	**Dam**		Surrounding ground cover		**Overall**									
Common, Wood & Sharp-tailed Sandpiper		**River/Creek/ Billabong**			**Dam**		**Overall**							
Black-tailed Godwit, Greenshank, Red-necked Stint, Marsh & Curlew Sandpiper		Dam												
Rufous Fantail, Satin Flycatcher, Black-faced & Spectacled Monarch		Canopy Cover			Shrub layer		River/Creek/ Billabong		**Overall**					
Rainbow Bee-eater	Canopy Cover		Shrub layer		**Overall**									
Australian Reed-Warbler		**River/Creek/ Billabong**			**Dam**		Fringing Vegetation			**Overall**				

Comments

Woodland and open forest on alluvial soils

All of this habitat type in the study area occurs on Land Zone 3, near-level alluvial plains with riverine components and wetlands (Sattler 1999). The soils include uniform and cracking clays, massive earths, sand, texture contrast soils and loams. Dominant tree species include Queensland Blue Gum, River Red Gum, Poplar Box, Silver-leaved Ironbark, Coolibah, Rough-barked and Smooth-barked Apple, and Gum-topped Box (EPA 2007).

The habitat is often characterised by a diverse and variable canopy tree assemblage, and may include a well developed low tree/shrub layer comprised of various combinations of Acacia, Eremophila, Callitris, Melaleuca and Allocasuarina species, among others. However, such a mid-layer may be absent, particularly in REs 11.3.3 and 11.3.4. The ground layer varies with soil and management conditions but may include grasses such as Bothriochloia, Chloris, Aristida, Eriachne, Panicum, Dichanthium and Themeda species, forb species and, particularly in riparian areas, sedges (EPA 2007).

A number of the typically dominant tree species, such as Queensland Blue Gum, River Red Gum and Poplar Box, develop large hollows when mature and provide very important roosting and nesting resources for fauna species including Glossy Black-Cockatoo, gliders and some owl and micro-bat species. The higher productivity of alluvial areas, particularly in riparian zones, supports more species overall and provides greater resources for predators such as Square-tailed Kite and owls. It is also the habitat most likely to support two endangered species, Red Goshawk and Swift Parrot, that are very occasional/ marginal within the study area. The floodplains, especially areas of cracking clays, will be important to frog species.

Of the sites surveyed within this habitat there is no consistent level of disturbance, with sites ranging from very low disturbance levels to severe, though the most frequent ranking (40% of sites) was 'moderate' disturbance. There was a high presence of, and high level of disturbance by, livestock (70%) and weeds were both more abundant and more species rich than in all other habitats, as expected based on soil nutrients, productivity and topography. The sites generally had little or no large coarse woody debris, significantly reducing their utility to larger terrestrial reptiles and mammals. This is likely to be a consequence of land use.

Virtually all conservation significant species regularly recorded in the study area occur in woodlands and open forests on alluvial soils, at least sporadically. Although the varying impacts of weeds and livestock and the variable amounts of terrestrial micro-habitats mean that faunal use will not be consistent across the habitat type, even within specific REs, this habitat type is very important to fauna, both conservation significant species and those considered of less priority.

Woodland and open forest on non-alluvial soils

This habitat type occurs on Land Zones 4, 5, 7, 9 and 10. This comparative diversity means that soil, vegetation community and topography encompass a wide range with the habitat. Soils include shallow soils, sand plains, texture contrast soils with sandy surfaces, deep sands, fine-grained sediments, loamy red earths, and, for RE 11.4.12, clay plains (EPA 2007).

RE 11.4.12 is the only RE in Land Zone 4 within the study area that is not a Brigalow community. It is dominated by Poplar Box, which is frequently the only canopy species, and generally has a low tree/tall shrub layer dominated by False Sandalwood, Myall and Wilga. It has been extensively cleared (EPA 2007). All Land Zone 5 REs in the study area fall within this habitat type and canopies are dominated by species such as Narrow-leaved Red Ironbark, Silver-leaved Ironbark, Poplar Box, Baradine Red Gum, Smooth- and

Tenement Name				Site Name				Date	
Recorders			GPS Co-ords						
Camera			Photo number(s)						
Landform	Downs	Alluvial Plains		Cliff/Scarp		Ridge	Jump-up	Channel Bed	
Slope	Crest	Ridge	Hillock	Simple Slope		Upper Slope		Midslope	
	Lower Slope		Flat	Open Depression		Closed Depression			
Soils	Cutting		Surface Observation		**Soil Colour**	Whitish		Greyish	
Mottled	Yellow	Orange	Red	Brown		Grey	Black	Dark	Pale
Soil Texture	Clay	Clay Loam	Silty Loam	Loam		Sandy Loam		Sand	
Stony	Silty Clay	Sandy Clay	Silty Clay Loam			Sandy Clay Loam		Loam Sand	
RE (mapped)		**RE correct**	yes	no		maybe			
If no, describe									
Dominant Tree Species (biomass)									
Subdominant Tree Species									
Canopy Height	<6 m	<10 m	10-15 m	15-20 m		20-30 m	>30 m		
Canopy structure	homogeneous	patchy	heterogeneous			Height of Tallest Emergent			
Canopy Cover	very sparse	sparse	mid-dense	dense					
Evidence of canopy species recruitment			none	some		strong			
Shrubs (branches <30 cm from ground)		very sparse	sparse	mid-dense		dense			
Ground Cover	very sparse	sparse	mid-dense	dense					
Spinifex	none	very sparse	sparse	mid-dense		dense			
No. of hollow-bearing trees (all hollows big enough for micro-bats)									
No. of hollow-bearing trees (hollows >10 cm diameter)									
No. of hollows (all hollows big enough for micro-bats)				No. of large Stags (40+ cm)					
No. of hollows (hollows >10 cm)				Diameter of largest Tree(s)					
Waterbody present	yes	no	**Type of Waterbody**		Dam	Lake	Creek		
Swamp	Spring	Gilgai	Seepage	**Hollow-bearing Stags in water**			yes	no	
Fringing Vegetation	Reeds	Sedges	Melaleuca	Other (state)					
Weeds (list species)									
Weed cover %	<5	5-25	25-50	>50	**Radius assessed**				
Disturbance type(s)	livestock	fire	recreational	logging		extractive industry			
Comments including other disturbance									
Disturbance severity (inc weeds)	none	very low	low	moderate		high	severe		
Fire History	days	weeks	months	years		decades			
Fire Severity	cool burn	scorched trunks	some crown death	much crown death					

Infrastructure	buildings	road/track	fence	culvert	
Other infrastructure (state)					
Human Debris	car bodies	sheets of tin	household refuse	vehicle tyres	
wood	other (state)				
Mistletoe	none	sparse	common	very common	**Glossy Black feeding signs**
Belah present	yes	no	**Fruiting**	yes	no

Coarse Woody Debris measured over 50 m transect where fallen timber intercepts the line				
Size classes (diameter cm)	3-10	11-30	31-50	>50
Exfoliating Bark (standing)	none	sparse	common	very common
Exfoliating Bark (fallen)	none	sparse	common	very common

Leaf Litter % of cover	<5	5-25	25-50	>50
Leaf Litter (average) depth mm	single leaf	<5	5-10	>10
Rock (general description)	sandstone	exfoliating slabs	cliff faces	loose rocks
Rock abundance	none	sparse	common	very common

Caves and crevices	describe:				
no	yes				
Burrows	no	yes	size(s)	number	
Evidence of Cane Toads	no	yes	**if yes:**	sparse	common	very common
Connectivity inc regrowth	isolated	poor	moderate	good	

Comments on connectivity

Movement Possibilities

Other Comments

Appendix B:
Relevant Ecological Legislation and Planning Instruments

APPENDIX B

RELEVANT ECOLOGICAL LEGISLATION AND PLANNING INSTRUMENTS

TERRESTRIAL ECOLOGY AND IMPACT ASSESSMENT REPORT – GAS FIELDS COMPONENT AUSTRALIA PACIFIC LNG PROJECT EIS

Table of contents

B.1 THE COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At the Commonwealth level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) identifies Matters of National Environmental Significance (MNES) that may be present in the Study Area. In terms of terrestrial ecology, these include threatened species and ecological communities, and listed migratory species (and their habitats, including Ramsar wetlands). One or more species and/or ecosystems having conservation significance may require specific management regimes dependant upon the level of impacts from any proposed activities.

In planning for the Project, there was a requirement for a referral to the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) as per the EPBC Act Policy Statement 1.1: Significant Impact Guidelines, Matters of National Environmental Significance (DEH 2006) for assessment against the EPBC Act. The Australian Government has determined that the project constitutes a controlled action pursuant to the EPBC Act (and therefore requires assessment and approval) as it is likely to have a significant impact on MNES, including listed threatened and migratory species and communities and Ramsar wetlands, and that the assessment would be under a bilateral agreement with the Queensland Government.

B.2 STATE LEGISLATION

B.2.1 THE QUEENSLAND STATE DEVELOPMENT AND PUBLIC WORKS ORGANISATION ACT 1971

The *State Development and Public Works Organisation Act 1971* allows the promotion and facilitation of large projects in Queensland through various means. This includes the ability of the Coordinator-General to declare a 'significant project' that requires a formal Environmental Impact Statement (EIS) process involving public notification that is linked to the Commonwealth process under the EPBC Act via a bilateral agreement. This over-rides other Environmental Impact Assessment processes, such as those under the *Integrated Planning Act 1997* and *Environmental Protection Act 1994*.

On 7 April 2009 the Coordinator-General declared the project a 'significant project' for which an EIS is required in accordance with Part 4 of the *State Development and Public Works Organisation Act 1971*.

B.2.2 THE QUEENSLAND ENVIRONMENTAL PROTECTION ACT 1994

The object of this Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends ('ecologically sustainable development').

This legislation is directly relevant to the Project in that, as for mining activities, environmental protection aspects of petroleum (including coal seam gas) exploration, extraction and pipeline licensing are regulated under the EP Act.

An environmental activity may be prescribed by regulation as an Environmentally Relevant Activity (ERA) and may be ascribed a 'Level 1' or 'Level 2' ERA depending on the risk of environmental harm. All ERAs are to be licensed by DERM (the Queensland Department of Environment and Resource Management). This can be achieved under an Integrated Environmental Management System.

Under the EP Act, proposed activities that will have a significant impact on Category A or B 'environmentally sensitive areas', involve the construction of a new pipeline under a pipeline licence for a transmission pipeline, and/or involve the construction of a petroleum refining or processing facility, require the preparation of an EIS and associated Environmental Management Plan (EMP). In terms of terrestrial ecology, Category A environmentally sensitive areas include National Parks, Conservation Parks and Forest Reserves, while Category B environmentally sensitive areas include Ramsar wetlands, State Forests and Endangered Regional Ecosystems.

B.2.3 THE QUEENSLAND NATURE CONSERVATION ACT 1992

One of the aims of the EP Act is to minimise environmental harm. Therefore, planning for the Study Area must consider the guidelines and provisions of Queensland's *Nature Conservation Act 1992* (NC Act), which lists protected areas (such as National Parks) and

species of significance at a state level and thereby assists in the determination of terrestrial ecological values of the Study Area.

The NC Act (Section 73) states that:

> 'Protected wildlife is to be managed to—
>
> (a) conserve the wildlife and its values and, in particular to—
>
> (i) ensure the survival and natural development of the wildlife in the wild; and
>
> (ii) conserve the biological diversity of the wildlife to the greatest possible extent; and
>
> (iii) identify, and reduce or remove, the effects of threatening processes relating to the wildlife; and
>
> (iv) identify the wildlife's critical habitat and conserve it to the greatest possible extent; and …'.

Protected wildlife is also linked to the Queensland *Vegetation Management Act 1999* (below) through the mapping of Remnant Vegetation and associated Essential Habitat for state significant species contained therein.

B.2.4 THE QUEENSLAND VEGETATION MANAGEMENT ACT 1999

The purpose of the *Vegetation Management Act 1999* (VM Act) is to regulate the clearing of native vegetation (i.e. remnant vegetation mapped as Regional Ecosystems (REs and high-value regrowth vegetation) that are: Endangered, Of Concern and Least Concern) to maintain ecological processes, ensure there is no loss of biodiversity or increase in land degradation from vegetation clearing and manage the effects of clearing. In addition, some areas of vegetation are further classified as Essential Habitat under the VM Act with specific reference to conservation significant species listed under the NC Act.

The VM Act is implemented through certified mapping of Remnant Vegetation, High-value Regrowth Vegetation and Essential Habitat. Clearing of mapped vegetation and/or Essential Habitat is subject to assessment by DERM against the relevant Regional Vegetation Management Code and Policy for Vegetation Management Offsets.

This legislation assists in the determination of terrestrial ecological values of the Study Area, as well as certain environmentally sensitive areas under the EP Act (i.e. Endangered REs). REs that are analogous to Nationally Listed Threatened Ecological Communities as listed under the provisions of the EPBC Act must also be considered and protected in accordance with Commonwealth law.

B.2.5 THE QUEENSLAND LAND PROTECTION (PEST AND STOCK ROUTE MANAGEMENT) ACT 2002

The main purpose of the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) is to provide pest management for agricultural lands. The LP Act lists several species of flora and fauna that are considered Class 1, 2 or 3 pests under the Act. In addition, there may be environmental weeds present within the Study Area that are not listed under the LP Act.

Future planning in the Study Area should incorporate appropriate weed and pest management to fulfil landholder obligations under the LP Act.

B.3 STATE PLANNING INSTRUMENTS

B.3.1 DERM'S REGIONAL BIODIVERSITY PLANNING ASSESSMENT

The DERM has prepared Biodiversity Planning Assessments (BPAs) for a number of Queensland Bioregions (as defined under the VM Act) in order to provide broadscale ecological data to advise a range of planning and decision-making processes.

The BPA process employs the Biodiversity Assessment and Mapping Methodology (BAMM) (EPA 2002) to determine the relative biodiversity significance of habitats and landscapes in relation to threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetland or other types of habitat important for the maintenance of biodiversity or ecological processes. This is based largely on remnant vegetation mapping data generated under the

VM Act, buffered significant flora and fauna records and expert panel determinations.

The BAMM assigns three levels of Biodiversity Significance:

- State Significance – areas assessed as being significant for biodiversity at the Bioregional or State scales. They also include areas assessed by other studies/processes as being significant at national or international scales.
- Regional Significance – areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- Local Significance and Other Values – areas assessed as not being significant for biodiversity at State or Regional scales. Local values are of significance at the local government scale.

The methodology uses seven diagnostic criteria: (i) habitat for significant taxa; (ii) ecosystem value; (iii) tract size; (iv) relative size of RE; (v) condition; (vi) ecosystem diversity; and (vii) context and connection, utilising Queensland Herbarium RE mapping and buffered significant flora and fauna records. Three supplementary criteria refine the mapped information by incorporating local knowledge and expert opinion. These are: (a) essential and general habitat for priority taxa; (b) special biodiversity values; and (c) corridors. Expert Panel Reports are compiled to document the decision-making process for assessing the supplementary criteria.

The Study Area is located within the Brigalow Belt South (BBS) bioregion and, as such, is part of the BBS BPA.

B.3.2 QUEENSLAND'S STRATEGY FOR THE CONSERVATION AND MANAGEMENT OF QUEENSLAND'S WETLANDS

The intent of the *Strategy for the conservation and management of Queensland's wetlands* is:

- To provide an integrating framework to guide State agencies responsible for wetlands management; and
- To set out initiatives to encourage and assist landholders to sustainably manage wetlands under their control.

Under this Strategy, wetlands are defined as:

> *Areas of permanent or periodic/intermittent inundation, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6m.*

The Queensland Government's objectives for wetlands are to:

- Avoid further loss or degradation of natural wetlands, unless overriding public interest can be shown;
- Ensure a comprehensive and adequate representation of wetland in the conservation reserve system;
- Base the management and use of natural wetlands on ecologically sustainable management and integrated catchment management practices; and\
- Develop community awareness of, and respect for, the values and benefits of wetlands, and involvement in their management.

The *Strategy for the conservation and management of Queensland's wetlands* is administered through various Queensland government agencies that have legislative responsibility with regard to wetlands. The DERM is the lead agency for co-ordinating the Strategy's implementation.

With regard to terrestrial ecological values, the intent and objectives of the Strategy are implemented through the VM Act.

B.3.3 QUEENSLAND'S 'BACK ON TRACK' SPECIES PRIORITISATION FRAMEWORK

The 'Back on Track species prioritisation framework' is an initiative of the Queensland government that prioritises Queensland's native species to guide conservation, management and recovery. It is designed to prioritise all species, regardless of their current classification under the NC Act or EPBC Act, using multiple criteria to allow the identification of species that are in trouble, and those which have the greatest chance of recovery. Further details may be found at http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/back_on_track_species_prioritisation_framework/

All the Back on Track species relevant to the Study Area are EVR or Near Threatened species under the NC Act and/or EPBC Act, or are non-EVR priority species of the BBS bioregion.

B.4 REGIONAL AND LOCAL INSTRUMENTS

B.4.1 CATCHMENT-BASED NATURAL RESOURCE MANAGEMENT PLANS

The Study Area is covered by three catchment-based Natural Resource Management Plans (NRMPs), each of which seeks to provide a framework to guide coordinated planning and on-ground action for improving the management and condition of natural resources. **Table B4.1** provides a summary of each Plan's 'Aspirational and Resource Condition Targets' that are relevant to the proposed works with regard to terrestrial ecology.

B.4.2 LOCAL COUNCIL ECOLOGICAL PROTECTION MEASURES AND PEST MANAGEMENT PLANS

A review of Planning Schemes available from the relevant Local Government Areas of Western Downs (Dalby) Regional Council, Maranoa (Roma) Regional Council and Toowoomba Regional Council indicates that areas of ecological significance identified at the local scale are typically defined by areas protected under the State NC Act and remnant vegetation defined under the State VM Act. Similarly, priority species listed under available Pest Management Plans for the areas of interest are largely consistent with those declared under the State LP Act, with additional species of local significance based on agricultural/grazing impacts, rather than impacts to native biodiversity.

Table B4.1. Relevant NRMP Aspirational and Resource Condition Targets

Responsible Organisation	Coverage	Theme	Aspirational Targets	Resource Condition Targets (aimed at achieving Aspirational Targets)
Condamine Alliance (2004) (http://www.condamineralliance.com.au/)	Upper Condamine River catchment, including the eastern portion of the Study Area (i.e. all or part of the Talinga, Kainama and Gilbert Gully tenements).	Vegetation communities, biodiversity and nature conservation.	• NCA 1 – Maintain, protect and enhance existing regional ecosystems and biodiversity by 2054; • NCA 2 – Regional ecosystems functioning to support the range of flora and fauna diversity by 2054; • NCA 3 – Environmental values and ecosystem services are recognised by 2054; and • NCA 4 – The impacts of exotic pests and weeds are not significant across the catchment by 2054.	• NC1 – No net increase in the extent and impact of priority weeds for nature conservation from 2006 extent by 2020; • NC2 – No net increase in the extent and impact of priority pest animals from 2006 levels by 2020; • NC3 – 5 subcatchments with less than 30% remnant or woody vegetation coverage in 2003 will achieve a 10% increase in vegetation cover by 2018; • NC5 – Increase the extent of endangered regional ecosystems as at 2001 levels by 2025; • NC6 – Increase the area and improve the condition of major bioregional corridors by 2015; and • NC7 – Increase the abundance and distribution of national and state endangered species from 2006 levels by 2020.
Queensland Murray-Darling Committee (2004 and revised in 2006) (http://www.qmdc.org.au/)	Queensland catchment of the Murray-Darling Basin and Bulloo catchment, including much of the central and western portions of the Study Area (i.e. all or part of the Talinga, Gilbert Gully, Condabri, Dalwogan, Carinya and Combabula/Ramyard tenements).	Wetlands and Floodplains	• AT3 – All regionally significant wetlands are maintained in current or better condition by 2035; • WFRCT5 – By 2015 the condition of high priority wetlands in the Maranoa-Balonne and Border Rivers catchments are maintained or improved relative to baseline conditions set by 2010.	

Table 2.1: Summary of State Forests and Reserves occurring within the study area

Area	Description of Location (Map in Appendix C)
Beilba State Forest	East of Injune, north-west of Combabula/Ramyard tenement (C.4).
Binkey State Forest	Between Miles and Wandoan, north of Dalwogan tenement (C.3).
Braemar State Forest	West of Dalby, between Kainama and Gilbert Gully tenements (C.1).
Cherwondah State Forest	Between Miles and Wandoan, east of Woleebee tenement (C.3).
Chinchilla Rifle Range Nature Reserve	Immediately south-east of Chinchilla (C.2).
Combabula State Forest	Between Wandoan and Roma, within Combabula/Ramyard tenement (C.3).
Condamine State Forest	South of Miles, between Condabri and Talinga/Orana tenements (C.2).
Daandine State Forest	West of Dalby, between Kainama and Gilbert Gully tenements (C.1).
Dalby State Forest	Between Dalby and Kainama tenement (C.1).
Dinoun State Forest	Between Wandoan and Roma, within Combabula/Ramyard tenement (C.3).
Dunmore State Forest	North-west of Millmerran, within Gilbert Gully tenement (C.1).
Emu State Forest	Between Wandoan and Roma, within Combabula/Ramyard tenement (C.3).
Gurulmundi State Forest	Between Miles and Wandoan and the Dalwogan and Woleebee tenements (C.3).
Hallett State Forest	East of Injune, north-west of Combabula/Ramyard tenement (C.4).
Hinchley State Forest	West of Wandoan, between Combabula/Ramyard and Woleebee tenements (C.3).
Inglebogie State Forest	East of Roma, south of Combabula/Ramyard tenement (C.3).
Juandah State Forest	West of Wandoan, between Combabula/Ramyard and Woleebee tenements (C.3).
Kumbarilla State Forest	South-west of Dalby, on northern boundary of the Gilbert Gully tenement (C.1).
Mount Organ State Forest	West of Wandoan, between Combabula/Ramyard and Woleebee tenements (C.3).
Stones Country Resource Reserve	Between Miles and Wandoan, within Woleebee tenement (C.3).
Weranga State Forest	West of Dalby, between Kainama and Gilbert Gully tenements (C.1).
Western Creek State Forest	West of Millmerran, within Gilbert Gully tenement (C.1).
Woodduck State Forest	North-east of Roma, within Combabula/Ramyard tenement (C.4).
Yuleba State Forest	East of Roma, south of Combabula/Ramyard tenement (C.3).

Rough-barked Apple and Gum-topped and Pilliga Box. White Cypress Pine may be either a canopy species or in the lower tree layer, which often contains Buloke. Ground cover is usually sparse or open and dominated by perennial grasses. These REs are found on sand plains and rises (EPA 2007).

This habitat includes all Land Zone 7 REs within the study area other than 11.7.5, a shrubland. Canopies are mostly dominated by Mountain Yapunyah, Lancewood, Bendee Acacia catenulata, Narrow-leaved Red, Dusky-leaved and Gum-topped Ironbark, Brown Bloodwood, Spotted Gum and White Cypress Pine. There is usually a low tree layer, which may be dense and is typically comprised of Acacia species and sometimes Buloke. On deeper soils on lower slopes RE 11.7.1 has a moderately dense layer of Belah and/or Brigalow. A shrub layer of species such as Wilga, False Sandalwood, Currant Bush Carissa ovata and Acacia species is often present. The ground layer is extremely sparse and dominated by grasses such as Aristida, Paspalidium and Brachiaria species. Soils are shallow loams, clays and lithosols, often with surface stones and boulders. The Land Zone occurs on slopes and scarps, often with lateritic duricrust (EPA 2007).

Land Zone 9 has a strong association with Brigalow communities but REs 11.9.7 and 11.9.9 do not normally include either Brigalow or Belah. RE 11.9.6 may include Brigalow but for the purposes of this report is not considered a Brigalow community. Canopies of these REs are dominated by Myall, Poplar Box or Narrow-leaved Red Ironbark and Gum-topped Box. RE 11.9.7 always has a dense tall shrub layer, with False Sandalwood often dominant. The ground layer varies from sparse to dense with grass species varying with RE and from east to west across the study area. Soils may be fine-grained sediments on gently undulating landscapes and slopes or deep loamy red earths or deep texture contrast soils on lower and middle slopes (EPA 2007).

All Land Zone 10 REs in the study area are included in this habitat. Canopies are mostly dominated by Narrow-leaved Red Ironbark, Silver-leaved Ironbark, Poplar Box, Clarkson's Bloodwood Corymbia clarksoniana, Spotted Gum, Smooth-barked Apple and White Cypress Pine. A low tree/tall shrub layer of species such as Wilga, White Cypress Pine, Buloke, Red Ash and Acacia species is often present. The ground layer is usually sparse but may be moderately dense, depending on rockiness, and dominated by perennial grass species, sometimes including Spinifex. Soils are mostly deep texture contrast soils and coarse-grained sediments, sometimes sandstone. The Land Zone occurs on hills and ranges (EPA 2007).

Generally, vegetation is similar in structure to woodlands and forests on alluvial soils except that the canopy is not as tall and hollows are much less common. Less fertile soils contribute to less grass cover and the habitat is less resilient to grazing. A scarcity of large hollows means that the habitat is generally not as suitable for larger arboreal mammals as wooded areas on flood plains, nor are the dominant tree species as favoured by folivores. The lower tree/shrub layer is more likely to be dense. There is a large overlap between species assemblages, though abundances of shared species are often lower on the less fertile soils.

Disturbance regimes within this habitat type vary substantially between relevant land zones. Land Zone 7 has shallow to very shallow soils with surface gravel, stones or boulders on slopes, scarps, hills, ranges and lateritic duricrust (EPA 2007). Although livestock were present at half the sites assessed disturbance was generally low or very low. This is a reflection of the substrate and topography, being neither particularly suitable for either weed invasion nor grazing. Weed species were restricted to Prickly Pear, at very low densities.

There was no obvious trend of disturbance across Land Zones 5, 9 and 10, though levels

Responsible Organisation	Coverage	Theme	Aspirational Targets	Resource Condition Targets (aimed at achieving Aspirational Targets)
Queensland Murray-Darling Committee (2004 and revised in 2006) *cont.* (http://www.qmdc.org.au/)	Queensland catchment of the Murray-Darling Basin and Bulloo catchment, including much of the central and western portions of the Study Area (i.e. all or part of the Talinga, Gilbert Gully, Condabri, Dalwogan, Carinya and Combabula/Ramyard tenements).	Vegetation and Biodiversity	• AT1 – Retain, regenerate or establish native vegetation in the region by 2035; • AT2 – Conserve and enhance ecologically viable areas of the regions by 2035; and • AT3 – Conserve and enhance biological diversity by 2030.	• VBRCT1 – A minimum of 30% native vegetation coverage is managed or conserved to maintain ecological processes and ecosystem linkages at priority catchment scales by 2020; • VBRCT3 – BY 2020 there is a ten% increase in area of sustainably managed native vegetation for landscape and biodiversity outcomes through traditional and innovative economic uses, based on representative areas to be determined by 2008; • VBRCT4 – By 2020 the extent of 'endangered' regional ecosystems across catchments with less than 30% remnant vegetation will be increased by 10% of the 2001 mapped extent; • VBRCT5 – By 2020 the extent of 'of concern' regional ecosystems across catchments with less than 30% remnant vegetation will be increased by 10% of the 2001 mapped extent; • VBRCT6 – By 2020 areas identified by the Biodiversity Planning Assessments as being of high nature conservation significance are maintained or improved as measured against baseline conditions to be set by 2008; • VBRCT7 – By 2020 decline in populations of 'at risk' flora and fauna species in the Maranoa-Balonne and Border River catchments is halted as determined against baseline data set by 2008; • VBRCT8 – By 2020 the biodiversity condition and ecological health of 10% of the area of native vegetation in priority catchments are maintained or improved as measured against baseline conditions to be set by 2008.

Responsible Organisation	Coverage	Theme	Aspirational Targets	Resource Condition Targets (aimed at achieving Aspirational Targets)
Queensland Murray-Darling Committee (2004 and revised in 2006) *cont.* (http://www.qmdc.org.au/)	Queensland catchment of the Murray-Darling Basin and Bulloo catchment, including much of the central and western portions of the Study Area (i.e. all or part of the Talinga, Gilbert Gully, Condabri, Dalwogan, Carinya and Combabula/Ramyard tenements).	Weeds and Pests	• AT1 – Stabilise and reduce the extent and impact of existing weed and pest animal threats by 2040; • AT2 – Avoid new or reduce impact of outbreaks of emerging weed and pest animal infestation by 2030; • WPRCT1 – The extent and impact of priority terrestrial and aquatic weeds and pests stabilised by 2015 and decreasing by 2025; and • WPRCT2 – Reduce incidence of recorded infestations of new weed and pest outbreaks.	
Fitzroy Basin Association (2004 and updated in 2005) (http://www.fba.org.au/)	Fitzroy Basin and adjacent coastal catchments, including the north of the Study Area (i.e. all or part of the Wolleebee and Combabula/Ramyard tenements).	Weeds and Pest Animals	• R2 – Impact of agricultural and environmental pest plants and animal (Class 2 & 3) is contained within 5 years and trend reversed within 10 years; • R3 – 100% control of outbreaks of new agricultural and environmental (Class 2 & 3) pest plants and animals, including pests of aquatic environmental significance ongoing.	
		Mining	• R6 – Reduce off-site impacts of mining operations within 10 years; and • R7 – No net decrease in water quality as a result of mining activity ongoing.	
		Ecosystem Health and Biodiversity	• R9 – Minimum 40% of original extent of native remnant vegetation coverage in patches of 500 ha or greater within 10 years; • R10 – 80% of regional ecosystems protected on state land primarily managed for conservation (National Parks and other reserves) within 10 years;	

Responsible Organisation	Coverage	Theme	Aspirational Targets	Resource Condition Targets (aimed at achieving Aspirational Targets)
Fitzroy Basin Association (2004 and updated in 2005) *cont.* (http://www.fba.org.au/)		Ecosystem Health and Biodiversity *cont.*	• R11 – 90% (aggregate) of 'endangered' regional ecosystems not protected under VMA (2004) are protected from habitat loss, and where this is not possible, full re-establishment of original vegetation following development, within 5 years; • R12 – 150000 ha of private land managed primarily for conservation and under voluntary agreements with the state within 10 years; • R13 – Additional 150000 ha of private land supporting regionally significant remnant vegetation voluntarily managed primarily for conservation within 10 years; • R14 – Additional 5000 ha of non-remnant native vegetation regenerated on private lands in areas forming wildlife corridors and linkages, particularly in riparian areas within 10 years.	
		Conserving Species	• R15 - No further loss of biodiversity at a species, subspecies or major geographic population level scale; • R17 – All significant habitats of migratory and breeding water birds, and drought refuges, are protected from incompatible activities, and population sizes are maintained within acceptable limits ongoing.	
		Riparian Zones, In-stream Habitats and Freshwater Wetlands	• R21 – Length of functional riparian areas increased by 20% within 10 years; • R22 – Habitat variability and condition of reaches with high ecological value maintained in each catchment ongoing; • R23 – Significant wetlands (including their riparian zones) protected, restored, and under appropriate management within 10 years and ongoing.	

B.4 REFERENCES

DEH (2006). 'EPBC Act Policy Statement 1.1: Significant Impact Guidelines, Matters of National Environmental Significance'. Department of Environment and Heritage, Canberra.

EPA (2002). 'Biodiversity Assessment and Mapping Methodology.' Environmental Protection Agency Biodiversity Planning Unit, Biodiversity Branch Version 2.1, July 2002. Brisbane.

Appendix C:
DERM Environmentally Sensitive Areas Mapping:
Terrestrial Ecology

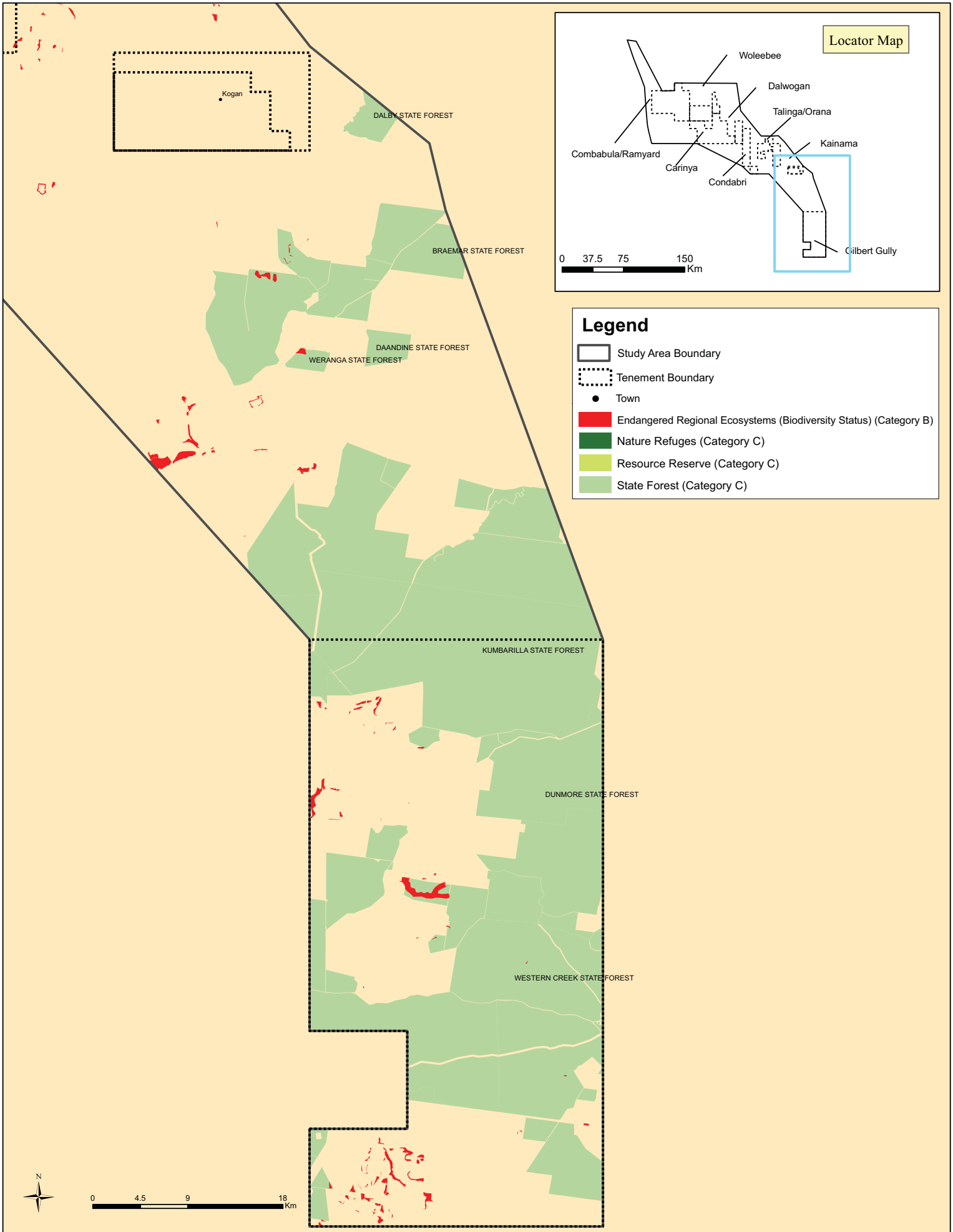
APPENDIX C

DERM ENVIRONMENTALLY SENSITIVE AREAS MAPPING: TERRESTRIAL ECOLOGY

TERRESTRIAL ECOLOGY AND IMPACT ASSESSMENT REPORT – GAS FIELDS COMPONENT

AUSTRALIA PACIFIC LNG PROJECT EIS

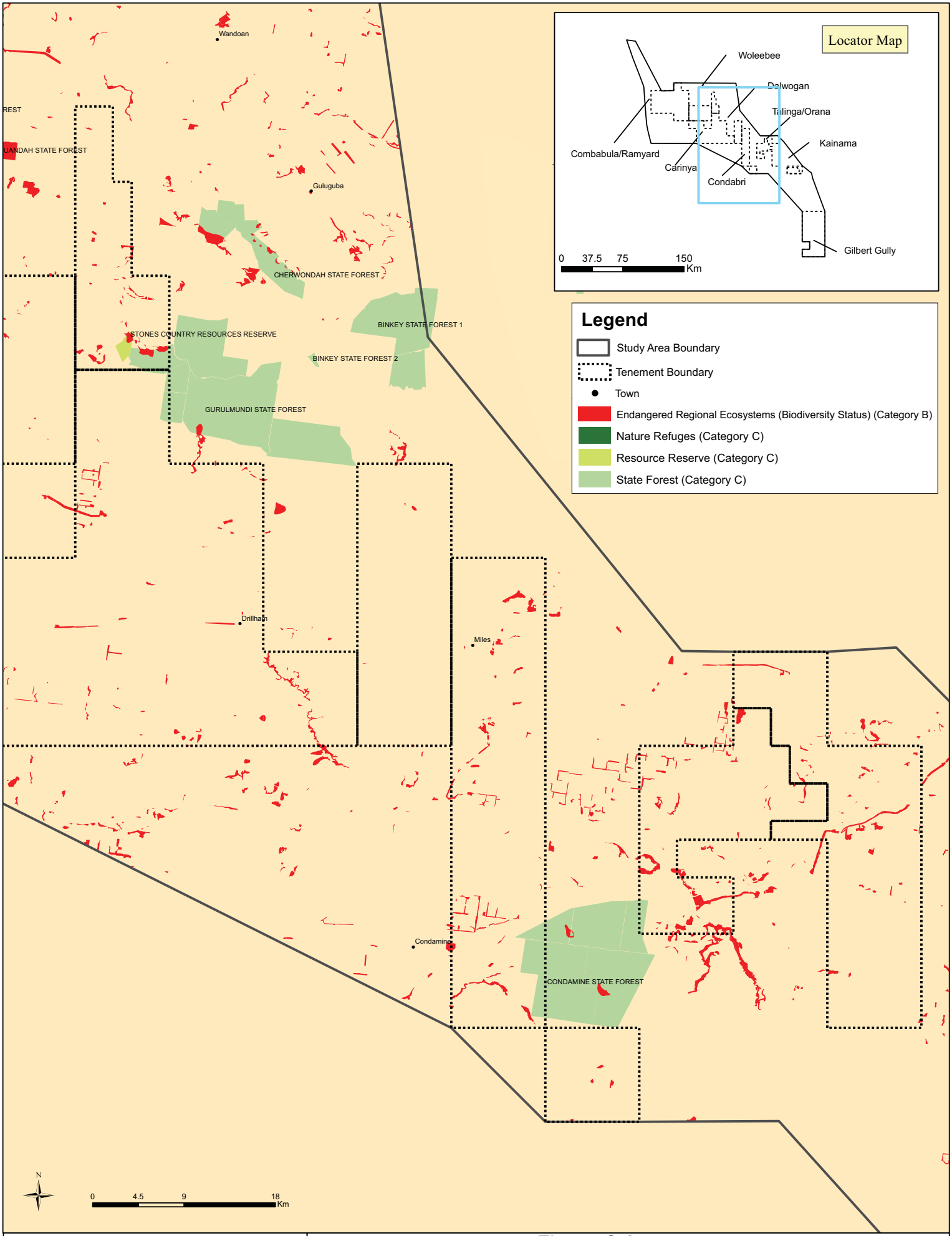
Table of contents



Biodiversity Assessment

Figure C.1
DERM Environmentally Sensitive Areas Mapping:Terrestrial Ecology

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

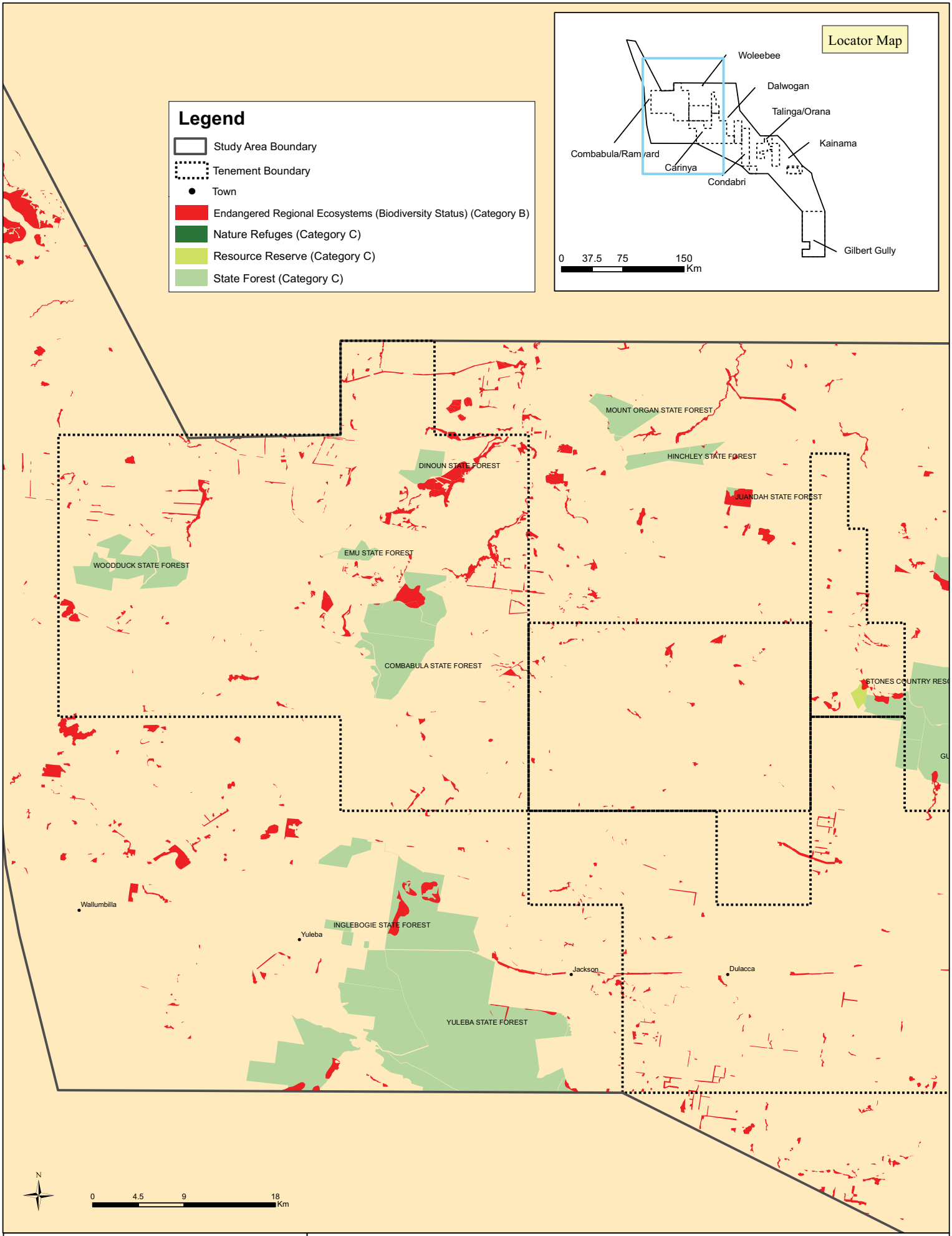


Biodiversity Assessment

Figure C.2

DERM Environmentally Sensitive Areas Mapping:Terrestrial Ecology

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

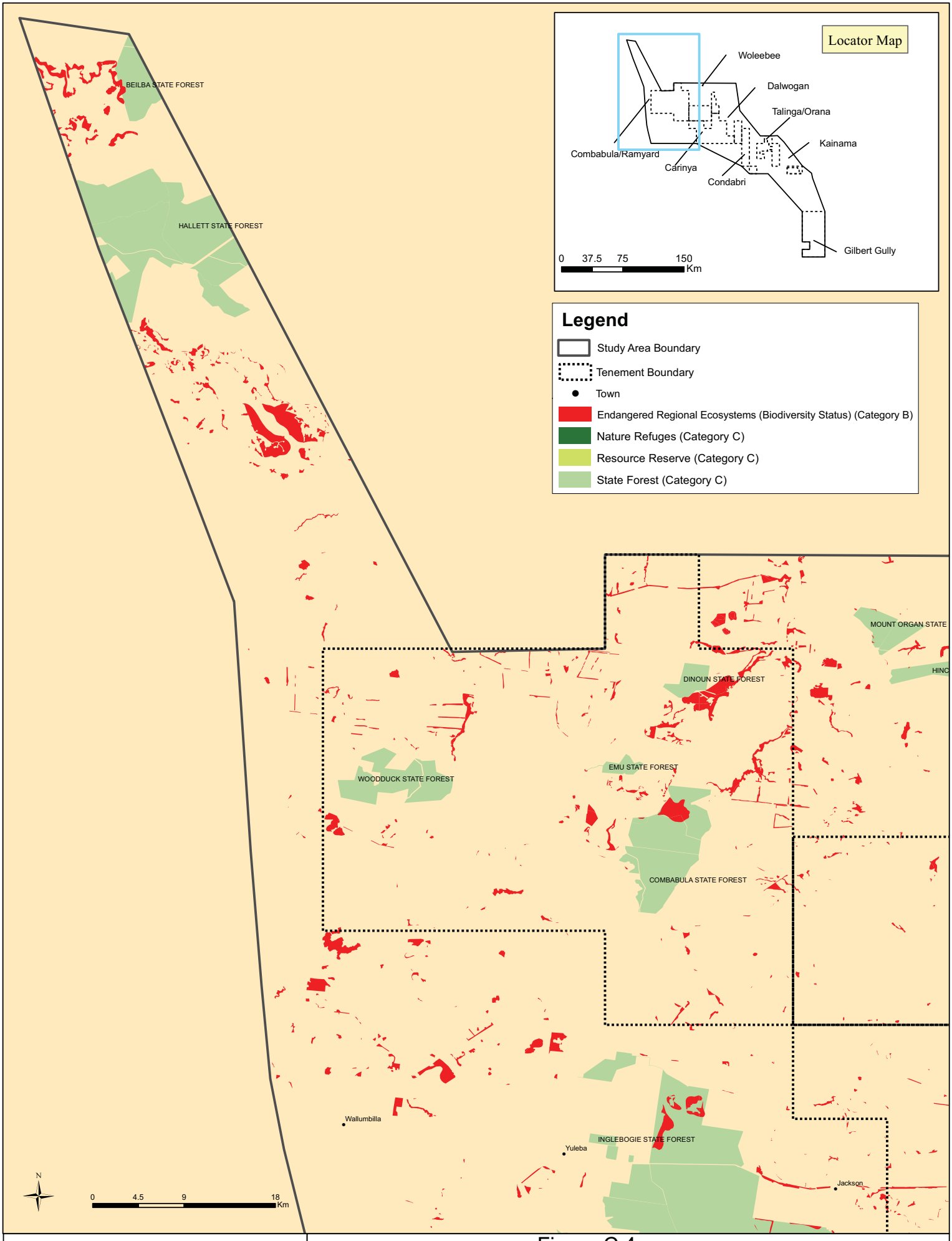


Biodiversity Assessment

Figure C.3

DERM Environmentally Sensitive Areas Mapping:Terrestrial Ecology

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS



Biodiversity Assessment

Figure C.4

DERM Environmentally Sensitive Areas Mapping:Terrestrial Ecology

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component) - Australia Pacific LNG Project EIS

were generally moderate to low. Livestock were present on most sites within Land Zones 5 and 9 but only 50% of Land Zone 10 sites had evidence of grazing. Weeds were most species rich in Land Zone 9, mostly Prickly Pear and Harrisia Cactus and occasionally Buffel Grass and Mother of Millions.

The diversity of soils, topography and vegetation communities results in the habitat type supporting a large number of conservation significant species. Species for which the study area is particularly important in terms of their overall distribution, such as Golden-tailed Gecko and Brigalow Scaly-foot, are widespread. Areas with a dense shrub layer provide habitat for the South-eastern Long-eared Bat and provide shelter and foraging resources for a number of regionally significant birds and mammals such as Speckled Warbler, babbler species and Northern Brown Bandicoot. The shrub layer affords protection from aggressive increaser species and reduces the viability of the habitat for Noisy Miner in particular.

In the Gilbert Gully area extensive patches of Buloke may provide habitat for the Bulloak Jewell butterfly, though targeted searches may be required to confirm its presence. Less well grazed areas that retain adequate cover of tussock grasses would provide resources for a number of reptile species.

Brigalow communities

This habitat type occurs on Land Zones 3, 4 and 9. Brigalow communities do not necessarily always include Brigalow itself. Instead, Belah may be the dominant species, particularly in REs 11.3.1, 11.4.3 and 11.9.5. Where present, Brigalow may be the canopy species or may be the lower tree layer under a canopy of Poplar Box or other eucalypt species. The lower tree/tall shrub layer typically includes Wilga, False Sandalwood and, sometimes, Narrow-leaved Bottle Tree Brachychiton rupestris. The ground layer is sparse and dominated by grasses in gilgaied cracking clays and deep texture contrast soils (EPA 2007).

Brigalow is important for the conservation significant invertebrates of the study area with both the Dulacca Woodland Snail and Pale Imperial Hairstreak butterfly known from the habitat. Rough Frog and the regionally significant Salmon-striped Frog both occur, the former in areas with cracking clays, especially those with gilgais. Brigalow communities are particularly important for several nationally listed reptile species which are either largely restricted to, or most frequently recorded from, this vegetation type. Golden-tailed Gecko, Brigalow Scaly-foot, Yakka Skink, Woma, Common Death Adder, Dunmall's Snake, Grey Snake (in areas of cracking clays) and several regionally significant species all occur. Brigalow on Land Zone 4 had high levels of large coarse woody debris, providing important micro-habitat resources for reptiles, as well as frogs and small mammals.

Although conservation significant birds generally are less dependent on Brigalow than reptiles the community is important in the landscape as some mature patches function as a closed forest/woodland system, extending the ranges of species found in rainforests to the east. Areas of Belah are very important to Glossy Black-Cockatoo as a food resource and individual plants supporting mistletoe are important for Painted Honeyeaters. Two conservation significant micro-bats, Little Pied Bat and South-eastern Long-eared Bat both utilise Brigalow patches and the regionally significant Black-striped Wallaby frequents the dense shrub layer.

The conservation status of these fauna species is, in part, a reflection of the loss of this vegetation community from the landscape. Large mature patches are important for all these species, though some species, such as the Pale Imperial Hairstreak, may be more dependent on such stands than others. Some species, including Brigalow Scaly-foot, will also occur in small and/or narrow Brigalow remnants, including roadside vegetation. In addition, the increased number of mistletoe in roadside Brigalow, probably

Table 2.2: Summary of BPA Results and Expert Panel information for the entire study area[1]

Criteria	Description	Study Area (Mapping and Expert Panel)
C Rating Tract Size	All REs within the study area	The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts. Remnant vegetation mapped as "Very High" value under this category includes: between Gilbert Gully gas field north-west to Talinga/Orana gas field (including Kumbarilla and Braemar SF); west and north of Condabri, Dalwogan and Carinya gas fields (joining and including Gurulmundi and Barakula SF); remnants adjacent to the southern boundary of Carinya gas field; west of Carinya gas field (Yuleba SF); remnants west of Combabula/Ramyard gas field; and remnants along Eurombah Creek in the north-west of the study area. Smaller tracts designated as "High" value under this category are scattered throughout the study area. However, most of the vegetation north of Eurombah Creek and south of Expedition National Park has been designated "High" value.
J Rating Corridors	Terrestrial Bioregional Corridor	Maintaining connectivity across a landscape through corridors or 'stepping stones' of remnant vegetation is important for the long-term conservation of biodiversity. Within the study area major areas have been designated as Terrestrial Bioregional Corridors of "State" significance including: remnant vegetation connecting (and including) Yuleba SF north-east, through Gurulmundi SF to Barakula SF in the east of the central portion of the study area; and remnants connecting vegetation south-west of (and including) Braemar SF (south of Kogan), west through Condamine SF, then north-east eventually connecting to Barakula SF. This corridor also extends south into the south-east corner of the study area.
	Riparian Bioregional Corridor	Within the study area remnant vegetation along several waterways has been designated as a Riparian Bioregional Corridor of "State" or "regional" significance. This includes remnants along Dawson River and Hutton Creek in the extreme north-west; along Juandah Creek west of the Leichhardt Highway; along Condamine River; and along Weir River in the south-east.

Source: EPA (2008a,b,c). Areas within each of the individual gas field tenements have also been covered in more detail under separate BPA analyses in **Appendix D**.

APPENDIX D

SUMMARY OF BIODIVERSITY PLANNING ASSESSMENT (BPA) RESULTS AND EXPERT PANEL DETERMINATIONS

TERRESTRIAL ECOLOGY AND IMPACT ASSESSMENT REPORT – GAS FIELDS COMPONENT

AUSTRALIA PACIFIC LNG PROJECT EIS

Table of contents

D.1 INTRODUCTION

DERM has prepared Biodiversity Planning Assessments (BPAs) for a number of Queensland Bioregions (as defined under the *Vegetation Management Act 1999*) in order to provide broad-scale ecological data to advise a range of planning and decision-making processes.

BPAs are based on the Biodiversity Assessment and Mapping Methodology (BAMM) (EPA 2002) using vegetation mapping data generated by the Queensland Herbarium. The methodology identifies areas with various levels of significance for biodiversity reasons, such as threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetland or other types of habitat important for the maintenance of biodiversity or ecological processes.

The BAMM assigns three levels of Biodiversity Significance:

- State Significance – areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales.
- Regional Significance – Areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- Local Significance and Other Values – Areas assessed as not being significant for biodiversity at State or Regional scales. Local values are of significance at the local government scale.

The methodology uses seven diagnostic criteria: Habitat for EVR taxa; Ecosystem Value; Tract Size; Relative Size of Regional Ecosystem; Condition; Ecosystem Diversity; and Context and Connection, utilizing Queensland Herbarium RE mapping and buffered EVR flora and fauna records. Three supplementary criteria refine the mapped information by incorporating local knowledge and expert opinion. These are: Essential and general habitat for priority taxa; Special biodiversity values; and Corridors. Expert Panel Reports are compiled to document the decision-making process for assessing the supplementary criteria.

The Australia Pacific LNG gas fields Study Area (the 'Study Area') falls within the Brigalow Belt South Bioregion, for which a BPA was initially prepared in 2002, and revised and updated in 2008 (EPA 2008a, b, c). The following section sets out the BPA results for the entire Study Area. The subsequent section addresses the BPA results of each of the gas field tenements within the Study Area.

D.2 STUDY AREA BPA RESULTS

The Study Area is a large (approximately 14500 km^2) irregularly shaped area incorporating all of the proposed tenements, lands between the tenements, and land extending north of Combabula/Ramyard tenement. Each of the tenements is addressed in detail in separate BPA analyses (**Sections D.3.1-D.3.8**). The Study Area extends roughly north-west from Gilbert Gully tenement (west of Milmerran) to an area south of Expedition National Park (approximately 90 km west of Taroom). Over such a large area the topography is naturally varied and is contained in Condamine River and Dawson River catchments (in the north of the Study Area). The Study Area includes several large tracts of land with native vegetation within public lands (State Forests). Within the Brigalow Belt South Bioregion the Study Area covers several subregions including: Inglewood Sandstones (32) in the south-east; through Eastern Darling Downs (31); Dulacca Downs (28); Barakula (27); Taroom Downs (25); Southern Downs (26) to Carnarvon Ranges (24) in the north-west of the Study Area.

Table D.1 sets out the results of BPA mapping and the relevant findings of the expert panels for flora, fauna and landscape (EPA 2008a, b, c) for the entire Study Area. **Figures D.1 to D.4** show the results of the mapping for overall Biodiversity Significance and Corridors.

Table D.1. Australia Pacific LNG Study Area BPA Results and Expert Panel Information (EPA 2008a, b, c)

AUSTRALIA PACIFIC LNG STUDY AREA - Mapping and Expert Panel Results
A Rating - Habitat for EVR Taxa
Under this category remnants containing precise record/s (≤ 500 m), or core habitat for one taxon (flora or fauna) listed as Vulnerable or Rare are afforded a "High" rating. Remnants containing precise records, or core habitat for one or more taxa listed as Endangered, or two or more taxa listed as Vulnerable or Rare are afforded a "Very High" rating. Much of the remnant vegetation encompassed by the Study Area is mapped as "Low" or "Medium" under this category. Remnants mapped as "High" or "Very High" are scattered throughout the Study Area, and are often associated with vegetation within, or in close proximity to State Forests (along with much of the "Medium" value remnants). Larger tracts of vegetation rated as "Medium" are located in (from north-west to south-east within the Study Area): State Forest (SF) and nearby remnants south of Expedition National Park (NP); a large block of vegetation directly west of Wood Duck SF; much of Yuleba SF and surrounds; Gurulmundi SF and vegetation adjacent to the west, and east towards Barakula SF; vegetation around the towns of Miles and Chinchilla; much of Condamine SF and surrounds; much of the vegetation centred around the town of Kogan, particularly to the south and south-west (including Braemar SF); and within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs). Concentrations of remnant habitat mapped as "High" or "Very High" are located: within Gurulmundi SF and surrounds; Condamine SF and surrounds; and Kumbarilla SF. Other large areas are located to the north of Yuleba SF and Combabula SF and surrounds. Several other smaller remnants mapped as "High" or "Very High" are scattered throughout the Study Area.
B1 Rating - State Ecosystem Value
Within this category all Endangered REs are mapped as "Very High" value and all "Of Concern" REs are mapped as "High" value. REs that are poorly conserved within the bioregion and remnant vegetation with <30% subdominant Endangered or Of Concern REs are mapped as being of "Medium" State Ecosystem Value. REs listed as 'No Concern at Present' with >50% of their original extent remaining within the bioregion are mapped as "Low" value. Within the Study Area all vegetation is mapped as "Medium" value or higher under this category. Remnants mapped as "High" or "very High" value are distributed throughout the Study Area, and are often located along and/or adjacent to waterways and road reserves. Concentrations of "High" and "Very High" value remnants are located within Yuleba and Combabula State Forests and surrounds.
B2 Rating - Regional Ecosystem Value
REs are afforded "Very High" value under this category when the RE has a pre-clearing extent of <300ha or <10% of the pre-clearing extent remains within the subregion. "High" conservation value areas are those REs of which 10-30% of the pre-clearing extent remains in the subregion. "Medium" value REs have: 30-50% of the pre-clearing extent remaining in the subregion; or are 'poorly conserved' within the subregion; or contain subdominant (<30%) 'high' or 'very high' conservation value RE. Within the Study Area all vegetation is mapped as "Medium" value or higher under this category, except for some small areas in the north-western extent south of Expedition NP. Remnants mapped as "High" or "very High" value are distributed throughout the Study Area, and are often located along and/or adjacent to waterways and road reserves. Relatively large "Very High" value remnants are located within Yuleba SF, Gurulmundi SF and Combabula State Forests and surrounds.
C Rating - Tract Size
The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts. Under this category much of the vegetation within the Study Area is mapped as "Very High" value, particularly south-east from Gurulmundi SF. In the north-west of the Study Area all vegetation north of Eurombah Creek has been designated as "High" value. Other medium-sized tracts designated as "High" value are scattered throughout the Study Area, particularly surrounding Combabula SF and Yuleba SF and close to the towns of Miles, Chinchilla and Kogan.
D1 Rating - State Relative Ecosystem Size
This category compares relative size of the RE occurring within the remnant unit compared with all other occurrences of the same RE within other remnant units within the bioregion. Large examples of an RE are more significant than smaller examples. REs that represent >75% of the largest example of that RE within the bioregion are mapped as "Very High" value areas. REs that represent 50 to 75% of the largest example of that RE within the bioregion are mapped as "High" value areas. Much of the remnant vegetation encompassed by the Study Area is mapped as "Low" or "Medium" under this category. However, several large remnants mapped as "High" or "Very High" are scattered through the Study Area, and are often associated with vegetation within, or in close proximity to State Forests (along with much of the "Medium" value remnants). Large tracts of vegetation rated as "Very High" are located (from north-west to south-east within the Study Area) in:

AUSTRALIA PACIFIC LNG STUDY AREA - Mapping and Expert Panel Results
Hallett State SF and nearby remnants south of Expedition NP; a large block of vegetation within Yuleba SF; Gurulmundi SF and vegetation to the east of the Leichhardt Highway (towards Barakula SF); much of Condamine SF and surrounds; and areas within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs). "High" value tracts are located: directly west of Gurulmundi SF; areas north of the towns of Miles and Kogan; two tracts south-east of Condamine SF; and areas within Kumbarilla and Western Creek SFs in the southern extent of the Study Area. Large "Medium" value tracts are distributed throughout the Study Area including: tracts north of Eurombah Creek; several tracts surrounding Combabula SF; parts of Yuleba SF; a large area north-west of Miles; several areas around the town of Kogan and Braemar SF; and several areas within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs).
D2 Rating - Regional Relative Ecosystem Size
Similar to the previous category, this compares relative size of the RE occurring within the remnant unit compared with all other occurrences of the same RE within other remnant units within the subregion. REs that represent >75% of the largest example of that RE within the subregion are mapped as "Very High" value areas. REs that represent 50 to 75% of the largest example of that RE within the subregion are mapped as "High" value areas. Several large remnants mapped as "High" or "Very High" are mapped through the Study Area, and dominate north of the Condamine River. Large tracts of vegetation rated as "Very High" are located (from north-west to south-east within the Study Area) in: Hallett State SF and nearby remnants south of Expedition NP; two large blocks of vegetation within Yuleba SF; Gurulmundi SF and surrounds and much of the vegetation to the east of the Leichhardt Highway and north of MIles; much of Condamine SF and surrounds as well as sections of the Condamine River and tributaries; and areas within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs). "High" value tracts are located: to the north of Combabula SF; north-east of Yuleba SF; west of Gurulmundi SF; a large area north-west of Miles; areas north of the towns of Miles and Kogan; two tracts south-east of Condamine SF; north of the town of Kogan; adjacent tro Braemar SF; and several areas within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs). "Medium" and "Low" value tracts are distributed throughout the Study Area but are more prevalent south-east of Condamine SF.
E Rating - Condition
The quality of remnant units is judged by the extent to which each resembles its natural condition, as indicated by the degree of anthropogenic disturbance. In the absence of a consistent assessment of vegetation condition across a bioregion, the remnant vegetation mapping by the Queensland Herbarium is taken to represent areas of vegetation in their natural state. All mapped REs within the Study Area are afforded a "Very High" condition rating.
F Rating - Ecosystem Diversity
This criterion is rated using Simpson's Diversity Index – a measure that incorporates both richness (number) and evenness (relative abundance). Remnants rated as "Very High" have a Simpsons Diversity Index >75% of the maximum value for the bioregion. Remnants rated as "High" have a Simpsons Diversity Index between 50-75% of the maximum value for the bioregion. Much of the Study Area is rated as "High" or "Very High" remnant vegetation under this category. Significant areas of "Very High" value remnants are located: within Gurulmundi SF and areas to the west and east towards Barakula SF; west of the Leichchardt Highway (adjacent to either side of the Warrego Highway); within and adjacent to Braemar SF and the town of Kogan; and several areas within State Forests located in the southern extent of the Study Area (Kumbarilla, Dunmore and Western Creek SFs).
G Rating - Context and connection
This category rates the extent to which the remnant unit incorporates borders or buffers to wetlands/waterways, endangered ecosystems or is connected to other vegetation, thereby contributing to biodiversity, habitat networks and habitat resilience. Within the Study Area much of the remnant vegetation north of Condamine SF has been designated as "Medium" value under this category. Within the south-east portion, the majority of remnants contained in State Forests (Condamine, Braemar, Kumbarilla, Dunmore and Western Creek) and adjacent areas are rated as "High" or "Very High". Other significant areas ("High" and/or "Very High" value) under this category include: Gurulmundi SF and adjacent areas to the east of the Leichhardt Highway (towards Barakula SF); a large tract north-west of Miles; remnants within Combabula SF; and several areas north of Eurombah Creek (south of Expedition NP).
H Rating- Core Habitat for Priority Taxa
This criterion is used to identify essential and general habitat for EVR and other priority taxa in addition to diagnostic criterion A. Within the Study Area mapped areas include: remnants along Dawson River and Hutton Creek in the extreme north-west - "Medium" value for Barking Owl *Ninox connivens*; large tracts joining Gurulmundi SF to Barakula SF largely east of the Leichhardt Highway - "High" value for plant taxon *Corymbia bloxsomei*; remnants adjacent to north-east boundary of Condabri tenement - "Medium" value for Koala *Phascolarctos cinereus*; remnants adjacent to Myangra Road (between Dalwogan and Carinya tenements) – "Medium" value for plant taxon *Eucalyptus bakeri* and

AUSTRALIA PACIFIC LNG STUDY AREA - Mapping and Expert Panel Results
other associated plant taxa of conservation value; remnants along Condamine River – "Medium" value for Barking Owl; remnants south-east of Kainama tenement – "Medium" value for Brown Treecreeper *Climacteris picumnus*; remnants adjacent to Old Moonie Road – "Medium" value for Barking Owl; and adjacent to the northern boundary of Gilbert Gully tenement – Koala.
I Rating - Special Biodiversity Values
Core Areas: Based on Tract Size analysis (criterion C), the expert panel identified core areas for the southern Brigalow Belt to be of State significance ("Very High" Special Biodiversity Values – refuge from clearing). Core Areas (as identified by the expert panel) included within the Study Area include: Inglewood Sandstones (including and adjacent to Gilbert Gully tenement); Barakula (including and adjacent to north-east of Dalwogan and Condabri gasfields); Yuleba (including Yuleba SF and adjacent remnants, particularly to the north, which are located within Combabula/Ramyard gasfield); and Expedition Range/Amphitheatre (north-west extent of Study Area).
Fragmented sub-regions (State): The expert panel designated fragmented remnants (in subregions with less than 30% remnant vegetation) to be of State significance ("Very High" Special Biodiversity Values – refuge from clearing), when containing the largest remaining examples of an RE within a subregion. This category is covered in more detail within the gasfield tenements in **Section D.3**. Outside of the gasfield tenements large areas classified under this category include; along the southern boundary of Carinya tenement; remnants adjacent to and including Gurulmundi SF; remnants within or adjacent to Yuleba SF; and remnants north of Eurombah Creek in the north-west of the Study Area. Other smaller areas are scattered throughout the Study Area, particularly along Wolleebee, Wandoan and Juandah Creeks and tributaries (north-east of Study Area) and Condamine River.
Fragmented sub-regions (Regional): The expert panel designated fragmented remnants to be of Regional significance ("High" Special Biodiversity Values – refuge from clearing), in subregions with less than 30% remnant vegetation. Remnants mapped under this category are scattered throughout the entire Study Area.
Fragmented sub-regions (stockroutes and road reserves): Stockroutes and associated reserves provide critical connectivity in fragmented landscapes. The expert panel designated these areas as of State significance ("Very High" Special Biodiversity Values – refuge from clearing) in subregions with less than 30% remnant vegetation. Most road reserves throughout the Study Area are identified under this category.
Gurulmundi: This is an area of diverse habitat types including shrubland on rock pavement, acacia thickets, mixed eucalypt slopes, cypress pine woodland and vine thickets. The area provides habitat for EVR plant taxa and localized endemics. Designated as of "State" significance (Special Biodiversity Values: centre of endemism; disjunct populations; geographic range limits; and high species richness). Large areas of vegetation mapped under this category are located in areas adjacent to and including Gurulmundi SF.
Remnant Vine Thickets: Vine-thickets have high flora species diversity and provide habitat for endemic fauna such as snails and insects. In the Brigalow Belt vine-thickets are considered mesic outliers of coastal vegetation types. Designated as of "State" significance (Very High Special Biodiversity Values: centre of endemism; refuge from clearing; and distinct variation in species composition). Within the Study Area, remnants mapped under this category are largely (but not solely) to areas within and close to Gurulmundi SF and scattered throughout and around the Combabula/Ramyard tenements.
Very High Conservation Value Wetlands: Nangram Lagoon near Condamine (150.29, -26.84) contains the southernmost extent of the lotus lily (Very High Special Biodiversity Values – Wetland).
High Conservation Value Wetlands – Upper Condamine Area: Tralee Lagoon near Chinchilla (150.65, -26.79) has high habitat and waterbird diversity.
Part of Vickery SF near Tara: This area contains disjunct populations of three mallee species (*Eucalyptus viridis, E. bakeri* and *E. curtisii*). Located north-west of Gilbert Gully tenement. Designated as of "Regional" significance (Special Biodiversity Values: disjunct populations and distinct variation in species composition).
RE 11.3.2 Poplar Box woodland on alluvium (Eastern Darling Downs): Locally, this RE varies in structure when compared to other subregions. It provides habitat for EVR and priority flora (eg. *Homopholis belsonii*) and is regionally endangered (7% remaining in Eastern Darling Downs). Designated as of State significance (Special Biodiversity Values: centre of endemism; refuge from clearing; and distinct variation in species composition). Scattered remnants are located along Condamine River and some tributaries within the Study Area.
Miles area – outliers of Mulga taxa: Eastern range limits of Mulga Lands taxa such as *Acacia aprepta, A. shirleyi* and *A. microsperma.* Large remnants within, and adjacent to the eastern boundary Condabri gasfield and south of Warrego Highway.
J Rating - Corridors
Terrestrial Bioregional Corridor: Maintaining connectivity across a landscape through corridors or 'stepping stones' of remnant vegetation is important for the long-term conservation of biodiversity. Within the Study Area major areas have been designated as Terrestrial Bioregional Corridors of "State" significance including: remnant vegetation connecting (and including) Yuleba SF north-east, through Gurulmundi SF to Barakula SF in the east of the central portion of the Study Area; and remnants connecting vegetation south-west of (and including) Braemar SF (south of Kogan), west through Condamine SF, then north-east eventually connecting to Barakula SF. This corridor also extends south into the extreme south-east corner of the Study Area.
Riparian Bioregional Corridor: Within the Study Area remnant vegetation along several waterways has been designated as a Riparian Bioregional Corridor of "State" or "regional" significance. This includes remnants: along Dawson River and Hutton Creek in the extreme north-west; along Juandah Creek west of the Leichhardt Highway; along Condamine

AUSTRALIA PACIFIC LNG STUDY AREA - Mapping and Expert Panel Results
River; and along Weir River in the south-east of the Study Area.
Bio_Sig - Biodiversity Significance
The Biodiversity Significance rating of REs as to their State, Regional or Local significance is based on a combination of results from the diagnostic criteria. Large tracts of vegetation have been designated as "State" significant under this category including: all vegetation north of Eurombah Creek in the north-west of the Study Area; much of the vegetation joining (and including) Yuleba SF through Gurulmundi Sf to Barakula SF; remnants north of Miles towards Barakula SF; vegetation Joining (and including Condamine SF to Braemar SF; and all vegetation in the south-east extent of the Study Area. There are many smaller tracts designated as "State" significant throughout the area including along road reserves and waterways. Large tracts of vegetation have been designated as "Regionally" significant under this category including: much of Combabula SF and surrounding remnants to the east and west; several remnants surrounding Gurulmundi SF; several areas surrounding the town of Miles; remnants in the south-east of Talinga/Orana gasfield; and remnants west of Braemar SF. There are many smaller tracts designated as "Regionally" significant throughout the area including along road reserves and waterways. Small areas designated as "State habitat for EVR taxa" are scattered throughout the south-east of the Study Area including: within Condamine SF and surrounds; areas south-east of Kogan, south-east of Chinchilla, east of the Leichhardt Highway and in Kumbarilla SF and several tracts located largely within Gurulmundi SF. Remnants mapped as "Local or other values" are located in the south-east of the Study Area including: large areas west of Miles; several remnants located between the Condamine River and Kumbarilla SF.

D.3 INDIVIDUAL TENEMENT BPA RESULTS

D.3.1 TALINGA/ORANA TENEMENT

The Talinga/Orana tenement covers an approximate area of 500 km^2 extending from approximately 2 km north of the Warrego Highway (13 km west of Chinchilla) to 29 km south of Chinchilla (**Figure D.1**). The eastern boundary commences 4 km west of Chinchilla extending to 20 km east of Condamine. Topography covered by this area is gently undulating. Major habitat features include the Condamine River which crosses from west to east across the tenement and includes several major tributaries including Boganbilla Creek in the west; Charleys Creek in the north-east; Wieambilla Creek in the south-west; and Wambo Creek in the south-east. The tenement covers two subregions within the Brigalow Belt South Bioregion: Eastern Darling Downs (31) and Inglewood Sandstones (32).

Table D.2 sets out the results of BPA mapping and the relevant findings of the expert panels for flora, fauna and landscape (EPA 2008a, b, c). **Figure D.2** shows the results of the Biodiversity Significance mapping within the tenement.

Table D.2. Talinga/Orana BPA Results and Expert Panel Information (EPA 2008a,b,c)

TALINGA/ORANA TENEMENT - Mapping and Expert Panel Results
A Rating - Habitat for EVR Taxa
Much of the tenement area has been mapped as 'Low' or 'Medium' value for EVR taxa. All known/mapped 'Endangered' REs in the tenement area are listed as having 'High' value for EVR taxa. Remnants are designated as having 'High' value when the unit has 'precise record/s or core habitat for one Vulnerable taxon or one Rare taxon. In the tenement area much of this comprises *Acacia harpophylla* and associated woodlands (e.g. REs 11.9.5, 11.4.3, 11.3.1) considered as essential habitat for the Glossy Black-Cockatoo and Painted Honeyeater. Linear strips of 'High' value habitat (often adjacent to scattered larger patches) follow the Warrego Highway, Chinchilla-Tara Road and the Kogan-Condamine Road. Larger areas of the same 'High' value habitat also occur in the south-west along Sandy Creek and Wieambilla Creek. Scattered fragments also occur, largely in the north-west of the tenement area. A single small remnant (approx. three ha) designated as 'Very High' value habitat lies adjacent to Greenswamp Road (west of Hubbards Road). Remnants are designated as having 'Very High' value when the unit has 'precise record/s or core habitat for one or more Endangered taxa or two or more Vulnerable or Rare taxa'. Listed record for *Gonocarpus urceolatus.*
B1 Rating - State Ecosystem Value
Many of the Regional Ecosystems within the tenement area are mapped as having "Very High" or "High" State Ecosystem Value for the following reasons:

TALINGA/ORANA TENEMENT - Mapping and Expert Panel Results
• All Endangered REs within the tenement area are mapped as having "Very High" State Ecosystem Value. Within the tenement area, linear strips with some adjacent larger patches follow the Warrego Highway, Chinchilla-Tara Road and the Kogan-Condamine Road (in the south-west). Larger areas also occur in the south-west along the Condamine River, Sandy Creek and Wieambilla Creek. Other isolated fragments also occur, largely in the north-west of the tenement area. • All Of Concern REs are afforded "High" State Ecosystem Value. Within the tenement area these REs largely follow watercourses, particularly the Condamine River and Wambo Creek. Several large remnants also occur in vegetation south of the Kogan-Condamine Road. The remaining REs are mapped as being of "Medium" State Ecosystem Value.
B2 Rating - Regional Ecosystem Value
Remnants mapped as "Very High Conservation Value" are scattered throughout the tenement area including: concentrations in the south-west along the Condamine River and Kogan-Condamine Road and in the south-east along Wambo Creek. REs under this category are largely *Acacia harpophylla* woodlands (eg. RE 11.4.3) or *Eucalyptus populnea* open woodland (RE 11.3.2). Remnants mapped as "High Conservation Value" areas are restricted to tracts in the south-east of the tenement area (south of Kogan-Condamine Road) and along Wieambilla Creek in the south-west. The remaining remnants within the tenement area are mapped as "Moderate Conservation Value".
C Rating - Tract Size
Within the tenement area much of the remnant vegetation south of, and including the Condamine River is designated "Very High" value tracts. Larger tracts north of the Condamine River, in the south-east of the tenement area and along Charleys Creek have been designated "High" value. The remaining tracts are designated "Low" and "Medium" value and are largely located north of the Condamine River.
D1 Rating - State Relative Ecosystem Size
Much of the area is mapped as "Low" value, with a few scattered "Medium" value remnants also present. REs that represent <25% of the largest example of that RE within the bioregion are mapped as "Low" value areas.
D2 Rating - Regional Relative Ecosystem Size
All remnant vegetation along the Condamine River, Charleys Creek and Wambo Creek within the tenement area is mapped as "Very High" or "High" value. Other "High Value" remnants are located in the south-west of the tenement area along the Kogan-Condamine Road and Wieambilla Creek, as well as two large remnants north of the Condamine River. Linear remnants along the Warrego Highway have been mapped as "High" value. All other vegetation in the tenement area is mapped as "Low" or "Medium" value remnants.
E Rating - Condition
All mapped REs within the tenement area are afforded a "Very High" condition rating.
F Rating - Ecosystem Diversity
Several areas of "Very High" Ecosystem Diversity are mapped in the south-west of the tenement area (along and Adjacent to Wieambilla Creek), in the west (along Chinchilla-Tara Road) and south-west (along Wambo Creeek and south of Kogan-Condamine Road). The remaining remnant vegetation south of, but including the Condamine River is mapped as "High" value except for a large tract of vegetation south of Kogan-Condamine Road. Vegetation along Warrego Highway is also rated as having "High" value. The majority of remaining REs are mapped rated as having "Medium" or "Low" Ecosystem Diversity.
G Rating - Context and connection
"Very High" and "High" value tracts of vegetation are mapped: in the south-west of the tenement area south of and including some of the Condamine River; a large area south of Kogan-Condamine Road; and several small tracts scattered to the north of these areas. The remaining vegetation is largely mapped as "Medium" value.
H Rating- Core Habitat for Priority Taxa
All remnant vegetation along the Condamine River and some connecting creek lines are mapped as "Medium" value for priority taxa (considered suitable for Barking Owl *Ninox connivens*). A single small remnant in the north-west is mapped as "Medium" value for *Acacia microsperma.* The remaining remnant vegetation in the tenement area is not mapped as having value for EVR or priority taxa.
I Rating - Special Biodiversity Values
Fragmented sub-regions (State): The expert panel designated fragmented remnants (in subregions with less than 30% remnant vegetation) to be of State significance ("Very High" Special Biodiversity Values – refuge from clearing), when containing the largest remaining examples of an RE within a subregion. The Eastern Darling Downs subregion, of which the Study Area is a part, is estimated to have approximately 14% remnant vegetation. Riparian vegetation along the Condamine River and a large remnant centrally located within the Study Area are mapped under this category.
Fragmented sub-regions (Regional): The expert panel designated fragmented remnants to be of Regional significance ("High" Special Biodiversity Values – refuge from clearing), in subregions with less than 30% remnant vegetation. Remnants mapped under this category are scattered throughout the Study Area including along Charleys Creek and Wieambilla Creek.
Fragmented sub-regions (stockroutes and road reserves): Stockroutes and associated reserves provide critical connectivity in fragmented landscapes. The expert panel designated these areas as of State significance ("Very High" Special Biodiversity Values – refuge from clearing) in subregions with less than 30% remnant vegetation. Road

TALINGA/ORANA TENEMENT - Mapping and Expert Panel Results
Reserves adjacent to Warrego Highway, Condamine-Tara Road and Kogan-Condamine Road are mapped under this category.
RE 11.3.2 Poplar Box woodland on alluvium (Eastern Darling Downs): Locally, this RE varies in structure when compared to other subregions. It provides habitat for EVR and priority flora (eg. *Homopholis belsonii*) and is regionally endangered (7% remaining in Eastern Darling Downs). Designated as of State significance (Special Biodiversity Values: centre of endemism; refuge from clearing; and distinct variation in species composition). Scattered small remnants are located throughout the tenement area, but particularly adjacent to Condamine River and tributaries.
Bellevue Swamp: Ephemeral swamp located approximately 22 km west of Chinchilla (south of Warrego Highway – 150.456, -26.722). Considered as significant waterbird breeding habitat, covering 50 ha when full. Designated as of Regional significance ("High" Special Biodiversity Values – wetland).
Part of Bracker SF area: Cypress pine/eucalypt woodlands and shrubby woodlands on sandstone. Values include a mix of Brigalow Belt and Nandewar bioregions. Designated as of Regional significance (Special Biodiversity Values: disjunct populations; distinct variation in species composition; and high species richness). Isolated remnant located south of Bellevue Swamp (150.412, -26.756).
J Rating - Corridors
Remnant vegetation including (riparian remnants along the Condamine River) running approximately south-west to north-east within the Study Area have been designated as of "State" significance as a Terrestrial Bioregional Corridor by the expert panel.
Riparian Bioregional Corridor: Remnant vegetation along the Condamine River and Charleys Creek have been afforded "State" significance as a Riparian Bioregional Corridor. Vegetation along Chinchilla-Tara Road that connects two sections of the Condamine River and small areas adjacent to Charleys Creek have been afforded "Regional" significance under the same category.
Bio_Sig - Biodiversity Significance
The majority of REs mapped for the Study Area are rated as "State Significant" except for tracts in the south-east.

D.3.2 CONDABRI TENEMENT

The Condabri Tenement is made up of two adjacent areas covering approximately 440km^2. The tenement comprises an 8 km wide, rectangular area extending from approximately 8 km north of the town of Miles to 8 km south of Condamine. A second relatively square area (8 km x 8 km) is located diagonally adjacent to the south-east corner of the former (**Figure D.1**). Topography covered by this area is gently undulating. Major habitat features include the Condamine River which crosses the central portion of the tenement and includes several major and minor tributaries, including Dogwood and Eleven Mile Creeks in the north. The southern extent of the tenement includes the eastern section of Condamine State Forest (SF). The tenement covers three subregions within the Brigalow Belt South Bioregion: Eastern Darling Downs (31), Inglewood Sandstones (32) and Barakula (27).

Table D.3 sets out the results of BPA mapping and the relevant findings of the expert panels for flora, fauna and landscape (EPA 2008a,b,c). **Figure D.2** shows the results of the Biodiversity Significance mapping within the tenement.

Table D.3. Condabri BPA Results and Expert Panel Information (EPA 2008a,b,c)

CONDIBRI TENEMENT - Mapping and Expert Panel Results
A Rating - Habitat for EVR Taxa
Much of the Study Area has been mapped as 'Low' or 'Medium' value for EVR taxa. All known/mapped 'Endangered' REs in the Study Area are listed as having 'High' value for EVR taxa. Remnants are designated as having 'High' value when the unit has 'precise record/s or core habitat for one Vulnerable taxon or one Rare taxon. In the tenement area much of this comprises *Acacia harpophylla* and associated woodlands (egs. REs 11.9.5, 11.4.3, 11.3.1) considered as essential habitat for Glossy-black Cockatoo and Painted Honeyeater. Linear strips of 'High' value habitat (often adjacent to scattered larger patches) follow the Leichhardt Highway and to a minor extent Kogan-Condamine Road. Other scattered fragments occur throughout the tenement area. Two areas within Condamine State Forest (SF) are designated as 'Very High' value habitat. Remnants are designated as having 'Very High' value when the unit has 'precise record/s or core habitat for one or more Endangered taxa or two or more Vulnerable or Rare taxa. Listed fauna records for these areas are for Brigalow Scaly-foot *Paradelma orientalis* (Vulnerable – NC Act) and Greater Long-eared Bat *Nyctophilus timoriensis* (Vulnerable – NC Act).

CONDIBRI TENEMENT - Mapping and Expert Panel Results
B1 Rating - State Ecosystem Value
Scattered Regional Ecosystems within the tenement area mapped as having "Very High" or "High" State Ecosystem Value for the following reasons: • All Endangered REs within the tenement area are mapped as having "Very High" State Ecosystem Value. Within the Study Area, linear strips with some adjacent larger patches follow the Leichhardt Highway and to a minor extent on Kogan-Condamine Road (in the south-west). Larger areas also occur north of Miles and along an unidentified creekline south of Kogan-Condamine Road. Other isolated fragments also occur, throughout the tenement area. • All Of Concern REs are afforded "High" State Ecosystem Value. Within the tenement area these REs largely follow watercourses, particularly the Condamine River, and Dogwood, Eleven Mile and Columboola Creeks, all located in the north. Two large remnants also occur in vegetation south of the Kogan-Condamine Road within Condamine SF and along Cobbareena Creek (south of Condamine SF). The remaining REs are mapped as being of "Medium" State Ecosystem Value.
B2 Rating - Regional Ecosystem Value
Remnants mapped as "Very High Conservation Value" are scattered throughout the tenement area including: concentrations north of Miles, along the Leichhardt Highway and along Kogan-Condamine Road and along a creekline south of Kogan-Condamine Road. REs under this category are largely *Acacia harpophylla* woodlands (eg. RE 11.4.3) or *Eucalyptus populnea* open woodland (RE 11.4.10). Remnants mapped as "High Conservation Value" are largely restricted to creeklines in the north of the tenement area (Dogwood, Eleven Mile and Columboola Creeks). The remaining remnants within the tenement area are mapped as "Moderate Conservation Value".
C Rating - Tract Size
Within the tenement area most of the remnant vegetation is mapped as "Very High" value tracts because of their connection to large tracts within Condamine SF in the south and Barakula SF in the north. Tracts south of the Miles (east of Leichhardt Highway) and north of Kogan-Condamine Road have been designated "High" value. The remaining tracts are designated "Low" and "Medium" value and are largely located north of the Condamine River.
D1 Rating - State Relative Ecosystem Size
Much of the area is mapped as "Low" value. However, large tracts of vegetation north of Miles and within or adjacent to Condamine SF have been mapped as "Very High" or "High" value.
D2 Rating - Regional Relative Ecosystem Size
Large remnants north of Miles and within or adjacent to Condamine SF have been mapped as "Very High" or "High" value within the tenement area. Remnant vegetation along Dogwood Creek, Eleven Mile Creek and part of the Condamine River are mapped as "Very High" value. Other "High Value" remnants are located along the Condamine River and adjacent remnants in the south-west of the tenement area. All other vegetation in the tenement area is mapped as "Low" or "Medium" value remnants.
E Rating - Condition
All mapped REs within the tenement area are afforded a "Very High" condition rating.
F Rating - Ecosystem Diversity
Much of the tenement area is mapped as having "Very High" or "High" Ecosystem Diversity. "Very High" areas are located in the north of the tenement area (along and adjacent to Dogwood Creek and Eleven Mile Creek) and south (along part of Condamine River and within Condamine SF). The majority of remaining REs are mapped rated as having "High" Ecosystem Diversity. Areas of "Medium" or "Low" Ecosystem Diversity are mapped in areas adjacent to Condamine SF, north of Miles and scattered smaller remnants throughout the tenement area.
G Rating - Context and connection
In the south of the tenement area much of the vegetation within and adjacent to Condamine SF is mapped as "Very High" or "High" value. Other remnants mapped as "Very High" value are scattered throughout, particularly north of Miles. The remaining vegetation is largely mapped as "Medium" value.
H Rating - Core Habitat for Priority Taxa
All vegetation along the Condamine River and is mapped as "Medium" value for priority taxa (considered suitable for Barking Owl *Ninox connivens*). Vegetation north of Miles is also mapped as "Medium" value for Koala *Phascolarctos cinereus.* The remaining vegetation in the tenement area is not mapped as having value for EVR or priority taxa.
I Rating - Special Biodiversity values
Core areas: Based on Tract Size analysis (criterion C), the expert panel identified core areas for the southern Brigalow Belt to be of State significance ("Very High" Special Biodiversity Values – refuge from clearing). Much of the vegetation north of Miles and along Dogwood and Eleven Mile Creeks is mapped under this category (Core Area – Barakula).
Fragmented sub-regions (Regional): Remnants mapped under this category are scattered throughout the Study Area south of Columboola Creek including along part of Condamine River.
Fragmented sub-regions (stockroutes and road reserves): The expert panel designated these areas as of State significance ("Very High" Special Biodiversity Values – refuge from clearing) in subregions with less than 30% remnant vegetation. Road Reserves adjacent to Leichhardt Hwy and Kogan-Condamine Rd are mapped under this category.
RE 11.3.2 Poplar Box woodland on alluvium (Eastern Darling Downs): Locally, this RE varies in structure when compared to other subregions. It provides habitat for EVR and priority flora (eg. *Homopholis belsonii*) and is regionally

Impact assessment indicates that, without mitigation, there is potential for Moderate to Significant impacts on seven endangered Ecological Communities (EPBC Act), and an additional endangered RE (NC Act). Disturbance of these communities will be avoided where they occur within Sensitivity Category 1. Where they occur within Sensitivity Categories 2 and 3, they will be avoided where practicable and subject to a separate approval process where disturbance is unavoidable. A 200m management buffer will be established around all occurrences of these communities throughout the study area. In avoiding these communities where practicable, and implementing management guidelines to control potential offsite effects of the Project, the predicted residual impact assessment for the above vegetation communities is reduced to 'minor' or 'negligible'.

Impact assessment indicates that, without mitigation, there is potential for 'moderate' to 'significant' impacts on twelve threatened flora species listed under the EPBC Act and an additional five species listed under the NC Act. Where avoidance of direct or indirect impacts is not possible translocation is recommended, subject to appropriate approvals from the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) and/or DERM. In some circumstances, the implementation of specific Threatened Species Management Guidelines may be required to mitigate the potential for offsite impacts on a particular species.

During construction, operations and decommissioning, the major threats to conservation significant communities are associated with the greater potential for increase in accidental fire and decreased habitat quality through edge effects. The preparation and strict implementation of Clearing Management and Habitat Management Guidelines, incorporating weed and ecological fire management components throughout the life of the Project, as well as the application of threatened species management guidelines for known occurrences of conservation significant species, would reduce potential impacts to minor or negligible.

The persistence of two flora species of special note (due to their highly restricted distribution) requires the identification and protection of the rock pavements of the Gurulmundi plateau.

Terrestrial Fauna

Impact assessment indicates that, without mitigation, there is potential for major impacts on the Brigalow Woodland Snail and moderate to significant impacts on 16 species considered threatened, rare or near threatened under the EPBC Act and/or NC Act. These species are highly restricted in distribution, occur very sparsely throughout their distribution and/or are difficult to detect without targeted surveys. Mitigation measures include pre-development surveys, avoidance, buffers and, where avoidance of direct or indirect impacts is not possible, application for their disturbance to DEWHA and/or DERM and preparation and implementation of specific Threatened Species Management Guidelines.

During construction, operations and decommissioning, the major threats to conservation significant fauna species are associated with the increased potential for accidental fire, decreased habitat quality through edge effects, increased access for feral predators and competitors, increased weed invasion - particularly exotic grasses, changes to hydrological conditions, the creation of artificial waterbodies and the more local effects of increased noise and night time lighting.

The preparation and strict implementation of Feral Species Management and Habitat Management Guidelines incorporating weed and ecological fire management components throughout the life of the project, as well as the application of Threatened Species Management Guidelines for known occurrences of conservation significant species, reduces potential impacts for many species to minor or negligible. Ten

due to increased water as run-off from roads (Norton et al. 1995; Bowen et al. 2009a) and providing food for Painted Honeyeater, means that this component of the landscape should not be underestimated in its value to fauna, despite the impacts of edge effects due to patch size and shape.

Disturbance by livestock is common in Brigalow patches, often due to the fragmented nature of the community. Many patches are small and surrounded by pasture, allowing easy access by livestock. Brigalow on Land Zones 3 and 9 are most likely to have weed infestations, though generally these remain low.

Semi-evergreen vine thicket

In the study area SEVT is restricted to Land Zones 8 and 9 on steep rocky hillsides (RE 11.8.3), on heavy clay soils on upper and middle slopes or shallow loams or clays on steep slopes in sandstone ranges (RE 11.9.4a), and cracking clays on undulating plains and rises (RE 11.9.4b). It is sometimes present as a low tree or tall shrub layer in RE 11.9.5 (EPA 2007), which is better regarded as a Brigalow community.

Brigalow and Belah may be emergent species or brigalow may form a fairly continuous canopy. Other canopy species include Narrow-leaved Bottle Tree and Crows' Ash Flindersia australis. The vegetation structure is complex with a dense low tree/tall shrub layer including Silver Croton Croton insularis and Currant Bush and with frequent vines such as Parsonsia species. The ground layer is sparse or very sparse. The fauna typical of these REs reflects the vine thicket understorey rather than the canopy species.

These habitats are structurally more complex than others in the study area. Canopy height is relatively uneven and low. Hollow-bearing trees are uncommon to non-existent. Fallen debris is common but generally small in size. Except for the locally marginal and regionally significant Common Ringtail Possum, trees in this habitat are generally not as suitable for arboreal mammals, however micro-bats do utilise the habitat, including Little Pied Bat. RE 11.8.3 also provides suitable resources for a range of small mammals and reptiles that utilise the many rocky crevices for shelter and the habitat is important for Common Death Adder and Long-nosed Bandicoot.

The habitat remains important for species typical of closed forests such as Australian Brush-Turkey Alectura lathami, Wonga Pigeon Leucosarcia picata, Varied Triller Lalage leucomela and the Migratory Rufous Fantail. This habitat is also favourable for some EVR species, including Grey Goshawk and Black-breasted Button-quail, though the former is a very occasional visitor and the latter may not be present in the study area. The status of these two species, however, may in part be a result of the clearing of SEVT in the region.

Patches of SEVT are also significant refugia for land snails and other invertebrates, generally having more diverse invertebrate communities than surrounding vegetation. A restriction to rock outcrops or favourable volcanic soils means that SEVT often supports locally endemic species. In an historical perspective they represent potential epicentres of evolution. Many of these thicket patches have been cleared and those remaining need to be preserved for the maintenance of biodiversity values.

Shrublands

In the study area only RE 11.7.5 is regarded as shrubland. Characteristic vegetation includes Calytrix, Hakea, Micromyrtus and Acacia species. Spinifex may occur as the ground layer and emergent Eucalyptus and Corymbia species may be scattered through the habitat or be found on the fringes. The soils are shallow and are often associated with natural scalds on lateritic duricrusts (EPA 2007).

Disturbance levels are generally low or very low, the soils not being conducive to weed invasion and only sparse fodder provided for

CONDIBRI TENEMENT - Mapping and Expert Panel Results
endangered (7% remaining in Eastern Darling Downs). Designated as of State significance (Special Biodiversity Values: centre of endemism; refuge from clearing; and distinct variation in species composition). Vegetation along part of the Condamine River (eastern extent within the tenement area) has been mapped under this category.
Miles area – outliers of Mulga taxa: Locally, this is the eastern range limit of Mulga Lands taxa (egs. *Acacia aprepta, A. shirleyi* and *A. microsperma*). Designated as of Regional significance (Special Biodiversity Values: disjunct populations; geographic range limits; and distinct variation in species composition). Several remnants located south of Miles on either side of Leichhardt Highway.
J Rating - Corridors
Terrestrial Bioregional Corridor: Maintaining connectivity across a landscape through corridors or 'stepping stones' of remnant vegetation is important for the long-term conservation of biodiversity. Within the Study Area remnant vegetation within and adjacent to Condamine SF in the south have been designated as of "State" significance as a Terrestrial Bioregional Corridor by the expert panel.
Riparian Bioregional Corridor: Remnant vegetation along the Condamine River has been afforded "State" significance as a Riparian Bioregional Corridor. Small remnants adjacent to riparian tracts along the Condamine River have been afforded "Regional" significance under the same category.
Bio_Sig - Biodiversity Significance
The Biodiversity Significance rating of REs as to their State, Regional or Local significance is based on a combination of results from the diagnostic criteria. The majority of REs mapped for the tenement area are rated as "State" significant with two tracts mapped as "State Significant for EVR Taxa" within Condamine SF. REs mapped as "Regionally" significant are scattered throughout the Study Area but are concentrated in vegetation west of the Leichhardt Highway and along Columboola Creek.

D.3.3 WOLEEBEE TENEMENT

The Woleebee Tenement is an irregularly shaped area adjacent to the northern boundary of Carinya tenement. This area covers approximately 140 km^2. The northern boundary of the tenement is approximately 11 km south-west of Wandoan and extends south for 25 km. The western boundary is more or less adjacent to the Jackson Wandoan Road (**Figure D.1**). Topography covered by this area is gently undulating in the north. In the south the terrain rises in altitude and there are several 'jump-ups' and steep hilly terrain in the Gurulmundi area. Major habitat features include Wolleebee Creek and several tributaries including Hellhole Creek and Sheepstation Creek. Native vegetation is concentrated in the south around Gurulmundi State Forest (SF), part of which is included within the tenement area.

The tenement covers two subregions within the Brigalow Belt South Bioregion: Taroom Downs (25) and Southern Downs (26). **Table D.4** sets out the results of BPA mapping and the relevant findings of the expert panels for flora, fauna and landscape (EPA 2008a,b,c). **Figure D.3** shows the results of the Biodiversity Significance mapping within the tenement.

Table D.4. Woleebee BPA Results and Expert Panel Information (EPA 2008a,b,c)

WOLEEBEE TENEMENT - Mapping and Expert Panel Results
A Rating - Habitat for EVR Taxa
Much of the vegetation in the tenement area has been mapped as 'Low' or 'Medium' value for EVR taxa. Areas mapped as "High" value habitat under this category are located in the south, within or adjacent to Gurulmundi SF. Listed fauna records for these areas are for Brigalow Scaly-foot *Paradelma orientalis* (Vulnerable – NC Act) and listed plant records are for Ooline *Cadellia pentastylis* (Vulnerable – NC Act). Another small area designated as this value is located centrally within the tenement area.
B1 Rating - State Ecosystem Value
Scattered Regional Ecosystems within the Study Area mapped as having "Very High" or "High" State Ecosystem Value for the following reasons: • All Endangered REs within the tenement area are mapped as having "Very High" State Ecosystem Value. Areas mapped under this category include several southern remnants within, or adjacent to Gurulmundi SF. These areas include Semi-evergreen Vine Thicket (RE 11.9.4a). linear strips following the Warrego Highway. Large areas also occur south of Warrego Highway along Drillham Creek. Another isolated fragment of *Acacia harpophylla* forest (RE 11.9.5) occurs in the north of the Study Area. • All Of Concern REs are afforded "High" State Ecosystem Value. One remnant mapped under this category is located in the north along Wolleebee Creek.

livestock. Large coarse woody debris is very scarce and, despite the low levels of disturbance, the habitat provides comparatively few resources for fauna generally.

However, this habitat has not been studied in depth within the study area and may prove important for a number of conservation significant species such as Eastern Pebble-mouse. Yakka Skink may occur on the fringes of the rock pavements, where suitable crevices develop, and the habitat may support Common Death Adder, particularly where there is substantial leaf litter beneath the dense shrub layer. This requires survey work for substantiation. In this habitat Common Death Adders are much less likely to be deleteriously affected by trampling from livestock or poisoning by Cane Toads Rhinella marina, impacts that severely depleted their population in the bioregion.

The abundance of nectar-producing plants may also support a substantial invertebrate assemblage which in turn provides prey for insectivorous vertebrates.

Grasslands (including pasture)

Large parts of the study area have been cleared and are dominated by grasslands, featuring both introduced pasture and native grass species. There is no native grassland RE known in the study area but they may have been present within Poplar Box and Brigalow communities on clay plains prior to large scale clearing.

The existing grasslands, regardless of grass species, are affected by livestock. Grazing alters vegetation structure and composition and trampling increases penetration resistance, which reduces both water infiltration and the buffer of the soil microclimate (Hobbs 2001). Grazing reduces both the diversity and abundance of species (Woinarski and Ash 2002; James 2003) and areas dominated by Buffel Grass typically have reduced species diversity, not just of reptiles, but for all terrestrial vertebrates (Hannah and Thurgate 2001). Nonetheless, the grasslands do provide resources for a number of native fauna species.

Conservation significant species encountered in grasslands include those species strongly associated with deep cracking clays and gilgais such as Rough Frog, Grey Snake and the regionally significant Narrow-nosed Planigale. These species occur even where the original vegetation has been cleared as long as the soil structure is not destroyed.

Birds are the most conspicuous component of the fauna assemblage of the grasslands. Squatter Pigeons, though very sparse in the study area, will forage on both native and introduced grasses and may be found in highly disturbed areas within paddocks such as cattle yards. Wetland species, Black-necked Stork, Australian Painted Snipe and the Migratory Latham's Snipe and Sharp-tailed Sandpiper, will all forage in flooded paddocks and other Migratory species such as White-throated Needletail, Cattle Egret and Rainbow Bee-eater will forage above or in paddocks. A number of common bird species such as Ground Cuckoo-shrike Coracina maxima, Australian Bustard Ardeotis australis and Banded Lapwing Vanellus ticolor are largely dependent on grasslands, including pasture.

The presence of conservation significant mammals is quite low. Some micro-bat species and the regionally significant macropods Rufous Bettong and Black-striped Wallaby may forage in or above the grasslands but rest and breed elsewhere.

Regrowth

The value of regrowth to vertebrate fauna has been little studied, and what has been published has an overwhelming emphasis on birds. Regrowth has been shown to support a greater species assemblage than cleared land but less than woodland areas (Hannah et al. 2007). Not surprisingly, the value of regrowth to fauna is generally dependent on its age, with older regrowth providing greater

resources. Old regrowth has developed a more 'tree-like' structure and typically supports more species and a greater abundance of species (Kutt 1996; Bowen et al. 2009b).

Regrowth is less likely to support nectarivorous and frugivorous birds due to a lack of food availability compared to mature forest and woodland and are more likely to support insectivorous species (Bowen et al. 2009b). Other factors, however, may affect the value of regrowth patches. Younger regrowth in more productive parts of the landscape or areas that have regrown around remnant trees may have values for fauna greater than some older regrowth (Taylor et al. 1997). Some fauna species, including regionally significant species, appear to actually favour regrowth in some areas (Dorricott et al. 1997).

Although the number of species in regrowth may be less than in remnant vegetation it may still support a substantial number of species - for example regrowth in central Queensland had 75% of the species richness of woodlands (Hannah et al. 2007). Regrowth does increase the amount of wooded habitat in the landscape and can buffer adjacent remnant vegetation from many edge effects (Mesquita et al. 1999; Laurance et al. 2001).

Rivers and Creeks

Rivers and creeks in the study area are typically fringed by RE 11.3.25, which is dominated by Queensland Blue Gum or River Red Gum with riparian species such as River She-oak *Casuarina cunninghamiana*, Black Tea-tree and Weeping Bottlebrush Callistemon viminalis. There are also natural lentic (non-flowing) waterbodies such as lakes, billabongs and depressions on floodplains with open water (RE 11.3.27b) that may or may not have aquatic plants and emergents. Fringing woodland for these waterbodies is usually dominated by River Red Gum or Coolibah (EPA 2007).

An important function of rivers and creeks is as corridors (Naiman et al. 1993), particularly in a degraded landscape, but riparian vegetation also allows some fauna species to extend their distributions into otherwise unsuitable areas (Woinarski et al. 2000). Riparian vegetation is usually more complex than adjacent plant communities (Hancock et al. 1996) and is often more susceptible to the impacts of grazing by livestock (for example, Martin and McIntyre 2007) and weed invasion (Hancock et al. 1996) than other nearby habitats.

Even where riparian vegetation in the study area is degraded and narrow, it would still serve as a route by which species traverse the landscape or as a stepping stone habitat for some migratory bird species that require more dense vegetation such as Rufous Fantail. Larger waterbodies also serve as important foraging areas for several bird predators such as the migratory White-bellied Sea-Eagle and Eastern Great Egret. Lakes and billabongs that have aquatic vegetation may occasionally support Cotton Pygmy-goose.

In addition to acting as watering points, rivers and creeks with overhanging vegetation act as flyways for foraging micro-bats, though activity patterns will vary with season and flying insect activity. Riparian zones are important foraging habitat for micro-bats, even ephemeral creeks (Seidman and Zabel 2001).

Many of the larger trees in the study area are in close proximity to drainage lines. Arboreal mammals such as regionally significant Koala and gliders use some of these trees as habitat for shelter and breeding hollows and as food. They would also move along the creeklines. The creeks provide habitat for Australia's only amphibious mammal species, Water Rat Hydromys chrysogaster and the regionally significant Platypus, though the latter is now known only from Hutton Creek within the study area (Craig Eddie pers. comm.).

Although creeks will attract a number of frog species when in flow, none of the species recorded for the study area is a species restricted to, or dependent on, lotic (flowing) waterbodies. Many species, including Rough Frog, are nonetheless reliant on flood events from these creeks for creation of breeding sites. Three regionally significant reptiles are restricted to this habitat, the two aquatic reptiles found in the study area, Macquarie Turtle and Broad-shelled Turtle, and the semi-aquatic Eastern Water Dragon that forages in the riparian zone.

Dams and other artificial waterbodies

There are many artificial waterbodies, of varying sizes, within the study area. The utility of such waterbodies is dependent on factors including depth, edge substrate, presence and nature of fringing vegetation, and disturbance regimes.

Most waterbodies at least function as watering points for fauna but they may also provide habitat for frogs and for those reptiles and birds that prey on them. Migratory species such as Eastern Great Egret will forage at many of these waterbodies and the conservation significant Black-necked Stork and Australian Painted Snipe will utilise those with suitably favourable characteristics. Artificial waterbodies are also more likely than most natural waterbodies in the study area to attract migratory sandpipers and White-bellied Sea-Eagle. The occurrence of sandpipers will be particularly dependent on water depth and the edge substrate.

Habitat Protection for Significant Species

Table 2.14 provides a summary of the current extent of remnant habitat within the relevant landscape for terrestrial fauna of special conservation significance considered possible occurrences within the study area, based on the summary of REs for each species in Table 2.13 and the extent of REs in the relevant provinces as provided by the EPA (2008d).

The value of habitats within the study area to conservation significant fauna has been discussed under broad headings above, most of which encompass a number of RE types. These headings are intended to reflect structural and floristic aspects of habitat that determine likelihood of use by particular species.

Data provided by the EPA (2008d) are used to indicate the areas of habitat suitable for conservation significant species. To determine the areas of habitat for significant species that are currently protected under the NC Act or Forestry Act, RE mapping has been used to provide some indication of the extent of suitable habitat within reserves, including national parks. Areas protected under the NC Act have been separated from those protected under the Forestry Act. The latter (that is, areas within state forests) may be subject to timber felling and to long-term grazing, which may significantly reduce the habitat quality of some areas for a range of fauna species.

The likelihood of a species occurring in an RE can be determined based on the description of the RE and the known distribution of the species in question. Table 2.13 lists the REs that are found in the study area which occupies part, or all, of the Relevant Provinces of the BBS bioregion and allocates them to conservation significant fauna species based on known or expected occurrence.

The exclusion of an RE in relation to a particular species does not mean that it may not at times occur there, especially for migratory species. Rather, the REs have been chosen to represent the habitats of greatest likelihood of regular occurrence. Waterbirds and wetland species, such as those associated with rank vegetation fringing waterbodies, may use many REs beyond those listed should if appropriate waterbodies exist within the area in question.

For example, Australian Painted Snipe is not particularly restricted to any RE types in the

If impacts are moderate or above after mitigation measures have been employed the provision of offsets is recommended.

Offsets require ongoing management actions to ensure that the offset is of sufficient quality to achieve its environmental outcome. In addition, all offset agreements must have ongoing monitoring, reporting and evaluation.

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

The optimal approach for offsetting will be to offset as much as possible within regrowth inside bioregional corridors, with the next highest priority being rehabilitation of cleared land inside bioregional corridors, and lastly to offset outside of biodiversity corridors using only regrowth vegetation.

It is expected that offsets, agreed with the relevant regulators, will compensate for habitat impacts that cannot be mitigated through management actions.

As the construction of the Project is proposed to be staged over a period of approximately six years, with a proposed lifespan of approximately 30 years, it is assumed that delivery of the offset package would also be staged as the development progresses.

Matters of National Environmental Significance

Under the EPBC Act, an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The recommended 'self-assessment' process of addressing significant impact criteria (as identified by DEWHA) has been completed.

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

Cumulative Impacts

An assessment of terrestrial ecological cumulative impacts must take into account not only the potential impacts of the subject Project, but its effects in combination with the impacts of other proposed projects that may have a significant potential to affect regional terrestrial biodiversity.

The other gas field tenements known to be subject to development applications have been mapped in conjunction with the Australia Pacific LNG tenements, as well as sites of other projects in the approval or early development stage, where they occur within the biodiversity provinces affected by the Australia Pacific LNG project.

A total of approximately 2,000,000ha of remnant vegetation falls within the boundaries of these project areas. There are several REs in the bioregion which are present within the relevant provinces that are approaching increasing VM Act remnant status from 'least concern' to 'of concern' and two REs approaching increasing status from 'of concern' to 'endangered'.

Clearing for the proposed Project would not reduce the extent of these REs within the Brigalow Belt bioregion such that their remnant status would be altered. However the cumulative effects of clearing for all projects within the bioregion need to be considered for the borderline REs. At present, there is insufficient data from other projects to allow such an assessment.

Maintenance and enhancement of bioregional corridors identified by the BBS BPA process have been identified as key recommended

BBS bioregion. It requires terrestrial shallow wetlands and will use inundated grasslands, saltmarsh, dams, rice crops, sewage farms and bore drains. Therefore, the area of conserved REs for this species gives little indication of the amount of suitable habitat as this species is often recorded from non-remnant vegetation. The habitat requirements of some other species (such as the White-throated Needletail and Rainbow Bee-eater), are so broad that they could occur in/above all REs.

It should also be noted that non-remnant vegetation may provide significant resources for many of the species listed.

Table 2.14 provides the total area of REs listed for each species listed in Table 2.13 and gives the land tenure, indicating the amount of habitat for conservation significant species that is currently conserved. This is, however, a broad scale approach as particular species do not occur in all available and apparently suitable habitats due to a variety of patch characteristics including habitat condition, connectivity and position in the landscape. Furthermore, an area mapped as remnant may be highly degraded, particularly in terms of its ground cover, and may not be suitable for ground-dwelling species, especially herpetofauna and ground-nesting birds. An actual habitat assessment is required to accurately identify the likelihood of a species occurring in a habitat patch. Specific habitat requirements for significant species are noted below.

Invertebrates

The entire known distribution of the Dulacca Woodland Snail is within the Carinya tenement and there is no known habitat for the species within areas protected under the NC Act or Forestry Act. There is no habitat known to be utilised by the Brigalow Woodland Snail protected under the NC Act or Forestry Act in the Relevant Provinces, which encompass its entire known distribution. The species occurs on alluvial soils with all except a single record from remnant vegetation.

Two butterfly species, Bulloak Jewell and Pale Imperial Hairstreak, are relevant to the study area, though the occurrence of the former requires substantiation. These species have 3,825ha and 6,200ha in NCAPA, respectively. Bulloak Jewell also has 354,682ha within FAPA land compared to 13,168 for Pale Imperial Hairstreak. The study area is likely to be more important for the Pale Imperial Hairstreak, which has suffered greater loss and fragmentation of its habitat as it occurs on more fertile soils than the REs that provide resources for Bulloak Jewell.

Frogs and Reptiles

The Rough Frog has 3,762ha of NCAPA land and 29,604ha of FAPA land. This species is dependent on substrate type rather than remnant vegetation. While significant areas of non-protected land support this species, areas of cleared land may do as well, though in some areas the necessary soil structure has been destroyed through agricultural practices.

Reptile species for which the study area is, or may be, quite important in terms of their overall population, that is, Golden-tailed Gecko, Brigalow Scaly-foot, Yakka Skink, Dunmall's Snake and Grey Snake, have variable areas of suitable habitat protected under the NC Act and Forestry Act. Golden-tailed Gecko, Brigalow Scaly-foot and Yakka Skink occur in a large number of comparatively widespread REs and each have 20,000+ha of NCAPA land and 800,000+ha of FCPA land.

Grey Snake, largely a frog predator, occurs on flood plains and is less dependent on remnant vegetation, though cattle grazing may reduce habitat suitability through soil compaction. Dunmall's Snake is poorly known and its likely occurrence within areas protected under the NC Act and Forestry Act is difficult to assess. These species are

susceptible to disturbance and the loss of suitable ground cover such as coarse woody debris and leaf litter and, in the case of Golden-tailed Gecko, trees with exfoliating bark, may reduce a habitat's viability (Richardson 2006). Non-reserved remnant vegetation may be grazed or otherwise disturbed and is less likely to provide suitable resources for these species than areas protected under the NC Act and Forestry Act, though Yakka Skink can occupy degraded areas with log piles or rabbit warrens to provide shelter and Brigalow Scaly-foot has been recorded from areas of Buffel Grass. Such use of degraded habitats should not, however, reduce the conservation significance of these species.

Due to the possible consequences of grazing, the extent of reserved land is of much greater importance for these species than for many other conservation significant species in the study area. The much more widespread Common Death Adder has declined substantially in the BBS bioregion due, in part, to Cane Toads and trampling by livestock. This species, therefore, is dependent on areas unsuitable for toads and where livestock are excluded and may also be very dependent on areas protected under the NC Act.

Table 2.14. Remnant Habitat Extent by Land Tenure within the Relevant Bioregional Provinces for Terrestrial Fauna Species of Special Conservation Significance Likely to Occur within the Study Area 1

Species Name	Common Name	Extent of Remaining Remnant Habitat (ha) and its Land Tenure within the Relevant Provinces2,3			Total (ha)
		Areas Protected under the NC Act4	Areas Protected under the Forestry Act5	Non-Protected Areas6	
Hypochrysops piceata	Bulloak Jewell	1683	224887	142593	369163
Jalmenus eubulus	Pale Imperial Hairstreak	6200	13168	191960	211328
Limnodynastes salmini	Salmon-striped Frog	6330	29461	432390	468181
Cyclorana verrucosa	Rough Frog	3762	29604	372395	405761
Emydura macquarii	Macquarie Turtle	663	9238	104889	114790
Macrochelodina expansa	Broad-shelled Turtle	663	9238	104889	114790
Strophurus taenicauda	Golden-tailed Gecko	21942	866227	1219288	2107457
Delma plebeia	Leaden Delma	3460	36902	416217	456579
Delma torquata	Adorned (Collared) Delma	14582	227857	717728	960167
Paradelma orientalis	Brigalow Scalyfoot	23347	893270	1260668	2177285
Ctenotus ingrami	Unspotted Yellow-sided Ctenotus	8567	252440	572825	833832
Cyclodomorphus gerrardii	Pink-tongued Skink	1798	63176	216222	281196
Egernia rugosa	Yakka Skink	23451	824686	1324553	2172690
Tiliqua rugosus	Shingle-back	10180	542420	901625	1454225
Chlamydosaurus kingii	Frilled Lizard	6467	559055	840356	1405878

Species Name	Common Name	Extent of Remaining Remnant Habitat (ha) and its Land Tenure within the Relevant Provinces2,3			Total (ha)
		Areas Protected under the NC Act4	Areas Protected under the Forestry Act5	Non-Protected Areas6	
Physignathus lesueurii	Eastern Water Dragon	133	7850	73196	81179
Varanus panoptes	Yellow-spotted Monitor	19189	743629	1266186	2029004
Aspidites ramsayi	Woma	8564	111656	557878	678098
Acanthophis antarcticus	Common Death Adder	9177	344354	548954	902485
Cryptophis boschmai	Carpentaria Snake	14780	418051	853327	1286158
Furina dunmalli	Dunmall's Snake	8963	383101	633045	1025109
Hemiaspis damelii	Grey Snake	3903	83661	419945	507509
Hoplocephalus bitorquatus	Pale-headed Snake	20808	796491	1268087	2085386
Pseudechis guttatus	Spotted Black Snake	8975	307217	678320	994512
Stictonetta naevosa	Freckled Duck	1870	17420	274728	294018
Nettapus coromandelianus	Cotton Pygmy-goose	1870	17420	274728	294018
Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	17619	795488	1144270	1957377
Hirundapus caudacutus	White-throated Needletail	26731	919667	1546046	2492444
Apus pacificus	Fork-tailed Swift	26731	919667	1546046	2492444
Ephippiorhynchus asiaticus	Black-necked Stork	1870	17420	274728	294018
Ardea modesta	Eastern Great Egret	1870	17420	274728	294018
Plegadis falcinellus	Glossy Ibis	1870	17420	274728	294018

Species Name	Common Name	Extent of Remaining Remnant Habitat (ha) and its Land Tenure within the Relevant Provinces2,3			Total (ha)
		Areas Protected under the NC Act4	Areas Protected under the Forestry Act5	Non-Protected Areas6	
Lophoictinia isura	Square-tailed Kite	19020	850648	1285097	2154765
Haliaeetus leucogaster	White-bellied Sea-Eagle	663	9238	104889	114790
Accipiter novaehollandiae	Grey Goshawk	663	9238	104889	114790
Erythrotriorchis radiatus	Red Goshawk	16782	853688	1128273	1998743
Lewinia pectoralis	Lewin's Rail	663	9238	104889	114790
Burhinus grallarius	Bush Stone-curlew	13149	125075	623907	762131
Rostratula australis	Australian Painted Snipe	3859	28659	373487	406005
Gallinago hardwickii	Latham's Snipe	1870	17420	274728	294018
Turnix melanogaster	Black-breasted Button-quail	3079	9963	85681	98723
Calyptorhynchus lathami	Glossy Black-Cockatoo	8498	278960	524259	811717
Lathamus discolor	Swift Parrot	397	97332	192776	290505
Neophema pulchella	Turquoise Parrot	1913	21942	284829	308684
Ninox connivens	Barking Owl	9012	857218	1058898	1925128
Tyto novaehollandiae	Masked Owl	2442	40675	374664	417781
Merops ornatus	Rainbow Bee-eater	26731	919667	1546046	2492444
Climacteris picumnus	Brown Treecreeper	2335	31955	298776	333066
Chthonicola sagittata	Speckled Warbler	10828	580678	847382	1438888

Haitats for Terrestrial Fauna Species of Special Conservation Significance

Refined terrestrial vegetation mapping, when cross-referenced with the RE/habitat preferences of terrestrial fauna species of special conservation significance known or considered possible occurrences in the study area (Table 2.13), provides a spatial representation of available habitat for these species within the study area. Mapping at the RE level identifies many heterogeneous polygons containing multiple REs and large tracts of habitat that may be multiple and contiguous REs, yet these REs may all provide very similar resources and be utilised as though one habitat type by a particular fauna species or suite of species. The habitat values to fauna are therefore discussed under broad headings to better reflect faunal use of the landscape.

Reference to species of conservation significance in this section includes only those listed as endangered, vulnerable, rare or near threatened at the National and/or State level, unless otherwise noted. Migratory (EPBC Act) and non-EVR priority species are identified where appropriate.

The habitats within and immediately surrounding the study area can be assigned to nine broad categories:

- Woodland and open forest on alluvial soils
- Woodland and open forest on non-alluvial soils
- Brigalow communities
- Semi-evergreen vine thicket
- Shrubland
- Grasslands, including pasture
- Regrowth
- Rivers and creeks, including ephemeral watercourses, lakes and billabongs, and
- Dams and other artificial waterbodies.

The listed habitat types are not all mutually exclusive. For example, a Brigalow community is also woodland on either alluvial or non-alluvial soil and Brigalow may contain semi-evergreen vine thicket (SEVT) elements (or vice versa) and grade from one habitat to the other within a single habitat patch. For clarification, Table 2.12 identifies which REs found within the study area are allocated to each of the habitat types with remnant vegetation, with comments on any confounding aspects. Woodland and forest have been separated on the basis of soils, alluvial versus non-alluvial, due to the typically greater productivity and species richness, of both flora and fauna, of habitats on alluvial soils (Jacquemyn et al. 2001; Woinarski and Ash 2002; Martin et al. 2006). The resultant allocations are visually represented on Figure 2.9, based on the refined vegetation mapping shown on Figures 2.6 to 2.8.

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

Structure refers to the abundance and complexity of the vegetation, debris and substrate. Habitats with abundant shrubs, thick ground cover and dense sub-canopy and canopy are vertically complex and provide abundant shelter and foraging sites, particularly for bird species. Horizontal complexity refers to characteristics such as the presence of ground plant species, open areas, fallen timber and rock crevices that provide sheltering opportunity for terrestrial species. Habitats with higher vertical and horizontal complexity will generally have higher fauna species diversity. Habitats with a diverse plant species assemblage tend to be more structurally complex due to the different growth forms of different species.

Species Name	Common Name	Extent of Remaining Remnant Habitat (ha) and its Land Tenure within the Relevant Provinces2,3			Total (ha)
		Areas Protected under the NC Act4	Areas Protected under the Forestry Act5	Non-Protected Areas6	
Melithreptus gularis	Black-chinned Honeyeater	19651	839297	1250478	2109426
Grantiella picta	Painted Honeyeater	9395	22435	385149	416979
Pomatostomus temporalis	Grey-crowned Babbler	23855	897251	1508296	2429402
Pomatostomus superciliosus	White-browed Babbler	8590	652979	686840	1348409
Rhipidura rufifrons	Rufous Fantail	4510	21507	219773	245790
Melanodryas cucullata	Hooded Robin	7121	37643	271904	316668
Acrocephalus australis	Australian Reed-Warbler	442	175	2536	3153
Stagonopleura guttata	Diamond Firetail	1797	66132	239398	307327
Ornithorhynchus anatinus	Platypus	663	9238	104889	114790
Phascogale tapoatafa	Brush-tailed Phascogale	16470	803369	1184235	2004074
Planigale tenuirostris	Narrow-nosed Planigale	3461	33131	387930	424522
Isoodon macrourus	Northern Brown Bandicoot	1474	268450	450198	720122
Perameles nasuta	Long-nosed Bandicoot	1988	1034	19054	22076
Phascolarctos cinereus	Koala	18717	471058	874845	1364620
Petaurus australis	Yellow-bellied Glider	5778	680850	671699	1358327
Petaurus norfolcensis	Squirrel Glider	939	60716	202268	263923
Petauroides volans	Greater Glider	20092	882109	1321972	2224173

Species Name	Common Name	Extent of Remaining Remnant Habitat (ha) and its Land Tenure within the Relevant Provinces2,3			Total (ha)
		Areas Protected under the NC Act4	Areas Protected under the Forestry Act5	Non-Protected Areas6	
Pseudocheirus peregrinus	Common Ringtail Possum	18	926	3252	4196
Trichosurus vulpecula	Common Brushtail Possum	18717	471058	874845	1364620
Aepyprymnus rufescens	Rufous Bettong	2787	191955	519803	714545
Macropus dorsalis	Black-striped Wallaby	7073	38347	302393	347813
Pteropus poliocephalus	Grey-headed Flying-fox	2719	412453	332119	747291
Chalinolobus dwyeri	Large-eared Pied Bat	4127	143099	227227	374453
Chalinolobus picatus	Little Pied Bat	25369	897146	1514767	2437282
Miniopterus orianae oceanensis	Eastern Bentwing-bat	233	46956	87278	134467
Nyctophilus corbeni (formerly timoriensis)7	South-eastern Long-eared Bat	24575	873741	1323834	2222150
Pseudomys patrius	Eastern Pebble-mouse	10565	229501	443714	683780

1 'Excludes Dulacca Woodland Snail and Brigalow Woodland Snail as there is no known habitat for these species within areas protected under the NC Act or Forestry Act.

2 'Based on RE/Habitat preference in Table 2.13 and data from EPA (2008d).

3 Relevant Provinces' include Provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion. Province 24 has large areas of National Park and other protected areas but has a relatively poor representation within the study area. As such, it has been excluded from the assessment due to its potential to result in misleading conclusions from the data.

4 Includes extent within National Parks, Conservation Parks, Forest Reserves, Resource Reserves and Nature Refuges.

5 Includes extent within State Forests and Timber Reserves. Such areas may be subject to timber felling and long-term grazing, which may significantly reduce the habitat quality for a range of fauna species.

6 Includes extent within Free Hold, Lease Hold and other areas not protected under the NC Act or Forestry Act.

7 Very recently described as Nyctophilus corbeni (Parnaby 2009).

Birds

Bird species for which the study area is arguably most important are Square-tailed Kite, which breeds in the Talinga tenement and would range over much of the open forest and woodlands, and Glossy Black-Cockatoo and Painted Honeyeater, for which the area provides substantial food resources. The broad habitat use of Square-tailed Kite means that substantial area are protected as NCAPA or FAPA, 19,020ha and 850,648ha, respectively, compared to less than 9,000 and 30,000ha for Glossy Black-Cockatoo and Painted Honeyeater. Both these species will forage in non-remnant vegetation, the cockatoo in isolated Belah and other Allocasuarina/Casuarina species if the fruit is of suitable quality, and the honeyeater in mistletoe clumps in roadside strips or isolated trees. The Glossy Black-Cockatoo is, however, probably dependent on large areas for food resources and requires large hollow-bearing trees for breeding and suitable watering points.

Mammals

Three significant micro-bat species do, or may, occur in the study area. One of these, Large-eared Pied Bat, is known from only one recent record and the relevance of areas protected under the NC Act and Forestry Act to this species is unknown. However, there are areas within Gurulmundi State Forest that appear suitable for the species for roosting.

Little Pied Bat and South-eastern Long-eared Bat both appear comparatively generalist in their habitat use. A lack of knowledge of the biology of the latter species, however, makes it difficult to make accurate assessments of its habitat use and it may require large, intact remnants (Turbill et al. 2008). It may be dependent on reserved lands despite very large areas of non-protected land that appear to be suitable.

Corridors

A wildlife corridor is a linear landscape element that connects two or more patches of vegetation (Soulé and Gilpin 1991). Vegetation, regardless of age, structure and floristic composition, may act as a corridor for movement by fauna even when it fails to provide adequate resources to support those species that move through it in the longer term. However, species that utilise the corridor will be determined by the age, structure, floristic composition, width, shape, patchiness, disturbance regimes and location in the landscape of the vegetation in question (Saunders and Hobbs 1991).

Maintaining connectivity across a landscape through corridors or ‘stepping stones’ of remnant vegetation is important for the long-term conservation of biodiversity. Within the study area, major areas have been designated as terrestrial bioregional corridors of State significance under BPA mapping (Figure 2.2 and Appendix D). Also identified are several state or regionally significant watercourses with remnant vegetation acting as riparian corridors including Juandah Creek west of the Leichhardt Highway; the Condamine River; and the Weir River.

Riparian areas are particularly important to the landscape. Not only are they diverse and dynamic habitats in themselves, but they also exert regulatory control over other landscape elements and general environmental vitality (Naiman et al. 1993). Their value as corridors is discussed under the broad habitat type Rivers and Creeks above.

A less well recognised landscape feature that facilitates movement is the vegetation, much of it remnant, that occurs in road and rail reserves and stock routes. Such vegetation is often continuous for large distances and incorporates a variety of land zones and REs. Large tracts of vegetation that make up state and regional corridors are often on less fertile soils as a result of the targeted clearing of fertile areas for agriculture and grazing. Road and rail reserves and stock routes are often

on fertile soils (Sutherst et al. 2007). Some road reserves within the study area, such as the Condamine-Tara Road and Kogan-Condamine Road, are mapped as being of state significance and having 'very high' special biodiversity values (EPA 2008c).

The Importance of the Study Area to Conservation Significant Fauna

The 1,470,000ha study area incorporates the known or expected distributions of 99 fauna species of special conservation significance. Table 2.10 discusses the likelihood of occurrence of these and other conservation significant species and identifies, where possible, the status of each species within the study area.

The number of known records of a species within the study area (Appendix J) does not by itself indicate the importance of the study area to that species in terms of its overall population. Two species may be equally common, or uncommon, within the study area but one may occur throughout Australia and even extralimitally and the other may have a more limited distribution centered on the BBS bioregion. Also a small number of records of a species that is difficult to detect and/or identify may indicate that the study area is quite important whilst a small number of records of an easily detectable and identifiable species suggests that the study area is of little importance. The study area, or part of, may fall within the extremes of a species' distribution and its occurrence there may be insignificant to its conservation despite the status of the species in question. Similarly species that are widespread may make little use of the study area due to a lack of suitable habitat, such as wetlands, and such records are not indicative of an area of importance to the species.

Table 2.15 lists species for which the study area is considered to be of high or very high importance. This assessment is based on a combination of the species' known occurrence within the study area and the extent of distribution beyond the study area. The study area also supports important populations of Salmon-striped Frog, Yellow-spotted Monitor, Woma, Pale-headed Snake, Square-tailed Kite and Little Pied Bat but the study area is a smaller percentage of their overall distribution. Despite a distribution that stretches north to Cape York the study area is considered of high importance to Yakka Skink due to its patchy occurrence within its range.

Feral Terrestrial Vertebrate Fauna

A total of 18 feral terrestrial vertebrate species are noted from surveys and from database searches (Table 2.16). Six of these species are recognised as Class 2 pests under the LP Act. None of these species is unexpected and all are commonly found in the BBS bioregion except for Nutmeg Mannikin Lonchura punctulata, which is typically coastal in occurrence, and Asian House gecko Hemidactylus frenatus which currently appears restricted to the town of Chinchilla (Craig Eddie pers. comm.).

The currently recognised densities and distributions in Table 2.16 are derived from mapping of pest species by the Primary Industries & Fisheries branch of the Queensland Department of Employment, Economic Development and Innovation (DEEDI). Density is categorised as abundant, common, occasional, absent or unknown. Distribution is either widespread or localised.

Given the size of the study area, multiple combinations of these categories may be mapped for a single species.

Under the LP Act, a Class 2 pest is one that 'is established in Queensland and has, or could have a substantial adverse economic, environmental, or social impact. The management of these pests requires co-ordination and they are subject to local government, community or landowner-led programs. Landowners must take reasonable steps to keep land free from Class 2 pests.'

The following is a brief summary of impacts on terrestrial ecological values due to each of the declared pest species. The impacts of

Cane Toads Rhinella marina are also briefly discussed, given the potential spread of this species throughout the southern and western parts of the study area.

Red Foxes Vulpes vulpes are highly adaptable omnivores, killing or scavenging food such as rabbits, hares, rodents, frogs and birds as well as invertebrates such as beetles, grasshoppers and earthworms (Bayley 1978; Catling 1988). In most locations mammals probably constitute the majority of their diet (Saunders et al. 2004), though they also feed on plant material, particularly fruits and berries. Native fauna species have not developed strategies to avoid fox predation. In fact, many species do not recognise, or are slow to recognise, the fox as a predator, making them particularly susceptible to predation (Griffin et al. 2001; Short et al. 2002). It is now generally recognised that land clearing and predation by introduced predators, particularly the Red Fox, are probably most responsible for the catastrophic loss of Australian biota.

mitigation actions for the Australia Pacific LNG Project. The treatment of these corridors by neighbouring developments would significantly influence the success of these actions to maintain and improve landscape connectivity.

Fragmentation has the capacity to degrade the quality of significant areas of adjacent habitat over time. Without cooperative management of terrestrial ecological impacts by all proponents, including community involvement, and without a broad-scale and integrated planning approach to rehabilitation and offset locations, the combination of the development projects currently proposed for the relevant provinces has the potential to result in long term degradation of habitats for a number of conservation significant flora and fauna species. Those species most at risk are those which are endemic to the region and rely specifically on connected, large tracts of intact, remnant vegetation.

Concentration of rehabilitation efforts within the bioregional corridors recommended for the Australia Pacific LNG project will have positive ecological benefits. However coordination of habitat rehabilitation efforts for all of the proposed gas field projects is outside of the authority of any of the individual proponents and will require government input to ensure that all of the projects adequately compensate for the potentially significant cumulative ecological impacts of fragmentation by cooperating to achieve long term landscape-scale ecological benefits.

Table 2.15. Terrestrial Fauna Species of Special Conservation Significance for which the Study Area is of Importance

Species Name	Common Name	Management Status1			Importance of Study Area 2
		EPBC Act	NC Act	BAM M	
In preparation 3	Dulacca Woodland Snail Camaenidae BL12 4	E 5			Very important – all known records are from the study area
In preparation 3	Brigalow Woodland Snail Camaenidae BL13 4	CE 6			Very important – only known from study area and its close surrounds
Cyclorana verrucosa	Rough Frog		R		Important – study area occupies a substantial part of known distribution (>10%) and includes large areas of suitable habitat
Strophurus taenicauda	Golden-tailed Gecko		NT		Very important – endemic to BBS and study area is a large portion of known distribution (>25%)
Paradelma orientalis	Brigalow Scaly-foot	V	V		Important – near endemic to BBS and study area is a large portion of known distribution (~25%)
Egernia rugosa	Yakka Skink	V	V		Important – colonial species with a patchy distribution.
Furina dunmalli	Dunmall's Snake	V	V		Important – near endemic to BBS and study area is a large portion of known distribution (~25%)
Hemiaspis damelii	Grey Snake		E		Important – study area is approximately 10% of known distribution and includes large areas of suitable habitat
Pseudechis guttatus	Spotted Black Snake		C	x	Important – study area is approximately 10% of known distribution and includes large areas of suitable habitat for a species that has declined to the east.

Species Name	Common Name	Management Status1			Importance of Study Area 2
		EPBC Act	NC Act	BAM M	
Calyptorhynchus lathami	Glossy Black-Cockatoo 7		V		Important – study area is within the core area for this species in Queensland.
Grantiella picta	Painted Honeyeater 7		R		Important – study area is within the core area for this species in Queensland.

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

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

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

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

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

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

7 'Back on Track' species
http://www.epa.qld.gov.au/nature_conservation/wildlife/back_on_track_species_prioritisation_framework/

–

Table 2.16. Feral Terrestrial Vertebrate Fauna Known from the Study Area

Species Name	Common Name	LP Act Status	Currently Recognised Density/ Distribution1 in the Study Area
Rhinella marina	Cane Toad		Occasional and widespread in the north. Occasional and localised in central-eastern portions. Absent in the south.
Hemidactylus frenatus	Asian House Gecko		Not mapped.
Columba livia	Rock Dove		Not mapped.
Streptopelia chinensis	Spotted Turtle-Dove		Not mapped.
Sturnus vulgaris	Common Starling		Not mapped.
Sturnus tristis	Common Myna		Occasional and localised in central-eastern portions.
Passer domesticus	House Sparrow		Not mapped.
Lonchura punctulata	Nutmeg Mannikin		Not mapped.
Mus musculus	House Mouse		Not mapped.
Rattus rattus	Black Rat		Not mapped.
Vulpes vulpes	Red Fox	Class 2	Common and widespread.
Canis lupus familaris/dingo	Domestic Dog/ Dingo	Class 2	Mostly common and widespread. Common and localised in southern portions.
Felis catus	Cat	Class 2	Common and widespread.
Lepus capensis	Brown Hare		Not mapped.
Oryctolagus cuniculus	Rabbit	Class 2	Occasional and widespread to the southwest of Combabula tenement.
Equus caballus	Horse		Common and localised in the north.
Sus scrofa	Pig	Class 2	Mostly common and localised but common and widespread in the western portions.
Capra hircus	Goat	Class 2	Absent. Common and widespread to the southwest. Occasional and localised to the south.

1 Based on most recent mapping from Pest Information Management, Biosecurity Queensland, Department of Primary Industries & Fisheries (http://www.dpi.qld.gov.au/4790_9537.htm).

Dingoes Canis lupus dingo were brought to Australia from Asia several thousand years ago. The species now occupies the entire Australian mainland. Dingoes are very common locally in forested areas north of the Dingo Barrier Fence (Hando and Hando 1997). Prey ranges in size from Swamp Buffalo Bubalus bubalus to invertebrates, though within a particular region Dingoes will tend to specialise on the commonest available wildlife. Dingoes tend to attack livestock only when native prey is scarce (Corbett 2008). Dingoes may actually help regulate native mammal communities through predation of smaller predators such as foxes, which benefits smaller mammals eaten by foxes, and of kangaroos and rabbits, which reduces overgrazing (Glen et al. 2007; Letnic and Koch 2009).

Cats Felis catus are a significant predator of native wildlife and have been implicated in the extinction of native fauna species on offshore islands (Bloomer and Bester 1992) and on mainland Australia (Dickman et al. 1993). Cats are adaptable and opportunistic predators. They prefer live prey , particularly animals of less than 600g, which often includes the young of larger mammals, although younger Rabbits appear to be their staple diet when abundant (Robley et al. 2004). Cats will also predate on birds, reptiles, invertebrates and carrion (Dickman 1996).

Rabbits Oryctolagus cuniculus eat grasses, roots, tree bark, leaves, grains, fruits, seeds and buds. They will select the more nutritious components in a sward and dig below the crowns of grass clumps to eat seeds and roots, thus altering the composition of plant communities and turning woodlands into grasslands. During dry conditions, Rabbits may also feed on bark and roots of shrubs, from which they can obtain most of the moisture they require (Williams and Myers 2008).

Rabbits inhibit the regeneration of native vegetation (Lange and Graham 1983; Cooke 1987); compete with native fauna for food (Dawson and Ellis 1979) and shelter (Priddel et al. 1995); support populations of foxes and cats (Catling 1988) and cause soil erosion (Norman 1988). The decline and extinction of many of Australia's terrestrial mammals that weigh between 35g and 5500g, particularly in the arid and semi-arid zones, was associated with the Rabbit's introduction (Calaby 1969).

Feral Pigs Sus scrofa are largely omnivorous, favouring succulent vegetation, fruit, grain and animals including invertebrates, reptiles, eggs of ground nesting birds or reptiles, small or young mammals and some carrion (Choquenot et al. 1993; Heise-Pavlov 2008). They need to drink daily in hot weather and are usually found within two kilometres of water under such conditions. The creation of farm dams and other waterbodies may have facilitated the spread of this species in semi-arid Australia (Mitchell 1993; Roberts et al. 1996). Pigs degrade habitat through surface soil destruction due to their foraging techniques. They up-root plants which facilitates erosion and most damage occurs in areas where the soil is soft such as around wetlands, swamps, lagoons, creeklines and associated watercourses or in low-lying areas after rain. This reduces regenerating forest plants and facilitates the invasion of both native and introduced weed species (Alexiou 1983; Statham and Middleton 1987; Hone 1995).

Goats Capra hircus have a significant impact on the composition of vegetation communities, even when they occur in low numbers, due to their broad dietary tolerance. When they occur in high numbers, they are capable of removing all foliage below 1.8m (and sometimes higher), decimating the vegetation. They suppress regeneration and contribute to erosion through a combination of vegetation removal and breaking the surface of soil with their hooves. Goats have also contributed to the decline of native mammals through competition for resources (Henzell 2008).

Cane Toads have caused extensive mortality, through poisoning, of native frog-eating species (Burnett 1997; Phillips et al. 2003).

Table 2.12. Regional Ecosystem allocation to broad habitat types

Habitat Type	Regional Ecosystems within Study Area	Comments
Woodland and open forest on alluvial soils	11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.18, 11.3.19, 11.3.25, 11.3.26	
Woodland and open forest on non-alluvial soils	11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.6, 11.9.7, 11.9.9, 11.10.1, 11.10.1d, 11.10.9, 11.10.11	RE 11.7.1 can include Brigalow or Belah. RE 11.9.6 can include Brigalow.
Brigalow Community	11.3.1, 11.3.17, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.9.1, 11.9.5, 11.9.10	Brigalow communities may be Brigalow and/or Belah. RE 11.4.3a may not include Brigalow or Belah but is associated with Brigalow communities. RE 11.9.5 may contain SEVT species.
Semi-evergreen Vine Thicket	11.8.3, 11.9.4a, 11.9.4b	REs 11.8.3 and 11.94a can include Brigalow and Belah. RE 11.9.4b has a Brigalow canopy.
Shrubland	11.7.5	
Grassland	nil	
Rivers, Creeks and Other Natural Waterbodies	11.3.27b	

In addition, the availability and variety of resources affect the number and type of vertebrate species inhabiting an area. Those habitats with abundant and variable resources may support more species, even if they compete, while the presence of a preferred dietary item will facilitate the presence of a particular species (for example, Belah for Glossy Black-Cockatoo). Habitat use by certain species may be seasonal or may reflect current conditions, for example recent rainfall or mass flowering events.

The suitability of habitats in the study area to many of the conservation significant fauna species is also dependent, in part, on other factors including disturbance levels and types, patch size and connectivity. These factors are very site specific and may be synergistic, though soil type is typically the driving factor. For example, soil type not only influences species richness and productivity but also influences susceptibility of a habitat to weed invasion and may encourage or discourage grazing/browsing by livestock or feral species.

Weed infestations and degradation by livestock can have deleterious impacts on fauna, particularly reptiles, small mammals and insectivorous birds that forage on the ground (Adair and Groves 1998; Woinarski and Ash 2002; Maron and Lill 2005), and may significantly alter the species assemblage of a habitat patch.

Similarly, micro-habitats such as coarse woody debris and a dense shrub layer are influenced by vegetation species composition, also a product of soil type, but may also reflect past and on-going human activities. For example, large amounts of coarse woody debris, including hollow logs, may be the result of historical logging. Shrub density may

The Cane Toad has been spreading through parts of the study area (Hando and Hando 1997) and is predicted to expand into central western New South Wales via the Murray Darling system (Phillips et al. 2003). There is some uncertainty about the likely extent of their expansion (Urban et al. 2007), but they are known to use roads, tracks and other linear clearing to disperse (Seabrook and Dettmann 1996; Brown et al. 2006) and they are apparently still being introduced both intentionally and accidently by humans (Phillips et al. 2007).

1.7 Summary of Existing Terrestrial Ecological Values and Associated Sensitivities to Disturbance

As a means of presenting the extensive terrestrial ecology information collected for this report in a format that could be used by Australia Pacific LNG project planners to inform ecologically sensitive infrastructure layout, a sensitivity map was developed following the methodology described in Appendix A. The infrastructure layout subsequently provided has formed the basis of the impact assessment (Section 3.0).

Figure 2.10 provides a summary visual representation of the results of the initial, relative terrestrial ecological importance assessment for the entire study area (that is, a 'heat map'), based on the refined vegetation mapping in Appendix I. The fundamental assessment criteria that contribute to the sensitivity (or 'heat') of the mapped vegetation include:

The conservation status of REs (identified on the refined vegetation mapping in **Appendix I**) under the VM Act and EPBC Act;

The suitability of each RE as habitat for significant terrestrial flora and fauna;

The conservation status of significant terrestrial flora and fauna species (known or considered likely to occur within the mapped REs within the study area) under the EPBC Act or NC Act;

The importance of the study area to the significant terrestrial flora and fauna species (that is, in terms of known distributions);

Contribution of vegetation (both remnant and regrowth) to significant corridors, as identified under the BPA; and

The tract size of each vegetation polygon, as identified under the BPA; and

Occurrence of vegetation within areas protected under the NC Act.

Figure 2.11 provides a visual representation of the results of the eventual sensitivity assessment for the entire study area, based on the grouping of final scores from the initial, relative terrestrial ecological importance assessment. The latter are summarised in Table 2.17 for areas of remnant and important regrowth vegetation.

Additional layers of sensitivity are also applied to the mapping, regardless of the sensitivity category of any relevant polygons, as follows:

- Areas known, or having high potential, to support any of two flora species, *Micromyrtus carinata* and *Calytrix gurulmundensis*, and two undescribed snail species, Brigalow Woodland Snail and Dulacca Woodland Snail. These species are of major conservation significance, with very restricted distributions.
- Areas within the Talinga tenement known to support populations of Yakka Skink or Painted Diuris (both vulnerable under the EPBC Act), or which contain habitat features such as caves and overhangs that are important to a number of conservation significant species.
- Waterbodies, due to their very high resource value, and certain areas of cleared land within floodplains that are subject to inundation during or

subsequent to rainfall events and may provide valuable resources for conservation significant fauna species such as Rough Frog and Grey Snake when flooded.

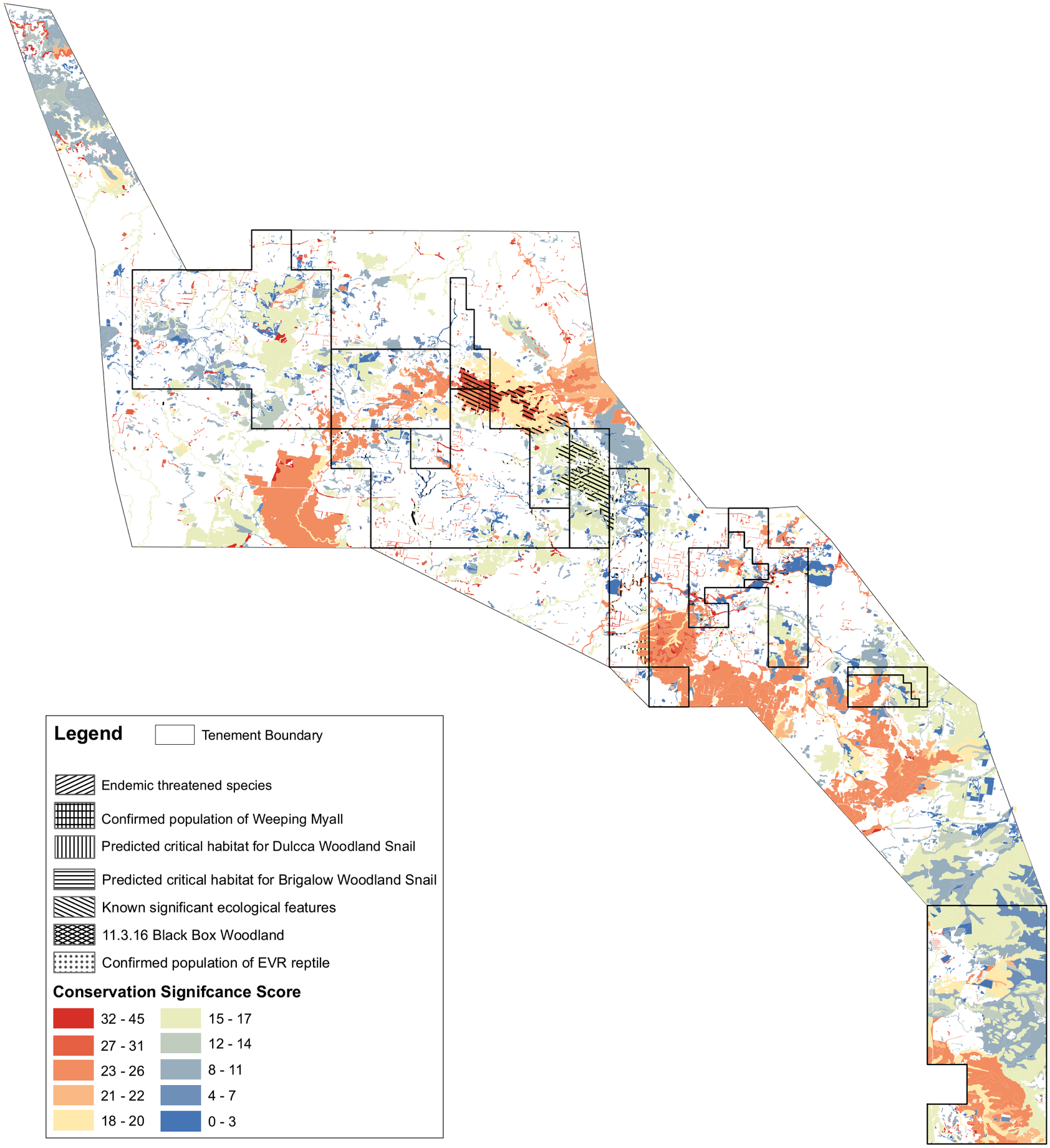
- The area of RE 11.3.16, confirmed by the Queensland Herbarium as the northernmost known population of this community in Australia.

Figure 2.11 shows that the most sensitive areas are associated with remnant Brigalow communities which are scattered throughout the study area. Also highly sensitive is remnant vegetation occurring within Bioregional corridors.

Table 2.17. Terrestrial Ecology Sensitivity Categories for Clearing and Infrastructure

Category	Sensitivity
1	Extremely sensitive Habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region and are likely to be in good condition due to minimal impacts of edge effects and located where they enhance ecological functions at a landscape level.
2	Highly Sensitive The majority of habitat patches within this category possess biodiversity characteristics that are unique and threatened at a National and a State level. These patches contain very high habitat values for threatened flora and fauna of the region. In comparison to those patches in Category 1, these patches have a reduced chance of being in good condition due to increased impacts of edge effects and are less likely to be located where they enhance ecological functions at a landscape level. Those patches that are of less importance at a National and State level or that possess lower habitat values are more likely to be in good condition and located where they enhance ecological functions at a landscape level.
3	Sensitive Biodiversity characteristics of these habitat patches are mostly unique at a sub-regional level. These patches are more likely to be in good condition due to their size and located where they enhance ecological functions at a landscape level.
4	Neutral Habitat patches within this category have a low chance of possessing biodiversity characteristics unique and threatened at a National or State level. These patches contribute little to ecological functions at a landscape scale and are likely to be in poor condition due to edge effects. Also includes patches that are either large in size or within recognised corridors and possess biodiversity values that are common within the bioregion.
5	Robust Biodiversity values within this category are generally common within the bioregion, patches are isolated from other remnant vegetation or likely to be in poor condition due to edge effects. The majority of species within these patches are either increaser species that proliferate in agro-ecosystems or unable to persist in the long-term as resources in the patch degrade.

Category	Sensitivity
6 and 7	Cleared These areas are currently devoid of vegetation or other habitat features and do not provide important habitat for many native species. Where such areas occur within a recognised corridor, they are afforded a higher category (6) due to the opportunity for enhancing landscape connectivity through rehabilitation of the preclearing vegetation community.



Biodiversity Assessment AND MANAGEMENT PTY LTD

Figure 2.10

Subject Area Terrestrial Ecology "Heat" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

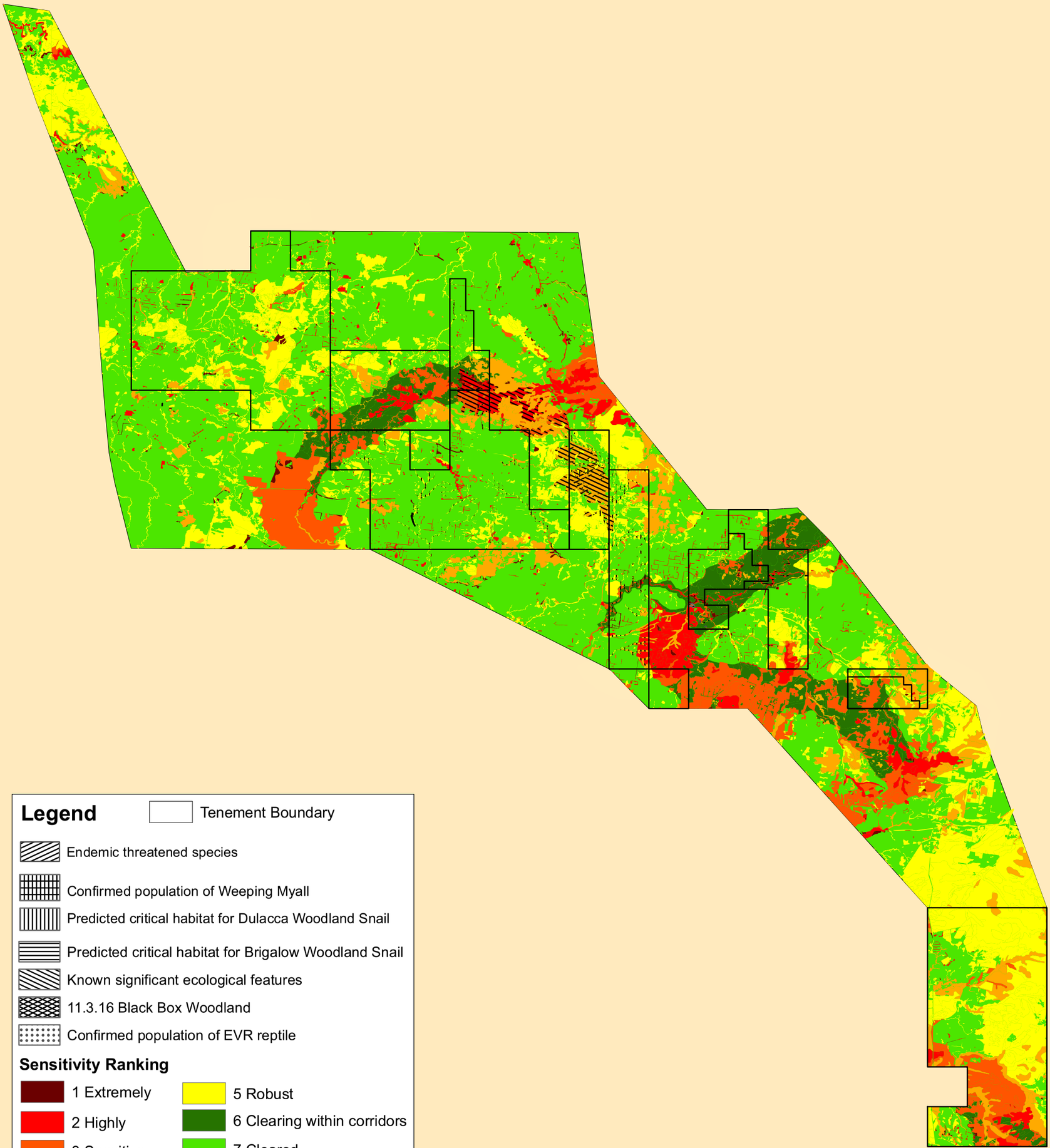


Figure 2.11

Biodiversity Assessment AND MANAGEMENT PTY LTD

Subject Area Terrestrial Ecology "Sensitivity" Map

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

2.0 Impact Assessment

2.1 The Impact Assessment Process

Australia Pacific LNG is aiming to achieve ecological sustainability for the Project. To facilitate early planning of the infrastructure footprint, Terrestrial Ecology Sensitivity Mapping for the study area was prepared and provided to Australia Pacific LNG (Figure 2.11) for planning purposes. More detailed sensitivity figures are presented in Appendix N. The infrastructure layout subsequently provided by Australia Pacific LNG has been used to determine clearing requirements for the Project and potential project impacts.

Impact mechanisms resulting from the proposed Project, including clearing, construction, operation and decommissioning are described in Section 3.2. The impact assessment methodology applied and impact assessment results are detailed in Sections 3.3 and 3.4 respectively. Outlines for relevant management guidelines are set out in Section 3.5. Offset opportunities are set out in Section 3.6. For ease of reference, all potential impacts on Matters of National Environmental Significance (MNES) relating to terrestrial ecology values are provided as a stand-alone document in Appendix P and are also discussed in a single section (Section 3.7).

At the landscape level, the cumulative impacts of habitat loss and disturbance as a result of the Australia Pacific LNG Project and other relevant proposed projects are addressed in **Section 3.8**.

2.2 Impact Mechanisms

This section sets out the impact mechanisms predicted to affect terrestrial flora and fauna in the study area. Identified impacts for the clearing, construction, operation and decommissioning phases of the Project have then been applied to the significant/sensitive aspects of the terrestrial flora and terrestrial fauna in Tables N.1 to N.8 (Appendix N), from which necessary mitigation actions are identified.

In general, impacts on ecological values can be considered in terms of direct and indirect effects, both short-term and long-term. Direct impacts refer to the loss of vegetation and habitat, usually through land clearing, while indirect impacts are secondary effects such as weed invasion and increased sedimentation. With the exception of precise gas well locations and associated access and local pipeline and water linkages, the Project disturbance footprint is shown on Figure 1.2. It includes areas that are proposed to be cleared for the construction of gas processing facilities and associated infrastructure such as pipelines and water treatment facilities. A gas well layout has not been provided in mapped format as the locations cannot be accurately plotted on the ground until detailed site assessments have been undertaken. An indicative layout of gas wells, informed by terrestrial ecological sensitivity mapping and other project development constraints, has been provided to the study team for impact assessment purposes.

Telecommunications towers are addressed separately in **Appendix L**.

2.2.1 Project Staging

Development of the gas fields and associated infrastructure is scheduled to commence in August 2010 and span approximately 30 years. The ‘rolling program’ of gas well development will continue for the life of the Project, beginning in Talinga and Combabula and ending in Carinya. Gas production and water treatment facilities construction will begin in 2010 in Combabula and Condabri. The last plant scheduled for construction is in Gilbert Gully in 2027. A summary of plant construction activities is provided in Table 3.1. Construction may begin in the year prior to commissioning.

TERRESTRIAL ECOLOGY AND IMPACT ASSESSMENT REPORT: GAS FIELDS COMPONENT

Australia Pacific LNG Project EIS

Table of Contents

Table 3.1. Development Staging Schedule

Development Area	GPF & WTF Construction Dates
Combabula	Aug-2010 – Nov-2012
Condabri South	Oct-2011 – Sep-2014
Condabri Central	Jul-2014 – Jul-2015
Orana and Orana North	Oct-2012 – Oct-2013
Ramyard	Sep-2017 – Sep-2018
Dalwogan	Oct-2015 – Oct-2016
Kainama	Oct-2014 – Oct-2015
Woleebee	Oct-2015 - Oct-2016
Gilbert Gully	Jun-2015 – Dec 2027
Carinya	Mar-2017 – Feb-2022
Talinga expansion	Aug-2012 – Jun-2013
Reedy Creek	Oct-2012 – Sep-2017
Pine Hills	Apr-2013 – Mar-2016

Staging of the development would allow for the establishment of offsets and rehabilitation works to be carried out ahead of some development components, potentially reducing the effects of lag times in the establishment of environmental offsets.

2.2.2 Clearing

Clearing will be required to prepare sites for the construction of a range of infrastructure within the study area. Clearing will also occur progressively during the life of the Project as the gas fields are developed and infrastructure is installed to service them. Overall, it is understood that a total area of approximately 6000ha of remnant vegetation as defined under the VM Act (and is mapped as part of surveys conducted for this report) is proposed to be disturbed over the life of the Project. Approximately one third of this area will be rehabilitated immediately following construction of the individual infrastructure components, and ongoing gas field development over the life of the Project will allow for the rehabilitation of some extraction sites and associated infrastructure prior to the disturbance of new development areas.

Clearing figures have been derived by overlaying the proposed project footprint with updated RE mapping for the study area. The approximate areas of each RE to be cleared, together with their description under DERM's REDD and their bioregional extent area contained in the study area is provided within Table 3.2.

This table shows that the 'Least Concern' RE 11.5.1 (Narrow-leaved Red Ironbark, White Cypress Pine, Smooth-barked Apple, Buloke woodland on Cainozoic sand plains and remnant surfaces and Poplar Box woodland with Buloke low tree layer on Cainozoic sand plains and remnant surfaces) stands out as the single RE that would be subject to most clearing as a result of the Project (approximately 2345ha).

Table 3.2 indicates that the Project will result in clearing of no more than 0.53% of the provincial extent of any RE that occurs within the study area. As such, issues of habitat fragmentation and isolation are considered to represent more important impacts than those related to loss of specific ecosystem types from the study area.

Clearing of native vegetation primarily results in a reduction of the overall amount of habitat and populations of flora and fauna, and has the potential to result in isolation of habitats and populations, changes to remaining vegetation that cause the loss of food and shelter for fauna, and exposure to introduced species that are either competitors or predators (Bennett et al. 2000).

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

- soil disturbance/exposure and altered water flow patterns, and subsequent erosion and sedimentation, which may

expose tree roots, smother vegetation, and potentially alter the physical form, chemical processes and ecological health of downstream aquatic habitats;

- salinisation of areas downslope, depending on the clearing extent and nature of the associated landform and geology/soils; and
- increases in desiccation, light penetration, wind-throw, herbivory, weed invasion, nest predation, and parasitism for adjacent flora and fauna (Murcia 1995). In particular, introduced weeds can change vegetation community composition and in some cases increase the intensity of fire, leading to further community degradation.

While the majority of the study area (63%) consists of pasture (60%) and regrowth vegetation (3%) which has limited values for significant flora and fauna species, the results of the proposed clearing have the potential to affect local and regional fauna movement and flora and fauna dispersal opportunities. Clearing is proposed to occur progressively and in a known sequence (Table 3.1) allowing offsetting for habitat loss to occur 12 to 18 months in advance of clearing. The impacts of habitat loss would be greatest during the operational phase of the Project, when all gas fields are fully developed and before offsets have established to maturity.

Assessment of the cumulative impacts associated with clearing on vegetation communities and significant species are, in part, taken into account in the assessment of REs and species of conservation significance under Commonwealth, State and Local Government legislation (Tables N.1 to N.8 – Appendix N). However these do not take into account the potential impacts of all gas field development projects in the Southern Brigalow Belt bioregion.

At the landscape level, the cumulative impacts of habitat loss and disturbance as a result of the Australia Pacific LNG Project and other relevant proposed projects are addressed in Section 3.8.

2.2.3 Construction Activities

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

Table 3.2. Approximate current extent of REs within the Relevant Provinces and Study Area and extent to be disturbed by the Project

RE	Management Status1			Total Current Extent (ha)		Extent to be Disturbed			
	EPBC Act	VM Act	EP Act	Relevant Provinces2,3	Study Area4	Total Area (ha)	% of Relevant Provinces Extent	% of Study Area Extent	% of Tenements Extent5
11.3.1	E	E	E	3111	792	4.51	0.15	0.57	1.68
11.3.2	E6	OC	OC	167893	14729	129.13	0.08	0.88	2.12
11.3.3		OC	OC	11335	656	7.81	0.07	1.07	3.50
11.3.4		OC	OC	14666	2596	10.21	0.07	0.39	1.40
11.3.14		LC	NC	60647	12590	195.67	0.32	1.55	1.95
11.3.16		LC	NC	08	73	2.96	n/a7	4.05	4.55
11.3.17		OC	E	4347	86	0.98	0.02	1.14	2.39
11.3.18		LC	NC	30093	3521	33.18	0.11	0.94	2.85
11.3.19		LC	NC	29242	1782	6.62	0.02	0.37	30.60
11.3.25		LC	OC	111637	24796	249.06	0.22	1.00	2.13
11.3.26		LC	NC	13261	83	0.00	0	0	0.00
11.3.27		LC	OC	3153	48	0.40	0.01	0.83	0.35
11.3.39		LC	NC	11121	920	3.10	0.03	0.34	n/a9
11.4.3	E	E	E	32277	4759	18.86	0.06	0.40	1.08
11.4.7	E	E	E	3063	292	0.43	0.01	0.15	0.65

be reduced due to thinning or be increased as a consequence of logging creating gaps. Recruitment of shrubs, and other plants, may be constrained by grazing, the intensity of which is determined by the landholder.

Patch size and shape determine edge effects and influence the likelihood of the presence of feral species and native 'increaser' species (Landsberg et al. 1997; Moran et al. 2004) such as Noisy Miner Manorina melanocephala, Pied Butcherbird Cracticus nigrogularis, Pied Currawong Strepera graculina and Laughing Kookaburra Dacelo novaeguineae. These large, aggressive species invade disturbed habitats and deleteriously affect many woodland and forest bird species, either through nest predation (Piper and Catterall 2004) or through competitive exclusion (Grey et al. 1998; Fischer and Lindenmayer 2002; Maron 2009). Their presence often reflects the degraded nature of a habitat (Recher 1999; Martin and McIntyre 2007).

Connectivity within the landscape also influences the assemblage of a particular patch of vegetation. Patches surrounded by cleared land have an increased abundance of medium and large-bodied generalist species, including the aggressive species mentioned above, and a decreased abundance of small-bodied insectivorous species (Loyn 1987; Barrett et al. 1994; Martin et al. 2006; Woinarski et al. 2006).

The description of the values of particular habitat types within the study area to fauna, therefore, must be considered in general terms, with ground-truthing required for accurate assessment of a particular habitat patch.

RE	Management Status1			Total Current Extent (ha)		Extent to be Disturbed			
	EPBC Act	VM Act	EP Act	Relevant Provinces2,3	Study Area4	Total Area (ha)	% of Relevant Provinces Extent	% of Study Area Extent	% of Tenements Extent5
11.4.10	E	E	E	1589	64	0.90	0.06	1.40	2.15
11.4.12		E	E	4337	1183	12.72	0.29	1.08	1.95
11.5.1		LC	NC	440592	165109	2344.70	0.53	1.42	2.83
11.5.4		LC	NC	85052	29540	398.35	0.47	1.35	2.43
11.5.5		LC 7	NC	83461	18235	213.17	0.26	1.17	3.62
11.5.20		LC	NC	82777	16064	170.75	0.21	1.06	3.75
11.5.21		LC	NC	72026	4049	0.01	0.00	0.00	0.76
11.7.1		LC	OC	39923	1951	13.83	0.03	0.71	1.99
11.7.2		LC	NC	34901	17402	176.06	0.50	1.01	2.04
11.7.4		LC	NC	174688	79344	641.41	0.37	0.81	2.18
11.7.5		LC	NC	52009	19765	125.89	0.24	0.64	1.90
11.7.6		LC	NC	178711	24070	83.42	0.05	0.35	2.21
11.7.7		LC	NC	164202	49179	513.04	0.31	1.04	2.13
11.8.3	E	OC	OC	11033	8	0.00	0	0	n/a9
11.9.1	E	E	E	3893	7	0.00	0	0	n/a9
11.9.4	E	OC	E	11043	3605	13.27	0.12	0.37	1.09

RE	Management Status1			Total Current Extent (ha)		Extent to be Disturbed			
	EPBC Act	VM Act	EP Act	Relevant Provinces2,3	Study Area4	Total Area (ha)	% of Relevant Provinces Extent	% of Study Area Extent	% of Tenements Extent5
11.9.5	E	E	E	76647	10897	45.21	0.06	0.41	0.97
11.9.6	E	E	E	371	118	0.00	0	0	n/a9
11.9.7		OC	OC	53614	2375	2.85	0.01	0.12	2.96
11.9.9		LC	NC	31101	758	0.00	0	0	n/a9
11.9.10		OC	E	50454	3140	19.80	0.04	0.63	1.58
11.10.1		LC	NC	134467	30743	140.78	0.10	0.46	4.15
11.10.3		LC	NC	72013	149	0	0	0	n/a8
11.10.7		LC	NC	123880	2752	0	0	0	n/a9
11.10.9		LC	NC	86194	14955	306.82	0.36	2.05	4.48
11.10.11		LC	NC	123513	7526	125.95	0.10	1.67	4.26
11.10.13		LC	NC	186936	208	0	0	0	n/a9

1 Where: E = Endangered, OC = Of Concern, LC = Least Concern, NC = No Concern at Present. 'EP Act' status is based on the 'Biodiversity Status' prescribed on DERM's Regional Ecosystem Description Database v6.

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

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

4 Based on GIS analysis of refined vegetation mapping (Appendix I).

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

6 Only where Weeping Myall Acacia pendula occurs.

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

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

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

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

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

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

An increase in traffic, both heavy vehicles and construction workers in light vehicles, during the construction phase could contribute to increased animal/vehicle collisions on local roads. Species particularly susceptible to traffic collisions include larger and slow-moving snakes (for example, Woma, Spotted Black Snake, Carpet Python), monitors and other large lizards, macropods and frogs (during wet periods).

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

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

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

2.2.4 Operational Phase

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

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

- potentially increasing the frequency of accidental fire due to increased human presence,
- Linear clearing for pipeline routes and tracks may alter natural mosaic burning patterns by acting as fire breaks.

2.2.5 Decommissioning Phase

Decommissioning activities have the potential to result in similar impacts to those identified for the construction phase.

As for construction, noise and dust have the potential to affect habitat adjacent to works areas due to ground disturbance and the operation and movement of machinery and vehicles.

Where underground infrastructure is removed, a potential impact, particularly for reptiles and small mammals, is becoming trapped in trenches or other excavations that remain open for any period of time. This may lead to mortality either by exposure, starvation, thirst or predation by other species.

An increase in traffic during decommissioning, both heavy vehicles and workers in light vehicles, could contribute to increased animal/vehicle collisions on local roads, although mitigation actions undertaken for the construction and operational phases of the project are likely to have identified and treated particular hot spots.

Increased activity involving vehicles from outside of the study area has the potential to introduce and/or spread weed species and plant pathogens in disturbed soil, while general waste and land disturbance caused by decommissioning activities has the potential to attract highly competitive and/or predatory exotic fauna species.

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

2.2.6 Impact Sources

Gas Wells, Gas and Water Gathering Lines and Access Tracks

Gas wells are planned for installation within tenements throughout the study area. Ideally, for gas production, the wells are situated approximately 750m apart in a grid pattern above productive coal seams. For each gas well, a cleared area of 1ha must be established for construction purposes, after which time approximately one-third of the disturbed area is proposed to be rehabilitated to reflect the preclearing vegetation type. Each well is connected by gas and water gathering lines and access tracks. A construction width of 10m has been used for estimation of clearing and a width of 8m has been used for operational width. These components of the development require the greatest amount of vegetation clearing over the largest area.

Each gas well takes between four and seven days to establish. The base case is that the drilling of wells will be conventional (vertical). Alternatives will include pad (directional) drilling and the use of slant rigs.

During construction, floodlighting during night time hours is required. Water for drilling is sourced from dams, bores or water trucks, with pump drilling fluids removed from the site by truck to a waste disposal facility. No dangerous goods are stored at these facilities during construction or operation.

Following establishment of each gas well and associated infrastructure, rehabilitation of areas not required for ongoing operations will be undertaken. It is estimated that approximately one-third of the disturbed area will be rehabilitated.

Access tracks between gas wells are to be maintained for the life of the well, with maintenance visits to each well taking place approximately fortnightly. A remote monitoring system will alert operators to any

technical problems at individual well sites outside of routine maintenance times.

It is understood that, over the course of the Project, as each gas well is depleted, a new well will be established in proximity. This process has not been accounted for in the assessment of terrestrial ecological impacts. Each well has a life span of between 10 years and 20 years. It is understood that the decommissioned sites will be returned to their previous agricultural or forestry land use, or will be rehabilitated to the preclearing vegetation type.

Gas Processing Facilities

Construction of 30 gas processing facilities (GPF) is proposed. The locations of eight of these facilities have been planned and are shown on Figure 1.2. Remaining GPFs have not yet been accurately located and are represented on Figure1.2 as 5km x 5km polygons to indicate their approximate required locations. For the purposes of the impact assessment, the central locations within the polygons have been taken as indicative GPF locations. Each facility will require a 50ha area (1000m x 500m) for establishment and operation. It is understood that during planning, locations for the GPFs will be selected so as to avoid, where possible, the clearing of remnant vegetation.

Typical construction traffic movements per day to each gas processing facility are estimated at 100 light vehicles, 10 heavy vehicles and one semi trailer. A bunded diesel fuel storage facility will be established at each construction site.

Waste from ablutions during construction will be stored and transported to an approved disposal site until permanent sewerage systems are installed.

These facilities will operate continuously (24hrs/day) and will be manned by approximately 15 staff. Lighting is required during operation, including night time lighting.

Chemicals stored on site during operations will be within approved storage areas.

Water Network Infrastructure

Installation of the Water Network Infrastructure shown on Figure 1.2 will be mostly in association with the High Pressure Gas Network, constructed within the same 50m corridor. Following construction, rehabilitation of areas not necessary for operation will be undertaken (rehabilitation to a 25m corridor has been used for assessment purposes). An access track must be maintained adjacent to the pipelines.

Water Treatment Facilities

Five new Water Treatment Facilities (WTFs) are proposed for the study area. There is an existing WTF established within the Talinga Tenement. The locations of the WTFs are indicated on Figure 1.2. For the purposes of the impact assessment, only the preferred WTF sites have been assessed, although potential alternative sites have been provided. Each facility will require an approximately 64ha development area for a base case of a 64ML/day treatment capacity. The associated brine holding ponds for each facility will occupy a footprint of 1.5-3ha, depending on the associated water salinity level.

There is a three month construction schedule per facility. Sites will require the construction of access roads and grading of the facility site.

The waste products from water treatment are salt solutions and filtration solids.

Lighting is required for the operational facility for safety purposes.

Chemicals stored on site during operations will be within approved storage areas.

Water Transfer Stations

A total of 33 Water Transfer Stations will be developed for the Project. Each station will require an area of approximately 6ha. Sites of Water Transfer Stations have been established for Condabri and are shown on

Figure 1.2. The remaining Water Transfer Stations have not yet been accurately located and are represented in Figure 1.2 as 5km x 5km polygons to indicate their approximate required locations. For the purposes of the impact assessment, the central locations within the polygons have been taken as indicative locations. It is understood that planning of the Water Transfer Station locations will be undertaken so as to avoid, where possible, the clearing of remnant vegetation.

Water Management

The initial solution for associated water involves:

- a low pressure water collection system delivering water to a series of central locations
- short-term storage ponds to facilitate initial water treatment and operational flexibility
- water treatment facilities to treat the water to a standard suitable for use
- Australia Pacific LNG owned and operated agricultural use, complimented with negotiated water supply to existing agricultural ventures
- discharge of high quality treated water to major watercourses in accordance with Environmental Flow Objectives and to mimic pre-development flows wherever practicable
- storage of brine (from the water treatment facilities) within ponds and encapsulation of the ponds when their use has expired.

Based on mitigation measures implemented as part of this initial case, the residual risk to the environment is considered low.

Further adaptive measures are still in development, and will be designed to maximise beneficial use and minimise environmental impacts. Five options are currently being targeted as listed below, with other innovative technologies being considered:

- water supply to industrial use
- urban water supply
- agricultural use
- aquifer injection
- salt recovery.

High Pressure Gas Network

Installation of the High Pressure Gas Network shown on Figure 1.2 requires a development area width of 25-50m (50m has been used to estimate clearing). Following construction, rehabilitation of areas not necessary for operation will be undertaken (rehabilitation to a 25m corridor has been used for assessment purposes). An access track must be maintained adjacent to the pipelines.

Gas Booster Stations

The location and number of Gas Booster Stations required will not be known until the gas pressure has been determined. Each station would have a footprint of 100m x 100m. It is understood that these will be planned for location outside of areas supporting remnant vegetation.

Electricity Supply

Electricity will be either imported from the national grid or generated on site. Lines carrying 132kV lines require a 30m wide cleared corridor. No locations for electricity transmission infrastructure are available - this component of the Project is not included in this assessment in terms of requirements for vegetation clearing.

Communications Infrastructure

The construction of eleven 50m high telecommunications towers is proposed to facilitate radio communications throughout the study area. Each tower site will have a 70m x 70m footprint. Additional Telecoms masts for well site information relay are

required. These masts will be 30m in height and will also have a 70m x 70m footprint. A separate impact assessment document (Appendix L) has been prepared for the tower locations as a number of the sites are outside of the study area as defined for this assessment.

Major Access Routes

The preferred route utilising the existing road network to service the Walloons gas fields is the Jackson-Wandoan Road. The many feeder tracks and side roads along this route can be upgraded to service the gas fields. Works required to widen any major roads or feeder tracks have not yet been identified and any clearing that may be required is not addressed in this assessment.

Camps, Offices and Workshops

Camps, offices and workshops will be co-located with the gas processing facilities. Six camps are proposed, with a maximum footprint of 300m x 200m each and all weather access.

Full camps will have a 90 day construction period, with approximately 1000 workers required. There will be no night time construction activity.

Portable toilet facilities will be provided to the construction workforce.

Each camp will house up to 200 personnel. All wastes will be contained within the boundaries of the camp and surface water will be diverted around the facilities.

A package sewage treatment plant will be installed at each facility, and treated effluent will generally be disposed of by irrigation or relocated to an approved storage and handling location.

The facilities will require lighting, including night lighting for safety purposes.

2.3 Impact Assessment Methodology

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

The complexity of this task has been addressed by the development of concise and consistent summary within matrices which set out each significant/ sensitive ecological element present in the study area, summarise the impact mechanisms and their potential effects on each element, provide appropriate mitigation measures (referencing sections that provide more detailed information for mitigation measures), and show the assessed residual impact.

For the purposes of this assessment, significant ecological elements refer to those species, communities or processes that are recognised under State and Commonwealth Legislation or by planning instruments (for example, species or ecological communities listed as significant under the provisions of the EPBC Act, NC Act, and/or the VM Act, relevant priority non-EVR species, and the State and regional bioregional corridors identified by the BPA for the Brigalow Belt South bioregion).

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

For fauna, assessment of the nature and scale of predicted impacts are based on known or likely occurrence, fecundity, dispersal abilities, home range, habitat specialisation, resilience to disturbance and mobility.

The tables in Appendix M further clarify the impact assessment process applied to the

impact assessment matrices. The terms used in the impact assessment tables to describe impact types and scales are defined hereunder.

Impact Type

Direct impact: Any impact that affects a species/community directly (for example, the actual removal of vegetation or the loss habitat for a species due to the Project).

Indirect impact: Any impact that affects a species/community indirectly, which may be as a result of ongoing edge-effects following clearing, or a direct impact on another species whose life history is interrelated with the species in question (for example, the loss of certain hollow-bearing trees directly reduces potential sheltering and breeding sites for arboreal mammals, which in turn reduces prey availability for a predator foraging over a large area).

Unmitigated impact: The predicted impact without any mitigation measures in place. While mitigation would be in place during all phases of the Project, an assessment of unmitigated impact is necessary for the planning phase assessment.

Mitigated (Residual) impact: The predicted remaining impact after mitigation measures are implemented. This represents the likely actual impact of the Project and should form the basis of discussions regarding compensations by means of offsets.

Unmitigated and Residual Impact Assessment

Levels of impact are assessed in relation to the following three factors:

1. **Impact Likelihood:** The likelihood of an identified impact occurring has been rated as either certain, probable, possible, unlikely or very unlikely.

2. **Impact Consequence:** Each impact is categorised as major, significant, moderate, minor or negligible in terms of its effect on the element in question, taking into account the geographic extent of impact (area), the duration and intensity of impacts, and the ability of the impacted element to recover (resilience).

Major impacts would result in the total extinction of a species.

Significant impacts may be notably detrimental or beneficial to the species or community on a population scale. Significant negative impacts may result in local extinction or local declines and a consequent substantial decrease in abundance and population viability at larger scales. Significant negative impacts may also be determined by the conservation status of a species being affected (for example, NC Act or EPBC Act – listed species). Significant positive impacts may result in substantial increases in local populations, increasing the overall abundance of a species, or in influxes, in the case of more mobile species, into the area from surrounding regions.

Moderate negative impacts may result in a substantial change to a local population, though this would not lead to extinction at any level. Moderate positive impacts may produce an increase in the local population sufficient, for breeding species, for the local area to act as a source population for nearby areas. This may not necessarily lead to an overall increase in the species' abundance.

Minor negative impacts may result in small decreases to a local population that would be overcome without mitigation (or without further mitigation). A minor positive impact may result in small increases that would not facilitate substantive species emigration from nearby areas. Any population changes resulting from minor impacts would fall within natural fluctuations of a local population, that is, within the normal carrying capacity of the area.

Negligible impacts are those that are likely to be undetectable.

Impacts are described as negative, neutral or positive. All impacts listed in the tables should be considered as negative, unless otherwise stated.

Impact Duration

Impacts are described as short term (two years), medium term (2-15 years), long term (15-50 years) or permanent (extending past the lifetime of the project (that is, >50 years).

Prediction Reliability

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

It is important to note that a species whose life history is poorly known and has a prediction reliability index of low may nonetheless be assessed as having a residual impact assessment that is low or negligible based on the considered importance of the study area to the species. For example, Large-eared Pied Bat is poorly known but, based on database records and predicted habitat use, the study area is considered of low importance. Therefore, despite a comparative lack of knowledge of its specific biology, the residual impacts due to clearing for the Project are assessed as negligible.

Impact assessment methodology matrices for unmitigated impacts, mitigated impacts and predication reliability that have been applied to this assessment are provided in Appendix M.

2.4 Impact Assessment Results

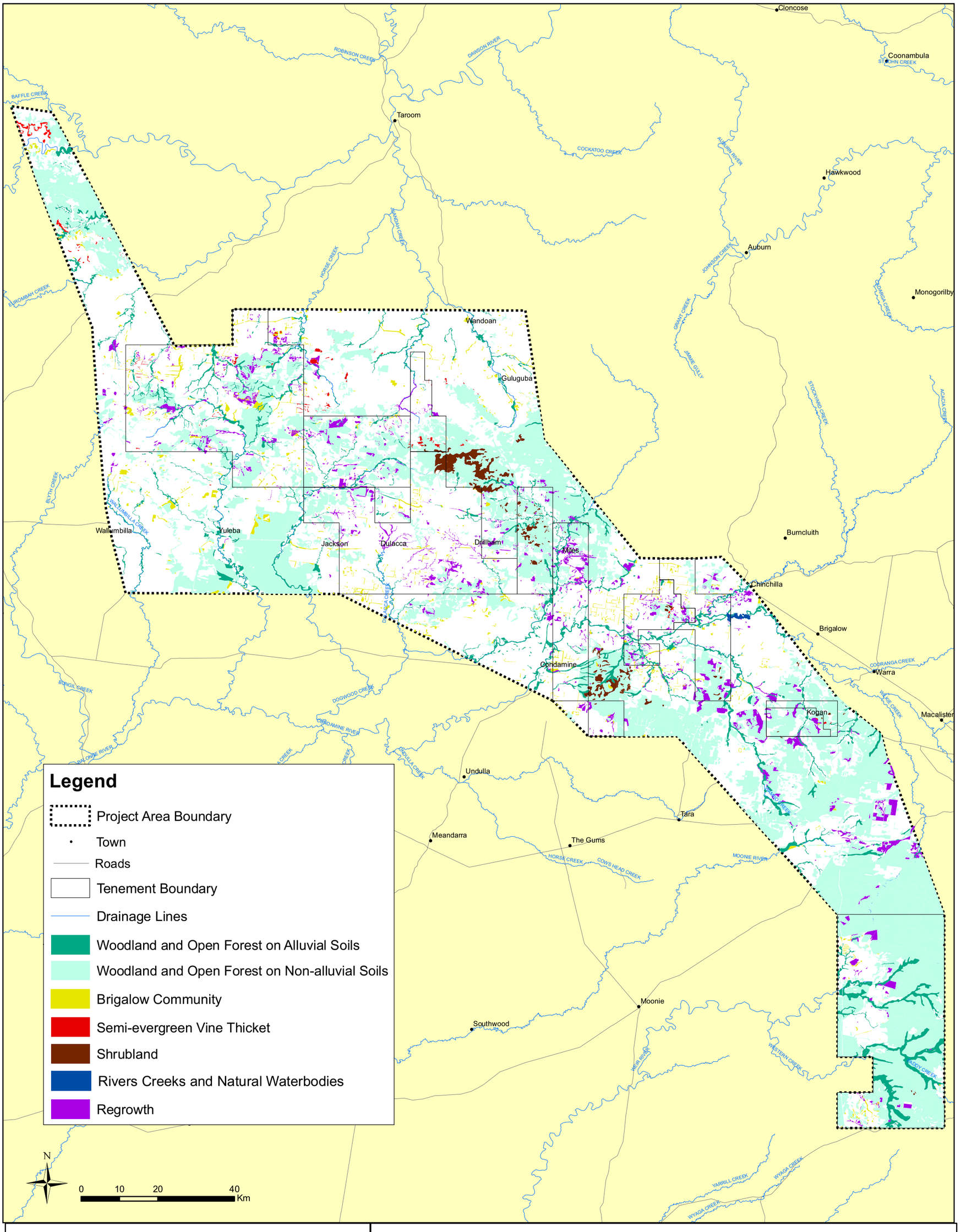
Impact assessment matrices for flora and fauna within the study area are provided in Appendix N. The quantity of information included in these matrices is such that all of the identified impact mechanisms, potential impacts, recommended mitigation measures and residual impacts cannot be readily summarised. As such, this discussion is restricted to those ecological elements for which 'moderate', 'significant' or 'major' impacts have been predicted and for which the application of mitigation measures is necessary.

Overall, a total of approximately 6,000ha of remnant vegetation would potentially be cleared. While no Regional Ecosystem would lose more than 0.53% of its extent within the relevant provinces (Table 3.2), the potential for clearing to further fragment habitats within the study area has significance for a number of flora and fauna species which are highly geographically restricted or occur sparsely throughout their distribution.

The recommended mitigation measures are designed to ensure that impacts are reduced to 'negligible' or at most 'minor' levels via the application of habitat management guidelines (Section 3.5), and where this cannot be achieved, through offset opportunities described in Section 3.6. The successful mitigation of potential impacts would rely on the quality and implementation of the habitat management guidelines. It is recommended that the habitat management guidelines are prepared and approved prior to commencement of the Project, including the preparation of threatened species management guidelines that can be applied to works that may affect each species of significance likely to be encountered during the life of the Project.

Management measures to mitigate landscape-scale ecological impacts for each of the ecological sensitivity categories initially described in Section 2.5 are as follows:

- Category 1: Extremely sensitive: Siting of infrastructure within these areas will be avoided.
- Category 2: Highly Sensitive: Infrastructure will only be located within or in proximity to existing cleared and disturbed areas to reduce fragmentation. Limited clearing (if necessary for incremental expansion of existing disturbance) for construction to be rehabilitated prior to operation.



Biodiversity Assessment AND MANAGEMENT PTY LTD

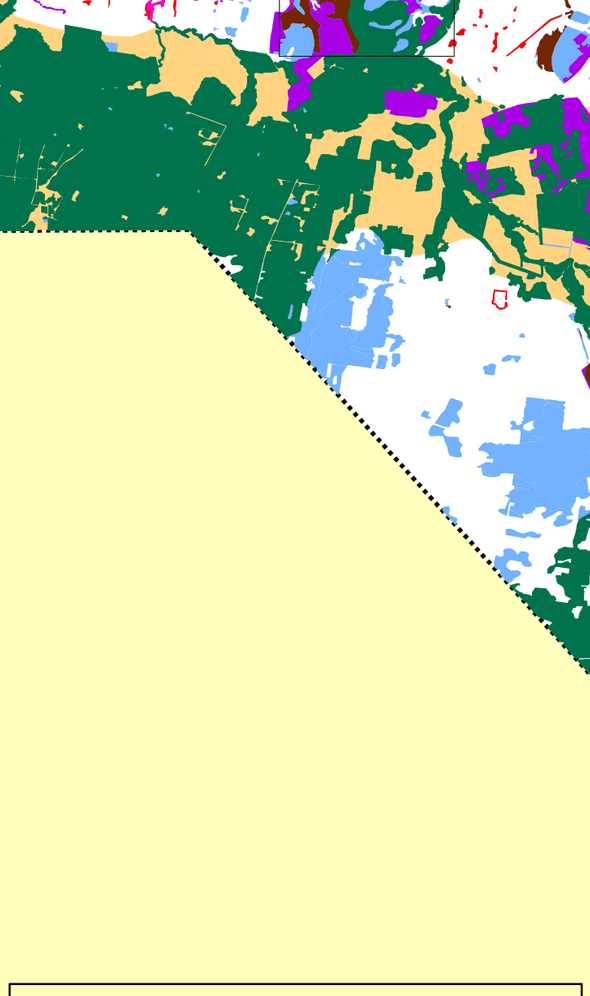
Figure 2.9

Broad Habitat Types Within the Project Area

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

- Category 3: Sensitive: Clearing only for linear infrastructure and well leases. Non-linear infrastructure to be located within or in proximity to existing cleared and disturbed areas. Disturbed areas not required for ongoing operation to be rehabilitated prior to operation.
- Category 4: Neutral: Clearing for linear and non-linear infrastructure is to minimise edge effects where possible.
- Category 5: Robust: Clearing for infrastructure, although hollow-bearing trees and habitat connectivity, particularly along watercourses, to be retained.
- Category 6 and 7: Cleared: Siting of infrastructure >100m from edges of categories 2-5 and >200m from category 1.

Figure 3.1 provides the results of proposed actions from the impact assessment process, indicating the locations of REs (and their analogous communities of national conservation significance) recommended to be maintained or offset, areas where further field investigations are required to accurately locate specific, highly restricted habitats and species and areas where offset actions would be most beneficial.



Legend

- Town
- Roads
- Project Area Boundary
- Tenement Boundary
- Vegetation Communities to be Maintained or Offset, (Dominant RE)
- Vegetation Communities to be Maintained or Offset, (Sub-dominant RE)
- Additional of Concern Communities to be Maintained, where possible or where Weeping Myall Occurs
- Other Remnant Vegetation
- Regrowth
- Remnant Vegetation in State / Regional Corridors (preferred offset location)
- Cleared area within Corridors (preferred offset location)

Further investigations required:

- Confirmed population of EVR Reptile
- 11.3.16 Black Box Woodland
- Confirmed population of Weeping Myall
- Known significant ecological features
- Endemic threatened species
- Predicted critical habitat for Brigalow Woodland Snail
- Predicted critical habitat for Dulacca Woodland Snail

N

0 3.75 7.5 15 Km

Figure 3.1a

Terrestrial Ecology Management Areas

Terrestrial Ecology and Impact Assessment Report (Gas Fields Component)
Australia Pacific LNG Project EIS

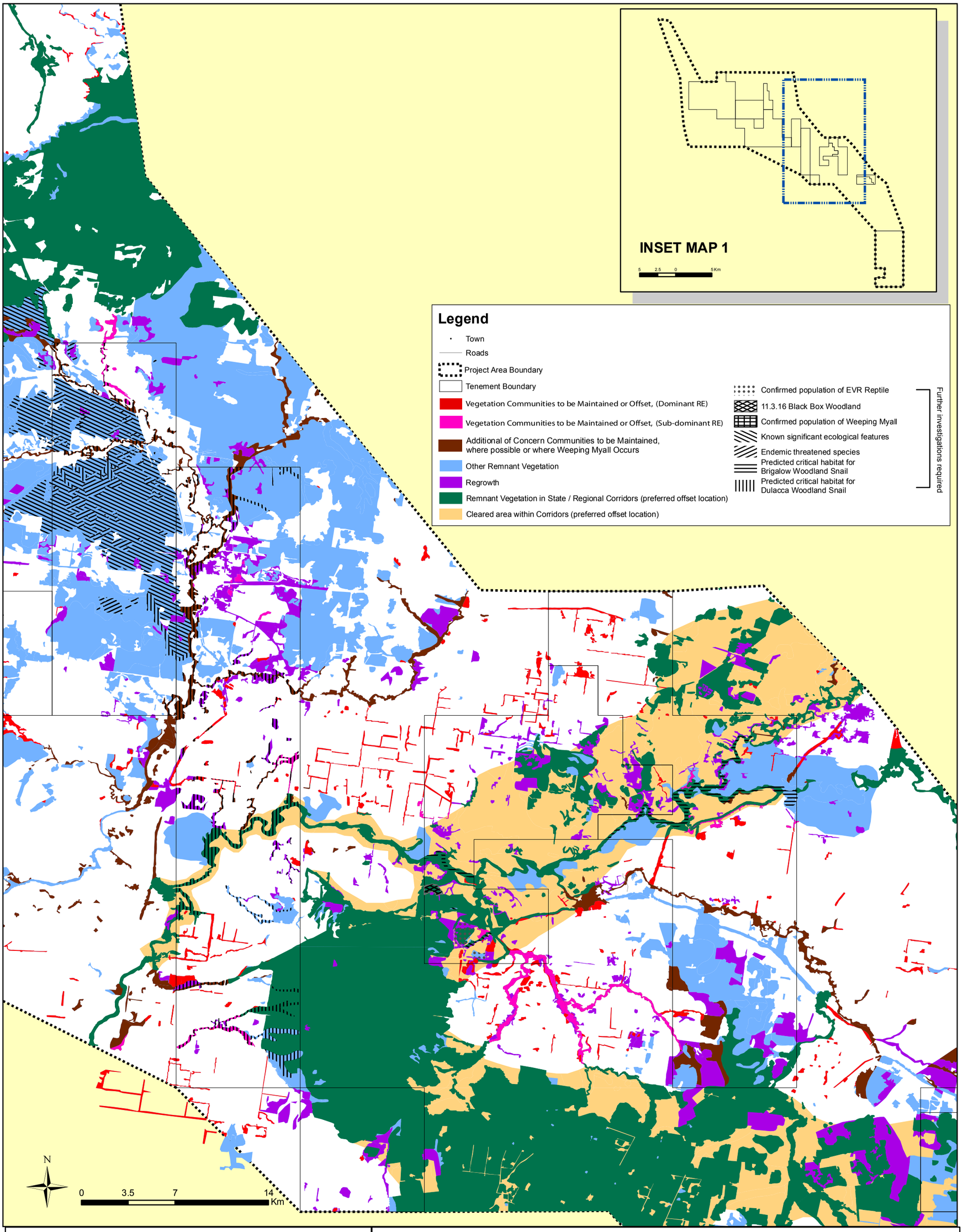


Figure 3.1b

Terrestrial Ecology Management Areas

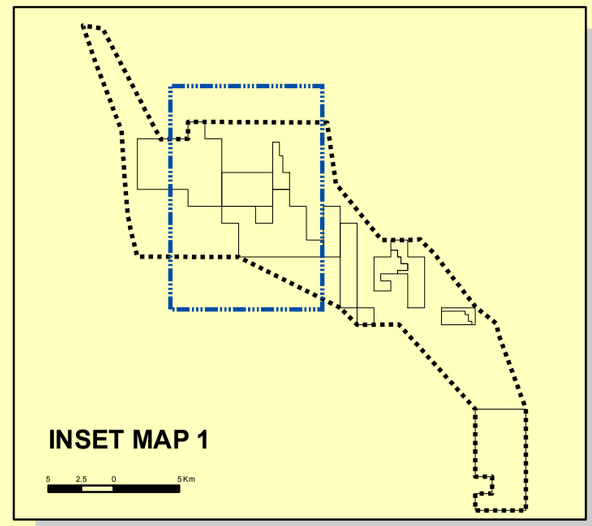
Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

Legend

- Town
- Roads
- Project Area Boundary
- Tenement Boundary
- Vegetation Communities to be Maintained or Offset, (Dominant RE)
- Vegetation Communities to be Maintained or Offset, (Sub-dominant RE)
- Additional of Concern Communities to be Maintained, where possible or where Weeping Myall Occurs
- Other Remnant Vegetation
- Regrowth
- Remnant Vegetation in State / Regional Corridors (preferred offset location)
- Cleared area within Corridors (preferred offset location)

Further investigations required:

- Confirmed population of EVR Reptile
- 11.3.16 Black Box Woodland
- Confirmed population of Weeping Myall
- Known significant ecological features
- Endemic threatened species
- Predicted critical habitat for Brigalow Woodland Snail
- Predicted critical habitat for Dulacca Woodland Snail



INSET MAP 1

5 2.5 0 5Km

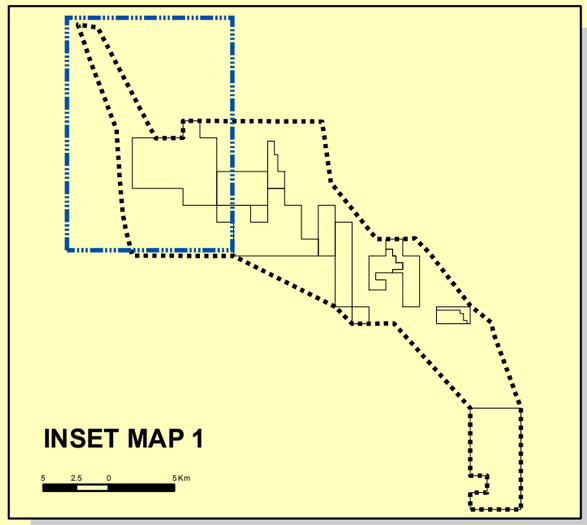
N

0 3 6 12 Km

Figure 3.1c

Terrestrial Ecology Management Areas

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS



Legend

- Town
- Roads
- Project Area Boundary
- Tenement Boundary
- Vegetation Communities to be Maintained or Offset, (Dominant RE)
- Vegetation Communities to be Maintained or Offset, (Sub-dominant RE)
- Additional of Concern Communities to be Maintained, where possible or where Weeping Myall Occurs
- Other Remnant Vegetation
- Regrowth
- Remnant Vegetation in State / Regional Corridors (preferred offset location)
- Cleared area within Corridors (preferred offset location)

Further investigations required:

- Confirmed population of EVR Reptile
- 11.3.16 Black Box Woodland
- Confirmed population of Weeping Myall
- Known significant ecological features
- Endemic threatened species
- Predicted critical habitat for Brigalow Woodland Snail
- Predicted critical habitat for Dulacca Woodland Snail

N

0 3 6 12 Km

Figure 3.1d

Terrestrial Ecology Management Areas

Terrestrial Ecology and Impact Assessment Report
(Gas Fields Component)
Australia Pacific LNG Project EIS

2.4.1 Conservation Significant Vegetation Communities and Flora

The most intensive and long term impacts on conservation significant vegetation communities and flora species would result from the clearing of 6000ha of remnant vegetation and the ongoing degradation of habitats though edge effects and fragmentation. Impact assessment (Tables N.1-N.4, Appendix N), indicates that, without mitigation, there is potential for 'moderate' to 'significant' impacts on the following vegetation communities, primarily related to their conservation status under Commonwealth and State legislation:

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

Disturbance of these communities will be avoided where they occur within Sensitivity Category 1. Where they occur within Sensitivity Categories 2 and 3, they will be avoided where practicable and subject to a separate approval process where disturbance is unavoidable. A 200m management buffer will be established around all occurrences of these communities throughout the study area. In avoiding these communities where practicable, and implementing management guidelines to control potential offsite effects of the Project, the predicted residual impact assessment for the above vegetation communities is reduced to 'minor' or 'negligible'. Offsetting is required whenever endangered and of concern REs are disturbed.

Thirty-six flora species of special conservation significance are known or considered possible occurrences within the study area. This includes species listed as threatened under the EPBC Act, listed as threatened, rare or near threatened under the NC Act and as non-EVR priority species for the BBS bioregion under the BAMM (EPA 2008a, b).

Two species are of special note due to their highly restricted distribution: Calytrix gurulmundensis and Micromyrtus carinata are generally restricted to the rock pavements (scalds) of the Gurulmundi Plateau. Some other occurrences of these species are noted within Dalwogan and Barakula State Forests (Craig Eddy pers comm.) The highly restricted distribution and high habitat specificity of these species means their long-term viability is highly susceptible to disturbance.

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

Impact assessment (Tables N.1-N.4, Appendix N) indicates that, without mitigation, there is potential for 'moderate' to 'significant' impacts on the following conservation significant flora species:

- EPBC Act endangered: Microcarpaea *Microcarpaea agonis*, Slender Tylophora *Tylophora linearis*.
- EPBC Act vulnerable: Chinchilla Wattle *Acacia chinchillensis*, Curly-barked Wattle *Acacia curranii*, Tara Wattle *Acacia lauta*, Thomby Range Wattle *Acacia wardellii*, Ooline *Cadellia pentastylis*, Gurulmundi Fringe Myrtle *Calytris gurulmundensis*, Belson's Panic Grass *Homopholis belsonii*, *Philotheca sporadica*, Dunmore Mint-bush *Prostanthera* sp, Cobar Greenhood Orchid *Pterostylis cobarensis*.
- NC Act endangered: Gurulmundi Heath-myrtle *Micromyrtus carinata*, Red-soil Woolly Wrinklewort *Rutidosis lanata*.
- NC Act vulnerable: Gonocarpus urceolatus.
- NC Act rare or near threatened: Scrub Wattle *Acacia tenuinervis*, Silky Cryptandra *Cryptandra ciliata*.

The nature of these species is that they are highly restricted in distribution and/or occur

very sparsely throughout their distribution. Mitigation measures include pre-development surveys to determine whether the species occur within 200m of any proposed disturbance. If any of these species are located within this distance, they should be avoided in the first instance, and if avoidance of direct or indirect impacts is not possible, application for their removal must be made to DEWHA and/or DERM, potentially resulting in translocation. Where they occur within 200m of any element of the development, specific threatened species management guidelines (Section 3.5) are to be prepared and implemented to mitigate the potential for offsite impacts on the species.

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

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

The preparation and strict implementation of a Clearing Management and Habitat Management Guidelines, incorporating weed and ecological fire Management components (Section 3.5) throughout and beyond the life of the Project, as well as the application of threatened species management guidelines for known occurrences of conservation significant species, reduce these potential impacts to 'minor' or 'negligible'.

For conservation significant REs that are subject to clearing, offsets are required under the Policy for Environmental Offsets (EPA 2008e). Under the draft Policy for Biodiversity Offsets (EPA 2008f) offsets are also stipulated for conservation significant flora species, although with the application of appropriate mitigation measures able to reduce impacts to 'minor' or 'negligible' (Tables N.1-N.4, Appendix N), offsets are not considered to be necessary for these species.

Opportunities for offsets for the Project are discussed in detail in Section 3.6.

2.4.2 Conservation Significant Fauna

The most intensive and long term impacts on conservation significant fauna species would result from the clearing of approximately 6000ha of remnant habitat and the ongoing degradation of habitats through edge effects and fragmentation. Impact assessment (Tables N.5-N.8, Appendix N), indicates that, without mitigation, there is potential for "major" impacts on the following conservation significant fauna species:

- EPBC critically endangered – listing pending: Brigalow Woodland Snail (Camaenidae BL 13).

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

Impact assessment (Tables N.5-N.8, Appendix N), indicates that, without mitigation, there is potential for 'moderate' to 'significant' impacts on the following conservation significant fauna species:

- EPBC endangered – listing pending: Dulacca Woodland Snail (Camaenidae BL 12).
- EPBC Act and NC Act vulnerable: Brigalow Scaly-foot *Paradelma orientalis*, Dunmall's Snake *Furina dunmalli*, South-eastern Long-eared Bat *Nyctophilus corbeni*, Yakka Skink *Egernia rugosa*.
- NC Act endangered: Grey Snake *Hemiaspis damelii.*
- NC Act vulnerable: Glossy Black-Cockatoo *Calyptorhynchus lathami*,

Pale Imperial Hairstreak (northern subspecies) *Jalmenus eubulus.*

- NC Act rare or near threatened: Common Death Adder *Acanthophis antarcticus*, Golden-tailed Gecko *Strophurus taenicauda*, Little Pied Bat *Chalinolobus picatus*, Painted honeyeater *Grantiella picta*, Rough Frog *Cyclorana verrucosa*, Square-tailed Kite *Lophoictinia isura*, Woma *Aspidites ramsayi*.

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

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

The Golden-tailed Gecko is endemic to the bioregion and is common and widespread in a variety of REs in the study area. The study area therefore supports a significant proportion of the species' overall population. Other species for which the study area is especially important are Rough Frog, Brigalow Scaly-foot, Grey Snake and Glossy Black-Cockatoo. It is also likely to be important for the little known Dunmall's Snake. Habitat management would be essential to prevent significant impacts to the viability of these species within the region.

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

- the potential for increase in accidental fire which causes direct mortality, alters the structure and therefore the suitability of habitats for fauna species, and facilitates weed invasion which may increase fire intensity;
- ongoing edge effects, for example, through increased solar radiation, increase wind effects, desiccation and vegetation dieback;
- the construction of access tracks through remnant vegetation causing increased access for feral predators such as Foxes, Cats and Cane Toads;
- the construction of access tracks causing increased access for competitors such as Cane Toads and Common Myna and aggressive native species (increaser species such as Noisy Miner and Rainbow Lorikeet) which may exclude other native species;
- increased access for native predators such as Laughing Kookaburra and Pied Butcherbird which may increase predation on native species, particularly small reptiles;
- construction of access tracks and artificial waterbodies leading to an increase of, or colonisation by, Cane Toads and subsequent increased potential mortality due to attempted predation of Cane Toads by native frog-eating species, particularly reptiles.
- increased weed invasion - particularly exotic grasses which outcompete native species and increase fire frequency and intensity;
- changes to hydrological conditions that may affect habitat for frogs;
- the creation of artificial waterbodies which may provide suitable resources for a variety of native fauna;
- the more local effects of increased noise and night time lighting.

The more significant threats posed by these mechanisms are discussed in the literature review (Appendix H).

List of Appendices

The preparation and strict implementation of a Feral Species Management and Habitat Management Guidelines incorporating weed and ecological fire Management components (Section 3.5) throughout and beyond the life of the Project, as well as the application of Threatened Species Management Guidelines (Section 3.5) for known occurrences of conservation significant species, reduces potential impacts for many species to 'minor' or 'negligible'. The exceptions are for the following species, which are still predicted to be subject to 'moderate' or significant impacts despite the recommended mitigation measures as shown in Table 3.3 with regards to proposed activities:

- EPBC Act and NC Act Vulnerable: Brigalow Scaly-foot *Paradelma orientalis*, Dunmall's Snake *Furina dunmalli*, Yakka Skink *Egernia rugosa*.
- NC Act Endangered: Grey Snake *Hemiaspis damelii.*
- NC Act Vulnerable: Glossy Black-Cockatoo *Calyptorhynchus lathami.*
- NC Act Rare or Near Threatened: Golden-tailed Gecko *Strophurus taenicauda*, Little Pied Bat *Chalinolobus picatus*, Rough Frog *Cyclorana verrucosa*, Square-tailed Kite *Lophoictinia isura*, Woma *Aspidites ramsayi*.

As mitigation measures cannot adequately ameliorate potential impacts, habitat offsets have been recommended for these species (Section 3.6).

For conservation significant fauna species habitat that is subject to clearing, offsets are set out in the draft Policy for Biodiversity Offsets (EPA 2008f) although this Policy is yet to be finalised and this Project is subject only to the Policy for Environmental Offsets (EPA 2008e). Where the application of the described mitigation measures is able to reduce impacts to 'minor' or 'negligible', offsets are not considered to be necessary for those species. Where impacts are still predicted to be 'moderate' or greater, offsets would be necessary to ensure that there is no net loss of biodiversity. The offset opportunities for the Project are discussed in detail in Section 3.6. Where direct offsets are unable to adequately mitigate potential impacts, such as the potential impacts of Cane Toads on reptiles of conservation significance, indirect offsets such as research to determine the most effective design of the artificial waterbodies necessary for the Project to discourage toad breeding, have been recommended.

Table 2.13. Conservation Significant Fauna[1] and Regional Ecosystems known or expected to provide habitat

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
in preparation5	Dulacca Woodland Snail Camaenidae BL126	E7			11.5.1, 11.7.4, 11.7.6, 11.7.7, 11.9.10
in preparation5	Brigalow Woodland Snail Camaenidae BL136	CE8			11.3.1, 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, 11.3.27b, 11.3.39
Hypochrysops piceata	Bulloak Jewell		E		11.3.14, 11.3.18, 11.5.1, 11.5.1a, 11.5.4
Jalmenus eubulus	Pale Imperial Hairstreak		V		11.3.1, 11.4.3, 11.4.7, 11.4.10, 11.7.1, 11.9.1, 11.9.5, 11.9.6, 11.9.10, 11.9.11, 11.10.3, 11.10.7
Limnodynastes salmini	Salmon-striped Frog		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.17, 11.3.25, 11.3.27b, 11.4.3, 11.4.7, 11.9.1, 11.9.5, 11.9.6, 11.9.10
Cyclorana verrucosa	Rough Frog		R		11.3.1, 1.3.2, 11.3.25, 11.3.27b, 11.4.3, 11.4.3a, 11.9.4b, 11.9.5
Emydura macquarii	Macquarie Turtle		C	x	11.3.25, 11.3.27b
Macrochelodina expansa	Broad-shelled Turtle		C	x	11.3.25, 11.3.27b
Strophurus taenicauda	Golden-tailed Gecko		NT		11.3.1, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.6, 11.7.7, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10 11.10.1, 11.10.1d, , 11.10.3, 11.10.7, 11.10.9, 11.10.11
Delma plebeia	Leaden Delma		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.19, 11.3.25, 11.4.3, 11.4.7, 11.4.10, 11.4.12, 11.9.1, 11.9.5
Delma torquata	Adorned (Collared) Delma3	V	V		11.3.1, 11.3.2, 11.4.3, 11.4.7, 11.4.10, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.7, 11.9.1, 11.9.5, 11.10.1, 11.10.1d, 11.10.7, 11.10.11, 11.10.13

Table 3.3. Conservation Significant Fauna Species for which Residual Impacts remain Moderate or Significant as a Result of Clearing

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
Nationally significant fauna - EPBC Act vulnerable							
Brigalow scaly-foot Paradelma orientalis (also listed as vulnerable under the NC Act)	Nineteen database and survey records. Study area is of high importance to the species.	Direct impacts: Potential loss of approximately 674ha potential habitat (0.13% of subregional extent) Mortality during clearing activities Barriers to movement created Indirect impacts: Increased access to habitat by feral predators Decreased prey abundance due to possible increased predation by feral species and loss of habitat	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required)	High
Dunmall's snake Furina dunmalli (also listed as vulnerable	Six database records. Study area is of high importance to the species.	Direct impacts: Potential loss of approximately 3,614ha potential habitat (0.35% of subregional extent) Mortality during clearing activities	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines.	Probable	Long term	Moderate (offset required)	Low

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
under the NC Act)		Barriers to movement created Indirect impacts: Increased access to habitat by feral predators Decreased prey abundance due to possible increased predation by feral species and loss of habitat	Implement feral animal management guidelines.				
Yakka skink Egernia rugosa (also listed as vulnerable under the NC Act)	Four database records. Study area of moderate importance to the species.	Direct impacts: Potential loss of approximately 5,272ha potential habitat (0.24% of subregional extent) Mortality during clearing activities Indirect impacts: Increased access to habitat by feral predators	Ground-truth for colonies and Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Probable	Long term	Moderate (offset required)	Medium
State significant fauna - NC Act endangered							
Grey snake Hemiaspis	Fourteen database	Direct impacts:	Avoid, where practicable, disturbance to soil structure of low-lying areas of cracking clays.	Probable	Long term	Moderate	Medium

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
damelii	records. Study area of high importance to the species.	Potential loss of approximately 674ha potential habitat (0.13% of subregional extent) Mortality during clearing activities Barriers to movement created Indirect impacts: Increased access to habitat by feral predators Decreased prey abundance due to possible increased predation by feral species and loss of habitat	Implement individual threatened species management guidelines for works both within these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.			(offset required)	
State significant fauna - NC Act vulnerable							
Glossy black-cockatoo Calyptorhynchus lathami	Uncommon. Study area is of moderate importance to the species.	Direct impacts: Potential loss of approximately 2,728ha potential habitat (0.34% of subregional extent) Indirect impacts: Increased competition for tree hollows used for nesting with other	Ground-truth for feed trees within proposed disturbance areas, including isolated trees and within non-remnant vegetation. Minimise loss of any identified food tree and of any large hollow-bearing trees in remnant or non-remnant vegetation. Implement individual threatened species management guidelines for works both within	Probable	Long term	Moderate (offset required)	High

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
		species displaced by clearing	these areas and within a 200m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.				
State significant fauna - NC Act rare or near threatened							
Golden-tailed gecko Strophurus taenicauda	Common and widespread in the study area. Endemic to bioregion. Study area is very important to the species.	Direct impacts: Potential loss of approximately 5,432ha potential habitat (0.26% of subregional extent) Mortality during clearing activities Barriers to movement created Indirect impacts: Increased access to habitat by feral predators	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Significant (offset required)	High
Little pied bat Chalinolobus picatus	Twenty-three database and survey records. Study area is	Direct impacts: Potential loss of approximately 5,828ha potential habitat (0.24% of subregional extent)	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat.	Certain	Long term	Moderate (offset required)	Medium

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
	of moderate importance to the species.	Mortality during clearing activities Indirect impacts: Increased competition for roosting sites	Implement clearing management guidelines.				
Rough frog Cyclorana verrucosa	Generally sparse, may be common in suitable habitat. Study area is of high importance to the species.	Direct impacts: Potential loss of approximately 458ha potential habitat (0.11% of subregional extent) Mortality during clearing activities Indirect impacts: Increased access to habitat by feral predators Any possible increase in feral Pigs will increase physical disturbance of wetlands Any possible increase in Cane Toads may increase competition	Minimise, where practicable, disturbance to soil structure of low-lying areas of cracking clays. Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required)	High
Square-tailed kite	Uncommon breeding	Direct impacts: Potential loss of approximately	Implement individual threatened species management guidelines for works both within	Certain	Long term	Moderate (offset	High

Species	Significance of Study Area	Impact Type	Mitigation and Compensatory Measures1	Mitigated impact			Prediction Reliability Index
				Likelihood of Impact Occurring	Residual Impact Duration	Residual Impact	
Lophoictinia isura	resident. Study area is of moderate importance to the species.	5,244ha potential habitat (0.24% of subregional extent) Indirect impacts: nil	these areas and within a 100m buffer of identified habitat.			required)	
Woma Aspidites ramsayi	Uncommon. Study area of moderate importance to the species.	Direct impacts: Potential loss of approximately 5,409ha potential habitat (0.27% of subregional extent) Mortality during clearing activities Indirect impacts: Increased access to habitat by feral predators Decreased prey abundance due to possible increased predation by feral species and loss of habitat	Implement individual threatened species management guidelines for works both within these areas and within a 100m buffer of identified habitat. Implement clearing management guidelines. Implement feral animal management guidelines.	Certain	Long term	Moderate (offset required)	High

1 Further detail on specific management guidelines are provided in Section 3.5.

Amphibious vertebrates of conservation significance known for the study area are Macquarie Turtle, Broad-shelled Turtle and Platypus, which are non-EVR priority species for the bioregion. These species are dependent on the terrestrial environment for breeding and for inputs into the waterbody such as fruit, leaf litter and logs that provide food and shelter resources directly or indirectly through provision of resources for prey species. Inputs from terrestrial environments also affect water quality. Turtles are susceptible to predation by terrestrial vertebrates such as Red Foxes and Feral Pigs, particularly of eggs and hatchlings.

Based on the number of database records and known distributions, the study area is considered to be of low, moderate and negligible importance for these three species, respectively. The residual impacts of each phase of the Project are all assessed as being negligible for all three species other than for operation in regards to the two turtle species for which the residual impact is assessed as minor. These assessments are made based on the information currently available, on the expectation of no impacts on permanent watercourses as a result of the Project and the implementation of relevant components of the habitat management guidelines (Section 3.5), in particular feral animal management guidelines, through the Environmental Management Plan for the Project. Potential impacts on watercourses that could deleteriously affect these amphibious species include the release of water which, depending on quantities and duration, could underscore banks and destroy nesting areas, remove riparian vegetation necessary for stream health and scour watercourse substrate destroying micro-habitats and flushing food resources downstream. The temperature, pH and salinity of water released into waterbodies may also negatively affect turtles and Platypus. Conversely, environmentally sound practices governing controlled release of water could enhance waterbodies, increasing habitat and resources for amphibious species.

2.4.3 Bioregional Corridors

State and Regional Bioregional Corridors (EPA 2008a, b, c) traverse the study area and a number of the gas field tenements (Appendix D). The significance of these corridors for flora and fauna is lent particular weight within the region due to extreme fragmentation and continued disturbance of remnant vegetation, primarily as a result of grazing practices. Many of the corridors are themselves highly fragmented and habitat patches act as “stepping stones” in some locations where only those species able to negotiate cleared areas can forage and disperse more widely. The creation of further barriers to fauna movement within the corridors, such as roads, pipelines and clearing for other Project infrastructure, would have a potentially significant and long term negative impact on regional biodiversity without mitigation.

The impacts of Project infrastructure within these corridor areas would be countered by offsetting habitat losses for the Project within the bioregional corridors occurring within Australia Pacific LNG tenement boundaries, subject to landholder agreement. This would include protection and enhancement of regrowth vegetation, replanting and re-establishing preclearing REs within currently cleared areas of the corridors, and rehabilitating infrastructure locations following decommissioning as part of the Offset Package (Section 3.6). Reconnecting currently fragmented habitat within these corridor areas over the life of the Project is predicted to result in a significant, long term positive impact on regional biodiversity. The scale of the positive impact would depend to a large extent on treatment of corridor areas outside of the tenement boundaries, and within the influence of other gas field development projects (Section 3.8).

2.4.4 Communications Towers

Assessment of the communications tower sites is provided in Appendix L as a number

of sites are outside of the gas fields study area and have not been ground-truthed. Approximately 0.5ha will need to be permanently cleared of all existing vegetation and associated habitat for the placement and operation of each telecommunications tower, while access tracks may also need to be established for the transportation of construction materials and machinery and to allow ongoing maintenance.

Table 3.4 provides an indicative assessment of potential impacts on currently recognised values as a result of this disturbance, along with recommended measures of avoidance, mitigation or offsetting. In general, all proposed locations should be ground-truthed to confirm whether potential or currently recognised values are present, such that appropriate management measures are adopted. In particular, it is recommended that National Parks and any significant vegetation communities are protected from all disturbances.

Table 3.4. Microwave Tower Location Sites - Indicative Assessment of Impacts on Currently Recognised Terrestrial Ecological Values

Currently Recognised Value	Relevant Location(s)	Potential Impacts1	Recommendations
Carnarvon National Park	Carnarvon Range	Loss of up to 0.5ha of National Park vegetation/habitat and/or degradation of National Park vegetation/habitat due to tower placement and operation. Loss of National Park vegetation/habitat, increased fragmentation and/or degradation of vegetation/habitat due to access track creation and operation.	No disturbance within National Park and maintain 200m buffer between proposed activities and National Park boundary or implement relevant components of Habitat Management Guidelines (Section 3.5) for works within 200m of boundary.
Stones Country Resource Reserve and Gurulmundi, Dunmore and Expedition State Forests	Conoli, Kumbarilla and Ergon Expedition Range	Loss of up to 0.5ha of State Forest/Resource Reserve vegetation/habitat (per location) and/or degradation of State Forest/Resource Reserve vegetation/habitat due to tower placement and operation. Loss of State Forest/Resource Reserve vegetation/habitat, increased fragmentation and/or degradation of vegetation/habitat due to access track creation and operation.	Offset habitat loss where management measures cannot adequately mitigate impact. Avoid placement of access tracks that results in unnecessary fragmentation. Use existing tracks where possible.
Braemar State Forest	Braemar South	Loss of State Forest vegetation/habitat, increased fragmentation and/or degradation of State Forest vegetation/habitat due to access track creation and operation.	Offset habitat loss where management measures cannot adequately mitigate impact. Avoid placement of access tracks that results in unnecessary fragmentation. Use existing tracks where possible.
Area of High/Very High Tract Size identified under the	All except Kincora and Ergon Mt Bassett	Increased fragmentation and/or degradation due to access track creation and operation.	Avoid placement of access tracks that results in unnecessary fragmentation. Use existing tracks where possible and implement relevant components of Habitat

List of Abbreviations

Australia Pacific LNG	Australia-Pacific LNG Pty Ltd (Origin Energy and ConocoPhillips joint venture)
BAAM	Biodiversity Assessment and Management Pty Ltd
BAMM	Biodiversity Assessment and Mapping Methodology
BBS	Brigalow Belt South (Bioregion)
BPA	Biodiversity Planning Assessment
DEEDI	The Queensland Department of Employment, Economic Development and Innovation
DERM	The Queensland Department of Environment and Resource Management
DEWHA	The Commonwealth Department of Environment, Water, Heritage and the Arts
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP Act	Queensland Environmental Protection Act 1994
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ERA	Environmentally Relevant Activity
EVR	Endangered, Vulnerable or Rare
FAPA	Forestry Act Protected Area
Forestry Act	Queensland Forestry Act 1959
LNG	Liquefied Natural Gas
LP Act	Queensland Land Protection (Pest and Stock Route Management) Act 2002
MNES	Matters of National Environmental Significance
NC Act	Queensland Nature Conservation Act 1992
NCAPA	NC Act Protected Area
NRMP	Natural Resource Management Plan
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SBRVMC	Southern Brigalow Regional Vegetation Management Committee
SEVT	Semi-evergreen Vine Thicket
SF	State Forest
VM Act	Queensland Vegetation Management Act 1999
WTF	Water Treatment Facility

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
Paradelma orientalis	Brigalow Scalyfoot	V	V		11.3.1, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.3, 11.10.7, 11.10.9, 11.10.11, 11.10.13
Ctenotus ingrami	Unspotted Yellow-sided Ctenotus		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.18, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.7.1, 11.7.2, 11.7.6, 11.7.7, 11.9.1, 11.9.5, 11.10.9
Cyclodomorphus gerrardii	Pink-tongued Skink		C	x	11.3.1, 11.3.3, 11.3.4, 11.3.14, 11.3.25, 11.3.27b, 11.9.5
Egernia rugosa	Yakka Skink	V	V		11.3.1, 11.3.2, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.4.3, 11.4.3a, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.9.1, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.1d, 11.10.7, 11.10.9, 11.10.11
Tiliqua rugosus	Shingle-back		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.4.3, 11.4.3a, 11.4.4, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.9.1, 11.9.3, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10
Chlamydosaurus kingii	Frilled Lizard		C	x	11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.5.1, 11.7.4, 11.7.4c, 11.7.6, 11.9.7, 11.10.1, 11.10.1d, 11.10.13
Physignathus lesueurii	Eastern Water Dragon		C	x	11.3.25
Varanus panoptes	Yellow-spotted Monitor		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.26, 11.3.25, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.4, 11.7.2, 11.7.4, 11.7.6, 11.7.7, 11.9.1, 11.9.5, 11.9.7, 11.10.1, 11.10.7, 11.10.9, 11.10.11
Aspidites ramsayi	Woma3		R		11.3.2, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.39, 11.4.3, 11.4.3a, 11.5.1, 11.5.1a,

Currently Recognised Value	Relevant Location(s)	Potential Impacts1	Recommendations
BPA			Management Guidelines (Section 3.5).
State/Regional Corridors identified under the BPA	Braemar South, Conoli, Ergon Telgazli, Carnarvon Range, Ergon Expedition Range and Roddas Lookout	Increased fragmentation, vegetation/habitat degradation and/or reduction in movement opportunities for cryptic/non-volant fauna due to access track creation and operation.	Avoid placement of access tracks that results in unnecessary fragmentation and/or severs corridors. Use existing tracks where possible and implement relevant components of Habitat Management Guidelines (Section 3.5).
Critically Endangered Ecological Communities under the EPBC Act	Captains Mountain (RE 11.8.2a) and Carnarvon Range (RE 11.8.2)2	Loss of up to 1ha of Critically Endangered ecological community and/or degradation due to tower placement and operation. Loss of Critically Endangered ecological community, increased fragmentation and/or degradation due to access track creation and operation.	No disturbance within any ground-truthed Critically Endangered ecological community and maintain 200m buffer between proposed activities and community boundary or implement relevant components of Habitat Management Guidelines (Section 3.5) for works within 200m of boundary.
Endangered Ecological Communities under the EPBC Act	Ergon Mt Bassett (RE 11.9.5a)2	Loss of up to 0.5ha of Endangered ecological community and/or degradation due to tower placement and operation. Loss of Endangered ecological community, increased fragmentation and/or degradation due to access track creation and operation.	No disturbance within any ground-truthed Endangered ecological community and maintain 200m buffer between proposed activities and community boundary or implement relevant components of Habitat Management Guidelines (Section 3.5) for works within 200m of boundary.
Endangered RE under the VM Act and/or EP Act	Ergon Mt Bassett (RE 11.9.5a)	Loss of up to 0.5ha of Endangered RE and/or degradation due to tower placement and operation. Loss of Endangered RE, increased fragmentation and/or degradation due to access track creation and operation.	No disturbance within any ground-truthed Endangered RE and maintain 200m buffer between proposed activities and RE boundary or implement relevant components of Habitat Management Guidelines (Section 3.5) for works within 200m of boundary.

Currently Recognised Value	Relevant Location(s)	Potential Impacts1	Recommendations
Other Remnant Vegetation	Braemar South, Orana, Conoli, Ewingdale, Muggleton, Kumbarilla, Ergon Telgazli, Grafton Range, Ergon Expedition Range and Roddas Lookout	Loss of up to 4.9ha of remnant vegetation and/or degradation due to tower placement and operation. Loss of remnant vegetation, increased fragmentation and/or degradation due to access track creation and operation.	Revegetate areas not required for operation immediately following construction. Implement relevant components of Habitat Management Guidelines (Section 3.5).
Significant Flora Species listed under the EPBC Act and/or NC Act and associated Habitat	All2	Loss and/or degradation of potential habitat due to tower placement/operation and/or access track creation/operation.	Undertake detailed seasonal field survey within 200m of proposed disturbance and implement threatened species management guidelines and other relevant components of Habitat Management Guidelines (Section 3.5) within 200m of proposed activities if species present. If disturbance is unavoidable, apply to DEWHA and DERM for disturbance approval and design and implement a translocation plan according to Australian Network for Plant Conservation (2004).
Non-EVR Priority Flora Species and associated Habitat	All2	Loss and/or degradation of potential habitat due to tower placement/operation and/or access track creation/operation.	Implement relevant components of Habitat Management Guidelines (Section 3.5).
Significant Fauna Species listed under the EPBC Act and/or NC Act and associated Habitat	All2	Loss and/or degradation of potential habitat due to tower placement/operation. Loss and/or degradation of potential habitat and/or reduction in movement opportunities for cryptic/non-volant	Undertake detailed seasonal field survey within 200m of proposed disturbance and implement threatened species management guidelines and other relevant components of Habitat Management Guidelines (Section 3.5) within 200m of proposed activities if species present.

Currently Recognised Value	Relevant Location(s)	Potential Impacts1	Recommendations
		fauna due to access track creation and operation. Mortality during clearing activities.	
Non-EVR Priority Fauna Species and associated Habitat	All2	Loss and/or degradation of potential habitat due to tower placement/operation. Loss and/or degradation of potential habitat and/or reduction in movement opportunities for cryptic/non-volant fauna due to access track creation and operation Mortality during clearing activities.	Implement relevant components of Habitat Management Guidelines (Section 3.5).

1 Subject to ground-truthing. Degradation of vegetation/habitat can result from increased fire frequency, weed invasion, disease, excessive dust, altered surface and subsurface hydrology and nutrient dynamics introduced through neighbouring activities and through physical edge effects (for example, increased light and temperature, decreased humidity).

2 Potential only, subject to ground-truthing.

2.5 Habitat Management Guidelines

Thirty-six flora and 99 fauna species of special conservation significance are known or considered possible occurrences within the study area. Many aspects of the construction and operation process can affect terrestrial flora and fauna. In particular the following potential impacts must be managed and mitigated to prevent or restrict their effects on flora and fauna:

- Habitat loss and fragmentation;
  - Identify amount of vegetation to be retained and buffers to be managed;
  - Identify the proportion of vegetation types and configuration of retained areas;
  - Identify areas for rehabilitation and enhancement;
- Impacts on threatened species;
  - Identify and protect threatened flora populations on a project scale;
  - Identify and protect threatened species populations at known locations;
- Introduction and/or spread of weeds and feral animal species;
- Erosion and sedimentation;
- Soil and water contamination from oil, fuel or chemicals;
- Noise, dust and vibration;
- Construction, operating and decommissioning traffic within fauna movement areas; and
- Establishment of stockpile areas, camps, offices, spoil dumps, refuse areas, and so forth.

To address these issues, habitat management guidelines would be developed for incorporation into the Environmental Management Plan, setting out the relationship of the individual ecological management guidelines with the overall goal of minimising, mitigating and offsetting ecological impacts arising from the construction, operation and decommissioning of the Project (Figure 3.2). The following individual management guidelines are to be prepared and incorporated in the EM Plan for the Project:

- Threatened species management guidelines (plus individual guidelines for specific species or groups of species where required);
- Clearing Management Guidelines;
- Weed Management Guidelines;
- Feral Animal Management Guidelines;
- Rehabilitation and Revegetation Management Guidelines; and
- Ecological Fire Management Guidelines.

Sections 3.5.1 to 3.5.6 provide a description of issues to be addressed.

Management of erosion and sedimentation, soil and water contamination, and noise, dust and vibration are standard components of Environmental Management Plans and are addressed within other specialist reports for the Australia Pacific LNG Project. However, suppression of dust for habitat quality reasons should be expressly dealt with in the Habitat Management Guidelines, especially over the term of operational practices.

Habitat loss and fragmentation has the potential to impact on overall biodiversity through loss per se and through interference with processes and ecological functioning. Strategies to minimise, mitigate and offset these impacts would be outlined in the Rehabilitation and Revegetation Management Guidelines and the Threatened Species Management Guidelines.

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

would be detailed within the Weed Management Guidelines.

Construction and operational traffic may come into contact with native fauna, particularly during dawn, dusk and night time hours. Impacts of this type would be dealt with in the Habitat and Threatened Species Management Guidelines.

Siting of stockpile areas, camps, offices, spoil dumps, refuse areas, vehicle parking areas, and so forth, must, where possible, be within areas that are already cleared, or are proposed to be cleared. Management of these areas for weed and feral animals would be achieved through the Weed and Feral Animal Management Guidelines. Such guidelines may need to be integrated into an overall Biosecruity Management Plan to be prepared for the Project.

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

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

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

The Habitat Management Guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological guidelines required for this project,
- Identification of potential impacts,
- Targets and performance indicators,
- Management strategies for:
  - vegetation clearing,
  - retained vegetation,
  - threatened species,
  - rehabilitation areas,
  - fauna movement corridors,
  - vehicle strike, and
- pest/weed management.
- Mitigation measures,
- Corrective and preventative actions,
- Monitoring plan describing:
  - frequency and methods of monitoring,
  - spatially accurate mapping of monitoring areas,
  - photographic monitoring,

  - quantitative monitoring, and
- species-specific monitoring.

2.5.1 Threatened Species Management Guidelines

The Threatened Species Management Guidelines would be developed in conjunction with the Habitat Management Guidelines.

The aims and objectives of the Threatened Species Management Guidelines are to ensure the protection and long-term persistence of threatened species within the study area.

Given the size of the study area and the extent and configuration of the clearing impacts on threatened species at a sub-regional level it is important to plan for their conservation and management over the entire study area as well as at a site-by-site basis. In this instance planning of rehabilitation and revegetation needs to account for the provision of core habitat and corridors for threatened species using knowledge of the ecology and biology of species. Multi-species models are required to maximize conservation benefits to all threatened species using focal and umbrella species in combination with landscape ecological theory.

The overall Threatened Species Management Guidelines would detail the measures required for the management of threatened species across the entire study area, including provision of movement corridors at the state and regional scale. Threatened species that are known to be present or is likely to be present within the study area would have relevant species management guidelines, describing specific management requirements for application wherever these species, or like groups of species, are encountered.

Implementation of successful threatened species management guidelines at the landscape level requires the following steps, some of which have already been undertaken for EIS purposes:

- Identification of the threatened species present within the study area,
- Establishment of the location, extent and health of threatened species' populations within the study area,
- Identification of threatening processes within the study area; including feral animals, weeds and fire and requiring integration with the relevant management guidelines,
- Establishing the importance of the study area to the conservation of individual species,
- Prioritisation of species according to threatened status and threatening processes,
- Preparing a strategy for protecting and enhancing habitats,
- Implementation of management practices to conserve threatened species and their habitat including:
  - physical identification and protection of extant populations,
  - eradication or lowering of threatening process,
  - active management to increase habitat quality,
  - extension of distribution through strategic rehabilitation/revegetation (requires this plan to be integrated with the rehabilitation and revegetation management guidelines, and
- re-introduction of populations of threatened species.
- Liaison with other land managers, government agencies and private land owners to enhance the study and conservation of threatened species within the study area,
- Monitoring the health and distribution of extant populations, and

- Training in identification and protection of threatened species to all parties involved in the Project.

The Threatened Species Management Guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Identification of known threatened species within the study area,
- Identification of locations and sizes of extant populations of threatened species,
- Profiles of threatened species, including autecology (population ecology),
- Identification of threatening process (direct and indirect),
- Threatened species management strategies for:
  - Vegetation clearing,
  - Retained vegetation, and
- Rehabilitation areas.
- Integrated mitigation measures,
- Including development of translocation plans if necessary.
- Targets and performance indicators,
- Corrective and preventative actions,
- Monitoring requirements describing:
  - Frequency and methods of monitoring,
  - Spatially accurate mapping of monitoring areas,
  - Photographic monitoring,
  - Quantitative monitoring, and
- Species-specific monitoring.
- Performance criteria and corrective actions.

Threatened flora species translocation plan

Translocation is the deliberate transfer of plants or regenerative plant material from an ex situ collection or natural population to a new site. Translocation can be undertaken using a diverse range of methods including: seed collection and propagation; propagation via cuttings or tissue culture; direct seeding; transplantation of seedlings or mature plants; and the transfer of soil, leaf litter or brush. It is essential that these translocations produce a viable self-replicating population that would persist in the environment in perpetuity. Translocation programmes should be considered a last resort to ensure the persistence of a population under threat (Vallee et al. 2004). However, if any threatened flora species requires translocation, plans would be prepared. These include:

- Purpose/Objectives:
- It is essential that the objectives of any translocation plan be clearly stated and that all stakeholders agree with the objectives to be achieved,
- Responsible parties:
- Key stakeholders and responsible parties should be listed, together with their roles and responsibilities,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Individual species' profiles for all target threatened species,
- A pre-translocation assessment that includes:
  - Biological and ecological assessment of the species,
  - Identification of propagation methodology,

  - Selecting source sites and designing a sampling strategy,
  - Selecting recipient sites,
  - Determining number of plants needed,
  - Designing an experimental translocation,
  - Timing of translocation,
  - Identification of post-translocation management and monitoring and evaluation methodology, and
- Licensing requirements and logistical assessment.
- A Pre-translocation Plan that includes:
  - Site preparation methodologies,
  - Methods for collection of source material, and
- Requirements and methods for establishment and maintenance of an *ex situ* collection.
- A Translocation Plan that includes:
  - Intended timing of actual plantings,
  - Methods for preparing plants for translocation, and
- Planting methodologies.
- A Monitoring Plan describing:
  - Spatially accurate mapping of monitoring areas,
  - Frequency and methods of monitoring,
  - Habitat management and threat abatement programme, and
- Evaluation of success, including milestones, indicators and adaptive responses to progress.

Threatened fauna species translocation plan

It is not considered necessary at this stage to recommend translocation of vertebrate fauna other than the role carried out by fauna catcher/spotters in relocating fauna during clearing and other activities. This is relocation at an individual not a population level.

The need for any translocation of conservation significant snail species would be considered on a site by site basis subsequent to any targeted surveys conducted as required.

2.5.2 Clearing Management Guidelines

The Clearing Management Guidelines would be developed and read in conjunction with the Habitat Management Guidelines. The aims and objectives of the Clearing Management Guidelines would be to minimise the impact of clearing of vegetation, on retained native plants and animals.

Clearing of vegetation and trees would be conducted in a manner which allows native fauna the opportunity to safely relocate. On a site by site basis, a protocol may be developed in consultation with a suitably trained specialist prior to construction activities. The protocol would be developed for locations where significant species, habitats or other biodiversity values have been identified.

The Clearing Management Guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Management of weed introduction and spread: The introduction and/or spread of weeds have the potential to degrade habitat outside of the study area over time. During construction, when soils are exposed and heavy machinery is exported to the site from external construction areas, the risk of those vehicles introducing weeds from

outside of the local area is considerable. Heavy machinery can also spread weed infestations within the study area. Vehicles must be certified as "clean" of soil from other sites before entering the study area. When working in weed-infested areas, the machinery must be cleaned before commencing work in a less affected area.

- Control of erosion and sedimentation during and following clearing: Removal of vegetation increases the opportunity for soil erosion and subsequent sedimentation of aquatic habitats. It is recommended that ground layer vegetation (grasses and herbs) be left *in situ* wherever possible to assist soil stability. Mulching of heavily disturbed areas can assist in reducing soil erosion. Where necessary, temporary interception devices such as hay bales or geotextile fabric fencing can be employed to slow stormwater and intercept sediment.
- Protection from heavy machinery and other disturbances of vegetation outside of the areas designated for clearing: Where clearing activities are scheduled adjacent to remnant vegetation, areas outside of the clearing zone would be clearly marked (usually with high visibility temporary fencing) and avoided.
- Use of cleared vegetation: Millable timber occurring within areas to be cleared would be harvested and used for commercial purposes. Non-millable vegetation can be mulched and used in rehabilitation or soil stabilisation works, provided it is ensured that no weeds are incorporated into the mulch. Piles of rubble, felled timber or any other material being stored for mulching or removal can provide an attractive and suitable habitat for a range of species. This is particularly so when active works has removed existing wildlife refuges or shelter. It is important that all materials are removed or mulched as quickly as possible; or placed in areas where further disturbance would not occur; or where wildlife-exclusion barriers are installed. If felled vegetation or other materials are stored for more than four days it must be assumed that they are occupied by wildlife; thus before being moved or disturbed again they must be checked by a fauna spotter/catcher.

2.5.3 Weed Management Guidelines

The Weed Management Guidelines would be developed and read in conjunction with the Habitat Management Guidelines.

The proliferation of weed species in the landscape can have a serious effect on biodiversity values and ecosystem function. On-ground and database searches reveal that there at least 195 exotic species within the study area, of which 16 are declared under the LP Act. Landholders are legally responsible for the control of pests (declared plants) on their land.

In general, infestation levels across the study area are low. The species currently observed to be causing the most notable ecological nuisance is Harrisia Cactus. This species proliferates on fine grained sediments characteristic of Land Zone 9. It has been observed to be particularly prevalent in isolated Brigalow remnants within the eastern portion of the study area where it may be preventing regeneration processes. Although not declared as an environmental or listed (LP Act) weed species, the encroachment of exotic grasses such as Buffel Grass, Green Panic and African Lovegrass into natural vegetation communities of the study area has the potential to degrade habitat condition both directly and through their influence on fire intensity and frequency. Crownbeard and Snake Cotton can also be prolific on disturbed sandy soils (for example, south of Chinchilla) and cause ecological nuisance, while densities of Castor Oil Plant along the Condamine River may inhibit native flora in places where it is abundant (for example, around Condamine township) (Craig Eddie

pers. comm.). Dense infestations of Mother of Millions are particularly problematic in linear remnants such as along roadsides (Craig Eddie pers. comm.).

Pest plants may be controlled by:

- Limiting the introduction of weeds and weed propagules into the area of interest,
- Rapidly controlling any weeds that become established on the site,
- Regularly monitoring of the area of interest, and
- Preparing a control/eradication plan with follow up action when and where needed.

The weed management guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Profiling of known and likely weed species,
- Monitoring plan describing:
  - frequency and methods of survey and monitoring for the presence of declared and environmental weed species, and
- spatially accurate mapping of monitoring areas.
- Management strategies for:
  - individual weed species management, and
- collective control strategies.
- Individual species profiles for all target weed species to inform all operators and sub-contractors,
- Prescriptive control measures of each of the target weed species,
- Performance criteria and corrective actions.

The following actions would be taken during the clearing and construction phases to reduce the possibility of weeds (or their propagules) entering the site:

- Survey the proposed construction (and associated infrastructure) area and identify and remove any declared pest weeds from the construction site before any work takes place. Treatment needs to take place in accordance with recommendations from the DERM including reference to Pest Fact series,
- Undertake training in weed awareness for construction workers,
- Develop a movement protocol for vehicles and plant to ensure that weeds are not spread by movement of vehicles entering the site or within the site,
- Prepare a car park (preferably gravelled) to house all vehicles entering the site. The car park would be regularly checked for any weeds and treated,
- Prepare a wash down area for any machinery or vehicles entering the site that have been working outside of the local area. This wash down area is to be regularly monitored. Washing would ensure that machinery to be used on-site is free of plant seeds, caked mud and any other debris,
- Obtain pest free certification for any soil, fill, mulch and other materials entering the site,
- Appoint a person responsible for regularly monitoring for potential pest occurrences (and treatment if required) of equipment, vehicles, machinery and materials (including soil, mulch, fill) entering the site,
- Monitor roads into construction areas regularly during construction to identify and remove any weed infestations, and

Scientific Name	Common Name	Management Status [2,3]			Habitat Regional Ecosystem ('Core' habitat in bold)4
		EPBC Act	NC Act	BAMM	
					11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.4c, 11.7.5, 11.7.6, 11.7.7, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.10.9
Acanthophis antarcticus	Common Death Adder		R		11.3.1, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.7.1, 11.7.4, 11.7.5, 11.7.6, 11.7.7, 11.8.3, 11.9.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.10.1, 11.10.7, 11.10.13
Cryptophis boschmai	Carpentaria Snake		C	x	11.3.1, 11.3.2, 11.3.4, 11.3.25, 11.3.27b, 11.4.3, 11.4.3a, 11.4.7, 11.5.1, 11.5.4, 11.9.1, 11.9.5, 11.10.1, 11.10.7, 11.10.9, 11.10.11
Furina dunmalli	Dunmall's Snake	V	V		11.3.1, 11.3.17, 11.3.25, 11.4.3, 11.4.3a, 11.5.1, 11.5.4, 11.5.5, 11.7.1, 11.9.4a, 11.9.4b, 11.9.5, 11.9.6, 11.9.10, 11.10.9
Hemiaspis damelii	Grey Snake		E		11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.25, 11.3.26, 11.3.27b, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.9.111.9.5
Hoplocephalus bitorquatus	Pale-headed Snake		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.19, 11.3.25, 11.3.26,11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.5.21, 11.7.6, 11.7.7, 11.9.1, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.10.1, 11.10.7, 11.10.9, 11.10.11
Pseudechis guttatus	Spotted Black Snake		C	x	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27b, 11.3.39, 11.4.3, 11.4.3a, 11.4.7, 11.4.10, 11.4.12, 11.5.1, 11.9.1, 11.9.4b, 11.9.5, 11.9.10
Stictonetta naevosa	Freckled Duck		R		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Nettapus coromandelianus	Cotton Pygmy-goose	M	R		11.3.2, 11.3.3, 11.3.25, 11.3.27b
Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	V	V		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, 11.3.27b, 11.3.39, 11.4.7, 11.4.12, 11.5.1, 11.5.4, 11.5.4a, 11.5.5, 11.5.20, 11.5.21, 11.7.4, 11.7.4c, 11.7.6, 11.9.9, 11.10.1, 11.10.1d, 11.10.7, 11.10.9, 11.10.11, 11.10.13

1.0 Introduction

1.1 Purpose of the Report

This technical report has been prepared for Worley Parsons on behalf of Australia Pacific LNG Pty Limited (Australia Pacific LNG). It provides a technical assessment of the terrestrial ecological values of lands potentially impacted by the gas fields component of the Australia Pacific LNG Project (hereafter referred to as 'the study area'), located in southern Queensland (Figure 1.1), and a subsequent assessment of potential ecological impacts from proposed activities and subsequent mitigation measures.

Elements of the final Terms of Reference (17/11/09) relevant to terrestrial ecology indicate the EIS… should describe the existing environmental values for nature conservation that may be affected by the project in terms of:

- integrity of ecological processes, including habitats of rare and threatened species and ecological communities;
- conservation of resources;
- biological diversity, including habitats of rare and threatened species; and
- integrity of landscapes and places including wilderness and similar natural places.

This technical report seeks to bring together all existing information regarding the terrestrial ecology of the study area and surrounds, to provide the results of field assessments and data analyses specifically designed to meet the requirements of the Terms of Reference, and to provide Australia Pacific LNG with a solid foundation for project planning to achieve ecological sustainability. The methodology adopted for the assessment of existing terrestrial ecological values is detailed in Appendix A.

In addition, the Terms of Reference specify that the EIS should also outline the proposed strategies to avoid, or minimise and mitigate impacts on the identified values within the project's footprint.

To determine the necessary and most effective means of avoiding, minimising or mitigating the potential impacts of the Project, the significance and sensitivity of each significant terrestrial ecological element within the study area has been assessed in relation to the proposed impact mechanisms. This has proved to be a complex task, given the broad range of habitats and species present within the 1,470,000ha study area and the disproportionately large number of species that have been impacted by past land use practices, particularly land clearance and grazing practices, and are now recognised for their conservation significance. The methodology adopted for the impact assessment is detailed in Section 3.0.

To ensure this technical report is easily readable, many of the data and subsequent analyses are presented in the form of appendices, tables and maps, with the results summarised in the main text of the report.

A significant body of literature exists for the terrestrial ecology of the subject bioregion and has been drawn on to assess the likely impacts of the Project. A comprehensive review of the literature relevant to the study area is provided in the appendices and is a good place to start for the reader to gain an understanding of the diversity, significance and sensitivity of the terrestrial ecosystems of the study area.

1.2 Study Area and Description of Proposed Gas Fields Development

Australia Pacific LNG proposes to develop a world scale project sustaining a long-term industry that utilises Australia Pacific LNG's coal seam gas resources in the Surat and Bowen Basins with the main development planned for the Walloons gas field's area.

The Walloons coal seam gas fields cover an area of 570,000ha in the Queensland Western

- Maximise the diversity and cover of native species when revegetating disturbed areas.

The following actions would be taken during the operations phase to reduce the possibility of weeds (or their propagules) entering the site:

- Regularly survey any construction and operation areas and associated infrastructure and identify and remove any declared pest species encountered. Treatment needs to take place in accordance with recommendations from DERM including reference to Pest Fact series,
- Provide training in weed awareness for workers and visitors to the area, and
- Prepare car parks (preferably gravelled) for all vehicles entering the site. These car parks should be regularly checked for any weed and pest plant incursions. All plants removed are to be treated.

2.5.4 Feral Animal Management Guidelines

The Feral Animal Management Guidelines should be developed and read in conjunction with the Habitat Management Guidelines.

The proliferation of feral animal species in the landscape can have a serious effect on biodiversity values and ecosystem function and under the LP Act landholders are legally responsible for the control of feral animals (Class 2 declared pests) on their land.

A total of 17 feral terrestrial vertebrate species are noted from surveys and from database searches (Table 2.16). Six of these species are recognised as Class 2 pests under the LP Act. Of these 17 species Red Fox, Cat, Rabbit, feral Pig, Goat and Cane Toad are of particular importance within the study area due to their potential to negatively impact on native species and their habitat.

With the exception of the Cane Toad it is unlikely that these species would be spread via vehicular movement associated with the project. However, clearing of vegetation can facilitate the movement and predation opportunities for a number of these species. Increases in most of the above species are expected to occur due to construction and operational activities if controls are not implemented.

Feral animals may be controlled by:

- Limiting the introduction of feral animals into the area of interest,
- Rapidly controlling any feral animals that become established on the site,
- Regularly monitoring the area of interest, and
- Preparing a control/eradication plan with follow up action when and where needed.

A properly designed feral animal management guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Monitoring plan describing:
  - frequency and methods of survey and monitoring of declared and listed feral animal species, and
- spatially accurate mapping of monitoring areas.
- Management strategies for:
  - individual feral animal species management, and
- collective control strategies.
- Individual species profiles for all target feral animal species to inform all operators and sub-contractors,
- Prescriptive control measures of each of the target feral animal species,
- Performance criteria and corrective actions.

The following actions should be taken during the clearing and construction phases to reduce the possibility of feral animals entering the site:

- Survey the proposed construction (and associated infrastructure) area and identify any declared feral animals within the construction site before any work takes place. Develop treatment regimes to take place in accordance with recommendations from DERM, including reference to Pest Fact series,
- Undertake training in feral animal awareness for construction workers,
- Develop a movement protocol for vehicles and plan to ensure that feral animals are not spread by movement of vehicles entering the site or within the site (especially in relation to Cane Toads),
- Appoint a person responsible for regularly monitoring potential pest occurrences (and treatment if required) of equipment, vehicles, machinery and materials (including soil, mulch, fill) entering the site, and
- Monitor roads into construction areas regularly during the construction to identify and remove any feral animals and pest plant infestations.

The following actions should be taken during the operations phase to reduce the possibility of feral animals entering the site:

- Regularly survey any construction or operation areas and associated buffers and identify and remove any declared pest species encountered. Treatment needs to take place in accordance with recommendations from DERM including reference to Pest Fact series, and
- Provide training in feral animal and exotic plant awareness for workers and visitors to the area.

2.5.5 Rehabilitation and Revegetation Management Guidelines

The Rehabilitation and Revegetation Management Guidelines would be developed and read in conjunction with the Habitat Management Guidelines.

Revegetation and rehabilitation of disturbed habitats and designated offset areas is required in order to compensate for loss of habitat within the study area and the decrease in the condition of habitat through increased edge effects and isolation, and to prevent adverse impacts such as soil erosion and weed infestation.

The location and extent of rehabilitation areas would be ascertained using principals such as:

- Re-establishment of REs as appropriate to land zones defined under the VM Act,
- Re-establishment of threatened plant habitat as appropriate to land zones defined under the VM Act,
- Provision of habitat suitable for native fauna, particularly those threatened, near threatened and rare species,
- Enhancement or creation of corridors to alleviate the disruption to movement caused by fragmentation.

Revegetation has the greatest value to fauna when it is planned and undertaken with the requirements of wildlife in mind. Animals require food, water, shelter from weather conditions and refuge from predators. Different species have different requirements for foraging substrate, food type, shelter and refuge, and reproductive conditions. For example, an arboreal mammal may require trees and tall shrubs in which to forage nectar and sap and tree hollows in which to rest and breed. Conversely, a skink may require leaf litter and fallen timber in which to forage, invertebrates on which to feed and exfoliating bark, fallen timber and other

ground cover in which to shelter and lay eggs (Bennett et al. 2000).

In addition to habitat quality, movement corridors act as a compensatory measure to mitigate against the barrier to dispersal created by clearing. A corridor is a continuous link of suitable habitat between two vegetation patches. Stepping stones are disconnected patches of habitat that more mobile species, or species with some tolerance to modified habitat, move through from one vegetation patch to another. A mosaic of natural and modified vegetation, even scattered trees within a paddock, would allow some more tolerant species to move between habitat patches (Bennett et al. 2000).

Establishing offsets within State and regional corridors (BPA mapping (EPA 2008a, b, c)) within the study area, subject to landholder approval, would provide high value offsets through increased ecological functionality.

The Rehabilitation and Revegetation Management Guidelines would include:

- Identification of the aims and intended outcomes of the revegetation and rehabilitation. The aims of the guidelines would include broad conservation values such as:
  - re-establishment of REs as appropriate to landform, particularly those endangered, regionally significant or locally significant,
  - re-establishment of locally significant plant species as appropriate to landform,
  - provision of habitat suitable for native fauna, particularly those threatened, near threatened and rare species, migratory species, and regionally or locally significant species known to occur or considered likely to occur,
  - enhancement of state and regionally significant corridors to alleviate the disruption to movement, and
- enhancement of the existing remnant vegetation to increase habitat values.
- Listing of responsible parties:
- This section should clearly prescribe the responsibilities of government, proponent, sub-contractors and community.
- Legislative and regulatory requirements;
- Relationship to other ecological plans required for this project,
- A spatially accurate plot of revegetation and rehabilitation areas:
- Mapping of intended revegetation areas should consider the principles for enhancing the conservation values of revegetation,
- Securing the tenure of the land required for any revegetation and rehabilitation to function as a corridor, or entering into a conservation agreement with the landholder(s) as appropriate,
- Details relating to:
  - rehabilitation techniques and requirements, including a review of appropriate methods and selection of method(s) to be used that best address the aims,
  - pest/weed management,
  - species selection of locally endemic flora to be used in revegetation areas,
  - seed collection,
  - selection of propagation techniques, for example, direct seeding, planting tube stock, brush matting, plant translocation, redistribution of on-site topsoil and mulch,
  - developing a schedule for site preparation and planting, and initial and ongoing maintenance,

  - appropriate supporting activities such as setting up and running a nursery, establishing and maintaining temporary soil dumps,
  - site preparation and seeding and/or planting,
  - initial site maintenance (fencing, watering, weed control) after planting,
  - organising the retention and storage of topsoil and plant material (mulching, retaining tree limbs and branches) disturbed and removed during construction,
  - developing accurate records of rehabilitation techniques, species planted, species surviving, species composition and distribution, successes, any remediation undertaken through the program and weed and pest animal control,
  - developing a short-term and long-term monitoring program,
  - planting densities and timing, and
- maintenance schedules.
- Monitoring plan describing:
  - frequency and methods of monitoring; and
- Spatially accurate mapping of monitoring areas,
- Performance criteria and corrective actions for rehabilitation and revegetation areas, and
- Reporting protocols and timing.

The conservation values of revegetation projects can be enhanced by various methods, these include:

- Using locally indigenous plant species,
- Matching plant species to the landform,
- Establishing natural layers in the vegetation,
- Promoting patchiness of vegetation by planting practices,
- Providing ground-layer components (using cleared vegetation and other elements from the inundation area),
- Managing vegetation community composition and structure,
- Controlling disturbance and degradation,
- Reducing edge effects,
- Positioning the revegetation to link with existing vegetation,
- Giving priority to streams as natural corridors, and
- Restoring remnants of depleted vegetation types (Bennett *et al.* 2000).

Locally indigenous plant species are most likely to provide natural habitat resources, and increase the likelihood of restoring plant-animal interactions such as pollination and seed dispersal, and processes such as leaf-litter accumulation and decomposition.

Natural vegetation corresponds closely with landform, soil types and topography. To ensure that the correct species are planted in the appropriate to position for slope and soil type, check nearby remnant vegetation on the same landform.

Different layers of vegetation provide different foraging substrates and locations for nesting and shelter of various species. Layers can be manipulated by selecting plant species that grow to different heights. Check nearby remnant vegetation to determine the appropriate number and types of layers.

Fine scale patchiness of vegetation provides a range of foraging and shelter resources for fauna and can be achieved in revegetation by spacing plantings at irregular distances, by using a variety of plant species with different growth forms and types of bark (such as smooth, rough and stringy) and, as a longer term management tool, by the use

of thinning and fire. Natural vegetation does not grow in rows, nor is it evenly spaced.

Ground layer components include fallen timber, leaf litter, lichens and mosses, low-growing vegetation and open spaces. These components provide shelter and resources for invertebrates and small vertebrates such as reptiles and frogs. These in turn provide food resources for larger species. Many of these larger predators also shelter and/or breed in hollow logs, under rocks and in low, dense vegetation. Logs and rocks should be deliberately added during rehabilitation, fallen timber should be allowed to accumulate, and low ground cover plants should be included in the planting regime. The ground layer component is an important component of ecosystem function. Leaf litter and ground vegetation trap rainfall, prevent erosion, and contribute to soil formation. Fungi, bacteria and small invertebrates within leaf litter contribute to the decomposition of dead organic matter and help recycle nutrients.

Planting for regeneration should be done in such a way as to maximise conservation values - the larger the size of the habitat the greater the value. Increased area can be achieved by planting a single large patch, by planting multiple patches that grow together over time and by planting adjacent to existing remnant vegetation. The shape of a revegetated patch determines the ratio between the perimeter and area. Long, thin patches have a high ratio of edge to area (Bennett et al. 2000).

Active management includes not tidying up revegetated areas, but rather adding logs and leaf litter, and by additional plantings to increase structural diversity, perhaps over a number of different seasons. Disturbance from introduced predators and other exotic animals, degradation of the ground and shrub layer by livestock and invasion by weeds needs to be controlled and minimised. Fencing is one of the most important management actions for revegetation projects (Bennett et al. 2000). Many restoration projects have failed due to browsing by cattle. Herbivory by native species such as wallabies may also inhibit revegetation, though grazing by wallabies, may be beneficial through reduction of competition by grasses (Kanowski et al. 2004).

2.5.6 Ecological Fire Management Guidelines

The Ecological Fire Management Guidelines would be developed and read in conjunction with the Habitat Management Guidelines.

There is no intention for these guidelines to interfere or substitute for the Project's fire management plan to protect human life, livestock and infrastructure. There are, however, aspects of fire management that have implications for the condition and functioning of native habitat and fauna within the study area.

The proliferation of fire in the landscape can have a serious effect on biodiversity values and ecosystem function. In particular the encroachment of exotic grasses (such as Buffel Grass, Green Panic and African Lovegrass) into natural vegetation communities of the study area can increase fire frequency and intensity, subsequently increasing encroachment of these grasses and contributing to die-back of native vegetation.

Appropriate fire intensity and frequency can be achieved through:

- Control of weed infestations,
- Control of fuel loads within buffer areas,
- Regularly monitoring the area of interest for fuel loads and weed infestations, and
- Preparation of control/eradication plan for weeds with follow-up action when and where needed.

Proper implementation of this plan requires integration with the weed management and rehabilitation and revegetation management guidelines.

The Ecological Fire Management Guidelines would include:

- Purpose/objectives,
- Responsible parties,
- Legislative and regulatory requirements,
- Relationship to other ecological plans required for this project,
- Research into appropriate fire regimes to manage natural vegetation health,
- Monitoring plan describing:
  - spatially accurate mapping of monitoring areas,
  - monitoring protocols, and
  - reporting procedures and requirements.
- Management strategies for:
  - identified weed infestations,
  - prescriptive control measures for fire prevention, and
  - prescribed burning regimes according to research into appropriate fire regimes;
- Performance criteria and corrective actions, and
- Reporting protocols and timing.

2.6 Offsets

2.6.1 Queensland Government Policy

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

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

The purpose of the draft Policy is to:

- ensure an equivalent or better biodiversity outcome on a State-wide basis where biodiversity values are lost to impacts from development or other activities,
- improve the long-term protection and viability of the State's biodiversity,
- increase the area of habitat restored and enhanced, and
- ensure development in Queensland is ecologically sustainable.

Biodiversity offsets must achieve an equivalent or better environmental outcome for the biodiversity values impacted.

The draft Policy does not apply to biodiversity offsets for impacts to the same biodiversity values that are already captured under other offset policies that address specific issues such as the Policy for Vegetation Management Offsets (Vegetation Management Act 1999), which does not apply to the Australia Pacific LNG Project.

Offsets may take the form of direct and indirect offset actions. Direct actions are those that provide biodiversity values, while indirect offsets are those that support the intended biodiversity outcome.

As the Project is a 'significant project' under Part 4 – 'Environmental coordination of the State Development and Public Works Organisation Act 1971, the Coordinator General, in consultation with DERM, may consider the appropriate offset requirements which may comprise an offset package.

The offset recommendations for the Project have been developed based on the predicted project biodiversity impacts. Clearing within EPBC Endangered Communities and Endangered and Of Concern REs (biodiversity status) requires offsetting. For individual species, if impacts are moderate or above after mitigation measures have been employed the provision of offsets has been recommended.

Offsets are to be provided with a minimal time-lag between the impacts and delivery of the offset.

For impacts of a development activity that trigger offset under both the Environmental Offsets Policy (EPA 2008e) and the Australian Government's EPBC Act, the Policy supports the use of an offset package to meet the requirements of both policies.

Offsets require ongoing management actions to ensure that the offset is of sufficient quality to achieve its environmental outcome. In addition, all offset agreements must have ongoing monitoring, reporting and evaluation.

2.6.2 Commonwealth Offset Policy

In the Draft Policy Statement: Use of Environmental Offsets under the EPBC Act 1999 (DEWR 2007a), the Australian Government defines environmental offsets as 'actions taken outside a development site that compensate for the impacts of that development – including direct, indirect or consequential impacts'.

Environmental offsets provide compensation for those impacts which cannot be adequately reduced through avoidance and mitigation.

Actions that can be considered as environmental offsets are generally categorised into direct and indirect offsets.

Direct offsets are aimed at on-ground maintenance and improvement of habitat or landscape values. They may include:

- Long-term protection of existing habitat – including through the acquisition and inclusion of land in the conservation estate, and covenanting arrangements on private land,
- Restoration or rehabilitation of existing degraded habitat, or
- Re-establishing habitat.

Indirect offsets are the range of other actions that improve knowledge, understanding and management leading to improved conservation outcomes. They may include:

- Implementation of recovery plan actions – including surveys,
- Contributions to relevant research or education programs,
- Removal of threatening processes,
- Contributions to appropriate trust funds or banking schemes that can deliver direct offsets through a consolidation of funds and investment in priority areas, or
- On-going management activities such as monitoring, maintenance, preparation and implementation of the Environmental Management Plan, and so forth.

Eight principles for the use of environmental offsets under the EPBC Act are 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 be targeted to 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 – which may include both direct and indirect offsets.

- Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.
- Environmental offsets should be located within the same general area as the development activity.
- Environmental offsets should be delivered in a timely manner and be long lasting.
- Environmental offsets should be enforceable, monitored and audited.

Guiding principles for determining the appropriate magnitude of offsets (DEWR 2007b) are:

- The magnitude of offsets needs to relate to the scale (extent) of the impacts of the development – including direct, indirect and consequential impacts, and
- Offsets should be commensurate (as a minimum) with the intensity of impact of the development and should provide for both maintenance and enhancement of the relevant protected matter. For example, offsets should aim to secure a positive environmental outcome through an increase in the overall habitat available to a threatened species to allow it to recover.

2.6.3 Potential Environmental Offsets for the Project

For the purposes of this assessment, the 'environmental metric' used to measure offsets is ha units of habitat for affected species. This has been applied to those species listed both under State and Commonwealth legislations, with proposals for offset ratios made on the basis of potential impacts on each biodiversity element as assessed and the predicted success of mitigation measures (Appendix N).

Table 3.5 (also provided as Table O.1 in Appendix O) lists the offset opportunities for the Project.

APPENDIX O
TABLE 0.1 OFFSET RECOMMENDATIONS

Biodiversity Value Impacted	Potential Area Affected for each Value[1]	Environmental Outcome Sought	Potential Offset Descriptions				Offset Trigger	Offset timing
			Values	Location (in order of preference)	Offset type and characteristics	Ratio of impact to offset		
Regional Ecosystems:								
EPBC Endangered Ecological Communities	Brigalow (*Acacia harpophylla*) and/or Belah (*Casuarina cristata*) open forest on alluvial plains - RE 11.3.1 Also listed as Endangered under the VM Act. Poplar Box (*Eucalyptus populnea*) or Narrowleaved Box (*E. pilligaensis*), Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*) open forest to woodland on margins of Cainozoic clay plains - RE 11.4.10. Also listed as Endangered under the VM Act. Brigalow (*Acacia harpophylla*) and / or Belah (*Casuarina cristata*) shrubby open forest on Cainozoic clay plains - RE 11.4.3. Also listed as Endangered under the VM Act Open forest to woodland of Poplar Box (*Eucalyptus populnea*) with Brigalow (*Acacia harpophylla*) and / or Belah (*Casuarina cristata*) on Cainozoic clay plains - RE 11.4.7. Also listed as Endangered under the VM Act. Semi-evergreen vine thicket on fine grained sedimentary rocks - RE 11.9.4. Also listed as Of Concern under the VM Act. Brigalow (*Acacia harpophylla*) and / or Belah (*Casuarina cristata*) open forest on fine-grained sedimentary rocks - RE 11.9.5. Also listed as Endangered under the VM Act	Improve extent of Endangered Ecological Communities	Same RE.	Within bioregional corridors within tenements. Outside of bioregional corridors within tenements.	Direct offset.	Offset ratios to be developed in consultation with DNRW and DEWHA..	Clearing within REs 11.3.1, 11.4.10, 11.4.3, 11.4.7, 11.9.4 and 11.9.5.	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.
State Significant Regional Ecosystems Endangered REs (those that are not also EPBC listed)	Poplar Box (*Eucalyptus populnea*) woodland on Cainozoic clay plains - RE 11.4.12. Black Tea-tree (*Melaleuca bracteata*) woodland fringing swamp associated with Brigalow (*Acacia harpophylla*) communities - RE 11.4.3a	Improve extent of Endangered REs	Same RE.	Within bioregional corridors within tenements. Outside of bioregional corridors within tenements.	Direct offset.	Offset ratios to be developed in consultation with DNRW.	Clearing within REs 11.4.12 and 11.4.3.	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs. Replanting-based offsets on maintenance twelve (12) months prior to clearing within listed REs.
State Significant Regional Ecosystems Of Concern REs (those that are not also EPBC listed)	Poplar Box (*Eucalyptus populnea*) woodland on alluvial plains - RE 11.3.2 Poplar Box (*Eucalyptus populnea*) woodland with Brigalow (*Acacia harpophylla*)	Long-term protection of existing REs – most likely through arrangements on private land; Restoration or	Same RE.	Within bioregional corridors within tenements. Outside of bioregional corridors within tenements.	Direct offset.	Offset ratios to be developed in consultation with DNRW.	Clearing within REs 11.3.2, 11.3.7, 11.3.3, 11.3.4 11.9.7 and 11.9.10.	Regrowth-based offsets on maintenance three (3) months prior to clearing within listed REs.