FINAL REPORT

Santos GLNG CSG Field Report - Nature Conservation

Prepared for

Santos Ltd

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Executive Summary

The aim of the Coal Seam Gas (CSG) field ecological investigation was to characterise the ecological values of the overall CSG field study area and determine biodiversity values for reasonably foreseeable development areas (RFDAs), with specific focus on significant species and vegetation. The study also provides mitigation strategies for potential impacts from gas field development.

The CSG field ecological study involves a three stage approach to ensure an appropriate level of biodiversity assessment is undertaken across Santos' CSG fields, to allow for adequate impact assessment and the development of future CSG field biodiversity management protocols. This approach departs from previous traditional EIS ecological studies due to the unique nature of this GLNG development which includes:

- the extent of the entire CSG field study area (approximately 22,010 km^2 (~ 2.2 million ha)); and
- the industry specific nature of CSG field development activities, which is anticipated to be ongoing over the next 25 years (approximately).

A detailed description of both these points above is provided in the "Project Description" chapter of the EIS.

An extensive field study of the CSG field study area is not a practical undertaking and so focus has been placed on a robust literature review of all known data sources for the CSG field, extensive field studies in the RFDAs (Fairview, Arcadia Valley and Roma), and field scoping protocols developed for exploration areas (Mahalo, Comet, Denison Trough, Scotia, Roma Other and Eastern Surat Basin). This is to ensure adequate field assessment of ecological values is undertaken in the exploration and development of CSG fields beyond the immediate proposed operations.

- Stage 1 of the study involved a comprehensive literature review;
- Stage 2 involved a number of targeted field studies within both the northern and southern CSG fields; and
- Stage 3 of the ecological investigation involves an assessment of potential ecological impacts from proposed CSG activities. Additionally, this includes the development and the future implementation of a number of protocols for further biodiversity assessment in exploration areas.

The CSG field study area is situated in Central Queensland and is comprised of a number of exploration and production tenements, including the northern CSG fields of Mahalo, Comet, Denison Trough, Scotia, Arcadia Valley, Roma Other and Fairview, and the southern CSG fields of Roma and the Eastern Surat Basin (Figure 1a and Figure 1b). Each stage of assessment has been split into the North and South CSG fields to allow for the logical delineation of landscape characteristics and for ease of information display.

The Literature review involved a review of all relevant species, vegetation and habitat databases, and a complete list of conservation significant flora and fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation Act 1999* (NC Act) was compiled from database searches. From this list, duplicated entries were removed and are presented in Appendix A.2 and A.3. The potential presence of these species was then assessed based upon habitat and resource availability. The review of databases indicates that the study area potentially supports a number of conservation significant species and vegetation communities including:

- 130 significant flora species identified by searches; 21 of these species are potentially occurring;
- 51 significant fauna species identified by searches; 28 of these species are potentially occurring; and
- Four Regional Ecosystems (REs) that are listed as 'Endangered' communities and one RE listed as 'Critically Endangered' under the *Environment Protection and Biodiversity Conservation Act 1999*.

Executive Summary

A number of REs mapped by state government RE mapping (DNRM&W, 2005) are described as significant under the *Vegetation Management Act, 1999*; including:

North CSG Field

- Arcadia Valley: 6 significant REs mapped. This includes 3 'Of Concern' REs and 3 'Endangered REs;
- Fairview: 7 significant REs mapped. This includes 4 'Of Concern' REs and 3 'Endangered' REs;
- Mahalo: 10 significant REs mapped. This includes 4 'Of Concern' REs and 6 'Endangered' REs;
- Comet: 14 significant REs mapped. This includes 6 'Of Concern' REs and 8 'Endangered' REs;
- Roma Other: 8 significant REs mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs;
- Denison Trough: 23 significant REs mapped. This includes 13 'Of Concern' REs and 10 'Endangered' REs; and
- Scotia: 8 significant REs mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs.

South CSG Field

- Roma: 19 significant REs. This includes 12 'Of Concern' REs and 7 'Endangered' REs; and
- Eastern Surat Basin: 7 significant REs. This includes 3 'Of Concern' REs and 4 'Endangered' REs.

A summary of sixteen previous ecological reports included well and drill site assessments, flora and fauna studies, Queensland Herbarium RE mapping and desktop research. These reports provided valuable insight into the flora and fauna and land-uses of the environs of the CSG fields. The reviewed literature primarily covered Fairview and Arcadia Valley fields, but also incorporated studies undertaken in the northern CSG field such as the Denison Trough CSG field. The flora reports included assessment of REs, vegetation communities, endangered flora species and introduced weeds, essential habitats and nationally important wetlands. Desktop studies and reviews of databases and previous reports have also provided information on the major environmentally sensitive areas within the CSG field study area.

Following initial literature review (Section 3) the survey design for the CSG field was based on the following broad steps:

- Initial consultation with regulatory bodies (including the EPA) to determine an appropriate scope for initial field investigations;
- Development of an adequate level of field investigations to be undertaken within the CSG development area to characterise broad conservation values in any apparent areas of significant communities or habitat (Section 4);
- Post survey consultation with regulatory bodies to report major findings and determine the appropriate approach for the development and implementation of further biodiversity assessment process for targeted well field development; and
- Development of protocols (Section 5.5) for targeted biodiversity assessments to be implemented at specific proposed well and infrastructure locations, at a level detailed enough to inform adequate impact assessment and implementation management strategies (this step informs the biodiversity component of an overall well field environmental and heritage assessment process).

Executive Summary

The flora survey was undertaken in four stages during August to November 2008. All reported weather observations were taken from the Bureau of Meteorology Roma Radar, as an indication of the weather conditions in the CSG fields during the entire survey period.

Flora values for the northern CSG field were determined from both desktop analysis (Stage1) and field surveys (Stage 2). Satellite photography coverage at 2.5m / pixel resolution (Geoimage, 2008) and current state government 1:100,000 Regional Ecosystem (RE) mapping v5.0 (DNRM&W , 2005) were utilised for analysis of vegetation communities present within the northern CSG fields of Mahalo, Comet, Denison Trough, Fairview, Scotia and Arcadia Valley (Figure 1a). Conservation significant species were identified from database searches conducted as per Section 3.1.

Further targeted flora field studies were then undertaken within the Arcadia Valley and Fairview CSG fields to ground-truth the RE mapping, search for targeted conservation significant flora species, and provide a greater understanding of the floral diversity and vegetation communities of the area.

The field survey of the northern CSG fields identified the presence of 156 taxa representing 52 families and 102 genera. Families represented by 3 or more genera included Asteraceae (7 genera), Cyperaceae (3), Euphorbiaceae (3), Fabaceae (5), Malvaceae (3), Myrtaceae (5), Poaceae (21) and Rutaceae (4).

Genera represented by 3 or more species included *Acacia* (9 species), *Aristida* (7), *Corymbia* (4), *Cyperus* (3), *Dianella* (3), *Dodonaea* (3), *Eremophila* (3), *Enteropogon* (4), *Eucalyptus* (7), *Lomandra* (6) and *Paspalidium* (3).

There was a relatively moderate diversity of weed species found with 11 species identified. Families with exotic weed taxa included Asclepediaceae (1), Asteraceae (1), Cactaceae (2), Malvaceae (1), Papaveraceae (1), Poaceae (3) and Verbenaceae (2). Weed species of concern within the northern CSG fields are discussed further below in Section 4.2.2.2

Thirty vegetation communities of the northern CSG fields were identified from desktop analysis as having either “Of Concern” or “Endangered” conservation status (as listed under the *Vegetation Management Act, 1999*) and 37 communities were identified as having “Of Concern” or “Endangered” biodiversity status (as determined by the EPA). Four of these vegetation communities were ground-truthed during the survey period. Fourteen vegetation communities were identified as “Endangered” under the EPBC Act and, of these, two vegetation communities were confirmed through ground truthing.

Flora values for the southern CSG field were determined from both desktop analysis (Stage 1) and field surveys (Stage 2). Current state government RE mapping v5.0 (DNRM&W, 2005) was utilised for analysis of vegetation communities present within the southern CSG fields of Roma and Eastern Surat Basin (Figure 1b). Conservation significant species were identified from the previous database searches as per Section 3.1.

Further targeted flora field studies were then undertaken within the Roma CSG field to ground-truth the RE mapping, search for targeted conservation significant flora species, and provide a greater understanding of floral diversity and vegetation communities of the area.

The survey identified the presence of 92 taxa representing 35 families and 62 genera. Families represented by three or more genera included Apocynaceae (3 genera), Asteraceae (3), Myrtaceae (4) and Poaceae (14).

Genera represented by three or more species included *Acacia* (9 species), *Dodonaea* (3), *Eremophila* (3) *Eucalyptus* (4) and *Lomandra* (4).

There was a relatively low diversity of weed species found with five species identified. Families with exotic weed taxa included Asclepediaceae (1), Cactaceae (1), Poaceae (2) and Verbenaceae (1)

Executive Summary

Desktop analysis for the southern CSG field identified 21 significant communities as having either “Of Concern” or “Endangered” conservation status (as listed under the *Vegetation Management Act, 1999*) and 27 communities as having “Of Concern” or “Endangered” biodiversity status (as determined by the EPA). Three of these vegetation communities were confirmed through ground truthing. Six of the vegetation communities listed are regarded as ”Endangered” under the EPBC Act.

For each CSG field, a summary of ecologically significant values is provided in table format. These are presented at the end of each CSG field section. Summaries of mapped REs, mapped significant REs and potentially present Endangered, Vulnerable and Rare (EVR) fauna and flora species are listed. The summary is centred around broad landscape elements which are based on EPA landzone categories.

The development of each CSG field will be undertaken in four distinct phases; Exploration, Construction, Operation and Decommissioning. Each phase consists of several activities, with corresponding potential impacts and mitigation measures. Potential and cumulative impacts and impact mitigation strategies are outlined in detail in Section 5.

Glossary and Abbreviations

Section 1

Abbreviations

ANZECC – Australian New Zealand Environment and Conservation Council

ATP - Authority to Prospect

CSG – Coal Seam Gas

DIWA - Directory of Important Wetlands in Australia

EIS – Environmental Impact Statement

EPA – Queensland Environmental Protection Agency

EPBC Act - *Environment Protection and Biodiversity Conservation Act 1999*

ESA - Environmentally Sensitive Areas

FPC – Foliage Projection Cover

HERBRECS - is a database maintained by the Queensland Herbarium that provides a list of specimens and collections for a specified search area.

LNG – Liquefied Natural Gas

LP Act - Queensland *Lands Protection (Pest and Stock Route Management) Act* 2002

MNES database – Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) Matters of National Environmental Significance database

NC Act – Queensland *Nature Conservation Act* 1992

PL - Petroleum Lease

RE – Regional Ecosystems

REDD - Regional Ecosystems Description Database

RFDA - Reasonably Foreseeable Development Areas

SF - State Forest

VM Act – Queensland *Vegetation Management Act* 1999

WONS - Weeds of National Significance

Section 1 Glossary and Abbreviations

Glossary

Alluvium is material deposited by a river or other running water typically made up of a variety of materials, including fine particles of silt, clay, articles of sand and gravel.

Alluvial relating to, composed of, or found in alluvium or alluvial soil.

Arboreal pertains to an animal which inhabits or frequents trees.

Biodiversity The number and variety of organisms found within a specified geographic region or within a given ecosystem.

Bioregion A landscape pattern that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale.

Brigalow Belt is a Bioregion that spans inland and eastern Queensland from Townsville in the north to northern New South Wales, covering an area of about six million hectares.

Colluvium refers to sediment that has been deposited or built up at the bottom of a low-grade slope through the effects of gravity, rather than the actions of water**.**

Conservation Significant See definition under 'Threatened species'

Ecosystem is an interdependent system of interacting plants, animals and other organisms together with the non-living (physical and chemical) components of their surroundings.

Ecology scientific study of abundance, distribution and interactions between organisms and their natural environment.

Floristics is the study of diversity, distribution, and relationships of plant species over a geographic area

Habitat The area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food resources and the presence of predators.

Herbarium Institution where a collection of dried plants are mounted, labelled, and systematically arranged for use in scientific study as reference material for describing plant taxa.

Nomenclature The procedure of assigning names to groups of organisms listed in a taxonomic classification

Northern CSG fields includes the Arcadia Valley, Fairview, Mahalo, Comet, Denison Trough, Roma Other and Scotia gas fields.

Protists are a diverse group of eukaryotic microorganisms which are either unicellular, or multicellular without specialized tissues. They include protozoans, algae and fungus-like organisms.

Quaternary sample plots – Is a standardised flora study to collect data to verify regional ecosystem and vegetation mapping. Data from these sites are generally collected throughout the field survey and entered on spreadsheets or databases. Quaternary sites may be collected at regular intervals along a traverse, and/or made where REs/vegetation communities change.

Ramsar wetlands of international significance The Ramsar Convention is an inter-governmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar and is focussed on the conservation and sustainable use of wetlands as important ecosystems. The addition of a site to the 'List of Wetlands of

International Importance' (the "Ramsar List") expresses the relevant government's commitment to take all steps necessary to ensure the maintenance of the ecological character of the site.

Regional Ecosystem (RE) Describes the relationships between major floral species and the environment at the regional scale. They are mostly derived from linking vegetation mapping units based on dominant canopy species, recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology, rainfall and landform. Under the VM Act REs are assigned a conservation status based on an assessment of the pre-clearing and remnant extent of a RE.

Remnant Vegetation - Vegetation is identified as 'remnant' under the VM Act where the predominant canopy of the vegetation: covers more than 50 % of the equivalent undisturbed canopy; averages more than 70 % of the vegetations undisturbed height and is composed of species characteristic of the vegetations undisturbed predominant canopy.

Scarp A steep slope, ridge or escarpment of rock.

Scats Animal pellets or faecal matter.

Secondary sample plots Secondary sample plots are standardised transects used for classification and detailed descriptions of REs and vegetation communities. Data collected include all location, environmental and overall floristic and structural information as well as a list of all species present and basal area, percentage cover and stem density measures of abundance.

Southern CSG fields includes the Roma and Eastern Surat Basin gas fields.

Threatened species generic term for a plant or animal species listed as critically endangered, endangered, vulnerable or rare under either state or commonwealth threatened species legislation. The terms 'threatened' and 'conservation significant' are interchangeable in this context.

Weeds are plant species that invade native ecosystems and can adversely affect the survival of indigenous flora and fauna, often competing with indigenous plants for resources such as nutrients, moisture and light. They can prevent natural regeneration, reduce wildlife habitat, alter water flows, increase soil erosion, introduce poisons into the soil or poison animals, change fire behaviour and may introduce foreign genes into local plant populations. Weed species are not necessarily exotic non-indigenous species, but can also be non-endemic natives that are naturalised to areas outside of their natural distribution.

Section 2 Introduction

2.1 Study Aim & Objectives

The aim of the ecological investigation was to characterise the ecological values of the overall study area and determine biodiversity values for reasonably foreseeable development areas (RFDAs), with specific focus on significant species and vegetation communities. The study also provided mitigation strategies for potential impacts from gas field development. In meeting this aim the specific objectives for the ecological studies included the following:

- Undertake a comprehensive literature review of relevant biodiversity databases and existing conservation reports to identify potential significant ecosystems, species and habitat, and characterise the ecological values of the CSG field;
- Establishment of a priority taxa list from reviewed data sources for targeted field studies;
- Identification of potential significant vegetation communities, fauna habitats and ecologically sensitive areas within CSG field area;
- Field assessment of the diversity of terrestrial vascular flora and identification of significant floral species within targeted RFDAs;
- Field identification of the occurrence or expected occurrence of significant terrestrial vertebrate fauna species or potential habitat of significant species within RFDAs;
- Assessment of the status of terrestrial floral and faunal pest species;
- Determination of the potential impacts of the proposed project activities within the CSG field;
- Development of strategies to minimise and manage potentially adverse ecological impacts; and
- Development of an operations protocol for targeted biodiversity assessments to be implemented at specific well lease and other infrastructure locations.

2.2 Study Approach

The CSG field ecological study involves a three stage approach to ensure an appropriate level of biodiversity assessment is undertaken across the CSG field, to allow for adequate impact assessment and the development of future CSG field biodiversity management protocols. This approach departs from previous traditional EIS ecological studies to accommodate the large extent of the entire CSG field study area of approximately 22,010 km^2 (~ 2.2 million ha). In addition, the nature of CSG field development program incorporates appraisal (exploration) and production phases occurring throughout the life of the project (approximately 20 years), with the outcomes of the appraisal program determining the location of production activities.

An extensive field study of the entire extent of the CSG field study area is not a practical undertaking and so focus has been placed on a robust literature review of all known data sources for the CSG field, extensive field studies in the RFDAs (Fairview, Arcadia Valley and Roma), and field scoping protocols developed for exploration areas (Mahalo, Comet, Denison Trough, Scotia, Roma Other, and Eastern Surat Basin). This is to ensure adequate field assessment of ecological values is undertaken in the exploration and development of CSG fields beyond the immediate proposed operations.

Stage 1 Literature Review

Stage 1 of the study involved a comprehensive literature review of all known data sources and existing ecological studies for the entire CSG field study area, to provide a background for targeted ground surveys and to ensure that adequate knowledge of biodiversity values is acquired for the remainder of the CSG field. Details on literature review methodology and results are provided in Section 3, and a visual display of the literature review study sites is shown in Figure 2a & Figure 2b.

Stage 2 Field Studies

Stage 2 involved a number of targeted field studies within both the northern and southern CSG fields. The field surveys targeted the RFDAs of Roma, Arcadia Valley and Fairview (Figures 7a, Figure 7b, Figure 8 and Figures10a-10h). Details of the field studies including field survey design; study area and site selection; survey methodology and investigation results is provided below in Section 4.

Stage 3 Impact Assessment and Recommended 'Phase 2' Protocols

Stage 3 of the ecological investigation involved an assessment of potential ecological impacts from proposed CSG field development activities. Additionally, this included the development and the future implementation of a number of protocols for further biodiversity assessment in exploration areas, as well as field scoping and site selection processes. Assessment of potential ecological impacts and further biodiversity assessment protocols are detailed in Section 5.

2.3 Study Area

The CSG field study area is situated in Central Queensland and is comprised of a number of exploration and production tenements, including the northern CSG fields of Mahalo, Comet, Denison Trough, Scotia, Arcadia Valley, Roma Other and Fairview, and the southern CSG fields of Roma and the Eastern Surat Basin (Figure 1a & Figure 1b). Each phase of assessment has been split into the north and south CSG fields to allow for the logical delineation of landscape characteristics and for ease of information display.

Desktop analysis of the CSG fields reveals that the northern CSG fields of Arcadia Valley, Comet, Fairview, Mahalo and the southern part of the Denison Trough have similar landscape characteristics consisting of mountain ranges, scarps and ledges. These areas are primarily densely vegetated and much less amenable to agricultural development. The northern parts of the Denison Trough, Fairview, Roma Other and Scotia have relatively similar landscape characteristics including flat to undulating relief that is largely cleared and developed for agricultural purposes. The mountain ranges of Carnarvon and Expedition are very prominent features of the landscape in the north and create defining landscape features that largely dictate the land use of the region.

The southern CSG fields of Roma and Eastern Surat Basin occur in predominantly cleared areas of largely flat agricultural land. This land occurs primarily within a single subregion and is therefore fairly uniform in landscape. These areas have been largely modified due to agricultural growth and much less remnant vegetation remains than is evident in many CSG fields in the north.

A description of the general location, extent and the primary conservation areas within proximity of each CSG field is provided below in the following sections and displayed in Figure 3a & Figure 3b. It should be noted that petroleum activities are generally prohibited from national parks and other protected areas.

Section 2 Introduction

2.3.1 Mahalo

Mahalo CSG field covers an area of approximately 62,645 ha (626 km^2) and consists of one Authority to Prospect (ATP804P). Within this area lies the Shotover State Forest and Expedition State Forest. This CSG field is situated approximately 70 km south-west of Duaringa, 84 km east of Springsure and 90 km north-west of Moura. In relation to the other CSG fields, Mahalo is situated above Comet CSG field and to the north-east of the Denison Trough CSG field.

2.3.2 Comet

Comet CSG field covers an area of approximately 171,650 ha (1716 km^2) and consists of two ATPs (ATP745P & ATP526P). These ATPs encompass parts of Expedition National Park, Mount Nicholson State Forest and Palmgrove National Park (Scientific). These ATPs are situated approximately 80 km west of Moura, 3 km north-west of Presho State Forest, 18 km north-east of Nuga Nuga National Park and 20 km west of Zamia Creek Conservation Park. Comet is situated above Arcadia Valley CSG field, directly below Mahalo CSG field and to the east of the Denison Trough CSG field.

2.3.3 Denison Trough

The Denison Trough is the most widespread of all the CSG fields and covers an area of approximately 592,311 ha (5923 km^2) consisting of two ATPs (ATP337P & ATP533P) and ten Petroleum Leases (PL41-45, PL54, PL67, PL173, PL183 and PL218). This field encompasses sections of Carnarvon National Park, Nuga Nuga National Park, Bandana State Forest, Boxvale State Forest, Serocold State Forest, Doonkuna State Forest and Expedition National Park. This CSG field lies approximately 8 km east of Emerald, 25 km east of Springsure and 38 km west of Blackwater. Mount Pleasant State Forest, Eden State Forest, Howe State Forest and Cardbeign State Forest all lie within a 10km radius. In relation to the other CSG fields, Denison Trough is situated to the east of Mahalo, Comet, Arcadia Valley and Fairview CSG fields.

2.3.4 Scotia

Scotia CSG field covers an area of approximately 75,345 ha (753 km^2) and consists of one ATP (EPP) (Exploration Permit for Petroleum) and one PL (PL176). This CSG field encompasses the town of Wandoan and lies approximately 20km south-east of Taroom. A number of state forests and national parks are located in close proximity to this field including Mundell State Forest (2 km west), Barakula State Forest (9 km west), Cooaga State Forest (10 km west), Cherwondah State Forest (12 km west) and Carraba Conservation Park (15 km south-east). In relation to the other CSG fields, Scotia is situated to the south-east of the Fairview CSG field and north-east of the Roma CSG field.

2.3.5 Arcadia Valley

Arcadia Valley CSG field covers an area of approximately 318,800 ha (3188 km^2) and consists of two ATPs (ATP526P & ATP653P) and five PLs (PL232, PL233, PL234, PL235, and PL236). This field encompasses sections of Expedition National Park, Belington Hut State Forest, Beilba State Forest, Expedition Resources Reserve, Stephenton State Forest and Presho State Forest and lies 63 km east of the town of Taroom. The Arcadia Valley CSG field is situated approximately 1 km south of Mount Nicholson State Forest, 2 km north of Hallett State Forest, 9 km west of Palmgrove National Park and 17 km east of Carnarvon National Park. In relation to the other CSG fields, Arcadia Valley CSG field is situated directly below the Comet CSG field and to the east of the Denison Trough CSG field. The Arcadia Valley CSG field is not restricted to the topographical valley of the same name; it also extends over a portion of the Expedition Range.

2.3.6 Fairview

Fairview CSG field covers an area of approximately 116,000 ha (1161 km^2) and consists of five PLs (PL90, PL91, PL92, PL99 and PL100). This CSG field intersects sections of Expedition National Park, Stephenton State Forest, Hallett State Forest (known locally as Pony Hills), Beilba State Forest, Doonkuna State Forest and Expedition Resources Reserve. Fairview CSG field is situated 64 km east of the town of Taroom and 81 km north of Roma. Environmentally sensitive areas in close proximity include Belington Hut State Forest (4 km south-west of Fairview), Forrest State Forest (18 km east of Fairview), Boxvale State Forest (21 km south-east of Fairview) and Gubberamunda State Forest 3 (40 km north of Fairview). In relation to the other CSG fields, Fairview CSG field is situated directly below the Arcadia Valley CSG field and to the east of the Denison Trough CSG field.

2.3.7 Roma Other

The Roma Other CSG field (so named due to its tenement association with the Roma CSG field and not its geographical position) is approximately 131,746.9 ha in size. It consists solely of EPP803 in two separate areas. It lies to the east of the Fairview and Arcadia Valley CSG fields and to the west and north of the township of Taroom. The Roma Other CSG field incorporates Lake Murphy Conservation Park, Carraba Conservation Park and parts of Gwambagwine State Forest and Theodore State Forest, Other environmentally sensitive areas in close proximity include Mebir State Forest, Tualka State Forest, Waterton State Forest, Isla Gorge National Park, Devil's Nest State Forest, Precipice National Park, Belington Hut State Forest and Presho State Forest.

2.3.8 Roma

The Roma CSG field covers an area of approximately 839,200 ha (8393 km^2) and consists of five ATPs (EPP631, EPP665, EPP708, ATP336P Roma & ATP655P) and eighteen PLs (PL3-PL10, PL10 Waldegrave, PL11, PL12 Oberina, PL12 T, PL12 Waldegrave, PL13, PL28 Waldegrave, PL69, PL89, and PL93). This CSG field is centred on the towns of Roma, Wallumbilla and Yuleba and intersects sections of Gubberamunda State Forest 1, Inglebogie State Forest, Yuleba State Forest, Wallabella State Forest 1, Wallabella State Forest 2, Tinowon State Forest, Yalebone State Forest 1, Trinidad State Forest 1, Trinidad State Forest 2 and Brucedale State Forest. Roma CSG field is situated approximately 20 km east of the town of Mitchell, 31 km north-west of Condamine and 35 km west of Miles. Environmentally sensitive areas in close proximity include Yalebone State Forest 2 (1 km north of Roma), Combabula State Forest (4 km south-west of Roma), Woodduck State Forest (5 km south-west of Roma), Hallett State Forest (6.5 km south-west of Roma), Gurulmundi State Forest (10 km south-west of Roma) and Stones Country Resources Reserve (11 km south-west of Roma). In relation to the other CSG fields, Roma CSG field is situated below the Fairview and Denison Trough CSG fields, and to the north-west of the Eastern Surat Basin.

2.3.9 Eastern Surat Basin

The Eastern Surat Basin CSG field covers an area of approximately 36,241 ha (362 km^2) and consists of three PLs (PL1 (1), PL1 (2) and PL17 Upper Stratum). This field lies approximately 16 km west of Tara and 50 km south-west of Condamine. A number of state forests and national parks are located in close proximity to this field including Southwood National Park (3km east), Booroondoo State Forest (8 km west) and Calingunee State Forest (14 km north). In relation to the other CSG fields, the Eastern Surat Basin is situated to the south-east of Roma CSG field.

Section 2 Introduction

2.4 Legislative Context

2.4.1 Environment Protection and Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) provides for the protection of the environment, especially matters of National Environmental Significance (Protected matters), and is administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA). It is designed to provide for the conservation of biodiversity through the protection of threatened species and ecological communities, migratory, marine and other protected species listed under the Act. In general, the EPBC Act streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places.

2.4.2 Nature Conservation Act

The Queensland *Nature Conservation Act, 1992* (NC Act)is administered by the Environmental Protection Agency (EPA) and is the principal legislation for the conservation and management of the State's native flora and fauna. The primary objective of the NC Act is the conservation of nature.

2.4.3 Lands Protection (Pest and Stock Route Management) Act

The Queensland *Lands Protection (Pest and Stock Route Management) Act*, *2002* (LP Act) provides 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.

2.4.4 Vegetation Management Act

The purpose of the Queensland *Vegetation Management Act,1999* (VM Act) is to regulate the clearing of native vegetation, i.e. Remnant Regional Ecosystems (REs), to prevent the loss of biodiversity or any increase in land degradation from vegetation clearing, to maintain ecological processes, reduce greenhouse gas emissions, and to manage the effects of clearing. Additionally, areas of remnant vegetation specific to conservation significant species (listed under the NC Act) are further classified as Essential Habitat.

The Department of Natural Resources and Water (DNRW) uses certified mapping of Remnant Vegetation and Essential Habitat to administer the VM Act. Clearing of native vegetation mapped as REs and/or Essential Habitat is subject to assessment by the DNRW against the applicable Regional Vegetation Management Code for the Brigalow Belt and New England Tableland Bioregions (DNRW, 2008).

2.4.4.1 Vegetation Clearing

The following information describes the circumstances in which the GLNG project must comply with the VM Act in regards to vegetation clearing (as per conversations with representatives of the Department of Mines and Energy).

Petroleum activities[1] (including the GLNG project) do not require a permit to clear native vegetation when the VM Act regards it as a 'specified activity' (under Schedule 8 of the *Integrated Planning Act*, *1997* (IP Act)). This exemption for clearing native vegetation does not extend to purposes outside the definition of an 'authorised

[1] As defined by the Petroleum and Gas Act 2004 and the Environmental Protection Act (EP Act) 1994

activity' [2] (Section 22 of the *Petroleum and Gas (Production and Safety) Act, 2004*). Petroleum activities are also exempt from assessment against a planning scheme (under Schedule 9 of IPA).

Note that any conditions contained in the Environmental Authority (under the Queensland *Environment Protection Act, 1994*) regarding vegetation management must be complied with.

Santos is authorised to undertake vegetation clearing when it is regarded as an 'incidental activity' for the following:

- Exploration or testing (Section 32 Exploration and testing (1) and 152 Petroleum production or storage testing (1);
- Pipeline construction or operation; and
- Construction or operation of a petroleum facility.

The clearing of native vegetation for the purpose of an 'incidental activity' is limited to that which is reasonably necessary for, or incidental to, another authorised activity for the lease. For example, clearing to enable the construction and operation of a petroleum well, natural underground reservoir for petroleum storage, pipeline or a petroleum facility. It is surmised that 'reasonably necessary' clearing of vegetation may include activities such as:

- Clearing within the infrastructure / building envelope to enable construction and operation; and
- Clearing for safety / maintenance purposes (e.g. fire break).

The clearing of vegetation should be viewed in context of the authorised activity and should be relative to the scale and /or nature of the activity. Where the clearing of native vegetation is for purposes outside of an authorised or incidental activity (as previously defined), the VM Act applies.

2.4.4.2 Remnant Vegetation Conservation Status

The Regional Ecosystem Description Database (REDD) lists the status of REs as gazetted under the VM Act (Vegetation Management Status) and their Biodiversity Status as recognised by the Environmental Protection Agency.

Biodiversity status of affected communities is to be listed in the EIS as requested within the Terms of Reference; however the VM Act status is the primary classification. It should be noted that due to different criteria, there are more vegetation communities identified as Endangered and Of Concern under the biodiversity status than the VM Act status.

Biodiversity Status is defined by the Environmental Protection Agency and is based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of REs in accordance with the following criteria:

[2] Such as exploration, production and storage activities; pipeline construction and operation; and petroleum processing (Part 2 of the *Petroleum and Gas Act, 2004*)

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Endangered

REs are listed as having 'Endangered' VM status when remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares.

REs are listed as having 'Endangered' biodiversity status when less than 10 per cent of the pre-clearing extent of remnant vegetation remains unaffected by severe degradation and/or biodiversity loss; or 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or it is a rare RE subject to a threatening process.

Of Concern

REs are listed as having 'Of Concern' VM status when remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 30 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares.

REs are listed as having 'Of concern' biodiversity status when remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 30 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, and if 10-30 per cent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.

Not of Concern / No Concern at present

REs are listed as having 'Not of concern' VM status when remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares.

REs are listed as having 'Not of concern' Biodiversity status when remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, the remnant area is greater than 10,000 hectares and the degradation criteria for endangered or of concern REs are not met.

3.1 Literature Review Methodology

A desktop review of ecological data and literature was undertaken to characterise the ecological values and identify the potential presence of conservation significant species, habitats and vegetation communities within the CSG field study area. The objectives for the desktop study include:

- Review of relevant biodiversity databases and conservation reports for the study area;
- Assessment of the broad conservation values of vegetation communities and fauna habitat present in the study area;
- Identification of the potential presence of conservation significant vascular flora species; and
- Identification of the potential presence of conservation significant terrestrial vertebrate fauna species.

3.1.1 Search Areas

Search areas for the above desktop surveys were based upon two broad areas covering the north and south CSG field area.

Northern CSG Fields: (Top left) 148.229610, -23.3956; (Bottom right) 150.353164, -26.189102.

Southern CSG Fields: (Top left) 148.142964, -26.239717; (Bottom right) 150.340752, -28.053393.

For each of the individual database searches these areas were further delineated by the following co-ordinates to comply with individual database search parameter requirements:

Wildlife Online

North: -23.3956; 148.229610; -23.3956; 150.353164; -26.189102; 150.353164; -26.189102; 148.229610.

South: -26.239717; 148.142964; -26.239717; 150.340752; -28.053393; 148.142964; -28.053393; 150.340752.

HERBRECS and Qld Museum

North: (Top left) 148.229610, -23.3956; (Bottom right) 150.353164, -26.189102.

South: (Top left) 148.142964, -26.239717; (Bottom right) 150.340752, -28.053393.

EPBC

North: -23.3956, 148.22961, -23.3956, 150.353164, -26.189102, 150.353164, -26.189102, 148.22961.

South: -26.239717, 148.142964, -26.239717, 150.340752, -28.053393, 150.340752, -28.053393, 148.142964.

3.1.2 Data Sources

Existing data sources and literature on the ecology of the CSG field study area was compiled through investigation of key references including:

- Queensland EPA Herbarium flora database (HERBRECS);
- Queensland EPA fauna and flora record database (Wildlife Online);
- Queensland Museum fauna record database;

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- Queensland EPA 1:100,000 Regional Ecosystems mapping;
- Queensland EPA Ecomap environmentally sensitive areas database;
- Commonwealth Department of Environment and Water Resources (DEW) 'Matters of National Environmental Significance (MNES)' database; and
- Current distribution texts for vascular flora and vertebrate fauna taxa.

These references were reviewed and an assessment was undertaken to identify the potential presence of significant[3] fauna and flora species, and significant vegetation communities as listed under state and Commonwealth legislation, including conservation significant flora and fauna taxa as per:

- The Queensland *Nature Conservation (Wildlife) Regulation 2006*, under the provisions of the *Nature Conservation Act 1992* (NC Act);
- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- Significant vegetation communities as described by the Queensland *Vegetation Management Act, 1999* (VM Act) and the EPBC Act.

3.1.2.1 Certified Regional Ecosystem Mapping

The Queensland Department of Natural Resources and Water (DNRW) uses REs to describe the relationships between vegetation communities and the environment at the bioregional scale. REs are mostly derived from linking vegetation mapping units recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology, rainfall and landform. Under the VM Act, REs are assigned a conservation status (Vegetation Management Status) based on an assessment of the pre-clearing and remnant extent of the RE.

The Queensland Herbarium has developed a program for mapping remnant[4] REs across Queensland, however it should be noted that there are inaccuracies inherent in RE mapping at a scale of 1:100,000. As a result, these maps provide an indication of what is potentially present and cannot be relied upon as an inherently correct source of vegetation mapping. On-site ground truthing is required to confirm the presence of RE types and extents, verify floristics and structure and confirm conservation status.

3.1.2.2 HERBRECS

HERBRECS is a database maintained by the Queensland Herbarium that provides a list of specimens kept within the Queensland Herbarium collections for a specified search area. Data provided is derived from the specimen label information and includes details on specimen, geographic location and habitat.

[3] Conservation significant species are those threatened species listed as either "Critically Endangered", "Endangered", "Vulnerable" or "Rare" under the NC Act and EPBC Act, and other note worthy species that carry significance other than legislative status occurring at the extent of their natural geographic range, or those that carry cultural heritage significance.

Conservation significant vegetation communities are communities listed as "Critically Endangered", "Endangered", "Of Concern" or "Vulnerable" under the VM Act or EPBC Act.

[4] Vegetation is identified as 'remnant' under the VM Act where the predominant canopy of the vegetation: covers more than 50% of the equivalent undisturbed canopy; averages more than 70% of the vegetations undisturbed height and is composed of species characteristic of the vegetation's undisturbed predominant canopy.

3.1.2.3 EPA Wildlife Online

The EPA Wildlife Online database contains recorded wildlife sightings and listings of plants, fungi, protists, mammals, birds, reptiles, amphibians, freshwater fish, marine cartilaginous fish and butterflies in Queensland. The database is based on collated species lists and wildlife records acquired by the EPA through a range of sources including specimen collections, research and monitoring programs and community wildlife recording programs.

3.1.2.4 EPBC Database

The DEWHA Matters of National Environmental Significance (MNES) database generates a list of protected matters (as per the EPBC Act) that may occur in or near the area. The database incorporates information from a range of sources including government, research and community organisations.

The MNES database has inherent limitations based on the accuracy of geographic data for some matters. In particular, confirmation of the presence of threatened or migratory species at a given site is not possible from the database, as data presented are for potential occurrences of species within a general area, rather than for known occurrences at a specific site. The relative reliability of this database must be born in mind as species highlighted by this search do not necessarily correlate to an actual observation. Species are highlighted by the database if their currently known distribution overlaps with the search area by one degree of latitude or longitude (approximately 100 km). This indication of potential presence does not take into account if suitable vegetation, geology, soil, climate or habitat types are actually present to support the occurrence of a significant species or community.

3.1.2.5 Queensland Museum

The Queensland Museum fauna record database provides a list of specimens kept within the Queensland Museum collections for a specified search area. Data provided includes details on collection locality, geographic location and collection date.

3.1.2.6 Existing Ecological Reports

Sixteen ecological reports as outlined below discuss the floral, faunal and habitat values of areas within the CSG field study area and include several Santos specific well site inspection reports. The main findings of each document are discussed within this report. It must be noted that Comet Ridge, as mentioned in the reports below, has now been split into the Arcadia Valley and Fairview CSG fields. The reports include:

- Boobook (2002), Rare and Threatened Plant Survey, Sardine Creek Well Lease Site;
- Boobook (2005), Humboldt 1 Preliminary Fauna and Flora Assessment;
- Boobook (2006a), Comet Ridge Field Pilot Program Environmental Constraints Preliminary and Final Reports;
- Boobook (2006b), Preliminary Assessment of Flora and Fauna Impacts for Proposed Wells: Comet Ridge Project Area, Fairview Gas Field;
- Boobook (2006c), Rare and Threatened Flora and Fauna lists;
- HLA-Envirosciences (2006), Flora and Fauna Study Report for the Proposed Comet Ridge to Wallumbilla Gas Pipeline;

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- J. W. Woinarski *et al*. (2006). Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002.
- Boobook (2008a), Well Site Inspection Report; Strathblane 1C;
- Boobook (2008b), Drill Site Inspection Report, FV 87, 88 and 89, Comet Ridge Pilot Program;
- Boobook (2008c), Drill Site Inspection Report, FV 161, Comet Ridge Pilot Program;
- Boobook (2008d), Drill Site Inspection Report; Arcadia Branch 2C & 3, Comet Ridge Pilot Program;
- Boobook (2008e), Proposed Dawson River Crossing (Comet Ridge): Preliminary Site Inspection Report;
- Boobook (2008f), Well Site Inspection Report (2008); Ironbark Gully 2;
- Boobook (2008g), Well Site Inspection Report; Emu Nest 1C;
- Connell Wagner (2008), Upgrade of Hutton and Moonah Creek, Fairview Platypus Survey Eastern Queensland Gas Fields; and
- URS (2008), Environmental Management Plan for Fairview Project Area Section 3, Description of Environmental Values and Potential Impacts;

3.2 Results of Literature Review

3.2.1 Bioregion

The project site is situated within the Brigalow Belt bioregion. The bioregions of Queensland are based on landscape patterns that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale and are used as the fundamental framework for the planning and conservation of biodiversity.

Nature conservation of the Brigalow Belt bioregion has received increasing attention due to the rapid and extensive loss of habitat that has occurred. Major impacts upon vegetation of the Brigalow Belt include tree clearing, high grazing pressure and the proliferation of exotic species such as the prickly pear (Young *et al*, 1999). As a consequence of habitat modification, many flora and fauna species have undergone severe range reductions and localised extinctions have occurred for several fauna species.

Vegetation clearing has occurred on most of the lowland landscapes including those formed on shales, however the more rugged topography associated with the sandstone and metamorphic ranges remains relatively undisturbed (Young *et al*, 1999).

3.2.2 Subregions

The Brigalow Belt bioregion contains 36 sub-regions or provinces that delineate significant differences in geology and geomorphology (Young *et al*, 1999). The northern CSG fields are situated across nine sub-regions including undulating downs country and ranges, whereas the southern CSG fields are situated across only three sub-regions of undulating downs country. The Roma CSG field also borders onto the Eastern Mulga plains sub-region of New South Wales. The following table (**Error! Reference source not found.**) describes the sub-regions associated with the CSG field and the dominant features of those sub-regions.

Table 3-1 Sub-regions of the CSG Field

Subregion Number	Subregion Name	Features of Subregion [1]	CSG Fields in Subregion
10	Basalt Downs	Formed almost entirely on Tertiary basalts. The more undulating areas carry a *Dichanthium sericeum* (bluegrass) grassland with *Eucalyptus coolibah* (mountain coolabah) on hillier areas, often with *E. melanophloia* (silver leaved ironbark) and *Corymbia erythrophloia* (red bloodwood).	**North:** Mahalo, Comet, Denison Trough
11	Isaac-Comet Downs	An extensive but diverse province that is largely undulating and dominated by Tertiary and other Cainozoic deposits. *Acacia harpophylla* (brigalow) and *Eucalyptus cambageana* (Dawson gum) communities on undulating clay or tenure contrast soils and *E. coolibah* on alluvium are the most predominant communities.	**North:** Comet, Denison Trough
16	Woorabinda	This subregion is situated on the Expedition and Dawson Ranges and the colluvium and alluvium derived from them. The sandstone ranges carry mixed eucalypt communities dominated by *Eucalyptus crebra* (narrow-leaved ironbark) and *Corymbia* spp.	**North:** Mahalo, Comet

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Subregion Number	Subregion Name	Features of Subregion [1]	CSG Fields in Subregion
20	Arcadia	Formed primarily on Triassic sediments of the Bowen Basin with minor areas of Permian sediments in the east. Eastern, southern and western areas are predominantly rugged on coarse sandstones with *Eucalyptus crebra* (narrow-leaved ironbark) and *Corymbia* spp. communities. The central and northern areas are more undulating and largely contained within a broad valley.	**North:** Comet, Denison Trough, Arcadia Valley, Fairview
21	Dawson River Downs	An undulating province in which outcrops of sediments of the Bowen Basin and Tertiary sediments occur in about equal proportions. The Tertiary soils form undulating to flat plains dominated by *Acacia harpophylla* (brigalow) and softwood communities.	**North:** Comet
24	Carnarvon Ranges	An extensive belt of predominantly coarse sandstones that form the north-eastern margin of the Great Artesian Basin. The most widespread vegetation type is a mixed eucalypt woodland or forest, usually with a shrubby understorey; dominated by *Eucalyptus crebra* (narrow-leaved ironbark), *Corymbia citriodora*,(spotted gum) and *Corymbia* spp.	**North:** Denison Trough, Arcadia Valley, Fairview, Roma Other
25	Taroom Downs	An undulating province formed on the argillaceous sediments of the Injune Downs Group of the Great Artesian Basin. The vegetation is dominated by *Acacia harpophylla* (brigalow), with areas of vine thicket and *Dichanthium sericeum* (bluegrass) downs.	**North:** Scotia, Roma Other
26	Southern Downs	Based on Jurassic and Cretaceous sediments, these are predominantly fine grained forming a low hilly landscape including the watershed formed by the Great Dividing Range. The province overlaps with the Mulga Lands bioregion in the far west.	**North:** Denison Trough, Fairview **South:** Roma
27	Barakula	Consists primarily of dissected low Jurassic sandstone and lateritised sandstone hills, plateau remnants and scarps, interspersed with and surrounded by undulating plains.	**North:** Scotia
28	Dulacca Downs	Undulating to low, hilly country on deeply weathered and dissected fine-grained Cretaceous sediments and associated colluvium and alluvium. Plains and lower slopes are predominantly *Acacia harpophylla* (brigalow), Casuarina cristata (belah) and/or *Eucalyptus populnea* (poplar box).	**South:** Roma
30	Tara Downs	Gently undulating landscape formed by deep weathering, erosion and deposition of the Cretaceous Griman Creek Formation to produce extensive clay plains interspersed with scattered lateritised residuals	**South:** Eastern Surat Basin
33	Moonie River-Commoron Creek Floodout	Level to gently undulating country on Quaternary alluvium derived from sandstone to the east, and overlying the Griman Creek Formation. These are also areas of partly consolidated Tertiary alluvial deposits. Major vegetation types include *Acacia harpophylla* (brigalow) and/or *Casuarina cristata* (belah) open forest.	**South:** Eastern Surat Basin

[1] Information derived from Young *et al.* (1999) In Sattler & Williams (1999).

3.2.3 Flora Databases

3.2.3.1 Regional Ecosystems

The following information provides an overview of the REs identified from the current RE mapping for the CSG field study area. A complete list of REs within each CSG field, the sum of each RE area and their conservation status is provided in Appendix A.1.

REs of conservation significance as described under the VM Act for each of the nine CSG fields within the study area are listed below. A total of 34 “Of Concern” REs and 34 “Endangered” REs are mapped within the Northern CSG field. Within the Southern CSG field 14 “Of Concern” REs and 11 “Endangered” REs are mapped.

Current State Government 1:100,000 Regional Ecosystem mapping v.5 (DNRM&W, 2005) of the study site is shown in Figures 4 to 11.

Northern CSG Fields

- **Mahalo**: 10 significant REs are mapped. This includes 4 ‘Of Concern’ REs and 6 ‘Endangered’ REs. Remnant vegetation covers approximately **67 %** of the Mahalo CSG field, including portions of the Shotover and Expedition State Forests. The majority of the remnant vegetation exists in the land zones of alluvial plains (land zone 3), sand plains (land zone 5), duricrusts (land zone 7), and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Comet**: 14 significant REs are mapped. This includes 6 ‘Of Concern’ REs and 8 ‘Endangered’ REs. Remnant vegetation covers approximately **39 %** of the Comet CSG field including a section of the Expedition Range; with cleared grazing land to the east and west of the Range. The majority of the remnant vegetation exists in the land zones of alluvial plains (land zone 3), sand plains (land zone 5), cones and plains on Cainozoic volcanics (land zone 8), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Denison Trough**: 23 significant REs are mapped. This includes 13 ‘Of Concern’ REs and 10 ‘Endangered’ REs. Remnant vegetation covers approximately **31 %** of the Denison Trough CSG field and includes portions of the Carnarvon Range, Arcadia Valley and the low undulating clay plains west of the Expedition and Shotover Ranges. Of the residual remnant vegetation the majority exists in the land zones of alluvial plains (land zone 3), gently undulating clay downs (land zone 4), sand plains (land zone 5), cones and plains on Cainozoic volcanics (land zone 8), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Arcadia Valley**: 6 significant REs are mapped. This includes 3 ‘Of Concern’ REs and 3 ‘Endangered’ REs. Remnant vegetation covers approximately **85 %** of the Arcadia Valley CSG field and exists predominantly on the Expedition Range. The majority of the remnant vegetation exists in the land zones of alluvial plains (land zone 3), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Fairview**: 7 significant REs are mapped. This includes 4 ‘Of Concern’ REs and 3 ‘Endangered’ REs. Remnant vegetation covers approximately **96 %** of the Arcadia Valley CSG field and includes both Santos operated leases and State Forest. The majority of the remnant vegetation exists in the land zones of alluvial plains (land zone 3), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).

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- **Scotia**: 8 significant REs are mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs. Remnant vegetation covers only approximately **4 %** of the Scotia CSG field. Of the remnant vegetation, the majority exists in the land zones of alluvial plains (land zone 3), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Roma Other**: 8 significant REs are mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs. Remnant vegetation covers only approximately **0.25 %** of the Roma Other CSG field. Of the remnant vegetation, the majority exists in the land zones of coarse-grained sediments on plateaus, scarps and hills (land zone 10), fine-grained sediments and lithic sandstones (land zone 9) and alluvial plains (land zone 3).

Southern CSG Fields

- **Roma**: 18 significant REs are mapped. This includes 11 'Of Concern' REs and 7 'Endangered' REs. Remnant vegetation covers only approximately **19 %** of the Roma CSG field, with the remaining 81 % of the area being developed land for agriculture and residential housing. Of the residual remnant vegetation the majority exists in the land zones of alluvial plains (land zone 3), sand plains (land zone 5), duricrusts (land zone 7), fine-grained sediments and lithic sandstones (land zone 9) and coarse-grained sediments on plateaus, scarps and hills (land zone 10).
- **Eastern Surat Basin**: 7 significant REs are mapped. This includes 3 'Of Concern' REs and 4 'Endangered' REs. Remnant vegetation covers only approximately **9 %** of the Eastern Surat Basin, with the remaining 81 % of the area being developed land for intensive grazing and cropping practices. Of the residual remnant vegetation the majority exists in the land zones of alluvial plains (land zone 3), gently undulating clay downs (land zone 4) and sand plains (land zone 5).

3.2.3.2 HERBRECS

Northern CSG Fields

The HERBRECS search of the study area generated a total of 22,783 records. The northern results included 15,440 records representing 2,657 flora species. This included 336 exotic species. A total of 88 species of conservation significance were recorded within the northern CSG fields (Appendix A.2).

Southern CSG Fields

The southern results included 7,343 records representing 1,577 flora species. This included 211 exotic species. A total of 29 species of conservation significance were recorded within the southern CSG fields (Appendix A.2).

3.2.3.3 EPA Wildlife Online

Northern CSG Fields

The Wildlife Online database search generated records for 2,698 flora species within the northern CSG field. These results included 90 flora species of conservation significance (Appendix A.2).

Southern CSG Fields

The Wildlife Online database search generated records for 1,394 flora species within the southern CSG field area. These results included 22 species of conservation significance (Appendix A.2).

3.2.3.4 EPBC Act

Northern CSG Fields

The MNES database search identified 26 conservation significant flora species as potentially being present within the northern CSG fields (Appendix A.2). The following four 'Endangered' ecological communities were also identified as potentially occurring on-site:

- Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt bioregions;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Semi-evergreen vine thickets of the Brigalow Belt; and
- The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.

Southern CSG Fields

The MNES database search identified 14 significant flora species as potentially being present within the southern CSG fields (Appendix A.2). The following four 'Endangered' ecological communities were also identified as potentially occurring on-site:

- Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions;
- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Semi-evergreen vine thickets of the Brigalow Belt and Nandewar[5] bioregions; and
- The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.

The following 'Critically Endangered' ecological community was also identified as potentially occurring on-site:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

[5] The Nandewar bioregion lies in northern NSW and across the Qld border. It is included in the Commonwealth listing but is not found as far north as the CSG fields.

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3.2.4 Fauna databases

3.2.4.1 Queensland Museum

Northern CSG Fields

A search of the database generated 2,252 records for the northern CSG fields representing 339 fauna species. This included three introduced species. Fourteen species of conservation significance were recorded within this search. This included two bird species, two frogs, four mammals and six reptiles (Appendix A.3).

Southern CSG Fields

The Queensland Museum search for the southern CSG fields generated 1,129 records representing 286 fauna species. This included five introduced species. Ten species of conservation significance were recorded within this search. This included two bird species, one frog, and seven reptiles (Appendix A.3).

3.2.4.2 EPA Wildlife Online

Northern CSG Fields

The Wildlife Online database search for the northern CSG fields generated records for 644 fauna species. These results included a total of 40 species of conservation significance including two amphibians, nineteen birds, seven mammals and twelve reptiles (Appendix A.3).

Southern CSG Fields

The Wildlife Online database search for the southern CSG fields generated records for 494 fauna species. These results included a total of 24 species of conservation significance including one amphibian, three mammals, twelve birds and eight reptiles (Appendix A.3).

3.2.4.3 EPBC Act

Northern CSG Fields

The MNES database search for the northern CSG fields identified 15 conservation significant fauna species as potentially being present on-site. This included six bird species, four mammals, and five reptiles (Appendix A.3).

Southern CSG Fields

The MNES database search for the southern CSG fields identified 15 conservation significant fauna species as potentially being present on-site. This included seven bird species, two mammals and six reptiles (Appendix A.3).

3.2.5 Summary of Significant Values from Database Searches

A complete list of conservation significant flora and fauna species listed under the EPBC Act and NC Act was compiled from the above database searches. From this list, duplicated entries were removed and are presented in Appendix A.2 and A.3. The potential presence of these species was then assessed based upon habitat and resource availability.

The review of the above databases indicated that the site potentially supports a number of conservation significant ecological values including:

- 130 significant flora species identified by searches; 21 of these species are potentially occurring based upon resources and habitat;
- 51 significant fauna species identified by searches; 28 of these species are potentially occurring based upon resources and habitat; and
- Four REs that are also listed as 'Endangered' communities and one RE listed as 'Critically Endangered' under the EPBC Act.

A number of Regional Ecosystems mapped within the CSG field study area by state government RE mapping (DNRM&W, 2005) are described as significant under the VM Act and include:

North

- Arcadia Valley: 6 significant REs mapped. This includes 3 'Of Concern' REs and 3 'Endangered' REs;
- Fairview: 7 significant REs mapped. This includes 4 'Of Concern' REs and 3 'Endangered' REs;
- Mahalo: 10 significant REs mapped. This includes 4 'Of Concern' REs and 6 'Endangered' REs;
- Comet: 14 significant REs mapped. This includes 6 'Of Concern' REs and 8 'Endangered' REs;
- Denison Trough: 23 significant REs mapped. This includes 13 'Of Concern' REs and 10 'Endangered' REs;
- Scotia: 8 significant REs mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs; and
- Roma Other: 8 significant REs mapped. This includes 4 'Of Concern' REs and 4 'Endangered' REs.

South

- Roma: 18 significant REs. This includes 11 'Of Concern' REs and 7 'Endangered' REs; and
- Eastern Surat Basin: 7 significant REs. This includes 3 'Of Concern' REs and 4 'Endangered' REs.

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3.2.6 Existing Ecological Reports

Sixteen previous ecological reports as outlined below discuss the floral, faunal and habitat values of areas within the CSG field study area and include several Santos specific well inspections (Figure 2a & Figure 2b). The main findings of each document are discussed below:

Boobook (2002), Rare and Threatened Plant Survey, Sardine Creek Well Lease Site.

Location: Denison Trough CSG field

- This report outlines the findings of a rare and threatened botanical survey, with dominant flora species and habitat features recorded in each stratum for the length of the proposed road (approximately 8 km) and CSG well site.
- Detailed database searches and literature reviews were conducted prior to the survey. A visual ground survey was undertaken by experienced ecologists on the 07 October 2002 within a 15 m wide buffing corridor, representing the proposed road alignment area.
- The results of the survey recorded no rare or threatened species in the 15 m wide buffer search corridor running parallel to the proposed pipeline route. A population of bluebell (*Wahlenbergia islensis*) (100 + plants) was recorded adjacent to Sardine Creek Gorge. This population is not expected to be disturbed as the colonisation is on sheer rock-faces within a sheltered sandstone gorge, which is a considerable distance from the proposed pipeline route.

Boobook (2005), Humboldt 1 Preliminary Fauna and Flora Assessment.

Location: South Mahalo CSG field

- This report outlines a flora and fauna assessment of a proposed gas well site (Humboldt 1) which is situated north-east of Rolleston, Queensland.
- The aim of the survey was to identify and locate rare, threatened and significant flora, fauna and sensitive habitats that may potentially be impacted by gas well construction and associated infrastructure such as road works and base camps.
- A ground survey was undertaken by experienced ecologists on the 04 May 2005, which included a visual site assessment of approximately 100m x 100m surrounding the proposed well site. Habitat descriptions were recorded including dominant flora species, weeds and other relevant habitat features.
- The result of the assessment classified the vegetation as a remnant RE 11.4.9 Brigalow/Dawson gum woodland and is listed as Endangered under the EPBC Act.
- No rare and threatened flora species or other plants of conservation significance were recorded within the areas of proposed works.
- The desktop fauna study identified the potential presence of seven rare and threatened fauna at the site.
- It is concluded the proposed well site would require the removal of less than 15 trees and shrubs, hence direct impacts upon likely rare and threatened fauna are likely to be minimal.

- Recommendations included seeking governmental advice prior to any clearing. It was suggested that clearing of intact habitat should be avoided and vehicle access roads should be aligned with existing tracks and adjoin clearings to reduce habitat fragmentation.

Boobook (2006a), Comet Ridge Field Pilot Program Environmental Constraints Preliminary and Final Reports.

Location: Arcadia Valley and Fairview CSG fields

- A preliminary Comet Ridge CSG field environmental constraints report made recommendations regarding movement of drilling site locations due to drilling infrastructure encroachments on rare and threatened flora and fauna.
- The final Comet Ridge CSG field environmental constraints report with the drilling locations re-evaluated, identified environmental constraints, land conservation status, RE mapping and land systems at different well drilling sites in the Comet Ridge land parcel. Synopses of the findings are included below:
  - The different drilling locations listed for survey included Hilltop, Sunnyholt, Arcadia, Castle Hill, Lonesome, Hillyvale, Gratz Gully, Waterview, Ironbark Gully, Precipice Creek, Yebna North, Yebna, Hallet and Strathblane.
  - The presence of the endangered RE 11.9.5 /11.9.4 (brigalow/semi-evergreen vine thicket) was identified adjacent the Hilltop 2 and Hilltop 5 drilling locations with a low probability that rare and threatened flora will be impacted.
  - The Arcadia area was identified as RE 11.10.13/11.10.1 (Ironbark/Spotted gum woodland) with a 'Not of Concern' status and a high probability of rare and threatened flora being encountered in the vicinity of the access tracks and/or well sites.
  - Ironbark Gully was identified as RE 11.3.2 (alluvial poplar box woodland) with an 'Of Concern' status with no rare and threatened flora likely to be encountered. However rare and threatened fauna (such as several reptiles and squatter pigeon) were considered likely to be on-site or adjacent to the site.
  - The other drilling locations surveyed identified constraints such as vehicle access difficulties and water crossings.

Boobook (2006b), Preliminary Assessment of Flora and Fauna Impacts for Proposed Wells: Comet Ridge Project Area, Fairview CSG Field.

Location: Arcadia Valley and Fairview CSG field

- This report represented the results of a survey to identify any significant impacts upon rare and threatened flora and fauna at four proposed gas well sites in the Fairview CSG field (part of the Comet Ridge Project Area) situated north-east of Injune. This included the well sites of Kentucky 1, Pony Hills 1, Fairview 141 and Fairview 108.
- The survey was undertaken by an experienced ecologist during a four day period in June 2006.
- A search for significant flora and fauna species was undertaken within a 500 m radius at each site. Habitat descriptions, flora and weed species were recorded, and an RE assigned to the vegetation communities.
- Field results included a description of the two REs observed during the study, RE 11.3.17 (Endangered Biodiversity Status) and RE 11.10.1 (Not of Concern Biodiversity Status).

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- No species of conservation significance under either the NC Act or the EPBC Act were identified on site. Eleven flora species were identified and collected within the Fairview CSG field and thus were also anticipated within the vicinity of the well sites, with sixteen listed fauna taxa anticipated.
- Three declared weed species as listed under the LP Act were observed during the survey.
- Recommendations included minimising clearing by situating the well sites in more open areas and retaining habitat trees. The high conservation values of Lonesome National Park were also recognised and maintaining the close relationship with the EPA was highlighted.

Boobook (2006c), Rare and Threatened Flora and Fauna lists.

Location: Arcadia Valley and Fairview CSG fields

- This report has been developed in Microsoft excel data file format and included rare and threatened flora and fauna lists of conservation significants within the study area. The data was sourced from desktop literature searches and site visit assessments.
- Rare and threatened flora identified in the study area included the *Eriocaulon carsonii* (salt pipewort), *Grevillea cyranostigma* (Carnarvon grevillea), *Acacia calantha* (a wattle), and *Melaleuca irbyana* (swamp paperbark). The associated data recorded in the report included locality, GPS points, mapped RE, habitat, and notes.
- Rare and threatened fauna identified in the study area included the glossy black-cockatoo (*Calyptorhynchus lathami*), grey goshawk (*Accipiter novaehollandiae*), squatter pigeon (*Geophaps scripta scripta*), golden-tailed gecko (*Strophurus taenicauda*), Herbert's rock wallaby (*Petrogale herberti*), platypus (*Ornithorhynchus anatinus*) and yellow-bellied glider (*Petaurus australis*). The associated data recorded in the report included locality, GPS points, mapped RE, habitat, date and notes.

HLA-Envirosciences (2006), Flora and Fauna Study Report for the Proposed Comet Ridge to Wallumbilla CSG Pipeline.

Location: Fairview and Roma CSG fields

A desktop study consisted of reviewing the Queensland Herbarium data (HERBRECS and CORVEG) and DEH flora data within approximately eight kilometres of the proposed Comet ridge to Wallumbilla alignment areas. The Queensland Herbarium Regional Ecosystem (RE) mapping, aerial photography, and the EPA Brigalow Belt Biodiversity Planning Assessment Data (2003) were also reviewed before commencement of the field surveys. The field surveys were conducted during the 28 November – 1 December 2005, which included surveying 25 sites along the proposed pipeline route corridor. The survey methodology utilised Quaternary, Secondary and Tertiary level surveying as recommended by the Queensland Herbarium. A synopsis of the study results included the following:

- Two vegetation communities listed as Endangered under the EPBC Act and the VM Act, which included RE 11.9.4 Semi-evergreen Vine Thicket, and RE 11.9.5 Brigalow Woodland;
- Two *Eucalyptus populnea* (poplar box) woodlands (RE 11.3.2 and RE 11.9.7) are listed as "Of Concern" under the VM Act;
- RE 11.3.2 was found at two locations and recorded as being in good condition. The area contained significant numbers of large hollow-bearing trees and is recognised by EPA (2003) as part of a wildlife refugium;

- RE 11.9.7 was identified at three locations and recorded as being in degraded condition. The EPA (2003) identified the areas as a Wildlife Refuge and having Special Biodiversity Values. However, the sites were recorded as open and adjacent to previously cleared areas;
- Six REs were listed as "Not of Concern" under the VM Act and included *Eucalyptus* and *Callitris* woodlands (RE 11.3.25, 11.10.7a, 11.10.9, 11.10.11 and 11.10.12) and a *Dichanthium* spp. (Bluegrass) and *Astrebla* spp. (Mitchell grass) dominated community (RE11.9.3);
- The findings of the field surveys confirmed that the Queensland Herbarium RE mapping was broadly accurate. For example, 13 of the 25 sites surveyed were found to have REs that were different to those mapped by the Queensland Herbarium;
- Review of the DEH and Queensland Herbarium HERBRECS flora databases for areas within 8 kilometres of the proposed alignment identified 17 species listed as Rare or Threatened under either the EPBC Act or the NC Act that are known to have ranges that overlap the study area;
- *Opuntia* spp.(Prickly pear), declared under the LP Act, was recorded during the surveys; and
- No WONS were recorded during the study.

J. W. Woinarski et al. (2006). Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002.

Location: Denison Trough CSG field

- This study compared a fauna inventory baseline study undertaken in 1973–1976 and a re-survey in 2001–2002. This paper compared bird, mammal and amphibian fauna data in the Emerald district, central Queensland.
- The study area was located within a 100 km radius around Emerald. The locations were chosen to broadly sample within the main vegetation types in the region, and hence create a terrestrial vertebrate biodiversity inventory for the Emerald region.
- The surveying employed ecological surveying techniques which targeted small mammals (trapping), amphibians (spotlighting) and birds (diurnal observation surveys). These surveys consisted of 29 bird sites, 32 small mammal trapping sites and 52 spotlighting sites.
- The results of the 2001–2002 surveys included a total of 223 vertebrate fauna species, with the 1973–1976 surveys recording 224 vertebrate species. A total of 285 vertebrate fauna species was recorded during the two survey sessions for the study area.
- Two reptile species, ornamental snake (*Denisonia maculata*) and yakka skink (*Egernia rugosa*), were recorded in the 1973–1976 surveys and were considered Vulnerable at State level. However, these reptile species were not found in the 2001–2002 survey.
- Limitations when comparing two different survey periods on fauna abundances included both seasonal variations (i.e. water bird numbers are impacted in drier periods), and habitat modifications (i.e. clearing, pastoralism).

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Boobook (2008a), Well Site Inspection Report; Strathblane 1C.

Location: Fairview CSG field

- This well site report identified site access, habitat values, fauna, and flora including weed species. Vegetation communities were also investigated and assigned with an RE code.
- A one-day survey was undertaken by experienced ecologists on the 14 February, 2008 at 'Strathblane' Lot 9 on Plan AB244, Tenement PL 100.
- The site assessment identified the vegetation community as RE 11.10.11 (poplar box, silver-leaved ironbark ± white cypress pine woodland).
- Six exotic weeds were identified in the site area which included *Verbena aristigera* (Mayne's pest), *Gomphrena celosioides* (soft khaki weed), *Bidens pilosa* (cobbler's pegs), *Opuntia tomentosa* (velvety tree pear), *Pennisetum ciliare* (buffel grass), and *Conyza bonariensis* (fleabane).
- Recommendations to limit the clearing of mature poplar box trees, unless the trees were deemed a safety hazard, were noted.

Boobook (2008b) Drill Site Inspection Report, FV 87, 88 and 89, Comet Ridge Pilot Program.

Location: Arcadia Valley and Fairview CSG field

- This reports documented drill site inspections at site FV 87, FV 88 and FV 89, on 20 March 2008 at 'Lonesome' Lot 807 on PH 1979 " Tenement PL 90.
- The site report included identifying site access, geological features, habitat values, fauna and flora species including weed species. Vegetation communities were also investigated and assigned with an RE code.
- The site assessment identified sites FV 88 and FV 99 as RE 11.3.39 (silver-leaved ironbark) which was a different vegetation community to the current 2008 Queensland RE mapping. These sites were recorded as being located in a large vegetated remnant of high conversation value with old growth trees. Heavy weed infestations were recorded in the riparian areas.
- Eighteen introduced flora species were identified in the drill site area.
- Cultural sites were recorded in close proximity to site FV 87 and along the Dawson River.
- Recommendations included further investigation of suitable creek crossing for vehicle access and the requirement for cultural heritage assessments if drilling commences.

Boobook (2008c), Drill Site Inspection Report, FV 161, Comet Ridge Pilot Program.

Location: Arcadia Valley and Fairview CSG field

- This report looked at a drill site inspection at site FV 161, on the 25 May 2008, on the property "Fairview" Lot 6 on CP90863, Tenement PL 92.
- The site report included identifying site access, geological features, habitat values, fauna and flora species including weed species. Vegetation communities were also investigated and assigned with an RE code.

- The site assessment identified the vegetation community as an intact and remnant RE 11.10.1 (narrow-leaved ironbark open forest). An endangered semi-evergreen vine thicket was present in close proximity to the drill site, however drilling activities were deemed to not impact the endangered vegetation community.
- Three exotic weeds were identified in the drill site area which included *Opuntia tomentosa* (velvety tree pear), *Malvastrum americanum* (spiked malvastrum) and *Bidens pilosa* (cobbler's pegs). It was noted that weed infestations were not at high levels at the time of the survey.
- One Class 2 pest, which is listed under the LP Act, was identified.
- Recommendations included limiting the clearing of mature trees and extensive access road networks. Ground debris should not be burnt but moved to the boundaries of the site as a potential fauna habitat.

Boobook (2008d), Drill Site Inspection Report; Arcadia Branch 2C & 3, Comet Ridge Pilot Program.

Location: Arcadia Valley and Fairview CSG fields

- This drill site report identified site access, habitat values, fauna and flora species including weed species. Vegetation communities were also investigated and assigned with an RE code.
- A one-day survey was undertaken by experienced ecologists on the 30 April, 2008 at 'Sunnyholt' Lot 5 on TR18 'Strathblane', tenement ATP 526P.
- The site assessment identified the vegetation community as a combination of RE 11.10.13 (mixed ironbark/bloodwood shrubby woodland) and RE 11.10.1 (narrow-leaved ironbark woodland).
- No exotic weeds were identified in the site area.
- Recommendations included shifting the proposed drilling points (Arcadia Branch 2C and Arcadia Branch 3) to flatter areas and any clearing should be kept to the minimum. Specifically, it was suggested to avoid any clearing of *Allocasuarina inophloia* (thready-barked she-oak) due to the importance of this food source to the 'Vulnerable' listed glossy black-cockatoo. The property owner had also requested that she-oak clearance be avoided given their timber values.
- The report suggested any new access tracks/roads to be constructed and/or if any substantial deviations from the existing tracks were required, further environmental assessments would be necessary.

Boobook (2008e), Proposed Dawson River Crossing (Comet Ridge): Preliminary Site Inspection Report.

Location: Fairview and Arcadia Valley CSG field

- This report looked at a preliminary inspection of a proposed access track near the junction of the Dawson River and Baffle Creek in the Comet Ridge gas field.
- A one-day survey was undertaken by experienced ecologists on the 13 March 2008.
- Habitat descriptions including geological features, habitat values, and flora species including weed species were listed. Vegetation communities were also investigated and assigned with an RE code.
- The field survey identified the study area as four vegetation communities. The communities included RE 11.3.25 (Queensland blue gum woodland) occurring as a narrow fringe along the Dawson River & Baffle

Creek and adjoined by RE 11.3.39 (silver-leaved ironbark woodland). RE 11.10.1 (narrow-leaved ironbark woodland) was located on the lower sandstone slopes and RE 11.10.13 (mixed ironbark/bloodwood shrubby woodland) was located on the steeper and rockier slopes.

- Seventeen exotic weed species were identified within the study area and surrounds, which included: *Verbena aristigera* (Mayne's pest), *Zinnia peruviana* (zinnia), *Verbesina encelioides* (crownbeard), *Malvastrum americanum* (spiked malvastrum), *Salvia reflexa* (mintweed), *Gomphrena celosioides* (soft khaki weed), *Bidens pilosa* (cobbler's pegs), *Opuntia tomentosa* (velvety tree pear), *Opuntia stricta* (common pest pear), *Pennisetum ciliare* (buffel grass), *Megathyrsus maximus* (green panic), *Conyza bonariensis* (fleabane), *Heliotropium amplexicaule* (blue heliotrope), *Alternanthera pungens* (khaki burr), *Echinochloa colona* (awnless barnyard grass), *Xanthium spinosum* x. *occidentale* (Bathurst burr), and *Sida rhombifolia* (Paddy's lucerne).
- Two Class 2 pests, which are listed under the LP Act, were identified.
- Recommendations included identifying alternate Dawson River crossing routes with the undertaking of detailed flora and fauna investigation(s) when the proposed infrastructure roads are defined. No works (including clearing) can commence until all environmental and cultural heritage investigations have been completed.
- The high conservation values of Expedition National Park were also recognised and maintaining a close relationship with the EPA was highlighted.

Boobook (2008f), Well Site Inspection Report (2008); Ironbark Gully 2.

Location: Fairview CSG field

- This well site report identified site access, habitat values, fauna and flora values including weed species. Vegetation communities were also investigated and assigned with an RE code.
- A one-day survey was undertaken by experienced ecologists on the 19 March 2008 at 'Lonesome' Lot 807 on Plan 1979, Tenement PL 90.
- The site was regionally mapped as RE 11.3.2. (poplar box woodland) which has an 'Of Concern' status.
- The site assessment identified the vegetation community as RE 11.3.39 (silver-leafed ironbark) which is significantly different to the current RE mapping and is listed as 'Not of Concern'.
- Eleven exotic weeds were identified in the site area which included *Verbena littoralis* (wild verbena), *Pennisetum ciliare* (buffel grass), *Malvastrum americanum* (spiked malvastrum), *Zinnia peruviana* (zinnia), *Opuntia tomentosa* (velvety tree pear), *Conyza bonariensis* (fleabane), *Tagetes minuta* (stinking roger), *Alternanthera pungens* (khaki burr), *Verbesina encelioides* (crownbeard), *Verbena aristigera* (Mayne's pest), and *Gomphrena celosioides* (soft khaki weed).
- Recommendations included keeping clearing to a minimum as the vegetation on-site was considered remnant and the site was encompassed by an area of high conservation value (proposed national park). It was noted that liaisons with Queensland Parks and Wildlife Service (QPWS) through the Roma office are highly recommended.
- The site is currently located on the eastern side of Ironbark Gully which would require construction of an access crossing. Several alternative sites were identified on the western side of the gully, close to the

vehicle track (no gully crossings) and further research was recommended to accurately define suitable alternative locations.

Boobook (2008g), Well Site Inspection Report; Emu Nest 1C.

Location: Fairview CSG field

- This well site inspection report identified site access, habitat values, and flora species including weed species. Vegetation communities were also investigated and assigned with an RE code.
- A one-day survey was undertaken by experienced ecologists on the 19 March 2008 at 'Lonesome' Lot 807 on Plan 1979, Tenement PL 234.
- The site was regionally mapped and listed as non-remnant.
- The site assessment identified the vegetation community as RE 11.9.5 (brigalow +/- belah shrubby open forest) regrowth, which is listed an endangered ecological community under the EPBC Act, when established.
- Six exotic weeds were identified in the site area which included *Pennisetum ciliare* (buffel grass), *Malvastrum americanum* (spiked malvastrum), *Zinnia peruviana* (zinnia), *Opuntia tomentosa* (velvety tree pear), *Conyza bonariensis* (fleabane) and *Xanthium occidentale* (Noogoora burr).
- Recommendations included any clearing of advanced brigalow regrowth may require a referral under the EPBC Act. Several alternative well sites (within a few hundred metres of the proposed drill site) were suggested that would negate the need to clear brigalow regrowth.

Connell Wagner (2008), Upgrade of Hutton and Moonah Creek, Fairview Platypus Survey Eastern Queensland CSG Fields.

Location: Fairview CSG field

- This report looked at the presence and abundance of platypus at two crossings in Hutton Creek (Fairview CSG field). Furthermore, the report detailed the habitat values of the existing project area, potential impacts of the proposed creek crossing upgrades and impact reduction recommendations.
- Two qualified ecologists spent a total of two days (24 hours survey time) at the two creek crossings (Hutton and Moonah) using dawn till dusk observational methodology from the creek banks and a small water craft. Habitat searches included searching and accessing burrows, woody debris, undercut banks, and high vertical alluvial banks. No trapping was employed.
- The results of the survey identified four adult individual platypus and habitat suitability within the 2.5 km surveyed section of Hutton Creek.
- Potential impacts to platypus were identified such as development works (including culverts) which may hinder platypus movements, habitat disturbance, and reduction in water quality. Mitigation strategies suggested minimising long-term impacts by adhering to current engineering standards and minimising disturbances to the natural creek environment.

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URS (2008), Environmental Management Plan for Fairview Project Area Section 3, Description of Environmental Values and Potential Impacts.

Location: Fairview CSG field

This environmental management plan was a desktop study that identified significant Level 1 petroleum activities and potential impacts on environmental values such as air quality, water quality, noise levels, waste, and land disturbances. The report outlined proposed environmental protection objectives and control strategies.

The nature conservation section within the land disturbance chapter was reviewed. This chapter outlined potential impacts relating to native vegetation removal, faunal movement, activity disruptions, and the introduction or the spread of exotic flora or fauna. The report also identified historical and present land use, environmentally sensitive areas, essential habitats, threatened species, exotic flora and fauna, historic flora and fauna assessments, cultural heritage assessments and management control mechanisms. The following bullet points are a synopsis of the Management Plan desk-top findings:

- Environmentally sensitive areas identified within the Fairview area were located in the northern section of Expedition National Park and include a). Robinson Gorge, b). Lonesome and c). Beilba. These areas contain scientific and aesthetic values such as rare and threatened fauna, flora and habitats.
- State forests located within the project area are Beilba State Forest, Belington Hut State Forest, Pony Hills State Forest, Stephenton State Forest, Doonkuna State Forest, and Expedition Resource Reserve.
- Six essential habitat areas were identified under the NC Act.
- The project area is located in the same catchment as Narren Lake Nature Reserve, Shoalwater and Corio Bay areas which are listed as Ramsar wetlands of international significants.
- Threatened ecological communities that were identified as likely to occur within the project area are semi-evergreen vine thicket, brigalow, and bluegrass dominant grasslands, as listed in the EPBC Act Protected Matters Report.
- The potential for twenty two threatened species (8 plants, 5 birds, 3 mammals, 1 ray-finned fish, 5 reptiles) and thirteen migratory species (6 birds, 7 wetland/marine birds), as listed in the MNES database, may occur within the project area.
- The nationally important wetlands of Palm Tree and Robinson Creek (Dawson River) are contained within the project area, as is Boggomoss Springs (Dawson River) (*The Australian wetlands database*).
- A detailed 2006 flora and fauna investigation by Boobook Consulting recorded three significant vegetation communities listed under the Queensland NC Act, and one endangered ecological community under the EPBC act.
- 180 weeds species were identified as potentially occurring in the study area. The primary concern is *Parthenium hysterophorus* (parthenium) as it is a Weed of National Significance and a Class 2 'declared pest' under the LP Act.
- Management mechanisms and suggestions included minimising disturbance to remnant or riparian vegetation communities, areas of faunal movements and rare and threatened species. Minimising weed introductions and the spreading of Class 2 weeds were also highlighted.

3.2.7 Summary of Significant Biodiversity Values from Previous Ecological Reports

A summary of the past reports included well and drill site assessments, flora and fauna studies, Queensland Herbarium RE mapping and desktop research. These reports provide valuable insight into the flora and fauna, and land-uses of the environs of the CSG field study area. The reviewed literature primarily covered Fairview and Arcadia Valley fields, but also incorporated studies undertaken in the northern CSG fields such as Denison Trough. The flora reports included assessment of REs, vegetation communities, endangered flora species and introduced weeds, essential habitats and nationally important wetlands.

Within the Fairview and Arcadia Valley CSG fields a considerable number of environmental investigations have been undertaken, primarily surrounding existing well sites and drill sites, as well as proposed well sites. Results from these studies show that there are several discrepancies between the current RE mapping of the area and the actual vegetation communities. Nonetheless, the presence of a number of 'Endangered' and 'Of Concern' REs were identified and include RE 11.3.2 (alluvial poplar box woodland) (Boobook 2006a), RE 11.3.17 (poplar box woodland) (Boobook 2006b), RE 11.9.5 (brigalow open forest) (Boobook 2008g), and RE 11.9.4 (semi-evergreen vine thicket) (Boobook 2008c; HLA-Envirosciences 2006).

These studies identified the potential presence of a significant number of introduced flora species (at least 180) within the Fairview CSG field, and include *Parthenium hysterophorus* which is both a 'Weed of National Significance' and a 'Class 2' declared pest under the LP Act. Five 'Class 2' fauna pests, which are listed under the LP Act, were identified at Comet Ridge (Boobook 2008b; 2008c; 2008e).

A total of six Essential Habitat areas were identified (as defined under the NC Act) in the Fairview CSG field and the importance of several Environmentally Sensitive Areas noted within Robinson Gorge, Lonesome Holdings, and Beilba. The Environmental Management Plan for Fairview Project Area (2008) identified the potential for 22 threatened species (8 plants, 5 birds, 3 mammals, 1 ray-finned fish, 5 reptiles) and thirteen migratory species (6 birds, 7 wetland/marine birds), as listed in the MNES database, as potentially occurring within the Fairview CSG field. Additionally, in Hutton Creek the presence of four adult platypuses was confirmed and suitable habitat identified within a 2.5 km section of the creek (Connell Wagner 2008). A total of five Class 2 fauna pests, which are listed under the LP Act, were identified at Comet Ridge (Boobook 2008b; 2008c; 2008e).

Desktop review for the Roma CSG field identified 17 flora species listed as 'Rare' or 'Threatened' under either the EPBC Act or the NC Act that are known to have ranges that overlap the region from Fairview to Wallumbilla (Fairview and Roma CSG fields) (HLA-Envirosciences, 2006). The Regional Ecosystems recorded as 'Of concern' (VM Act) included RE 11.10.1 (Boobook 2006b), RE 11.3.2 and RE 11.9.7 (poplar box woodlands) (HLA, Envirosciences 2006).

Studies from the northern Denison Trough CSG field revealed a total of 223 fauna species recorded and expected within the Emerald region. Previous surveys within the region identified an additional two vulnerable reptile species, namely the ornamental snake (*Denisonia maculata*) and yakka skink (*Egernia rugosa*) (Woinarski *et al*. 2006). From these studies it is evident that both seasonal variations and habitat modifications have impacted the distribution of fauna species within the region. Flora surveys for the Denison Trough CSG field are limited, although a significant population (100 + individuals) of the *Wahlenbergia islensis* (native bluebell) (as listed under the NC Act) was recorded within the area (Boobook, 2002).

Results from studies undertaken in the Mahalo CSG field area revealed an absence of rare or threatened flora species or other plants of conservation significance. Nonetheless, the desktop fauna study recorded a potential for seven rare and threatened fauna likely to be present at the study site (Boobook, 2005). Field investigation of

vegetation communities within a section of the Mahalo CSG field identified the Endangered RE 11.4.9 brigalow/Dawson gum woodland (as listed under the EPBC Act) as being present (Boobook, 2005).

It is evident from these studies that the biodiversity values of the CSG field appear to be greater within the more vegetated northern CSG fields of the Arcadia Valley, Fairview, Mahalo, Comet and Denison Trough. A number of environmentally sensitive areas and conservation significant vegetation communities exist within these areas and therefore need to be considered as development progresses in these CSG fields. The potential presence of a number of rare and threatened flora and fauna species across the CSG fields highlights the need to ensure that potential impacts to these species are mitigated prior to CSG field development.

3.2.8 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) include national parks, state forests, world heritage areas, Ramsar wetlands, nationally important wetlands and Essential Habitat. This section details those present within the CSG field study area. The following table identifies national parks and state forests within the northern and southern CSG fields (Table 3-2). All ESAs are shown in Figures 3a & 3b.

Table 3-2 CSG Field State Forests and National Parks

CSG Field	Name of ESA	Area within CSG (ha)	Values/Comments
Northern CSG Fields			
Mahalo (62, 645 ha)	Shotover SF	4177.56	Adjoins Blackdown Tablelands NP
	Expedition SF	7058.98	Extends along the Expedition Range north of the Dawson Highway
Denison Trough (592,311 ha)	Carnarvon NP	8067.78	Large area featuring sandstone gorges and high biodiversity
	Nuga Nuga NP	623.943	Noted for remnants of endangered *Macropteranthes leichhardtii* (bonewood) scrub and the vulnerable *Cadellia pentastylis* (Ooline tree).
	Bandana SF	6856.71	Borders Serocold SF
	Boxvale SF	3907.37	Shares a border with Carnarvon NP
	Serocold SF	906.84	Shares borders with Bandana SF and Carnarvon NP
	Doonkuna SF	8141.412	Shares a border with Forrest SF
	Expedition (Limited Depth) NP Lonesome Section Beilba Section	320.893	The Lonesome Section was gazetted in 1972 to protect scientific and aesthetic values. The Beilba section preserves an important corridor along Dawson River to the north and Baffle Creek to the south. It protects an intact example of escarpment country.
	Forrest SF	19505.61	Adjoins Doonkuna SF
Comet (171,650 ha)	Expedition SF	21759.35	Extends along the Expedition Range north of the Dawson Highway
	Mount Nicholson SF	8644.51	Extends along the Expedition Range south of the Dawson Highway
	Expedition (Limited Depth) NP	229.515	Small section extreme northern tip of Expedition NP.

CSG Field	Name of ESA	Area within CSG (ha)	Values/Comments
	Palmgrove NP (Scientific)	0.83789	Borders Theodore and Presho SF. Set aside for the protection of species or habitats that are of exceptional scientific value.
Arcadia Valley (318,800 ha)	Expedition (Limited Depth) NP	73173.94	Large expanse of Expedition NP included within the Arcadia Valley CSG Field.
	Belington Hut SF	32438.07	Key refugial area for *Eucalyptus curtisii* (Plunkett's mallee) and *Eucalyptus rubiginosa* (Isla Gorge mahogany).
	Beilba SF	1281.13	Shares a border with Expedition NP
	Expedition Resources Reserve	2239.87	Located at the southern tip of Expedition NP.
	Stephenton SF	298.088	Small reserve to the south-east of Expedition Resources Reserve
	Presho SF	2043.71	Area of special flora and fauna values especially flora species of sandstone country that are locally restricted or scattered. Joins Expedition and Palmgrove National Parks. 69% of the area selected contains poorly conserved REs. 45% of the area selected contains RE patches that are of high quality based on relative size across the Brigalow Belt. The area has also been subject to limited disturbance/ human impact.
Fairview (116,000 ha)	Beilba SF	1829.97	Shares a border with Expedition NP
	Doonkuna SF	872.484	Shares a border with Forrest SF
	Expedition (Limited Depth) NP Lonesome Section Beilba Section	6423.87	The Lonesome Section was gazetted in 1972 to protect scientific and aesthetic values. The Beilba section preserves an important corridor along Dawson River to the north and Baffle Creek to the south. It protects an intact example of escarpment country.
	Expedition Resources Reserve	420.786	Located at the southern tip of Expedition NP.
	Hallett SF (Pony Hills)	15745.68	No details available.
	Stephenton SF	617.679	Small reserve south-east of Expedition Resources Reserve
Roma Other (131,747 ha)	Theodore State Forest		Borders Presho SF, Isla Gorge NP and Palmgrove NP.
	Gwambagwine State Forest		No details available
	Lake Murphy Conservation Park		A perched lake that provides a seasonal refuge for waterbirds
	Carraba Conservation Park		A small roadside vegetation community
Southern CSG Fields			
Roma (839,200 ha)	Brucedale SF	2482.36	No details available
	Gubberamunda SF 1	1056.49	No details available
	Inglebogie SF	340.456	No details available
	Tinowon SF	0.6175	No details available
	Trinidad SF 1	1358.67	No details available

Section 3 Stage 1 Background Information Review

CSG Field	Name of ESA	Area within CSG (ha)	Values/Comments
	Trinidad SF 2	428.981	No details available
	Wallabella SF 1	26.4697	No details available
	Wallabella SF 2	659.473	No details available
	Yalebone SF 1	243.212	No details available
Eastern Surat Basin (36,241 ha)	Nil areas		

The following section describes environmentally sensitive values in terms of World Heritage areas, Ramsar wetlands, Nationally Important wetlands and essential habitats for the RFDA.

3.2.8.1 World Heritage Areas

No world heritage areas or national heritage places are listed within the RFDAs (EPA, 2007a).

3.2.8.2 Ramsar Wetlands of International Significance

The CSG fields are located within the Fitzroy (north) and Condamine-Balonne (south) Catchments. Ramsar wetlands of international significance located within these catchments include Narran Lake Nature Reserve, Shoalwater Bay and Corio Bay. These wetlands are not located in close proximity to the CSG fields (EPA, 2007b).

3.2.8.3 Nationally Important Wetlands

The Directory of Important Wetlands in Australia (DIWA) lists 3 nationally important wetlands in the CSG field study area (EPA, 2007a) (Figure 3a and Figure 3b). The nationally important wetlands include:

- Palm Tree and Robinson Creeks wetland (Dawson River) is situated 28 kilometres north of Taroom and is approximately 50,223 hectares in area. The wetland is situated within the Fitzroy catchment and is characterised by its U-shape, shallow lakes and seasonal streams associated with the junction of Palm Tree and Robinson Creeks (DEWHA, 2008a).
- Boggomoss Springs Wetland (Dawson River) is located 20 km northeast of Taroom and covers approximately 400 hectares. Boggomoss Springs is situated within the Fitzroy catchment and is nationally important due to the active artesian springs which is considered a rare wetland habitat type and supports *Arthraxon hispidus,* a rare plant species (DEWHA, 2008b).
- Lake Nuga Nuga wetland, which is approximately 2070 hectares in area, is located 93 km north-northeast of Injune and extends eight kilometres in a northwest to southeast direction. The wetland is situated within the Comet River catchment with the following habitats recognised within the Lake Nuga Nuga Wetland: (i) open water supporting extensive aquatic beds (*Nymphaea* spp.); (ii) saline shrubland; and (iii) lake margin (*Acacia harpophylla, Casuarina cunninghamiana*) (DEWHA, 2008c).

3.2.8.4 Essential Habitat

An area of essential habitat is a vegetation community in which a species that is endangered, vulnerable, rare or near threatened, as defined by the NC Act, has been known to occur. The following table lists the essential habitat areas and their corresponding REs within the northern CSG field study area (Table 3-3).

Table 3-3 Northern CSG fields essential habitats and regional ecosystem

CSG field	Number of Essential Habitats	REs associated with Essential Habitat	ATPs and PLs associated with Essential Habitat
Arcadia Valley CSG	6	RE 11.3.2, RE 11.3.25, RE 11.9.4b, RE 11.9.5, RE 11.10.1, RE 11.10.13a, RE 11.10.3	PL 232, PL 233, PL 234, PL 235
Fairview CSG	8	RE 11.5.5, RE 11.9.4a, RE 11.9.4b, RE 11.10.1, RE 11.10.9, RE 11.10.13a	PL 90, PL 99
Mahalo CSG	3	RE 11.4.7, RE 11.10.13, RE 11.10.13a	ATP 804P
Comet CSG	3	RE 11.10.1, RE 11.10.13a	ATP 526P
Denison Trough CSG	9	RE 11.3.25, RE 11.3.3, RE 11.3.1, RE 11.3.27, RE 11.3.39, RE 11.10.1, RE 11.10.3, RE 11.10.7a	PL 42, PL 218, ATP 337P,
Scotia CSG	2	RE 11.9.4b, RE 11.9.5, RE 11.10.9, RE 11.3.2	PL 176
Roma Other CSG	12	RE 11.10.1 RE11.10.13a RE11.9.4b RE11.5.9d RE11.5.9 RE11.9.5 RE11.3.27a	EPP 803

The following table lists the essential habitat areas and their corresponding REs within the southern CSG field study area (Table 3-4).

Table 3-4 Southern CSG fields essential habitats and regional ecosystem

CSG field	Number of Essential Habitats	REs associated with Essential Habitat	ATPs and PLs associated with Essential Habitat
Roma CSG	23	RE 11.3.2, RE 11.3.19, RE 11.3.25, RE 11.4.3, RE 11.5.1, RE 11.5.4, RE 11.5.5, RE 11.7.6, RE 11.9.10, RE 11.3.28, RE 11.10.9,	EPP 631, EPP 708, PL 6, PL 8, ATP 336P Roma
Eastern Surat Basin CSG	1	RE 11.5.4	PL 1(1)

Section 4 Stage 2 CSG Field Surveys

4.1 Survey Methodology

4.1.1 Survey Design

Following initial literature review (Section 3) the survey design for the CSG field study area was based on the following broad steps:

- Initial consultation with regulatory bodies (including the EPA) to determine an appropriate scope for initial field investigations;
- Development of an adequate level of field investigation to be undertaken within the CSG field study area to characterise broad conservation values in any apparent areas of significant communities or habitat (Section 4);
- Post survey consultation with regulatory bodies to report major findings and to determine the appropriate approach for the development and implementation of further biodiversity assessment processes; and
- Development of protocols (Section 5.5) for targeted biodiversity assessments to be implemented at specific proposed well and infrastructure locations, at a level detailed enough to inform adequate impact assessment and implementation management strategies.

4.1.2 Field Survey Sites

Due to the extensive nature of the CSG field study area (approximately 22,193 km^2 (`2.2 million ha) in area), the field investigation component of this study focussed on the RFDAs (Arcadia Valley, Fairview and Roma) in locations representative of the overall landscape. The overall RFDA is approximately 12,742 km^2 (1.3 million ha) in extent.

Selection of survey site locations within the RFDAs targeted representative areas of different landscape elements of the region to encompass the greatest variety of habitat features.

The selection of study sites within the RFDAs was based upon several environmental factors. Survey site selection was undertaken to ensure that representative vegetation communities and habitats of the CSG field study area were sampled, and potential presence of conservation significant species and communities was investigated. A number of information sources were analysed to allocate representative survey sites, including the interpretation of:

- Satellite photography at a resolution of 2.5 m / pixel (Geoimage, 2008):
- State government Regional Ecosystem Mapping (DNRM&W, 2005);
- Bioregional Wildlife Corridor Mapping;
- Stage Government Essential Habitat Mapping (DNRM&W, 2005);
- Location of environmentally sensitive areas and conservation estate including State Forests and National Parks;
- Location of conservation significant flora identified by the Queensland Herbarium database search;
- Location of conservation significant fauna identified by the Queensland Museum database search; and
- Locations of known conservation significant communities and species identified from previous ecological reports.

Given this information, study sites were further selected based upon access availability and evenness of spread throughout the RFDAs.

4.1.3 Flora Survey Assessment Methodology

The flora survey employed an assessment of floral taxa and vegetation communities in keeping with the methodology employed by the Queensland Herbarium for the survey of Regional Ecosystems and vegetation communities (Neldner *et al.* 2005). Preliminary identification of the vegetation communities of the CSG field study area was conducted prior to the commencement of fieldwork via interpretation of current 1:100,000 Regional Ecosystems coverage Version 5.0 for the region (DNRM&W, 2005).

Definition of communities was used to identify locations for representative field survey sites to ground truth communities and obtain floristic and structural data. Fieldwork for the flora survey was conducted over four periods during August to November 2008. Field surveys included the conduct of botanical assessments in environmentally sensitive areas, including vegetation communities of conservation significance, riparian areas and EPA Essential Habitat. A number of standard botanical assessment methods were employed including secondary sample plots, quaternary sample plots, and random meander searches. Vehicle traverses of the selected study sites were also undertaken throughout the survey period to identify changes in landform and community boundaries. Community structural formation classes were assessed according to Specht (1970). Regional ecosystem classification of communities was determined as per Sattler and Williams (1999) and in accordance with the Regional Ecosystems Description Database (REDD) (EPA, 2005).

Secondary Plots

Field surveys employed twenty-seven (27) secondary sample plots within the CSG field study area. Secondary plots were comprised of 10x50m (500 m^2) transects. A complete list of data collected for each secondary site can be found in Appendix B.1, and locations for each secondary sample plot are presented in Figures 4 to 11.

Descriptive site information recorded at secondary transects included location, orientation, aspect, slope, soil type, landform, disturbance, fire history and general notes on ecological integrity. Several time-encoded digital photographs were taken at each plot as a visual reference. Locations of transects were recorded using a handheld GPS unit.

Floristic analysis included plant identification and species diversity characterisation of all flora present. Relative abundance was assigned for all species recorded.

Structural analysis included recording the height class and life form of the dominant species within each strata present. The height of each stratum was recorded using ocular estimation. Foliage projective cover (FPC) of the mid and upper strata was calculated along each transect, where foliage projection intersected the 50m centre tape. FPC of the ground layer was determined using ocular estimation of cover within five 1m subplots spaced at 10m intervals along the primary transect.

Quaternary Plots

Twenty-eight (28) quaternary plots were utilised to ground truth vegetation communities and confirm dominant characteristic species. A complete list of data collected for each quaternary site can be found in Appendix B.1 and locations for each quaternary sample plot are presented in Figures 4 to 11.

Descriptive site information recorded at quaternary sites included location, orientation, aspect, slope, soil type, landform, disturbance, fire history and general notes on ecological integrity. Several time encoded digital

photographs were taken at each plot as a visual reference. Locations of transects were recorded using a handheld GPS unit.

Floristic analysis included determination of the dominant species within the mid and canopy strata. Structural analysis included recording the height class and life form of the dominant species within the mid and canopy strata. The height of each stratum was recorded using ocular estimation.

Meander Searches

Following assessment of each secondary plot and selected quaternary plots, an area of approximately 1 ha surrounding each survey site was searched for 20 minutes utilising the random meander technique (Cropper, 1993). Care was taken to avoid sampling in different vegetation types to those of the plots. Meander searches were employed to:

- Identify additional less abundant species not recorded within survey plots;
- Identify any potential significant threatened or species not identified within the survey plot;
- Confirm the representativeness of plot locations; and
- Confirm boundaries and ecotonal areas between vegetation communities.

Nomenclature

Taxonomic nomenclature used for the description of floral species is according to Henderson (2002). Introduced species (as per Henderson, 2002) are signified in all text by an asterix (*). Any additional changes in taxonomic nomenclature have been incorporated as described in Jessup (2002, 2003 and 2005). Field references utilised for the identification and description of floral species include: Anderson (2003); Brooker and Kleinig (1994); Johns (2006); Milson (2000); and, Stanley and Ross (1986, 1989, 1995).

Specimen Identification

Where available, fruiting and/or flowering specimens were taken to assist with identification, where plant species were not identified in the field. For those species not field identified, samples were pressed and dried and positive identifications of plant specimens were subsequently made under laboratory conditions or forwarded to the Queensland Herbarium for identification. All identifications were made by qualified botanists with experience identifying flora taxa of central Queensland vegetation communities.

4.1.4 Fauna Habitat Assessment Methodology

An assessment of faunal habitat values was undertaken for all the CSG fields. Site visits were undertaken within the Roma, Fairview and Arcadia Valley CSG fields as these fields are targeted for near future operations. These assessments utilised habitat assessments and opportunistic observations in conjunction with a detailed desktop study to determine conservation values and potential habitat utilisation. Field surveys were undertaken during four separate field trips over a total of 22 days between September and November 2008. The fauna assessment methodology was developed in agreement with the EPA.

Techniques utilised during field visits included direct observations of fauna as well as analysis of fauna signs, tracks and scats. The assessments were conducted concurrently with the flora surveys at 27 secondary level and 28 quaternary level vegetation assessment sites (Figures 4 to 11).

Habitat suitability assessments were conducted within targeted vegetation communities to ascertain the suitability and extent of potential fauna habitat supported within the CSG fields. Habitat assessments were also designed to specifically target habitat of any conservation significant species identified as potentially present from detailed literature reviews.

Sites were chosen based on accessibility, representativeness of habitat within the landscape and to target areas identified as potential Essential Habitat (DNRM&W, 2005) for conservation significant species. Key characteristics assessed for habitat suitability included:

- Structure and dominant floristics of woodland canopy;
- Presence of large mature trees for arboreal fauna, nesting bird species, insectivorous bats and perching raptors;
- Presence of faunal refugia such as hollow bearing trees, fallen timber and large woody debris;
- Diversity and density of the shrub layer and ground cover provided as habitat for ground dwelling mammals;
- Presence of rock outcrops and dry cracking clays as habitat for reptile and small ground dwelling mammal species; and
- Connectivity and linkages of riparian corridors, core habitat and major habitat units.

Specific methods used to assess fauna presence at each site included:

- Opportunistic observations of birds mammals, reptiles and amphibians;
- Targeted bird observations for the duration of the site assessment (45 minutes at each site);
- Targeted micro-habitat searches concentrating on features such as loose bark, fallen woody debris , cracking clay surfaces, rocky habitat, flowering trees; and
- Analysis of tracks, signs, scats and scratch marks to indirectly determine faunal usage of the site.

Incidental observations of fauna were also recorded whilst driving through the region and between survey sites.

The CSG fields not targeted for detailed ground surveys (Mahalo, Comet, Denison Trough, Scotia, Roma Other and Eastern Surat Basin fields) were the subject of a detailed desktop study (including literature on previously

undertaken ground surveys), in association with an assessment of habitat values and fauna usage based on an understanding of physical, geological and natural values of the localities. This assessment was undertaken via:

- Satellite photography (Geoimage 2008), 1:100,000 RE mapping, and vegetation community analysis to assess habitat suitability;
- Assessment of previous individual fauna records for each locality to gain an appreciation of potential fauna presence;
- Interpretation of microhabitat values from vegetation cover, soil, land zone, relief and topography; and
- Accumulated knowledge of the ecological characteristics and fauna potentially found within the CSG fields and localities of similar physical & natural attributes.

This enabled an assessment of the likely faunal assemblages and potential presence of conservation significant species for each CSG field within the CSG field study area.

4.2 Survey results

4.2.1 Survey Conditions

The flora survey was undertaken in four stages during August to November 2008. All reported weather observations are taken from the Bureau of Meteorology Roma Radar, as an indication of the weather conditions in the CSG fields during the entire survey period.

Survey Period 1:

- 4 days in August 2008 (August 26 - 29).
- Location: Fairview CSG field.

Weather conditions for the August period were typical for the season in the region; warm days and cool nights with occasional gusty winds. Minimum and maximum temperatures were 6.0°C and 26.0°C respectively. Relative humidity for August averaged 39.0 %; however no rainfall was recorded over the four days of survey (BoM, 2008).

Survey Period 2:

- 4 days in September 2008 (September 23 - 26).
- Location: Roma CSG field.

During the September survey period, temperatures ranged between 8.2°C and 26.4°C and relative humidity for the month averaged 46.5 %. A total of 7.6 mm of rainfall was recorded during the survey period; however 9.2 mm of rainfall was recorded only one day prior to survey commencement (BoM, 2008).

Survey Period 3:

- 4 days in October 2008 (30 September - 3 October).
- Location: Fairview CSG field.

During October, temperatures ranged between 9.5°C and 30.1°C during the survey period with winds predominantly from a north-north-east direction. Relative humidity for the month averaged 39.5 % and no rainfall was recorded during the survey period (BoM, 2008).

Survey Period 4

- 5 days in November 2008 (November 4 - 8).
- Location: Arcadia Valley CSG field.

Weather conditions for the November period were again fairly typical for the season, with temperatures increasing and ranging from 15.9°C to 36.5°C. Relative humidity for October averaged 43.0 % and a total of 0.6 mm rainfall was recorded during the survey period (BoM, 2008).

4.2.2 Flora Values - Northern CSG Fields

Flora values for the northern CSG fields were determined from both desktop analysis (Stage 1) and field surveys (Stage 2). Satellite photography coverage at 2.5m / pixel resolution (Geoimage, 2008) and current state government 1:100,000 Regional Ecosystem (RE) mapping v5.0 (DNRM&W , 2005) were utilised for analysis of vegetation communities present within the northern CSG fields of Mahalo, Comet, Denison Trough, Fairview, Scotia, Roma Other and Arcadia Valley (Figure 1a). Conservation significant species were identified from database searches conducted as per Section 3.1.

Further targeted flora field studies were then undertaken within Arcadia Valley and Fairview CSG fields to ground-truth the RE mapping, search for targeted conservation significant flora species, and provide a greater understanding of floral diversity and vegetation communities of the area.

4.2.2.1 Species Diversity

The field survey of the northern CSG fields identified the presence of 156 taxa representing 52 families and 102 genera. Families represented by 3 or more genera included Asteraceae (7 genera), Cyperaceae (3), Euphorbiaceae (3), Fabaceae (5), Malvaceae (3), Myrtaceae (5), Poaceae (21) and Rutaceae (4).

Genera represented by 3 or more species included *Acacia* (9 species), *Aristida* (7), *Corymbia* (4), *Cyperus* (3), *Dianella* (3), *Dodonaea* (3), *Eremophila* (3), *Enteropogon* (4), *Eucalyptus* (7), *Lomandra* (6) and *Paspalidium* (3).

There was a relatively moderate diversity of weed species found, with 11 species identified. Families with exotic weed taxa included Asclepediaceae (1), Asteraceae (1), Cactaceae (2), Malvaceae (1), Papaveraceae (1), Poaceae (3) and Verbenaceae (2). Weed species of concern within the northern CSG fields are discussed further below in Section 4.2.2.2. A full list of all floral species identified at all quaternary and secondary study sites surveyed in the northern CSG fields is provided in Appendix B.2.

4.2.2.2 Weeds of Concern

Of the eleven exotic weed species described in this survey of the northern CSG facility study area, three species were identified as being of management concern (Table 4-1). These species are listed as pest species under the LP Act. One of these species (lantana) is also listed as a Weed of National Significance (WONS). Developed by ANZECC, WONS are exotic weed species identified as causing significant environmental damage on a national scale (Thorp and Lynch, 2000). All exotic weed species identified in this study are listed within the full flora species list in Appendix B.2.

Section 4 Stage 2 CSG Field Surveys

Table 4-1 Declared exotic weed species identified in the northern CSG field

Species	Common Name	Declared Status [1]	Regional Ecosystems affected
Lantana camara*	Lantana	Class 3/ WONS	11.9.4a
Opuntia stricta var. stricta*	Prickly pear	Class 2	11.10.13a
Opuntia tomentosa*	velvet tree pear	Class 2	11.10.9, 11.10.1d, 11.10.3, 11.10.7, 11.5.9

[1] Declared under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002*

Lantana

*Lantana camara** (lantana) was identified in only one vegetation community within the northern CSG fields; however densities appeared to be low. Lantana is a Weed of National Significance and is regarded as one of the worst weeds in Australia. Lantana forms dense, impenetrable thickets that take over native bushland and pastures throughout the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock (Weed Management CRC, 2003).

Prickly Pear and Velvety Tree Pear

Opuntia stricta var. *stricta** (prickly pear) and *Opuntia tomentosa** (velvety tree pear) were found in a number of vegetation communities, although densities were consistently low. These species were introduced into pastoral districts in the 1840's and by 1925 the pest had invaded over 24 million hectares. The introduction of the moth, *Cactoblastis cactorum*, in the 1920's controlled the pest, and by the mid-1930's, prickly pear was no longer a major problem (DNRW, 2006).

4.2.2.3 Vegetation of Conservation Significance

Thirty vegetation communities of the northern CSG fields were identified from desktop analysis as having either "Of Concern" or "Endangered" conservation status (as listed under the VM Act); and 37 communities were identified as having "Of Concern" or "Endangered" biodiversity status (as determined by the EPA). Four of these vegetation communities were ground-truthed during the survey period. Fourteen vegetation communities were identified as "Endangered" under the EPBC Act, and of these, two vegetation communities were confirmed through ground truthing. The conservation status of the conservation significant vegetation communities identified, CSG field location and relevant survey site number is detailed below in Table 4-2.

Table 4-2 Conservation Significant REs Identified for the Northern CSG Field

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[1]	CSG field
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	OC	OC	Not Listed	Desktop	Comet, Denison Trough, Arcadia Valley, Fairview
11.11.13	*Acacia harpophylla* or *A. argyrodendron*, *Terminalia oblongata* low open forest on deformed and metamorphosed sediments and interbedded volcanics	OC	OC	Not Listed	Desktop	Denison Trough
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	E	E	E	Desktop	Mahalo, Comet Denison Trough
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	OC	E	Not Listed	Desktop	Denison Trough, Arcadia Valley, Fairview
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	OC	OC	Not Listed	Desktop, Q25	Mahalo, Comet Denison Trough, Arcadia Valley, Fairview, Scotia, Roma Other
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils	E	E	Not Listed	Desktop	Denison Trough
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	NC	OC	Not Listed	Desktop, S17, S20, Q18, Q23, Q27	Mahalo, Comet Denison Trough, Arcadia Valley, Fairview, Scotia
11.3.27	Freshwater wetlands	NC	OC	Not Listed	Desktop	Comet Denison Trough
11.3.27a	Lacustrine wetland	NC	OC	Not Listed	Desktop	Denison Trough
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	OC	OC	Not Listed	Desktop	Denison Trough, Roma Other
11.3.3a	Riverine wetland or fringing riverine wetland.	OC	OC	Not Listed	Desktop	Denison Trough

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Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[1]	CSG field
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	OC	OC	Not Listed	Desktop	Mahalo Comet Denison Trough, Scotia, Roma Other
11.3.6	*Eucalyptus melanophloia* woodland on alluvial plains	NC	OC	Not Listed	Desktop	Denison Trough
11.4.1	Semi-evergreen vine thicket ± *Casuarina cristata* on Cainozoic clay plains	E	E	E	Desktop	Comet
11.4.2	*Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains	OC	OC	Not Listed	Desktop	Comet Denison Trough
11.4.7	Open forest to woodland of *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* on Cainozoic clay plains	E	E	E	Desktop	Mahalo
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	E	E	E	Desktop	Mahalo, Comet Denison Trough
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	E	E	E	Desktop, S15, Q24, Q26	Denison Trough
11.4.9a	*Acacia harpophylla*, *Lysiphyllum carronii* ± *Casuarina cristata* open-forest to woodland	E	E	E	Desktop	Mahalo, Comet Denison Trough
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces	NC	E	E	Desktop	Denison Trough
11.5.18	*Micromyrtus capricornia* shrubland on Cainozoic sand plains/remnant surfaces	OC	OC	Not Listed	Desktop	Mahalo
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	OC	OC	E	Desktop	Mahalo, Comet Denison Trough

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[1]	CSG field
11.8.11a	*Melaleuca bracteata* woodland drainage depressions. Occurs in drainage depressions	OC	OC	E	Desktop	Denison Trough
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks. Steep hillsides	NC	OC	E	Desktop	Mahalo, Comet Denison Trough
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks	E	E	E	Desktop	Mahalo, Comet Denison Trough, Scotia, Roma Other
11.9.4a	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable	E	E	E	Desktop, S23, S24	Comet, Fairview
11.9.4b	Semi-evergreen vine thicket	E	E	E	Desktop	Mahalo, Comet, Fairview
11.9.5	Acacia harpophylla and/or Casuarina cristata open forest on fine-grained sedimentary rocks	E	E	E	Desktop	Comet, Fairview
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	OC	OC	Not Listed	Desktop	Comet, Denison Trough, Fairview
11.9.8	*Macropteranthes leichhardtii* thicket on fine grained sedimentary rocks	NC	E	Not Listed	Desktop	Comet
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks	OC	E	Not Listed	Desktop	Denison Trough, Fairview, Scotia, Roma Other
11.9.13	*Eucalyptus moluccana* or *E. microcarpa* open forest on fine grained sedimentary rocks	OC	OC	Not Listed	Desktop	Denison Trough
11.9.4a	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable	E	E	Not Listed	Desktop	Denison Trough, Arcadia Valley, Scotia, Roma Other

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Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[1]	CSG field
11.9.4b	Semi-evergreen vine thicket with dense softwood scrub understorey	E	E	Not Listed	Desktop	Denison Trough, Arcadia Valley, Roma Other
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rock	E	E	Not Listed	Desktop	Denison Trough, Arcadia Valley, Scotia, Roma Other
11.9.6	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks	E	E	Not Listed	Desktop	Scotia
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	OC	OC	Not Listed	Desktop	Denison Trough, Scotia

[1] Information gathered from State Government 1: 100 000 Regional Ecosystem Mapping v.5 (DNRM&W, 2005). Study site numbers from both quaternary (Q) and secondary (S) surveys are included to indicate ground-truthing of the community where applicable.

4.2.2.4 Regional Connectivity

Regional connectivity of remnant vegetation across the northern CSG fields is reasonably continuous and is dominated by mountain ranges, state forests and national parks. Northwards from Mahalo CSG field, connectivity is retained to the Blackdown Tablelands. From the CSG field of Mahalo southwards to Arcadia Valley CSG field lies the contiguous remnant vegetation of the Expedition Range which encompasses both Shotover State Forest and Expedition National Park. Fairview CSG field is situated directly south of the range, however vegetation fragmentation is much more evident in this field. Continuity of vegetation in the east-west direction stretches from Expedition National Park (Lonesome Section) located at the southern end of the Arcadia Valley, and extends across to the Carnarvon Ranges. For further descriptions of corridor linkages and habitat connectivity refer to Section 4.2.7.

4.2.3 Flora Values - Southern CSG Fields

Flora values for the southern CSG fields were determined from both desktop analysis (Stage 1) and field surveys (S2). Current State Government Regional Ecosystem (RE) mapping v5.0 (DNRM&W, 2005) was utilised for analysis of vegetation communities present within the southern CSG fields of Roma and Eastern Surat Basin (Figure 4). Conservation significant species were identified from the previous database searches as per Section 3.1.

Further targeted flora field studies were then undertaken within the Roma CSG field to ground-truth the RE mapping, search for targeted conservation significant flora species, and provide a greater understanding of floral diversity and vegetation communities of the area.

4.2.3.1 Species Diversity

The survey identified the presence of 92 taxa representing 35 families and 62 genera. Families represented by three or more genera included Apocynaceae (3 genera), Asteraceae (3), Myrtaceae (4) and Poaceae (14).

Genera represented by three or more species included *Acacia* (9 species), *Dodonaea* (3), *Eremophila* (3) *Eucalyptus* (4) and *Lomandra* (4).

There was a relatively low diversity of weed species found with five species identified. Families with exotic weed taxa included Asclepediaceae (1), Cactaceae (1), Poaceae (2) and Verbenaceae (1). Weed species of concern within the southern CSG fields are discussed further below in Section 4.2.3.2.

4.2.3.2 Weeds of Concern

Of the five exotic weed species described in this survey of the southern CSG fields, one species was identified as being of management concern (Table 3-3) and is listed as a pest species under the LP Act. All exotic weed species identified in this study are listed within the full flora species list in Appendix B.2.

Table 4-3 Declared exotic weed species identified in the southern CSG fields.

Species	Common Name	Declared Status [1]	Regional Ecosystems affected
Opuntia tomentosa	velvet tree pear	Class 2	11.5.1, 11.10.11, 6.5.3

Velvety Tree Pear

*Opuntia tomentosa** (velvety tree pear) was found in a number of vegetation communities within the southern CSG fields, although densities were consistently low. This species was introduced into pastoral districts in the 1840's and by 1925 the pest had invaded over 24 million hectares. The introduction of the moth, *Cactoblastis cactorum*, in the 1920's controlled the pest, and by the mid-1930's, prickly pear was no longer a major problem (DNRW, 2006).

4.2.3.3 Vegetation of Conservation Significance

Desktop analysis of the southern CSG fields identified 21 significant communities as having either "Of Concern" or "Endangered" conservation status (as listed under the VM Act) and 27 communities as having "Of Concern" or "Endangered" biodiversity status (as determined by the EPA). Three of these vegetation communities were confirmed through ground truthing. Six of the vegetation communities listed are regarded as Endangered under the EPBC Act. The conservation status of all conservation significant communities identified, CSG field location and relevant survey site is detailed in Table 4-4.

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Table 4-4 Conservation Significant REs Identified for the Southern CSG Fields

Regional Ecosystem[1]	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[2]	CSG field
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	OC	E	Not Listed	Desktop	Roma, Eastern Surat Basin
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	OC	OC	Not Listed	Desktop	Roma, Eastern Surat Basin
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils	E	E	Not Listed	Desktop	Roma
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	NC	OC	Not Listed	Desktop, S4	Roma, Eastern Surat Basin
11.3.27b	Palustrine wetland	NC	OC	Not Listed	Desktop	Eastern Surat
11.3.28	*Casuarina cristata* +/- *Eucalyptus coolabah* open woodland on alluvial plains	OC	OC	Not Listed	Desktop	Roma
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	OC	OC	Not Listed	Desktop	Roma, Eastern Surat Basin
11.4.10	*Eucalyptus populnea* or *E. pilligaensis*, *Acacia harpophylla*, *Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains	E	E	Not Listed	Desktop	Eastern Surat Basin
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains	E	E	Not Listed	Desktop	Eastern Surat Basin
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains	E	E	E	Desktop	Roma, Eastern Surat Basin
11.4.3a	Palustrine wetland (e.g. vegetated swamp). *Melaleuca bracteata* woodland associated with *Acacia harpophylla* communities.	E	E	E	Desktop	Eastern Surat Basin
11.4.7	Open forest to woodland of *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* on Cainozoic clay plains	E	E	E	Desktop	Roma

Regional Ecosystem[1]	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Source[2]	CSG field
11.5.13	*Eucalyptus populnea* +/- *Acacia aneura* +/- *E. melanophloia* woodland on Cainozoic sand plains/remnant surfaces	OC	OC	Not Listed	Desktop	Roma
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	OC	OC	E	Desktop	Roma
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks. Steep hillsides	NC	OC	E	Desktop	Roma
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks	E	E	E	Desktop	Roma
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks	OC	E	Not Listed	Desktop	Roma
11.9.11	*Acacia harpophylla* shrubland on fine-grained sedimentary rocks	OC	OC	Not Listed	Desktop	Roma
11.9.4a	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable	E	E	Not Listed	Desktop	Roma
11.9.4b	Semi-evergreen vine thicket with dense softwood scrub understorey	E	E	Not Listed	Desktop	Roma
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rock	E	E	Not Listed	Desktop	Roma
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	OC	OC	Not Listed	Desktop	Roma
11.9.7a	*Eucalyptus populnea* predominates forming a distinct but discontinuous canopy (10-15 m high).	OC	OC	Not Listed	Desktop	Roma
6.4.3	*Eucalyptus populnea, Casuarina cristata* or *Acacia harpophylla* ± *Geijera parviflora* woodland on clay plains	OC	E	Not Listed	Desktop	Roma,
6.5.1	*Acacia aneura, Eucalyptus populnea, E. melanophloia* open forest on undulating lowlands	NC	OC	Not Listed	Desktop, S8	Roma
6.5.3	*Eucalyptus populnea*, *Acacia aneura* ± *Eremophila mitchellii* woodland within *A. aneura* communities	NC	OC	Not Listed	Desktop, S9	Roma
6.7.5	*Eucalyptus thozetiana* or *E. cambageana*, *Acacia harpophylla* woodland on scarps	NC	OC	Not Listed	Desktop	Roma

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.
[2] Information gathered from State Government 1:100 000 Regional Ecosystem Mapping v.5 (DNRM & W, 2005). Study site numbers from both quaternary (Q) and secondary (S) are included to indicate ground-truthing of the community where applicable.

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4.2.3.4 Regional Connectivity

Vegetative connectivity across the landscape of the southern CSG fields is highly fragmented and limited to the remnant vegetation associated with roadside and riparian vegetation, together with several state forests in the south-west of the Roma CSG field. The result is a number of tenuously linked patches of vegetation scattered across a largely cleared and flat landscape, creating very little connectivity on a regional scale. For further details on corridor linkages and habitat connectivity refer to Section 4.2.7.

4.2.4 CSG Field Fauna Habitat Values

The results of the field and desktop assessments of habitat values and fauna species of the CSG field are presented below. The CSG Fields were split into southern and northern groupings based on similarities in landscape and habitat characteristics. The northern CSG fields comprise the Mahalo, Comet, Denison Trough, Scotia, Fairview, Roma Other and Arcadia Valley CSG Fields. The southern CSG fields include the Roma and Eastern Surat Basin CSG Fields. Figure 1a and Figure 1b show the locations of the respective CSG fields.

Desktop fauna records for the CSG fields have been sourced from Wildlife Online, Queensland Museum and EPBC Protected Matters reports. These are displayed in Appendix A.3. Reference to various common and significant species as an illustration of habitat suitability is made in the text for each CSG field. Queensland Museum fauna data is supplied with spatial references (i.e. latitude/ longitude for each record) and as such this dataset has been used to derive an understanding of fauna distribution within each CSG fields.

4.2.5 CSG Field Significant Fauna Species Records

Significant fauna species include those recognised under various categories of the NC Act or EPBC Act[6]. The potential presence of significant species in a designated area is determined through a field assessment of habitat regional values, and a desktop search of available databases such as Queensland Museum records, Wildlife Online and the EPBC protected matters report. Whilst all of these databases were accessed, only the Queensland Museum data includes spatial references. Therefore searches for significant fauna at specific sites (i.e. within the CSG field boundaries) could only be undertaken using this database. Records are based primarily on the submission of results from various independent studies or individuals and therefore they are not necessarily complete for an area, however are useful as a guide to indicate the diversity of fauna present. Conversely, absence from such a list does not necessarily mean absence of a certain species. Queensland Museum fauna records (Qld Museum, 2008) for the CSG field note 14 significant species. These results are displayed below with the corresponding conservation status in Table 4-5.

[6] The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**.

The EPBC Act uses the following categories for significant fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

Table 4-5 Conservation significant fauna Species known for the CSG field study area

Scientific Name	Common Name	Conservation Significance	
		NC Act	EPBC Act
Falco hypoleucos	grey falcon	R	-
Geophaps scripta scripta	squatter pigeon (southern form)	V	V
Nyctophilus timoriensis	long-eared bat	V	V
Onychogalea fraenata	bridled nailtail wallaby	E	E
Chalinolobus dwyeri	large-eared pied bat	R	V
Chalinolobus picatus	little pied bat	R	-
Cyclorana verrucosa	warty waterholding frog	R	-
Adelotus brevis	tusked frog	V	-
Acanthophis antarcticus	common death adder	R	-
Anomalopus brevicollis	burrowing skink	R	-
Delma torquata	collared delma	V	V
Denisonia maculata	ornamental snake	V	V
Egernia rugosa	yakka skink	V	V
Furina dunmalli	Dunmall's snake	V	V

Summary of Significant Conservation Values

For each CSG Field, a summary of ecologically significant values is provided in table format. These are presented at the end of each CSG field section. Summaries of mapped REs, mapped significant REs and potentially present Endangered, Vulnerable and Rare (EVR) fauna and flora species are listed. The summary is centred around broad landscape elements which are based on EPA landzone categories. It should be noted that the EVR fauna listed for each CSG field is not complete, and requires field survey confirmation. These species are presented as an indication of the potential habitat quality likely to be present and the capacity to potentially support such EVR species.

4.2.6 Fauna Habitat Values - Northern CSG fields

4.2.6.1 Mahalo CSG Field

General Description and Location

As shown in Table 4-6 the Mahalo CSG field covers portions of the Shotover and Expedition State Forests (SF). The state forests, which comprise 18% of the Mahalo field, are located primarily in the eastern portions of the field on the plateau of the Expedition and Shotover Ranges, with Shotover SF the more northern of the two. Western areas of this CSG field are generally cleared for grazing, with the steep scarp of the Expedition Range forming the boundary between the two land uses. Blackdown Tablelands National Park is contiguous with Shotover SF to the north of the Mahalo field. As a protected area diverse in fauna and flora, this national park is an important adjunct to the forested estate and acts as a secure source for fauna dispersing along the range. The Mahalo CSG field is depicted in Figure 4a and Figure 4b.

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Habitat Diversity

The majority of the remnant vegetation in the Mahalo CSG field is held within Expedition and Shotover State Forests and adjacent leasehold land on the Expedition and Shotover Range plateaux. However, a large stand of remnant vegetation is also found on the low-lying undulating land to the west of the scarp. This is primarily situated on state land (Lot 2 SP168790) in the middle portion of the Mahalo CSG field. The remainder of the field has mainly been cleared for grazing.

An analysis of RE mapping within the Mahalo CSG field shows that a diversity of REs are present. Broadly grouped based on the underlying landzones, the fauna habitat types present are discussed below.

The Expedition Range is formed on sandstones of the Clematis and Precipice groups (Willmott, 2006). Fluvial action has caused erosion and weathering of softer rocks resulting in the formation of scarps and gorges. Vegetation typically found on the tablelands of the ranges includes open-forest/ woodland with a range of canopy species including narrow-leaved ironbark (*Eucalyptus crebra*), Gympie messmate (*E. cloeziana*), Nanango ironbark (*E. melanoleuca*), Henderson's bloodwood (*C. hendersonii*), brown bloodwood (*C. trachyphloia*), spotted gum (*C. citriodora*) and Bailey's stringybark (*E. baileyana*). Crests and ridge tops occasionally support *Acacia* open forest with species such as bendee (*Acacia catenulata*) or lancewood (*A. shirleyi*) dominant. The mid story in these woodlands and open forests varies between sparse and dense, and the sparse ground layer is comprised of grasses and forbs.

The rugged topography of the Expedition Range generally precludes the formation of deep alluvial soils. However, small patches present on waterways, especially in the north-east of the CSG field, support tall woodlands of forest red gum (*Eucalyptus tereticornis*).

The western scarps and foothills of the Expedition Range are formed on outwash from weathered sandstones (Landzone 5) and chemically altered sediments and duricrusts (Landzone 7). Typically, vegetation found on Landzone 7 in these areas includes stands of lancewood (*Acacia shirleyi*) and/ or bendee (*Acacia catenulata*) with occasional domination by rosewood (*A. rhodoxylon*), Burrow's wattle (*A. burrowii*) and other species. Emergent eucalypt species can also be present. Sandy duplex outwash from the scarp supports mixed *Eucalyptus* / *Corymbia* woodland comprising of species such as narrow-leaved ironbark (*Eucalyptus crebra*), long-fruited bloodwood (*Corymbia clarksoniana*), spotted gum (*C. citriodora*) and gum-topped box (*E. moluccana*).

Most of the low-lying areas to the west of the scarp are devoid of remnant vegetation, having been cleared for agricultural activities. The landscape has been heavily fragmented and vegetated patches are generally small and isolated. Remnant vegetation is typically dominated by *Acacia* communities. Low rises in the undulating landscape are often the vestiges of lateritic duricrusts and support stands of lancewood (*Acacia shirleyi*) or bendee (*Acacia catenulata*). Occasional small patches of brigalow (*Acacia harpophylla*) are present, as are silver-leaf ironbark (*Eucalyptus melanophloia*) woodlands on igneous rocks on hillsides (EPA, 2008).

These habitat types are also present within the Comet, Denison Trough, Arcadia Valley and Fairview CSG fields and therefore descriptions given above generally apply to these Fields.

Habitat Values

Whilst fauna will utilise all areas within the field, remnant vegetation acts as primary habitat for the greater diversity of fauna. Macropods such as eastern grey kangaroos (*Macropus giganteus*) will be expected to utilise open pasture, as will a range of common snakes, skinks, frogs and birds. However, remnant vegetation

generally offers superior feeding, roosting, nesting and refuge habitat for the vast majority of fauna. Therefore these areas, especially within the current fragmented landscape, are significant for the continued presence of many fauna groups in this field. Whilst there are many animals that specialise in using grasslands (e.g. grassland birds, raptors, macropods), many others will utilise these only in the process of migration, dispersal or displacement.

The sandstones of the Expedition Range have weathered to form rocky scarps, piles of boulders and gorges. Caves, overhangs and crevices are included among the rocky microhabitat features available that typically support a wide range of mammals and reptiles. Macropods such as common wallaroos (*Macropus robustus*), Herbert's Rock-wallaby (*Petrogale herberti*) and black-striped wallabies (*Macropus dorsalis*) are known to favour areas of rugged terrain and are all considered possibly present on the Expedition Range and adjacent lower slopes. A range of microbats favour roosts within caves and crevices. Species potentially roosting in rocky habitat include the common sheath-tailed bat (*Taphozous georgianus*), Gould's wattled bat (*Chalinolobus gouldii*) and the eastern cave bat (*Vespadelus troughtoni*).

The *Eucalyptus* and *Corymbia*-dominated woodlands and open forests, mostly located on the Expedition Range, form the greatest proportion of the vegetated areas within this Field. The large extent and connectivity of vegetation along the Expedition Range provides excellent habitat for a wide range of fauna. Typically, woodlands such as these are utilised by a large suite of species from all animal groups. Observations of similar nearby areas have revealed that there are often large dead and living trees present bearing habitat hollows despite historical clearing, logging and thinning practices. The open woodlands generally support a dense ground cover with fallen timber which suits reptiles and small ground mammals. Within the less disturbed habitat on the Expedition Range, a diversity of small ground mammals is expected to be present. These could include the common planigale (*Planigale maculata*), yellow-footed antechinus (*Antechinus flavipes*), stripe-faced dunnart (*Sminthopsis macroura*), fawn-footed melomys (*Melomys cervinipes*) and pale-field rat (*Rattus tunneyi*).

Variations in grazing intensity within the tableland habitat are likely to impact on the distribution and abundance of species such as these. The likelihood of an abundance of ground mammals persevering within the remnant lowland habitats to the west of the Range is low considering historic disturbance and current grazing practices despite excellent connectivity to the bushland of the Expedition Range. Reptiles generally are less constrained by habitat disturbance when prey items are still available. Insectivorous and omnivorous reptiles (i.e. skinks, geckos and Agamids (dragons)) are less impacted than those seeking mainly mammalian prey such as larger colubrid and elapid snakes. Monitor lizards can survive through the scavenging of dead animals (including roadkill) and are likely to be found throughout the CSG field, even in degraded or cleared habitats.

Arboreal mammal presence is generally dependant upon the availability of suitable tree hollows. Common brushtail possums (*Trichosurus vulpecula*), feathertail gliders (*Acrobates pygmaeus*) squirrel gliders (*Petaurus norfolcensis*) and greater gliders (*Petauroides volans*), all of which would be expected to be present within the Mahalo CSG field, have specific nest hollow requirements which would dictate their distribution. Pastures and patches of regrowth vegetation generally have fewer habitat trees and therefore arboreal mammal populations are reduced in these areas. The exception to this is where a narrow riparian corridor within a cleared landscape can sustain a fringe of large forest red gums (*Eucalyptus tereticornis*), noted for their propensity to form hollows and support gliders, microbats and hollow-nesting birds.

Avifauna would be well represented throughout the Mahalo CSG field due to the diversity and security of habitats on the Ranges. All feeding groups would be present, including insectivores, raptors, honeyeaters, frugivores and forest gleaners.

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Corridor Linkages

Uninterrupted bushland stretches south approximately 260 km along the Expedition Range, from the Capricorn Highway near Blackwater to east of Injune. Despite being subjected to a range of activities including forestry, grazing and conservation practices, the integrity of this corridor is such that there is virtually unrestricted movement for fauna in a north-south direction. The Dawson Highway acts as a minor barrier to movement, and while fauna mortality from road strikes is notable across the Range, traffic is generally light and the majority of fauna is able to cross the road successfully.

West of the Range on the undulating clay plains, corridor linkages have generally been compromised by the clearing of vegetation for grazing. In a heavily fragmented landscape featuring isolated pockets of vegetation, corridors are limited to tenuous riparian strips along ephemeral streams. Birds, being mobile, are least affected by this patchy nature of vegetation within grazing lands.

Fauna Records

The Queensland Museum Fauna Database lists records for 5 species for the Mahalo CSG field including the rufous bettong (*Aepyprymnus rufescens*), Boulenger's Skink (*Morethia boulengeri*), dwarf Litter-skink (*Menetia timlowi*), house gecko (*Gehyra dubia*) and the spotted marsh frog (*Limnodynastes tasmaniensis*). None are listed under the NC Act or the EPBC Act.

Conservation Significant Species

There are no records of significant species from the Mahalo CSG field. However, the tusked frog (*Adelotus brevis*) and a burrowing skink (*Anomalopus brevicollis*) were recorded from Blackdown Tableland National Park to the north of the Mahalo CSG field. Given the proximity and connectivity, these species could be present in the Expedition Range portion of the Field. The squatter pigeon (southern) (*Geophaps scripta scripta*), although listed as Vulnerable under both the EPBC Act and NC Act, is widespread in the area and would be present in open woodland within the Field.

Another 11 significant species were recorded for the northern CSG fields. Ten of these species (including a long-eared bat (*Nyctophilus timoriensis*), large-eared pied bat (*Chalinolobus dwyeri*), little pied bat (*Chalinolobus picatus*), grey falcon (*Falco hypoleucos*), warty waterholding frog (*Cyclorana verrucosa*), common death adder (*Acanthophis antarcticus*), collared delma (*Delma torquata*), ornamental snake (*Denisonia maculata*), yakka skink (*Egernia rugosa*) and Dunmall's snake (*Furina dunmalli*)) can possibly be found within habitat of the Mahalo CSG field. The other (the bridled nailtail wallaby (*Onychogalea fraenata*)), survives in small populations at Taunton Scientific Reserve near Dingo and Idalia National Park south of Longreach and is not expected to be present within the Mahalo or other CSG Fields.

Feral Species

No feral species records are listed by the Queensland Museum for the Mahalo CSG field. Red Foxes (*Vulpes vulpes**), feral cats (*Felis catus**), wild dogs / dingoes (*Canis lupus dingo**) and feral pigs (*Sus scrofa**) are widespread in the region and would be expected to be active within the Mahalo CSG field.

Table 4-6 Mahalo CSG Field Summary of Ecologically Significant Values

Broad Landscape Element (BLE)	Relevant ATP/ PL	Land Zone	Mapped REs[1]	Potential Significant Regional Ecosystems			Potential EVR Flora Species and Communities[4]	Potential EVR Fauna Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
Woodland on alluvium	ATP 804P	3	11.3.1 11.3.2 11.3.4 11.3.25	11.3.1 11.3.2 11.3.4	11.3.1 11.3.2 11.3.4 11.3.25	11.3.1	Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Cyclorana verrucosa* *Egernia rugosa*
undulating lowland woodland on clay and sand plains	ATP 804P	4 5	11.4.7 11.4.8 11.4.9a 11.5.18 11.5.2 11.5.20 11.5.2a 11.5.3 11.5.5c 11.5.9b	11.4.7 11.4.8 11.4.9a 11.5.18	11.4.7 11.4.8 11.4.9a 11.5.18	11.4.7 11.4.8 11.4.9a	*Aristida annua* *Eleocharis blakeana* *Xerothamnella herbacea*	*Adelotus brevis* *Cyclorana verrucosa* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*
Acacia or *Eucalyptus* woodland on laterites	ATP 804P	7	11.7.2					*Delma torquata* *Geophaps scripta scripta* *Chalinolobus dwyeri*
Forested low hills on basalt derived cracking clays	ATP 804P	8	11.8.4 11.8.5 11.8.11	11.8.11	11.8.11	11.8.11	*Aristida annua* *Dichanthium queenslandicum* *Dichanthium setosum*	*Geophaps scripta scripta* *Chalinolobus picatus*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	ATP 804P	9, 10	11.9.1 11.9.4b 11.10.1 11.10.3 11.10.13 11.10.13a	11.9.1 11.9.4b	11.9.1 11.9.4b	11.9.1 11.9.4b	*Acacia storyi* *Apatophyllum teretifolium* *Baeckea trapeze* *Cadellia pentastylis* *Cycas megacarpa* *Eucalyptus curtisii* *Grevillea singuliflora* *Macrozamia*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Paradelma orientalis* *Accipiter novaehollandiae* *Calyptorhynchus*

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Broad Landscape Element (BLE)	Relevant ATP/ PL	Land Zone	Mapped REs[1]	Potential Significant Regional Ecosystems			Potential EVR Flora Species and Communities[4]	Potential EVR Fauna Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
							platyrhachis *Wahlenbergia islensis*	*lathami* *Erythrotriorchis radiatus* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature trees	ATP 804P	3, 4, 5, 8, 9, 10	N/A				*Dichanthium queenslandicum*	*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

4.2.6.2 Comet CSG Field

Location and General Description

The Comet CSG field is to the south of and contiguous with the Mahalo CSG field. It straddles the Expedition Range and extends into cleared grazing land to the east and west of the Range. The Expedition and Nicholson State Forests comprise a large proportion of the field on the Expedition Range, and make up approximately 18% of the entire field land area. The Comet CSG field marginally intersects the northern and north-western extremities of Expedition NP and Palmgrove NP respectively. Together, less than 0.2% of these national parks are within the Comet CSG field. The Comet CSG field is depicted in Figure 5a and Figure 5b..

Habitat Diversity

The vegetation within the Comet CSG field shows strong correlation to that found in the Mahalo CSG field due to the proximity and similarity in geology and relief. Woodlands and open forests of *Corymbia* and *Eucalyptus* dominate vegetation patterns as with the Mahalo CSG field. However, a greater diversity of vegetation communities and canopy species is present. Common canopy species present include spotted gum (*C. citriodora*), poplar box (*E. populnea*), silver-leaved ironbark (*E. melanophloia*), Gympie messmate (*E. cloeziana*), narrow-leaved ironbark (*E. crebra*), coolibah (*E. coolabah*), forest red gum (*E. tereticornis*) and Dawson gum (*E cambageana*). Woodlands of *Acacia, Callitris, Allocasuarina and Casuarina* are also found within the field. The woodlands and open forests are present on a variety of soils originating from alluvium, sedimentary rocks, clay plains, sand plains, duricrusts and igneous rocks. Small areas of semi-evergreen vine thickets, freshwater wetlands and Queensland bluegrass (*Dichanthium sericeum*) grasslands are also distributed within the field.

Habitat Values

Habitat values are similar to those described for the Mahalo CSG Field (Section 4.2.6.1). The woodlands, depending upon the levels of disturbance and maturity, have the capacity to sustain a large range of vertebrate fauna. Macropods, gliders, possums and small ground mammals are expected to be present. As with Mahalo, a large diversity of birds, amphibians and reptiles would be utilising the Comet CSG field, especially in areas displaying intactness and integrity. The size of the bushland on the range, in conjunction with the proximity of the state forests and adjacent National Parks, indicates that core habitat is present from which dispersing fauna can readily populate suitable adjacent areas.

The low-lying fertile clay plains to the east and west of the Comet CSG field are mostly cleared for grazing and cropping. In places, spurs of remnant or regrowth bushland extend onto the plains from the foothills. Whilst these patches possess some habitat value, they are impacted by their size and surrounding land uses and would not act as significant fauna refuge. Isolated patches of vegetation and narrow riparian corridors extend east and west from the Range across the plains landscape. Their relative remoteness would mostly preclude them from possessing significant value, and would typically suit highly mobile species such as many birds and macropods seeking refuge whilst crossing open pasture. Narrow strips of riparian vegetation often consist of mature *E. tereticornis* (forest red gums); a species that readily forms hollows. Throughout central Queensland, these communities are often the only relic of former vegetation patterns and thus act as valuable habitat for hollow nesting or roosting birds, microbats and arboreal marsupials.

Corridor Linkages

As with the adjacent Mahalo CSG field, the major corridor for dispersal and movement of fauna and flora is the bushland of the north-south Expedition Range. Connectivity with the leasehold land and reserves within the CSG fields is very high. The mostly cleared valleys have few functioning corridors apart from the remnant riparian corridors alongside the area's ephemeral and semi-permanent streams.

Fauna Records

The Queensland Museum Database lists 5 species from the Comet CSG field. These include the fawn-footed melomys (*Melomys cervinipes*), eastern yellow robin (*Eopsaltria australis*), buff-rumped thornbill (*Acanthiza reguloides*), striped wall skink (*Cryptoblepharus virgatus*) and fence skink (*C. plagiocephalus*).

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Significant Species

None of the species sourced from the Queensland Museum database are listed under the NC Act or the EPBC Act.

Feral Species

As with the Mahalo CSG field, a number of feral fauna species are expected to be prevalent including feral cats, foxes, pigs and wild dogs / dingoes.

Table 4-7 Comet CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
Woodland on alluvium	ATP 745P, ATP 526P	3	11.3.1 11.3.2 11.3.4 11.3.18 11.3.19 11.3.25 11.3.27	11.3.1 11.3.2 11.3.4	11.3.1 11.3.2 11.3.4 11.3.25	11.3.1	Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Cyclorana verrucosa* *Egernia rugosa*
undulating lowland woodland on clay and sand plains	ATP 745P, ATP 526P	4 5	11.4.1 11.4.2 11.4.8 11.4.9a 11.5.2 11.5.2a 11.5.3 11.5.5c 11.5.20	11.4.1 11.4.2 11.4.8 11.4.9a	11.4.1 11.4.2 11.4.8 11.4.9a	11.4.1 11.4.7 11.4.8 11.4.9a	*Aristida annua* *Eleocharis blakeana* *Xerothamnella herbacea*	*Adelotus brevis* *Cyclorana verrucosa* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*
Acacia or *Eucalyptus* woodland on laterites	ATP 745P, ATP 526P	7	11.7.2					*Delma torquata* *Geophaps scripta scripta* *Chalinolobus dwyeri*
Forested low hills	ATP 745P, ATP	8	11.8.3	11.8.11	11.8.3	11.8.3	*Aristida annua*	*Geophaps scripta*

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Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
on basalt derived cracking clays	526P		11.8.4 11.8.5 11.8.11	11.8.11a	11.8.11	11.8.11	*Dichanthium queenslandicum* *Dichanthium setosum*	*scripta* *Chalinolobus picatus*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	ATP 745P, ATP 526P	9, 10, 11	11.9.1 11.9.2 11.9.4a 11.9.4b 11.9.5 11.9.7 11.10.1 11.10.3 11.10.4 11.10.7 11.10.8 11.10.11 11.10.13a	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.10.8	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.10.8	11.9.1 11.9.4a 11.9.4b 11.9.5	*Cadellia pentastylis* *Cycas megacarpa* *Eucalyptus curtisii* *Grevillea singuliflora* *Wahlenbergia islensis*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Paradelma orientalis* *Accipiter novaehollandiae* *Calyptorhynchus lathami* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature trees.	ATP 745P, ATP 526P	3, 4, 5, 7, 8, 9, 10, 11	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

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4.2.6.3 Denison Trough CSG Field

General Description and Location

The Denison Trough CSG field is a very large field comprising several disjunct areas. It is approximately 592,311 ha in size and covers portions of the Carnarvon Range, Arcadia Valley and the low undulating clay plains west of the Expedition and Shotover Ranges. The northern portion lies to the immediate east of Emerald and the field extends south for approximately 280 km to the Injune area. It is approximately 60 km east-west at its widest point and lies mostly to the west of the Expedition Range. National parks and state forests make up approximately 8% of the total CSG area, with Carnarvon NP, Bandana SF, Doonkuna SF and Forrest SF the largest contributors. Nuga Nuga NP and Expedition NP are only marginally included in the Denison Trough CSG field. The Denison Trough CSG field is depicted in Figure 7a to Figure 7h.

Habitat Diversity

Approximately 31% of the Denison Trough CSG field is mapped as remnant vegetation. The remaining 69% consists of land cleared of native vegetation for grazing and cropping, and non-remnant regrowth vegetation.

Most of the remnant vegetation is within state forests and national parks generally located on the low sandstone ranges including the southern Carnarvon Range. A large proportion of the remnant vegetation consists of woodlands and open forests of *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum), *E. populnea* (poplar box) and *Callitris glaucophylla* (white cypress) on sedimentary rocks. Also well represented throughout the field are *Dichanthium sericeum* (Queensland bluegrass) grasslands on basalt and woodlands and open forests of *E. tereticornis* (forest red gum), *E. populnea*, *E. coolabah* (coolibah) and *E. melanophloia* (silver-leaved ironbark) on alluvium. Smaller areas of *Acacia* spp. woodlands on lateritic duricrusts and sedimentary rocks, along with freshwater wetlands and patches of semi-evergreen vine thickets are also present.

As with the Mahalo and Comet CSG fields, the majority of the lowland vegetation on the fertile undulating clay plains has been cleared for intensive grazing and cropping practices. This has resulted in the sandstone ranges supporting the majority of the remnant vegetation and therefore providing the core habitat for fauna. The Carnarvon Range in particular has been recognised for its fauna and flora values and at present 298,000 ha of the Range has been gazetted as the Carnarvon National Park (EPA, 2005). The Denison Trough CSG field overlaps with approximately 8,068 ha of the Moolayember Section of the Carnarvon NP.

Habitat Values

A range of landforms including scarps, gorges, tablelands, undulating hills and river systems contribute to a diversity of habitat types. Opportunities for fauna are similar to the CSG fields described previously, and given the proximity of all northern fields, it is reasonable to assume that a similar suite of species is found throughout the region. However, as the Denison Trough CSG field incorporates a greater proportion of cleared land (especially in the north), it would be expected that overall diversity is lower than the other Fields.

Sixty mammals, 210 birds, over 90 reptiles, 22 frogs and at least 10 species of fish have been recorded in the Carnarvon Gorge NP (EPA, 2005). As the Denison Trough CSG field overlaps a small and narrow south-eastern portion of the national park, it can be assumed that many of the more sensitive of these species will be restricted to core habitat within the centre of the national park isolated from impacts such as grazing and tourism. However, there is scope for many of the generalist species to be present on hilly, forested habitat within the CSG, especially along the Carnarvon Range and in Nuga Nuga NP. Mammals potentially present within the field in suitable habitat could include common planigale (*Planigale maculata*), yellow-bellied glider (*Petaurus*

australis), squirrel glider (*Petaurus norfolcensis*), greater glider (*Petauroides volans*), feathertail glider (*Acrobates pygmaeus*), eastern horseshoe-bat (*Rhinolophus megaphyllus*), common bentwing-bat (*Miniopterus schreibersii*), eastern chestnut mouse (*Pseudomys gracilicaudatus*) and fawn-footed melomys (*Melomys cervinipes*). Nine species of macropods are also present and many could be represented within suitable sections of the Field, although cleared areas typically support a lower diversity and often restricted to just the eastern grey kangaroo (*Macropus giganteus*). Of the 210 birds recorded from Carnarvon NP, many would be restricted to pockets of suitable habitat found in only within the national park. Other less-specialised species would be found throughout the CSG field, with a diminution in diversity corresponding to an increase in the level of alteration of the landscape. This applies equally to amphibians and reptiles.

Corridor Linkages

As with the CSG fields previously described above, functional fauna corridors are generally restricted to the well-vegetated sandstone ranges and their foothills. Within the cleared landscape, corridors are often tenuous and restricted to riparian vegetation along watercourses.

Fauna Records

The Queensland Museum fauna database show 77 fauna species recorded from within the Denison Trough CSG field. This list consists of 17 birds, 13 frogs, 12 mammals and 35 reptiles. This relatively high diversity of records (as compared to the CSG fields described above) can be attributed due to a greater survey effort as part of the management of the Carnarvon NP. In addition, the protected habitats of Carnarvon and Nuga Nuga NPs act as sources for fauna dispersal to surrounding areas. The birds are typical of woodland and pastoral species in the region. A relatively high diversity of frogs indicates that suitable aquatic habitat is prevailing in the area. Mammal records are divided between rodents, microbats, macropods arboreal marsupials and dasyurids. This also indicates that enough habitat variety is present to support members of the major terrestrial mammal groups found in the region. The large number of reptiles listed indicates both habitat suitability and intensity of survey effort.

Significant Species

Of the 77 species listed by the Queensland Museum for the Denison Trough CSG field, only the yakka skink (*Egernia rugosa*) is of conservation significance. It is listed as Vulnerable under both the NC Act and the EPBC Act. Given the reasonable habitat present on the sandstone ranges, a greater range of conservation significant fauna species would be expected to be present. These could include the collared delma (*Delma torquata*), golden-tailed gecko (*Strophurus taenicauda*), glossy black-cockatoo (*Calyptorhynchus lathami*) squatter pigeon (southern subspecies) (*Geophaps scripta scripta*), powerful owl (*Ninox strenua*) and northern quoll (*Dasyurus hallucatus*). Sections of the CSG field in proximity to the Carnarvon National Park would tend to support a greater diversity of significant species than other areas due to the proximity of core protected habitat.

Feral Species

The house mouse (*Mus musculus**) and cane toad are the only introduced species listed in records sourced from the Queensland Museum. There would also be a range of other feral species present including the black rat (*Rattus rattus**), feral pig (*Sus scrofa**), red foxes (*Vulpes vulpes**), feral cats (*Felis catus**) and wild dogs/ dingoes (*Canis lupus dingo**).

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Table 4-8 Denison CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
Woodland on alluvium	ATP553P ATP337P PL 218 PL67 PL54 PL41 PL173 PL42 PL 43 PL 44 PL 45 PL 183	3	11.3.1 11.3.2 11.3.3 11.3.3a 11.3.4 11.3.6 11.3.17 11.3.18 11.3.19 11.3.21 11.3.25 11.3.27 11.3.27a 11.3.37 11.3.39	11.3.1 11.3.2 11.3.3 11.3.3a 11.3.4 11.3.17 11.3.21	11.3.1 11.3.2 11.3.3 11.3.3a 11.3.4 11.3.6 11.3.17 11.3.21 11.3.25	11.3.1 11.3.21	Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Cyclorana verrucosa* *Egernia rugosa*
Undulating lowland woodland on clay and sand plains	ATP553P ATP337P PL67 PL54 PL41 PL173	4 5	11.4.2 11.4.3a 11.4.8 11.4.9 11.4.9a 11.5.2 11.5.3 11.5.5 11.5.5c 11.5.15 11.5.20	11.4.2 11.4.3a 11.4.8 11.4.9a	11.4.2 11.4.3a 11.4.8 11.4.9a 11.5.15	11.4.3a 11.4.7 11.4.8 11.4.9a 11.5.15	*Aristida annua* *Eleocharis blakeana* *Xerothamnella herbacea*	*Adelotus brevis* *Cyclorana verrucosa* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*
Acacia or *Eucalyptus* woodland on laterites	ATP337P ATP553P	7	11.7.2					*Delma torquata* *Geophaps scripta scripta* *Chalinolobus dwyeri*
Forested low hills on basalt derived cracking clays	ATP337P ATP553P PL67 PL54	8	11.8.2 11.8.3 11.8.4	11.8.11 11.8.11a	11.8.3 11.8.11 11.8.11a	11.8.3 11.8.11 11.8.11a	*Aristida annua* *Dichanthium queenslandicum* *Dichanthium*	*Geophaps scripta scripta* *Chalinolobus picatus*

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
	PL41 PL173 PL42		11.8.5 11.8.11 11.8.11a				*setosum*	
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	ATP337P ATP553P PL173 PL42 PL183 PL218 PL 43 PL 44 PL 45	9, 10, 11	11.9.1 11.9.2 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.9 11.9.10 11.9.13 11.10.1 11.10.3 11.10.4 11.10.7a 11.10.8 11.10.9 11.10.11 11.10.12 11.10.13a 11.11.13	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10 11.10.8 11.11.13	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10 11.10.8 11.11.13	11.9.1 11.9.4a 11.9.4b 11.9.5	*Apatophyllum teretifolium* *Cadellia pentastylis* *Cycas megacarpa* *Eucalyptus curtisii* *Grevillea singuliflora* *Wahlenbergia islensis* *Grevillea cyranostigma* *Livistona nitida*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Denisonia maculata* *Egernia rugosa* *Paradelma orientalis* *Strophurus taenicauda* *Accipiter novaehollandiae* *Calyptorhynchus lathami* *Erythrotriorchis radiatus* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature	ATP553P ATP337P PL 218 PL67 PL54 PL41 PL173 PL42 PL 43 PL 44 PL 45 PL 183	3, 4, 5, 7, 8, 9, 10, 11	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An ‘a’ or ‘b’ following the RE number indicates the presence of different vegetation communities within that RE.

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[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

4.2.6.4 Scotia CSG Field

General Description and Location

Scotia CSG field is the second smallest of the fields (after Eastern Surat Basin) and covers an area of approximately 75,345 ha. It is the most easterly of the northern CSG Fields, with the southern portion centred on the town of Wandoan. The Scotia CSG field is depicted in Figure 9.

Habitat Diversity

The Wandoan area has little remaining remnant vegetation due to the intensive grazing and cropping activities in the area. RE mapping reveals that approximately 3.8% of the Scotia CSG field's area remains as remnant vegetation, found mostly as isolated pockets and along watercourses.

Habitat Values

Most of the Scotia CSG field is underlain by fine-grained sedimentary rocks. Typical vegetation communities include woodlands and open forests of *Acacia harpophylla* (brigalow) and *E. populnea* (poplar box), with very small patches of semi-evergreen vine thicket. The heavily fragmented nature of the remnant vegetation and typically small individual areas do not encourage the retention of fauna. Often, such areas also sustain populations of feral predators such as red foxes (*Vulpes vulpes*) and cats (*Felis catus*), further reducing opportunities for fauna. It is therefore not expected that a high diversity of fauna exists. However, a large diversity of generalist bird species would be expected to be present.

Corridor Linkages

Very few functional corridors exist within and linking beyond the Scotia CSG field. Roadside vegetation and narrow riparian strips offer restricted capacity for fauna movement. Avian species in particular are less affected by the fragmented vegetation pattern due to their greater mobility.

Significant Species

There are no records of significant species from the Scotia CSG field. It is likely that the squatter pigeon (*Geophaps scripta scripta*), the square-tailed kite (*Lophoictinia isura*) and other birds may utilise degraded habitat in the area.

Fauna Records

The Queensland Museum database shows records for 11 species of frogs, birds and reptiles. Whilst this may partly be a result of a lack of dedicated surveys undertaken in the area, it is probably more a reflection of a lack of suitable habitat necessary to support a diversity of species. Snakes including the Eastern brown snake

(*Pseudonaja textilis*), Myall snake (*Suta suta*), pale-headed snake (*Hoplocephalus bitorquatus*), yellow-faced whipsnake (*Demansia psammophis*), keelback (*Tropidonophis mairii*), red-naped snake (*Furina diadema*) and Australian coral snake (*Brachyurophis australis*) dominate the records.

Feral Species

As mentioned above, feral predators such as the feral cat and red fox are likely to be widespread throughout the area, and would offer the greatest threat to fauna within the Scotia CSG field region.

Table 4-9 Scotia CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
Woodland on alluvium	PL176 EPP	3	11.3.2 11.3.4 11.3.19 11.3.25	11.3.2 11.3.4	11.3.2 11.3.4 11.3.25		*Gossypium sturtianum*	*Geophaps scripta scripta* *Chalinolobus dwyeri*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	PL176 EPP	9, 10,	11.9.1 11.9.4b 11.9.5 11.9.6 11.9.7 11.9.10 11.10.9	11.9.1 11.9.4b 11.9.5 11.9.7 11.9.10	11.9.1 11.9.4b 11.9.5 11.9.7 11.9.10	11.9.1 11.9.4b 11.9.5		*Adelotus brevis* *Calyptorhynchus lathami* *Geophaps scripta scripta* *Chalinolobus picatus*
Cleared grazing land, non-remnant regrowth or scattered mature	PL176 EPP	3, 9, 10	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

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4.2.6.5 Fairview CSG Field

General Description and Location

The Fairview CSG field is located to the north-east of Injune and is due south of, and contiguous with, the Arcadia Valley CSG field. It is approximately 116,000 ha in size and includes portions of Doonkuna SF, Expedition NP (Lonesome and Beilba Sections), Expedition Resources Reserve and Hallett SF. It has been subjected to grazing, forestry and gas extraction activities over a considerable period of time and therefore levels of disturbance are relatively high. The Fairview CSG field is depicted in Figure 8.

Habitat Types

The Fairview CSG field is formed upon the same geological patterns as elsewhere in the northern CSG field area, with sedimentary rocks and alluvium having the greatest influence on vegetation. Approximately 57% of the vegetation present in the Fairview CSG field is mapped as remnant. Grazing lands are dominated by pastures of *Pennisetum ciliare* (buffel grass) with large areas of *Acacia* spp (wattle) regrowth. Remnant vegetation is typically woodland or open forest dominated in the canopy by species such as *C. citriodora* subsp. *citriodora* (lemon-scented gum), *E. populnea*, *E. cloeziana* (Gympie messmate), *E. crebra* (narrow-leaved ironbark) and *Callitris glaucophylla* (white cypress pine). Patches of *Acacia harpophylla* (brigalow) and semi-evergreen vine thicket are also present.

Landforms are similar to the other northern CSG fields, with tablelands and plateaux separated from gorges and valleys by steep scarps and rocky cliffs. This relief provides a range of opportunities for fauna. Heavy disturbance from clearing for grazing in central portions of the CSG field has limited functional habitat mostly to the periphery of the field within managed and protected estate.

Habitat Values

Remnant vegetation in the northern and eastern sections of the CSG field displays better integrity than elsewhere in the CSG field. There is an intensive track network servicing gas wells which has tended to fragment the bushland. However traffic is light and the tracks are generally narrow, these impacts do not significantly impact faunal usage and habitation. A similar scenario exists in Hallett SF in the south of the field where forestry and gas extraction practices have subdivided the *Callitris glaucophylla* (white cypress) and *E. populnea* (poplar box) woodlands into discrete blocks. Intensive clearing in central portions along with significant vehicle movement along the major roads has impacted upon the habitat values and security for fauna. However, overall habitat values are not overly compromised within remnant vegetation.

The macropods are the greatest beneficiaries of the current landscape, as a matrix of open pastures amongst bushland provides both forage and refuge. The diversity of structural attribute within vegetation communities also favours diversity of avifauna, and to a lesser degree, reptiles. The permanent waterholes of Hutton Creek support a population of platypuses (*Ornithorhynchus anatinus*) (Connell Wagner, 2008), and probably a range of turtles and fish. FRC Environmental (2008) note that the banks of Hutton Creek offer excellent habitat opportunities for aquatic fauna due to the presence of overhanging vegetation, piles of branches, and undercut banks.

As elsewhere in the region, pastures of introduced *Pennisetum ciliare* (buffel grass) and immature shrubby regrowth vegetation act as inferior habitat for most species. The exceptions are macropods as mentioned above, grassland birds and some reptile species.

Corridor Linkages

Opportunities for fauna movement through central portions of the CSG field are limited due to the predominance of open grassland. However, patches of vegetation are spaced in such a way that mobile fauna such as macropods and birds are not too disadvantaged. Reptiles, small mammals and frogs are inconvenienced by this pattern and are open to increased rates of predation in these areas. Substantial areas of *Acacia* spp. regrowth are present towards the north of the Field, and while these tend to offer reasonable protection for dispersing fauna, they lack resources such as structural and floristic complexity, nesting and roosting opportunities and yield a reduced range of food and prey items. East-west connectivity is improved in the far north of the field where the Carnarvon and Expedition Ranges converge.

Fauna Records

A search of the Queensland Museum database revealed records for 19 species of fauna including 2 frogs, 5 reptiles and 12 mammals. All records are from well-vegetated portions of the CSG field, including the Carnarvon Range bushland, Beilba SF and Hallett SF. Seven of the mammals are microbats, and the remainder are small ground mammals including delicate mouse (*Pseudomys delicatulus*), common planigale (*Planigale maculata*) and striped-faced dunnart (*Sminthopsis macroura*). These records indicate that despite disturbances to habitat, the integrity is sufficient to retain a suite of sensitive ground mammals. In addition, the presence of a diversity of bats indicates that suitable habitat, including tree hollows and rock crevices and caves, are present.

Thirty-nine species of fauna were observed during the fieldwork in the Fairview CSG field. These include 34 species of bird, 1 reptile and 4 species of mammal. Birds were observed from all feeding groups, in particular raptors, grassland specialists, wading and waterbirds, honeyeaters and woodland insectivores. The echidna (*Tachyglossus aculeatus*), black-striped wallaby (*Macropus dorsalis*) and eastern grey kangaroo (*Macropus giganteus*) were the common native mammals observed.

Significant Species

The squatter pigeon (southern) (*Geophaps scripta scripta*) was commonly observed in suitable habitat throughout the CSG field. This species prefers open woodland with a grassy understorey and adjacent grasslands; habitat which is abundant in the area. No significant fauna records were derived from the Queensland Museum database.

Feral Animals

Records of house mouse (*Mus musculus**) and black rat (*Rattus rattus**) were sourced from the Museum database. These introduced species are prevalent throughout much of Australia, and their presence does not necessarily indicate a reduction in habitat values. The house mouse is generally associated with human habitation. Whilst no feral fauna was detected during the fieldwork, it is likely that the red fox (*Vulpes vulpes**), feral cat (*Felis catus**), dingo/wild dog (*Canis lupus dingo**) and feral pig (*Sus scrofa**) are widespread and common in the region.

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Table 4-10 Fairview CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Status[3]		
Woodland on alluvium	PL90 PL91 PL92 PL99 PL100	3	11.3.2 11.3.17 11.3.18 11.3.19 11.3.25 11.3.39	11.3.2 11.3.17	11.3.2 11.3.17 11.3.25		Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Nyctophilus timoriensis*
undulating lowland woodland on clay and sand plains	PL99	5	11.5.5				*Aristida annua*	*Adelotus brevis* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	PL90 PL91 PL92 PL99 PL100	9, 10	11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10 11.10.1 11.10.3 11.10.4 11.10.7 11.10.7a 11.10.9 11.10.11 11.10.13a	11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10	11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10	11.9.4a 11.9.4b 11.9.5	*Cadellia pentastylis* *Wahlenbergia islensis*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Calyptorhynchus lathami* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature	PL90 PL91 PL92 PL99 PL100	3, 5, 9, 10	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

4.2.6.6 Arcadia Valley CSG Field

General Description

The Arcadia Valley CSG field is located on the eastern rim of the Arcadia Valley and incorporates parts of the south-eastern Carnarvon Range and southern Expedition Range. It is approximately 318,800 ha in size of which 36 % (111,475 ha) is managed and protected estate including parts of Expedition NP, Expedition Resources Reserve, Belington Hut SF and Beilba SF. The Arcadia Valley CSG field is depicted in Figure 7a and Figure 7b.

Habitat Types

145,316 hectares (or 45%) of the Arcadia Valley CSG field vegetation is mapped as remnant. The ranges are comprised of a similar suite of rock types as found elsewhere in the northern CSG fields and as such vegetation communities are similar overall. Woodlands and open forests again dominate the low sedimentary hills and tablelands, with communities typically dominated by canopy species such as *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum), *E. cloeziana* (Gympie messmate), *E. decorticans* (gum-topped ironbark) and *Acacia* spp. Also prominent are *E. melanophloia* (silver-leaved ironbark) and *E. populnea* (poplar box) woodlands on alluvium, and patches of semi-evergreen vine thicket on fine-grained sedimentary rocks.

Habitat Values

A large expanse of woodland and open forest is found on the sandstone tablelands, hills and catchments of the Expedition and Carnarvon Ranges within and contiguous with the Arcadia Valley CSG field. Whilst some grazing and forestry activities are occurring within this area, the overall size and condition allows for significant fauna refuge.

Within the *Eucalyptus* and *Corymbia* woodlands on the ranges, a dense shrubby midlayer can be locally common. These variations in density are valuable for promoting a large diversity of birds. In addition, macropods seek denser vegetation in which to rest during the day and rely on these communities for secure diurnal refuge. The open woodlands on deeper soils tend to support a dense groundlayer consisting of native grasses and forbs which is suitable for small ground-dwelling reptiles and mammals. Woodlands and open forests on shallow, rocky soils feature a sparser groundlayer that provides less vegetative cover for fauna, but the presence of other microhabitat such as rocks and fallen timber tends to compensate for this. The ranges are also recognised for rocky habitat such as cliffs, gorges, scarps, rocks, boulders, caves and crevices. These features offer valuable refuge for a suite of mammal and reptiles in particular, with shy macropods utilising the rugged terrain and a range of microbats using fissures and crevices as roost sites. Reptiles abound due the array of microhabitats in which they and their prey shelter.

The Dawson River, which traverses Expedition NP and Belington Hut SF within the Arcadia Valley CSG field, supports platypuses (*Ornithorhynchus anatinus*), five species of turtle (EPA, 2008) and 7 species of fish within permanent waterholes (frc environmental, 2008). The upper Dawson River is one of the few waterways within

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the CSG fields that possesses permanent waterholes, and thus offers significant habitat and feeding resources for a large range of species.

As with elsewhere within the northern CSG fields, fertile soils on undulating land within the valleys have been subjected to intensive clearing of native vegetation resulting in a patchwork of isolated stands of woodland. These generally offer inferior habitat value to fauna due to the size, isolation, surrounding land use and use by cattle as shelter.

Corridor Linkages

Significant capacity for fauna movement is held within the forested Expedition and Carnarvon Ranges. Fauna dispersal, migration and movement are possible in an east-west direction at the southern end of the Arcadia Valley and in a north-south direction along the Expedition Range to the east of the Arcadia Valley. Large expanses of vegetation exist beyond the Field boundary, apart from the Arcadia Valley which possesses only very tenuous links between isolated remnants within a fragmented landscape.

Fauna Records

117 fauna records comprising 53 birds, 14 amphibians, 14 mammals and 36 reptiles have been extracted from the Queensland Museum database for the Arcadia Valley CSG field. Whilst this indicates a greater diversity than the CSG fields previously described above, it is probably more suggestive of a greater past ecological study effort. Woodland birds such as honeyeaters, doves, canopy gleaners and insectivores dominate the avian species. A typical range of frogs is presented, and the diversity of reptiles suggests survey work has been focussed on this group. Elapid and colubrid snakes are recorded, as well as a large range of skinks and geckos. The mammal list appears typical for this area and is dominated by microbats and small ground-dwelling rodents and dasyurids.

During flora studies for the Arcadia Valley CSG field survey work, 30 fauna species were incidentally observed. These include 25 birds, 2 reptiles and 3 mammals. As fauna observations were not a focus of this study, this list is not representative of all fauna found within the field. A small number of species of birds from all feeding groups were observed, including raptors, honeyeaters insectivores and waterbirds. Whilst all are typical of the area, a much greater diversity would be present. The reptiles recorded were the nobbi dragon (*Amphibolurus nobbi*) and the lace monitor (*Varanus varius*). A high diversity of cryptic species such as the skinks and geckos would be expected with an intensive survey effort. The eastern grey kangaroo (*Macropus giganteus*) and the red-necked wallaby (*M. rufogriseus*) were the only macropods positively identified. However macropod scats were plentiful within all areas visited.

Significant Species

The Queensland Museum database provides records for 5 significant species within the Arcadia Valley CSG field: golden-tailed gecko (*Strophurus taenicauda*) squatter pigeon (southern) (*Geophaps scripta scripta*), glossy black-cockatoo (*Calyptorhynchus lathami*), yakka skink (*Egernia rugosa*) and Dunmall's snake (*Furina dunmalli*).

Feral Species

The cane toad (*Bufo marinus**) and house mouse (*Mus musculus**) are noted from Museum records for the Arcadia Valley CSG Field. The European rabbit (*Oryctolagus cuniculus**) was the only feral animal noted during the fieldwork.

Table 4-11 Arcadia Valley CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	Bio Status[2]	EPBC Act[3]		
Woodland on alluvium	ATP526P ATP653P PL232 PL233 PL234 PL235 PL236	3	11.3.2 11.3.17 11.3.25 11.3.39	11.3.2 11.3.17	11.3.2 11.3.17 11.3.25		Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Cyclorana verrucosa* *Egernia rugosa* *Nyctophilus timoriensis*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	ATP526P ATP653P PL232 PL233 PL234 PL235 PL236	9, 10, 11	11.9.2 11.9.4a 11.9.4b 11.9.5 11.10.1 11.10.3 11.10.4 11.10.7a 11.10.8 11.10.9 11.10.11 11.10.13a	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10 11.10.8	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.10 11.10.8	11.9.1 11.9.4a 11.9.4b 11.9.5	*Cadellia pentastylis* *Cycas megacarpa* *Eucalyptus curtisii* *Grevillea singuliflora* *Macrozamia platyrhachis* *Wahlenbergia islensis*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Paradelma orientalis* *Accipiter novaehollandiae* *Calyptorhynchus lathami* *Erythrotriorchis radiatus* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature	ATP526P ATP653P PL232 PL233 PL234 PL235 PL236	3, 9, 10, 11	N/A				*Dichanthium queenslandicum*	*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and

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Rare. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

4.2.6.7 Roma Other CSG Field

General Description and Location

The Roma Other CSG field is 131,746 ha in size and comprises two disjunct areas. The main body lies immediately west of the township of Taroom and incorporates part the Lynd and Murphy Ranges. The other part of the tenement lies to the north and is positioned on the Bigge Range. Southern portions feature lightly undulating terrain with intensive grazing and cropping present. Lake Murphy Conservation Park, Carraba Conservation Park and parts of Gwambagwine State Forest and Theodore State Forest are found within the tenement. The Roma Other CSG field is depicted in Figure 12a and Figure 12b.

Habitat Types

The Roma Other CSG Field comprises a variety of landforms and landuses. The southern portion of the tenement is predominantly gently undulating and has been heavily impacted by clearing for agricultural and pastoral activities. The middle and northern sections of this area feature the vegetated tableland topography prevalent in most of the northern CSG fields. However, the tablelands are generally isolated amongst the cleared valley areas, Other habitat present is generally restricted to riparian, fenceline or roadside remnants, with occasional larger scattered patches. The northern portion of the tenement is predominantly heavily vegetated upon the sandstone geology prevalent throughout the region. Clearing has been undertaken in areas, especially within the broader valleys. Woodlands and open forests dominate the low sedimentary hills and tablelands in the north, with communities dominated by *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum).

Habitat Values

Given the fragmentation of the landscape in the southern portion of the tenement, there is unlikely to be significant habitat values present. Remnant vegetation is generally restricted to low isolated sandstone tablelands or strips of riparian woodland. Larger areas of remnant vegetation are present but are generally isolated. As most of the remnant vegetation is held on private land, it is likely that these areas have been subjected to impacts from cattle and selective timber harvesting. Therefore habitat values will possibly be reduced in these areas. Despite this, isolated patches of remnant vegetation can be valuable for a range of native fauna, in particular birds and macropods which are more mobile. Species sensitive to disturbance, such as many reptiles, frogs and small ground mammals may not be able to persist in areas where disturbance has resulted in changes to habitat size, quality and connectivity.

The northern portion of the tenement provides greater opportunities for fauna due to the extent of remnant vegetation within and beyond the CSG field boundaries. This portion is dominated by woodlands and open forests of *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum) and *E. crebra* (narrow-leaved ironbark). Alluvium within the valleys supports woodlands of *E. tereticornis* (forest red gum) and *E. populnea* (poplar box). Patches of *Acacia harpophylla* (brigalow) are also present. The sandstone ranges are typically less impacted by grazing or forestry and thus provide significant habitat resources for a wide range of fauna. The connectivity along the well-vegetated ranges allows for dispersal of fauna which assists in maintaining populations of all fauna groups.

Corridor Linkages

Corridor links within the southern portion of the Roma Other CSG field are tenuous at best, Riparian, roadside and fenceline vegetation remains as a vestige of the former widespread matrix of woodlands. This relatively poor network of corridor linkages is unlikely to act as functional habitat for fauna attempting to move throughout the landscape. The northern portion of the tenement is mostly vegetated with secure habitat in national parks and state forests in all directions around the area. Therefore connectivity for fauna is high in this section.

Fauna Records

The Queensland Museum fauna database notes records for 41 species of fauna in the Roma Other CSG field. These include 12 birds, 10 amphibians, 4 mammals and 15 reptiles. The birds listed are typical of the area and generally feature woodland insectivores and canopy gleaners, with some pasture and grassland species also recorded. The amphibians are common species and all are mostly adaptable to changes in habitat quality and structure. The mammals feature 3 macropods including the black-stripe wallaby (*Macropus dorsalis*), eastern grey kangaroo (*Macropus giganteus*) and swamp wallaby (*Wallabia bicolor*) as well as the koala (*Phascolarctos cinereus*). It is possible that swamp wallabies are present in larger areas of remnant vegetation in the lowlands. It is likely that black-stripe wallabies are restricted to the well-vegetated sandstone ranges in the north. The eastern grey kangaroo would probably be found in pastures, grassland and open woodland throughout the CSG field. The koala may still be present in small numbers where suitable habitat exists. The reptile records mainly feature a range of common skinks. However, a turtle, geckos and a monitor are also listed. Most are common species.

Significant Species

The golden-tailed gecko was recorded from near Taroom, This species is listed as Rare under the NC Act. It is likely that the squatter pigeon (*Geophaps scripta scripta*) would be found throughout the lowland areas, and species such as the powerful owl (*Ninox strenua*) would utilise denser vegetation in the northern section.

Feral Animals

The cane toad (*Bufo marinus**) is listed in the Queensland Museum fauna database. It is likely to be present throughout the region. The red fox (*Vulpes vulpes**), feral cat (*Felis catus**), dingo/wild dog (*Canis lupus dingo**) and feral pig (*Sus scrofa**) will all be present in portions of the Roma Other CSG field.

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Table 4-12 Roma CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
Woodland on alluvium	EPP803	3	11.3.2 11.3.3 11.3.19 11.3.25 11.3.27a 11.3.39	11.3.2 11.3.3 11.3.17	11.3.2 11.3.3 11.3.25 11.3.27a		Gossypium sturtianum	Geophaps scripta scripta Chalinolobus dwyeri Adelotus brevis Cyclorana verrucosa Egernia rugosa
Undulating lowland woodland on clay and sand plains	EPP803	5	11.5.1 11.5.9 11.5.9d				*Aristida annua* *Melaleuca irbyana*	*Adelotus brevis* *Cyclorana verrucosa* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	EPP803	9, 10	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.10 11.10.1 11.10.4 11.10.7a 11.10.13a	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.10	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.10	11.9.1 11.9.4a 11.9.4b 11.9.5	*Cadellia pentastylis*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Paradelma orientalis* *Accipiter novaehollandiae* *Calyptorhynchus lathami* *Erythrotriorchis radiatus* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land, non-remnant regrowth or scattered mature	EPP803	3, 5, 9,10	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3] Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4] Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses

the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

4.2.7 Fauna Habitat Values - Southern CSG Fields

4.2.7.1 Roma CSG Field

General Description

The Roma CSG field is essentially centred on the township of Roma, with two outlying tenements to the north near Injune. It is 839,200 ha in size and covers all, or portions of, Brucedale, Gubberamunda, Inglebogie, Tinowon, Trinidad, Wallabella and Yalebone State Forests. The area has been subjected to intensive historical grazing and agricultural pressure and this is reflected in the fragmented nature of the remnant vegetation. Only 19% of the Roma CSG field is mapped as remnant vegetation, most of which is retained in private ownership. The Roma CSG field is depicted in Figure 10a to Figure 10h.

Habitat Types

The majority of remnant vegetation is comprised of woodlands and open forests dominated by canopy species such as *C. glaucophylla* (white cypress), *E. populnea* (poplar box), *E. crebra* (narrow-leaved ironbark), *E. melanophloia* (silver-leaved ironbark) and *Acacia* spp. (wattles) on a variety of landforms and geology. Narrow fringing riparian woodland is a common feature of the landscape.

Habitat Values

The Roma district is characterised by intensive pastoral and agricultural production. The long history of these activities has resulted in a fragmented landscape that consists of patches of remnant vegetation amongst cleared pasture and broadacre cropping. Vegetation held in forestry reserves is subject to impacts such as logging and grazing. Impacts from cattle are common within privately-held bushland. Given the intensity of agricultural activities and the fragmented nature of remnant vegetation, it is unlikely that populations of sensitive small ground mammals have been retained, especially in smaller patches and where a predominance of *Pennisetum ciliare* (buffel grass) is found. The presence of feral predators would also have had a huge impact on populations of susceptible species. As with other cleared areas, mobile fauna such as macropods (especially the eastern grey kangaroo in this context) and common birds would proliferate. Mature *E. tereticornis* (forest red gums) along waterways are a relatively plentiful resource as riparian vegetation, albeit often a narrow strip, is usually retained by graziers. Forest red gums and mature *E. populnea* (poplar box) are characterised by the ready formation of arboreal hollows which are utilised by nesting birds, roosting microbats and arboreal mammals.

Corridor Linkages

The highly fragmented nature of the landscape has resulted in a patchwork of remnant vegetation tenuously connected by roadside and riparian vegetation. Whilst usually narrow, they are successfully utilised by larger mammals such as macropods, birds, and to a lesser degree, reptiles and amphibians. The narrowness of the vegetated corridors leaves many of the smaller animals susceptible to predation by native and feral predators as they attempt to disperse through the landscape. There are no large, effective corridors linking the Roma CSG field to external habitat.

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Fauna Records

Ninety-nine fauna records for the Roma CSG field were sourced from the Queensland Museum database. These included 20 birds, 9 frogs, 16 mammals and 54 reptiles. All bird species are typical of woodland and open grassland assemblages, with all adaptable to fragmented landscapes. The frog diversity is also typical for the area, and includes members of the *Cyclorana, Limnodynastes, Litoria and Uperoleia* genera. Mammals are represented by microbats, dasyurids, arboreal and ground marsupials and a monotreme; the echidna (*Tachyglossus aculeatus*). A large diversity of reptiles was recorded, including members of the elapid snakes (14 species), skinks (16 species), geckoes (9 species), blind snakes (5 species), flap-footed lizards (4 species), pythons (3 species), monitors (2 species) agamids (1 species) and colubrid snakes (1 species). The diversity of reptiles and small ground mammals is high considering the widespread disturbance to native vegetation in the area. As many of these records are more than 40 years old, it is likely that many of the recorded species are now locally extinct or contained within small and unsustainable populations.

Fieldwork within the Roma CSG field detected 74 species of fauna including 58 birds, 6 reptiles, 2 frogs and 8 mammals. As would be expected in a highly altered landscape, most species are common with woodland insectivores, nectarivores, waterbirds, grassland generalists and raptors dominating the bird tally. Two species of macropod were observed: the red-necked wallaby (*Macropus rufogriseus*) and eastern grey kangaroo (*Macropus giganteus*). Signs of the echidna (*Tachyglossus aculeatus*) were evident in larger remnants.

Significant Species

Queensland Museum data shows records for 4 significant species in the Roma CSG field area including the death adder (*Acanthophis antarcticus*), woma (*Aspidites ramsayi*), warty waterholding frog (*Cyclorana verrucosa*) and squatter pigeon (southern) (*Geophaps scripta scripta*). Many of these records are historical (> 40 years ago) and thus local extinctions may have occurred in the intervening period.

The squatter pigeon (southern) (*Geophaps scripta scripta*) was observed occasionally within open woodland with a grassy groundcover. It would be locally common in suitable habitat throughout the Roma CSG field.

Feral Animals

Domestic cattle (*Bos taurus**), dog (*Canis lupus**), feral pig (*Sus scrofa**) and red fox (*Vulpes vulpes**) were listed within the Queensland Museum database for the Roma CSG field.

The European rabbit (*Oryctolagus cuniculus**) and the feral pigeon (*Columba livia**) were the only feral animals observed during the fieldwork. The red fox (*Vulpes vulpes**) and feral cat (*Felis catus**) would be common throughout the region.

Table 4-13 Roma CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
Woodland on alluvium	PL3 PL4 PL5 PL6 PL7 PL8 PL9 PL10 PL10 Waldegrave PL11 PL12 Waldegrave PL13 PL28 Waldegrave PL89 PL93 EPP631 EPP665 EPP708 ATP336P Roma ATP655P	3	11.3.2 11.3.3 11.3.17 11.3.18 11.3.19 11.3.21 11.3.25 11.3.28	11.3.2 11.3.3 11.3.17 11.3.21	11.3.2 11.3.3 11.3.17 11.3.21 11.3.25	11.3.21	*Gossypium sturtianum* Mound springs communities	*Geophaps scripta scripta* *Chalinolobus dwyeri* *Adelotus brevis* *Cyclorana verrucosa* *Egernia rugosa*
Undulating lowland woodland on clay and sand plains	PL3 PL6 PL7 PL9 PL10 PL10 Waldegrave PL11 PL12 T PL12 Waldegrave PL28 Waldegrave PL 69 PL 89 EPP 631 EPP665 ATP 336P Roma	4 5	6.4.3 6.5.1 6.5.2 6.5.3 11.4.3 11.4.7 11.5.1 11.5.4 11.5.5 11.5.9a 11.5.13	6.4.3 11.4.3	6.4.3 6.5.1 6.5.3 11.4.3	11.4.3 11.4.7	*Aristida annua* *Melaleuca irbyana*	*Adelotus brevis* *Cyclorana verrucosa* *Denisonia maculata* *Egernia rugosa* *Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus picatus* *Chalinolobus dwyeri*

Section 4 Stage 2 CSG Field Surveys

Broad Landscape Element	Relevant ATP/PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
Acacia or *Eucalyptus* woodland on laterites	PL 5 PL 6 PL 9 PL12 Waldegrave PL 28 Waldegrave EPP 631 EPP 665 ATP 336P Roma	7	6.7.1 6.7.5 11.7.1 11.7.2 11.7.4 11.7.5 11.7.6 11.7.7		6.7.5			*Delma torquata* *Geophaps scripta scripta* *Chalinolobus dwyeri*
Forested low hills on basalt derived cracking clays	PL 4 PL 13 EPP 665	8	11.8.3 11.8.5 11.8.11	11.8.11	11.8.3 11.8.11	11.8.3 11.8.11	*Dichanthium queenslandicum*	*Geophaps scripta scripta* *Chalinolobus picatus*
Woodland and open forest on sandstone tablelands and ranges. Includes semi-evergreen vine thickets.	PL3 PL4 PL5 PL6 PL7 PL8 PL9 PL10 PL10 Waldegrave PL11 PL12 T PL12 Waldegrave PL13 PL 28 Waldegrave PL69 PL89 PL93 EPP631 EPP665 EPP708 ATP 336P Roma ATP 655P	9, 10, 11	11.9.1 11.9.3 11.9.3a 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.7a 11.9.10 11.9.11 11.10.1 11.10.9 11.10.11	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.7a 11.9.10	11.9.1 11.9.4a 11.9.4b 11.9.5 11.9.7 11.9.7a 11.9.10	11.9.1 11.9.4a 11.9.4b 11.9.5	*Cadellia pentastylis*	*Adelotus brevis* *Cyclorana verrucosa* *Aspidites ramsayi* *Egernia rugosa* *Paradelma orientalis* *Accipiter novaehollandiae* *Calyptorhynchus lathami* *Erythrotriorchis radiatus* *Geophaps scripta scripta* *Ninox strenua* *Chalinolobus picatus* *Dasyurus hallucatus* *Chalinolobus dwyeri*
Cleared grazing land,	PL3 PL4	3, 4, 5, 7,	N/A					*Geophaps scripta scripta*

Broad Landscape Element	Relevant ATP/PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
non-remnant regrowth or scattered mature	PL5 PL6 PL7 PL8 PL9 PL10 PL10 Waldegrave PL11 PL12 Oberina PL12 T PL12 Waldegrave PL13 PL 28 Waldegrave PL69 PL89 PL93 EPP631 EPP665 EPP708 ATP 336P Roma ATP 655P	8, 9, 10, 11						*Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

Section 4 Stage 2 CSG Field Surveys

4.2.7.2 Eastern Surat Basin CSG Field

General Description and Location

The Eastern Surat Basin (ESB) CSG field is 36,241 ha in size and comprises three disjunct areas to the west of the towns of Tara and Moonie. The area is lightly undulating and features intensive grazing and cropping practices. There are no forestry or conservation areas situated within the ESB CSG field. The ESB CSG field is depicted in Figure 11a and Figure 11b.

Habitat Types

The landscape within the ESB CSG field is mostly devoid of remnant vegetation, having been cleared for intensive agricultural and pastoral purposes. RE mapping shows remnant vegetation as small isolated patches, fenceline and roadside strips, and narrow riparian remnants. Remnant vegetation comprises of open forest and woodland of *Acacia harpophylla* (brigalow), *E. populnea* (poplar box), *E. tereticornis* (forest red gum) and *E. melanophloia* (silver-leaved ironbark) on alluvium, clay plains or sand plains. Small patches of *E. decorticans* (gum-topped ironbark) on lateritic duricrust are also present.

Habitat Values

Given the fragmentation, size and shape of remnant vegetation communities, there is unlikely to be significant habitat values present within the ESB CSG field. Forest red gum and poplar box woodlands on alluvium are often retained and mature individual trees within these communities can provide arboreal hollows capable of supporting populations of arboreal nesting and roosting microbats, birds and marsupials. It is probable that many of the larger woodlands are utilised by cattle for shelter and browsing and this can have a detrimental effect on soils, microhabitat and through the introduction of weeds. Assemblages of small ground mammals sensitive to disturbance are unlikely to survive in such a landscape.

Corridor Linkages

Corridor links within the ESB CSG field are virtually non-existent, especially between patches of remnant vegetation. Riparian vegetation and roadside vegetation is present in places, however these are not continuous for long distances. The vegetation patterns within the field best suit macropods (e.g. the eastern grey kangaroo) and birds due to their mobility.

Fauna Records

The Queensland Museum fauna database notes records for 8 species of fauna in the ESB CSG field. These are eastern brown snake (*Pseudonaja textilis*), a blind snake (*Ramphotyphlops weidii*), bandy bandy (*Vermicella annulata*), warty waterholding frog (*Cyclorana verrucosa*), short-footed waterholding frog (*C. brevipes*), salmon-striped frog (*Limnodynastes salmini*), spotted marsh frog (*L. tasmaniensis*) and a dunnart (*Sminthopsis* sp.).

Significant Species

Warty-waterholding frog (*C. verrucosa*) is listed as Rare under the NC Act. However, this record is 30 years old and this species may not still be present in the area. Given the highly fragmented nature of vegetation communities and intensive agricultural and pastoral activities, the ESB CSG Field is unlikely to support a

diversity of significant species. Birds such as the squatter pigeon (*Geophaps scripta scripta*) and the square-tailed kite (*Lophoictinia isura*) are examples of species that may occasionally use or overfly suitable habitat.

Feral Animals

It is likely that the red fox (*Vulpes vulpes**), feral cat (*Felis catus**), dingo/wild dog (*Canis lupus dingo**) and feral pig (*Sus scrofa**) are present in the CSG field.

Table 4-14 Eastern Surat Basin CSG Field Summary of Ecologically Significant Values

Broad Landscape Element	Relevant ATP/ PL	Land Zone	Potential REs[1]	Potential Significant Vegetation Communities			Potential EVR Flora Species and Communities[4]	Potential Fauna Habitat / EVR Species[4]
				VM Status[2]	BD Status[2]	EPBC Status[3]		
Woodland on alluvium	PL1(1) PL17 Upper Stratum	3	11.3.2 11.3.3 11.3.17 11.3.25 11.3.27b	11.3.2 11.3.3 11.3.17	11.3.2 11.3.3 11.3.17 11.3.25 11.3.27b			*Geophaps scripta scripta*
undulating lowland woodland on clay and sand plains	PL1(1) PL1(2) PL17 Upper Stratum	4 5	11.4.3 11.4.3a 11.4.10 11.4.12 11.5.4 11.5.5	11.4.3a 11.4.10 11.4.12	11.4.3a 11.5.15 11.4.10 11.4.12	11.4.3a 11.4.10		*Geophaps scripta scripta* *Lophoictinia isura* *Chalinolobus dwyeri*
Acacia or *Eucalyptus* woodland on laterites	PL1(2)	7	11.7.4					*Geophaps scripta scripta*
Cleared grazing land, non-remnant regrowth or scattered mature	PL1(1) PL1(2) PL17 Upper Stratum	3, 4, 5, 7	N/A					*Geophaps scripta scripta* *Lophoictinia isura*

[1] An 'a' or 'b' following the RE number indicates the presence of different vegetation communities within that RE.

[2] As per current State Government Regional Ecosystems 1: 100,000 Coverage v.5.0 (DNRM&W, 2005).Significant REs are listed under the VM Status and BD Status as Of Concern and Endangered.

[3]Significant vegetation communities are those listed under the EPBC Act as: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

[4]Potential EVR flora and fauna species are those listed under the NC Act and EPBC Act as significant. The NC Act uses the following categories for significant fauna species: **Extinct in the wild, Endangered, Vulnerable, Near Threatened** and **Rare**. The EPBC Act uses the following categories for significant flora and fauna species: **Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable** and **Conservation Dependent**

Section 5 Potential Impacts and Mitigation

5.1 Development of the CSG Fields

The development of each CSG field will be undertaken in four distinct phases comprising Exploration, Construction, Operation and Decommissioning. Each phase consists of several activities, as outlined below (refer also to the “Project Description” chapter of the EIS for further details). Activities, potential impacts and mitigation measures are outlined in Table 5-1.

5.1.1 Exploration Phase

The exploration phase comprises the following stages:

- Establishment of access tracks;
- Seismic and geophysical surveys; and
- Corehole drilling to collect solid coal and rock cores for testing.

5.1.2 Construction Phase

The construction phase proceeds if seismic, corehole or geophysical testing confirms the potential presence of a resource. Upon confirmation of the economic viability of the resource, a pilot or appraisal well is constructed. Typically, the construction phase consists of the following components:

- Construction of pilot/ appraisal wells;
- Upgrade/ conversion to production wells;
- Gas and water pipeline gathering systems;
- Gas processing facilities;
- Associated water infrastructure including storage ponds and water treatment facilities;
- Accommodation facilities and associated infrastructure;
- Road construction; and
- Borrow pits, laydown and storage areas.

5.1.3 Operation Phase

Typical components of the operational phase include:

- Operation of production wells;
- Operation of gas processing facilities;
- Use of borrow pits;
- Use of laydown and storage areas and roads; and
- Progressive rehabilitation.

5.1.4 Decommissioning Phase

Decommissioning includes remediation and rehabilitation during the entire duration of the CSG field development program. The following components will be subject to decommissioning:

- Seismic lines including all historic seismic lines;
- Wells and well sites including infrastructure;
- Gas and water pipelines;
- Processing and associated facilities including administration buildings, workshops, accommodation facilities and stores;
- Water management facilities including treatment plants, tanks as well as any water management ponds;
- Waste management areas including waste storage facilities and soil remediation areas;
- All roads and access tracks;
- Borrow pits and storage areas including pipe stockpiles and construction materials; and
- Remediation of areas used for storage of petroleum or chemical products, waste management areas and sites that have been subject to historical oil spills;

5.2 Potential Impacts

It should be noted that all phases of development may be occurring concurrently within the same CSG field for different leases and sites. Therefore, it would not be expected that the following activities and impacts are occurring in isolation and a combination of any of the mitigation actions outlined within Table 5-1 may be required within each CSG field.

5.2.1 Exploration Phase

5.2.1.1 Impacts to Fauna and Flora

The primary potential impacts on fauna, flora and habitat during the exploration phase could include some loss of habitat. This phase will involve, in part, preparation of access tracks and the clearing or trimming of vegetation for preparation of seismic testing and corehole drilling. This may result in the removal of a small amount of vegetation and microhabitat within the area of disturbance. For example, the area around the corehole drilling lease (60m x 60m) may be slashed, and not entirely cleared, to reduce any potential for erosion and to improve rehabilitation. Impacts to fauna as a result of these activities will generally be slight, with a small chance of fauna mortality in areas affected. Given that much of the clearing will only involve the removal of selected trees and shrubs and the lopping of tree braches to allow vehicle and equipment access, impacts to fauna will generally be low. Much of the CSG field study area is highly altered and is devoid of significant habitat. The development of a road network over this area will place fauna at a greater risk of being struck by vehicles. Marker pegs and open shotholes remaining from the exploration phase may offer a physical hazard to fauna and stock if left unattended. Mitigation strategies for potential impacts to flora and fauna are detailed within Table 5-1, below. For the exploration phase, the following activities may impact on flora and fauna:

- Seismic surveys;
- Establishment of coreholes;

Section 5 Potential Impacts and Mitigation

- Establishment of access tracks; and
- Vehicular use of tracks.

5.2.1.2 Fragmentation and Loss of Fauna Movement Opportunities

The relatively low-level of activity undertaken during the exploration phase will not significantly impact on the ability of fauna to move through the landscape. Historic clearing and grazing activities have previously substantially contributed to the loss of effective corridor linkages throughout much of the CSG field area. Mitigation strategies for potential impacts to fauna corridors are detailed within Table 5-1, below. For the exploration phase, the following activities may impact on the ability of fauna to move through the landscape:

- Establishment of coreholes; and
- Establishment of access tracks.

5.2.1.3 Weeds and Pest Species

Desktop and field studies have confirmed the presence of the declared weeds *Parthenium hysterophorus** (parthenium), *Opuntia tomentosa** (velvety tree pear), *O. stricta** (prickly pear) and *Lantana camara** (lantana) within or near the CSG fields. Of these species, parthenium has the greatest potential to significantly impact upon grazing and ecological values in the area. Many of the CSG fields remain free of parthenium. However, the weed could easily be introduced to new areas through poor weed hygiene practices. Introduction to areas previously free of infestations could result in major issues with loss of grazing potential, reduction in habitat value and increase in risk to human health.

As populations of red foxes, pigs, feral cats and dogs and cane toads (among others) already populate the CSG fields, it is highly unlikely that the proposed works will result in a proliferation of these species. The introduction of exotic ant fauna is a potential risk. Yellow crazy ants (*Anoplolepis gracilipes*) and fire ants (*Solenopsis invicta**) are exotic ants that have the potential to seriously impact on native flora, fauna and ecological communities. They are capable of being transported from infested sites to new construction sites on equipment or within materials. Whilst many colonies of both species have been eradicated elsewhere in Queensland, there remains a slight chance of spreading ants to new areas. Mitigation strategies to reduce impacts from pests and weeds are detailed within Table 5-1, below. For the exploration phase, the following activities may offer opportunities for weed and pest spread and infestation:

- Seismic surveys;
- Establishment of coreholes;
- Establishment of access tracks; and
- Vehicular use of tracks.

5.2.1.4 Erosion

There is potential for erosion on areas disturbed by works associated with the creation of seismic lines and access tracks. Where these activities occur on erosive soils and/or on slopes, mobilisation of sediment into watercourses can occur. Impacts to aquatic ecosystems can include build-up of sediment in waterholes with a subsequent reduction in available habitat, smothering of aquatic plants and substrate and cumulative downstream impacts on estuarine and offshore marine habitats. Mitigation strategies for potential impacts from

erosion are detailed within Table 5-1 below. For the exploration phase, the following activities may require erosion controls:

- Seismic surveys;
- Establishment of coreholes;
- Establishment of access tracks; and
- Vehicular use of tracks.

Refer to the separate EIS Soils and Terrain technical report for further details on erosion impacts.

5.2.1.5 Dust Impacts

Deposition of dust, sand and soil may have potential impacts on vegetation if excessive levels are sustained over extended periods. When dust settles on plant foliage, it can reduce the amount of light penetration on the leaf surface, block and damage stomata, and slow rates of gas exchange and water loss. Reduction in the ability to photosynthesise due to physical effects may result in reduced growth rates of vegetation and decreases in floral vigour and overall community health. The potential effects of dust deposition on vegetation are determined by a number of factors including:

- The characteristics of leaf surfaces, such as surface roughness, influencing the rate of dust deposition on vegetation;
- Concentration and size of dust particles in the ambient air and its associated deposition rates; and
- Local meteorological conditions and the degree of penetration of dust into vegetation;

The dominant woodland species of the vegetation communities within the CSG fields typically exhibit physiological qualities that are not sensitive to dust deposition. The sclerophyllous foliage of *Eucalyptus* and *Corymbia* species is generally pendulous (i.e. points down), with a thick smooth cuticle that does not encourage particulate matter to remain on the surface. The dominant woodland species are also generally hardy and well adapted to adverse conditions (e.g. extended dry conditions and low nutrient soils).

Control measures will be implemented to minimise dust generation during the exploration phase of the CSG field development program, and it is not expected that potential effects of dust deposition on vegetation will be significant. The use of dirt tracks and roads within the CSG fields will generate dust. Mitigation strategies for potential impacts to flora and fauna from excessive dust are detailed within Table 5-1 below. For the exploration phase, the following activities may generate excessive dust:

- Seismic surveys;
- Establishment of coreholes;
- Establishment of access tracks; and
- Vehicular use of tracks.

Refer to the separate EIS Air quality technical study for further details on dust impacts.

5.2.1.6 Noise Impacts

Fauna may be affected in the short-term by noise stemming from activities such as road construction and seismic testing. Fauna will generally move away from the source to avoid these impacts and will return to the

area when the disturbance ceases. Where the impact is low-level but continuous, acclimatisation by some species will occur over the longer term. It is not expected that noise impacts will cause significant impacts to fauna during the exploration phase. Mitigation strategies to reduce potential impacts to fauna from noise are detailed within Table 5-1 below. For the exploration phase, the following activities may result in the generation of noise:

- Seismic surveys;
- Establishment of coreholes;
- Establishment of access tracks; and
- Vehicular use of tracks

Refer to the separate EIS Noise and Vibration technical report for further details on noise impacts.

5.2.1.7 Contamination

Small scale releases of contaminants such as hydraulic fluids, oils and drilling fluids could occur during the exploration phase, especially during corehole drilling. There is a slight risk of these entering watercourses. It is not anticipated that contamination from these sources will cause significant impacts to the environment due to the localised and small-scale nature of the potential releases. Mitigation strategies for potential impacts to ecosystems from contaminants are detailed within Table 5-1 below. For the exploration phase, the following activities may result in the release of contaminants:

- Seismic surveys;
- Establishment of coreholes;
- Establishment of access tracks; and
- Vehicular use of tracks.

Refer to the separate EIS Preliminary Site Investigation technical report for further details on potential contamination impacts.

5.2.2 Construction Phase

5.2.2.1 Impacts to Flora and Fauna

Once a promising geological structure has been identified by the seismic surveys and/or corehole drilling program, the presence of a resource and the thickness and internal pressure of a reservoir is confirmed by drilling an appraisal well. The corehole site is expanded to a cleared lease of approximately 100m x 110m. Where environmental or other constraints are present, this may be reduced to approximately 65m x 80m. Upon confirmation of the economic viability of the resource, the appraisal well is upgraded to a production well. The construction of the appraisal well will require the removal of all vegetation within the lease area. This may result in loss of habitat, fragmentation of habitat and fauna mortality. All habitat within the lease area will be removed, with the potential for harm to reptiles and frogs in particular as these typically utilise ground microhabitat such as rocks, logs, grass tussocks and soil cracks and fissures. If a woodland community is affected, arboreal fauna may also be impacted. Impacts to fauna will be greatly reduced where sites are chosen within cleared or disturbed areas, especially in grazing areas dominated by buffel grass (*Pennisetum ciliare*), which offers inferior

habitat for native fauna. These impacts could also potentially occur during the development of other associated infrastructure such as pipelines, gas processing facilities, water storage ponds and accommodation facilities. The construction of a road and track network will present additional impacts to fauna and flora. In general, the placement of infrastructure, facilities and roads in disturbed or cleared areas will present fewer impacts to ecosystems overall.

When an appraisal well is upgraded to a production well (approximately 0.1 to 0.5 ha) the majority of the lease area is rehabilitated to a standard consistent with the prevalent land use and natural values existing prior to development. Therefore, the overall impacts of the lease in the context of the landscape are significantly reduced. Mitigation strategies for potential impacts to flora and fauna are detailed within Table 5-1 below. For the construction phase, the following activities may impact on flora and fauna:

- Construction of pilot and appraisal wells;
- Construction of gas and water pipeline gathering systems;
- Construction of gas processing facilities;
- Construction of associated water infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction;
- Construction of borrow pits and storage areas; and
- Vehicular use of roads

5.2.2.2 Fragmentation and Loss of Movement Opportunities

Individually, each CSG infrastructure component will have a relatively minor impact on the ability of fauna and flora to move through the landscape, especially given that various levels of disturbance are already present throughout the CSG fields. Within the pastoral landscape, ecological corridors are generally tenuous and restricted to riparian woodland, fenceline vegetation and roadside remnants. Development of infrastructure and roads within these areas could alter the functionality of these corridors. Within woodlands, small reptiles, amphibians and ground mammals may be exposed to a higher risk of predation by using cleared areas or by having to travel further around them within their home ranges. As outlined in Section 1.1, cumulative impacts could be significant when all components are taken as a whole. Intensive activity within a small area could potentially cause total avoidance by certain species, especially those that are more sensitive to disturbance. Any changes to movement patterns could result in isolated, unsustainable populations and a reduction in genetic diversity.

The upgrade of an appraisal well to a production well will incorporate rehabilitation of the balance of the site. This will ultimately allow fauna to utilise the majority of the former lease area, especially as, where possible, native species and habitat material will be reintroduced to enhance the natural values. Mitigation strategies for potential impacts to fauna corridors are detailed within Table 5-1 below. For the construction phase, the following activities may impact on the ability of fauna to move through the landscape:

- Construction of pilot and appraisal wells;
- Construction of gas and water pipeline gathering systems;

- Construction of gas processing facilities;
- Construction of associated water infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction; and
- Construction of borrow pits and storage areas.

5.2.2.3 Weeds and Pest Species

The potential for introducing weeds during the exploration phase is highlighted in Section 5.2.1.3. During the construction phase, the risk of introducing weeds is potentially increased due to a likely increase in the movement of materials and people. Therefore, greater vigilance and adherence to weed protocols will be required.

The construction of water storages and borrow pits has the potential to create conditions suitable for a build-up of biting insects. Biting pests such mosquitoes can rapidly build-up populations when appropriate breeding conditions are provided. Additional issues can result from the pooling of water in depressions resulting from earthworks.

As populations of red foxes, pigs, feral cats and dogs and cane toads (among others) already populate the CSG fields, it is highly unlikely that the proposed works will result in a proliferation of these species. The introduction of exotic ant fauna is a potential risk. Yellow crazy ants (*Anoplolepis gracilipes**) and fire ants (*Solenopsis invicta**) are exotic ants that have the potential to seriously impact on native flora, fauna and ecological communities. They are capable of being transported from infested sites to new construction sites on equipment or within materials. Whilst many colonies of both species have been eradicated elsewhere in Queensland, there remains a slight chance of spreading ants to new areas. Mitigation strategies to reduce impacts from pests and weeds are detailed within Table 5-1 below. For the construction phase, the following activities may offer opportunities for weed and pest spread and infestation:

- Construction of pilot and appraisal wells;
- Construction of gas and water pipeline gathering systems;
- Construction of gas processing facilities;
- Construction of associated water infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction;
- Construction of borrow pits and storage areas; and
- Vehicular use of roads

5.2.2.4 Potential harm to Stock and Wildlife

The construction of water and gas in-field pipelines will require trenching to be conducted. Portions of the trench left open overnight effectively act as a large pitfall trap where fauna may fall in and are unable to escape. Heat stress can cause fauna mortality if opportunities for escape or shelter are not provided.

Borrow pits, water impoundments and evaporation ponds may provide a hazard to fauna and stock. Lined evaporation ponds potentially offer the greatest risk to fauna and stock from drowning as animals cannot get purchase on the lining to climb out.

The extra traffic likely to be generated by construction activities will potentially result in a greater number of vehicular collisions with wildlife or stock. Mortality of the animal is the most likely outcome of such collisions. There is also scope for human injury or death as a result. Mitigation strategies for potential impacts to stock and wildlife are detailed within Table 5-1 below. For the construction phase, the following activities may result in impacts to stock and native fauna:

- Construction of gas and water pipeline gathering systems (in particular during the trenching operations);
- Construction of associated water infrastructure;
- Construction of borrow pits and storage areas; and
- Vehicular use of roads

5.2.2.5 Erosion

Due to the increased activity during the construction phase, there will be more opportunities for erosion and sedimentation to occur. The mobilisation of sediment into waterways is considered the major issue. The will be exacerbated when construction or earthmoving activities occur during rain events. Timing of these activities to coincide with the dry season is preferred but not necessarily possible. Therefore, the implementation of control measures at all times is imperative. Mitigation strategies for potential impacts from erosion are detailed within Table 5-1, below. For the construction phase, the following activities may require erosion controls:

- Construction of pilot and appraisal wells;
- Construction of gas and water pipeline gathering systems;
- Construction of gas processing facilities;
- Construction of associated water infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction; and
- Construction of borrow pits and storage areas.

Refer to the separate EIS Soils and Terrain technical report for further details.

Section 5 Potential Impacts and Mitigation

5.2.2.6 Dust Impacts

Potential dust impacts on vegetation are also covered in Section 5.2.1.5. There is the potential for increased levels of dust during the construction phase as a result of increased levels of activity. This is especially relevant during the construction of water management ponds, which can result in high amounts of dust generated. Control measures will be implemented to minimise dust generation during the construction phase of the CSG field development with effort and strategies employed dependant upon activity and scale of potential impact. The use of dirt tracks and roads within the CSG fields will generate dust. It is not expected that dust generated on roads will significantly impact sensitive habitat. Mitigation strategies for potential impacts to flora and fauna from excessive dust are detailed within Table 5-1 below. For the construction phase, the following activities may generate excessive dust:

- Construction of pilot and appraisal wells;
- Construction of gas and water pipeline gathering systems;
- Construction of gas processing facilities;
- Construction of associated water infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction;
- Construction of borrow pits and storage areas; and
- Vehicular use of roads

Refer to the separate EIS Air quality technical study for further details on dust impacts.

5.2.2.7 Noise Impacts

In the construction phase, noise is expected to be consistently generated during earthmoving on leases, and at field compressor facilities and water management ponds in particular given the size of the sites and construction requirements. Despite this, it is likely that impacts will be temporary and fauna (apart from the more sensitive species) affected by noise will return to the area following cessation of activities. Mitigation strategies to reduce potential impacts to fauna from noise are detailed within Table 5-1 below. For the construction phase, the following activities may result in the generation of noise:

- Construction of pilot, appraisal and development wells;
- Construction of in-field gas and water pipeline gathering systems;
- Construction of gas compression facilities;
- Construction of associated water management infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction;
- Road use; and
- Construction of borrow pits and storage areas.

Refer to the separate EIS Noise and Vibration technical report for further details on noise impacts.

5.2.2.8 Contamination

The potential for contamination during the construction phase is likely to be similar to that possible during the exploration phase. However, given the potential for an increase in machinery in the CSG fields, and the range of activities undertaken, the chance of a contamination event occurring is increased. Contamination to the local soil is the most likely outcome; however a large spill could potentially enter waterways during significant rainfall events. Mitigation strategies for potential impacts to ecosystems from contaminants are detailed within Table 5-1 below. For the construction phase, the following activities could potentially result in the release of contaminants:

- Construction of pilot, appraisal and development wells;
- Construction of in-field gas and water pipeline gathering systems;
- Construction of gas compression facilities;
- Construction of associated water management infrastructure;
- Construction of accommodation facilities and associated infrastructure;
- Road construction; and
- Construction of borrow pits and storage areas.

Refer to the separate EIS Preliminary Site Investigation technical report for further details on potential contamination impacts.

5.2.3 Production Phase

5.2.3.1 Impacts to Flora and Fauna

The production phase is characterised by a reduction in earthmoving and construction activities, with most activities occurring within established plant or facilities. Therefore, clearing and creation of roads and infrastructure has essentially been completed. Accordingly, it is anticipated that this phase will involve few impacts to fauna and flora from clearing and construction activities. Mitigation strategies for potential impacts to flora and fauna are detailed within Table 5-1 below. For the production phase, the following activities may impact on flora and fauna:

- Presence of associated water management infrastructure;
- Presence of borrow pits and storage areas; and
- Vehicular use of roads.

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5.2.3.2 Fragmentation and Loss of Movement Opportunities

Again, as clearing has been finalised, further fragmentation of habitat will not occur. Therefore it is not expected that there will be further impacts that may affect the ability of fauna to disperse or migrate through the landscape.

5.2.3.3 Weeds

Despite the cessation of construction activities resulting in a reduction in site traffic, there still remains a risk of the introduction of weeds into the CSG fields. The continued adherence to the weed management protocol (Santos EHS09 Weed and Pest Animal Control) is required to ensure new weed introductions do not occur.

5.2.3.4 Potential harm to Stock and Wildlife

A reduction in traffic during the production phase will potentially reduce the likelihood of vehicular impacts with stock and wildlife. However, precautions to minimise the risk of impacts to animals will still be required during this phase. Mitigation strategies for potential impacts to stock and wildlife are detailed within Table 5-1 below. For the production phase, the following activities may impact on stock and native fauna:

- Presence of associated water management infrastructure;
- Presence of borrow pits and storage areas; and
- Vehicular use of roads.

5.2.3.5 Erosion

As construction and earthworks have been finalised, the majority of sites will have been stabilised. However, there may still be leases, roads or sites that require ongoing monitoring and management to ensure erosion is not a continuing problem. Mitigation strategies for potential erosion impacts are detailed within Table 5-1 below. For the operational phase, the following facilities may need to be monitored for potential erosion issues:

- Roads;
- Well leases;
- Borrow pits and laydown and storage areas; and
- Other areas previously subjected to earthworks.

Refer to the separate EIS Soils and Terrain technical report for further details on erosion impacts.

5.2.3.6 Dust Impacts

Dust impacts will be minimal in the production phase as construction and earthmoving has generally ceased. However, the use of dirt tracks and roads within the CSG fields will continue to generate dust. It is not expected that dust generated on roads will significantly impact sensitive habitat. Mitigation strategies for potential impacts to flora and fauna from excessive dust are detailed within Table 5-1 below. For the operational phase, the following activities may generate excessive dust:

- Vehicular use of roads;
- Unstabilised well leases;

- Unstabilised borrow pits and laydown and storage areas; and
- Other areas previously subjected to earthworks and not yet stabilised.

Refer to the separate EIS Air quality technical study for further details on dust impacts.

5.2.3.7 Noise Impacts

Fauna may be affected in the short-term by noise stemming from the operation of CSG plant such as the gas compression facilities. Fauna will generally move away from the source to avoid these impacts. However, acclimatisation by some species will occur over the longer term. It is not expected that significant impacts to fauna will occur. This is evident at the Fairview CSG field where wallabies are found in close proximity to an operational compressor station. Sudden loud noises have a greater effect and may lead to shock in certain species. Mitigation strategies to reduce potential impacts to fauna from noise are detailed within Table 5-1 below. For the operational phase, the following activities may result in the generation of noise:

- Operation of gas compression facilities; and
- Road use.

Refer to the separate EIS Noise and Vibration technical report for further details on noise impacts.

5.2.3.8 Contamination

As construction has ceased the potential for spills from machinery is significantly reduced. However, gas compression facilities and other plant could be a source of potential contaminants. Mobilisation of contaminants into ground or surface water is an issue. The risk of this occurring is very low as sufficient volumes of potential contaminants will not be stored without bunding and other precautions. Mitigation strategies for potential impacts to ecosystems from contaminants are detailed within Table 5-1 below. For the operational phase, there is a low to negligible risk of the release of contaminants from:

- Gas compression facilities;
- Accommodation facilities and associated infrastructure; and
- Vehicles traversing the field.

Refer to the separate EIS Preliminary Site Investigation technical report for further details on potential contamination impacts.

5.2.4 Decommissioning Phase

Decommissioning will occur throughout the life of the project and will be ongoing at various stages and sites throughout the CSG fields. As the focus of decommissioning will be to remove project infrastructure, there will ultimately be an overall improvement to natural values as sites are rehabilitated. Therefore, impacts are significantly reduced in the long-term. However, decommissioning activities will involve earthworks and vehicle movements, with potential issues of dust, noise, erosion, contamination and weeds as in the preceding phases.

5.2.5 Environmentally Sensitive Areas

This report has identified that most of the CSG fields intersect with or wholly contain Environmentally Sensitive Areas (ESAs); which include national parks, state forests, nationally important wetlands and EPA Essential

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Habitat. These areas are afforded various degrees of protection or management due to their inherent natural and geophysical values.

CSG field operations can be undertaken in state forests with approval from the relevant state government body and in cooperation with the local state forest group.

Nationally important wetlands & their immediate surrounds will not be the focus of CSG field development activities due to the natural values present & the difficulty of conducting works in areas of shallow water tables.

Areas of Essential Habitat (EH) denote the presence of habitat upon which a certain species of significant plant or animal is dependant. Under certain circumstances, some activities can be conducted within or near areas mapped as EH. The identification of EH should be undertaken during the well field scoping and site biodiversity assessment process and all efforts should be made to avoid these areas.

Whilst not identified in this report, water and camping reserves and stock routes gazetted by the state government often possess biodiversity values and should be retained for their original purpose where possible. These areas are detailed within the Land Use Technical Report.

5.2.6 Significant Vegetation Communities and Fauna and Flora Species

Significant vegetation communities and fauna and flora have been identified within this report. RE mapping currently shows the presence of the significant vegetation communities. This mapping should be used as an initial guide for avoidance of these areas. However, ground-truthing should be undertaken at potential well sites to confirm the mapping prior to development. Generally, significant specimens of flora and fauna have not been individually mapped. The exception is for areas mapped as Essential Habitat. Detailed ground-truthing or surveys at specific locations by experienced professional ecologists should be undertaken to determine the presence or absence of significant species. Liaison with local QPWS staff should also be undertaken where appropriate to assist in the identification of values.

In order to accurately identify and keep up-to date with ESAs and significant flora, fauna and vegetation communities, Santos should adopt a protocol to ensure the latest GIS data layers are sourced from the respective state government organisations. This will ensure that the most recent data is available prior to field scouting for potential well development.

5.3 Cumulative Impacts

The development of each CSG field will involve a range of activities and require the construction of a variety of components. These include exploration activities such as seismic surveys, corehole drilling, construction of appraisal wells, production wells, gas and water pipeline gathering systems, gas compression facilities and associated water management infrastructure, amongst others. These activities will also require the construction of a network of tracks and roads.

Individually, each component is unlikely to have a significant impact on fauna and flora. The maximum well lease pad size for an appraisal well is approximately 100m x 100m. Within cleared pasture, impacts will be slight. In open woodlands, impacts could be greater, yet are manageable. However, when development in each field is taken as a whole, there is potential for increased and more widespread impacts. For the RFDAs, it is estimated that 2,650 wells could be drilled over the next 25+ years. In addition, the gas and water gathering system for these areas will involve construction of approximately 2,000 km of pipeline and 6,800 km of access

roads will need to be constructed. The expected total clearing requirement for the production wells and associated roads/facilities required to produce the CSG for Train 1 of the LNG facility is approximately 2,500 ha.

The total CSG field study area is approximately 22,010 km^2. Based on the above figures, it is estimated that the total area of impact will be less than 1.2% of the CSG field study area. Clearing will also be widely dispersed over the area, and will occur gradually over a 25+ year timeframe. Rehabilitation of disturbed areas such as seismic lines and well lease pads will also occur progressively over the life of the project. The conversion of appraisal wells to operating wells in particular will result in a significant reduction in the cleared area with rehabilitation of the impacted area to a standard matching the existing land use and vegetation type.

The habitat values of each individual field have been discussed in Sections 4.2.2 and 4.2.3. An outcome of this habitat assessment was the appreciation of the similarities and disparities between the CSG fields. The Mahalo, Comet, Denison Trough, Arcadia Valley, Roma Other and Fairview CSG fields share similarities in that all possess significant areas of cleared land and remnant vegetation, as well as a variety of landforms. The Roma, Scotia and Eastern Surat Basin CSG fields on the other hand, are dominated by intensive agricultural and pastoral pursuits with remnant vegetation in the minority. Development within the latter fields will potentially incur fewer ecological impacts due to the prevalence of cleared land and disturbance to woodlands. The former CSG fields comprise a greater proportion of remnant vegetation and therefore there is a greater risk of incurring ecological impacts. However, pre-development identification of natural values and the preferred placement of infrastructure within cleared areas will tend to mitigate these impacts.

The greatest cumulative impacts from the development of the CSG fields will be the fragmentation of habitat and disturbance to microhabitat such as hollow-bearing trees, fallen timber and thickets of vegetation. Progressive rehabilitation, appropriate field planning and pre-development scouting will assist in the mitigation of these cumulative impacts.

Substantial amelioration of potential impacts can also be undertaken through the identification and rehabilitation of corridor linkages within the CSG fields. Fauna movement would be greatly enhanced by improvement to habitat within areas such as the Lonesome Holdings and Fairview leases, and along waterways in general throughout the CSG fields.

5.4 Impact Mitigation Strategies

The following table (Table 5.1) is a guide to the minimum mitigation strategies to be employed for each activity. This table should be used in conjunction with the appropriate documents to ensure that comprehensive management of potential impacts is undertaken. For example:

- Santos EHS01 Land Disturbance;
- Santos EHSMS09.5 Environmental Impact Assessment and Approvals including;
- Santos EHSMS11-11 Decommissioning and Abandonment;
- Santos EHSMS14 Monitoring, Management & Reporting;
- Santos EHS09 Weed and Pest Animal Control;
- Environmental Management Plans for relevant CSG fields; and
- Other relevant reports and management plans.

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Table 5-1 Potential Impacts and Mitigation Measures

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Exploration			
Seismic Surveys.	Flora, Fauna and vegetation Communities. Erosion Weeds Pest Animals	The removal of selected trees and the lopping of tree branches to allow vehicle and equipment access.	• Avoid remnant vegetation and isolated stands of timber where practicable. • Minimise the width of the seismic line. • Retain habitat trees. • Progressive rehabilitation and revegetation of disturbed areas.
		Removal of fallen timber on the seismic line to allow vehicle and equipment access.	• Return cleared timber to the seismic line following the survey to discourage third party access and to recreate habitat for small mammals, frogs and reptile species.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Detour tracks required due to rough terrain (i.e. erosion zones, watercourses) causing disturbance to habitat.	• Avoid traversing remnant vegetation and isolated stands of timber where practicable. • Use natural breaks or existing crossings along watercourses for locating new access tracks. • Minimise the width of the seismic line. • Retain habitat trees. • Progressive rehabilitation and revegetation of disturbed areas.
		Fauna mortality or injury from vehicle strikes.	• Vehicle speed limits. • Driver education. • Liaison with wildlife rescue organisations or individuals
		Potential harm to stock, wildlife and humans from shotholes left open.	• Plug all shotholes. • Field inspection of seismic line to report on condition of works and any outstanding remedial works required.
		Potential for erosion on seismic lines or associated access tracks.	• Install appropriate erosion control measures as required. • Field inspection of seismic line to report on condition of works and any outstanding remedial works required.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• Progressive rehabilitation and revegetation of disturbed areas.
		Potential for marker pegs left on site after the completion of the seismic program to cause harm to stock and wildlife.	• Field inspection of seismic line to report on condition of works and any outstanding remedial works required.
Establishment of Coreholes.	Flora, Fauna and vegetation Communities Erosion Weeds Pest animals	Fauna mortality/ injury	• Retain habitat trees. • Avoid clearing remnant vegetation and isolated stands of timber where practicable. • Field scouting of proposed corehole site by competent person. • Liaison with wildlife rescue organisations or individuals.
		Loss of habitat	• Retain habitat trees. • Avoid clearing remnant vegetation and isolated stands of timber, where practicable. • Minimise lease pad clearing area. • Rehabilitate unsuccessful coreholes as soon as reasonably practicable.
		Potential for erosion due to corehole development.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Noise impacts to fauna	• Drilling activities are short term and the exposure to noise generated would not be sufficient to cause long term impacts. • Maintain mufflers and other noise suppression devices.
Establishment of access tracks.	Flora, Fauna and vegetation Communities Erosion Weeds Pest animals	Fauna mortality/ injury	• Avoid clearing remnant vegetation and isolated stands of timber, where practicable. • Field scouting of proposed corehole site by competent person. • Liaison with wildlife rescue organisations or individuals.

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• Retain habitat trees.
		Loss of habitat	• Avoid clearing remnant vegetation and isolated stands of timber, where practicable. • Where practicable, minimise clearing by reducing road width. • Minimise impact to surrounds by constructing roads that are two-tyre tracks only where standards allow. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential for erosion on seismic lines or associated access tracks.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
Use of access tracks.	Fauna Dust	Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk. • Driver education. • Liaison with wildlife rescue organisations or individuals.
		Dust associated with vehicles	• Use dust suppression around sensitive receptors (e.g. houses/ sensitive flora communities). • Progressive rehabilitation and revegetation of disturbed areas.
Construction			
Construction of pilot and appraisal wells.	Flora, Fauna and vegetation Communities. Erosion Weeds Pest animals	Fauna mortality/ injury	• Avoid clearing remnant vegetation and isolated stands of timber, where practicable. • Liaison with wildlife rescue organisations or individuals. • Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• Retain habitat trees. • Infield infrastructure should be fenced for security reasons as well as for the exclusion of livestock and native animals.
		Loss and fragmentation of habitat	• Avoid clearing remnant vegetation and isolated stands of timber where practicable. • Minimise lease pad clearing area, where practicable. • Where practicable, position wells and access roads to reduce the potential for “vegetation islands”. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential for erosion on well leases.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs when necessary.
		Noise impacts to fauna	• Drilling activities are short term and the exposure to the noise generated would not be sufficient to cause long term impacts to wildlife. • Maintain mufflers and other noise suppression devices.
Upgrade to production wells (Reduction in lease pad size as part of the partial rehabilitation process).		Potential erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential contamination caused by spillage of drilling fluids or other chemicals and regulated wastes.	• Field inspection of lease pad to report on condition of works and any outstanding remedial works required. • All potential contaminants are to be bunded according to AS.1940 and the Santos EHSMS.
		Improper storage of topsoil	• Topsoil is to be stored for later

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			use in rehabilitation. Topsoil stockpiles are not to exceed 2m in height and are to be marked "Not for General Use - For Rehabilitation Only" or similar. • Topsoil that is to be stored for over 6 months is to be kept free of declared weeds, covered with a suitable grass species and watered to ensure biological integrity of the material is maintained. Appropriate erosion controls devices are to be installed where required, to ensure topsoil does not wash away. • Topsoil that is to be stored for over 6 months is to be fenced or signed where practicable to ensure that no vehicles or other equipment drive over it. • Stockpiling should be undertaken as per best practice guidelines.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control.
Gas and water pipeline gathering systems.	Flora, Fauna and vegetation Communities. Weeds Pest animals Dust Noise Erosion	Fauna mortality/ injury	• Avoid traversing remnant vegetation and isolated stands of timber, where practicable. • Liaison with wildlife rescue organisations or individuals. • Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk. • Infield infrastructure should be fenced for security reasons as well as for the exclusion of livestock and native animals. • Temporary fencing should be installed around open trenches to prevent harm to stock and native fauna.
		Fragmentation of habitat	• Vegetation removed from the pipeline easement is to be stockpiled for use during rehabilitation. Habitat timber within the ROW is to be replaced for fauna habitat where practical and where landowner or forestry activities permit.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• Where practicable, the clearing required for pipeline installation for in-field gathering lines is to be kept to a minimum to allow fauna movement. • Where practicable, pipelines are to be located adjacent to existing infrastructure e.g. fencelines or access tracks. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Dust impacts to fauna and vegetation communities	• As pipeline activities will be localised for a short duration, the potential impacts to flora and fauna can be managed as required. Dust suppression mechanisms should be implemented when needed.
		Noise impacts to fauna	• Pipeline activities will be localised and for a short duration therefore impacts to fauna form noise would be minimal. • Maintain mufflers and other noise suppression devices.
		Fauna trapped in trench leading to mortality or injury.	• Avoid traversing remnant vegetation and isolated stands of timber, where practicable. • Liaison with wildlife rescue organisations or individuals. • Trench is to be backfilled overnight with minimum trench area left open. The open trench is to have materials installed to allow fauna to escape e.g. ramping of the trench. • Inspection of trenches at the start of work is to be conducted by a component person for the removal of species caught in the trench.

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Gas processing facilities (250m x 200m compound area).		Fauna mortality/ injury	• Where practicable, locate compressor stations in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Compressor stations and other infield infrastructure should be fenced for security reasons as well as for the exclusion of livestock and native animals.
		Loss and fragmentation of habitat	• Where practicable, site compressor stations in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where practicable, minimise the area of the compound facility. Design and location of compound areas should be reviewed against the relevant constraints map for correct placement of the facility in the landscape. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Potential for erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression program.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices.
Associated water infrastructure- storage ponds and water treatment		Fauna mortality/ injury	• Where practicable, site storage ponds and water treatment facilities in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
facilities.			of timber. • Fence storage ponds to prevent ingress by stock and wildlife.
		Loss and fragmentation of habitat	• Where practicable, site storage ponds and water treatment facilities in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where practicable, minimise the area of the storage ponds and water treatment facilities. Design and location of storage ponds and water treatment facilities should be reviewed against the relevant constraints map for correct placement of the facility in the landscape. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential for erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices.
Accommodation facilities and associated infrastructure.		Fauna mortality/ injury	• Where practicable, site infrastructure in locations that have been previously cleared. • Avoid clearing remnant vegetation, isolated stands of timber. • Infrastructure should be fenced for security reasons as well as for the exclusion of livestock and native animals.
		Loss and fragmentation of habitat	• Where practicable, site infrastructure in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			of timber. • Where practicable, minimise the area of disturbance for construction of infrastructure. • Design and location of infrastructure should be reviewed against the relevant constraints map for correct placement of the facility in the landscape. • Progressive rehabilitation and revegetation of disturbed areas.
		Potential for erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices.
Road construction.		Fauna mortality/ injury	• Utilise existing road and track network where practicable. • Where practicable, place roads in locations that have been previously cleared. • Avoid clearing remanent vegetation, isolated stands of timber. • Construct road at a minimum width for intended traffic
		Loss and fragmentation of habitat	• Utilise existing road and track network where practicable • Where practicable, place roads in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where practicable, minimise the area of the compound facility. • Design and location of compound areas should be

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			reviewed against the relevant constraints map for correct placement of the facility in the landscape. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per Santos EHS09 Weeds and Pest Animal Control.
		Potential for erosion during road construction	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices.
Borrow pits and laydown and storage areas.		Fauna mortality/ injury	• Where practicable, place borrow pits and storage areas in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Borrow pits should be fenced to exclude livestock and native fauna.
		Loss and fragmentation of habitat	• Where practicable, place borrow pits and storage areas in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where practicable, minimise the area of the borrow pits and storage areas. • Design and location of borrow pits and storage areas should be reviewed against the relevant constraints map for correct placement of the facility in the landscape. • Progressive rehabilitation and revegetation of disturbed areas.
		The potential for weed seed and pest animal spread.	• Implement weed and pest animal control protocols as per

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			Santos EHS09 Weeds and Pest Animal Control.
		Potential for erosion during earthworks at the site.	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices.
Operation			
Operation of production wells.	Flora, Fauna and vegetation Communities. Noise. Erosion. Dust. Weeds.	No impacts to flora, fauna and vegetation communities	• Production wells are greatly reduced in size and surrounds are rehabilitated.
		No noise impacts to fauna	• Production wells operate with virtually no noise output.
		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.
Operation of Compressor Stations.		Noise	• Minimise noise output where practicable.
Road Use.		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.
		Dust	• Implement dust suppression programs where necessary.
Borrow pits.		Weed infestations	• Monitor disturbed areas for declared and environmental weeds. • Implement a weed management program. • EHS09 Weeds and Pest Animal Control that outlines the requirements for weed management.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Laydown and storage areas.		Dust	• Implement dust suppression programs where necessary.
		Erosion	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Weed infestations	• Monitor disturbed areas for declared and environmental weeds. • Implement a weed management program. • Comply with EHS09 Weeds and Pest Animal Control that outlines the requirements for weed management.
Decommissioning			
Production Wells Pipelines. Processing and Associated Facilities. Infrastructure. Treatment plants, pipes, tanks water ponds. Roads and Access Tracks. Borrow pits and Storage Areas.	Flora, Fauna and vegetation Communities. Erosion.	Dust	• Implement dust suppression programs.
		Potential for erosion during decommissioning activities	• Install appropriate erosion control measures as required. • Field inspection of disturbed area to report on condition of works and any outstanding remedial works required. • Progressive rehabilitation and revegetation of disturbed areas.
		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Exploration			

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Seismic Surveys.	Flora, Fauna and vegetation Communities. Erosion Weeds	The removal of selected trees and the lopping of tree braches to allow vehicle and equipment access.	• Avoid remnant vegetation and isolated stands of timber where possible. • Minimise the width of the seismic line. • Retain habitat trees.
		Removal of fallen timber on the seismic line to allow vehicle and equipment access.	• Return cleared timber to the seismic line following the survey to discourage third party access and to recreate habitat for small mammals, frogs and reptile species.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Detour tracks required due to rough terrain (i.e. erosion zones, watercourses) causing disturbance to habitat.	• Avoid traversing remnant vegetation and isolated stands of timber where possible. • Use natural breaks or existing crossings along watercourses for locating new access tracks. • Minimise the width of the seismic line. • Retain habitat trees.
		Fauna mortality or injury from vehicle strikes.	• Vehicle speed limits • Driver education • Liaison with wildlife rescue organisations or individuals
		Potential harm to stock, wildlife and humans from shotholes left open.	• Plug all shotholes. • Field inspection of seismic line to report on condition of works and any outstanding remedial works required.
		Potential for erosion on slope areas caused by seismic lines or associated access tracks.	• Field inspection of seismic line to report on condition of works and any outstanding remedial works required. • Install erosion controls e.g. contour banks to manage water movement.
		Potential for marker pegs left on site after the completion of the seismic program to cause harm to stock and wildlife.	• Field inspection of seismic line to report on condition of works and any outstanding remedial works required.
Establishment of Coreholes.	Flora, Fauna and vegetation Communities.	Fauna mortality	• Retain habitat trees. • Avoid clearing remnant vegetation and isolated stands of timber where possible. • Field scouting of proposed

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
	Erosion Weeds		corehole site by competent person. • Liaison with wildlife rescue organisations or individuals
		Loss of habitat	• Retain habitat trees. • Avoid clearing remnant vegetation and isolated stands of timber, where possible. • Minimise lease pad clearing area • Rehabilitate unsuccessful coreholes as soon as reasonable practicable
		Potential for erosion on slope areas caused by corehole development.	• Field inspection of coreholes to report on condition of works and any outstanding remedial works required. • Install erosion controls e.g. contour banks to manage water movement.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Noise impacts to fauna	• Drilling activities are short term and the exposure to noise generated would not be sufficient to cause long term impacts. • Maintain mufflers and other noise suppression devices.
Establishment of access tracks.	Flora, Fauna and vegetation Communities. Erosion Weeds	Fauna mortality	• Avoid clearing remnant vegetation and isolated stands of timber, where possible. • Field scouting of proposed corehole site by competent person. • Liaison with wildlife rescue organisations or individuals. • Retain habitat trees
		Loss of habitat	• Avoid clearing remnant vegetation and isolated stands of timber, where possible. • Where practicable, minimise clearing by reducing road width. • Minimise impact to surrounds by constructing roads that are two-tyre tracks only.
		Potential for erosion on slope areas caused by seismic lines or associated access tracks.	• Field inspection of seismic line to report on condition of works and any outstanding remedial works required. • Install erosion controls e.g. contour banks to manage water

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			movement.
		The potential for weed seed spread	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
Use of access tracks.	Fauna Dust	Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk. • Driver education • Liaison with wildlife rescue organisations or individuals
		Dust associated with vehicles	• Use dust suppression around sensitive receptors (e.g. houses/ sensitive flora communities) • Consider sealing roads around sensitive receptors
Construction			
Construction of pilot and appraisal wells.	Flora, Fauna and vegetation Communities. Erosion.	Fauna mortality	• Avoid clearing remnant vegetation and isolated stands of timber, where possible. • Liaison with wildlife rescue organisations or individuals. • Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk. • Retain habitat trees.
		Loss and fragmentation of habitat	• Avoid clearing remnant vegetation and isolated stands of timber where possible. • Minimise lease pad clearing area, where possible. • Where possible, position wells and access roads to reduce the potential for “vegetation islands”.
		Potential for erosion on well leases.	• Field inspection of well leases to report on condition of works and any outstanding remedial works required. • Install erosion controls e.g. contour banks to manage water movement.
		The potential for weed seed spread.	• Implement weed control

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			protocols as per Santos EHS09 Weeds and Pest Animal Control
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs when necessary.
		Noise impacts to fauna	• Drilling activities are short term and the exposure to the noise generated would not be sufficient to cause long term impacts to wildlife. • Maintain mufflers and other noise suppression devices
Upgrade to production wells (Reduction in lease pad size as part of the partial rehabilitation process.		Potential erosion caused during earthworks at the site.	• Field inspection of lease pad to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		Potential contamination caused by spillage of drilling fluids or other chemicals and regulated wastes.	• Field inspection of lease pad to report on condition of works and any outstanding remedial works required. • All potential contaminants are to be bunded according to AS.1940 and the Santos EHSMS.
		Improper storage of topsoil	• Topsoil is to be stored for later use in rehabilitation. Topsoil stockpiles are not to exceed 1.5m in height and are to be marked “Not for General Use - For Rehabilitation Only” or similar. • Topsoil that is to be stored for over 6 months is to be kept weed free, covered with a suitable grass species and watered to ensure biological integrity of the material is maintained. Appropriate erosion controls devices are to be installed where required, to ensure topsoil does not wash away. • Topsoil that is to be stored for over 6 months is to be fenced to ensure that no vehicles or other equipment drive over it.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
Gas and water pipeline gathering	Flora, Fauna and vegetation Communities.	Fauna mortality	• Avoid traversing remnant vegetation and isolated stands of timber, where possible. • Liaison with wildlife rescue

Section 5 Potential Impacts and Mitigation

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
systems.			organisations or individuals. • Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.
		Fragmentation of habitat	• Vegetation removed from the pipeline easement is to be stockpiled for use during rehabilitation. Cleared timber is to be placed over the pipeline during rehabilitation to provide habitat to small mammals and reptiles. • Where possible, the clearing required for pipeline installation for in-field gathering lines is to be kept to a minimum to allow fauna movement. • Where possible, pipelines are to be located adjacent to existing infrastructure e.g. fencelines or access tracks.
		Potential erosion caused during earthworks at the site.	• Field inspection of pipeline construction zones to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Dust impacts to fauna and vegetation communities	• As pipeline activities will be localised for a short duration, the potential impacts to flora and fauna can be managed as required. Dust suppression mechanisms should be implemented when needed.
		Noise impacts to fauna	• Pipeline activities will be localised and for a short duration therefore impacts to fauna form noise would be minimal. • Maintain mufflers and other noise suppression devices
		Fauna trapped in trench leading to mortality or injury.	• Avoid traversing remnant vegetation and isolated stands of timber, where possible. • Liaison with wildlife rescue organisations or individuals.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• Trench is to be backfilled overnight with minimum trench area left open. Trench left open overnight is to be temporary fenced to exclude stock and wildlife. The open trench is to have materials installed to allow fauna to escape e.g. ramping of the trench. • Inspection of trenches at the start of work is to be conducted by a component person for the removal of species caught in the trench.
Gas processing facilities (250m x 200m compound area).		Fauna mortality	• Where possible, locate compressor stations in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber.
		Loss and fragmentation of habitat	• Where possible, site compressor stations in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where possible, minimise the area of the compound facility. Design and location of compound areas should be reviewed against the relevant constraints map for correct placement of the facility in the landscape.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Potential erosion caused during earthworks at the site.	• Field inspection of facility site to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression program.
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices
Associated water infrastructure-storage ponds and water		Fauna mortality	• Where possible, site storage ponds and water treatment facilities in locations that have been previously cleared.

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
treatment facilities.			• Avoid clearing remnant vegetation and isolated stands of timber. • Fence storage ponds to prevent ingress by stock and wildlife
		Loss and fragmentation of habitat	• Where possible, site storage ponds and water treatment facilities in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where possible, minimise the area of the storage ponds and water treatment facilities. Design and location of storage ponds and water treatment facilities should be reviewed against the relevant constraints map for correct placement of the facility in the landscape.
		Potential erosion caused during earthworks at the site.	• Field inspection of excavation areas to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHSMS
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices
Accommodation facilities and associated infrastructure.		Fauna mortality	• Where possible, site infrastructure in locations that have been previously cleared. • Avoid clearing remnant vegetation, isolated stands of timber
		Loss and fragmentation of habitat	• Where possible, site infrastructure in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where possible, minimise the area of disturbance for construction of infrastructure. • Design and location of

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			infrastructure should be reviewed against the relevant constraints map for correct placement of the facility in the landscape.
		Potential erosion caused during earthworks at the site.	• Field inspection of facilities area to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices
Road construction.		Fauna mortality	• Utilise existing road and track network where possible • Where possible, place roads in locations that have been previously cleared. • Avoid clearing remanent vegetation, isolated stands of timber. • Construct road at a minimum width for intended traffic
		Loss and fragmentation of habitat	• Utilise existing road and track network where possible • Where possible, place roads in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where possible, minimise the area of the compound facility. • Design and location of compound areas should be reviewed against the relevant constraints map for correct placement of the facility in the landscape.
		The potential for weed seed spread.	• Implement weed control protocols as per Santos EHS09 Weeds and Pest Animal Control
		Potential erosion caused during road construction	• Field inspection of road construction sites to report on condition of works and any outstanding remedial works required.

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
			• The installation of erosion controls i.e. contour banks to manage water movement.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices
Borrow pits and laydown and storage areas.		Fauna mortality	• Where possible, place borrow pits and storage areas in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber.
		Loss and fragmentation of habitat	• Where possible, place borrow pits and storage areas in locations that have been previously cleared. • Avoid clearing remnant vegetation and isolated stands of timber. • Where possible, minimise the area of the borrow pits and storage areas. • Design and location of borrow pits and storage areas should be reviewed against the relevant constraints map for correct placement of the facility in the landscape.
		The potential for weed seed spread.	• Implement weed control protocols as per EHS09 Weeds and Pest Animal Control.
		Potential erosion caused during earthworks at the site.	• Field inspection of construction sites to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		Dust impacts to fauna and vegetation communities	• Implement dust suppression programs
		Noise impacts to fauna	• Maintain mufflers and other noise suppression devices
Operation			
Operation of production wells.	Flora, Fauna and vegetation	No impacts to flora, fauna and vegetation communities	• Production wells are greatly reduced in size and surrounds are rehabilitated.

Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
	Communities. Noise. Erosion. Dust. Weeds.	No noise impacts to fauna	• Production wells operate with virtually no noise output
		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.
Operation of Compressor Stations.		Noise	• Minimise noise output where possible
Road Use.		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.
		Dust	• Consider sealing roads around sensitive receptors to reduce dust
Borrow pits.		Weed infestations	• Monitor disturbed areas for declared and environmental weeds. • Implement a weed management program • EHS09 Weeds and Pest Animal Control that outlines the requirements for weed management.
Laydown and storage areas.		Dust	• Implement dust suppression programs where necessary
		Erosion	• Install erosion controls i.e. contour banks to manage water movement where necessary.
		Weed infestations	• Monitor disturbed areas for declared and environmental weeds. • Implement a weed management program • Comply with EHS09 Weeds and Pest Animal Control that outlines the requirements for weed management.
Decommissioning			
Production Wells	Flora, Fauna and vegetation	Dust	• Implement dust suppression programs

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Phase / Activity	Ecological Aspect	Potential Impact	Mitigation Strategies
Pipelines. Processing and Associated Facilities. Infrastructure. Treatment plants, pipes, tanks water ponds. Roads and Access Tracks. Borrow pits and Storage Areas.	Communities. Erosion.		• Consider sealing roads around sensitive receptors
		Potential erosion caused during decommissioning activities	• Field inspection of activity sites to report on condition of works and any outstanding remedial works required. • The installation of erosion controls i.e. contour banks to manage water movement.
		Fauna mortality or injury from vehicle strikes	• Enforce speed limits when driving in areas of high vegetation cover to reduce likelihood of hitting wildlife and during times of high wildlife activity i.e. dawn and dusk.

5.5 Wellfield Scoping & Site Biodiversity Assessment

Given that targeted ecological field surveys were not an appropriate method of biodiversity assessment for all of the CSG gas fields of the study area (Section 2.2) the mechanism to implement targeted field assessment of biodiversity values and assess potential impacts for new development areas will be triggered by the current Santos environmental management practices at the development and scoping stage for specific exploration fields.

The Santos environmental management practice for well field development activities was implemented for all CSG field activities commencing from 2009 (Work instruction for planning and obtaining approval for CSG activities, Santos 2008) This work instruction outlines a process to optimise field planning and ensure sustainable environmental practices. In addition, impact minimisation is implemented for all activities in the development of CSG field activities. The work instruction outlines responsibilities and details a staged process for the implementation of measures to ensure correct field assessments are undertaken to an appropriate level, and potential impacts are correctly assessed and minimised. The broad elements of the process relevant to the assessment of biodiversity and potential impacts are outlined below in Table 5-2.

Table 5-2 Process for further Biodiversity Assessment at specific well field operations

Scouting protocol	Trigger	Responsibility	Actions	Outcome
Desktop Review	Proposed Ground disturbance	Santos Activity Manager	Constraints mapping, assessment of ATP / PL number against Environmental Values summary Tables (Section 4.2.6)	Identification of desktop Environmental Values & any potential conservation values requiring field confirmation

Scouting protocol	Trigger	Responsibility	Actions	Outcome
Site Field Scouting	Identification of potential desktop conservation Values	Santos Environmental Group	Site investigation of potential significant conservation values	Identification of any ecological values requiring further characterisation & assessment of conservation value. Outline of regulatory approval process to be undertaken
Specialist Investigation	Confirmation of potential conservation values requiring specialist investigation	Qualified Ecology Team	Assessment of baseline environmental values potential ecological impacts	Ecological report detailing Impact assessment and mitigation measures for regulatory approval

Where a proposed activity involves any new ground disturbance a field scouting protocol is triggered whereby an assessment is made to determine the level of environmental assessment to be undertaken relevant to the potential environmental constraints and ecological sensitivities at each location. Broad steps of the process include:

- Advise of necessary environmental management personnel to mitigate potential environmental impacts to an acceptable level;
- Advise whether a specific management plan is required prior to commencing development ; and
- Advise whether specialist investigations are required.

5.5.1 Desktop Review- Constraints Mapping

Where any ground disturbance is proposed by a CSG field activity, the first stage of development is the implementation of a desktop investigation. A series of investigations and constraints maps are produced to overlay the proposed activities on a geographical depiction of all environmental sensitivities that must be considered prior to determining a location for a well field operation including:

- Regional Ecosystems (Vegetation Management status);
- Regional Ecosystems (Biodiversity Management Status);
- EPA Essential Habitat locations;
- Biodiversity Corridors;
- Environmentally Sensitive areas and Conservation Estate;
- Waterways; and
- Terrain & Soils Characteristics.

To minimise potential impacts, buffer zones will be established around environmentally sensitive areas that have been identified.

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5.5.2 Site Field Scouting

The next step in the assessment is a site scouting field investigation that is undertaken for all proposed well field operation sites. This is undertaken to assess a number of potential sensitivities including cultural heritage, landholder liaison, and environmental considerations where desktop evaluation identified these as a requirement. This being the case, an appropriately qualified and experienced Santos environmental adviser will undertake a site investigation to determine a number of factors including:

- All regulatory approvals required to develop the proposed activity;
- Whether a specific management plan is required to implant best management practice; and
- Whether potential environmental sensitivities identified from desktop studies require specialist investigation to quantify baseline values and undertake adequate impact assessment.

A number of strategies are investigated at the site scoping stage to determine the appropriate level of impact controls, including but not limited to:

- Avoiding sites of known scientific and natural significance and/or cultural heritage sites;
- Minimising or where possible avoiding clearance of trees and shrubs;
- Minimising disturbance of natural drainage patterns;
- Avoiding inversion of soil profile;
- Avoiding impacts to third party infrastructure and activities e.g. fencing, stock yards
- Minimising risks to wildlife and stock;
- Locating accommodation facilities as close to work areas as possible;
- Minimising the area of impact e.g. lease area, road or pipeline width;
- Using existing roads or tracks where possible (ie. rationalising access);
- Using common or adjacent easements for pipelines, roads or seismic lines;
- Avoiding impact on floodplains, wetlands or permanent waterholes;
- Evaluating need for erosion control measures in vulnerable locations e.g. gibber plain, steep sites to minimise erosion risk;
- Avoiding interference with natural drainage (or restores drainage where required);
- Avoiding introduction of weeds;
- Using a central waste facility whenever possible;
- Facilitating rehabilitation and/or restoration; and
- Considering post-construction land use.

5.5.3 Specialist Ecological Field Assessment

Where field scouting investigations identify the potential for any impacts to significant ecological factors (e.g. conservation significant REs, species, or potential essential habitat, or environmentally sensitive areas; a specialist ecological field assessment will be commissioned to undertake a full baseline ecological study including impact assessment and mitigation prescriptions to ensure minimisation of all potential ecological impacts. Where required, such studies may include:

- Ground truth and refine constraints mapping;
- Vegetation community / RE mapping and analysis;
- Targeted trapping or observational Fauna species studies;
- Targeted Flora species surveys; and
- Development of specific species conservation management strategies and impact minimisation prescriptions.

5.6 Biodiversity Offsetting

A program to implement offsetting of cleared vegetation communities should be implemented in accordance with current Commonwealth and State legislative criteria for the offsetting of significant vegetation communities. A biodiversity offset strategy and management plan will be developed. Criteria for offset suitability will be in accordance with EPA, DNRW and DEWHA guidelines and best practice. General suitability criteria will, where practicable, include:

- The offset strategy will be in compliance with the requirements of the Policy for Vegetation Management Offsets (DNRW, 2007) and the regional vegetation management codes both for the coastal bioregions and Brigalow Belt Bioregions, under the provisions of the Queensland VM Act (DNRW, 2006a and DNRW 2006b);
- The offset strategy will include reference to existing Santos biodiversity offsets including the Environmental Management Plan for Fairview Project Area offset strategy (Santos 2008);
- The acquisition of a remnant/regrowth community that is greater in area than that which will be impacted by the project;
- Support the same suite of plant species contained in RE types impacted by the project;
- Consider maximising biodiversity gains through site selection, (e.g. habitat requirements for migratory species that will be impacted by loss of foraging areas and water resources);
- Offset locations will be preferentially close (at least within the locality) to communities impacted by the project;
- Offset sites will be preferentially larger contiguous stands of vegetation with connectivity to other habitat types to increase the viability of ecological processes;
- Place potential offset(s) parcels under a secure protection such as a conservation covenant to ensure that protection runs with title;

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- Management measures to ensure offset areas remain viable in perpetuity. Such measures may include the management of supplementary planting, weed, fire, feral animal, livestock management and restriction on access; and
- Monitoring and maintenance activities to measure success and viability of the offset.

Conclusions and Recommendations

Section 6

The desktop and field studies conducted for the CSG field ecological assessment have determined that each field possesses a range of ecological values. The northern CSG fields of Mahalo, Comet, Denison Trough, Arcadia Valley, Roma Other and Fairview each include elements of the forested Expedition and Carnarvon Ranges as well as cleared pastoral areas. The forested ranges, by way of their rugged topography, large areas of bushland and interconnectedness, typically possess greater potential for supporting significant fauna, flora and vegetation communities than other portions of the CSG fields.

The northern CSG field of Scotia and the southern CSG fields of Roma and Eastern Surat Basin hold relatively lesser values due to the extensive clearing that has previously occurred within these areas.

Fieldwork has verified the ecological values of the RFDAs. Future development of these CSG fields has the potential to impact on natural values. A considered approach to development involving the implementation of mitigation strategies, as outlined in the report, will ensure that impacts to fauna and flora are minimised and the CSG fields will continue to support a range of significant species and vegetation communities.

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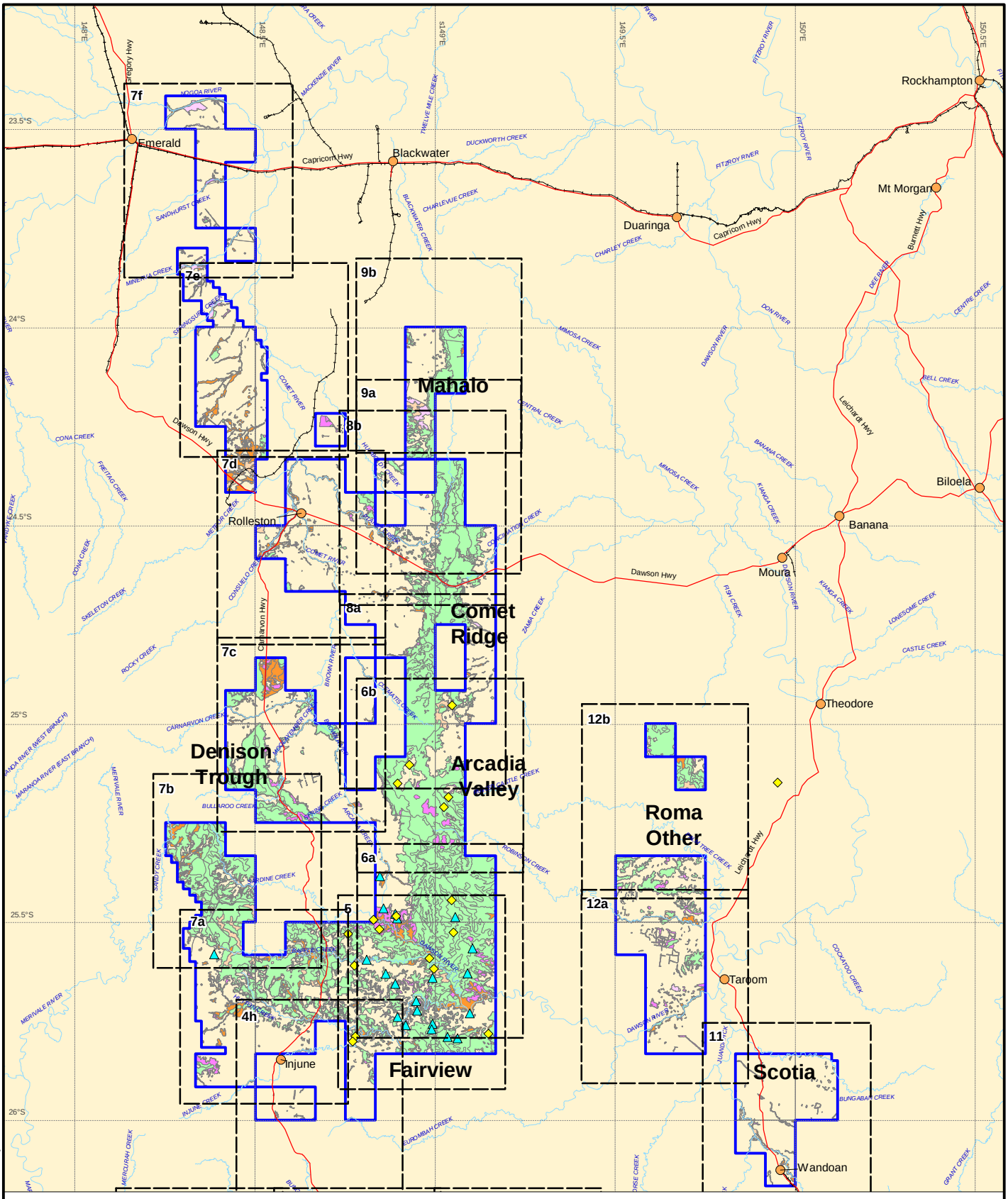
Figures



Client

Project

GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title

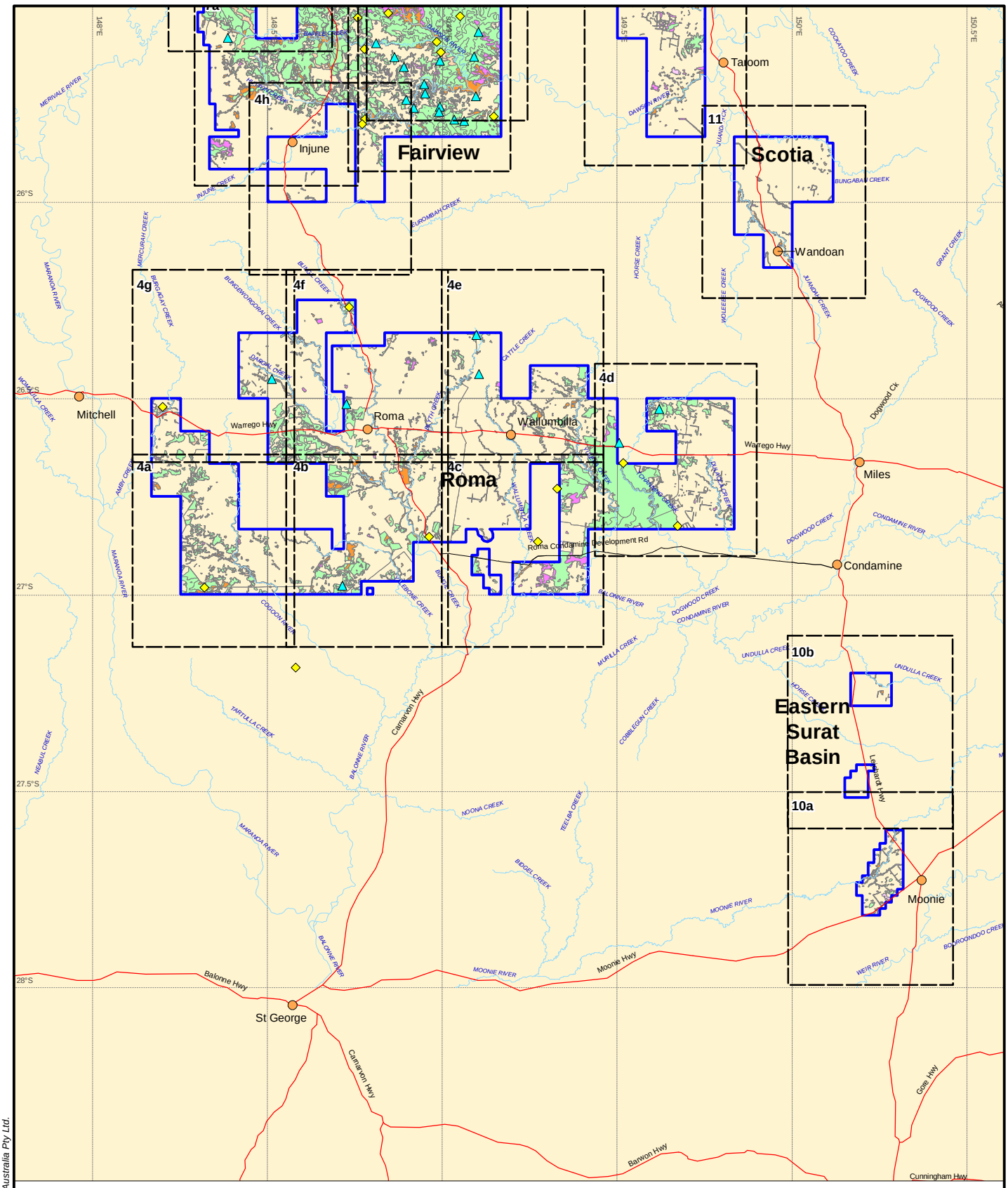
RE MAPPING OF THE CSG FIELD - NORTHERN CSG FIELD

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-711wor	

Figure: **1a**

Rev:A

A4



Client

Project

GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title

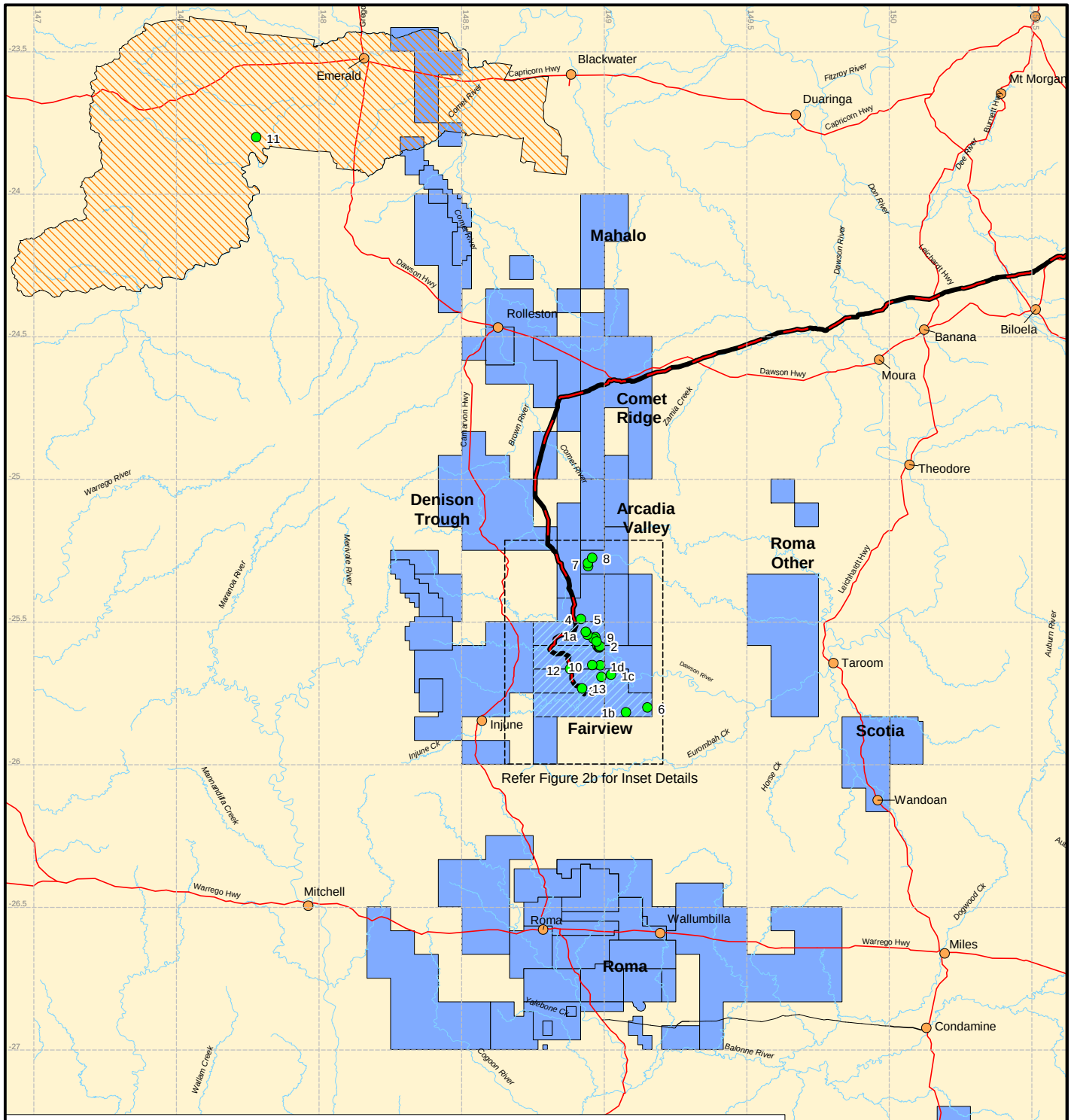
RE MAPPING OF THE CSG FIELD - SOUTHERN CSG FIELD

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-711wor	

Figure: **1b**

Rev:A

A4



Primary Road
Secondary Road
Major Drainage
Gas Transmission Pipeline
Literature Review Site
CSG Field
Emerald Shire Boundary (Site Reference 11)
Fairview CSG Field (Site Reference 12)

N W E S

0 37.5 75km

Scale: 1:2 000 000 (A4)
Datum : GDA94

Literature Review Site Reference by Location

1. Boobook (2006) Preliminary Assessment of Flora and Fauna Impacts for Proposed Wells: Comet Ridge Project Area (Fairview Gas Field), Prepared by Boobook.
2. Boobook (2008) Proposed Dawson River Crossing (Comet Ridge): Preliminary Site Inspection Report (19 March 2008).
3. Drill Site Inspection Report; Comet Ridge Pilot Program, Boobook Consulting.
4. Well Site Inspection Report - Emu Nest 1C, Boobook Consulting.
5. Well Site Inspection Report - Ironbark Gully 2, Boobook Consulting.
6. Well Site Inspection Report - Strathblane 1C, Boobook Consulting.
7. Drill Site Inspection Report: Comet Ridge Pilot Program.
8. Rare & Threatened Flora Survey: Sardine Creek Well Lease (central GPS mark)
9. Drill Site Inspection Report: Comet Ridge Pilot Program March 2008), Boobook Consulting.
10. Project: Comet Ridge Pilot Program (FV 113), Boobook Consulting.
11. Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002. J. C. W. Woinarski et al.
12. Environmental Management Plan for Fairview Project Area (April 2008) URS.
13. Eastern Queensland Gas Fields - Upgrade of Hutton and Moonah Creek, Fairview Platypus survey (August 2008) Connell Wagner.

Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

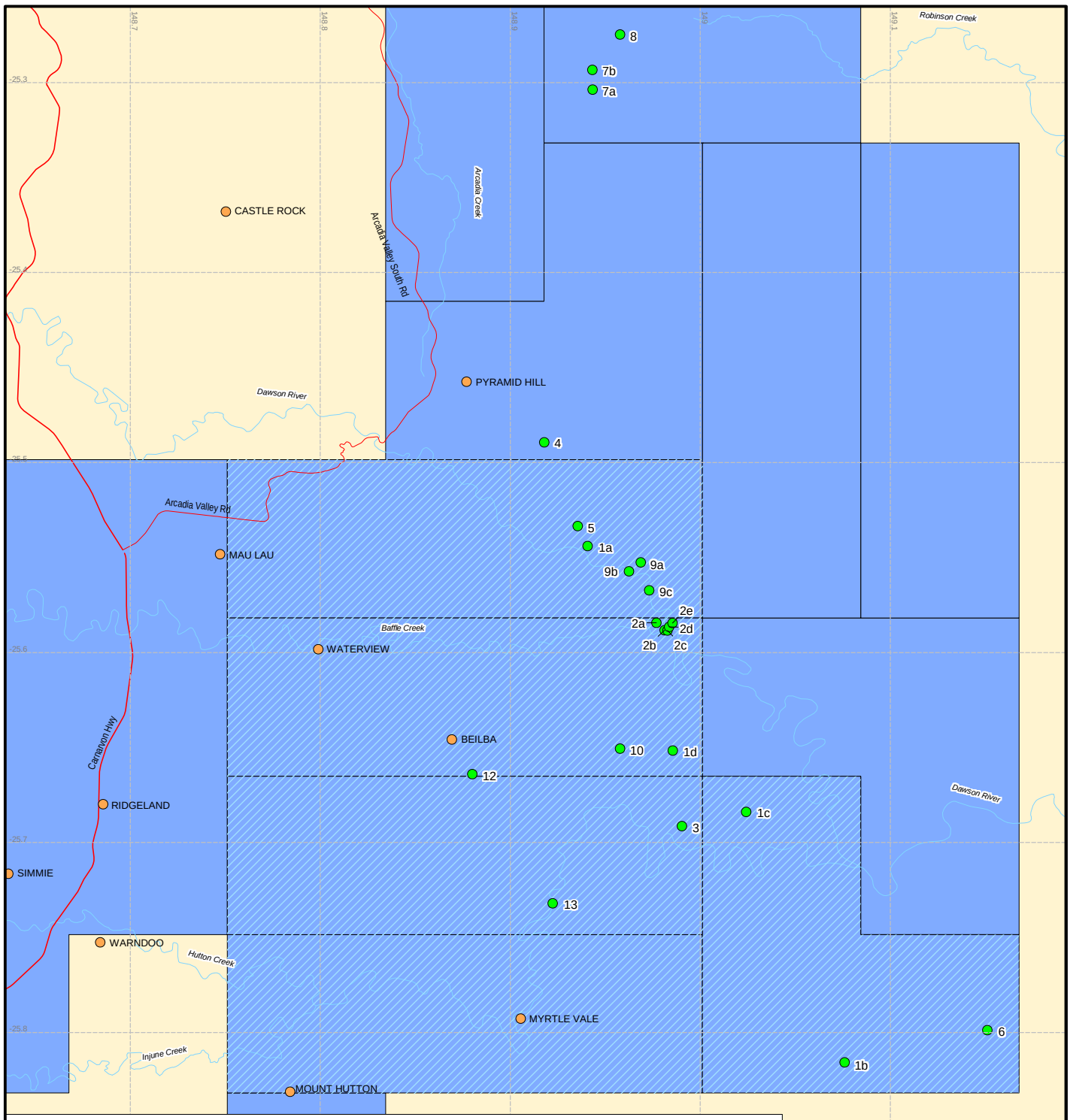
Title: **LOCATION OF CSG FIELD AND LITERATURE REVIEW SITES**

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-710.wor	

Figure: **2a**

Rev:A

A4



Primary Road
Secondary Road
Major Drainage
Gas Transmission Pipeline
Literature Review Site
CSG Field
Emerald Shire Boundary (Site Reference 11)
Fairview CSG Field (Site Reference 12)

N
W E
S

0 5 10Km

Scale: 1:300 000 (A4)
Datum : GDA 94

Literature Review Site Reference by Location

1. Boobook (2006) Preliminary Assessment of Flora and Fauna Impacts for Proposed Wells: Comet Ridge Project Area (Fairview Gas Field), Prepared by Boobook.
2. Boobook (2008) Proposed Dawson River Crossing (Comet Ridge): Preliminary Site Inspection Report (19 March 2008).
3. Drill Site Inspection Report; Comet Ridge Pilot Program, Boobook Consulting.
4. Well Site Inspection Report - Emu Nest 1C, Boobook Consulting.
5. Well Site Inspection Report - Ironbark Gully 2, Boobook Consulting.
6. Well Site Inspection Report - Strathblane 1C, Boobook Consulting.
7. Drill Site Inspection Report: Comet Ridge Pilot Program.
8. Rare & Threatened Flora Survey: Sardine Creek Well Lease (central GPS mark)
9. Drill Site Inspection Report: Comet Ridge Pilot Program March 2008), Boobook Consulting.
10. Project: Comet Ridge Pilot Program (FV 113), Boobook Consulting.
11. Monitoring change in the vertebrate fauna of central Queensland, Australia, over a period of broad-scale vegetation clearance, 1973–2002. J. C. W. Woinarski et al.
12 Environmental Management Plan for Fairview Project Area (April 2008) URS.
13 Eastern Queensland Gas Fields - Upgrade of Hutton and Moonah Creek, Fairview Platypus survey (August 2008) Connell Wagner.

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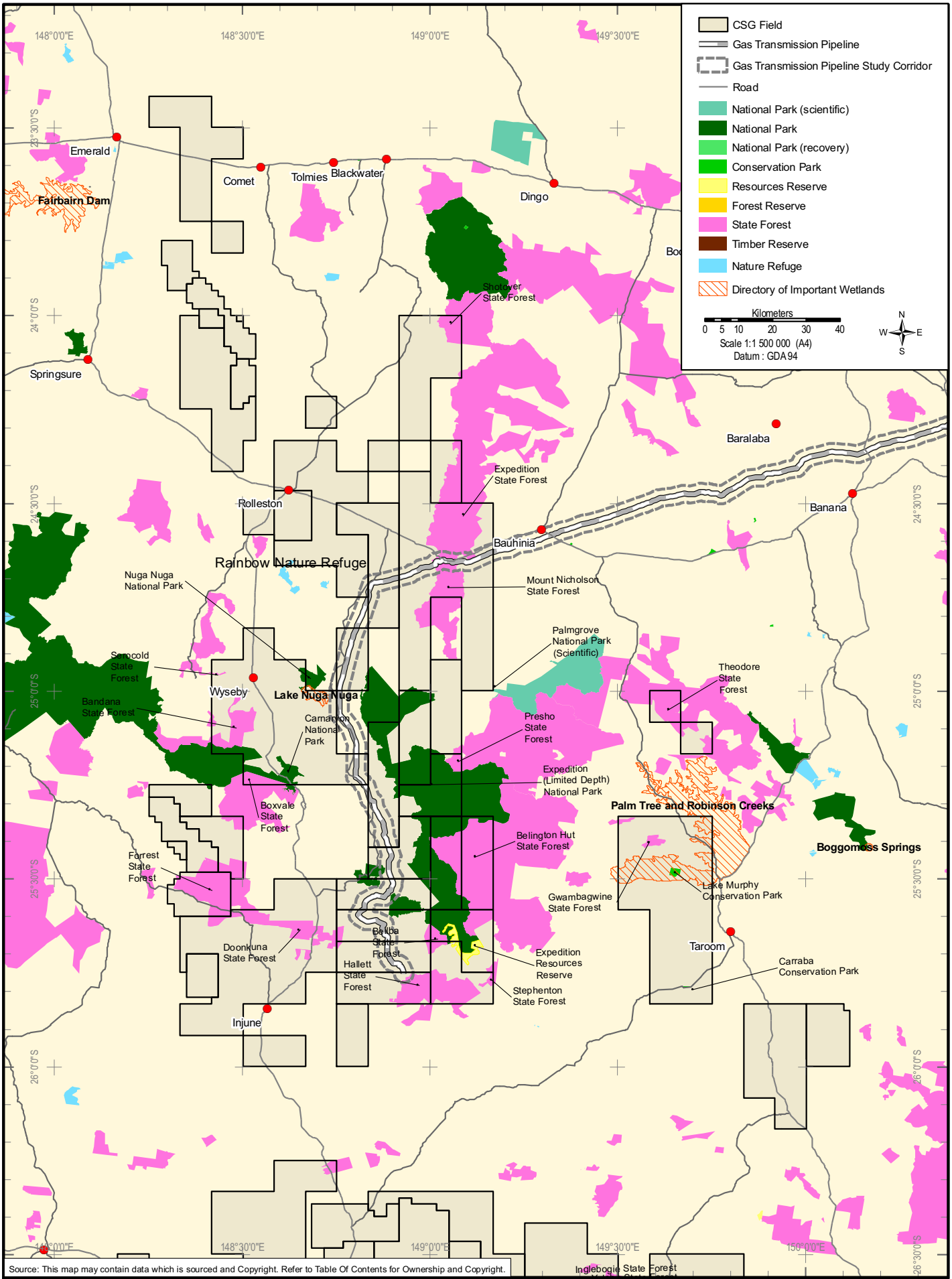
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **LOCATION OF CSG FIELD AND LITERATURE REVIEW SITES INSET**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **2b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-710.wor			**A4**



Client

LNG

URS

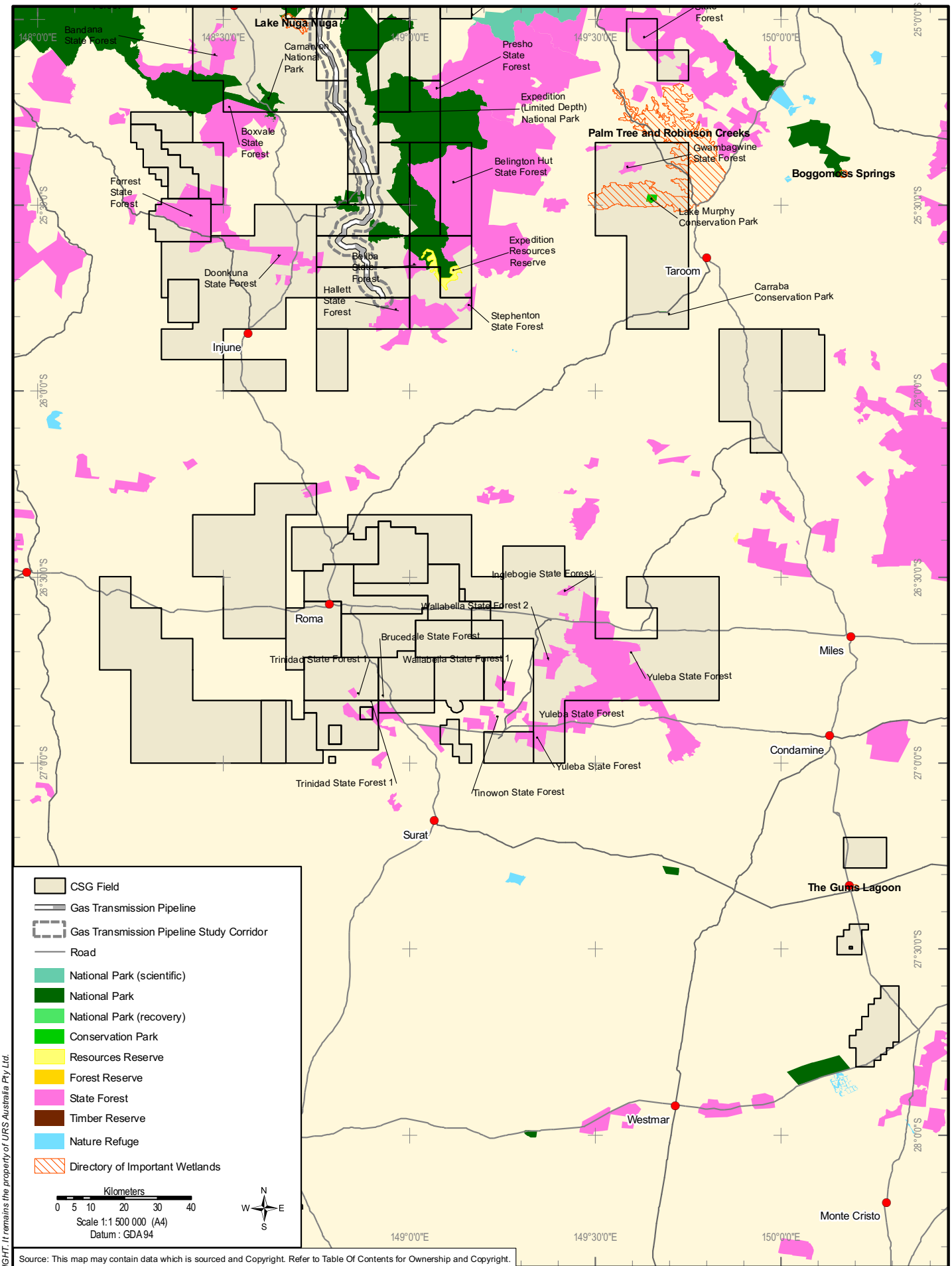
Project

GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title

CONSERVATION AREAS AND FORESTRY AREAS CSG FIELDS (NORTHERN SECTION)

Drawn: MG	Approved: JB	Date: 22-01-2009	Figure: **3a**	Rev. A
Job No.: **4262 6220**	File No.: 42626220-g-775.mxd			A4



Client

Project

GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title

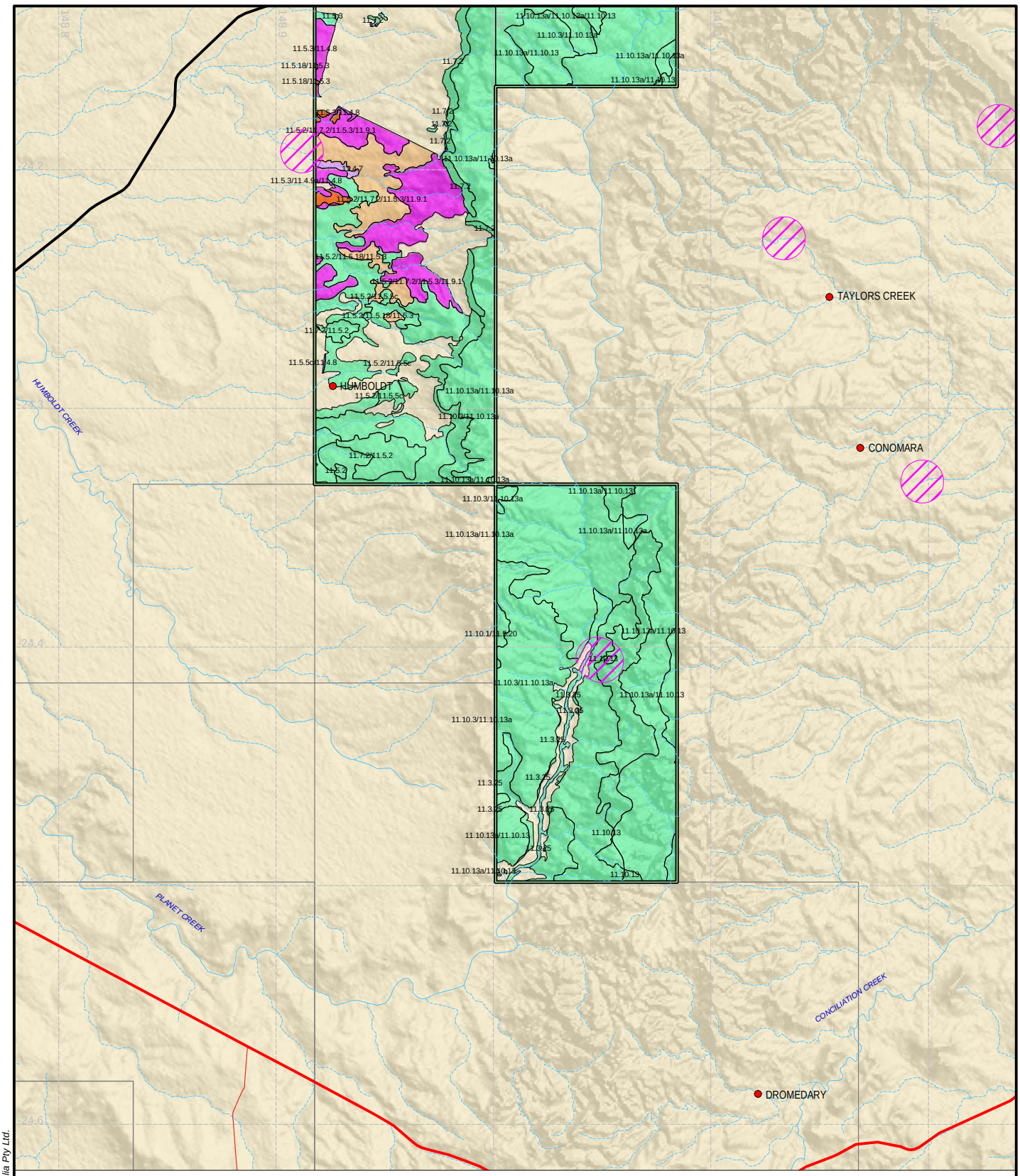
CONSERVATION AREAS AND FORESTRY AREAS CSG FIELDS (SOUTHERN SECTION)

Drawn: MG	Approved: JB	Date: 22-01-2009
Job No.: **4262 6220**	File No.: 42626220-g-774.mxd	

Figure: **3b**

Rev. A

A4



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Mahalo CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

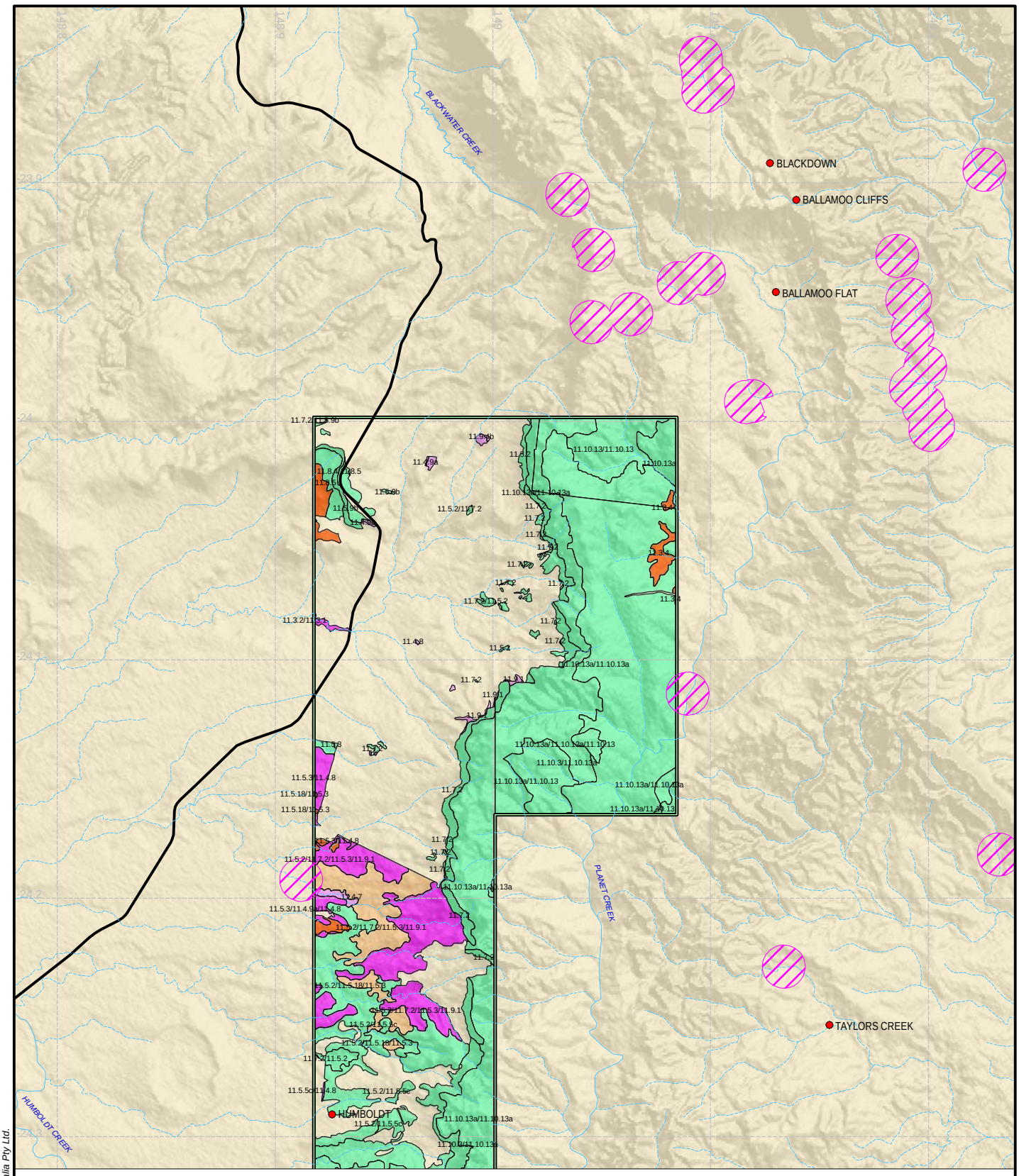
Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - MAHALO CSG FIELD 1 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-781.wor	

Figure: **4a**

Rev:A

A4



N
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0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Mahalo CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

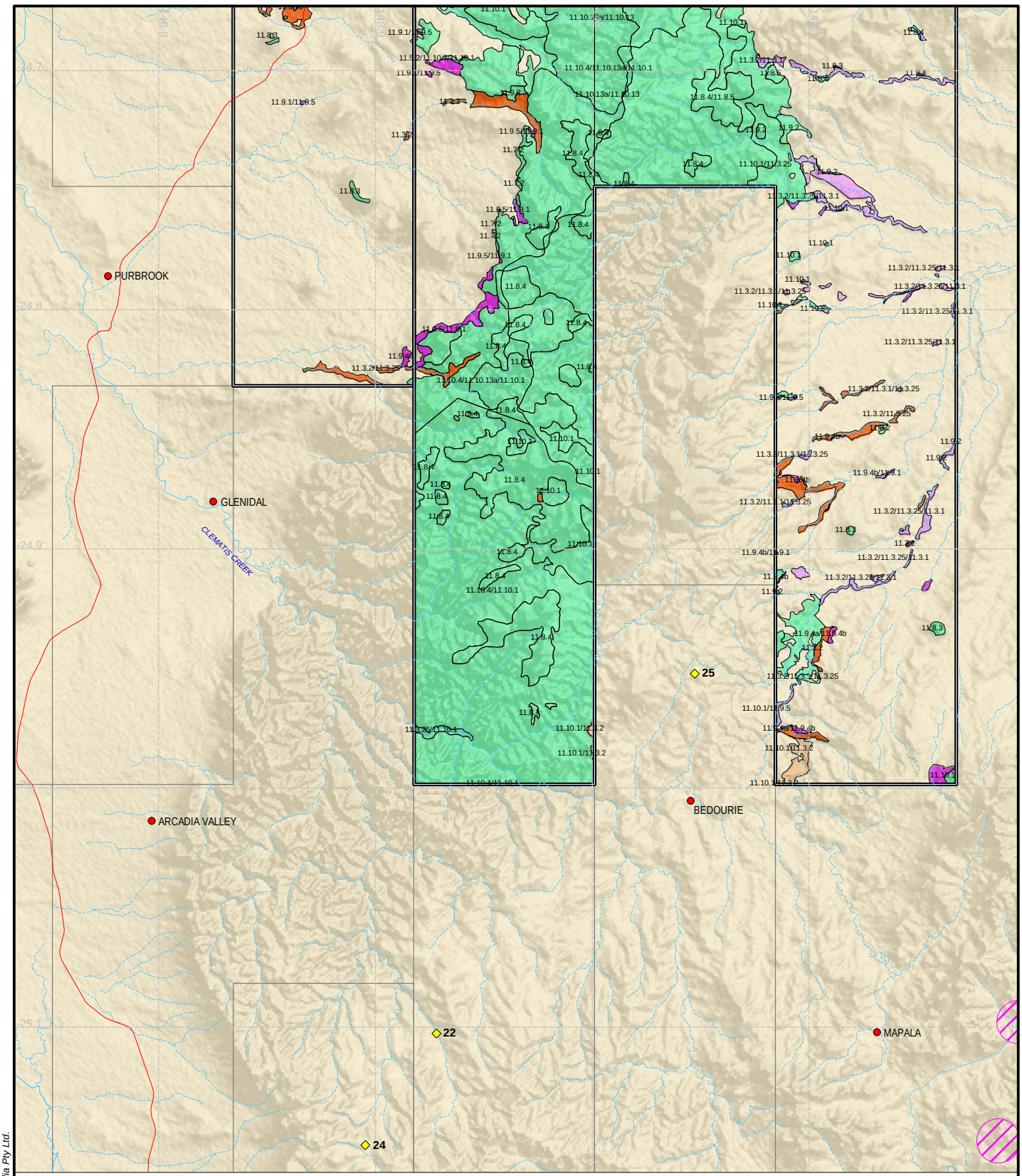
Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title:
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - MAHALO CSG FIELD 2 OF 2

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **4b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-781.wor			**A4**



N
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0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Comet CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

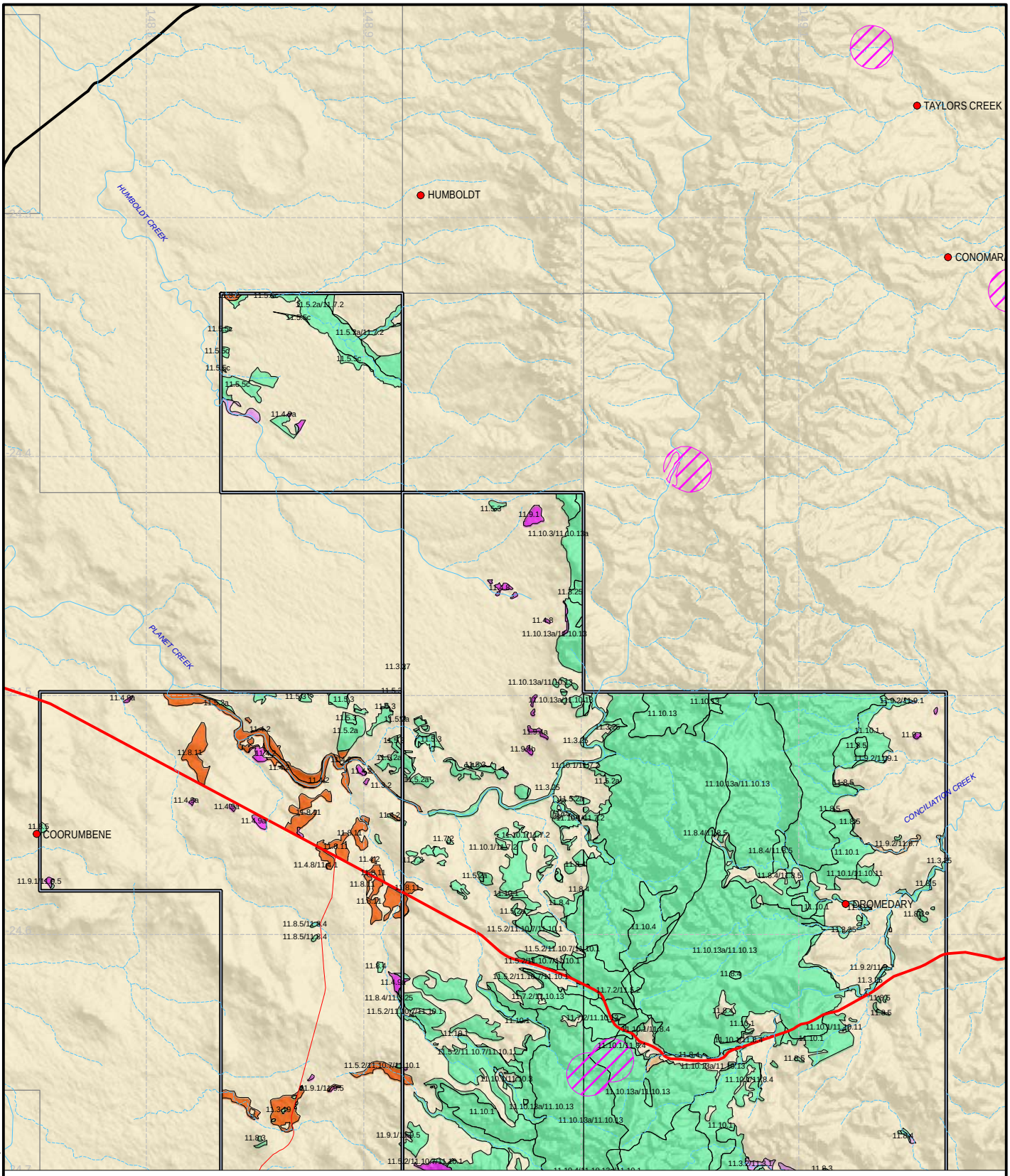
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - COMET CSG FIELD 1 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **5a**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-780.wor			**A4**



N
W E
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0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Comet CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

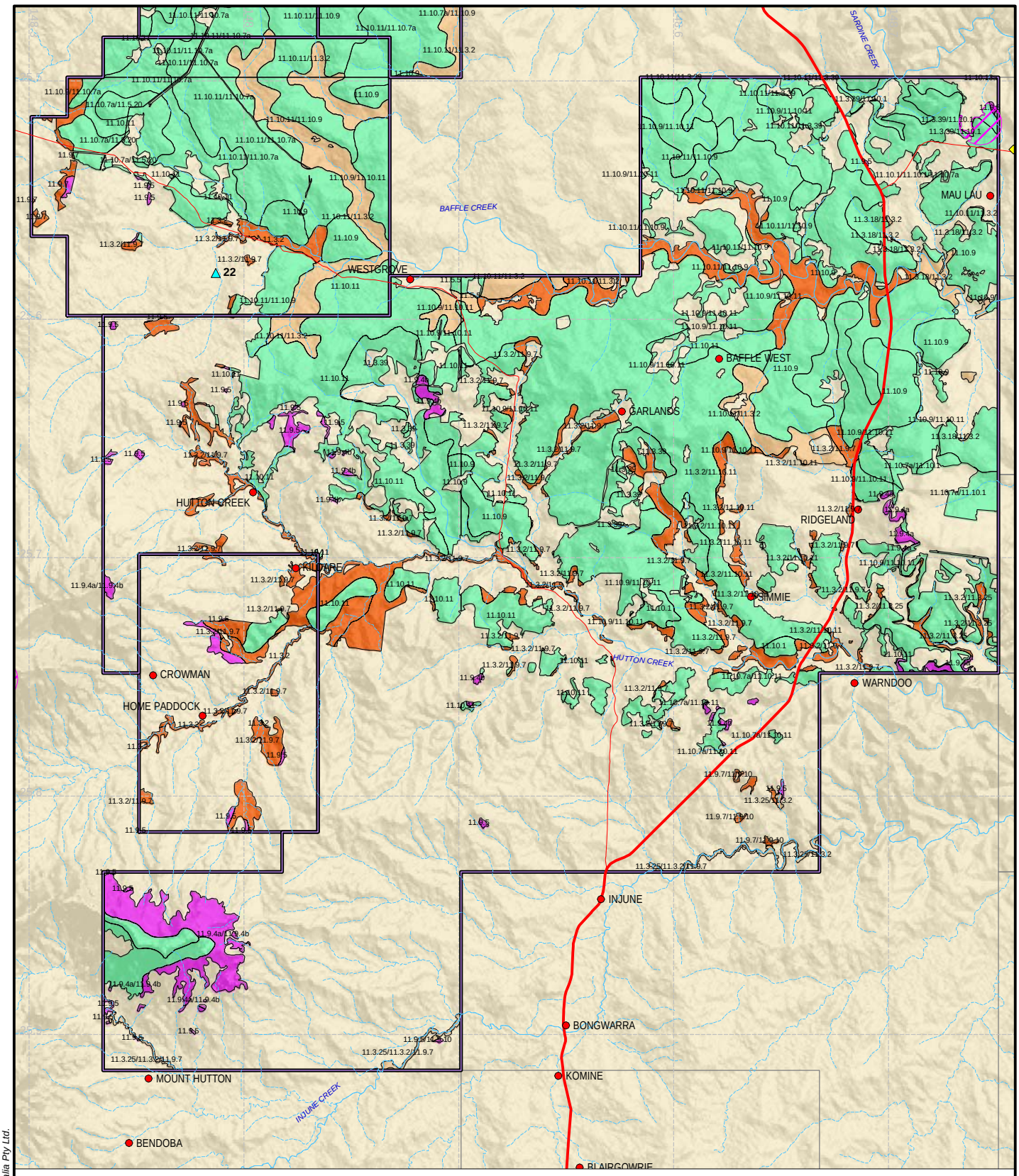
Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - COMET CSG FIELD 2 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-780.wor	

Figure: **5b**

Rev:A

A4



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

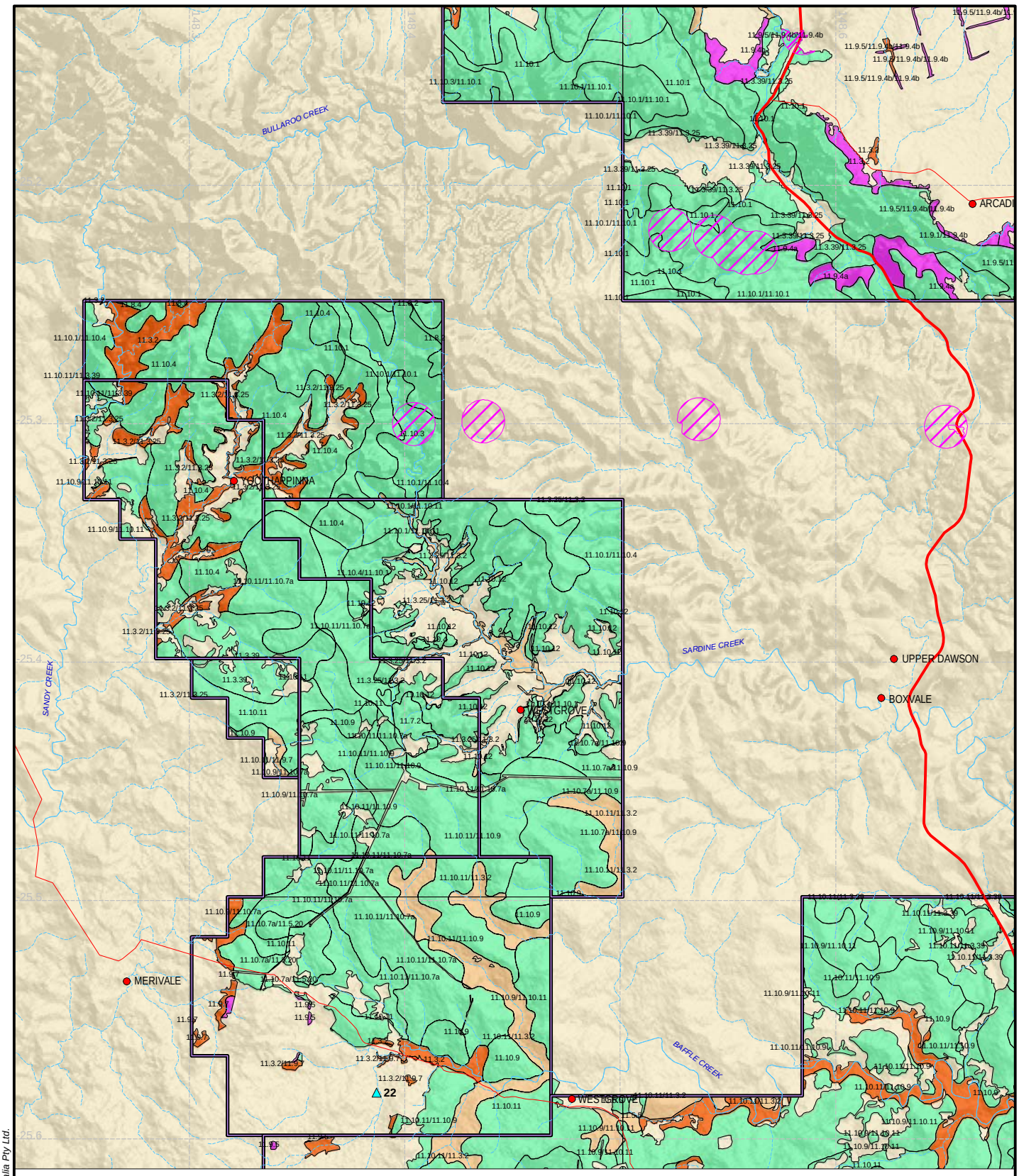
- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 1 OF 6

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **6a**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-779.wor			**A4**



N
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S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

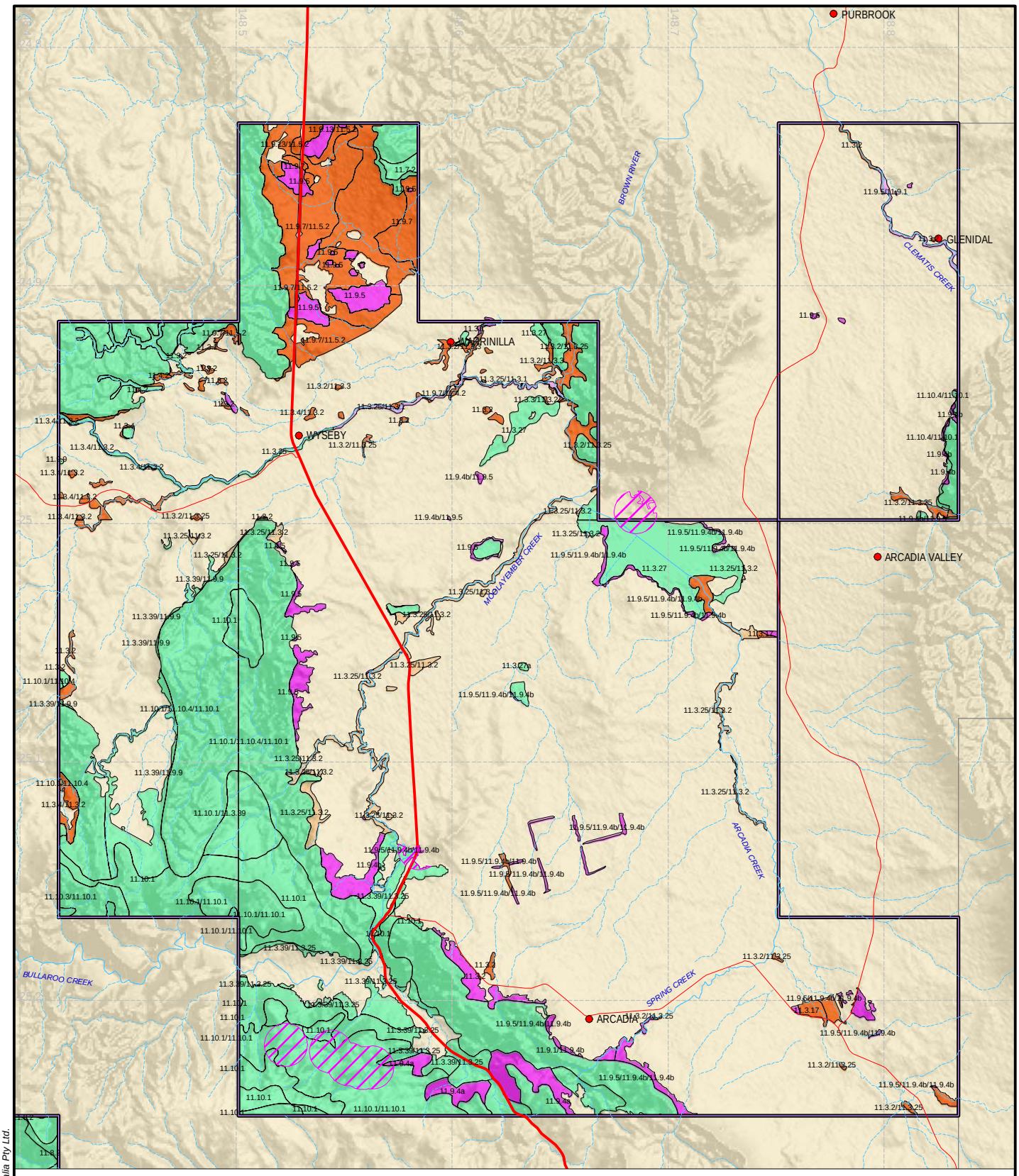
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 2 OF 6**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **6b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-779.wor			**A4**



N
W E
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0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

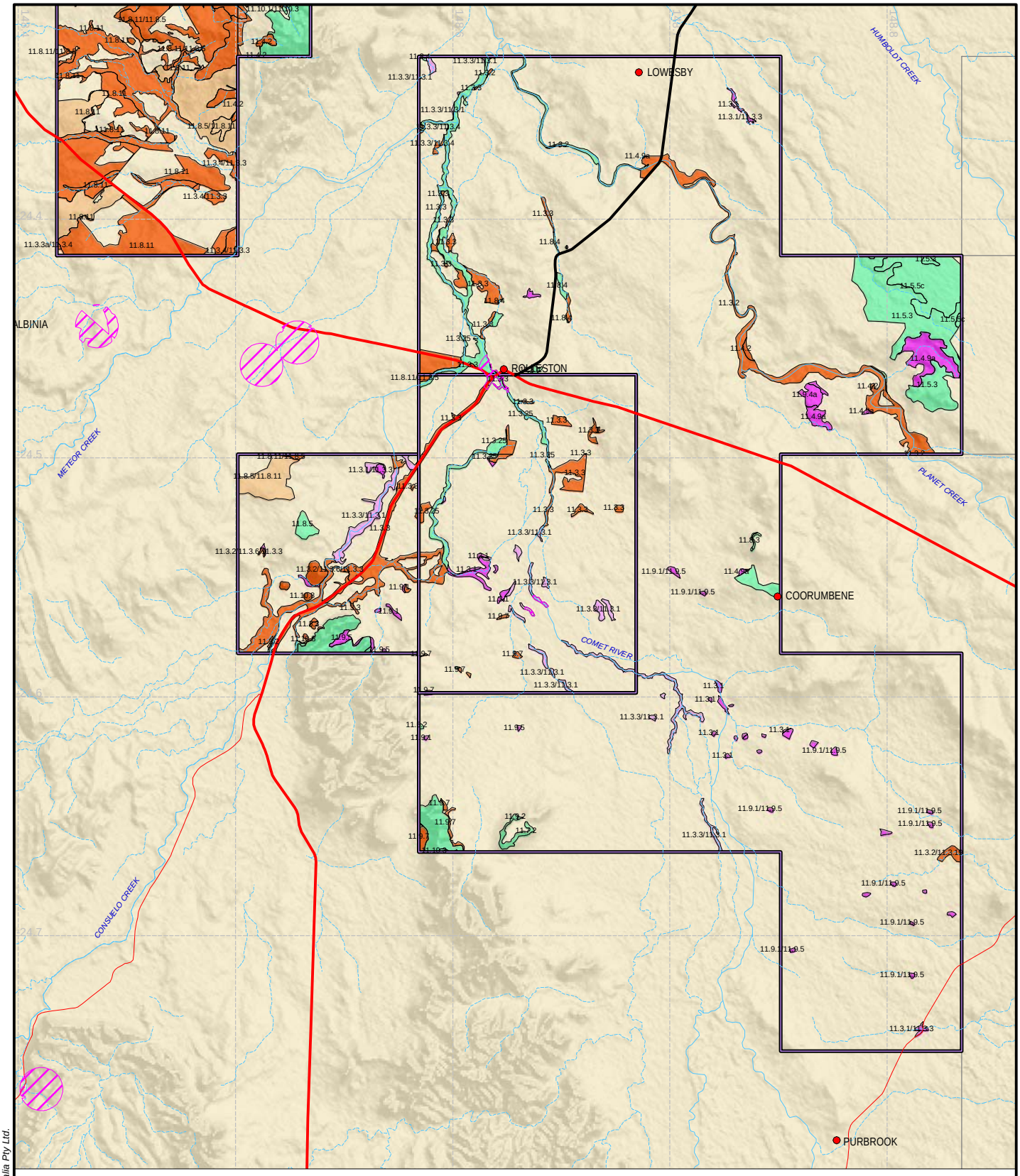
Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 3 OF 6**

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-779.wor	

Figure: **6c**

Rev:A

A4



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

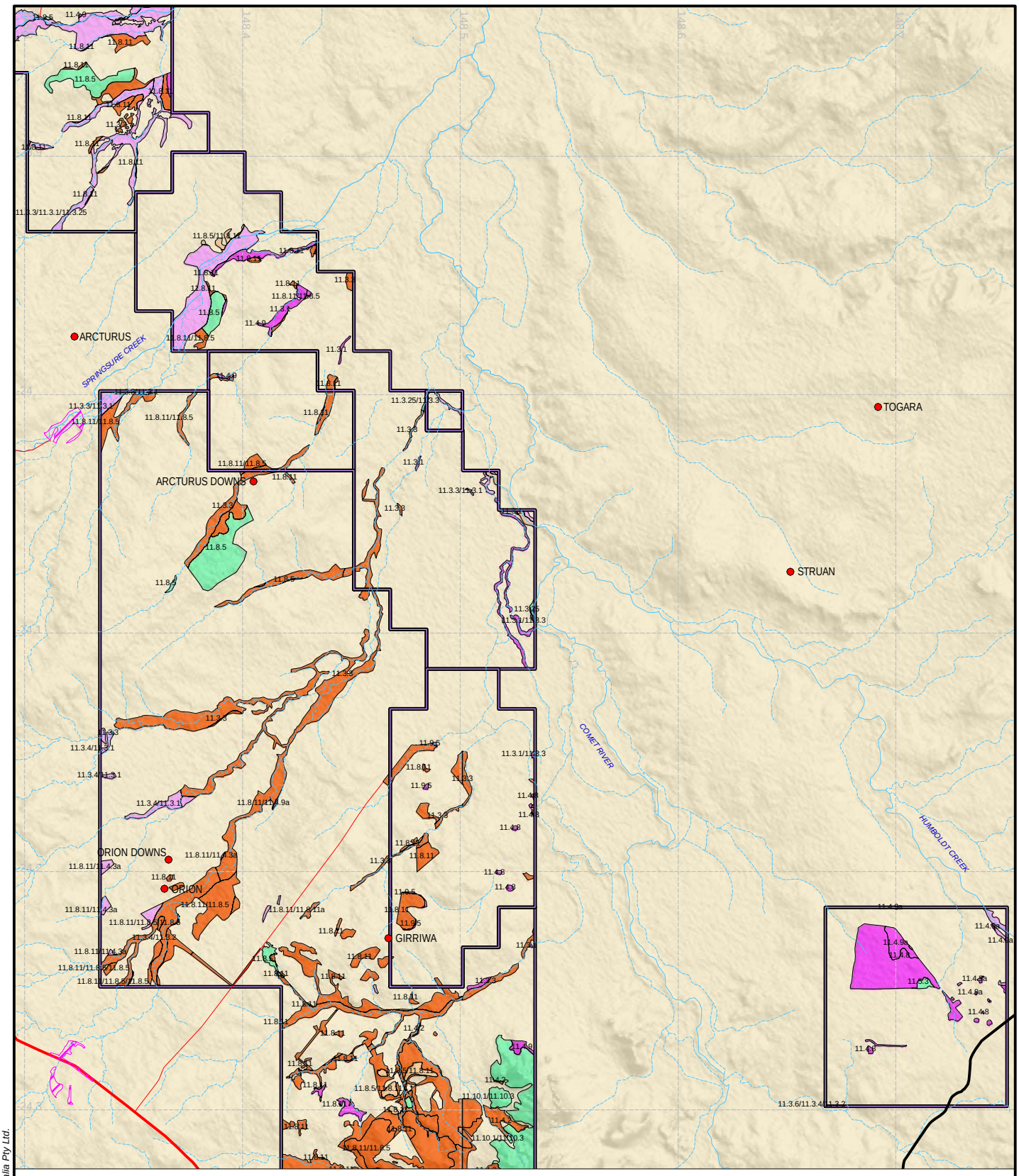
Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title:
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 4 OF 6

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **6d**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-779.wor			**A4**



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

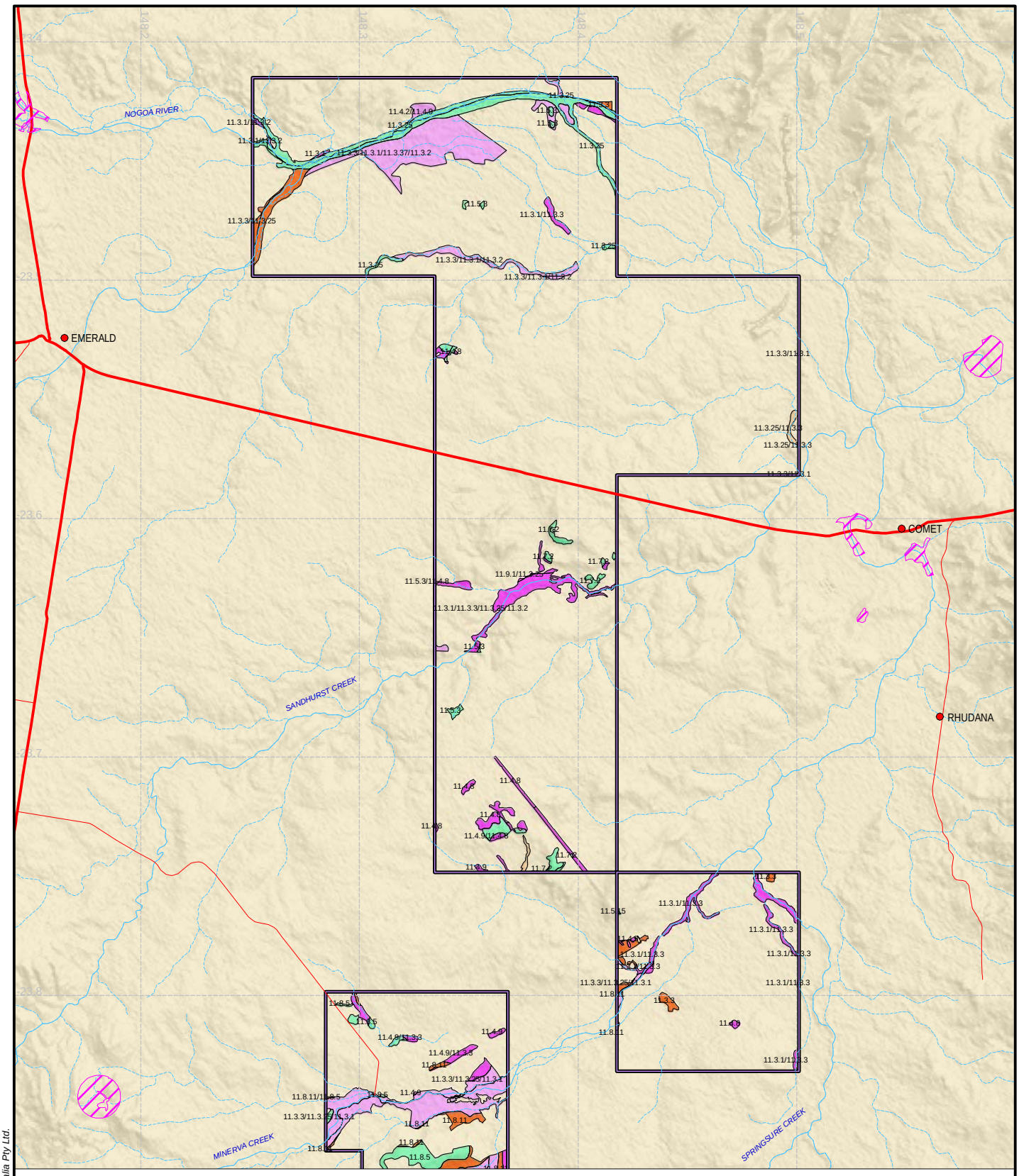
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 5 OF 6**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **6e**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-779.wor			**A4**



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Denison Trough CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

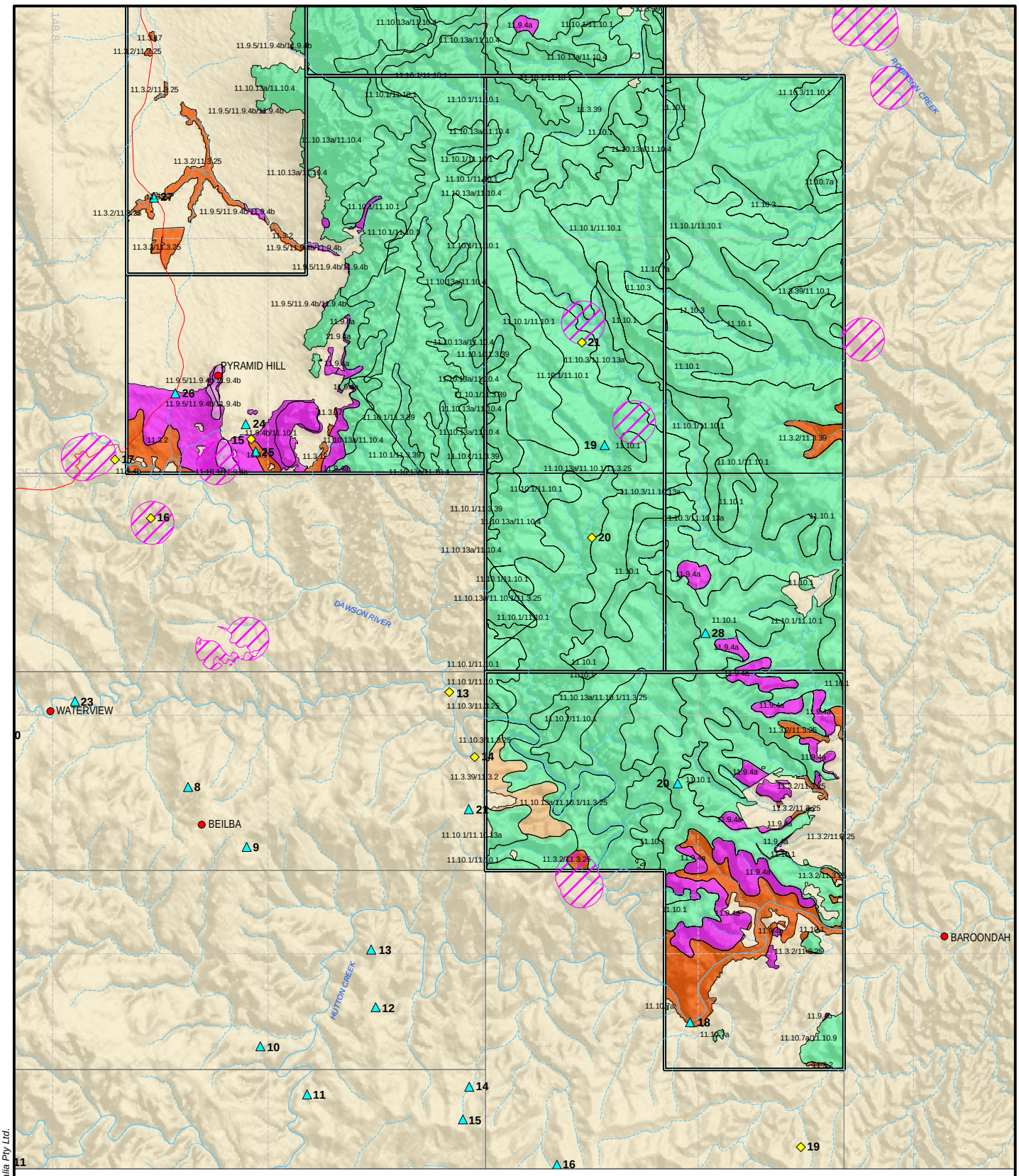
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - DENISON TROUGH CSG FIELD 6 OF 6**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **6f**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-779.wor			**A4**



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Arcadia Valley CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

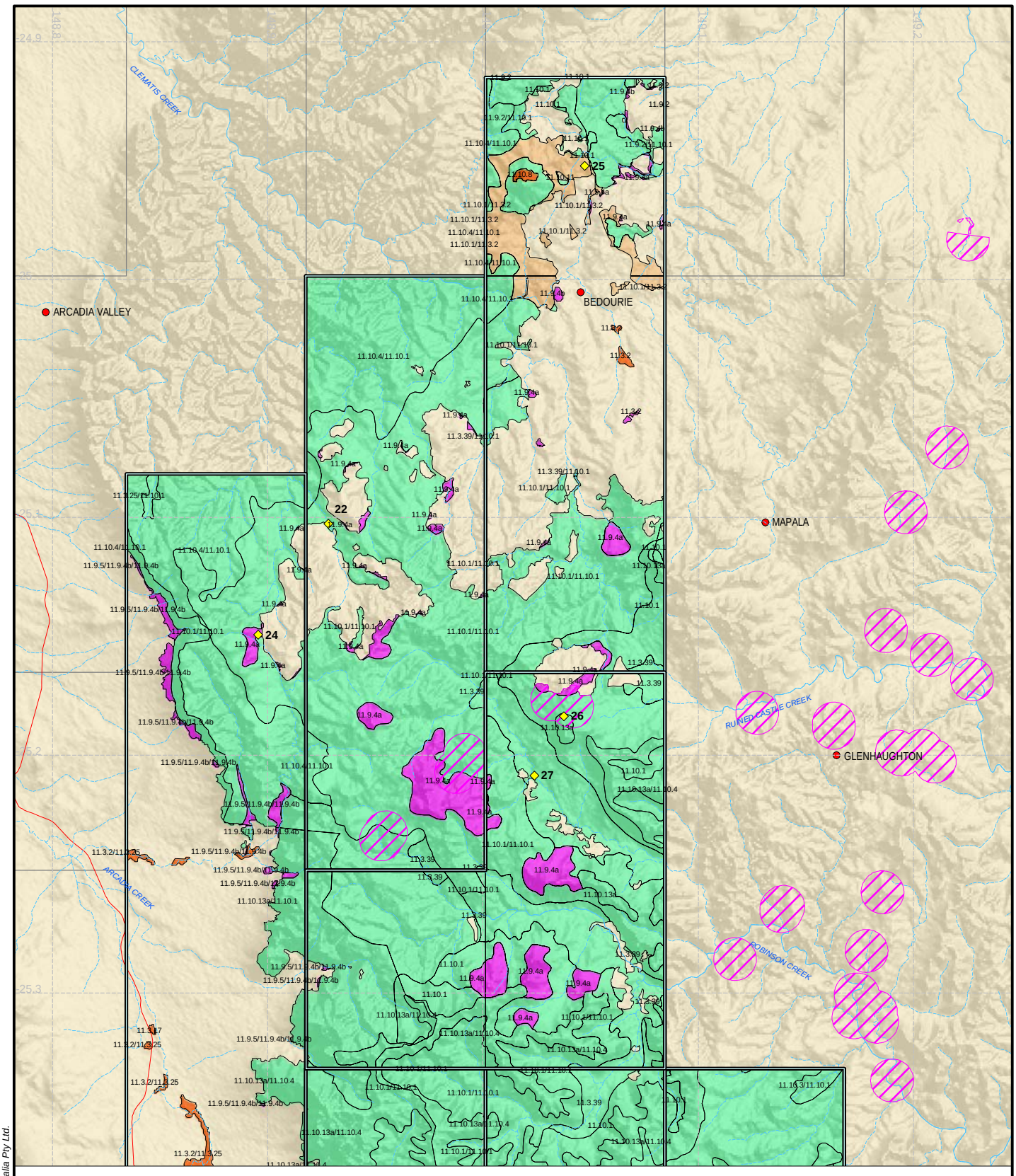
Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ARCADIA VALLEY CSG FIELD 1 OF 2

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-778.wor	

Figure: **7a**

Rev:A

A4



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Arcadia Valley CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

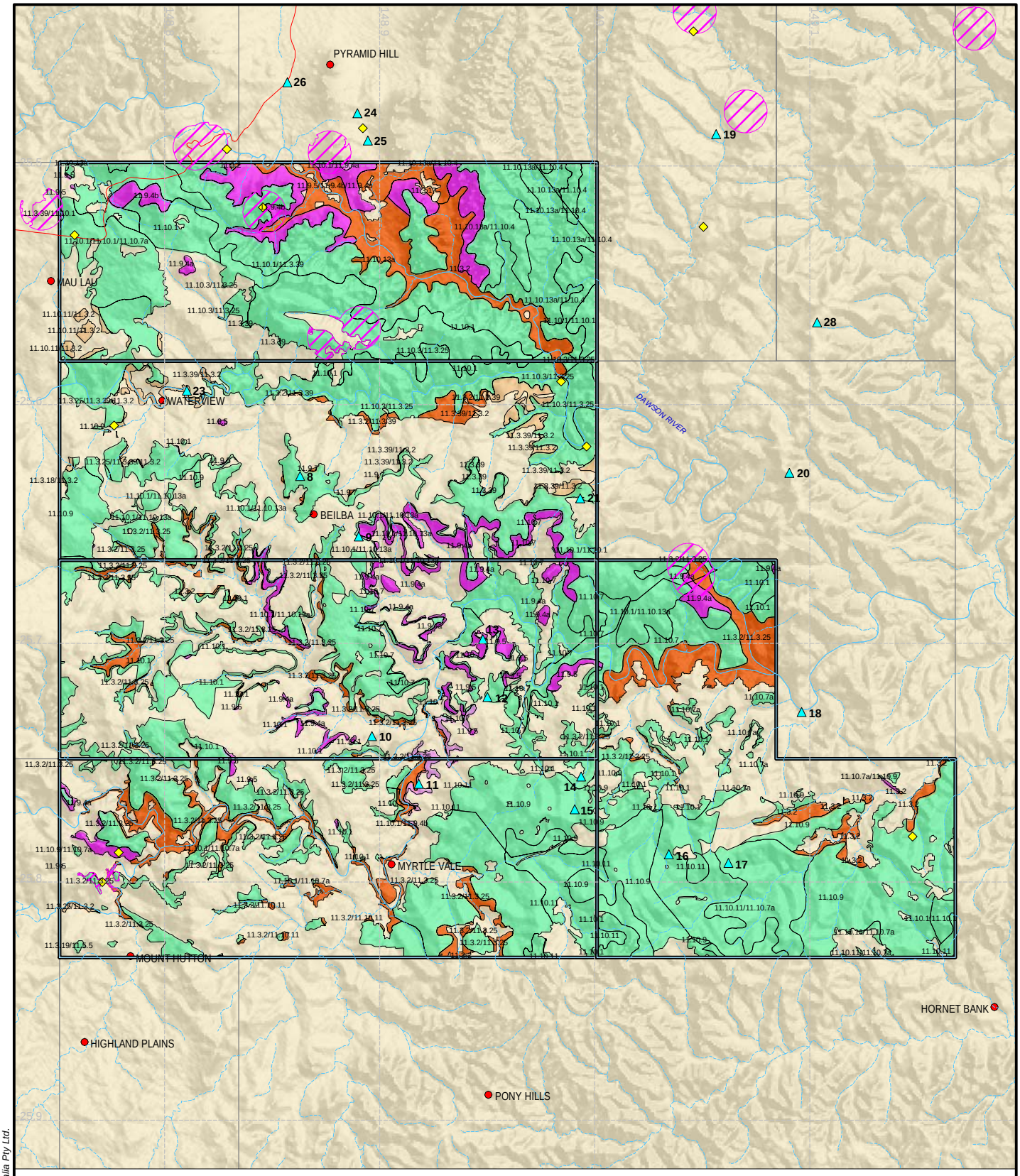
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ARCADIA VALLEY CSG FIELD 2 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **7b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-778.wor			**A4**

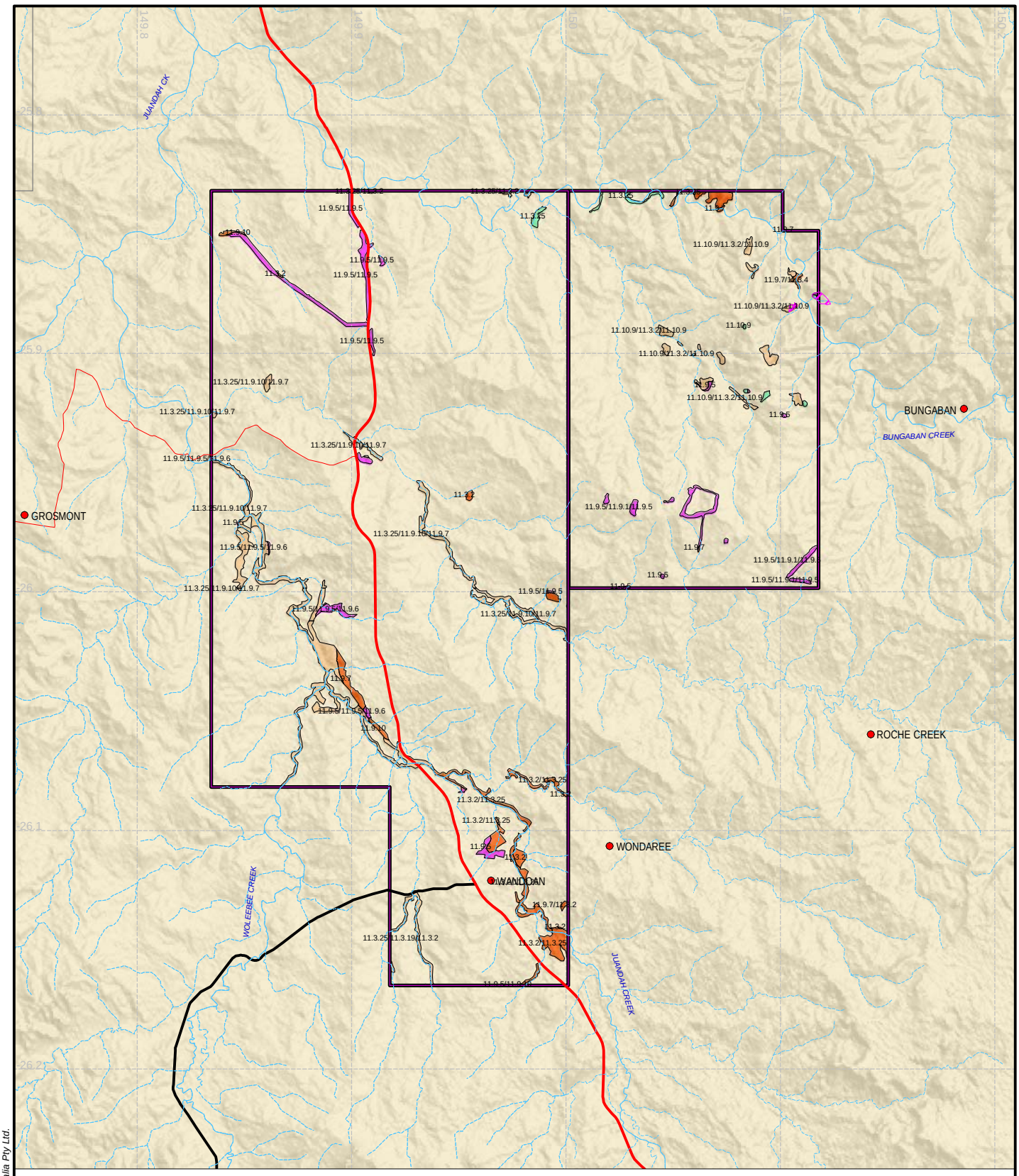


Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - FAIRVIEW CSG FIELD

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: 8	Rev:A
Job No: **4262 6220**	File No: 42626220-g-777.wor			A4



N
W E
S

0 3.75 7.5km

Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
- Scotia CSG Field
- Other CSG Field
- Secondary Site
- Quaternary Site
- Essential Habitat
- Endangered dominant RE
- Endangered sub-dominant RE
- Of concern dominant RE
- Of concern sub-dominant RE
- Not of concern RE

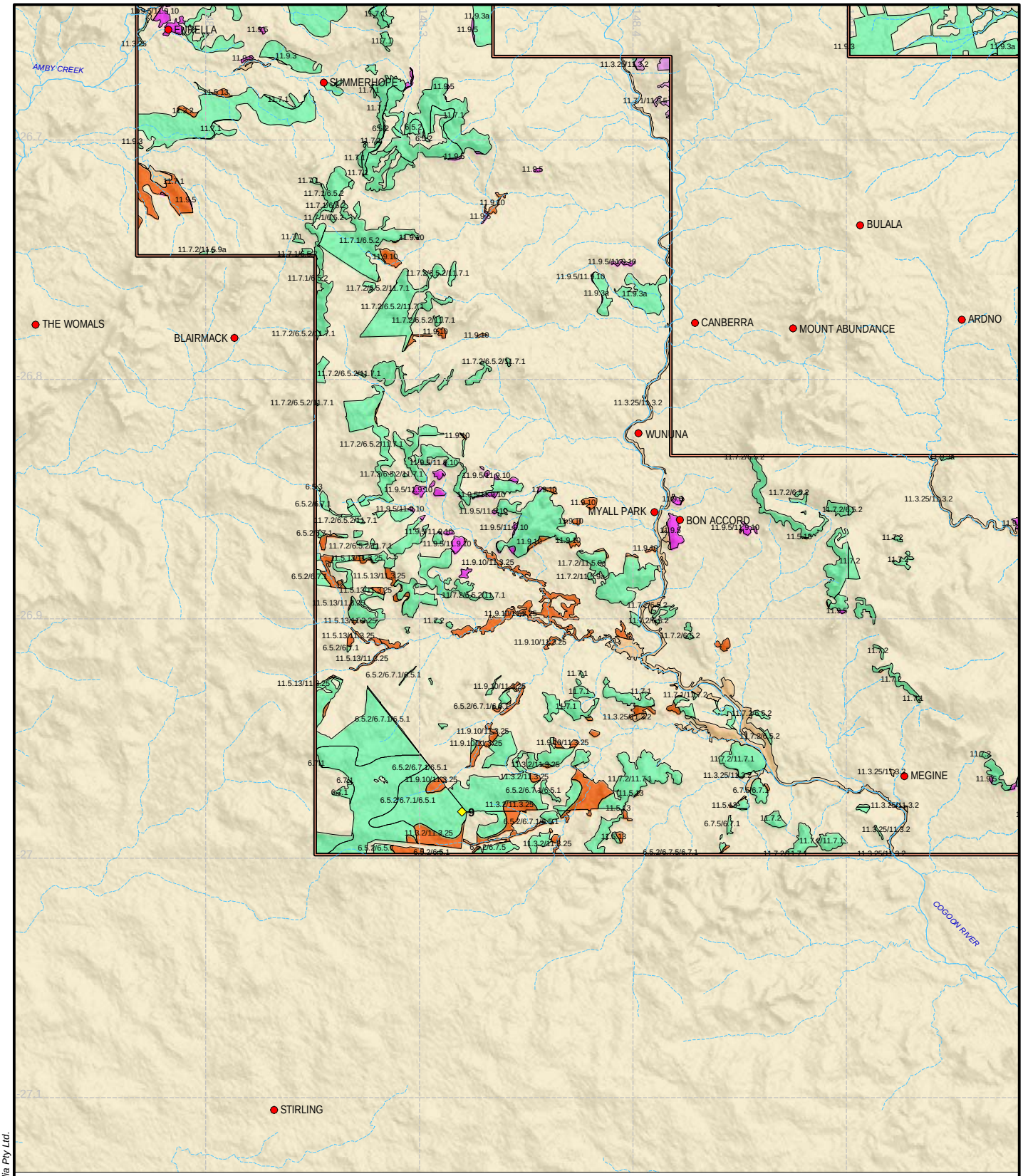
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - SCOTIA CSG FIELD**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **9**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-783.wor			**A4**



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Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
- Major Road
- Minor Road
- Major Drainage
- Minor Drainage
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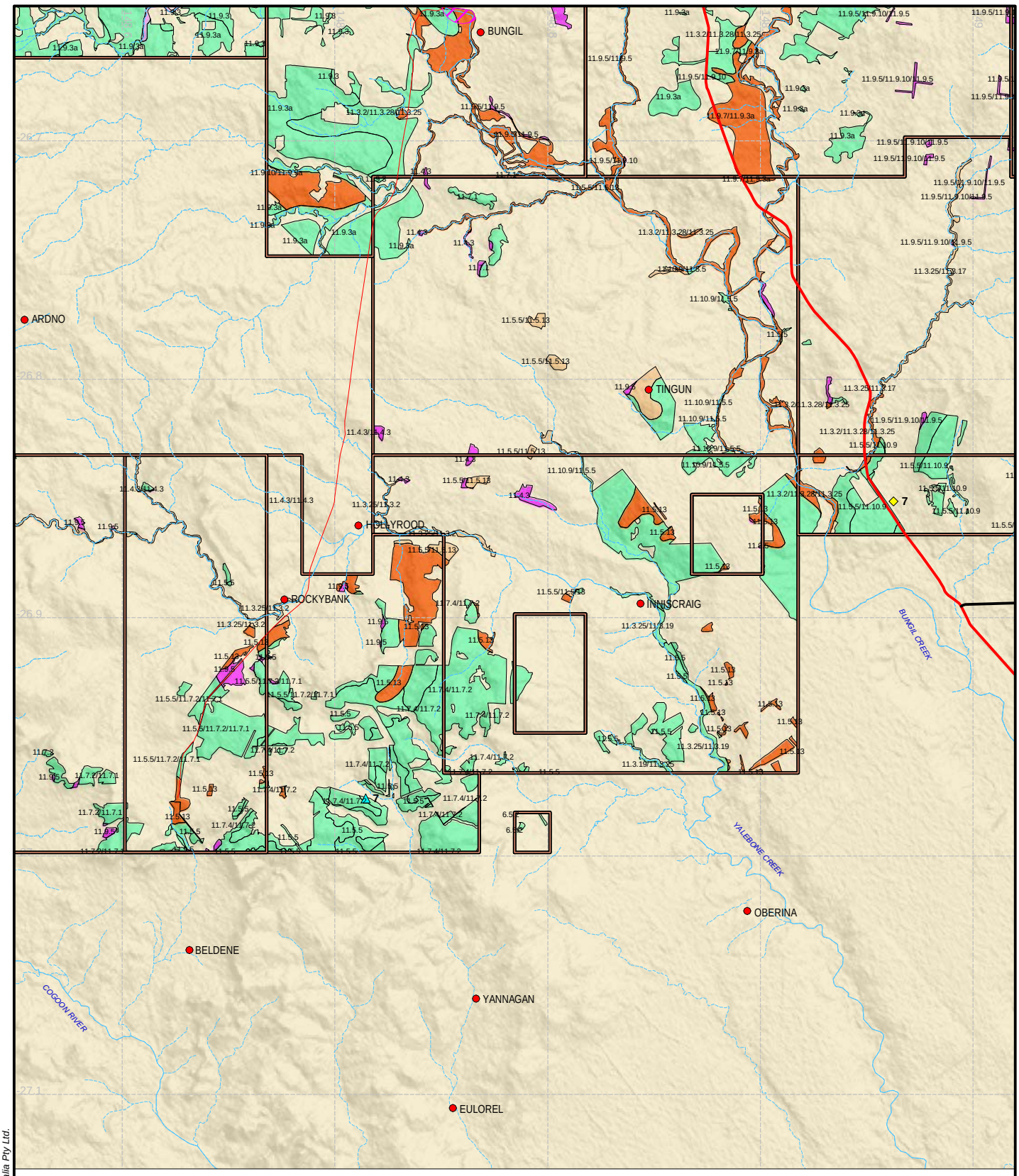
Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 1 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10a**
Job No: **4262 6220**	File No: 42626220-g-776.wor		Rev:A A4

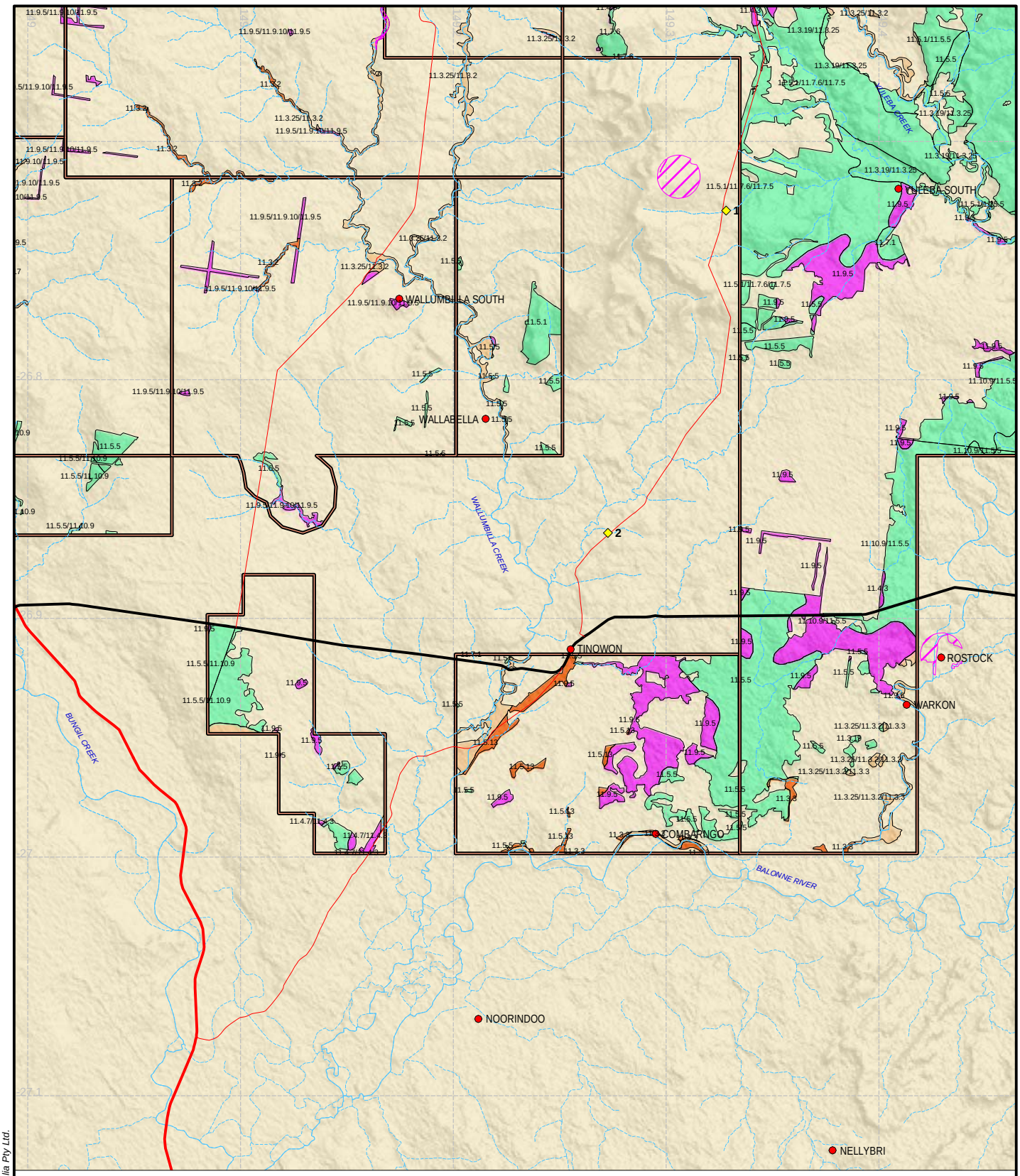


Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 2 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-776.wor			**A4**



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Client: LNG

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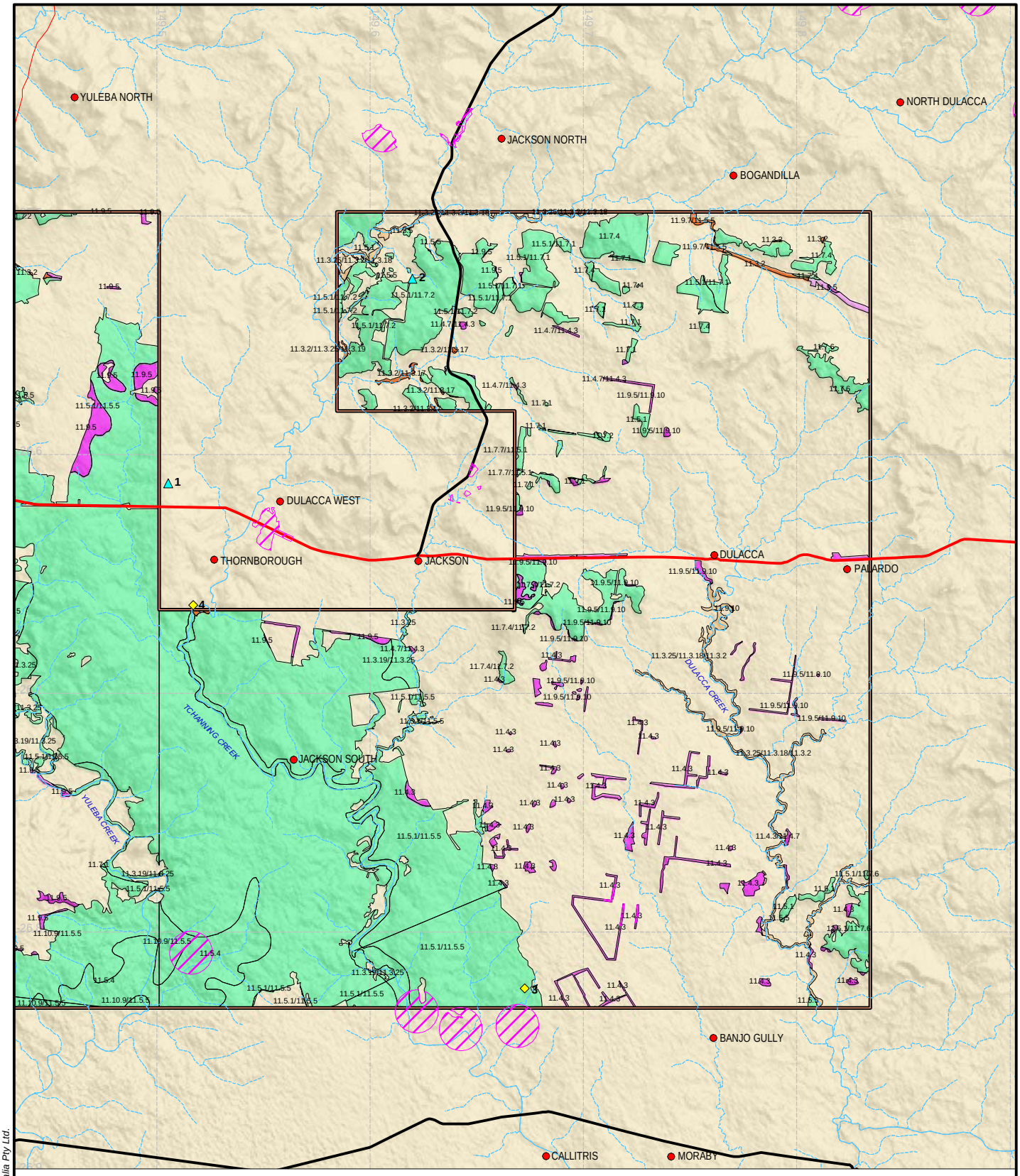
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 3 OF 8**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10c**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-776.wor			**A4**



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Scale: 1:250 000 (A4)
Datum: GDA94

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Client: LNG

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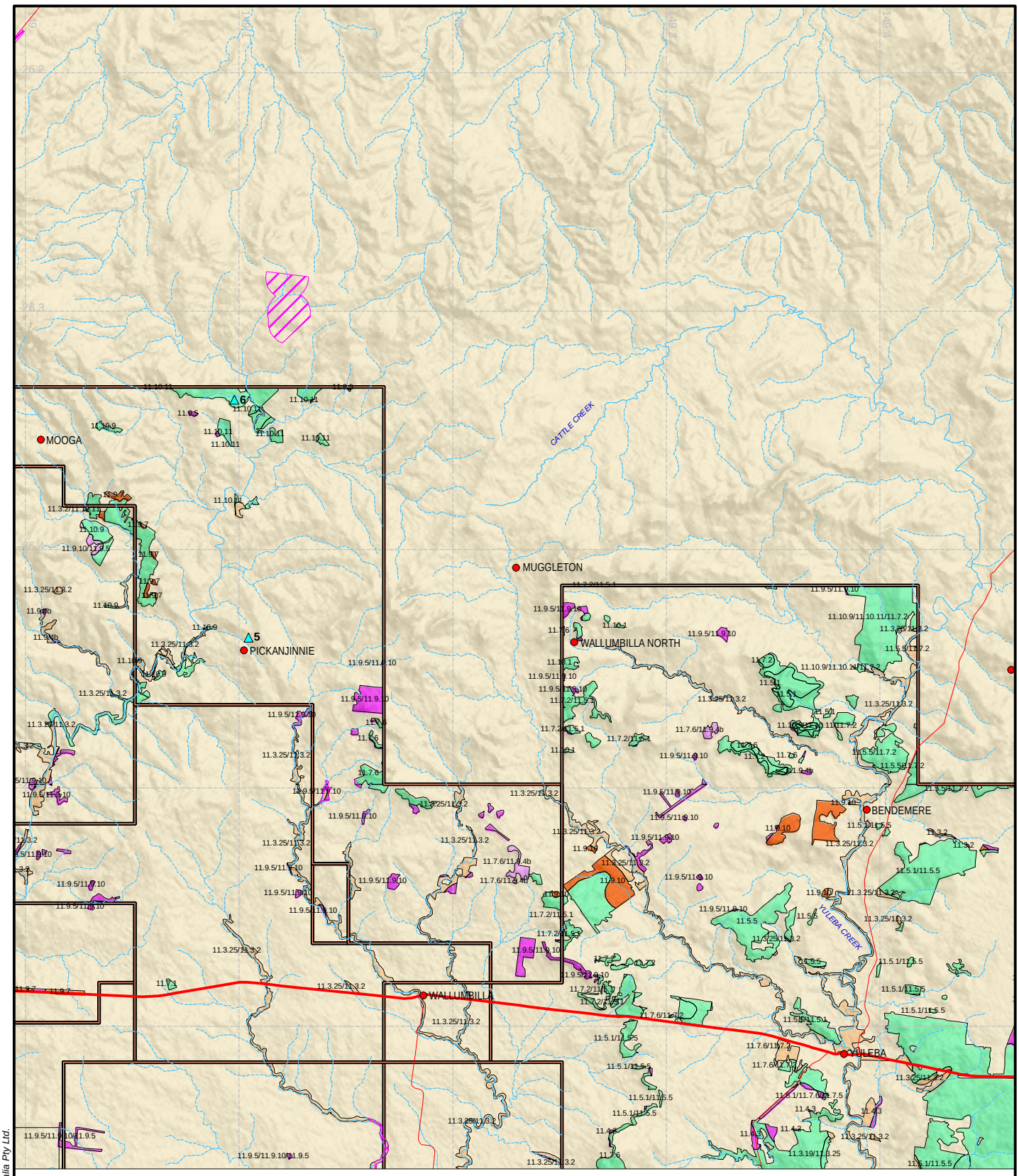
Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 4 OF 8**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10d**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-776.wor			**A4**



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Scale: 1:250 000 (A4)
Datum: GDA94

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GLADSTONE LNG PROJECT
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CSG FIELD

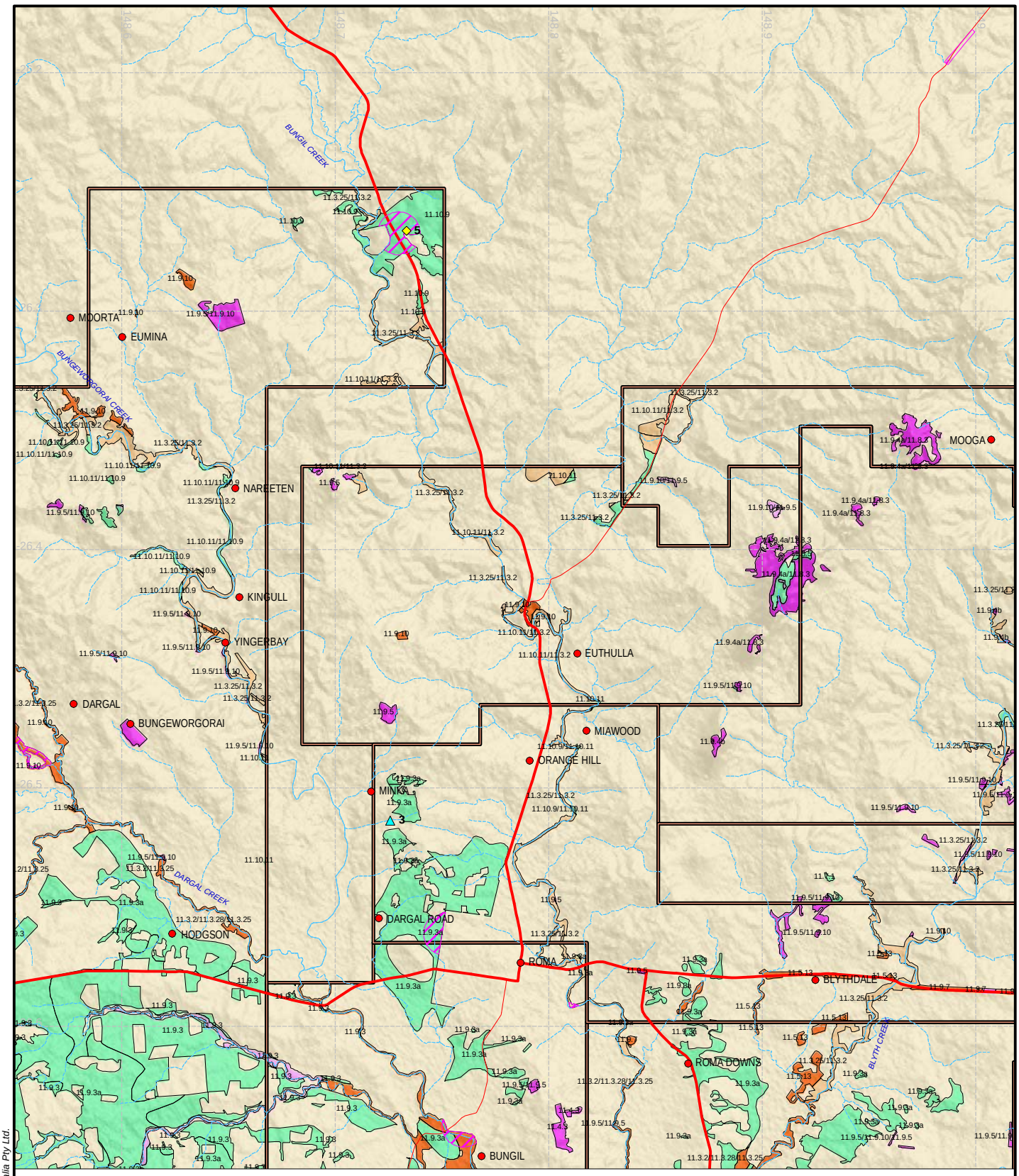
Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 5 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-776.wor	

Figure: **10e**

Rev:A

A4



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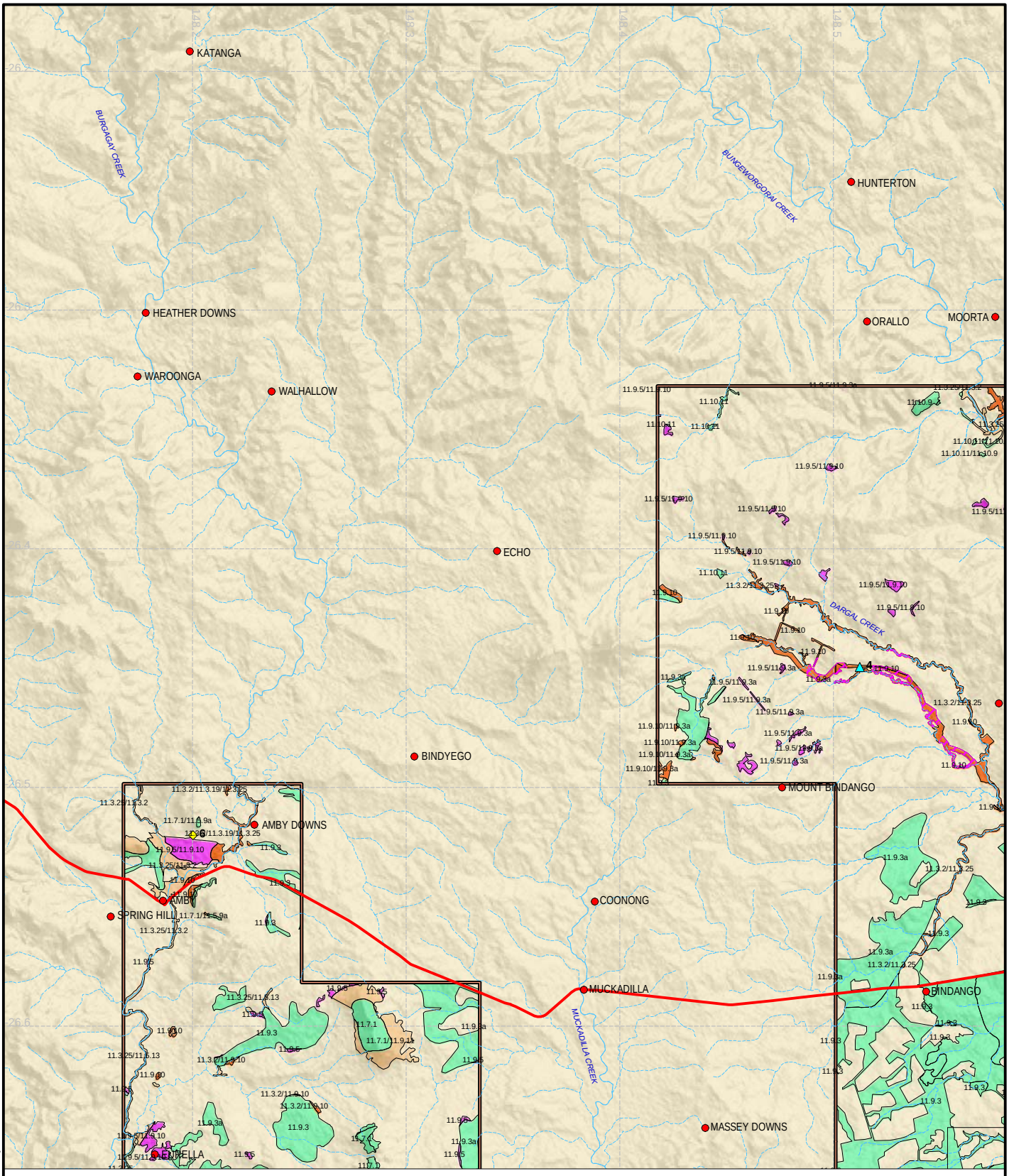
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 6 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10f**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-776.wor			**A4**



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Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 7 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-776.wor	

Figure: **10g**

Rev:A

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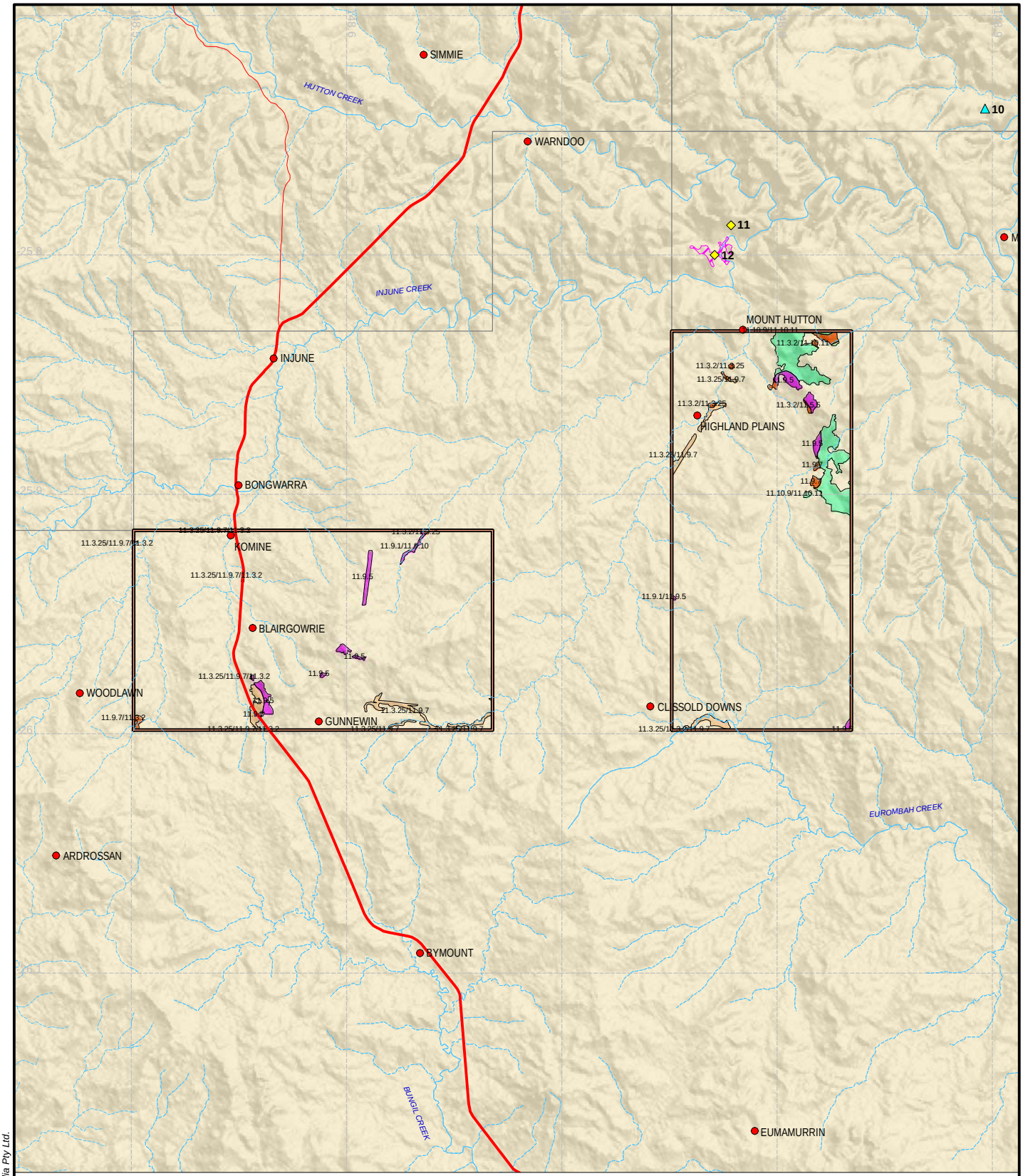

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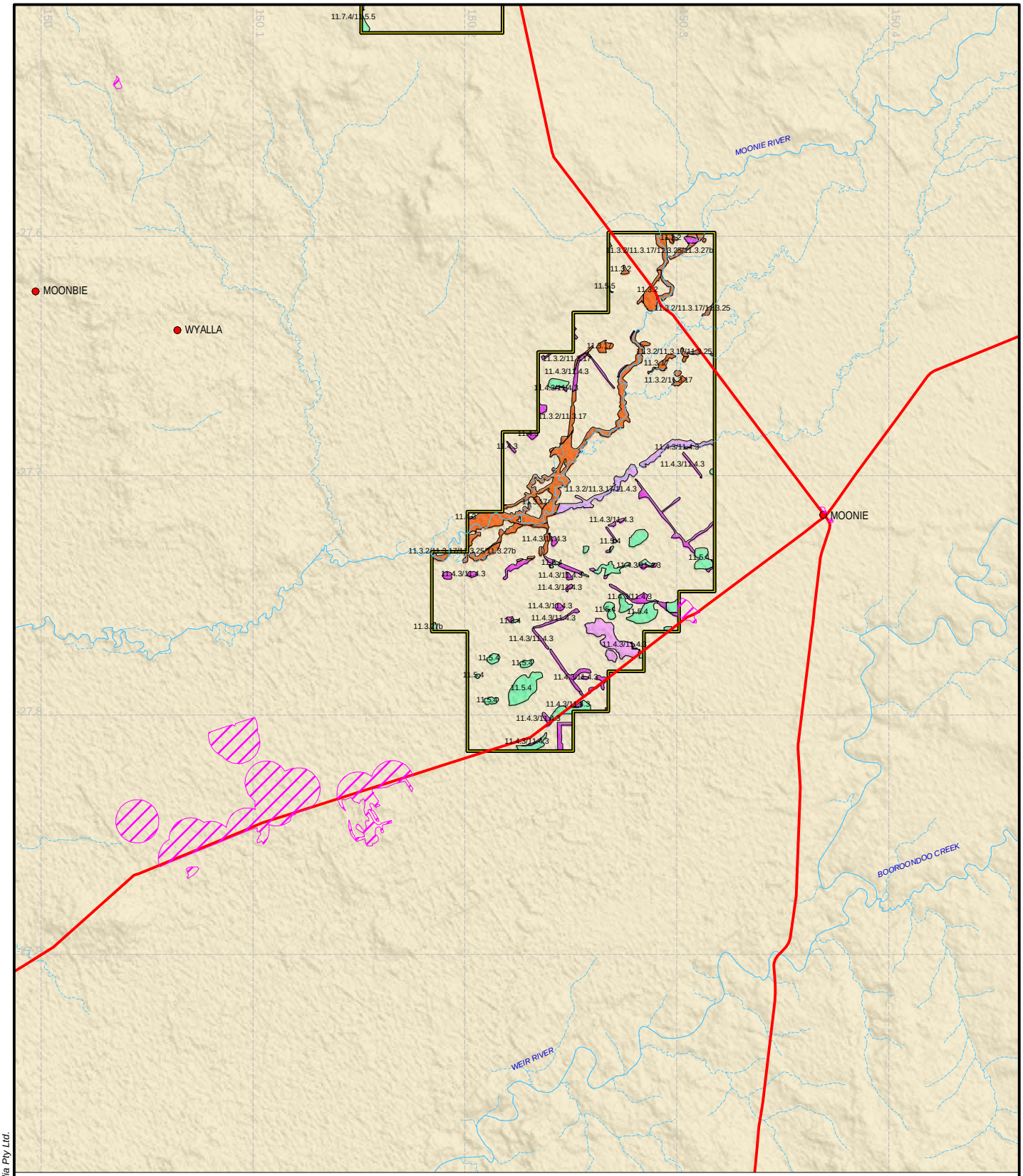
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA CSG FIELD 8 OF 8

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **10h**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-776.wor			**A4**



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Scale: 1:250 000 (A4)
Datum: GDA94

- Major Highway
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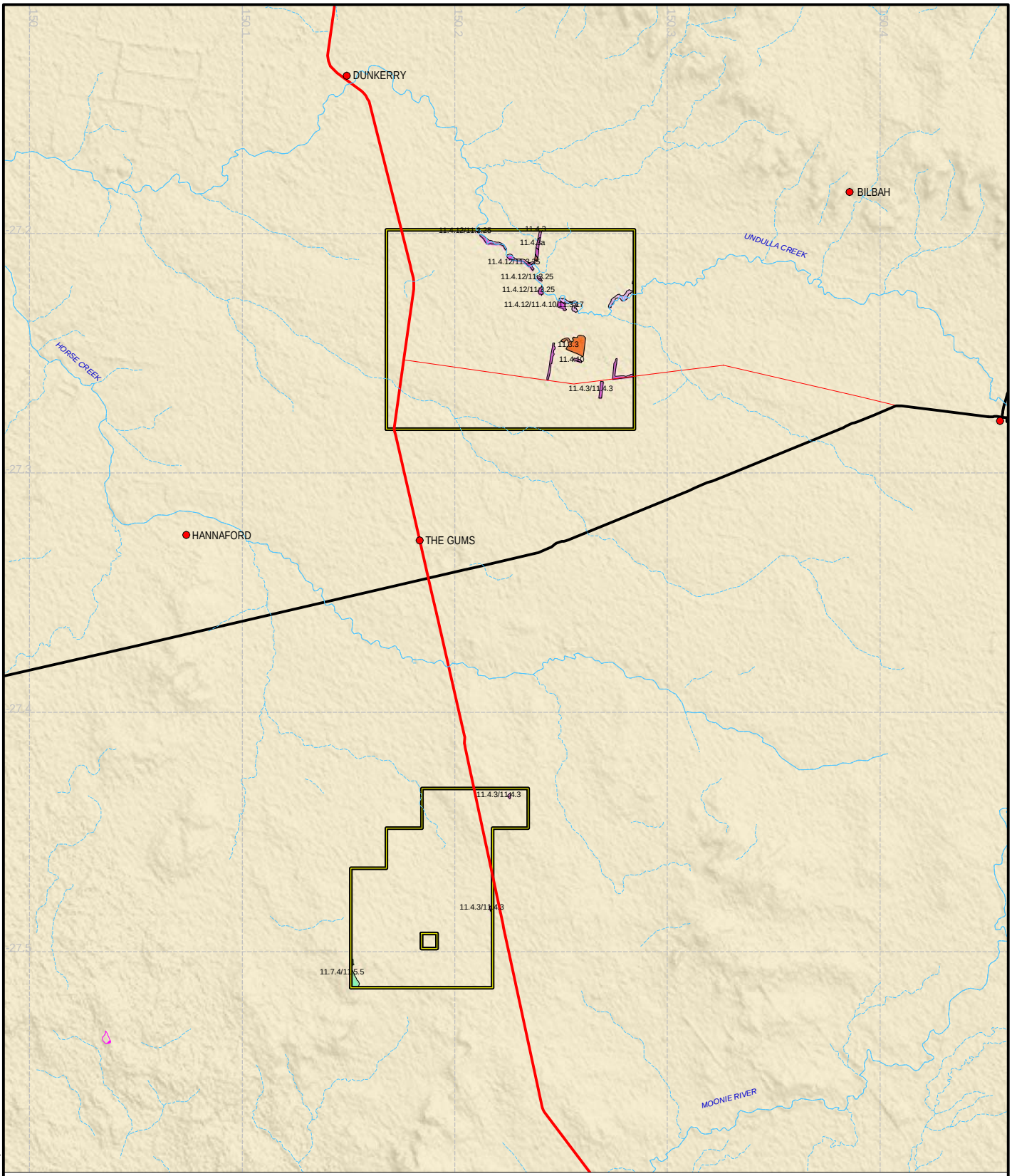
Client: LNG

URS

Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - EASTERN SURAT BASIN CSG FIELD 1 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **11a**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-782.wor			**A4**



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Datum: GDA94

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Client: LNG

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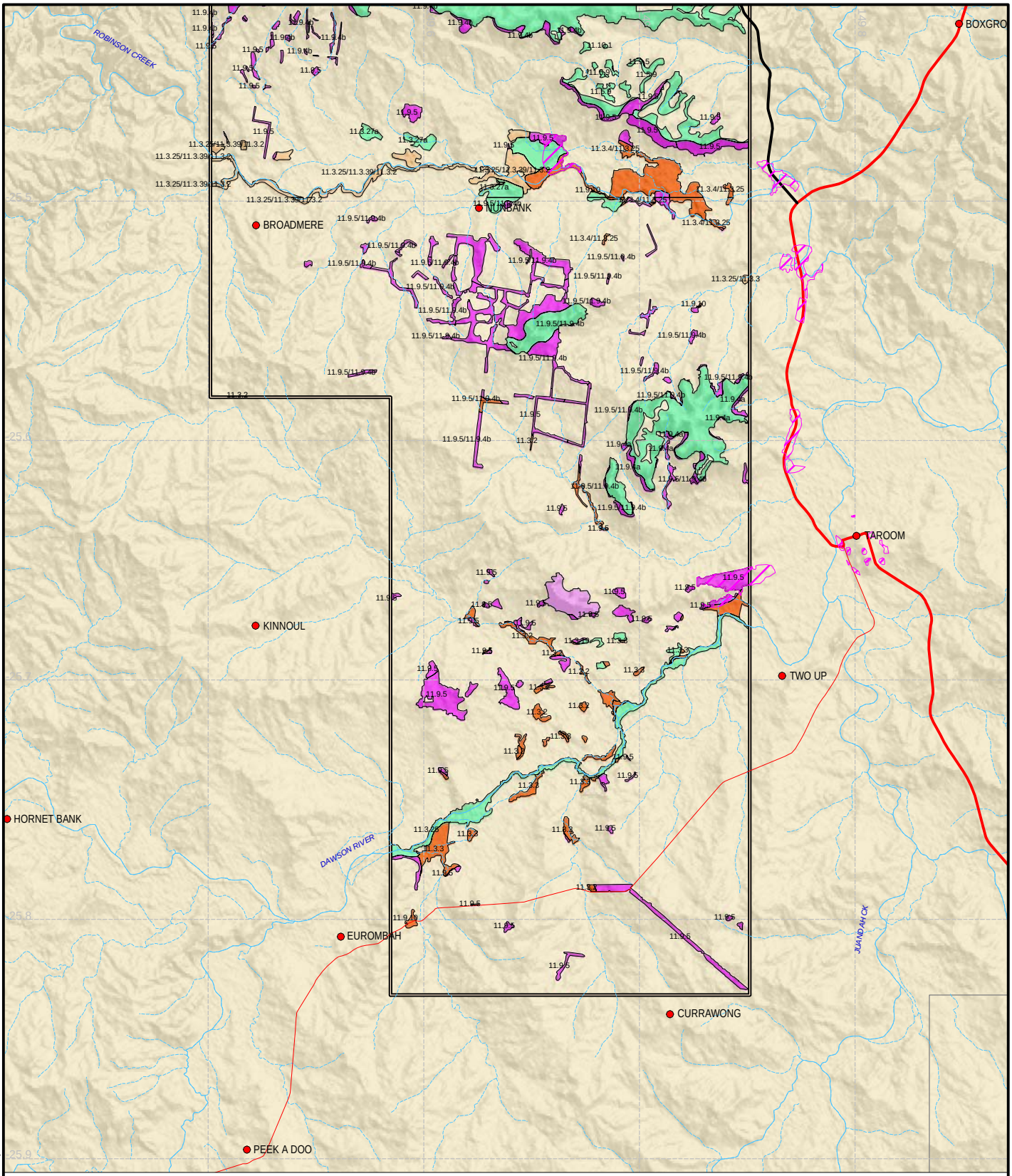
Project: GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title: **REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - EASTERN SURAT BASIN CSG FIELD 2 OF 2**

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **11b**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-782.wor			**A4**

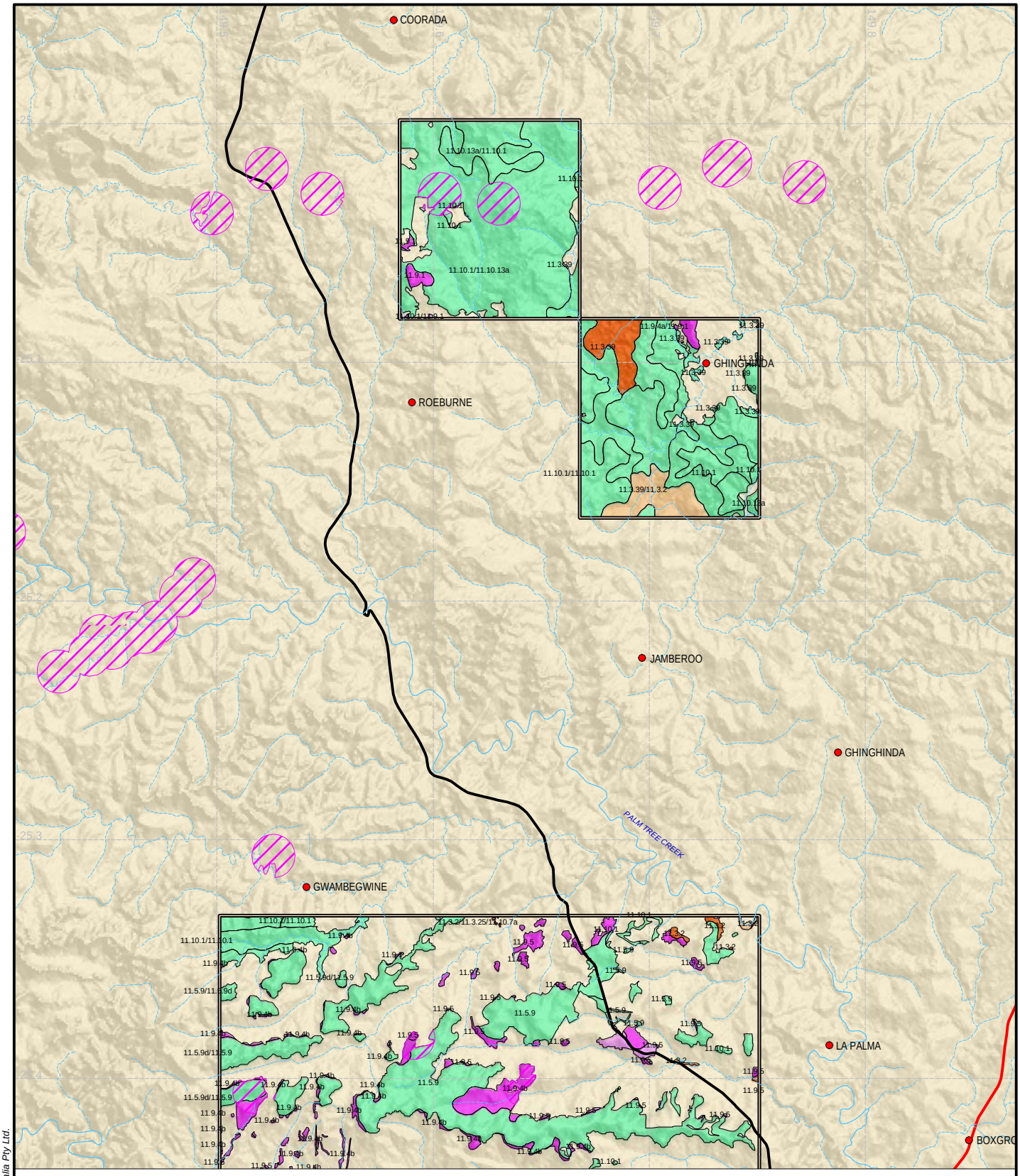


Client

Project
GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title
REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA OTHER CSG FIELD 1 OF 2

Drawn: RG	Approved: JB	Date: 27-01-2009	Figure: **12a**	Rev:A
Job No: **4262 6220**	File No: 42626220-g-784.wor			**A4**



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Client

LNG

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GLADSTONE LNG PROJECT
TERRESTRIAL FLORA ASSESSMENT
CSG FIELD

Title

REGIONAL ECOSYSTEM MAPPING OF THE CSG FIELD AND LOCATION OF URS FIELD SURVEY SITES - ROMA OTHER CSG FIELD 2 OF 2

Drawn: RG	Approved: JB	Date: 27-01-2009
Job No: **4262 6220**	File No: 42626220-g-784.wor	

Figure: **12b**

Rev:A

A4

Gas Field Ecological Assessment

Appendix A

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	NC	NC	Not Listed	481	9189	31768	88405	20367	-	63	-
11.10.11	*Eucalyptus populnea*, *E. melanophloia* +/- *Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	NC	NC	Not Listed	-	73	32503	10	3174	-	1643	-
11.10.9	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	NC	NC	Not Listed	-	-	-	-	-	207	7833	-
11.10.12	*Eucalyptus populnea* woodland on medium to coarse-grained sedimentary rocks	NC	NC	Not Listed	-	-	870	-	-	-	-	
11.10.13	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	NC	NC	Not Listed	5257	6738	-	-	-	-	-	-
11.10.13a	*Eucalyptus cloeziana* ± *E. melanoleuca* ± *Corymbia bunites* ± *E. sphaerocarpa* woodland to open-forest	NC	NC	Not Listed	18106	17116	69	18571	5653	-	-	-

Gas Field Ecological Assessment

Appendix A

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.10.3	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps	NC	NC	Not Listed	6385	304	2088	2690	3450	-	-	-
11.10.4	*Eucalyptus decorticans, Lysicarpus angustifolius* ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks. Crests and scarps	NC	NC	Not Listed	-	14192	17466	15440	770	-	-	-
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	NC	NC	Not Listed	-	482	-	-	2810	-	-	-
11.10.7a	*Eucalyptus crebra* ± *Callitris glaucophylla* ± *Angophora leiocarpa* ± *Eucalyptus* spp woodland	NC	NC	Not Listed	-	-	5335	552	1531	-	-	-
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	OC	OC	Not Listed	-	20	111	49	14757	-	-	-
11.10.9	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	NC	NC	Not Listed	-	-	25533	108	-	-	-	-

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.11.13	*Acacia harpophylla* or *A. argyrodendron*, *Terminalia oblongata* low open forest on deformed and metamorphosed sediments and interbedded volcanics	OC	OC	Not Listed	-	-	10	-	-	-	-	-
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	E	E	E	2	100	1563	-	-	-	-	-
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	OC	E	Not Listed	-	-	135	180	385	-	61	276
11.3.18	*Eucalyptus populnea*, *Callitris glaucophylla*, *Allocasuarina luehmannii* shrubby woodland on alluvium	NC	NC	Not Listed	-	533	200	-	10	-	182	-
11.3.19	*Callitris glaucophylla*, *Corymbia* spp. and/or *Eucalyptus melanophloia* woodland on Cainozoic alluvial plains	NC	NC	Not Listed	-	36	15	-	20	80	2324	-
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	OC	OC	Not Listed	36	2138	12605	2781	5342	528	5646	928
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils	E	E	Not Listed	-		6	-	-	-	15	-

Gas Field Ecological Assessment

Appendix A

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	NC	OC	Not Listed	641	985	5721	1501	2018	1065	9643	169
11.3.27	Freshwater wetlands	NC	OC	Not Listed	-	4	2240	-	-	-	-	-
11.3.27a	Lacustrine wetland	NC	OC	Not Listed	-	-	210	-	-	-	-	-
11.3.27b	Palustrine wetland	NC	OC	Not Listed	-	-	-	-	-	-	-	125
11.3.28	*Casuarina cristata* +/- *Eucalyptus coolabah* open woodland on alluvial plains	OC	OC	Not Listed	-	-	-	-	-	-	1231	-
11.3.39	*Eucalyptus melanophloia* +/- *E. chloroclada* woodland on undulating plains and valleys with sandy soils	NC	NC	Not Listed	-	-	-	6575	1533	-	-	-
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	OC	OC	Not Listed	-	-	8206	-	-	-	235	61
11.3.37	*Eucalyptus coolabah* fringing woodland on alluvial plains	NC	NC	Not Listed	-	-	159	-	-	-	-	-
11.3.39	*Eucalyptus melanophloia* ± *E. chloroclada* woodland on undulating plains and valleys with sandy soils	NC	NC	Not Listed	-	-	8025	-	-	-	-	-
11.3.3a	Riverine wetland or fringing riverine wetland.	OC	OC	Not Listed	-	-	348	-	-	-	-	-
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	OC	OC	Not Listed	202	9	1536	-	-	2	-	-

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.3.6	*Eucalyptus melanophloia* woodland on alluvial plains	NC	OC	Not Listed	-	-	75	-	-	-	-	-
11.4.1	Semi-evergreen vine thicket ± *Casuarina cristata* on Cainozoic clay plains	E	E	E	-	3		-	-	-	-	-
11.4.10	*Eucalyptus populnea* or *E. pilligaensis*, *Acacia harpophylla*, *Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains	E	E	Not Listed	-	-	-	-	-	-	-	7
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains	E	E	Not Listed	-	-	-	-	-	-	-	52
11.4.2	*Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains	OC	OC	Not Listed	-	203	659	-	-	-	-	-
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains	E	E	E	-	-	-	-	-	-	1315	672
11.4.3a	Palustrine wetland (e.g. vegetated swamp)	E	E	E	-	-	-	-	-	-	-	6
11.4.7	Open forest to woodland of *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* on Cainozoic clay plains	E	E	E	68	-	-	-	-	-	93	-

Gas Field Ecological Assessment

Appendix A

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	E	E	E	78	95	1022	-	-	-	-	-
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	E	E	E	-	-	371	-	-	-	-	-
11.4.9a	*Acacia harpophylla*, *Lysiphyllum carronii* ± *Casuarina cristata* open-forest to woodland	E	E	E	61	93	645	-	-	-	-	-
11.5.1	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces	NC	NC	Not Listed	-	-	-	-	-	-	28037	-
11.5.13	*Eucalyptus populnea* +/- *Acacia aneura* +/- *E. melanophloia* woodland on Cainozoic sand plains/remnant surfaces	OC	OC	Not Listed	-	-	-	-	-	-	2957	-
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces	NC	E	E	-	-	44	-	-	-	-	-

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.5.18	*Micromyrtus capricornia* shrubland on Cainozoic sand plains/remnant surfaces	OC	OC	Not Listed	570	-		-	-	-	-	-
11.5.2	*Eucalyptus crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces	NC	NC	Not Listed	4942	1875	469	-	-	-	-	-
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa*/ *E. pilligaensis* ± *E. crebra* woodland on Cainozoic sand plains	NC	NC	Not Listed	206	26	202	-	-	-	-	-
11.5.2a	*Allocasuarina luehmannii* low tree layer with or without emergent woodland	NC	NC	Not Listed	114	1111		-	-	-	-	-
11.5.3	*Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces	NC	NC	Not Listed	738	177	1512	-		-	-	-
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands.	NC	NC	Not Listed	-	-	-	-	-	-	2251	901

Gas Field Ecological Assessment

Appendix A

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.5.5	*Eucalyptus melanophloia, Callitris glaucophylla* woodland on Cainozoic sand plains/remnant surfaces. Deep red sands	NC	NC	Not Listed	-	-	83	-	42	-	26981	19
11.5.5c	*E. melanophloia* ± *Callitris glaucophylla* ± *E. populnea* woodland	NC	NC	Not Listed	666	297	735	-	-	-	-	-
11.5.9a	*Eucalyptus melanophloia* woodland on Cainozoic sand plains/remnant surfaces, plateaus and broad crests	NC	NC	Not Listed	-	-	-	-	-	-	310	-
11.5.9b	*E. crebra*, *E. tenuipes*, *Lysicarpus angustifolius* + *Corymbia* spp woodland	NC	NC	Not Listed	147	-	-	-	-	-	-	-
11.7.1	*Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on lateritic duricrust	NC	NC	Not Listed	-	-	-	-	-	-	5025	-
11.7.2	*Acacia* spp. woodland on lateritic duricrust. Scarp retreat zone	NC	NC	Not Listed	2375	1003	559	-	-	-	7356	-
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia spp., Acacia* spp., *Lysicarpus angustifolius* on lateritic duricrust	NC	NC	Not Listed	-	-	-	-	-	-	4457	12

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	NC	NC	Not Listed	-	-	-	-	-	-	310	-
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on lateritic duricrust	NC	NC	Not Listed	-	-	-	-	-	-	3372	-
11.7.7	*Eucalyptus fibrosa* subsp. *nubila* ± *Corymbia* spp. ± *Eucalyptus* spp. on lateritic duricrust	NC	NC	Not Listed	-	-	-	-	-	-	350	-
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	OC	OC	E	208	735	6874	-	-	-	23	-
11.8.11a	*Melaleuca bracteata* woodland drainage depressions. Occurs in drainage depressions	OC	OC	E	-	-	92	-	-	-	-	-
11.8.2	*Eucalyptus tereticornis*, *E. melliodora* woodland on Cainozoic igneous rocks	NC	NC	Not Listed	-	-	508	-	-	-	-	-
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks. Steep hillsides	NC	OC	E	-	99	8	-	-	-	85	-
11.8.4	*Eucalyptus melanophloia* woodland on Cainozoic igneous rocks. Hillsides	NC	NC	Not Listed	5	6383	562	-	-	-	-	-

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Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	NC	NC	Not Listed	228	541	3368	-	-	-	194	-
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks	E	E	E	250	190	173	-	-	59	14	-
11.9.2	*Eucalyptus melanophloia* ± *E. orgadophila* woodland on fine-grained sedimentary rocks	NC	NC	Not Listed	-	643	-	297	-	-	-	-
11.9.4a	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable	E	E	E	-	146	-	-	2295	-	-	-
11.9.4b	Semi-evergreen vine thicket	E	E	E	7	46	-	-	1609	-	-	-
11.9.5	Acacia harpophylla and/or Casuarina cristata open forest on fine-grained sedimentary rocks	E	E	E	-	252	-	-	606	-	-	-
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	OC	OC	Not Listed	-	15	-	-	14	-	-	-
11.9.8	*Macropteranthes leichhardtii* thicket on fine grained sedimentary rocks	NC	E	Not Listed	-	248	-	-	-	-	-	-

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Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks	OC	E	Not Listed	-	-	25	-	5	142	2719	-
11.9.11	*Acacia harpophylla* shrubland on fine-grained sedimentary rocks	OC	OC	Not Listed	-	-	-	-	-	-	132	-
11.9.13	*Eucalyptus moluccana* or *E. microcarpa* open forest on fine grained sedimentary rocks	OC	OC	Not Listed	-	-	123	-	-	-	-	-
11.9.2	*Eucalyptus melanophloia* ± *E. orgadophila* woodland on fine-grained sedimentary rocks	NC	NC	Not Listed	-	-	9	-	-	-	-	-
11.9.3	*Dichanthium* spp., *Astrebla* spp. grassland on fine-grained sedimentary rocks	NC	NC	Not Listed	-	-	-	-	-	-	10270	-
11.9.3a	*Eucalyptus* spp., and/or *Acacia* spp. open-woodland	NC	NC	Not Listed	-	-	-	-	-	-	16542	-
11.9.4a	Semi-evergreen vine thicket, generally dominated by a low tree layer (5-10m high) which is floristically diverse and variable	E	E	Not Listed	-	-	2167	5721	-	4	731	-
11.9.4b	Semi-evergreen vine thicket with dense softwood scrub understorey	E	E	Not Listed	-	-	1226	1156	-	-	56	-

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Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rock	E	E	Not Listed	-	-	2265	1281	-	509	7520	-
11.9.6	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks	E	E	Not Listed	-	-	-	-	-	12		-
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	OC	OC	Not Listed	-	-	5362		-	203	938	-
11.9.7a	*Eucalyptus populnea* predominates forming a distinct but discontinuous canopy (10-15 m high).	OC	OC	Not Listed	-	-	-	-	-	-	203	-
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	NC	NC	Not Listed	-	-	310	-	-	-	-	-
6.4.3	*Eucalyptus populnea, Casuarina cristata* or *Acacia harpophylla* ± *Geijera parviflora* woodland on clay plains	OC	E	Not Listed	-	-	-	-	-	-	63	-
6.5.1	*Acacia aneura, Eucalyptus populnea, E. melanophloia* open forest on undulating lowlands	NC	OC	Not Listed	-	-	-	-	-	-	1055	-

Appendix A Gas Field Ecological Assessment

Regional Ecosystem	Vegetation Community Description	VM status	Biodiversity Status	EPBC Status	Mahalo	Comet	Denison Trough	Arcadia Valley	Fairview	Scotia	Roma	Eastern Surat Basin
6.5.2	*Eucalyptus populnea, Acacia aneura* and/or *E. melanophloia* woodland on Quaternary sediments	NC	NC	Not Listed	-	-	-	-	-	-	3838	-
6.5.3	*Eucalyptus populnea*, *Acacia aneura* ± *Eremophila mitchellii* woodland within *A. aneura* communities	NC	OC	Not Listed	-	-	-	-	-	-	30	-
6.7.1	*Acacia catenulata* ± *A. shirleyi* ± *Eucalyptus* spp. open scrub on crests and slopes	NC	NC	Not Listed	-	-	-	-	-	-	946	-
6.7.5	*Eucalyptus thozetiana* or *E. cambageana*, *Acacia harpophylla* woodland on scarps	NC	OC	Not Listed	-	-	-	-	-	-	119	-
Non-remnant	-	-	-	Not Listed	-	-	-	48299	49440.83694	-	680614	-

CSG Field Flora Survey Sites

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Appendix B CSG Field Flora Survey Sites

Secondary 1 **Roma CSG Field**	
Vegetation Community	*Eucalyptus crebra* woodland
Actual RE	11.5.1
Transect Start	X 149.328234; Y -26.728977
Transect End (50m)	X 149.328073; Y -26.729216
Bearing	200^0 south
Aspect	Hillcrest
Slope	Flat area within transect – gentle slopes east and west of transect
Soil	Sandy/ gravelly loam, gravel content high - especially within surface layer (<20 cm).
Weeds	*Opuntia tomentosa**
Erosion	Nil
Grazing impacts	Minimal
Fire history	>10 years
Fauna Habitat	Occasional fallen decayed logs/debris, occasional stag trees, high rocky reptile habitats
Fauna observations	High small forest bird diversity
Notes	Bandicoot and echidna diggings, red-necked wallaby scats, abundant avifauna vocalisations.
Strata	**Dominant Species**
Canopy (T1): 12-15 m **FPC:** 34%	*Eucalyptus crebra*
	-
Mid-Storey (T2): 7-10 m	*Callitris glaucophylla*
	Angophora leiocarpa
Shrub (S1): 1-5 m **FPC:** 8%	*Petalostigma pubescens*
	*Opuntia tomentosa**
	Acacia leiocalyx
	Callitris glaucophylla
Ground (G): <1 m **FPC:** 11.8% **Litter:** 60% **Bare:** 22.2%	*Lomandra multiflora*
	Goodenia rotundifolia
	Cheilanthes sieberi
	Aristida caput-medusae
	Brunoniella australis
	Sida filiformis

CSG Field Flora Survey Sites

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Secondary 2

Roma CSG Field

Vegetation Community	*Eucalyptus melanophloia/ Callitris glaucophylla* open forest
Actual RE	11.10.11
Transect Start	X 149.272657; Y -26.864199
Transect End (50m)	X 149.272466; Y -26.863783
Bearing	340^0 North
Aspect	North
Slope	Flat
Soil	Brown, sandy/loam, highly siliceous
Weeds	*Opuntia tomentosa**
Erosion	Minimal
Fire history	>10 years
Grazing impacts	Low
Fauna Habitat	Fallen logs/debris, occasional stag tree, reptile burrows
Fauna observations	Bearded dragon (*Pogona barbata*), lace monitor (*Varanus varius*), noisy miner (*Manorina melanocephala*)
Notes	Red-neck wallaby scats, echidna diggings, pig scat
Strata	**Dominant Species**
Canopy (T1): 12-15 m **FPC:** 44%	*Eucalyptus melanophloia*
	Callitris glaucophylla
	Angophora leiocarpa
	Eucalyptus populnea
Mid-Storey (T2): 7-10 m	*Callitris glaucophylla*
	Allocasuarina luehmannii
	Eucalyptus melanophloia
	Corymbia tessellaris
Shrub (S1): 1-5 m **FPC:** 20%	*Eucalyptus melanophloia*
	Allocasuarina luehmannii
	Eremophila mitchellii
Ground (G): <1 m **FPC:** 4.6% **Litter:** 61.4% **Bare:** 34%	*Aristida caput-medusae*
	Paspalidium caespitosum
	Chloris ventricosa
	Enneapogon lindleyanus

Appendix B CSG Field Flora Survey Sites

Secondary 3 **Roma CSG Field**	
Vegetation Community	*E. crebra* woodland
Actual RE	11.5.1
Transect Start	X 149.672459; Y -26.823739
Transect End (50m)	X 149.669764; Y -26.83124
Bearing	350^0 north
Aspect	North
Slope	2^0
Soil	Red/brown, sandy loam, skeletal/siliceous
Weeds	*Opuntia tomentosa**
Erosion	Nil
Grazing impacts	Nil
Fire history	>10 years
Fauna habitat	Fallen decayed logs/debris, stag trees, tree hollows
Fauna observations	Nobbi dragon *(Amphibolurus nobbi),* Australian raven (*Corvus coronoides)*, grey shrike-thrush (*Colluricinla harmonica*), noisy friarbird (*Philemon corniculatus*), green-tree frog (*Litoria caerulea*)
Notes	Echidna diggings, kangaroo scats, reptile burrows, Most grass spp. not identifiable due to lack of seed heads present
Strata	**Dominant Species**
Canopy (T1): 14-18 m **FPC:** 72%	*Eucalyptus crebra*
	-
Mid-Storey (T2): 7-10 m	*Eucalyptus crebra*
	Callitris glaucophylla
	Allocasuarina luehmannii
Shrub (S1): 1-5 m **FPC:** 15%	*Allocasuarina luehmannii*
	Geijera parviflora
	Eremophila mitchellii
	Acacia decora
Ground (G): <1 m **FPC:** 7.8% **Litter:** 77.4% **Bare:** 14.4%	*Brunoniella australis*
	Enchylaena tomentosa
	*Opuntia tomentosa**
	Calotis cuneifolia
	Aristida caput-medusae

CSG Field Flora Survey Sites

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Secondary 4 **Roma CSG Field**	
Vegetation Community	Forest red gum woodland
Actual R.E.	11.3.25
Transect Start	X 149.517036; Y -26.663046
Transect End (50m)	X 149.526043; Y -26.658142
Bearing	North
Aspect	North-west
Slope	5%
Soil	Sandy/silt, crumbly, dry
Weeds	Weeds located throughout site
Erosion	minimal
Grazing impacts	Nil
Fire history	>10 years
Fauna Habitat	Occasional fallen decayed logs/debris, occasional stag trees upslope on the eastern side of watercourse, very high colonisation of 0-1.5metre grasses
Fauna observations	Striated pardalote (*Pardalotus striatus*), noisy friarbird (*Philemon corniculatus*)
Notes	Watercourse was not flowing at the time of survey – grasses spp. have heavily colonised within flow areas - indicating no recent flow events.
Strata	**Dominant Species**
Canopy (T1): 18-25 m **FPC:** 74%	*Eucalyptus tereticornis*
	Angophora floribunda
Mid-Storey (T2): 10-12 m	*Callitris glaucophylla*
	Eucalyptus tereticornis
Shrub (S1): 1-5 m **FPC:** 6%	*Callistemon viminalis*
	-
Ground (G): <1 m **FPC:** 96.6% **Litter:** 3.4% **Bare:** 0.0%	*Cyperus difformis*
	*Verbena aristigera**
	*Cynodon dactylon**
	Gomphocarpus physocarpus
	Lomandra longifolia
	Chloris ventricosa
	Oxalis corniculatum

Appendix B CSG Field Flora Survey Sites

Secondary 5 **Roma CSG Field**	
Vegetation Community	Silver-leaved ironbark/ white cypress open forest
Actual R.E.	11.10.9
Transect Start	X 148.733420; Y -26.266142
Transect End (50m)	X 148.733475; Y -26.265534
Bearing	320^0 west
Aspect	West
Slope	2^0
Soil	Light brown, sandy/silty/clay, siliceous
Weeds	Nil
Erosion	Cattle access tracks and cattle pad (trampled vegetation)
Fire history	>10 years
Grazing impacts	Moderate
Fauna Habitat	Fallen logs/debris, stag trees, thickets, reptile burrows
Fauna observations	Echidna diggings, high avifauna vocalisations, cattle sighted and scats found
Notes	**-**
strata	**Dominant Species**
Canopy (T1): 9-12 m **FPC:** 80%	*Eucalyptus melanophloia*
	Callitris glaucophylla
Mid-Storey (T2): 7-9 m	*Eucalyptus melanophloia*
	Callitris glaucophylla
	Eucalyptus populnea
Shrub (S1): 1-3 m **FPC:** 2%	*Carissa ovata*
	Callitris glaucophylla
	Eucalyptus melanophloia
Ground (G): <1 m **FPC:** 79% **Litter:** 8.6% **Bare:** 12.4%	*Enneapogon lindleyanus*
	Aristida calycina
	Eragrostis brownii
	Aristida caput-medusae
	Pandorea pandorana

CSG Field Flora Survey Sites

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Secondary 6 **Roma CSG Field**	
Vegetation Community	*E. populnea* open woodland
Actual R.E.	11.10.11
Transect Start	X 148.200329; Y -26.52001
Transect End (50m)	X 148.199771; y -26.531514
Bearing	320^0 West
Aspect	South-south-east
Slope	1^0
Soil	Light brown, sandy/silty/clay, dry/friable
Weeds	*Opuntia tomentosa**
Erosion	Nil
Fire history	Nil
Grazing impacts	Minimal
Fauna Habitat	Fallen logs/debris
Fauna observations	Echidna diggings, rabbit scats
Notes	Site fragmented, few grass spp. identified due to seasonal factors (browned-off with no seed heads)
Strata	**Dominant Species**
Canopy (T1): 8-12 m **FPC:** 36%	*Eucalyptus populnea*
	-
Mid-Storey (T2): 6-8 m	*Eucalyptus populnea*
Shrub (S1): 1-5m **FPC:** 10%	*Geijera parviflora*
	Acacia salicina
	*Opuntia tomentosa**
	Eremophila mitchellii
	Grevillea striata
Ground (G): <1 m **FPC:** 28% **Litter:** 62% **Bare:** 10%	*Themeda triandra*
	*Verbena aristigera**
	Salsola kali
	Cymbopogon refractus
	Aristida calycina
	Eremophila debilis

Appendix B CSG Field Flora Survey Sites

Secondary 7 **Roma CSG Field**	
Vegetation Community	*E. populnea* open woodland
Actual R.E.	11.10.11
Transect Start	X 148.962630; Y -26.85128
Transect End (50m)	X 148.96315; y -26.85096
Bearing	320^0 West
Aspect	East
Slope	Flat
Soil	Orange/brown, sandy/loam, dry/friable
Weeds	*Opuntia tomentosa**
Erosion	Nil
Fire history	>10 years
Grazing impacts	High
Fauna Habitat	Fallen logs/debris, occasional stag tree, termite mounds
Fauna observations	Abundant echidna diggings, cattle scats, avifauna vocalisations, macropod scats, blue-tongue lizard
Notes	High amounts of decayed biomass throughout site, very low amounts lower storey/ground layer vegetation
Strata	**Dominant Species**
Canopy (T1): 9-12 m **FPC:** 72%	*Eucalyptus populnea*
	Callitris glaucophylla
Mid-Storey (T2): 6-8 m	*Callitris glaucophylla*
	Eucalyptus populnea
	Eremophila mitchelli
Shrub (S1): 1-4m **FPC:** 6%	*Geijera parviflora*
	Acacia salicina
	*Opuntia tomentosa**
	Eremophila mitchellii
	Dodonaea viscosa
Ground (G): <1 m **FPC:** 2.1% **Litter:** 26.3% **Bare:** 71.4%	*Brunoniella australis*
	Calotis cuneifolia
	*Verbena aristigera**
	Enneapogon lindleyanus
	Aristida caput-medusa
	*Opuntia tomentosa**
	Rostellularia adscendens
	Sida rohlenae

CSG Field Flora Survey Sites

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Secondary 8 **Roma CSG Field**	
Vegetation Community	*Acacia aneura* (mulga) woodland
Actual R.E.	6.5.3
Transect Start	X 148.580270; Y -27.184046
Transect End (50m)	X 148.580774; Y -27.185559
Bearing	78^0 east-north-east
Aspect	East
Slope	Flat
Soil	Red/brown, clay loam, friable/angular, dry
Weeds	*Opuntia tomentosa**
Erosion	Nil sighted – potential for erosion is high due to exposed bare earth
Fire history	>10 years
Fauna Habitat	Fallen decayed logs/debris, small stag trees, tree hollows
Fauna observations	Avifauna vocalisations
Notes	High lower-storey biomass, echidna diggings, cattle scats, macropod scats (suspected grey kangaroo).
Strata	**Dominant Species**
Canopy (T1): 9-12 m **FPC:** 50%	*Eucalyptus melanophloia*
	Eucalyptus populnea
	Acacia aneura
Mid-Storey (T2): 7-9 m	*Acacia aneura*
	Eucalyptus populnea
Shrub (S1): 1-5 m **FPC:** 35%	*Geijera parviflora*
	Eremophila longifolia
	Eremophila mitchellii
	Senna artemisioides
	Carissa ovata
	*Opuntia tomentosa**
Ground (G): <1 m **FPC:** 16.2% **Litter:** 24.8% **Bare:** 59%	*Cheilanthes sieberi*
	Brunoniella australis
	*Pennisetum ciliare**
	Solanum stelligerum

Appendix B CSG Field Flora Survey Sites

Secondary 9 **Roma CSG Field**	
Vegetation Community	Mulga open forest/woodland
Actual R.E.	6.5.1
Transect Start	X 148.319965; Y -26.980540
Transect End (50m)	X 148.319965; Y -26.979947
Bearing	368^0 south-south-west
Aspect	East
Slope	Flat
Soil	Red/orange/cream, sandy/clay/loam, dry, friable
Weeds	Nil
Erosion	Nil – high erosion potentials due to no ground layer vegetation
Fauna Habitat	Very high fallen decayed logs/debris, messy dead biomass site
Fauna observations	Nil
Notes	Very dry site with very high dead biomass debris and bare ground. Historically the site has been selectively cleared/pushed - dead trees uprooted with intact root balls. Echidna diggings, cattle scats, abandoned rabbit warren
Strata	**Dominant Species**
Canopy (T1): 8-10 m **FPC:** 90%	*Acacia aneura*
	Eucalyptus populnea
	Eucalyptus melanophloia
	Brachychiton rupestris
Mid-Storey (T2): 6-8 m	*Acacia aneura*
	Eucalyptus populnea
Shrub (S1): 1-2 m **FPC**: 10%	*Senna artemisioides*
	Eremophila longifolia
	Eremophila mitchellii
	Grevillea striata
Shrub (s2): 1m	*Parsonsia eucalyptophylla*
Ground (G): <1 m **FPC:** 3.4% **Litter:** 30.2% **Bare:** 68.4%	*Evolvulus alsinoides*
	Cheilanthes sieberi
	Solanum stelligerum

CSG Field Flora Survey Sites

Secondary 10 **Roma CSG Field**	
Vegetation Community	*Callitris glaucophylla* open forest/woodland
Actual R.E.	11.10.9
Transect Start	X 148.776661; Y -25.608755
Bearing	106^0 South
Aspect	-
Slope	30^0
Soil	Grey brown sandy colluvium
Weeds	*Opuntia tomentosa**
Erosion	Nil – high erosion potentials due to no ground layer vegetation
Fauna Habitat	Moderate fallen decayed logs/debris, high rocky outcropping on hillside
Fauna observations	Wallaby scats, high avifauna vocalisations, bandicoot diggings
Notes	Selective thinning observed downslope of site, site mapped as 11.3.25.
Strata	**Dominant Species**
Canopy (T1): 8-10 m **FPC:** 90%	*Callitris glaucophylla*
	-
Mid-Storey (T2): 6-8 m	*Callitris glaucophylla*
	-
Shrub (S1): 1-2 m **FPC**: 10%	*Callitris glaucophylla*
	-
Shrub (s2): 1m	-
Ground (G): <1 m **FPC:** 3.4% **Litter:** 30.2% **Bare:** 68.4%	*Setaria surgens*
	Eragrostis brownii
	Solanum stelligerum

Appendix B CSG Field Flora Survey Sites

Secondary 11 **Arcadia CSG Field**	
Vegetation Community	*Eucalyptus melanophloia* woodland
RE	11.10.9
Transect Start	X 148.778632; Y -25.78773333
Bearing	19°
Aspect	200° south-south-west
Slope	45°
Soil	Grey/brown sand stone
Fire	No obvious burn in the past 10 years
Grazing Impacts	Low grazing impacts
Fragmentation	Restricted to topography, hilly slope
Erosion	Moderate erosion
Fauna Habitat	Rocky outcrops/ some hollow bearing large ironbarks. Woody debris with increased reptile habitat diversity.
Weeds	Low diversity. Mainly native groundcover with *Opuntia tomentosa**, *Pennisetum ciliare**
Notes	R.E. mapping indicates Endangered R.E. 11.9.4b on lower slopes (brigalow/vine thicket). However, more dominated by 11.10.9 on slopes with pockets of vine thicket on steeper topography- see quaternary site.
Strata	**Dominant Species**
Canopy (T1): 18-20 m **FPC:** 32 %	*Eucalyptus melanophloia*
	Eucalyptus orgadophila
Sub-canopy (T2): 15 m **FPC:** 7 %	*Callitris glaucophylla*
	-
Shrub (S1): 2-4 m	*Callitris glaucophylla*
	Terminalia oblongata
Shrub (S2): 1 m	*Carissa ovata*
Ground (G): <1 m **FPC:** 25 %	*Eremophila debilis*
	*Pennisetum ciliare**
	Chloris divaricata
	Bothriochloa decipiens var. *decipiens*
	Eragrostis brownii
	Aristida latifolia

CSG Field Flora Survey Sites

Appendix B

Secondary 12 **Arcadia CSG Field**	
Vegetation Community	*Callitris glaucophylla* woodland
R.E	11.10.9
Bearing	130° East
Transect Start	X 148.7710; Y -25.79995
Aspect	40° north-east
Slope	10°
Soil	Yellow/red sandy loam
Fire	No obvious burn in the past 10 years
Grazing Impacts	High grazing impacts
Fragmentation	Relatively well connected
Erosion	Low erosion
Fauna Habitat	No hollow bearing trees, low ground habitat features.
Weeds	High number of weed/ exotic species from grazing impacts - *Pennisetum ciliare*, Verbena aristigera*.*
Notes	Up slope from riparian 11.3.2/11.3.25 adjacent. Essential habitat for flora species.
Strata	**Dominant Species**
Canopy (T1): 12-15 m **FPC:** 42 %	*Eucalyptus populnea*
	Callitris glaucophylla
Shrub (S1): 1-3 m **FPC: N/A**	*Callitris glaucophylla*
	Acacia decora
Ground (G): <1 m **FPC:** 77 %	*Pennisetum ciliare**
	*Verbena aristigera**
	Wahlenbergia graniticola
	Aristida caput-medusae
	Eragrostis brownii
	Cyanthillium cinereum
	Senecio brigalowensis

Appendix B CSG Field Flora Survey Sites

Secondary 13 **Arcadia CSG Field**	
Vegetation Community	*Eucalyptus crebra* woodland with open grassy understorey and *Corymbia* spp.
R.E	11.10.1d
Bearing	210° south-west
Transect Start	X 148.984255; Y -25.59026
Aspect	60° Northeast
Slope	5°
Soil	Dark brown sandstone loam with metamorphic rocks + organic matter in A horizon
Fire	Evidence of past fire over 2 years ago.
Grazing Impacts	Low grazing impacts; increased diversity of native shrub/ground layer
Fragmentation	Some fragmentation due to well site
Erosion	Low erosion
Fauna Habitat	Native ground cover, fallen logs, rocky landscape, fairly dense low shrub layer, some stag trees.
Weeds	Low diversity. Mainly native groundcover with *Opuntia tomentosa**.
Notes	On edge of scarp; valley with Dawson River below. Changes community from low shrub/heathland with emergent eucalypts to more of a grassy open woodland. Ecological integrity relatively high, Bandicoot diggings, scats of eastern grey kangaroo
Strata	**Dominant Species**
Canopy (T1): 20-25 m **FPC:** 62 %	*Eucalyptus crebra*
Sub-canopy (T2): 4-8 m **FPC:** 16 %	*Callitris endlicheri*
Shrub (S1): 2-4 m **FPC:** 24 %	*Acacia bancroftiorum*
	Acacia leiocalyx
	Dodonaea filifolia
	Alphitonia excelsa
	Boronia occidentalis
Ground (G): <1 m **FPC:** 75 %	*Aristida calycina*
	Lomandra longifolia
	Lomandra obliqua

CSG Field Flora Survey Sites

Appendix B

Secondary 14 **Arcadia CSG Field**	
Vegetation Community	*Acacia shirleyi* woodland
R.E	11.10.3
Bearing	180° south
Transect Start	X 148.99618; Y -25.617477
Aspect	250° west
Slope	15°
Soil	Hard, light Grey/brown sandy loam with metamorphic rocks
Fire	Recently burnt (past 2 years)
Grazing Impacts	Low grazing impacts
Fragmentation	Continuous remnant
Erosion	No obvious erosion
Fauna Habitat	Good ground litter; low hollow bearing trees; native cover.
Weeds	Low diversity. Mainly native groundcover with *Opuntia tomentosa**.
Notes	Edge of scarp- Dawson River cliff line. *Acacia shirleyi* community on scarp.
Strata	**Dominant Species**
Emergent: 18-25 m	*Eucalyptus crebra*
Sub-canopy (T2): 15 m **FPC:** 64 %	*Acacia shirleyi*
Shrub (S1): 2-4 m **FPC:** 24 %	*Callitris endlicheri*
	Acacia bancroftiorum
	Lysicarpus angustifolius
	Boronia occidentalis
Ground (G): <1 m **FPC:** 96 %	*Opuntia tomentosa**
	Cheilanthes sieberi
	Scleria brownii

Appendix B CSG Field Flora Survey Sites

Secondary 15 **Arcadia CSG Field**	
Vegetation Community	*Acacia harpophylla* woodland
R.E	11.4.9
Bearing	230° west
Transect Start	X 148.8922 ; Y -25.48417
Aspect	Flat
Slope	0°
Soil	Red/brown clay
Fire	No
Grazing Impacts	Moderate; less than adjacent because of density of brigalow.
Fragmentation	cattle tracks, relatively low erosion.
Erosion	-
Fauna Habitat	No hollow trees; low ground debris; good native ground cover.
Weeds	Low diversity. Mainly native groundcover dominated by *Paspalidium caespitosum* with some *Opuntia tomentosa**.
Notes	Very dense low shrubby regrowth. Approximately 70% of height so most likely remnant. Patches of taller remnant throughout emergent scattered tall *Eucalyptus populnea* with dieback.
Strata	**Dominant Species**
Emergent: 18-20 m	*Eucalyptus populnea* (dieback evident)
Canopy: (T1): 15 m **FPC:** 36%	*Acacia harpophylla*
Shrub (S1): 2-4 m **FPC:** 46%	*Acacia harpophylla*
	Alectryon diversifolius
Ground (G): <1 m **FPC:** 63%	*Acacia harpophylla*
	*Pennisetum ciliare**
	Paspalidium caespitosum
	*Opuntia tomentosa**
	Sporobolus caroli

CSG Field Flora Survey Sites

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Secondary 16 **Arcadia CSG Field**	
Vegetation Community	*Eucalyptus crebra* woodland
R.E	11.10.7
Bearing	230° west
Transect Start	X148.84559; Y-25.51732
Aspect	Flat
Slope	0°
Soil	Light brown sandy soil on metamorphic rocks
Fire	Evidence of fire in the last 1-2 years (intense burn).
Grazing Impacts	Very little/None
Fragmentation	Contiguous with other bushland
Erosion	-
Fauna Habitat	Increased diversity: sandstone rocky outcrops; native understorey; dense grass post fire.
Weeds	Native understorey
Notes	Epicormic budding on *Eucalyptus acmenoides*. Relatively high ecological integrity. Community on high ridgeline, Conical Bandicoot diggings.
Strata	**Dominant Species**
Canopy (T1): 18-22 m **FPC: 56 %**	*Eucalyptus crebra*
	Corymbia clarksoniana
Sub-canopy (T2): 5-10 m **FPC: 20 %**	*Callitris endlicheri*
	Corymbia clarksoniana
	Eucalyptus crebra
	Eucalyptus acmenoides
Shrub (S1): 1-4 m **FPC: 30 %**	*Acacia bancroftiorum*
	Dodonaea filifolia
	Eucalyptus acmenoides
	Eucalyptus crebra
	Corymbia clarksoniana
Ground (G): <1 m **FPC: 25 %**	*Panicum effusum*
	Calotis cuneifolia

Appendix B CSG Field Flora Survey Sites

Secondary 17 **Arcadia CSG Field**	
Vegetation Community	*Eucalyptus melanophloia* woodland
R.E	11.3.25
Bearing	320°
Transect Start	X 148.8289 ; Y -25.4928
Aspect	-
Slope	7°
Soil	Alluvial light brown/grey sandy
Fire	Previous intense burn 2-5 years ago
Grazing Impacts	Low grazing impacts
Fragmentation	Restricted to topography, hilly slope
Erosion	Moderate erosion
Fauna Habitat	High. Massive hollow trees for arboreal mammals.
Weeds	*Argemone ochroleuca**, *Verbena aristigera**, *Megathyrsus maximus* var. *maximus**
Notes	High ecological integrity. Especially large *Callistemon* trees. NB: Intercepts for T1 and T2 estimated from 2 adjacent transects on same axis to pick up bank zonation.
Strata	**Dominant Species**
Canopy (T1): 30-35 m **FPC: 48 %**	*Eucalyptus tereticornis*
	Angophora floribunda
Sub-canopy (T2): 18-20 m **FPC: 24 %**	*Eucalyptus melanophloia*
	Eucalyptus tereticornis
Shrub (S1): 8-10 m **FPC: 34 %**	*Callistemon viminalis*
Shrub (S2): 2-5 m	*Callistemon viminalis*
	Geijera parviflora
Ground (G): <1 m **FPC: 25 %**	*Argemone ochroleuca**
	*Verbena aristigera**
	*Oxalis corniculatum**
	Lomandra longifolia
	Lomandra confertifolia subsp. *pallida*
	*Cynodon dactylon**
	Megathyrsus maximus var. *maximus**
	Einadia nutans
	Bothriochloa decipiens

CSG Field Flora Survey Sites

Appendix B

Secondary 18 **Arcadia CSG Field**	
Vegetation Community	*Corymbia citriodora* and *Angophora leiocarpa* woodland
R.E	11.5.9
Bearing	130° East
Transect Start	X 148.758156 ; Y -25.52886
Aspect	Flat
Slope	0°
Soil	Grey/brown sand stone
Fire	No obvious burn in the past 10 years
Grazing Impacts	Low grazing impacts
Fragmentation	Restricted to topography, hilly slope
Erosion	Moderate erosion
Fauna Habitat	Open native grassy understorey. Goanna scratchings.
Weeds	*Opuntia tomentosa**
Notes	High ecological integrity, Non-impacted natural succession, Open native understorey with some Acacia regrowth.
Strata	**Dominant Species**
Canopy (T1): 25-30 m FPC: 32 %	*Corymbia citriodora*
	Angophora leiocarpa
Sub-canopy (T2): 10-15 m FPC: 20 %	*Callitris glaucophylla*
	Eucalyptus crebra
Shrub (S1): 1-2 m FPC: 5 %	*Angophora leiocalyx*
	Corymbia citriodora
	Acacia leiocalyx
	Acacia bancroftiorum
Ground (G): <1 m FPC: 40 %	*Dianella revoluta*
	Panicum effusum
	Lomandra confertifolia subsp. *pallida*
	Aristida caput-medusae
	Eragrostis brownii
	Aristida calycina

Appendix B CSG Field Flora Survey Sites

Secondary 19 **Arcadia CSG Field**	
Vegetation Community	*Callitris glaucophylla* woodland
R.E	11.10.9
Bearing	20° North
Transect Start	X 149.1477; Y -25.78101
Aspect	320° north-west
Slope	5°
Soil	Light brown/yellow sandy loam
Fire	Burn occurred 5-10 years ago
Grazing Impacts	Moderate grazing impacts
Fragmentation	Contiguous in State Forest
Erosion	Slightly erodible soils. Erosion present on tracks.
Fauna Habitat	Ground cover moderate; some weeds and some tree hollows.
Weeds	*Verbena aristigera**, *Opuntia tomentosa**, *Pennisetum ciliare**
Notes	*Eucalyptus populnea* open woodland with *Eremophila mitchellii* and *Geijera parviflora*. Semi-degraded community, Grass species growing in mosaic patches- possibly post-fire.
Strata	**Dominant Species**
Canopy (T1): 17-22 m **FPC: 32 %**	*Eucalyptus populnea*
	Callitris glaucophylla
Sub-canopy (T2): 15 m **FPC: 7 %**	*Callitris glaucophylla*
	Eucalyptus populnea
	Eremophila mitchellii
	Eucalyptus melanophloia
Shrub (S1): 2-4 m	*Callitris glaucophylla*
	Dodonaea viscosa subsp. *spatulata*
	Eremophila mitchellii
	Acacia leiocalyx
Ground (G): <1 m **FPC: 25 %**	*Themeda triandra*
	*Pennisetum ciliare**
	*Verbena aristigera**
	Einadia nutans
	Eragrostis brownii
	*Opuntia tomentosa**

CSG Field Flora Survey Sites

Appendix B

Secondary 20 **Arcadia Valley CSG Field**	
Vegetation Community	Eucalyptus woodland fringing drainage lines
Actual RE	11.3.25
Transect Start	X 149.05074; Y -25.525440
Transect End (50m)	X 149.048251; Y -25.524209
Bearing	South 160^0
Aspect	West
Slope	20^0
Soil	yellow/light brown sandy loam, highly siliceous, alluvium deposits
Weeds	nil
Erosion	minor channelling erosion – run-off from higher slopes
Grazing impacts	moderate cattle scats and tracks to watercourse
Fire history	<5 years (fire scars evident – hot burn)
Fauna Habitat	high rocky outcropping, occasional fallen decayed logs/debris, moderate litter
Fauna observations	High avifauna vocalisations, high invertebrate activity, very high reptile activity (*Ctenotus* spp.)
Notes	Transect running parallel to watercourse, very few canopy trees, hot-fire-scars evident on mid and high storey vegetation which is colonised on the higher slopes.
Strata	**Dominant Species**
Canopy (T1): - 12-18m **FPC: 38%**	*Eucalyptus acmenoides*
	Angophora leiocarpa
Mid-Storey (T2): - 6-10m	*Angophera leiocarpa*
	Callistemon viminalis
Shrub (S1): - 1-3m **FPC: 10%**	*Dodonaea triangularis*
	Dodonaea filifolia
	Callistemon viminalis
Ground (G): <1 m **FPC: 29%** **Litter: 20%** **Bare: 51%**	*Themeda triandra*
	Megathyrsus maximus var. *maximus**
	*Cynodon dactylon**
	Panicum effusum

Appendix B CSG Field Flora Survey Sites

Secondary 21 (essential habitat) **Arcadia Valley CSG Field**	
Vegetation Community	*Eucalyptus Crebra* open grassland
Actual RE	11.10.1d
Transect Start	X 149.045860; Y -25.443606
Bearing	south 200^0
Aspect	west
Slope	2^0
Soil	brown/grey sandy loam, dry, friable
Weeds	nil
Erosion	nil
Grazing impacts	moderate cattle tracks
Fire history	5 - 10 years
Fauna Habitat	minor hollows, high-moderate fallen debris/biomass
Fauna observations	high avifauna vocalisations, wallaby scats, high Hymenoptera activity, termite mounds
Notes	High grass colonisations (0.5m – 1.0m), native re-growth adjacent to site (north), area is indicative of modified open scrub. Site is classified/mapped as essential habitat.
Strata	**Dominant Species**
Canopy (T1): - 17-20m **FPC: 94%**	*Eucalyptus crebra*
	Angophora leiocarpa
Mid-Storey (T2): - 12-15m	*Eucalyptus crebra*
	Angophora leiocarpa
	Eucalyptus melanophloia
Shrub (S1): - 1-3m **FPC: 5%**	*Angophora leiocarpa*
	Acacia leiocalyx
Ground (G): <1 m **FPC: 50%** **Litter: 28%** **Bare: 22%**	*Cyanthilium cinereum*
	Themeda triandra
	Calotis cuneifolia
	Panicum decomposition

CSG Field Flora Survey Sites

Appendix B

Secondary 22 **Arcadia Valley CSG Field**	
Vegetation Community	*Eucalyptus crebra* woodland
Actual RE	11.10.1d
Transect Start	X 148.928196; Y –25.102655
Transect End (50m)	X 148.948680; Y -25.089362
Bearing	north 350^0
Aspect	west
Slope	flat
Soil	yellow sandy loam, cracking, low clay content
Weeds	*Opuntia tomentosa**
Erosion	200-500m west of transect moderate slumping present
Grazing impacts	Cattle tracks sighted (verbal accounts of historical cattle grazing)
Fire history	>10 years
Fauna Habitat	high fallen debris, moderate hollows, 1 – 1.2 metre grass and current bush habitats present
Fauna observations	high avifauna vocalisations, echidnae and wallaby sp. tracks, goanna tracks, termite mounds
Notes	mid-storey sparse with high grass spp.
Strata	**Dominant Species**
Canopy (T1): - 18-25m **FPC: 110%**	*Eucalyptus crebra*
	Eucalyptus populnea
Mid-Storey (T2): - 10-15m	*Eucalyptus crebra*
	Eucalyptus melanophloia
Shrub (S1): -2-5m **FPC: 5%**	*Geijera parviflora*
	-
Shrub (S2)	*Carissa ovata*
	Geijera parviflora
Ground (G): <1 m **FPC: 27%** **Litter: 38%** **Bare: 33%**	*Lomandra longifolia*
	-
	-
	-

Appendix B CSG Field Flora Survey Sites

Secondary 23 **Arcadia Valley CSG Field**	
Vegetation Community	semi-evergreen vine thicket
Actual RE	11.9.4a
Transect Start	X 149.950812; Y -25.147686
Transect End (50m)	X 148.952019; Y -25.147829
Bearing	West 270^0
Aspect	South
Slope	25^0
Soil	brown sandy loam, humus layer
Weeds	*Lantana camara**
Erosion	nil
Grazing impacts	nil
Fire history	> 10 years
Fauna Habitat	leaf littler high, high-moderate fallen debris/biomass, rocky outcrops
Fauna observations	high avifauna vocalisations, wallaby scats, high, Australian Brush-turkey nest
Notes	site located on ridge slope into a gully – very thick vegetation
Strata	**Dominant Species**
Canopy (T1): - 20-25m **FPC: 76%**	*Brachychiton populneus*
	-
Mid-Storey (T2): - 12-20m	*Eremophila mitchellii*
Shrub (S1): 3-8m **FPC: 5%**	*Alphitonia excelsa*
	-
Shrub (S2): 1-2m	*Carissa ovata*
	Alectryon diversifolius
	Alchornea ilicifolia
	Alyxia ruscifolia
Ground (G): <1 m **FPC: 10%** **Litter: 14%** **Bare: 85%**	*Everistia vacciniifolia*
	Pouteria sericea
	-
	-

CSG Field Flora Survey Sites

Appendix B

Secondary 24 **Arcadia Valley CSG Field**	
Vegetation Community	semi-evergreen vine thicket
Mapped RE	mapped as 11.9.4a
Actual RE	11.9.4a
Transect Start	X 148.895464; Y -25.149419
Transect End (50m)	one GPS point only
Bearing	south 160^0
Aspect	east
Slope	flat
Soil	light brown sandy loam
Weeds	nil
Erosion	nil
Grazing impacts	moderate cattle scats and tracks to watercourse
Fire history	>10 years
Fauna Habitat	High fallen decayed logs/debris, sporadic grass spp. clumps and current bush habitat
Fauna observations	moderate avifauna vocalisations, macropod scats, echidna diggings
Notes	no Crow's Ash (*Flindersia australis*) trees close to the cleared boundaries of the vegetation polygon
Strata	**Dominant Species**
Canopy (T1): - 20-27m **FPC: 166**%	*Brachychiton populneus*
	Flindersia australis
Mid-Storey (T2): - 12-18m	*Petalostigma pubescens*
	Eremophila mitchellii
Mid-Storey (T3): - 6-11m	*Alphitonia excelsa*
	Atalaya hemiglauca
Shrub (S1): - 1-3m **FPC: 5**%	*Carissa ovata*
	Alectryon diversifolius
Ground (G): <1 m **FPC: 9%** **Litter: 76%** **Bare: 19**%	*Everistia vacciniifolia*
	-
	-
	-

Appendix B CSG Field Flora Survey Sites

Secondary 25 **Arcadia Valley CSG Field**	
Vegetation Community	*Corymbia citriodora* open-forest
Actual RE	11.10.1
Transect Start	X 149.047192; Y –24.952182
Transect End (50m)	X 149.043109; Y -24.950090
Bearing	South-south-west 220^0
Aspect	East-east-south
Slope	3^0
Soil	Yellow brown sandy loam, high clay content
Weeds	*Opuntia tomentosa**
Erosion	Cattle access tracks through transect
Grazing impacts	Cattle tracks sighted
Fire history	<5 years
Fauna Habitat	High fallen debris/decaying biomass
Fauna observations	High avifauna vocalisations, echidnae and wallaby sp. tracks, goanna tracks, termite mounds
Notes	Transect located 100 metres up-slope from drainage line with severe slumping and scouring erosion, very little mid-storey vegetation with all mid-storey Ironbark trees dead.
Strata	**Dominant Species**
Canopy (T1): 25-35m **FPC: 136**%	*Corymbia citriodora*
	Angophora leiocarpa
Mid-Storey (T2): 13-22m	*Eucalyptus crebra*
	Angophora leiocarpa
	Eucalyptus melanophloia
Mid-Storey (T3): 3-10m	*Eucalyptus crebra*
	Eucalyptus melanophloia
Shrub (S1): -2-5m **FPC: 0.2**%	-
	-
Ground (G): <1 m **FPC: 24**% **Litter: 51**% **Bare: 25**%	*Eragrostis brownii*
	Tripogon loliiformis
	Fimbrystylis spp.
	-

CSG Field Flora Survey Sites

Appendix B

Secondary 26 (essential habitat)

Arcadia Valley CSG Field

Vegetation Community	*Corymbia citriodora* open-forest on scarps
Actual RE	11.10.13a
Transect Start	X 149.037549; Y -25.183675
Transect End (50m)	X 149.037852; Y -25.184070
Bearing	east-east-south 130^0
Aspect	south- south-west
Slope	3^0
Soil	grey/brown sandy loam, charcoal layer present
Weeds	*Opuntia stricta* var. *stricta**
Erosion	nil
Grazing impacts	cattle scats
Fire history	1-2 years
Fauna Habitat	moderate fallen debris/biomass, high small rocky outcrops, minimal hollows, occasional rocky outcrop
Fauna observations	high avifauna vocalisations, wallaby scats, echidna diggings
Notes	very high canopy, minimal mid-storey, limited grass spp. in ground layer
Strata	**Dominant Species**
Canopy (T1): - 20-25m **FPC: 102**%	*Corymbia citriodora*
	Eucalyptus crebra
Mid-Storey (T2): - 12-20m	*Eucalyptus crebra*
	Corymbia citriodora
Shrub (S1): 1-4m **FPC: 0.2**%	*Eucalyptus crebra*
	Alphitonia excelsa
	Corymbia citriodora
Ground (G): <1 m **FPC: 33**% **Litter: 14**% **Bare: 53**% (mostly rocky outcropping)	*Rostellularia adscendens*
	Chloris ramosus
	Themeda triandra
	Chloris divaricata *Cyanthillium cinereum*

Appendix B CSG Field Flora Survey Sites

Secondary 27 **Arcadia Valley CSG Field**	
Vegetation Community	*Eucalyptus melanophloia* woodland
Actual RE	11.3.39
General site name	Arcadia Valley
Transect Start	X 149.023946; Y -25.208508
Transect End (50m)	X 149.025108; Y -25.209084
Bearing	west 270^0
Aspect	south
Slope	flat
Soil	light brown/yellow sandy clay
Weeds	nil
Erosion	nil
Grazing impacts	nil
Fire history	1 – 2 years (fire scars present to 4 metres high)
Fauna Habitat	moderate fallen and decayed logs/debris, high stag trees present
Fauna observations	moderate avifauna vocalisations, macropod scats, echidna diggings
Notes	transect is located in small riparian vegetation strip adjacent deep drainage lines, grass spp. colonised heavily to at least 2 metres high
Strata	**Dominant Species**
Canopy (T1): - 20-35m **FPC: 54**%	*Eucalyptus melanophloia*
	Eucalyptus tereticornis
Mid-Storey (T2): - 8-15m	*Eucalyptus melanophloia*
	Erythrina vespertilio
Shrub (S1): - 1-3m **FPC: 5**%	-
	-
Ground (G): <1 m **FPC: 89%** **Litter: 5%** **Bare: 6**%	*Themeda triandra*
	Cyanthillium cinereum
	Paspalidium caespitosum
	Dianella brevipedunculata

CSG Field Flora Species List

Appendix C

CSG Field Flora Species List

Appendix C

Table C-1 Roma Gas Field - Flora Species List

Family	Scientific Name	Common Name	Relative Abundance[1]																			
			S1	S2	S3	S4	S5	S6	S7	S8	S9	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Mimosaceae	*Acacia aneura*	mulga								C	A											
Mimosaceae	*Acacia complanata*	flat-stem wattle											U				U					
Mimosaceae	*Acacia decora*	pretty wattle											R				O	O				
Mimosaceae	*Acacia leiocalyx*	black hickory wattle	O	O									R				R					
Mimosaceae	*Acacia salicina*	sally wattle						O														
Casuarinaceae	*Allocasuarina luehmannii*	bulloak		A	C							O				O						R
Myrtaceae	*Angophora floribunda*	rough-barked apple				C																
Myrtaceae	*Angophora leiocarpa*	smooth-barked apple	R	U									O				O					
Poaceae	*Aristida calycina*	dark wiregrass	O		O		C	O				O	C			O	C					
Poaceae	*Aristida caput-medusa*	many headed wire-grass	O	C	C		O		O				C				C					
Steruliaceae	*Brachychiton rupestris*	narrow-leaved bottletree									R											R
Acanthaceae	*Brunoniella australis*	blue trumpet	C		C								C				C					
Myrtaceae	*Callistemon viminalis*	weeping bottlebrush				A																
Cupressaceae	*Callitris glaucophylla*	white cypress pine	A	A	C	O	C		C		O	C	O			A	O	A				
Asteraceae	*Calotis cuneifolia*	a native daisy	O		C		C		C				O		A		O					
Asteraceae	*Calotis lappulacea*	yellow burr-daisy		C				C														
Apocynaceae	*Carissa ovata*	currant bush					C		C	A								A				
Adiantaceae	*Cheilanthes sieberi*	mulga fern	O		C		A		A	A	A	O				O						
Poaceae	*Chloris truncata*	windmill grass						A														
Poaceae	*Chloris ventricosa*	plump windmill grass		R		A																
Myrtaceae	*Corymbia tessellaris*	morton bay ash, carbeen		U																		
Asteraceae	*Cyanthillium cinereum*	vernonia		U																		
Poaceae	*Cymbopogon refractus*	barbwire grass		U				O														
Poaceae	*Cynodon dactylon**	couch				A																
Cyperaceae	*Cyperus difformis*	rice sedge				C																
Cyperaceae	*Cyperus rigidellus*	dwarf flat-sedge		U																		
Hemerocallidaceae	*Dianella revoluta*	spreading flax lily			O							O	O			O						
Sapindaceae	*Dodonaea vestita*		O										U									
Sapindaceae	*Dodonaea viscosa*	giant hop bush															U					
Chenopodiaceae	*Enchylaena tomentosa*	ruby saltbush			O																	
Poaceae	*Enneapogon lindleyanus*		C	C			C		C													
Poaceae	*Entolasia stricta*	wiry panic	A																			
Poaceae	*Eragrostis brownii*	brown's lovegrass	C	C			C				U	O				O						
Myoporaceae	*Eremophila debilis*	winter apple						R														
Myoporaceae	*Eremophila longifolia*	weeping emubush								O	U											
Myoporaceae	*Eremophila mitchellii*	false sandalwood		U				C		C												
Myrtaceae	*Eucalyptus crebra*	narrow-leaved ironbark	C		C								C				C					
Myrtaceae	*Eucalyptus melanophloia*	silver-leaved ironbark		U			C		C	C	O	O				C						

CSG Field Flora Species List

Appendix C

Family	Scientific Name	Common Name	Relative Abundance[1]																			
			S1	S2	S3	S4	S5	S6	S7	S8	S9	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Myrtaceae	*Eucalyptus populnea*	poplar box		**U**			R	A	R	C	O		A	O			A		O			R
Myrtaceae	*Eucalyptus tereticornis*	river red gum				C																
Convolvulaceae	*Evolvulus alsinoides*	blue periwinkle		U							R											
Rutaceae	*Geijera parviflora*	wilga						U		C								R				
Fabaceae	*Glycine tabacina*	glycine pea					R		R													
Asclepiadaceae	*Gomphocarpus physocarpus**	balloon cotton bush				O																
Goodeniaceae	*Goodenia rotundifolia*		O																			
Proteaceae	*Grevillea striata*	beefwood		O				U			R			A					A			
Poaceae	*Heteropogon contortus*	giant speargrass						R														
Xanthorrhoeaceae	*Lomandra longifolia*	mat rush				O																
Xanthorrhoeaceae	*Lomandra multiflora*	many-flowered Mat Rush	O	C									U				U					
Xanthorrhoeaceae	*Lomandra sp.*				O																	
Cactaceae	*Opuntia tomentosa**	velvety tree pear	O	O	O			R	O	O												
Oxalidaceae	*Oxalis corniculata*	wood sorrel				A					R				O					O		
Bignoniaceae	*Pandorea pandorana*	wonga vine					R		R													
Poaceae	*Paspalidium caespitosum*	brigalow grass		C																		
Poaceae	*Pennisetum ciliare**	buffel grass								E				O	A				A	A		A
Euphorbiaceae	*Petalostigma pubescens*	quinine tree	U																			
Chenopodiaceae	*Salsola kali*	prickly roly poly		U				U														A
Santalaceae	*Santalum lanceolatum*	true sandalwood	O																			
Caesalpiniaceae	*Senna artemisioides*	desert cassia								O	U		C				C					
Malvaceae	*Sida rohlenae*									O	C											
Solanaceae	*Solanum ellipticum*	potato bush					C			O			C									
Solanaceae	*Solanum stelligerum*	star nightshade							C	O	A						C					
Poaceae	*Sporobolus caroli*	fairy grass			O			O														
Verbenaceae	*Stackhousia sp.*											O				O						
Poaceae	*Themeda triandra*	kangaroo grass						A														
Verbenaceae	*Verbena aristigera**	mayne's pest*			R	C		C					A	O	A		A		A	A		A
Campanulaceae	*Wahlenbergia gracilis*	bluebells						O														

S: Secondary site

Q: Quaternary site

Exotic species

[1] Relative abundances: A – Abundant (>100 plants per transect); C – Common (50-100 plants); O – Occasional (20-49 plants);

U – Uncommon 5 – 20 plants; R – Rare (<5 plants); I – Incidental (recorded outside transect but within same RE).

CSG Field Flora Species List

Table C-2 Arcadia Gas Field - Flora Species List

Family	Scientific Name	Common Name	Relative Abudance[1]								
			S20	S21	S22	S23	S24	S25	S26	S27	Q28
Acanthaceae	*Rostellularia adscendens*			O					O		
Apocynaceae	*Carissa ovata*	currant bush				A					
Asteraceae	*Calotis cuneifolia*	a native daisy	U	C							
Asteraceae	*Calotis lappulacea*	yellow burr-daisy		C							
Asteraceae	*Cyanthillium cinereum*	vernonia		U					A	A	
Cactaceae	*Opuntia stricta* var. *stricta*	velvety tree pear							O		
Cactaceae	*Opuntia tomentosa**	velvety tree pear			U						
Casuarinaceae	*Allocasuarina torulosa*	forest oak									U
Combretaceae	*Terminalia oblongata*	yellow wood			U						
Convolvulaceae	*Evolvulus alsinoides*	blue periwinkle							U		
Elaeocarpaceae	*Elaeocarpus angustifolius*	silver quandong	U								
Euphorbiaceae	*Petalostigma pubescens*	quinine tree			R		C				
Fabaceae	*Erythrina vespertilio*	bats wing coarl tree			U					U	
Hemerocallidaceae	*Dianella brevipedunculata*		A								
Hemerocallidaceae	*Dianella caerulea*	blue flax lily							U		
Mimosaceae	*Acacia leiocalyx*	black hickory wattle	O	C							
Myoporaceae	*Eremophila mitchellii*	false sandalwood				O					
Myrtaceae	*Angophora leiocarpa*	smooth-barked apple	O	U				A			
Myrtaceae	*Callistomon viminalis*	weeping bottlebrush	C								
Myrtaceae	*Corymbia citriodora*	lemon scented gum							A		
Myrtaceae	*Eucalyptus acmenoides*	white mahogany	A								
Myrtaceae	*Eucalyptus crebra*	narrow-leaved ironbark		A	C			O	A		
Myrtaceae	*Eucalyptus melanophloia*	silver-leaved ironbark		O	O			O		R	
Myrtaceae	*Eucalyptus populnea*	poplar box			O						
Myrtaceae	*Eucalyptus tereticornis*	river red gum								C	
Oxalidaceae	*Oxalis corniculata*	wood sorrel	U								
Poaceae	*Chloris divaricata*	slender chloris		C	U						
Poaceae	*Cynodon dactylon**	couch	C								
Poaceae	*Enteropogon ramosus*	curly windmill grass			U						
Poaceae	*Eragrostis brownii*	brown's lovegrass		A				O			
Poaceae	*Heteropogon contortus*	giant speargrass	O								
Poaceae	*Megathyrsus maximus**	guinea grass	A								
Poaceae	*Panicum decompositum*	native millet		O							
Poaceae	*Paspalidium caespitosum*	brigalow grass		R						O	
Poaceae	*Sporobolus caroli*	fairy grass							C		
Poaceae	*Themeda triandra*	kangaroo grass	A	A					O	A	
Rhamnacae	*Alphitonia excelsa*	soap tree							R		
Rhamnaceae	*Alphitonia excelsa*	red ash				U					

CSG Field Flora Species List

Family	Scientific Name	Common Name	Relative Abudance[1]								
			S20	S21	S22	S23	S24	S25	S26	S27	Q28
Rutaceae	*Flindersia australis*	Australian teak					O				
Rutaceae	*Geijera parviflora*	wilga			A						
Sapindaceae	*Alectryon diversifolius*	holly bush			C	U					
Sapindaceae	*Dodonaea filifolia*		A								
Sapindaceae	*Dodonaea triangularis*		A								
Solanaceae	*Solanum ellipticum*	potato bush			O						
Solanaceae	*Solanum stelligerum*	star nightshade					R				
Steruliaceae	*Brachychiton populneus*	kurrajong					U				
Steruliaceae	*Brachychiton rupestris*	narrow-leaved bottletree				R					
Verbenaceae	*Lantana camara**	Lantana				A					
Xanthorrhoeaceae	*Lomandra longifolia*	mat rush			O						

S: Secondary site

Q: Quaternary site

* Exotic species

1 Relative abundances: A – Abundant (>100 plants per transect); C – Common (50-100 plants); O – Occasional (20-49 plants); U – Uncommon 5 – 20 plants; R – Rare (<5 plants); I – Incidental (recorded outside transect but within same RE).

Table C-3 Fairview Gas Field - Flora Species List

Family	Scientific Name	Common Name	Relative Abundance[1]																												
			S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Malvaceae	*Abutilon malvifolium*											O																			
Mimosaceae	*Acacia amblygona*	fan wattle		U																											
Mimosaceae	*Acacia bancroftiorum*		C			C					A																				
Mimosaceae	*Acacia complanata*	flat-stemmed wattle																							O						
Mimosaceae	*Acacia decora*	pretty wattle															R								C						
Mimosaceae	*Acacia harpophylla*	brigalow						A	A																	O	A			A	
Mimosaceae	*Acacia leiocalyx*	black wattle				C					A	C	C	C			U			C	O			C	C						
Mimosaceae	*Acacia longispicata*																			R	A										
Mimosaceae	*Acacia salicina*	sally wattle																													C
Mimosaceae	*Acacia shirleyi*	lancewood					A																								
Amaranthaceae	*Achryanthes aspera*	farmers friend										O																			
Euphorbiaceae	*Alchornea ilicifolia*	native holly		R																						O	C				
Sapindaceae	*Alectryon diversifolius*	scrub boonaree						O	O																						
Casuarinaceae	*Allocasuarina luehmannii*	bull oak	U																	A											
Rhamnaceae	*Alphitonia excelsa*	soap tree				U								C		U	U	U		O	U										
Myrtaceae	*Angophora floribunda*	rough-barked apple								C																					
Myrtaceae	*Angophora leiocarpa*	smooth-barked apple					R				A						R									C	C				
Papaveraceae	*Argemone ochroleuca**	Mexican poppy								A													C								
Poaceae	*Aristida calycina c. calycina*	dark wiregrass				O			O		C		C	C			A														
Poaceae	*Aristida caput-medusae*	many headed wire-grass	U	O							C							A			C										
Poaceae	*Aristida latifolia*	feathertop wiregrass		O																											
Poaceae	*Aristida leichhardtii*										C																				
Poaceae	*Aristida platychaeta*	curled wiregrass																A	A												
Poaceae	*Aristida queenslandica*	queensland wiregrass				O																									
Poaceae	*Aristida ramosa*	purple wiregrass			C																										
Poaceae	*Arundinella nepalensis*	reedgrass	C										O																		
Rutaceae	*Boronia occidentalis*					A	C																					C			
Poaceae	*Bothriochloa decipiens* v *decipiens*	pitted bluegrass		U						C		C															O				
Sterculiaceae	*Brachychiton populneus*	Kurrajong												U				R													
Phyllanthaceae	*Breynia oblongifolia*	coffee bush																R													
Acanthaceae	*Brunoniella australis*	blue trumpet														R						U									
Portulacaceae	*Calandrinia balonensis*																			R	O										
Myrtaceae	*Callistemon viminalis*	weeping bottlebrush								C													U								C
Cupressaceae	*Callitris endlicheri*	black cypress pine	O			C	A																								
Cupressaceae	*Callitris glaucophylla*	cypress pine		C							O	A	O	U		C	A	A	C	A	A	O									
Asteraceae	*Calotis cuneifolia*	purple burr-daisy	C									A					U				A										
Capparaceae	*Capparis arborea*																								U						
Apocynaceae	*Carissa ovata*	currant bush		C								O		C		R		C	R			A									
Asteraceae	*Cassinia quinquefaria*															R	R														
Casuarinaceae	*Casuarina*	river sheoak								U													O								

CSG Field Flora Species List

Appendix C

Family	Scientific Name	Common Name	Relative Abundance[1]																														
			S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
	cunninghamiana																																
Adiantaceae	*Cheilanthes sieberi*	rock fern		O		R	C				O		U				U			O	C	R										
Poaceae	*Chloris divaricata*	slender finger-grass		O										U					A													
Poaceae	*Chloris truncata*	windmill grass										C																					
Commelinaceae	*Commelina diffusa*	scurvy weed								R																							
Myrtaceae	*Corymbia citriodora*	lemon-scented gum									A													A	O							
Myrtaceae	*Corymbia clarksoniana*	Clarkson's bloodwood	C														R															
Myrtaceae	*Corymbia intermedia*	pink bloodwood																			R											
Myrtaceae	*Corymbia tessellaris*	moreton bay ash								R						R				R												C
Euphorbiaceae	*Croton insularis*	silver croton												U																		
Apiaceae	*Cyclospermum leptophyllum*	marsh parsley								O																						
Orchidaceae	*Cymbidium canaliculatum*	black orchid		R																												
Poaceae	*Cymbopogon refractus*	barbed wire grass																	O													
Poaceae	*Cynodon dactylon**	blue green couch								A																						
Cyperaceae	*Cyperus exaltatus*	giant sedge								O																						
Cyperaceae	*Cyperus fulvus*	sticky sedge				O																										
Cyperaceae	*Cyperus gracilis*	slender sedge				R			R			A																				
Celastraceae	*Denhamia oleaster*	yellow-fruited tree		O																												
Fabaceae	*Desmodium rhytidophyllum*				U																											
Liliaceae	*Dianella brevipedunculata*	flax lilly		U																												
Hemerocallidaceae	*Dianella revoluta*	blue flax-lilly									O																					
Poaceae	*Digitaria ramularis*					O																										
Ebenaceae	*Diospyros humilis*									U																						
Sapindaceae	*Dodonaea filifolia*		A			A																										
Sapindaceae	*Dodonaea triangularis*						O																									
Sapindaceae	*Dodonaea triangularis*												U																			
Sapindaceae	*Dodonaea viscosa subsp. spatulata*											C													U							
Myrtaceae	*E. fibrosa* subsp. *nubila*	dusky-leaved ironbark																							O							
Poaceae	*Echinochloa colona*	awnless barnyard grass																						R								
Chenopodiaceae	*Einadia nutans*	climbing saltbush							U	C	U	C		R	R	R	U	C		A				R	O							
Poaceae	*Enneapogon pallidus*																	C														
Poaceae	*Enteropogon acicularis*	curly windmill grass										C							A			A										
Poaceae	*Enteropogon ramosus*	twirly windmill grass																C	A													
Poaceae	*Enteropogon unispiceus*											C															C					
Poaceae	*Eragrostis brownii*	Brown's lovegrass		C							A	C					U		O		A	C		A								
Myoporaceae	*Eremophila bignoniiflora*	dogwood								O																						O
Myoporaceae	*Eremophila debilis*	winter apple		R																				R					R			
Myoporaceae	*Eremophila mitchellii*	false sandalwood										A																				
Myoporaceae	*Eremophila mitchellii*	false sandalwood											U			R	U	O	O			C										
Myrtaceae	*Eucalyptus acmenoides*	white mahogany	A																													
Myrtaceae	*Eucalyptus crebra*	narrow-leaved iron bark	A			C	U				O		O	U			C	U						C	O							
Myrtaceae	*Eucalyptus melanophloia*	silver-leaved ironbark		U						U		R				U																

CSG Field Flora Species List

Appendix C

Family	Scientific Name	Common Name	Relative Abundance[1]																													
			S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Myrtaceae	*Eucalyptus orgadophila*	mountain coolibah		C																												
Myrtaceae	*Eucalyptus populnea*	poplar box						O	C			A							C	A		A								A		
Myrtaceae	*Eucalyptus tereticornis*	forest red gum								C													O									A
Poaceae	*Eulalia aurea*	silky browntop									U																					
Connaraceae	*Evolvulus alsinoides*																R															
Cyperaceae	*Fimbristylis dichotoma*	common finger rush									O																					
Asteraceae	*Gamochaeta calviceps**			O																												
Rutaceae	*Geijera parviflora*	wilga								O		C				R		O	O			C										
Fabaceae	*Glycine tabacina*	glycine pea										O																				
Asclepiadaceae	*Gomphocarpus physocarpus**	balloon cotton bush																												C		
Goodeniaceae	*Goodenia rotundifolia*	star goodenia	U																													
Proteaceae	*Grevillea striata*	beefwood										R								R												U
Lamiaceae	*Hemigenia cuneifolia*		C																													
Poaceae	*Heteropogon contortus*	black spear grass																								C						
Malvaceae	*Hibiscus sturtii*	hill hibiscus										U																C				
Fabaceae	*Hovea lorata*		U																													
Violaceae	*Hybanthus monopetalus*	ladies' slippers					U																									
Oleaceae	*Jasminum didimum subsp. lineare*	desert jasmine									O																					
Oleaceae	*Jasminum simplicifolium*	stiff jasmine												R				R														
Xanthorrhoeaceae	*Lomandra confertifolia subsp. pallida*	matrush								C	C																					
Laxmanniaceae	*Lomandra hystrix*	slender mat rush																					O									
Laxmanniaceae	*Lomandra leucocephala*	woolly mat rush																				R										
Laxmanniaceae	*Lomandra longifolia*	mat rush				O				C			U																			
Laxmanniaceae	*Lomandra multiflora*	many flowered mat rush								C	A	O	O											U	U							
Laxmanniaceae	*Lomandra obliqua*					U																										
Myrtaceae	*Lysicarpus angustifolius*	budgeroo		U		U	R				R																		A			
Poaceae	*Megathyrsus maximus v maximus*	guinea grass								A									R	O												C
Poaceae	*Melinis repens**	red natal grass		U												R																
Oleaceae	*Notolaea microcarpa*	native olive					U																									
Cactaceae	*Opuntia tomentosa**	velvety tree pear		U			O	O	O		R									R		U			R		O					
Meliaceae	*Owenia acidula*	emu apple		R																						C						
Oxalidaceae	*Oxalis corniculata**	creeping oxalis								A											U	R		U								
Bignoniaceae	*Pandorea pandorana*													R				R			R											
Poaceae	*Panicum effusum*	hairy panic	C					O			C	C	O													O						
Poaceae	*Paspalidium caespitosum*	brigalow grass						A	A			R												R						C		
Poaceae	*Paspalidium globoideum*	Shot grass										U	C				O															
Poaceae	*Pennisetum ciliare**	buffel grass		O				C	C	O		A			A	C			O	C	O											A
Picrodendraceae	*Petalostigma pubescens*	quinine																U				U										
Rubiaceae	*Psydrax odorata*	shiny-leaved canthium				U																					O		A			
Acanthaceae	*Rostellularia adscendens*		O									O						U			U											

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Appendix C

Family	Scientific Name	Common Name	Relative Abundance[1]																														
			S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Asteraceae	*Rutidosis murchisonii*			R																												
Santalaceae	*Santalum lanceolatum*	sandalwood																O															
Cyperaceae	*Scleria brownii*						O																			O						
Asteraceae	*Senecio brigalowensis*					U				O																A				A		
Caesalpiniaceae	*Senna artemisioides*	silver cassia																R	R			O										
Poaceae	*Setaria surgens*	pigeon grass										U								U	O						U		O			
Malvaceae	*Sida cordifolia**	flannel weed				U														C							O					
Malvaceae	*Sida rohlenae*															C																
Solanaceae	*Solanum ellipticum*	potato bush	O													R	R							R								
Poaceae	*Sporobolus caroli*	fairy grass							O		A														C		C					
Poaceae	*Sporobolus creber*	sporobolus		U																								C				
Combretaceae	*Terminalia oblongata*	yellow wood		O								R										R						C				
Poaceae	*Themeda triandra*	kangaroo grass	U					U	U			A	R						O						C							
Verbenaceae	*Verbena aristigera**	mayne's pest								A		C			R	U			U	C		U	C						C	A	A	
Asteraceae	*Vittadinia cuneata* var. *hirsuta*																	A		C												
Asteraceae	*Vittadinia dissecta*																	C														
Campanulaceae	*Wahlenbergia graniticola*	granite bluebell														R					A									O			

S: Secondary site

Q: Quaternary site

* Exotic species

1 Relative abundances: A – Abundant (>100 plants per transect); C – Common (50-100 plants); O – Occasional (20-49 plants);

U – Uncommon 5 – 20 plants; R – Rare (<5 plants); I – Incidental (recorded outside transect but within same RE).