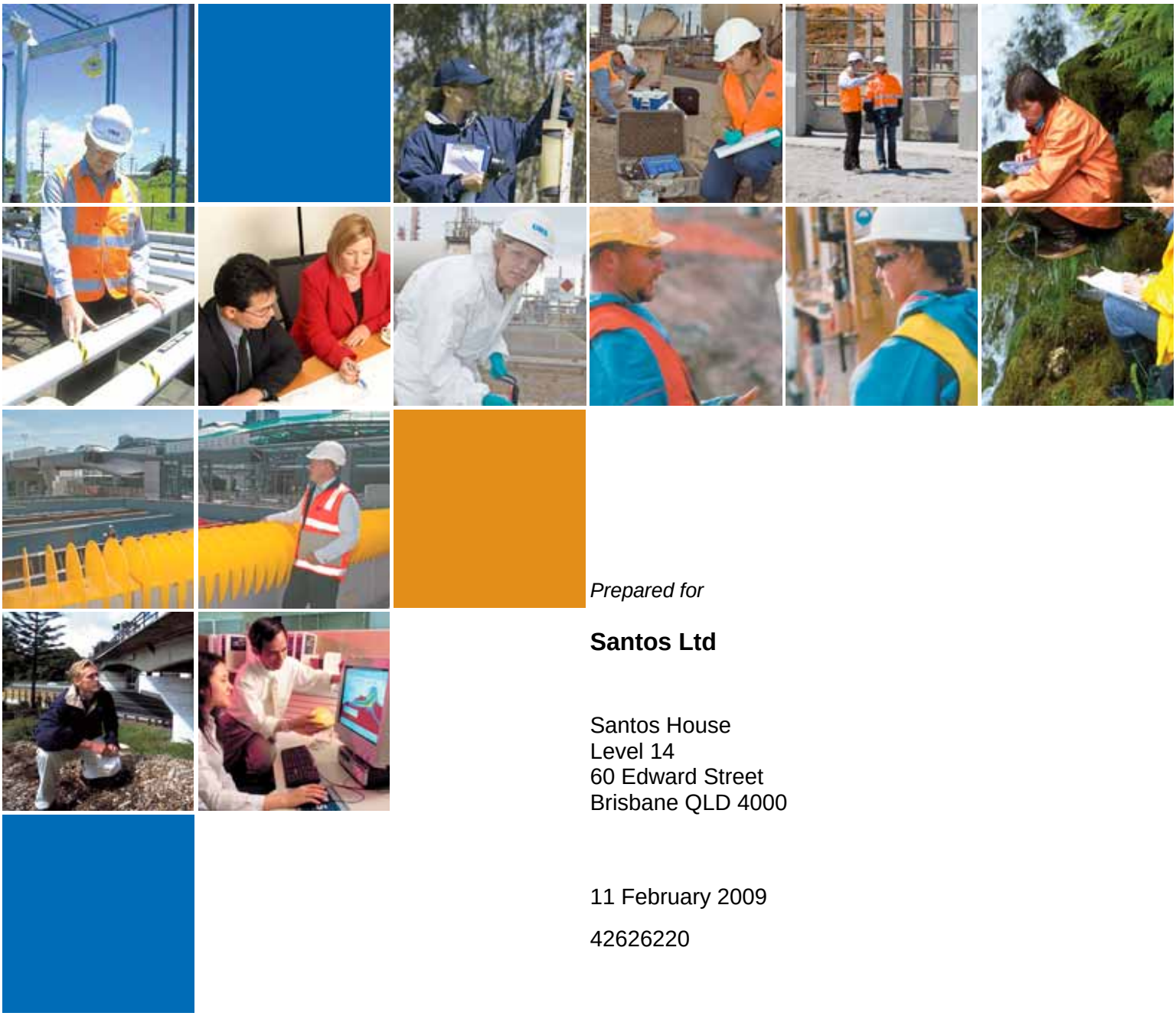
FINAL REPORT

GLNG EIS Visual Assessment – CSG Field and Gas Transmission Pipeline Development



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Executive Summary

This section of the Gladstone Liquefied Natural Gas (GLNG) Environmental Impact Statement (EIS) presents the visual assessment study carried out by URS Australia Pty Ltd (URS) on behalf of Santos Ltd (Santos) for the proposed coal seam gas (CSG) field and gas transmission pipeline corridor. The CSG field visual assessment has focussed on the Santos' "Reasonably Foreseeable Development Area" comprising the Roma, Fairview and Arcadia Valley CSG fields in central west Queensland. It is these fields that the RFDA are expected to be subject to the most development activity in the foreseeable future, with development of areas outside these three fields dependent on the success of this initial exploration program. The gas transmission pipeline will link these CSG fields to the Liquefied Natural Gas (LNG) facility on Curtis Island, near Gladstone.

The visual assessment involved a field inspection to analyse and describe the existing landscape character of the CSG fields and gas transmission pipeline. Results of this assessment provided the baseline against which the potential incremental impact of the proposed development has been assessed.

The extent to which the major components of the CSG fields and gas transmission pipeline are likely to be visible was assessed, with particular attention given to typical viewing situations associated with public roads, towns and homesteads. Due to the large number of proposed well sites the visual assessment did not attempt to analyse the potential visual impact of each well site. However, the visual assessment does address each development component, both temporary and long term, of the CSG fields and gas transmission pipeline.

Potential levels of visual impact, which include high, medium, low and negligible, are defined and used to describe the predicted visual impact of the individual components of the CSG fields and gas transmission pipeline development. Photographs of existing well sites and sections of gas transmission pipeline are used to illustrate aspects of the visual assessment. The cumulative visual impact of multiple well sites is illustrated by photomontages of views from two selected locations.

The proposed development of the Roma, Fairview and Arcadia Valley CSG fields (the "Reasonably Foreseeable Development Area") and the gas transmission pipeline will create both temporary and longer term changes to the visual landscape character of the areas in which they are located. These changes will result primarily from the removal of vegetation and conduct of earthworks that will be carried out to create a series of flat leases at the gas well sites plus create the gas transmission pipeline trench. The most visible components of the CSG field development will be exposed soil, new access roads and the movement of vehicles and equipment associated with the establishment of the gas wells and installation of pipelines. In situations where these components are visible from public roads, towns or homesteads the visual impact is likely to be moderate, although generally short term. In situations where the CSG field development activities are not visible from public roads or homesteads then the visual impact will be negligible.

The longer term components of the production wells are relatively small in scale and do not form visually prominent elements in the rural landscape in which the CSG fields are to be developed. In situations where these components are not visible from public roads or homesteads, the longer term visual impact will be negligible. Even in situations where the well heads are visible from public roads or homesteads, the visual impact will generally be low or negligible. The permanent production wells will constitute a relatively minor component of the wider landscape view and might be missed by the majority of casual observers. Awareness of the wells, however, would not have a marked effect on the overall quality of the view. Implementation of the mitigation measures, which are generally consistent with current Santos work methods, should ensure that any visual impacts are minimised.

The potential visual impact of other components of the CSG fields and gas transmission pipeline development, which include compressor stations, accommodation facilities, water storage dams, lay down and storage areas,

Executive Summary

have also been assessed. In most situations these components will not be visible from public roads or homesteads and therefore the visual impact will be negligible. In those situations where they are visible from public roads or homesteads, the visual impact will generally be low. Implementation of best practice mitigation measures will in most situations reduce the visual impact to negligible.

A range of best practice mitigation measures have been identified that would minimise the level of potential visual impact associated with the various components of the proposed CSG fields and gas transmission pipeline development. The mitigation measures are generally consistent with current Santos work methods, which aim to ensure that any visual impacts are minimised.

Decommissioning of the CSG fields and gas transmission pipeline at the end of their economic life will involve removal of most of the surface facilities and rehabilitation of sites to uses compatible with the adjoining land uses. At the completion of the decommissioning process the residual visual impact of the project will be negligible.

1.1 Introduction

Santos Ltd (Santos) proposes to expand its existing Coal Seam Gas (CSG) field operations in the Surat and Bowen Basins of central west Queensland to provide feed gas supply for its Gladstone Liquefied Natural Gas (GLNG) project. This will involve drilling over 2 600 additional wells in its CSG fields (including the major fields at Roma, Fairview and Arcadia Valley which are described as the "Reasonably Foreseeable Development Area") over the next 20 to 25 years. Gas from these wells will be transported via a 435 kilometre underground gas transmission pipeline to a new LNG facility on Curtis Island (near Gladstone). The regional context of the CSG fields and gas transmission pipeline are illustrated in Figure 1, which shows the network of major roads, drainage lines and townships.

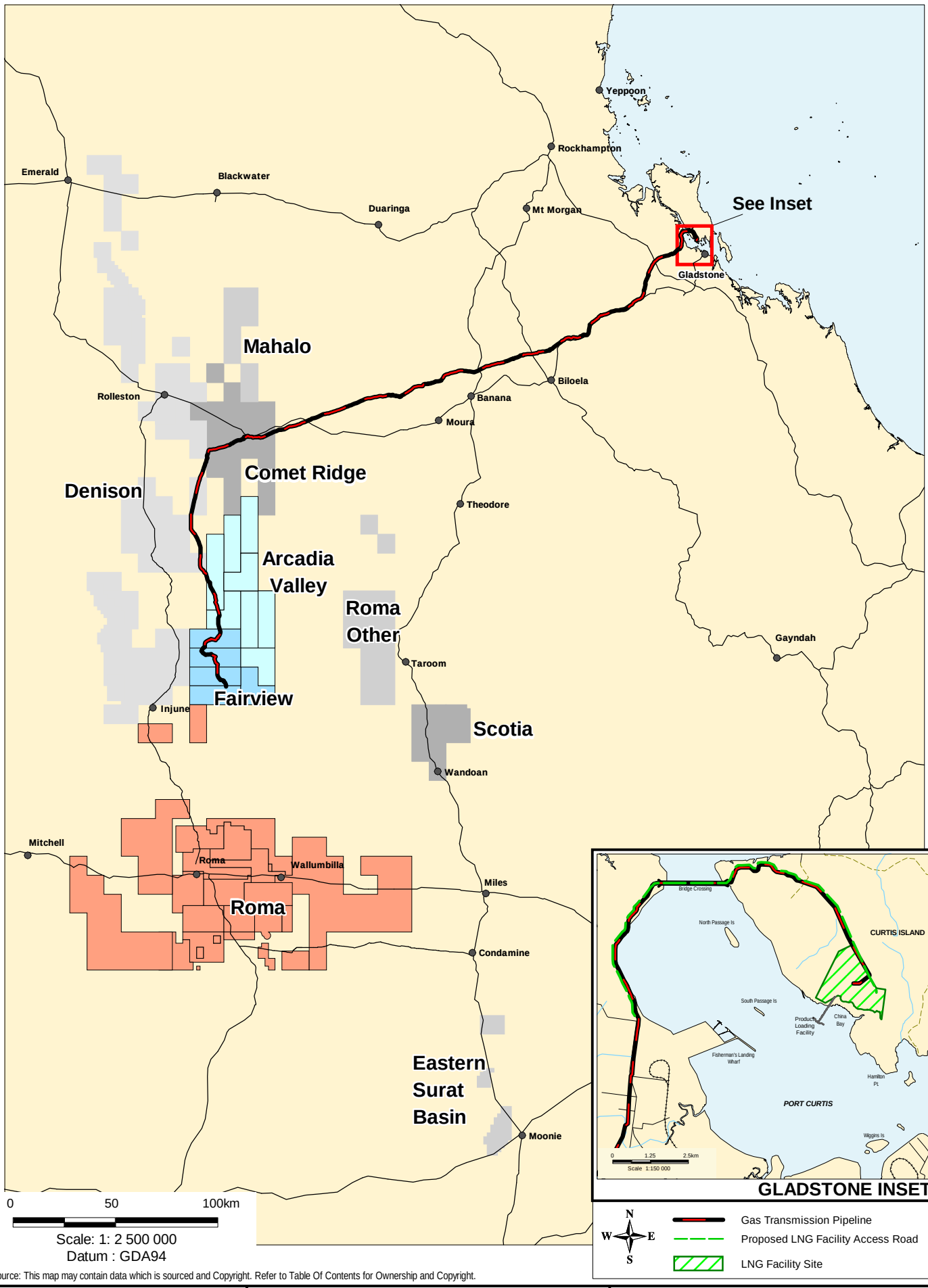
The visual assessment of the existing landscape character has been carried out to provide a baseline against which the potential incremental impacts of the proposed CSG field and gas transmission pipeline development can be assessed. The visual assessment has involved a field inspection to review, photograph and describe the existing landscape character in each of the three major CSG fields (Roma, Fairview and Arcadia Valley) in which the gas extraction operations are proposed to be expanded. The field inspection also included a review of the visual aspects of existing CSG operations, which include exploration and production well drilling and infrastructure associated with field development and operational activities. The field inspection and assessment was carried out by a Registered Landscape Architect and Senior Consultant to URS.

Assessment of the existing landscape character focused on views from public roads and other publicly accessible locations within the CSG field area and gas transmission pipeline corridor.

The results of this baseline landscape character assessment, combined with a review of proposed CSG field and gas transmission pipeline development activities (including access tracks and roads, fencing, well head equipment, plant and equipment storage facilities, gas pumping stations, water storage facilities, staff accommodation and administration buildings) .has allowed an assessment of potential visual impacts to be made.

The visual assessment is presented by describing the works and illustrating them with annotated photographs. Comments are also presented in relation to the typical visual impacts of each component and the time frame of such impacts.

A range of typical mitigation measures have been identified that would minimise the level of potential visual impact of the proposed CSG field and gas transmission pipeline development.



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Client	Project	Title	
	GLADSTONE LNG PROJECT VISUAL AMENITY ASSESSMENT CSG FIELD AND PIPELINE CORRIDOR	**OVERALL CSG FIELD LOCATIONS**	
Drawn: LL/CA	Approved: JB	Date: 11-02-2009	Figure: **1**
Job No: **4262 6220**	File No: 42626220-g-600.wor		Rev:A **A4**

Existing Landscape Character

Section 2

2.1 Background

The landscape character of the Roma, Fairview and Arcadia Valley CSG fields differs significantly as a result of variations in the combination of landform, vegetation and land uses. The original landscape character has been changed most dramatically in areas of high soil fertility where clearing has been undertaken to allow cultivation and grazing.

The most notable of these areas is the gently undulating agricultural land in the vicinity of Roma and Wallumbilla that is associated with Bungil Creek and its tributaries that drain to the south into the Condamine River system. Clearing of the original woodland vegetation has opened up views to the mid and long distance across cultivated paddocks and grasslands. The visual character of these areas changes significantly throughout the year with extensive areas of bare soil visible following cultivation, followed by a period in which the green growth of the young crop is visually dominant and then a period in which the yellow/straw colours of the maturing crop dominate.

In less fertile areas the landscape character has also been changed as a result of clearing for grazing purposes but the seasonal variation is in most cases less dramatic than the areas of cultivation. The landscape character in these areas generally consists of grassland with scattered trees together with remnant patches of woodland or forest, often along drainage lines. This landscape character is typical of the northern portion of the Roma CSG field where grazing is the dominant land use.

In areas with the least fertile soils the landscape character is dominated by extensive areas of native forest and woodland. The landform in many of these areas is strongly undulating and includes visually prominent ridges and hills. State forests and national parks cover a substantial portion of this rugged area of landscape. Views from within these areas are commonly blocked by the tree cover and local landform features. This landscape character is common throughout the Fairview and Arcadia Valley CSG fields.

The majority of people who view the variation in landscape character do so from the network of public roads throughout the area. The two major public roads in the vicinity of the CSG fields are the Warrego Highway, which runs east-west through Roma, Wallumbilla and Yuleba, and the Carnarvon Development Road, which runs north-south through Roma and Injune. A series of townships are located along these two highways within the CSG fields and adjoining areas.

The landscape character of the CSG fields is also viewed from the numerous homesteads located throughout the area. The pattern of rural homesteads is directly related to the pattern of public roads and land uses. Areas of fertile soils within the Roma CSG field generally accommodate a relatively dense pattern of homesteads while the more remote and rugged forest and national park areas in the Fairview and Arcadia Valley CSG fields have a significantly lower density of homesteads. The potential for views of activities associated with exploration drilling and production gas well establishment is higher in those areas where the pattern of homesteads is more intense.

While a substantial number of gas wells have already been established within the CSG fields they do not generally form a prominent element in the landscape. The well head and associated equipment is relatively small in scale and only visually prominent in relatively short distance views. Consequently, most of the established wells are not visible from public roads.

The most visually prominent aspect of the gas extraction operations is associated with well lease construction, and exploration and production drilling activities. It is during this period that equipment, vehicles, temporary structures and earthworks are visible within the rural landscape. However, the period of visibility is relatively

Section 2 Existing Landscape Character

short in duration as site rehabilitation works usually return the majority of the disturbed areas to their original or comparable land use. Permanent elements of the CSG field development include production equipment at well heads, compressor stations, access roads and water storage dams. However, access roads and water storage dams are common elements in the rural landscape (although the number of these would be expected to increase as field development expands), and the compressor stations are limited in number relative to the scale of the landscape in which they are located. Visual aspects of the proposed CSG field development are addressed in detail in Section 3.

2.2 Landscape and Character Zones (CSG Fields)

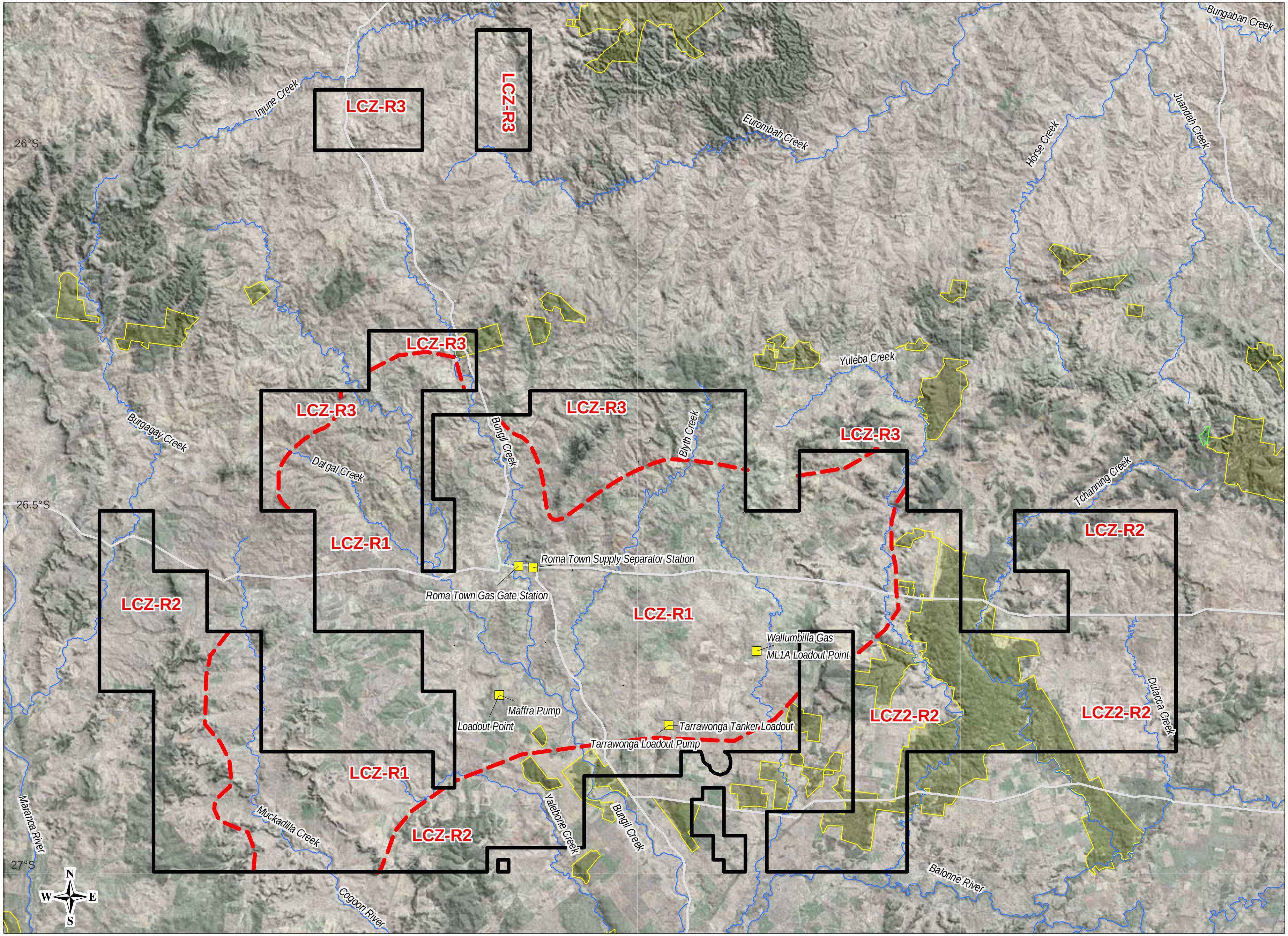
There is substantial variation in the landscape character within and between the Roma, Fairview and Arcadia Valley CSG fields, resulting from different combinations of landform, vegetation and land uses. In order to understand the baseline landscape context of each CSG field a landscape analysis was carried out. The landscape analysis involved identification of a series of Landscape Character Zones (LCZ's) within each of the CSG fields that are illustrated on figures and described in the following sections. Each LCZ incorporates an area in which the combination of landform, vegetation, land use and development is relatively consistent. While individual LCZ's may incorporate some visual variation, they provide a broad baseline landscape context in which the CSG field development will take place.

2.2.1 Roma CSG Field

The original pre-settlement landscape character throughout the Roma CSG field has been altered dramatically in areas of high soil fertility that are suitable for cultivation. These areas include agricultural land use in the central portion of the CSG field in the vicinity of Roma and Wallumbilla townships. Clearing of the original woodland vegetation in these areas has opened up mid and long distance views across cultivated paddocks and grasslands. This landscape character is visible from sections of the Warrego Highway and Carnarvon Development Road that run though the Roma CSG field.

The northern portion of the Roma CSG field is characterised by a system of visually prominent hills and ridges defining wide valleys in which grazing is the predominant land use. The landscape character of the southern and western portions of the Roma CSG field is characterised by extensive areas of forest and woodland vegetation on moderately undulating landforms.

Three distinct LCZ's have been identified within the Roma CSG field as shown on Figure 2. Each of the LCZ's is described with photographs and summarised on the following pages.



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Datum : GDA94

LCZ - Landscape Character Zone
Roma CSG Field
Facilities
National Park
State Forest
Major Road
Major Drainage

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Client

Project
GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
CSG FIELD AND PIPELINE CORRIDOR

Drawn: CA
Approved: JB
Date: 11-02-2009
Job No: 4262 6220
File No: 42626220-g-597.wor

Title
ROMA CSG FIELD - LANDSCAPE CHARACTER ZONES

Figure: 2
Rev:A
A4

Section 2 Existing Landscape Character

Landscape Character Zone R1 – Roma/Wallumbilla agricultural area

- Gently undulating to flat landform drained by a system of creeks flowing into Bungil Creek;
- Predominantly agricultural land uses at low elevation to the north and south of Warrego Highway;
- Extensive areas of cultivation together with grassland used for grazing;
- Visual character varies throughout the year, with bare soil visible after cultivation, followed by green growing crop and then the yellow/straw colours of the maturing crop;
- Open views across cultivated and grazing paddocks from public roads; and
- Patches of woodland commonly associated with drainage corridors and road reserves.

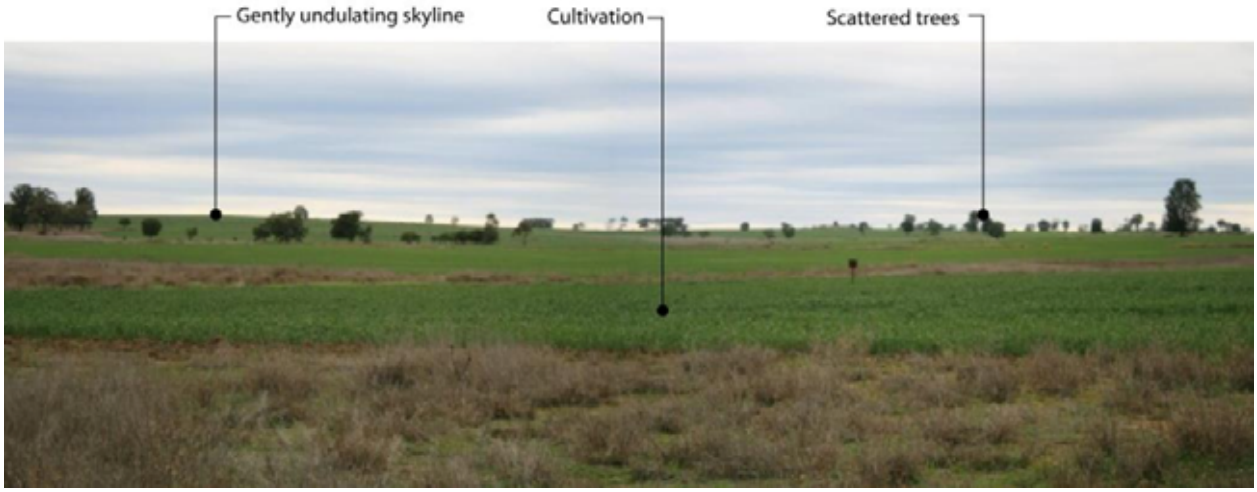

Plate 1 View across typical cultivation area

Plate 2 View from Warrego Highway

Landscape Character Zone R2 – Hills/slopes with forest & grazing land uses

- Moderately undulating landform drained by a system of creeks flowing into Bungil Creek;
- Patches of grassland used for grazing;
- Extensive areas state forest and patches of remnant woodland; and
- Views from public roads vary and include open long distance views as well as short distance views where roadside vegetation is present.

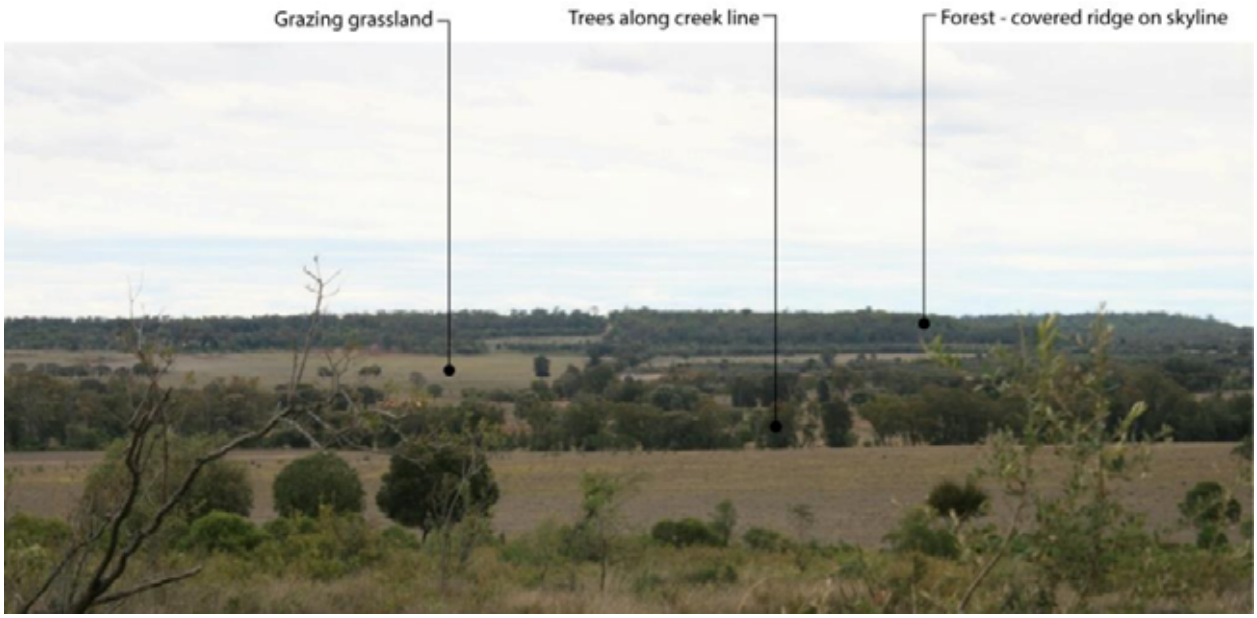

Plate 3 Typical view across undulating landform

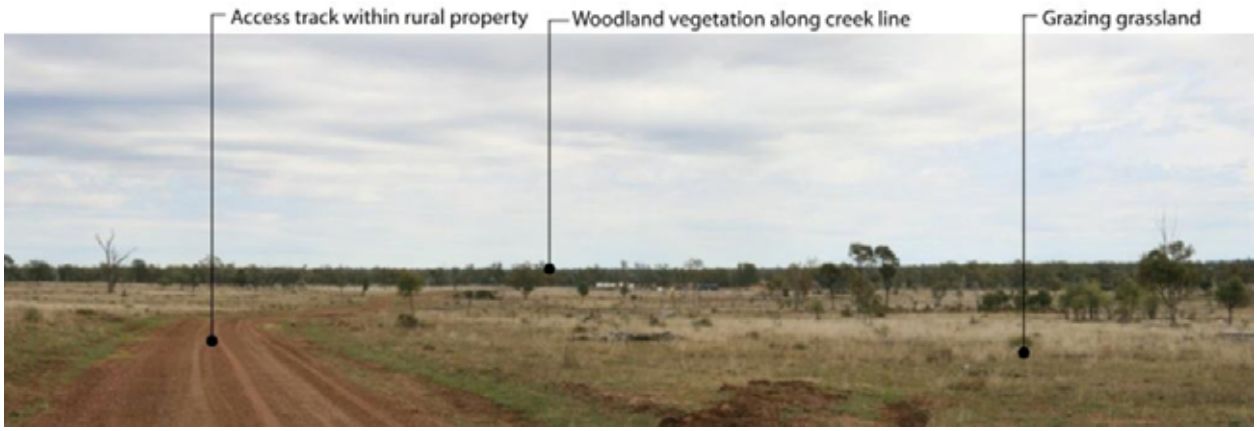

Plate 4 Typical view across grazing area

Section 2 Existing Landscape Character

Landscape Character Zone R3 – Hills/Valleys with grazing & forestry land uses

- System of hills and valleys in higher elevation area in northern portion of the CSG field;
- Patches of grassland used for grazing often include scattered trees and shrubs;
- Patches of remnant woodland, particularly along creek and gully drainage lines; and
- Long distance views from ridge tops across wide valleys.

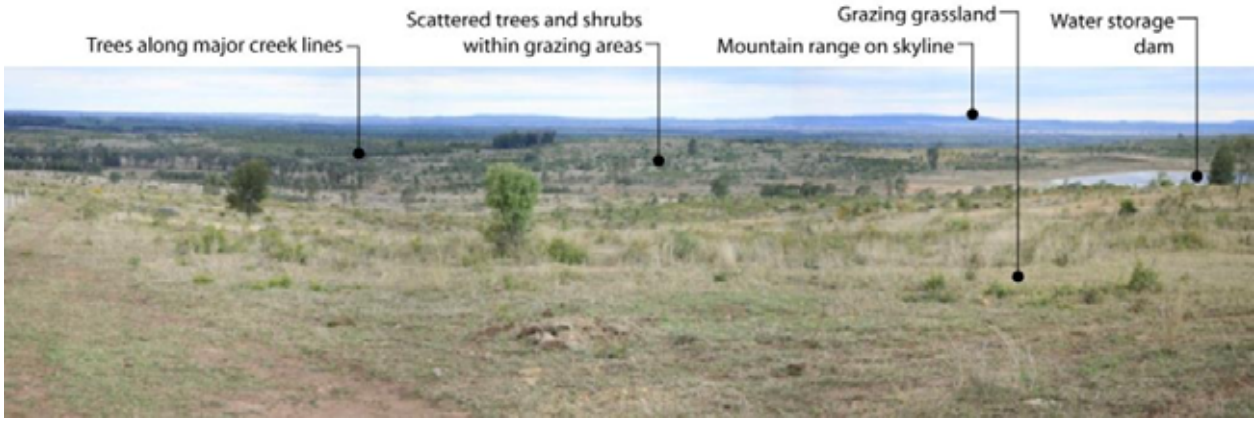

Plate 5 Typical view from ridge top across valley

Plate 6 Typical view across ridge top

2.2.2 Fairview CSG Field

The general landscape character throughout the Fairview CSG field reflects a combination of strongly undulating landforms, plateaus, scarps and drainage systems with extensive areas of forest and woodland vegetation. A series of deeply incised valleys associated with the Dawson River and its tributaries drain the area from west to east.

Pony Hills Hallett State Forest covers an extensive area in the southern portion of the CSG field, while Expedition National Park occupies a large area of rugged landscape in the northern portion. Areas of grassland commonly occur on the relatively flat cleared plateaus located between the deeply incised valleys.

Valleys associated with Horse Creek in the northern portion of the CSG field and Robinson Creek in the eastern portion are relatively broad. The bases of these valleys have been extensively cleared of the original woodland vegetation to establish grassland for grazing with scattered remnant trees. Views from within the valleys are generally short to mid distance across the grassland areas with tree-covered ridges and hills visible on the skyline.

Views from the tops of ridges and hills may extend across the valleys where clearing has taken place, but generally views are blocked by the extensive tree cover throughout state forests and national parks areas.

Three distinct LCZ's have been identified within the Fairview CSG field as shown on Figure 3, and described on the following pages.

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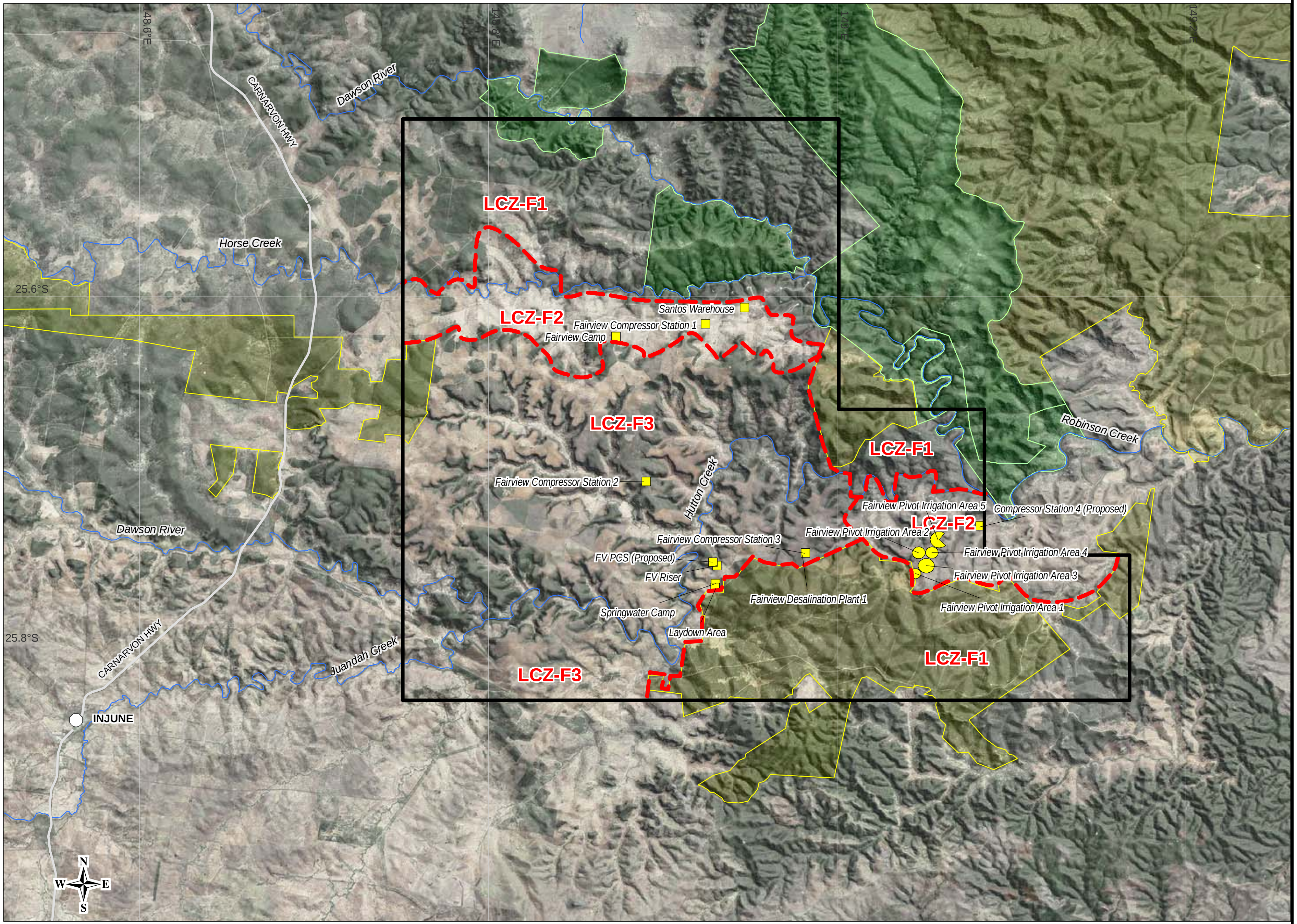

0 5 10Km
Scale 1:300,000 (A4)
Datum: GDA94

LCZ - Landscape Character Zone
Fairview CSG Field
Facilities
National Park
State Forest
Major Road
Major Drainage

URS

Client: LNG

Project: GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
CSG FIELD AND PIPELINE CORRIDOR

Drawn: CA | Approved: JB | Date: 11-02-2009

Job No: **4262 6220** | File No: 42626220-g-598.wor

Title: **FAIRVIEW CSG FIELD - LANDSCAPE CHARACTER ZONES**

Figure: **3**

Rev:A

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Landscape Character Zone F1 – Forests & National Parks

- Strongly undulating landform with visually prominent hills and deeply incised drainage lines;
- Forest-covered hills in Expedition National Park and private land in northern portion of the zone;
- Hallett State forest in south eastern portion of the zone;
- Patches of grassland with scattered trees on isolated areas of grazing; and
- Views from public roads often blocked by forest cover.

Plate 7 Typical view within Hallett State Forest from Injune – Taroom Road

Plate 8 Typical view within Hallett State Forest of mixed Eucalypt/Cypress Pine forest

Section 2 Existing Landscape Character

Landscape Character Zone F2 - Broad valleys

- Wide east-west valleys defined by visually prominent hills and ridges along the northern and southern edges;
- Extensive areas of grassland for grazing with scattered trees; and
- Views from within the valleys are generally across the grassland areas between trees with forest-covered ridges visible on the skyline.

Plate 9 Typical view along valley floor

Plate 10 Typical view of valley floor

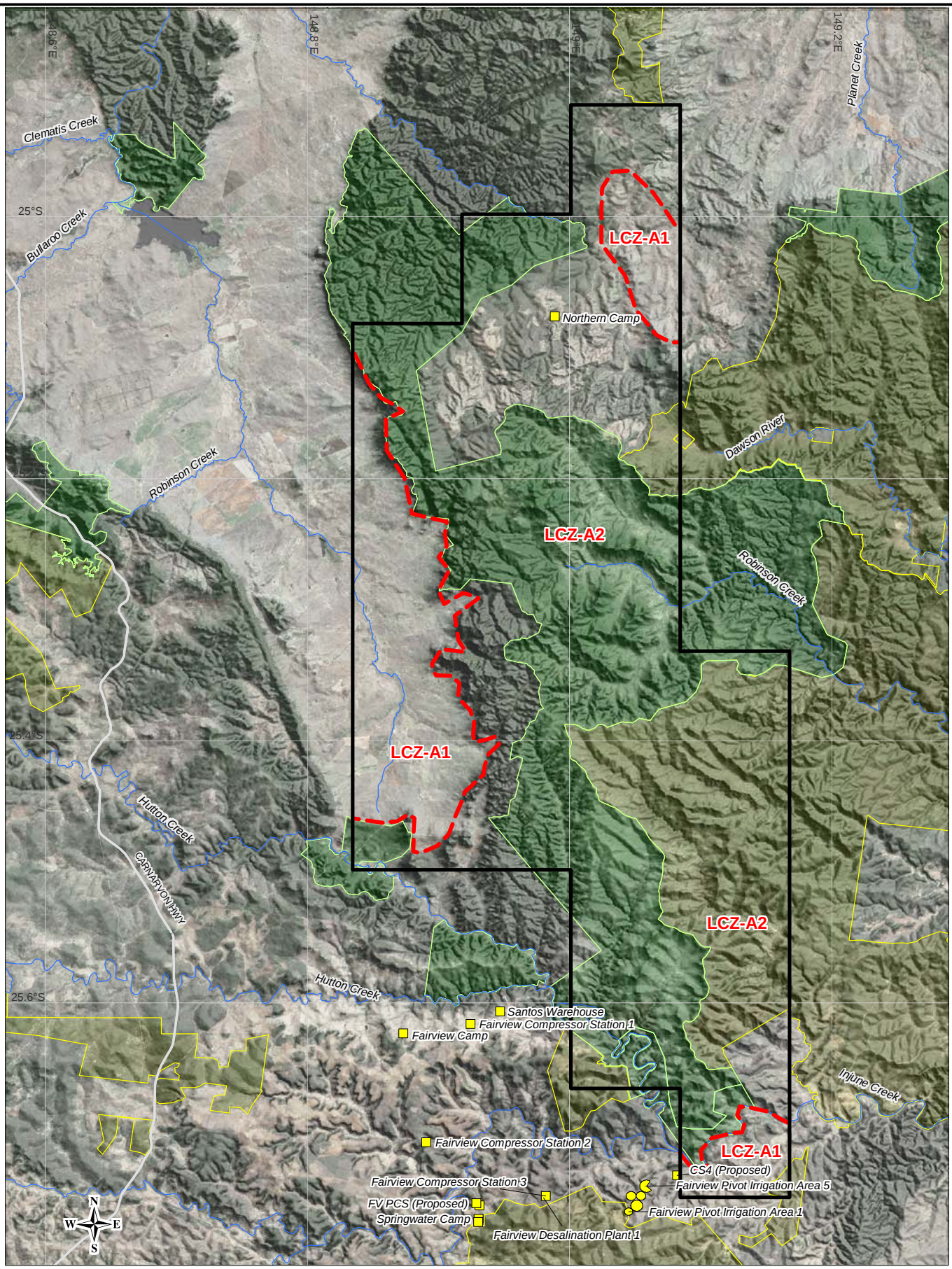
Landscape Character Zone F3 – Valleys and Plateaus

- Strongly dissected landforms with steep sided valleys and plateaus between;
- Remnant forest on steep slopes and along creeks;
- Plateau areas generally covered by grassland with scattered trees and some clumps of remnant woodland; and
- Views from ridge tops are typically long distance.

Plate 11 Typical view across valleys and plateaus

2.2.3 Arcadia Valley CSG Field

Substantial areas of State forests and national parks occur within the CSG fields, particularly on more rugged areas and higher elevation areas. Public lookouts are located on some of the major peaks within National Parks providing long distance views across adjoining areas of rural land use. Two distinct LCZ's have been identified within the Arcadia Valley CSG field as shown on Figure 4 and described on the following pages.



Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
CSG FIELD AND PIPELINE CORRIDOR

Title

**ARCADIA VALLEY CSG FIELD-
LANDSCAPE CHARACTER ZONES**

Drawn: CA	Approved: JB	Date: 11-02-2009
Job No: **4262 6220**	File No: 42626220-g-599.wor	

Figure: **4**

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Landscape Character Zone A1 – Valley

- Arcadia Valley is a well defined north-south valley that is visually defined by prominent ridge lines along its eastern and western edges;
- Arcadia Creek drains the valley to the north into Lake Nuga Nuga;
- Extensive areas of grassland are used for grazing, with scattered trees on the valley floor;
- Two smaller valleys (one in the northern and the other in the southern portion of the zone) predominantly contain grassland with scattered trees; and
- Views from within the valleys generally extend across the grassland areas to forest-covered ridges on the skyline.

Plate 12 View across plateau to Arcadia Valley and surrounding escarpments

Plate 13 View across plateau to Arcadia Valley and adjoining mountain ranges

Section 2 Existing Landscape Character

Landscape Character Zone A2 – Mountain Range

- Visually prominent mountain range east of Arcadia Valley comprising a system of deeply incised valleys draining to the east;
- Forest-covered ridge lines, slopes and valleys;
- A large proportion of the zone is covered by Expedition National Park, with the balance covered by state forests and remnant forest on private land; and
- Views from ridge tops are generally blocked by tree cover but some long distance views are available where openings occur.

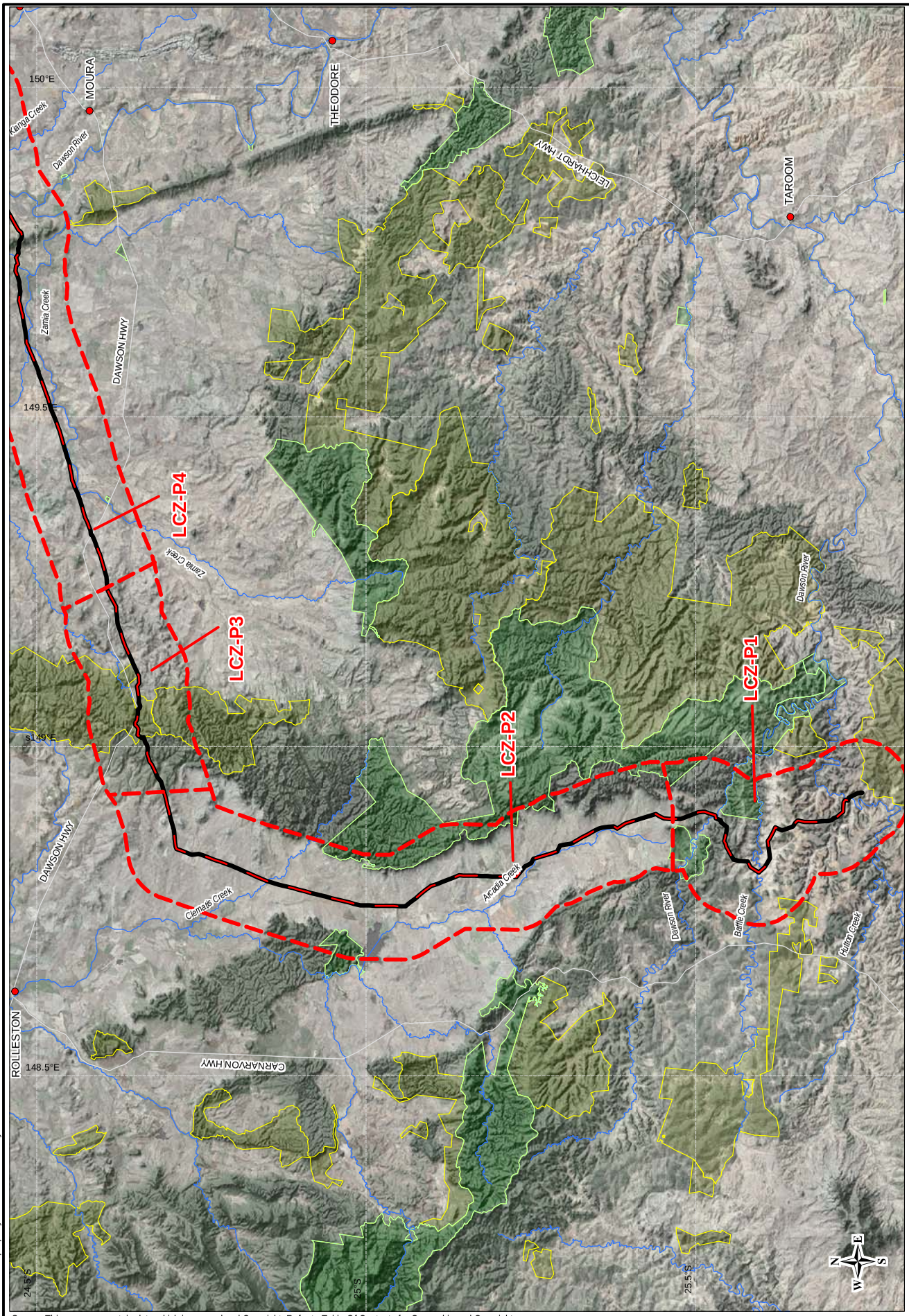
Plate 14 Typical view across deep valley

Plate 15 View across deep valleys and plateaus

2.3 Landscape Character Zones (CSG Transmission Pipeline)

The CSG transmission pipeline will pass through a diverse range of landscapes along the route from the CSG fields to the LNG facility on Curtis Island, near Gladstone. The diversity of landscapes results from varying combinations of landform, vegetation and land uses. In order to understand the existing landscape character along the gas transmission pipeline corridor a baseline landscape analysis was carried out.

The landscape analysis involved identification of a series of Landscape Character Zones (LCZ's) that are illustrated on Figure 5a and Figure 5b and described on the following pages. Each LCZ comprises an area that is relatively consistent in terms of the combination of landform, vegetation and land use within the zone. While individual LCZ's may incorporate some visual variation, they are relatively consistent and provide a broad baseline landscape context in which the gas transmission pipeline will be constructed.



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Project
GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
CSG FIELD AND PIPELINE CORRIDOR

Title
PROPOSED PIPELINE CORRIDOR (WESTERN SECTION) LANDSCAPE CHARACTER ZONES

Drawn: CA	Approved: JB	Date: 11-02-2009	
Job No: **4262 6220**	File No: 42626220-g-601.wor	Figure: **5a**	Rev: A
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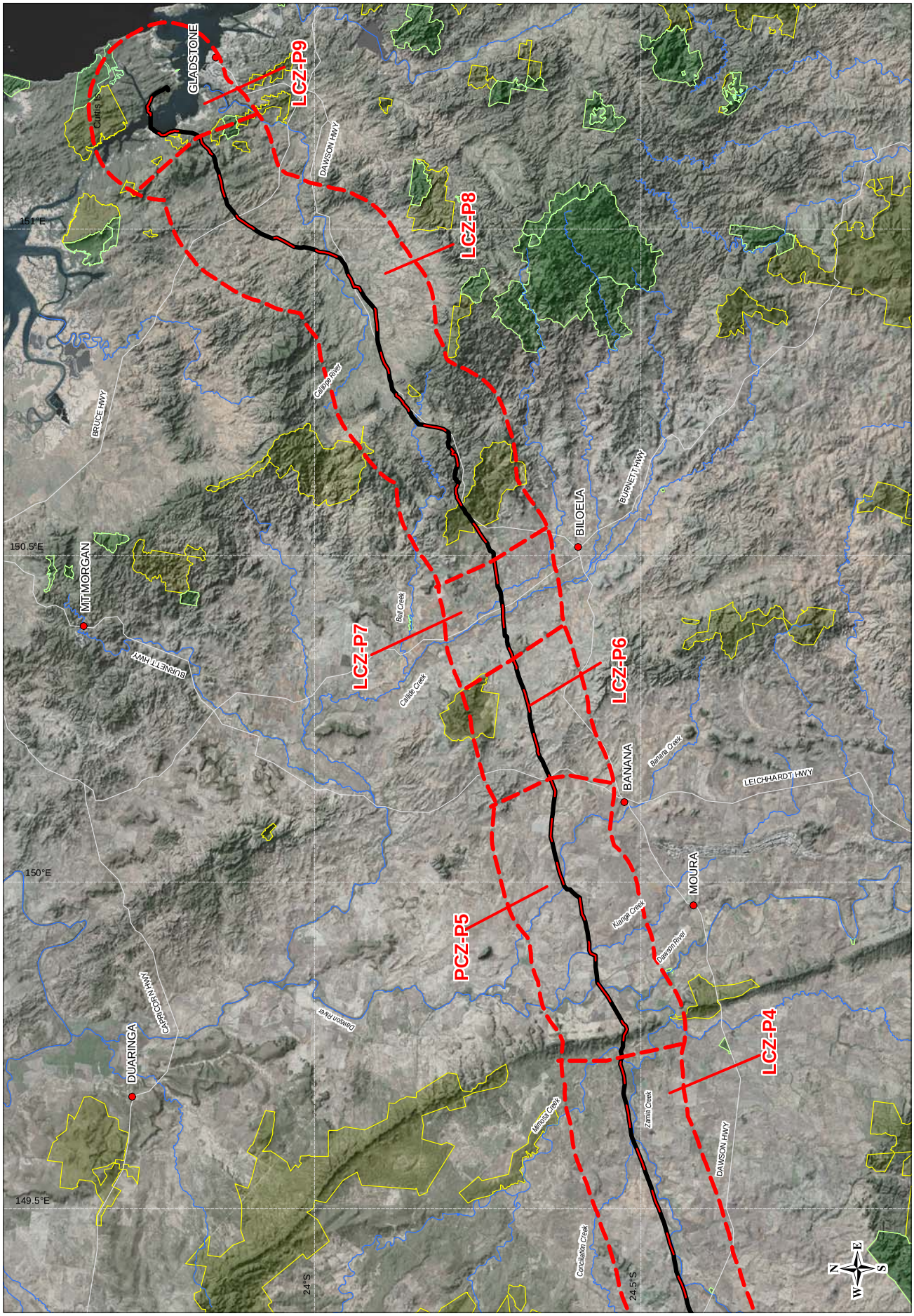

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Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
CSG FIELD AND PIPELINE CORRIDOR

Title

PROPOSED PIPELINE CORRIDOR (EASTERN SECTION) LANDSCAPE CHARACTER ZONES

Drawn: CA	Approved: JB	Date: 11-02-2009	
Job No: **4262 6220**	File No: 42626220-g-601.wor	Figure: **5b**	Rev: A
			A4

Section 2 Existing Landscape Character

Landscape Character Zone P1 – Valleys and Mountain Range

- Strongly dissected landforms with steep sided valleys and plateaus between them;
- Remnant forest on steep slopes and along creeks;
- Plateau areas generally covered by grassland with scattered trees and some clumps of remnant woodland; and
- Views from ridge tops are typically long distance.

Landscape Character Zone P2 – Arcadia Valley

- Broad north-south valley defined by visually prominent ridge lines along eastern and western edges;
- Arcadia Creek flows north along the valley floor to Lake Nuga Nuga;
- Predominantly grassland used for grazing with scattered trees on valley floor; and
- Views from within the valley generally extend across the grassland to forest-covered ridges on the skyline.

Landscape Character Zone P3 – Forest-covered Mountain Range

- Forest-covered mountain range;
- Views from the Dawson Highway, which runs approximately parallel to the proposed gas transmission pipeline corridor, vary from open long distance views to views that are visually enclosed by forest cover and local landforms; and
- Land use that is primarily forestry, with some grazing on grassland in the eastern portion of the LCZ.

Landscape Character Zone P4 – Valleys of Conciliation & Zamia Creeks

- Broad valley formed by Conciliation and Zamia Creeks flowing east to the Dawson River;
- Predominantly grassland used for grazing with scattered trees on upper slopes; and
- Views from the Dawson Highway, which runs through the western portion of the LCZ, are generally across grassland to forest-covered ridges on the skyline.

Landscape Character Zone P5 – Dawson River Valley

- Broad valley formed by Dawson River and tributaries (Banana and Kianga Creeks);
- Predominantly grassland used for grazing with scattered trees on upper slopes; and
- Views within valley extend across grassland to forest-covered ridges on the skyline.

Landscape Character Zone P6 – Forest-covered Mountain Range

- Forest-covered upper slopes and ridge lines on mountain ranges in the western and eastern portions of the LCZ; and
- Land uses predominantly forestry and rough grazing.

Landscape Character Zone P7 – Callide River Valley

- Callide River valley defined by steep slopes to the east and west;
- Extensive grassland across valley floor with scatted trees and stands of woodland; and
- Views from the Burnett Highway, which runs along the valley floor, extend across grassland to forest-covered ridge lines on the skyline.

Landscape Character Zone P8 – Forest-covered Mountains & Valleys

- Calliope River valley in central portion of the LCZ with grassland and scatted woodland vegetation; and
- Forest-covered upper slopes and ridge lines on mountain ranges in the western and eastern portions of the LCZ.

Landscape Character Zone P9 – Gladstone Harbour Valley

- Broad valley formed by central ridge of Curtis Island to the east and mountain range to the south;
- Forest-covered upper slopes and ridge lines;
- ‘The Narrows’ water way forming the base of the valley;
- Industrial developments generally surrounded by woodland located along western side of the LCZ; and
- Urban development of Gladstone dominates the southern portion of the LCZ.

Section 2 Existing Landscape Character

2.4 Landscape Significance of the CSG Fields

The local, regional, state, national or international significance of the landscape in each of the three CSG fields varies significantly.

Arcadia Valley and Fairview CSG Fields

The Arcadia Valley and Fairview CSG fields cover extensive areas of rugged and visually attractive landscape. In particular, Expedition National Park, which covers large areas of the Fairview and Arcadia Valley CSG fields, is recognised as being significant at a regional, state and national level. The rugged natural landscape character of the National Park provides spectacular views into deep gorges and valleys. It attracts visitors from throughout the region and other parts of the state as well as interstate and overseas visitors. The landscape of Expedition National Park would generally be considered to be of state and national level significance.

Arcadia Valley Road, which passes through parts of the Fairview and Arcadia Valley CSG fields, is used by visitors to Expedition National Park as well as Lake Nuga Nuga and Nuga Nuga National Park at the northern end of Arcadia Valley.

At a local level, the landscape in which the Fairview and Arcadia Valley CSG fields are located is of significance to a relatively small number of people who live in the area. The national park areas contained within the Fairview and Arcadia Valley fields will not be impacted from CSG activities as no surface works are planned to occur in these locations.

Roma CSG Field

The landscape significance of the Roma CSG field is very different to that of Fairview and Arcadia Valley CSG fields. The more gently undulating landform combined with extensive cultivation and grazing throughout the Roma CSG field results in a rural landscape character that contrasts with the more rugged, natural landscape character of the Fairview and Arcadia Valley CSG fields.

At a local level, the rural landscape of the Roma CSG field is primarily of significance to the relatively large number of people who live and work throughout the area.

At a regional and state level, the landscape significance of the Roma CSG field is primarily related to the sections of Warrego Highway and Carnarvon Development Road that pass through the area. These sections of highway carry substantial tourist traffic travelling from coastal areas, Brisbane and New South Wales to the Expedition, Carnarvon and Nuga Nuga National Parks. Views from the highways therefore form part of the visual experience of these tourists visiting the region. The landscape of the Roma CSG field would not be considered to be significant at a national or international level.

2.5 Capacity of CSG Field Areas to visually absorb change

Roma CSG Field

The extensively cleared and intensive pattern of roads, tracks, fencing, rural structures and homesteads throughout the Roma CSG field generally increases the capacity to visually absorb changes associated with the proposed CSG field development. The gently undulating landform means that gas wells are only visible (from ground level) when they are located close to public roads or homesteads. The ground level visual impact from the tops of the low hills is expected to be low as the above ground components of production wells are relatively low in height (typically 2-3 metres),and are readily screened from view by vegetation and local variations in landform in areas between the well site and public roads or homesteads. Similarly, other components of the CSG field development including access roads, temporary accommodation and gas compression stations can be relatively easily screened from ground level view by vegetation and local landforms.

Visual impact of the CSG field from the air would be expected to be more prominent, however the major Brisbane – Roma – Charleville flight path only traverses the southern part of the Roma CSG field in an east-west direction. This portion of the CSG field has been subject to major agricultural development, therefore expanded CSG development activities would be occurring in an already altered (from a visual impact perspective) environment, which would tend to make any new gas exploration and development activities less visually intrusive.

In the northern portion of the Roma CSG field, where the landform becomes more undulating, the capacity to visually absorb components of the CSG field development decreases. Cut and fill slopes resulting from construction of well leases on steeper slopes and ridge lines become more visible (from both he ground and air), particularly where the vegetation cover is primarily grassland. This part of the CSG field is not located under any major flight paths.

Fairview and Arcadia Valley Fields

The Fairview and Arcadia Valley CSG fields have the potential to visually absorb changes resulting from the development of CSG wells and associated infrastructure due to the visual screening provided by the extensive forest and woodland cover, although the steeper nature of the landscape (as compared to the Roma field) does create the potential for scarring as a result of increased earthworks activity. This visual absorption potential is dependent on adequate existing tree cover being maintained to provide visual screening to new developments from public roads and viewpoints. On those upper slopes and hill top areas where the main vegetation cover is grassland, the capacity to visually absorb changes associated with CSG field development is significantly reduced. Cut and fill slopes associated with the construction of CSG well leases are more visible due to the lack of visual screening. However, their visual prominence decreases relatively quickly as the viewing distance increases.

In more heavily timbered areas visual impacts from the air would be expected to be higher, however the Fairview and Arcadia Valley fields are not located under any major flight paths.

Section 3 Visual Assessment

3.1 Visual Assessment

Development of the CSG fields involves a sequence of activities that commences with initial site investigations and progresses through to the establishment of production wells, gas gathering lines and associated transmission infrastructure. The nature, scale, timing and visual impact of each of these activities varies significantly.

A key factor influencing the potential visual impact of the various activities and facilities associated with CSG field development will be the level of visibility from individual locations. Visibility is a measure of the extent to which a particular activity or facility may be visible from surrounding areas, the relative number of viewers, the period of the view, view distance and context of the view. The potential visual impact of the CSG field development will primarily be influenced by the level of visibility or extent to which the various activities or facilities would be visible from surrounding areas. It is also influenced by the degree of visual contrast between those activities or facilities and the landscape context in which they are viewed.

Visual contrast results primarily from differences in colour between elements that are visible in the landscape. For example, the light brown or red colour of exposed soil generally contrasts with the green or beige colour of grass in grazing paddocks. Similarly light grey sandy soils will contrast with the dark green and grey colours associated with forest vegetation.

Distance imposes a strong influence on potential visibility because the proportion of the total view occupied by works or facilities associated with the CSG field decreases with distance. In addition, the visual contrast between those works or facilities and the surrounding rural landscape decreases with distance due to atmospheric effects of dust and water vapour. Each of the principal components of the CSG field development is addressed separately from the visual perspective in the following sections.

In assessing the potential visual impact associated with the various components of the CSG field development one of four categories may be applied. The categories are defined as:

- **Negligible Visual Impact** - only a very small part of the CSG field development component would be discernible and/or it would be located at such a distance that it would be scarcely visible;
- **Low Visual Impact** – the CSG field development component would constitute only a minor part of the wider landscape view and might be missed by the casual observer. Awareness of the development would not have a marked effect on the overall quality of the view;
- **Moderate Visual Impact** - the CSG field development component may form a visible and recognisable new element within the overall landscape view and may be readily noticed by an observer; and
- **High Visual Impact** - the CSG field development component would form a significant and immediately apparent part of the landscape view that would affect and change its overall character (the change may be positive or negative).

3.2 CSG Field Development Activities

A detailed description of CSG field development activities is provided in the "Project Description" chapter of the main EIS report. However, a summarised version of the various stages of CSG field development is provided below.

3.2.1 Exploration (Seismic and Geophysical) Surveys

The first activity in the development of a CSG field is exploration of gas reserves. This activity involves seismic and geophysical surveys. The most common method of seismic survey involves the use of a generator and vibrator pad (vibroseis method) to transmit vibrations through a range of frequencies into the earth. The shot hole (dynamite) method may be used where preservation of vegetation cover is required.

The survey activities create relatively short term visual impacts that only last for the period that the survey equipment is located on the site. Any site disturbance is required to be rehabilitated unless the landholder requests otherwise.

While the visual impact of this activity may be moderate in situations where they are visible from public roads or homesteads, the impact is short term and the visual impact will become negligible when the site is rehabilitated.

3.2.2 Core Hole Drilling

Following or in place of seismic surveys, exploratory core hole drilling is undertaken to collect solid coal and rock cores for testing. Holes are typically between 100 mm and 300 mm in diameter. When work is finished at a specific site, the hole is usually filled with grout and the area appropriately rehabilitated. A well lease area of approximately 60 m x 60 m is usually required for drilling coreholes.

3.2.3 Pilot / Appraisal Well Drilling and Testing

Once a promising geological structure has been identified by the seismic surveys and/or core hole drilling program, the presence of a resource and the thickness and internal pressure of a reservoir is confirmed by drilling pilot wells (also referred to as appraisal wells). The location of a well lease depends on the characteristics of the underlying geological formations, soil, terrain and seasonal variations.

A drilling pad is constructed at the chosen site to accommodate the drilling equipment and support services. Typically, this pad may range from (80m by 60m) to (100 by 110m) in area. Preparation of the site includes:

- Clearing of surface vegetation and topsoil which are stockpiled for future rehabilitation;
- Levelling the ground surface for the drill rig; and
- Fencing the site boundary of some sites.

A temporary workforce accommodation facility may be established for the duration of the drilling operations, which typically covers an area of up to 6,000m^2. This facility will be located away from the drilling site and generally include accommodation buildings, canteen facilities, communications, vehicle maintenance and parking areas, fuel handling and storage areas as well as waste management facilities.

Drilling occurs continuously (24 hours/day) for approximately 2-3 days. The precise time to complete drilling is dependent on the depth of the well, the geology of the area and the type of rig used. After drilling is completed and the initial testing of the gas resource has been carried out, the drilling rig is dismantled and transported to the next exploration site.

Section 3 Visual Assessment

Visual impacts associated with the exploration wells will result from:

- Clearing of vegetation and stockpiling top soil;
- Fencing the site in some situations;
- Establishing the drilling rig and associated equipment and structures on the well lease;
- Lighting during night operations; and
- Establishment of the workers accommodation facilities.

The duration of the visual impacts associated with the exploration wells should generally be limited to the 2 to 5 days that the drilling equipment is on the site. If the drilling does not indicate a commercial resource then the site will be rehabilitated and returned to its pre-disturbance land use. The rehabilitation works will include removal of fencing, regrading the site, spreading top soil from the stockpile and establishment of a vegetation cover. The time required for the vegetation cover to be re-established will depend on seasonal growing conditions, but in most situations the site will be fully revegetated within 1 – 2 years, with an initial grass cover established in a period of months.

The significance of the visual impact will depend strongly on the visibility of the site from public roads, homesteads or townships. Where the well site is to be located close to a public road or homestead then the level of visual impact may be moderate to high. However, even in these situations the visual impact will generally be short term and will become negligible after removal of the drilling equipment and rehabilitation of the site. Examples of exploration drilling operations are illustrated in the following photographs.

Plate 16 Typical exploration drilling operations viewed from a public road

Plate 17 Typical exploration drilling operations viewed from a public road

Plate 18 Exploration drilling rig

3.2.4 Production Wells

If the exploratory drilling indicates a commercial CSG resource then a wellhead valve assembly will be installed and a production casing string will be set. A surface production facility will then be installed that includes a well pump, gas engine to drive the pump, a water/gas separator and flare stack. The site will then be rehabilitated by removal of fencing, regrading/re-contouring the area, spreading topsoil from the stockpile and re-establishing vegetation cover to allow the former land use to continue. A new fence will be established around the well head area which will typically be approximately 20m by 20m in area.

Following rehabilitation of each CSG production well site, only the relatively small surface production components will be visible. Even in situations where the well site is visible from public roads or homesteads, the visual impact will generally be low. The visual impact is predicted to be negligible in most situations where the well site is in a rural landscape and not visible from public roads or homesteads. If flaring occurs at a well head then the visual impact will generally be more significant, particularly at night if it is visible from homesteads or public roads.

Section 3 Visual Assessment

The following photographs of existing gas wells illustrate a number of key points, including:

- The colour contrast between exposed soil and the adjoining vegetated areas is the primary factor influencing the level of visual impact prior to revegetation of the well site;
- The use of white on some of the well head components increases the contrast between them and the surrounding landscape elements compared to dark coloured components;
- Gas flares are more visually prominent when seen against a dark coloured background compared to the lighter coloured background of the sky; and
- Regrading of cut and fill slopes to gentle gradients that are compatible with the adjoining landform minimises their visibility.

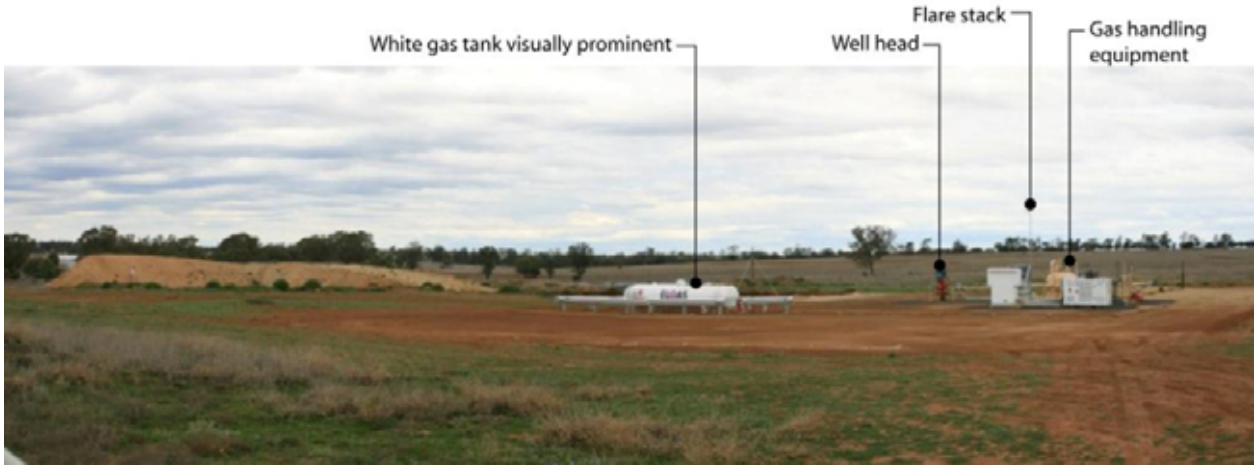

Plate 19 Production well on gently undulating landform

Plate 20 Production well site on undulating landform showing cut and fill slopes prior to revegetation

Plate 21 Production well site on sloping landform in Hallett State Forest prior to revegetation

Plate 22 Production well on ridge top with cut and fill slopes prior to revegetation

The production wells will generally be spaced on a 750 m by 750 m grid with the location of individual wells adjusted as necessary to take account of existing land uses and avoidance of environmentally sensitive areas. As a result of this 750 m spacing it is likely that more than one well site may be visible from an individual view location. The number of well sites that will be visible from a particular location will depend on the screening effect of local landform and vegetation.

In order to illustrate the extent to which well sites may be visible from a single viewing point, a set of photomontages have been prepared. Two contrasting view situations have been selected including:

- View Example 1 which includes an area of rural landscape with strongly undulating landform with extensive grassland and scattered trees; and
- View Example 2 which shows extensive tree regeneration together with remnant mature trees.

Section 3 Visual Assessment

Plate 23 View Example 1 – Existing rural landscape with well sites and access road added

Plate 24 View Example 2 – Existing rural landscape with well sites and access road added

The photomontages illustrate a number of key points in relation to the visual impact associated with the proposed development of CSG production wells, including:

- Red coloured well head components are visible even when they are relatively small in size compared to other components;
- The use of dark green and grey colours on the well head components significantly reduces their visibility compared to white and beige colours;
- In situations where a viewer is looking down on a well head from an elevated position, a larger proportion of the well head equipment is visible compared to situations where the viewer is looking up to a well head from a lower elevation;
- Gravel access roads are visually compatible with the rural landscape character of both View Examples; and

- Trees and shrubs have the potential to provide effective visual screening.

It should be noted that the photomontages represent views that the general public would not see as they are located on private property in a rural landscape. Comparable views would only be available to the general public in situations where well heads are to be located in similar landscape within 1 km or so of a public road or lookout. Comparable views may be presented to residents from homesteads that will be located a similar distance from well heads.

3.2.5 In-field CSG Collection Pipelines

A network of in-field gathering pipelines is being established to collect CSG and transfer it to the main gas transmission pipeline for transmission to the Gladstone LNG facility. The scope of work involved with installation of these underground pipelines will include:

- Clearing of vegetation along the pipeline alignment;
- Striping and stock piling top soil;
- Excavating a trench;
- Placing the pipe in the trench;
- Backfilling and compaction;
- Placing top soil and establishing a grass cover; and
- Installation of surface markers.

The visual impact of these works may be moderate in situations where the pipeline is located within, or crosses a road corridor or is visible from homesteads. However, the visual impact will be relatively short term. Following rehabilitation of the pipeline easement the visual impact is predicted to reduce to negligible. The duration of the visual impact associated with pipeline installation works will vary depending on terrain but generally it will be no more than 2 months in any individual area.

Obviously, any installation of in-field pipelines that require significant clearing of vegetation would create a higher level of visual impact. However, selection of pipeline route alignments always attempts to use existing disturbed areas wherever possible.

The only significantly visible element following installation of pipelines will be the surface markers that indicate the alignment of the underground pipeline. Given the relatively small size of the markers, their visual impact post-rehabilitation will be negligible, even in situations where the pipeline runs parallel to or crosses public roads or is in proximity to homesteads.

The photographs of existing CSG collection pipelines being installed and following site rehabilitation provide an indication of the potential visual impact of the proposed pipeline installation works.

Section 3 Visual Assessment

Plate 25 Gas collection pipeline laid out along easement in forest area prior to trenching and installation

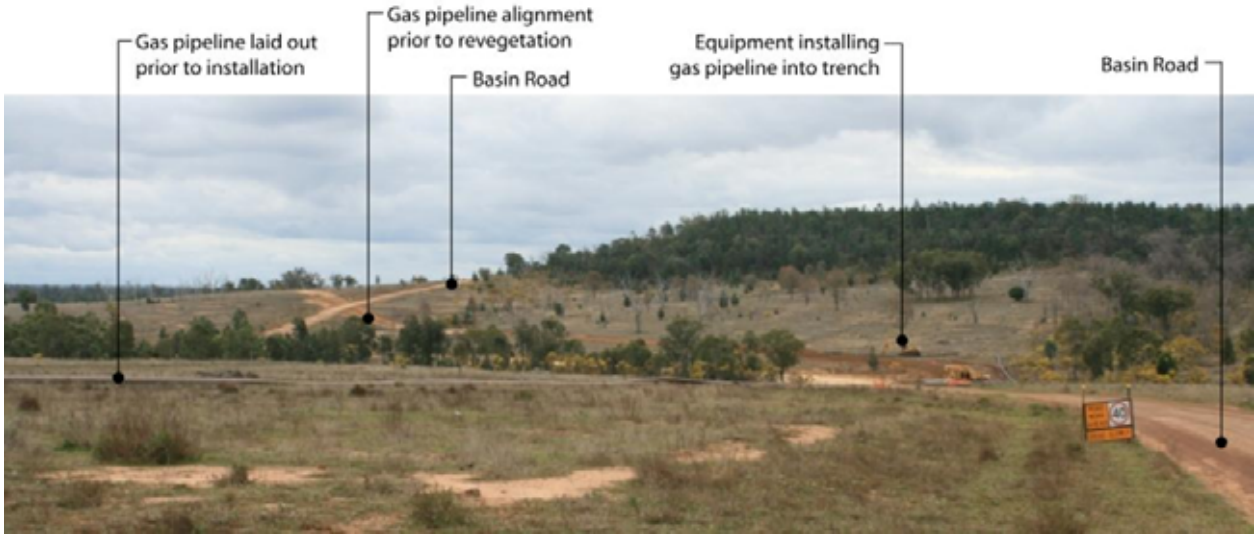

Plate 26 Gas collection pipeline being installed in area of grassland and remnant tree clumps

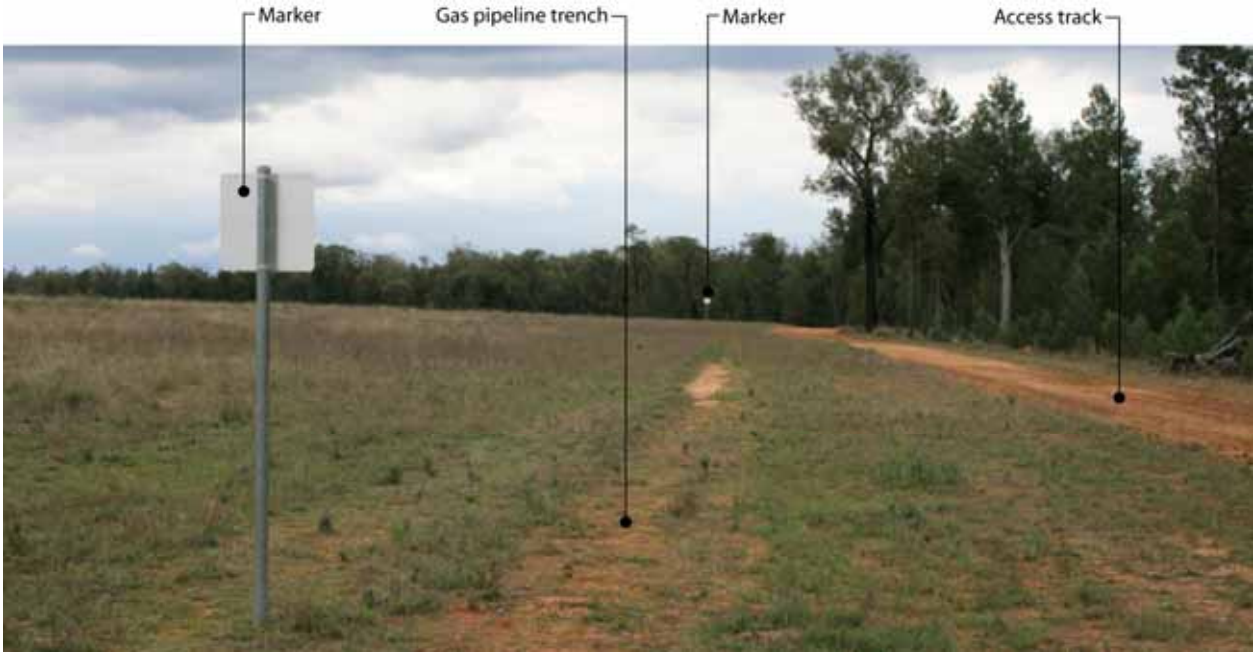

Plate 27 Existing underground pipeline along edge of forest area

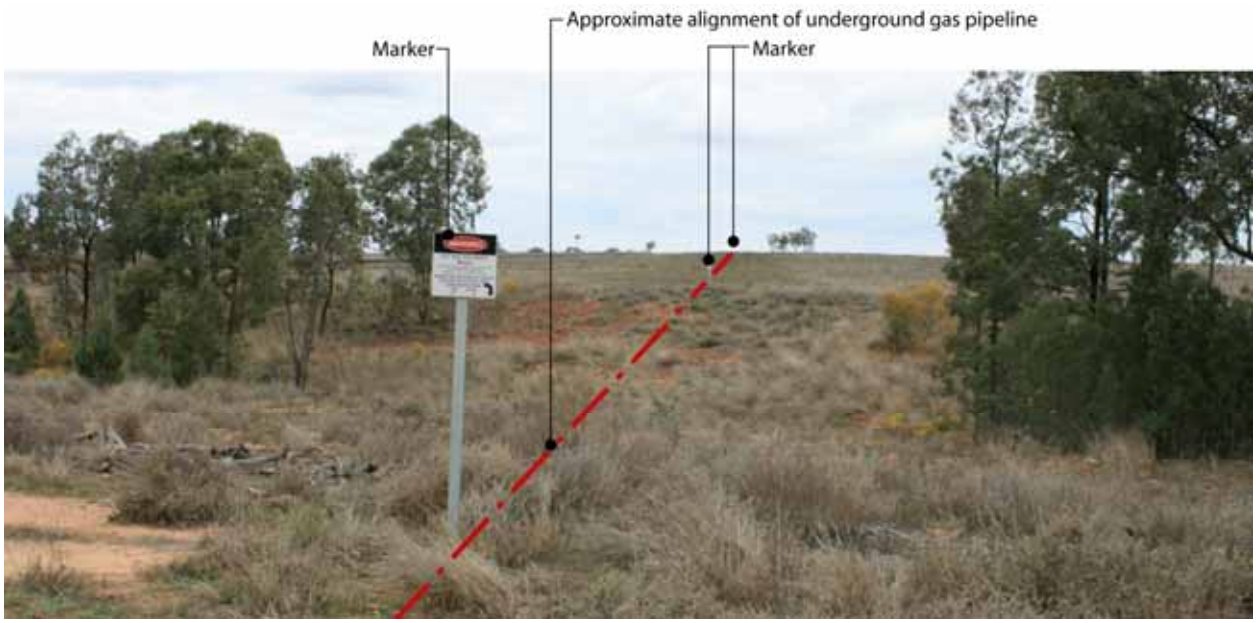

Plate 28 Existing underground pipeline through grazing paddock

3.2.6 Water Infrastructure and Management

The CSG extraction process requires water to be removed from the coal seam before the gas can be extracted. The water generated from the gas wells is collected by a network of pipes that carry it to a series of storage dams. As the quality of water varies from drinkable to brackish, the potential for re-use also varies significantly. Management options for this water include irrigation, stock watering, discharge to streams, injection into suitable sub-surface aquifers, treatment and use for industrial or municipal purposes and evaporation (refer to the separate “Associated Water Management Strategy” report in the EIS for further details). While the water collection pipelines are underground and therefore create no significant long term visual impact a range of options are available for the infrastructure to manage the water generated. The potential visual impact will vary significantly between the options.

In situations where the collected water is to be stored in dams that will be constructed specifically for that purpose, the resulting visual impact is likely to be considered positive by most viewers as it will result in the creation of a water element in the landscape. However, if the areas of bare earth created by construction of the storage dam are not revegetated effectively then the resulting soil erosion will result in a major negative visual impact.

The visual impact of the water storage construction works will generally be moderate in situations where the works are visible from pubic roads or homesteads. However, it is predicted that the visual impact will become negligible in most situations following rehabilitation of the site. If the water surface of the storage facility is visible from public roads or homesteads and the surrounding slopes have been revegetated then the visual impact will be perceived by most observers as a positive moderate to high visual impact.

The photographs presented below illustrate two different water storage solutions that may be used to manage water generated by future CSG wells. The first photograph depicts an unlined storage dam with bare cut and fill slopes that would be perceived by most observers as a negative visual impact that detracts from the positive visual impact of the water surface. If, however, the site was re-vegetated then the visual impact of the water surface and surrounding slopes would be perceived by most observers as a positive moderate to high visual impact. The second photograph is of a lined water storage dam in which part of the black impermeable synthetic liner is visible. If this liner was visible from an adjoining public road or homestead it would be perceived by most viewers as producing a moderate negative visual impact that significantly diminishes the positive visual impact of the water surface. If, however, the lined storage dam is not visible from a public road or homestead then the visual impact will be negligible. It should be noted that both of the storage dams in the photographs below are located on private property and not visible from a public road or homestead.

Plate 29 Water storage dam constructed near Coxon Creek

Plate 30 Water storage dam constructed with impermeable liner

Plate 31 Water storage dam embankment with erosion control matting used to establish a protective grass cover

3.2.7 CSG Compressor Stations

Gas produced from the CSG fields will be compressed in order to collect it from the individual gas wells and then carry it to the CSG transmission pipeline. A series of compressor stations are to be located near the gas wells in each field to perform this function. While the compressor stations are substantial industrial structures they are to be located away from residents, schools and townships. Consequently the visual impact of these installations is predicted to be negligible in most situations. If, however, it becomes necessary to locate a CSG compressor within the potential view of a public road or homestead the mitigation measures that could be adopted include tree and shrub planting combined with earth mounding where necessary to block potential views and reduce the visual impact to negligible.

Section 3 Visual Assessment

Plate 32 Fairview compressor station under construction near Springwater Camp

3.2.8 Access Roads

New roads will be constructed to provide access for vehicles and equipment during the drilling operations as well as to allow inspections and ongoing maintenance of the well heads, CSG collection and transmission facilities and other associated infrastructure. The unsealed access roads will generally be located along fence lines and where possible will avoid remnant vegetation, cultivated paddocks, steep slopes and erosion prone soils. The surface gravel material to be used in the construction of any new access roads will be similar to that used on existing rural tracks in the area. The visual contrast between the sections of new access road and the landscape in which they are located will therefore be minimal.

While the development of these access roads will result in a significant increase to the extent of roads throughout the CSG fields, the visual impact at individual locations will vary significantly. In areas where new access roads will be visible from public roads, townships or homesteads the visual impact is predicted to be moderate to low. However, the majority of new access roads associated with the CSG fields will only be visible from the private rural properties in which they are located. Consequently the visual impact is predicted to be perceived generally as low to negligible.

The photographs presented below illustrate two different types of existing access road. The first is a section of public road that provides access to numerous CSG well sites, compressor stations and a workforce accommodation facility. The extent of this category of road to be constructed to provide access to new CSG wells is expected to be limited, although sections of existing public road may be upgraded to provide adequate access to new CSG well sites.

The second example is more typical of access roads that will be constructed through rural properties to provide access to CSG well sites.

Plate 33 Major access road to Springwater Camp and Fairview wells

Plate 34 Typical access road within grazing paddock

3.2.9 Storage and Lay-down Areas

Development of the CSG fields will involve the use of relatively large amounts of materials and equipment. Accordingly, there is a requirement for storage and lay-down areas. These areas will generally be located away from public roads and homesteads and therefore result in negligible visual impact. If however, it becomes necessary to locate such facilities within the viewshed of public roads then best practice mitigation measures such as earth mounding and planting will be carried out to provide visual screening.

Section 3 Visual Assessment

3.2.10 Accommodation

Accommodation will be provided by Santos in both temporary and long term facilities for drilling crews, pipeline crews and field operators. The majority of these accommodation facilities will be removed following completion of the CSG field development. Consequently the long term visual impact will be negligible.

Long term accommodation facilities will be located so as not to be visible from public roads, townships or homesteads. Consequently, their visual impact is predicted to be negligible.

The following photographs show examples of existing temporary accommodation facilities as well as long term accommodation.

Plate 35 Typical temporary accommodation associated with drilling operations

Plate 36 Fairview accommodation

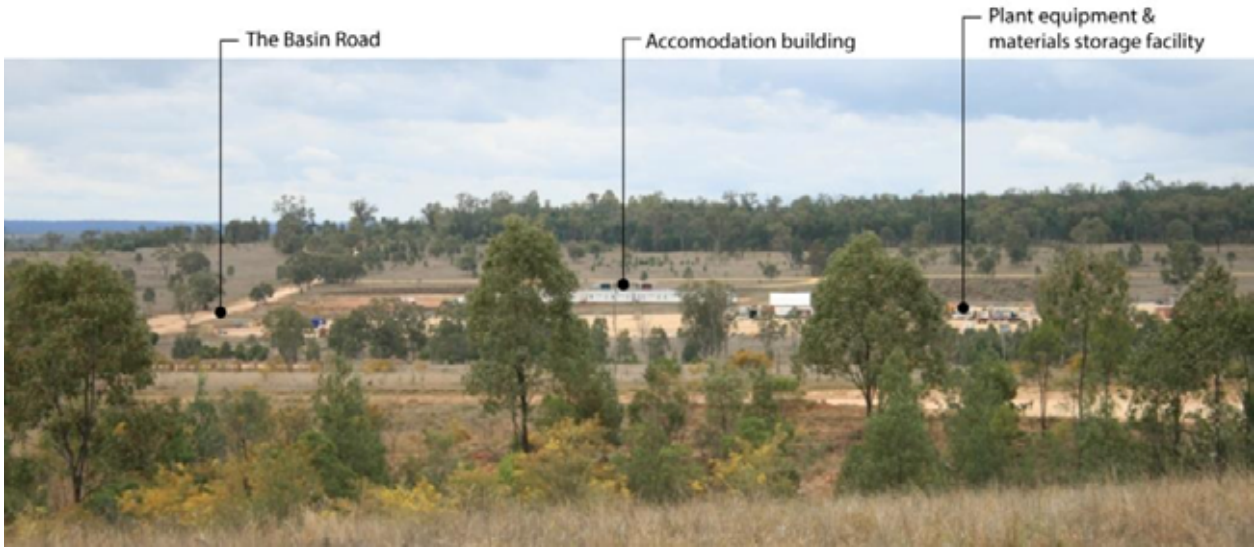

Plate 37 Major accommodation facilities at Springwater accommodation with plant and materials storage area

3.2.11 Borrow Pits

Gravel and other construction materials are sourced from borrow pits for construction of well sites, access roads and storage areas. The borrow pits are generally located close to where the material is used, which in most situations throughout the gas fields is in a rural landscape. Siting of future borrow pits will avoid them being visible from public roads, townships or homesteads, in which case their visual impact will be negligible. If necessary, best practice mitigation measures such as earth mounding and tree planting will be carried out to screen any potential views of any new borrow pits that may be required. In addition, borrow pits will be rehabilitated when they are no longer required. Consequently, the visual impact of borrow pits it predicted to be negligible.

3.2.12 Rehabilitation and Decommissioning

Each component of the CSG field development has a limited life span, at the end of which any redundant plant, equipment or other relevant infrastructure will be decommissioned, removed from site and the site/s rehabilitated. The period of use varies significantly from the exploration wells (which may only be used for a matter of days), to the production wells, pipelines, compressors and other production related infrastructure that may remain operational throughout the 20 to 25 year life of the CSG fields. Following decommissioning and site rehabilitation of the production well and compressor sites the visual impact will be reduced to negligible.

The following photographs show examples of rehabilitation works that have been carried out on existing well sites. The first photograph shows a well site that is in the process of being revegetated, while the second shows a site that has been rehabilitated for a period of years. It should be noted that Santos is continually refining the process of siting CSG wells and site rehabilitation techniques to achieve best practice outcomes.

Section 3 Visual Assessment

Plate 38 **Exploration drilling site in grazing paddock after regrading and top soiling**

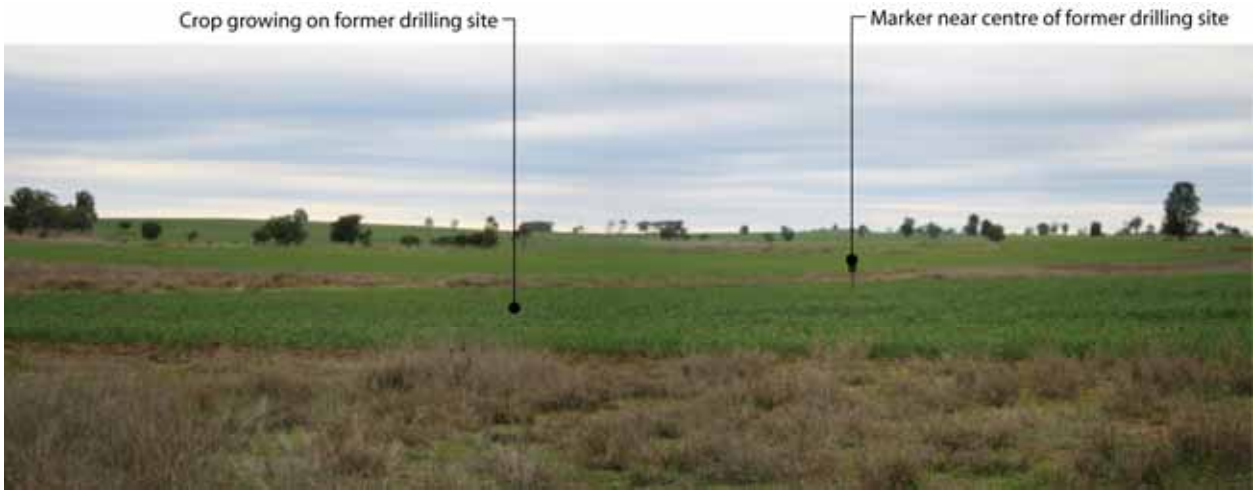

Plate 39 **Example of completed and rehabilitated exploration drilling site within cultivated paddock**

3.3 CSG Transmission Pipeline

3.3.1 Introduction

CSG from the Roma, Fairview and Arcadia Valley CSG fields will be transmitted to the Gladstone LNG facility via an underground gas transmission pipeline. In general, the alignment of the new pipeline will follow an existing gas pipeline (the Queensland Gas Pipeline) corridor except where deviations are required to address environmental, cultural heritage, terrain and land use constraints. The 435 kilometre long gas transmission pipeline will be constructed of high pressure steel pipe installed in a trench and backfilled, although there will be a number of sections (such as across major water courses, highways and railway lines) where horizontal direction drilling (HDD) techniques may be adopted.

The scope of work to complete the 435 kilometre pipeline is expected to take 18 to 24 months. However, individual sections will generally be completed within a 2 to 3 month period, depending on terrain and weather conditions. Consequently, the visual impacts resulting from the gas transmission pipeline development will be relatively short term. The principal long term visible changes to the landscape will be the installation of pipeline markers and access tracks.

3.3.2 Visual Impact Assessment

Development of the CSG transmission pipeline will involve the following activities:

- Survey of the pipeline route;
- Construction of access tracks or upgrading of existing tracks where necessary;
- Clearing of vegetation, removal and storage of top soil, grading and installation of temporary fencing where necessary within the gas transmission pipeline corridor, which is typically 30m wide;
- Excavation of the pipeline trench and placement of soil along one side of the trench;
- Laying out sections of pipe in preparation for welding into approximately 1000m long ‘pipe strings’;
- Welding pipe sections;
- Placing bedding material and lowering of the ‘pipe strings’ into the trench;
- Backfilling and compacting the trench with suitable material; and
- Rehabilitation of the gas transmission pipeline corridor by re-spreading top soil and cleared vegetation and seeding (where applicable) to re-establish cover.

The visual impact associated with the gas transmission pipeline development will primarily result from excavation of the pipeline trench and temporary stockpiling of soil material. This activity will result in the creation of a high visual contrast between the exposed soil and the adjoining vegetated areas, which are typically grassland or woodland. However, the pipeline installation works along individual sections of the pipeline corridor will typically be completed within a 2 to 3 month period, depending on the terrain and weather conditions. Machinery used for trenching, as well as handling and installation of the pipeline, will also be visible for a relatively short period within individual sections of the gas transmission pipeline corridor. Consequently, the visual impacts resulting from the pipeline development will be relatively short term. In situations where the pipeline development activities are visible from public roads and homesteads the visual impact is likely to be moderate to high depending on the distance of the view. However, even in these situations the visual impact

following rehabilitation works will generally be negligible. Where the pipeline easement is not visible from public roads or homesteads then the visual impact of the pipeline installation activities will generally be negligible.

While sections of the pipeline route will run alongside public roads, a large proportion will run through rural landscape areas. Consequently the visibility of the pipeline development works will generally be limited to a relatively small number of people engaged in agricultural land management activities. The visibility of pipeline development activities along those sections that run parallel to public roads will vary substantially depending on the distance from the road edge and the presence of screening vegetation alongside the road. Nevertheless, the period of visual impact of the works will be relatively short.

The most significant long term visible changes to the landscape will result from installation of aboveground pipeline markers and permanent access tracks that will be constructed along the pipeline corridor. However, the visual impact of these elements will be negligible in most situations.

The revegetation techniques that are adopted by Santos have proven to be effective in re-establishing vegetation along previously completed sections of pipeline. In most instances the original land use will be re-established after the rehabilitation works have been completed, unless the land owner requests the site be rehabilitated to a different land use.

The following photographs illustrate a typical section of pipeline installation works as well as a section of pipeline corridor that has been rehabilitated for some years. It should be noted that in situations where the gas transmission pipeline needs to cross a highway, major watercourse or railway line then directional drilling techniques will be used in most instances.

Plate 40 Typical trench with 'pipe string' laid out ready for installation

Plate 41 **Typical pipeline easement after backfilling trench and prior to revegetation works**

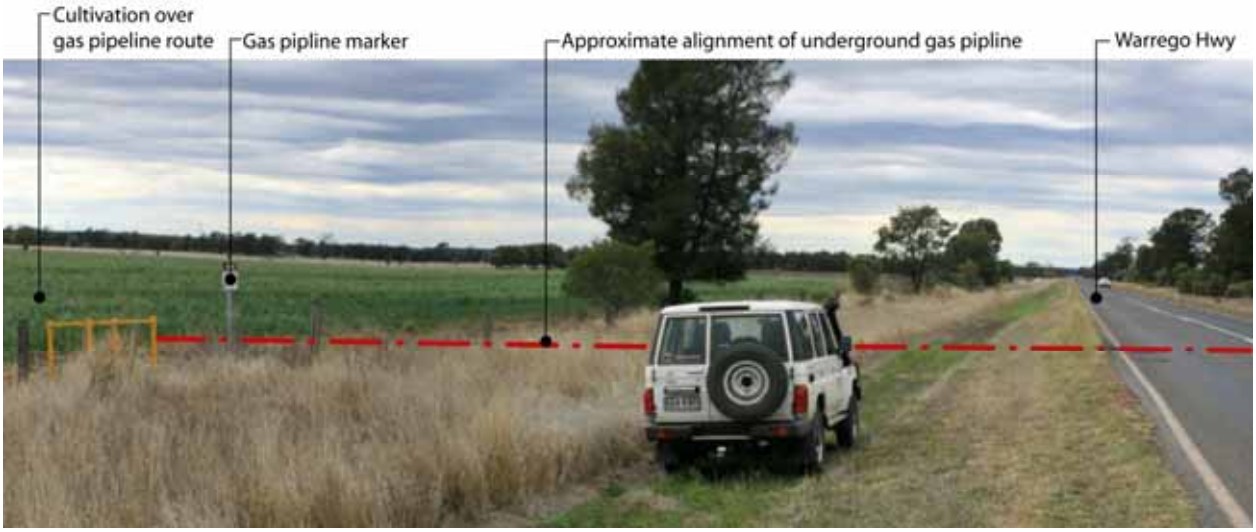

Plate 42 **Existing underground pipeline crossing below the Warrego Highway**

Section 4 Mitigation Measures

4.1 Introduction

The current work methods employed by Santos in the CSG field development and gas transmission pipeline installation are aimed at minimising the visual impacts. However, these work methods are constantly reviewed with the intent of improving their effectiveness. Consequently the mitigation measures addressed in this section include many of the current work methods adopted by Santos, together with other measures that will further minimise the potential visual impact of CSG field and pipeline development activities.

The mitigation measures aim to achieve the following objectives:

- Minimise the extent of disturbed areas that are visible from public roads, homesteads and towns;
- Minimise the degree of visual contrast between the CSG field works, as well as permanent structures, and the landscape setting in which they are located;
- Minimise permanent changes to the natural landform; and
- Take advantage of existing vegetation and local landform variations to create screening of potential views of CSG field and gas transmission pipeline development activities from public roads, homesteads and towns.

Specific mitigation measures relevant to the major components of the CSG field and gas transmission pipeline development process are summarised in the following sections.

4.1.1 Exploration Wells

While the period of activities associated with exploration wells is relatively short the following mitigation measures are recommended to be implemented:

- Minimise the extent of the works area and clearly define the site boundary;
- Locate and orientate well leases as much as practicable to minimise the amount of cut and fill earthworks and vegetation clearing required to establish the drill pad;
- Stockpile top soil for reuse in rehabilitation works;
- Minimise the period in which soil remains exposed; and
- Rehabilitate disturbed areas as soon as possible after completion of works by Recontouring, re-spreading top soil and re-establishing the vegetation cover.

4.1.2 Production Wells

Equipment associated with CSG production wells will remain in place for the productive life of the gas well (potentially a number of years for each individual well, and 20-25 years for the CSG field as a whole). Recommended mitigation measures include:

- Plan the location and well establishment works to avoid steep slopes and minimise the amount of cut and fill required to create the flat platform for the well head;
- Design permanent earthworks so they are visually compatible with the surrounding natural landforms;
- Re-establish vegetation cover on disturbed areas that is compatible with the adjoining land use;

- In forest areas locate wells so as to maintain a vegetation buffer (minimum of 50 metres) between the well site and any public roads;
- In the more rugged, remote northern areas of the CSG fields assess the presence of public roads and other potential viewpoints (e.g. State Forest or National Park public look-outs) when locating well leases and consider measures to reduce the visual impact from such locations; and
- Select colours for above ground equipment that minimise the visual contrast between such equipment and the surrounding landscape.

4.1.3 Water Management Infrastructure

Major visible items of plant, equipment and facilities required for management of CSG field associated water include underground water pipelines, water storage dams and treatment facilities such as Reverse Osmosis (RO) plants. Recommended mitigation measures to minimise the visual impacts include:

- Siting of facilities as far as practicable in areas that are not visually intrusive (e.g. exposed ridge lines and plateaus);
- Minimise the amount of cut and fill earthworks undertaken to reduce the creation of artificially steep slopes that may be susceptible to erosion;
- Minimise the extent of vegetation clearing undertaken, and make use of existing stands of vegetation to act as natural screens/buffers;
- Select colours for above ground equipment that minimise the visual contrast between such equipment and the surrounding landscape; and
- Commence rehabilitation works as soon as possible after construction (particularly on areas of exposed earth). This may comprise a staged rehabilitation process.

4.1.4 CSG Field Compressors

A series of field compressor stations will be constructed throughout the CSG fields. Recommended mitigation measures will include:

- Locating compressors away from residents, schools and townships;
- Tree and shrub planting combined with earth mounding where necessary to block potential views; and
- In any areas that may be in close proximity to public roads, residents or built up areas consideration be given to enclosing compressor facilities (or part components thereof) within sheds or enclosures.

4.1.5 Access Roads and Tracks

Existing tracks and roads are to be used as much as possible in order to minimise track duplication and the extent of new road construction. However, significant lengths of new roads and tracks will be required for access to the CSG wells during their establishment and longer term production periods. Recommended mitigation measures include:

- Aligning access roads and tracks as much as possible with the existing pattern of fencing and natural drainage;

- Avoid impacting upon vegetated areas if possible, particularly along drainage lines (tracks should be deviated so that drainage lines are crossed in naturally clear areas);
- Where vegetated areas do need to be traversed, weave tracks to avoid clearing dense stands of vegetation or mature trees (this practice also breaks up the line of sight);
- Where new roads/tracks are required, orientate them (where safe to do so) so that they intersect existing roads at an angle. This will help disguise them from the general public and discourage unauthorised access from public roads;
- Avoiding roads traversing across steep slopes and highly visible ridges and hills;
- Minimising the width of roads and tracks
- Revegetating table drains and shoulders immediately after construction of access roads;
- Implementing erosion control measures during road construction; and
- Removing temporary roads and tracks as quickly as possible after they are no longer required and immediately carrying out revegetation works.

4.1.6 Gas Pipeline Development (infield and transmission pipelines)

The CSG field development includes installation of:

- Infield pipelines that will collect CSG from individual wells; and
- The gas transmission pipeline that will carry the CSG to the Gladstone LNG facility.

While the installation processes for these two categories of pipeline are similar, the size and type of pipes as well as the scale of operations do differ. The following mitigation measures are consistent with current pipeline development practices:

- Minimise the length and width of roads and tracks required to carry out the pipe installation works and use existing roads and tracks where possible;
- Minimise the extent of vegetation clearing and stockpile cleared vegetation and top soil for reuse in rehabilitation;
- Minimise the area covered by excavated material alongside the trench;
- Carefully place and compact excavated subsoil material to backfill the trench; and
- Spread top soil over the area and apply seed to re-establish a grass cover.

Conclusion Section 5

In assessing the potential visual impact associated with the various components of the CSG field and gas transmission pipeline development the following four categories have been adopted:

- **Negligible Visual Impact** - only a very small part of the development component would be discernible and/or it would be located at such a distance that it would be scarcely visible;
- **Low Visual Impact** – the development component would constitute only a minor part of the wider landscape view and might be missed by the casual observer. Awareness of the development would not have a marked effect on the overall quality of the view;
- **Moderate Visual Impact** - the development component may form a visible and recognisable new element within the overall landscape view and may be readily noticed by an observer; and
- **High Visual Impact** - the development component would form a significant and immediately apparent part of the landscape view that would affect and change its overall character (the change may be positive or negative).

The proposed development of the Roma, Fairview and Arcadia Valley CSG fields and the gas transmission pipeline to the Gladstone LNG facility will create both temporary and longer term changes to the visual landscape character of the areas in which they are located. These changes will result primarily from the removal of vegetation and conduct of earthworks that will be carried out to create a series of flat platforms at the gas well sites plus create the trench to house the gas transmission pipeline. The most visible components of the CSG field development will be exposed soil (particularly in steeper areas), new access roads and the movement of vehicles and equipment associated with the establishment of the gas wells and installation of pipelines. In situations where these components are visible from public roads, towns or homesteads the visual impact is likely to be moderate, although generally short term. In situations where the development activities are not visible from public roads or homesteads then the visual impact will be negligible.

The longer term components of the production wells are relatively small in scale and do not form visually prominent elements in the rural landscape in which the CSG fields are to be developed. In situations where these components are not visible from public roads or homesteads, the longer term visual impact will be negligible. Even in situations where the well heads are visible from public roads or homesteads, the visual impact will generally be low or negligible. The permanent production wells will constitute a relatively minor component of the wider landscape view and might be missed by a casual observer. Awareness of the wells, however, would not have a marked effect on the overall quality of the view.

Visual impact from the air is not considered to be high as the majority the CSG fields (and the gas transmission pipeline corridor) are not located under major flight paths (note that the Brisbane-Roma-Charleville flight path does traverse the southern Roma field, however this area has historically been highly modified due to past and ongoing agricultural activities which reduces to visual impact of additional gas field development works).

Implementation of the mitigation measures, which are generally consistent with current Santos work methods, should ensure that any visual impacts are minimised.