Landscape and visual amenity L

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Gas Field Development Project

Landscape Character and Visual Amenity Technical Report

Santos GLNG

2014

Rev1a

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Abbreviations

Abbreviation	Definition
2009 EIS	GLNG Project EIS
Constraints protocol	GFD Project Environmental Protocol for Constraints planning and Field Development
DAMP	Decommissioning and Abandonment Management Plan
EHS	Environment Hazard Standards
EHSMS	Environment, Health and Safety Management Standard
EIS	Environmental impact statement
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
GFD Project	Gas Field Development Project
GLNG Project	Gladstone Liquefied Natural Gas Project
Ha	Hectare
JVP	JVP Visual Planning and Design
km	Kilometre
LCZ	Landscape character zone
m	Metre
ML	Megalitres
Mtpa	Million tonnes per annum
SIMP	Social impact management plan
ToR	Terms of reference
URS	URS Australia Pty Ltd

1 Introduction

JVP Visual Planning and Design (JVP) was engaged by URS Australia Pty Ltd (URS), on behalf of Santos GLNG, to conduct an assessment of the potential impacts on landscape character and visual amenity associated with the construction, operations, decommissioning and rehabilitation of the Santos GLNG Gas Field Development Project (the GFD Project). This assessment responds to section 4.2.5 of the *Terms of reference* (ToR) *for an environmental impact statement* (EIS) issued March 2013.

1.1 GFD Project overview

Santos GLNG intends to further develop its Queensland gas resources to augment supply of natural gas to its existing and previously approved Gladstone Liquefied Natural Gas (GLNG) Project.

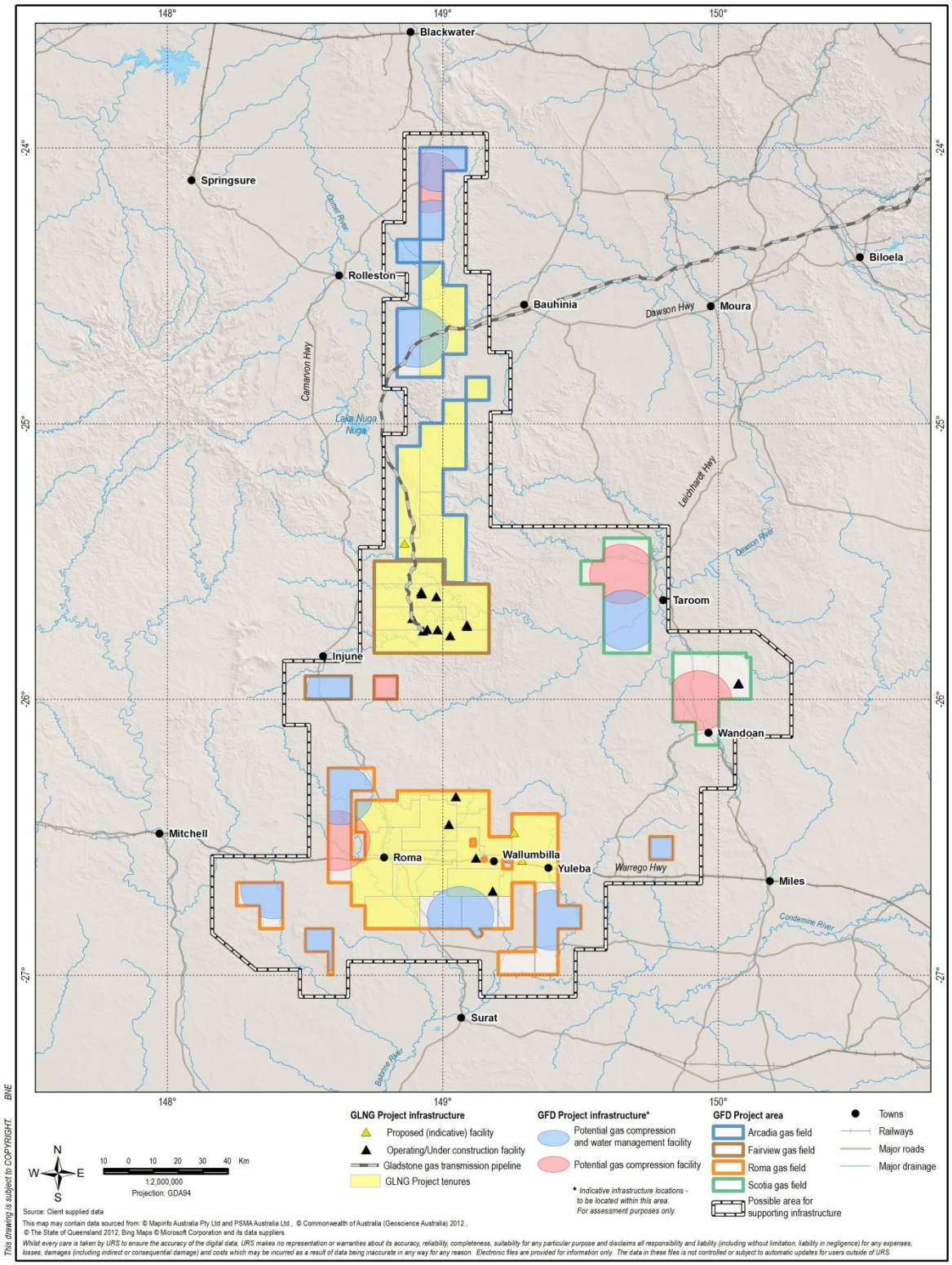
The Santos GLNG Gas Field Development Project (the GFD Project) is an extension of the existing approved gas field development and will involve the construction, operation, decommissioning and rehabilitation of production wells and the associated supporting infrastructure needed to provide additional gas over a project life exceeding 30 years.

Specifically, the GFD Project seeks approval to expand the GLNG Project's gas fields tenure from 6,887 km^2 to 10,676 km^2 to develop up to 6,100 production wells beyond the currently authorised 2,650 wells; resulting in a maximum of up to 8,750 production wells. The GFD Project will continue to progressively develop the Arcadia, Fairview, Roma and Scotia gas fields across 35 Santos GLNG petroleum tenures in the Surat and Bowen basins, and associated supporting infrastructure in these tenures and adjacent areas. The location of the GFD Project area and primary infrastructure is shown on Figure 1-1.

The GFD Project will include the following components:

- Production wells
- Fluid injection wells, monitoring bores and potentially underground gas storage wells
- Gas and water gathering lines
- Gas and water transmission pipelines
- Gas compression and treatment facilities
- Water storage and management facilities
- Access roads and tracks
- Accommodation facilities and associated services (e.g. sewage treatment)
- Maintenance facilities, workshops, construction support, warehousing and administration buildings
- Utilities such as water and power generation and supply (overhead and/or underground)
- Lay down, stockpile and storage areas
- Borrow pits and quarries
- Power lines and communications.

Figure 1-1 GFD Project area and major infrastructure



Source: URS, 2014; File No: 42627064-g-1051b.mxd

The final number, size and location of the components will be determined progressively over the GFD Project life and will be influenced by the location, size and quality of the gas resources identified through ongoing field development planning processes, which include consideration of land access agreements negotiated with landholders, and environmental and cultural heritage values.

Where practicable, the GFD Project will utilise existing or already approved infrastructure (e.g. accommodation camps, gas compression and water management facilities) from the GLNG Project or other separately approved developments. The GFD Project may also involve sourcing gas from third-party suppliers, as well as the sharing or co-location of gas field and associated facilities with third parties.

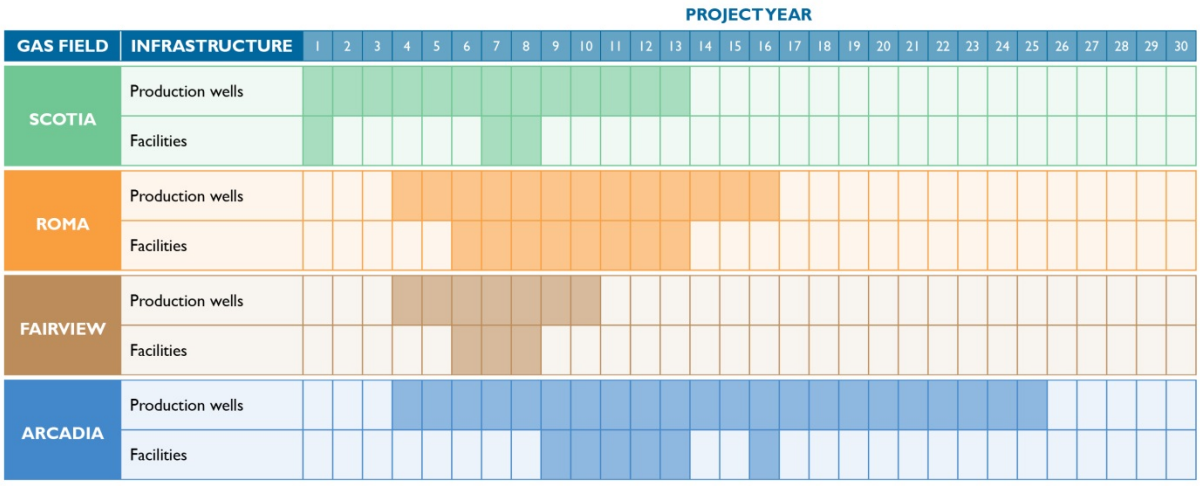
For the purposes of transparency this EIS shows an area off-tenure that may be used for infrastructure such as pipelines and temporary camps (supporting infrastructure area). While not assessed specifically in this EIS, any infrastructure that may be located within this area would be subject to further approval processes separate to this EIS.

Approved exploration and appraisal activities are currently underway across the GFD Project's petroleum tenures to improve understanding of the available gas resources. As the understanding of gas resources increases, investment decisions will be made about the scale, location and timing of the next stages of field development.

For the purposes of this EIS, a scenario based on the maximum development case was developed at the approval of the Terms of Reference. This scenario assumed that production from the wells and upgrading of the gas compression facilities in the Scotia gas field would commence in 2016, followed by the GFD Project wells in the Roma, Arcadia and Fairview gas fields in mid-2019. This schedule is indicative only and was used for the purpose of the impact assessment in this EIS.

The potential GFD Project schedule is outlined in Figure 1-2. This schedule provides an overall field development scenario for the purposes of assessment in this EIS.

Figure 1-2 Proposed GFD Project development schedule



To minimise the disturbance footprint of the GFD Project, decommissioning and rehabilitation will occur progressively throughout the life of the GFD Project as construction activities cease and exhausted gas wells are decommissioned. However, final decommissioning and rehabilitation will occur at the end of gas production in accordance with relevant approvals and regulatory requirements.

1.2 Scope of this assessment

The primary objective of the assessment is to address section 4.2.5 of the GFD Project's ToR. This comprises assessment of two components:

- Baseline landscape character and visual amenity
- Potential impacts and mitigation measures.

The description of landscape character outlines the existing character of the landscape that may be affected by the GFD Project in general terms. Landscape character in this context is defined as the distinct, recognisable and consistent pattern of elements that make one area unique, including changes that have already been made to the natural landscape since European settlement.

The baseline landscape character discussion 'sets the scene' for the description and assessment of potential impacts on views and visual amenity. The assessment of visual amenity describes the existing visual resource, including landscape features, panoramas and views that have, or could be expected to have, local, regional, State, national or international significance.

2 Regulatory and policy framework

2.1 Regulatory framework

The primary legalisation relevant to this visual impact assessment is the *Environmental Protection Act 1994* (Qld) (EP Act). The EP Act aims to protect the environment and achieve sustainable development in Queensland. Under Section 8 of the Act, the environment includes:

> *(c) the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community; and*
>
> *(d) the social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned in paragraphs (a to c).*

This visual impact assessment outlines the characteristics of the GFD Project area that contribute to defining the landscapes and visual amenity of the GFD Project area and surrounds. This is undertaken with a view to protecting these from undesired impact from the GFD Project, in line with the objectives of the Act.

These schemes were reviewed to understand values placed on visual amenity within the GFD Project area:

- *Bauhinia Shire Planning Scheme*
- *Taroom Shire Planning Scheme*
- *Roma Town Planning Scheme*
- *Bungil Shire Planning Scheme*
- *Bendemere Shire Planning Scheme.*

2.2 Santos GLNG policy framework

The following sub-sections introduce the high level policies and Environment, Health and Safety Management System and standards employed by Santos GLNG in their general operations. The framework is used to inform corporate responsibility and key principles across all Santos GLNG operations at the corporate level. As such, they will also apply to the proposed GFD Project.

Santos GLNG has adopted the corporate *Environmental Policy*, which details the Santos GLNG's environmental vision to "lighten the footprint of [Santos GLNG] activities"; it includes specific commitments for maintenance and improvement of the Environment, Health and Safety Management System, and provides general principles of environmental stewardship responsibilities for Santos GLNG employees and contractors.

The *Environmental Policy* also outlines a commitment to operations compliance, including monitoring, auditing, reviewing and reporting processes. The Environment, Health and Safety Management System and accompanying Environment Health and Safety Standards (EHSMS) are designed to facilitate achievement of the commitments outlined at corporate level, and therefore provide practical guidance and procedures for operations activities. These standards have been applied to develop the management plans outlined in Section 5.3 for mitigation of potential impacts within the visual environment.

Table 2-1 and Table 2-2 explain how each of the Environment, Health and Safety Management System standards will be applicable to the management of visual environmental values within the GFD Project area.

Table 2-1 Santos GLNG management standards and corporate policies relevant to visual amenity

Management standard	Description	Applicability to GFD Project
EHSMS01	Environment, health and safety policies	Activities of Santos GLNG employees and contractors with regards to improving environment, health and safety performance.
EHSMS02	Legal and other obligations	Compliance with environmental authority (EA) conditions, legislation, permits, industry codes, commitments and other obligations.
EHSMS07	Consultation and communication	Details the requirements for consultation and communication with workers and other stakeholders.
EHSMS09	Hazard identification, risk assessment and control	Defines the requirements for the development and maintenance of processes to systematically identify hazards and to assess and control their risks to as low as reasonably practicable.

Table 2-2 Santos GLNG environmental hazard standards relevant to visual amenity

Environment hazard standard	Description	Applicability to GFD Project
EHS01	Biodiversity and land disturbance	Outlines requirements for planning and conducting operations in a way that avoids or minimises disturbances to land and allows affected areas to be restored within reasonable time frames.

EHS: Environment hazard standard

2.2.1 Post-EIS field planning process

The constraints approach is based upon the *GFD Project environmental protocol for constraints planning and field development* (Constraints protocol) (Santos GLNG, 2014). The Constraints protocol applies to all gas field related activities. The scope of the Constraints protocol is to:

- Enable Santos GLNG to comply with all relevant State and Federal statutory approvals and legislation
- Support Santos' environmental policies and the General Environmental Duty (GED) as outlined in the EP Act
- Promote the avoidance, minimisation, mitigation and management of direct and indirect adverse environmental impacts associated with land disturbances
- Minimise cumulative impacts on environmental values.

The Constraints protocol details the process that Santos GLNG will use to identify, assess and manage potential impacts to the environment during field planning and development. This process has been successfully used for the approved GLNG Project, which increases the certainty of GFD Project environmental outcomes.

The general principles of the Constraints protocol, in order of preference, are to:

- Avoid — avoid direct and indirect impacts
- Minimise — minimise potential impacts
- Mitigate — implement mitigation and management measures to minimise adverse impacts
- Remediate and rehabilitate — actively remediate and rehabilitate impacted areas
- Offset — offset residual risk in accordance with regulatory requirements.

Consistent with Santos GLNG's environmental management hierarchy, the Constraints protocol prioritises avoidance of environmental impact during field planning by identifying those areas that are not amenable to development. This includes areas of high environmental value as identified in

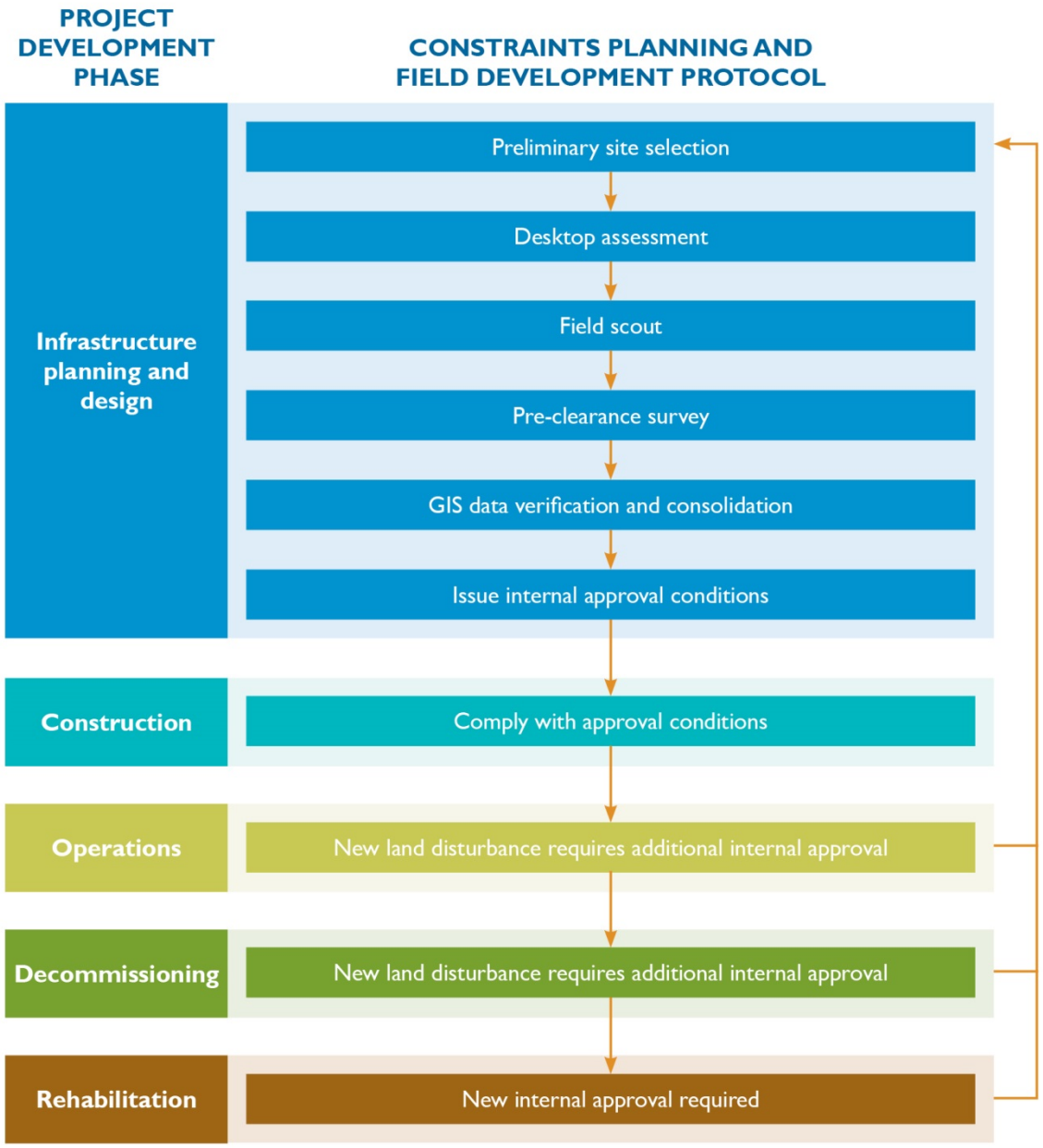
regulatory frameworks and Santos GLNG's baseline surveys. For areas that are considered appropriate to develop, Santos GLNG will identify impacts to environmental values that could potentially occur due to the construction, operations and decommissioning activities of the GFD Project, and determine pre-mitigated impacts (i.e. those that would occur without mitigation).

Relevant mitigation and management measures based on the approved environmental management framework already implemented for the GLNG Project are then applied to the pre-mitigated impacts to identify the mitigated (residual) impacts. This process increases certainty about potential impacts by identifying those areas that are not amenable to development, and for those areas where development could occur, how development should proceed.

The post-EIS field development process is a continuation of the field planning process and will be ongoing throughout the life of the GFD Project. The field development process will inform the GFD Project's design, together with a range of other factors including technical feasibility, cost and risk as required by standards applicable to the design, construction, operations, decommissioning and rehabilitation of gas developments. This information will be used to support the subsequent approvals process such as environmental approval application and the plan of operations.

The tasks involved in the field development process are summarised in Figure 2-1.

Figure 2-1 Field development process



3 Assessment methodology

There were three key stages to the landscape character and visual amenity assessment:

- Stage 1: Baseline study
- Stage 2: Impact assessment
- Stage 3: Evaluation and mitigation of potential impacts.

These are described in the following sections.

3.1 Stage 1: Baseline study

3.1.1 Desktop study

A desktop study of relevant existing literature was undertaken to collect data on topography, land use, and landscape and settlement patterns within the GFD Project area. This included:

- Visual assessment completed for the GLNG Project EIS (hereafter referred to as the 2009 EIS)
- Environmental authority conditions for the Arcadia, Fairview and Roma gas fields
- Local government planning schemes and related documentation.

3.1.2 Field study

A field study was undertaken and photographic records obtained. The field survey was carried out according to the *Guidelines for Landscape and Visual Impact Assessment* (Landscape Institute and Institute of Environmental Management and Assessment, 2002). To gain a consensus of opinion on field conditions, two visual impact assessment specialists carried out the field survey. Two field trips were undertaken to assess existing landscape settings, and predict potential for visual impact. These trips occurred on 27 June 2012 and from the 1 to 3 August 2012.

Fieldwork was completed to collect visual data relating to landform, land use, vegetation, boundaries and more perceptual aspects like scale, enclosure and visual unity. At the same time, information was collected on the condition of landscape features and elements that contribute to the overall character of the area. Information relating to the visual character of existing gas production and transmission was also obtained.

3.2 Stage 2: Impact assessment

The visual impact of the GFD Project is a product of the interaction between the existing visual environment and its capacity to absorb change, the sensitivity of receptors, and the introduction of GFD Project activities to these. This assessment considers these three characteristics in light of the significance assessment methodology outlined below.

3.2.1 Assessment framework

While the GFD Project's main infrastructure types and quantities are known, their locations and timing for development will be determined progressively during the project life. The GFD Project will use the assessment framework approach, which has been approved and successfully implemented for the GLNG Project. This process is tried and tested, thus increasing certainty in the GFD Project's environmental outcomes.

Constraints assessment is a key component of the management framework. The assessment increases certainty about potential impacts by identifying those areas that are not amenable to development, or if they were to be developed, how development should proceed. This occurs by identifying the constraints to development that exist within the GFD Project area and the environmental management controls to be applied to project activities in these constrained areas. In this way, Santos GLNG can optimise environmental outcomes, by avoiding sensitive receptors wherever possible. Where avoidance is not possible, Santos GLNG will use a range of management and mitigation measures.

Santos GLNG has already undertaken a constraints assessment of the GFD Project area, inclusive of landscape and visual amenity. This assessment established the environmental values within the GFD Project area and the level of constraint to be placed on GFD Project activities, as shown in Table 3-1. These are captured within Santos GLNG's planning and field development processes through the Constraints protocol.

The assessment framework and constraints classification have influenced the methodology of this visual impact assessment as follows:

- As the location of GFD Project activities is not yet defined, this visual impact assessment has not depicted specific views or viewsheds from given viewpoints. Similarly although a general appreciation of the scale and spread of GFD Project activities based on functional needs was available, their siting within actual landscape settings has yet to be fixed making seen area analysis not feasible. Rather, this visual impact assessment provides a qualitative measure of visual impact that will be used to inform the field planning process, as per the assessment framework and the Constraints protocol.
- This impact assessment scenario has not considered those areas that will not be exposed to surface development (no-go areas and surface development exclusion areas), and therefore visual impact, according to the GFD Project constraints listed in Table 3-1. The buffers placed on other environmental values have also been taken into consideration in assessing the potential impact. For example, the 100 m buffer surrounding water courses results in maintenance of riparian vegetation and its associated visual absorption capacity by GFD Project design.
- In addition to the constraints listed below, Santos GLNG will negotiate the placement of GFD Project activities with landholders where assets will be placed on property that is not held by Santos GLNG. This is discussed further in Section 5.3.

Table 3-1 GFD Project constraints

Level of constraint	Constraint layer
No-go area	Category A environmentally sensitive areas including national parks, conservation parks, and forest reserves (NC Act).
	EPBC Act-listed spring vents and complexes including primary 200 m buffer.
	Wetlands of national importance including 200 m buffer.
	Wetlands of high ecological significance or high conservation value (*Map of Referrable Wetlands*).

Level of constraint	Constraint layer
Surface development exclusion area	Primary 200 m buffer for Category A environmentally sensitive areas.
	The following Category C environmentally sensitive areas[3]: • Nature refuges (NC Act) • Koala habitat areas (*Nature Conservation (Koala) Conservation Plan 2006)* • Declared catchment areas (*Water Act 2000* (Qld)).
	The following Category B environmentally sensitive areas: • Coordinated conservation areas (NC Act). • State forest park / special forestry areas (*Forestry Act 1959* (Qld) (Forestry Act)). • Ramsar sites listed as wetlands of international importance.
High constraint area	Watercourses (stream orders) including 100 m buffer.
	Wetland defined as 'general ecologically significant wetland' or 'wetland of other environmental value' (*Map of Referrable Wetlands*).
	Spring vents and complexes (not protected under the EPBC Act) including primary 200 m buffer.
Moderate constraint area	Secondary 100 m buffer for Category A environmentally sensitive areas.
	Secondary 100 m buffer for spring vents and complexes (EPBC Act).
	Matters of national environmental significance including habitats (threatened species habitat and migratory species habitat), threatened communities (derived from state regional ecosystem mapping or verified from field surveys), and flora species.
	State forests and timber reserves.
	Endangered regional ecosystems including primary 200 m buffer.
	The following Category C environmentally sensitive areas: • Essential habitat including primary 200 m buffer (NC Act). • Essential regrowth habitat including primary 200 m buffer (NC Act). • Of concern regional ecosystems including primary 200 m buffer. • Resource reserve (NC Act). • State forests/timber reserves (Forestry Act)
	Endangered, vulnerable and near-threatened species (NC Act)
Low constraint areas	High value regrowth (endangered and of concern regional ecosystems)
	No concern at present regional ecosystems
	Type A species (NC Act)
	Existing Santos GLNG infrastructure
	Existing road, rail, pipeline and other infrastructure.
	Remaining areas once other constraints have been applied.

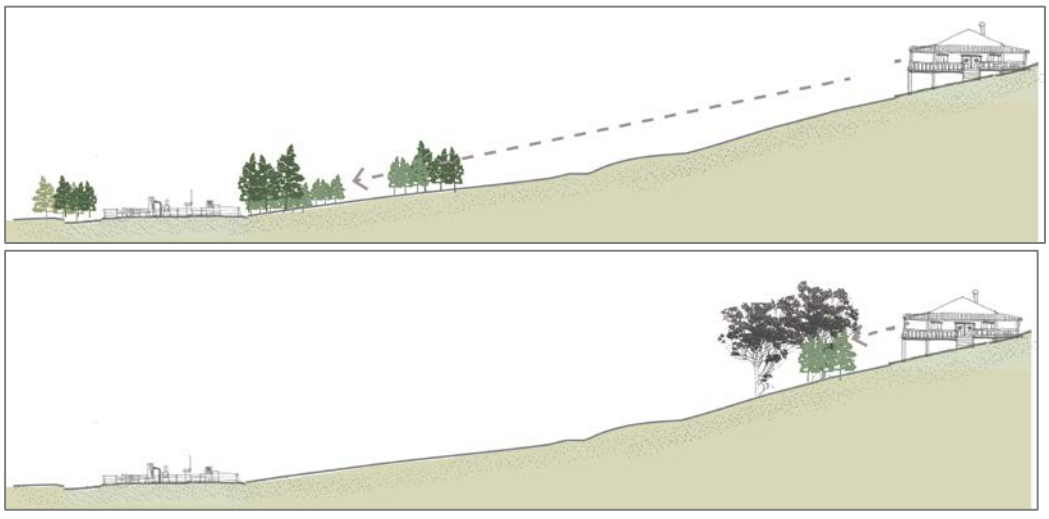
[1] **Low impact petroleum activities** means petroleum activities that do not result in the clearing of native vegetation, earthworks or excavation work that cause either: a significant disruption to the soil profile; or permanent damage to vegetation that cannot be easily rehabilitated immediately after the activity is completed. Examples of such activities include (but are not necessarily limited to): chipholes, coreholes, geophysical surveys, seismic surveys, soil surveys, topographic surveys, cadastral surveys, ecological surveys, and installation of environmental monitoring equipment (including surface water).
[2] **Limited petroleum activities** mean any low impact petroleum activity and single well leases (includes observation, pilot, injection and production wells) and associated infrastructure (water pumps and generators, sumps, flare pits or dams) located on the well lease; multi-well leases and associated infrastructure (water pumps and generators, sumps, flare pits, dams or tanks) located on the well leases; construction of new access tracks that are required as part of the construction or servicing a petroleum activity; upgrading or maintenance of existing roads or tracks, power and communication lines, gas gathering lines from a well lease to the gas compression facility; water gathering lines from a well lease to water storage; and camps within well lease that may involve sewage treatment works that are a no release works.
[3] **Petroleum activities** include low impact petroleum activities, limited petroleum activities, and all other GFD Project activities including major facilities such as permanent accommodation camps, gas treatment facilities, air strips, gas compression facilities, water management facilities such as water storage and water treatment facilities.
[4] **Linear infrastructure** means linear infrastructure including (but not limited to) gas and water gathering lines, low and high pressure gas and water transmission pipelines, power lines, communication, roads and access tracks.

3.2.2 Landscape character and visual absorption capacity

Visual landscape values were determined based on the following:

- **Landscape character**
  Landscapes are classified into landscape character zones (LCZs). Each LCZ contains similar patterns of topography, vegetation, hydrology and land use. The LCZs described in this report are based on those that were defined in the 2009 EIS, which have been expanded to include the GFD Project tenures that were not a part of the 2009 EIS.
- **Visual absorption capacity**
  Visual absorption capacity is the ability of topography and vegetation pattern to screen and or visually integrate introduced visual elements, such as the GFD Project activities.
  Topographic features such as valleys, rivers and creeks, ridgelines, knolls, hills, and mountains provide the potential for screening GFD Project activities from receptors. Small-scale topographical features, such as low ridgelines, can be highly effective screens.
  Vegetation has the potential to screen receptors from GFD Project activities, either through surrounding the component itself or when it screens the receptor, such as gardens around homesteads, as shown in Figure 3-1.

Figure 3-1 Vegetation screening and visual absorption capacity



3.2.3 Receptor sensitivity

The receptors for visual impact assessment are people, conducting various activities within a landscape. These activities have different requirements for landscape and visual amenity. Thus, it is the receptor activity that informs the assigned value. Although these activities can take place anywhere (e.g. picnicking or camping on rural production land), the most useful way to define them is through land use zoning and dominant activity (e.g. rural residence, agricultural use, tourism, etc.). The receptors identified most likely to be affected by the GFD Project are as follows:

- Houses or homesteads
- Tourist/recreational areas and designated tourist roads
- Main roads/regional roads and rail lines
- Minor local roads in rural zone
- Broad acres rural lands
- Industrial areas
- State forests and forest reserves (noting that protected estates such as national parks are designated as a no-go area by the Constraints protocol).

The criteria used to assess the sensitivity of receptors are described in Table 3-2.

Table 3-2 Sensitivity criteria - receptors

Sensitivity	Description	Receptors
High	The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance. The environmental value is intact and retains its intrinsic value. The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area which is poorly represented in the region, territory, country or the world. It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value. GFD Project activities would have an adverse effect on the value.	• Houses or homesteads • Tourist/ recreational areas and designated tourist roads
Moderate	The environmental value is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers. The environmental value is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. It is relatively well represented in the systems/areas in which it occurs but its abundance and distribution are limited by threatening processes. Threatening processes have reduced its resilience to change. Consequently, changes resulting from GFD Project activities may lead to degradation of the prescribed value. Replacement of unavoidable losses is possible due to its abundance and distribution.	• Main roads/ regional roads and rail line
Low	The environmental value is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g., historical societies. The environmental value is in a poor to moderate condition as a result of threatening processes, which have affected its intrinsic value. It is not unique or rare and numerous representative examples exist throughout the system / area. It is abundant and widely distributed throughout the host systems / areas. There is no detectable response to change or change does not result in further degradation of the environmental value. The abundance and wide distribution of the environmental value ensures replacement of unavoidable losses is achievable.	• Minor local roads in rural zone • Broad acre rural lands • Industrial sites • Designated State forests

The visual sensitivity of receptors based on their value and level of visual exposure is shown in Table 3-3. Sensitivity would be modified depending on the visual absorption capacity of the landscape that the GFD Project component was placed in and the visual orientation of receptor.

The understanding of the visual sensitivity of receptors outlined in Table 3-3 will be used to inform siting decisions during field planning, as per the Constraints protocol in conjunction with an understanding of the visual impact significance for each GFD Project component provided in Section 5.

Table 3-3 Visual sensitivity of receptors within the GFD Project area

Receptor		Visual sensitivity, distance to GFD Project component			
		< 1.0 km	1 km – 2.5 km	2.5 km – 7.5 km	7.5+ km
High value Sensitivity Low value	Houses or homesteads	High	High	Moderate	Low
	Tourist/recreational areas including national parks and designated tourist roads	High	Moderate	Low	Low
	Main roads/regional roads and rail lines	Moderate	Low	Low	Low
	Minor local roads in rural zone	Moderate /Low	Low	Negligible	Negligible
	Broad acres rural lands; industrial sites; designated State forests	Low	Low	Negligible	Negligible

3.2.4 Significance assessment

In the case of landscape character and visual amenity, the sensitivity of the landscape (i.e. visual absorption capacity described in Section 4.2.1) and receptor (described in Section 3.2.3) values can change considerably across the GFD Project area. Santos GLNG will rely on further location-specific constraints planning, assessment and design to evaluate and mitigate potential impacts to sensitive landscapes once the location of GFD Project activities is known (as described in Sections 1.1 and 2.2.1).

As a result of the varying sensitivity of both the existing landscape and receptor values, it is not possible to undertake a significance assessment where the sensitivity of underlying values remains static before and after mitigation measures are applied. Rather, this impact assessment has assessed sensitivity based on the nature of GFD Project activities and frequency at which they occur within the landscape to potentially alter the visual amenity values of a receptor, as outlined in Table 3-4.

Table 3-4 Sensitivity criteria

Sensitivity	Description
High	The GFD Project activity is clearly visible, it is numerous, continuous and widespread and likely to intrude upon the visual amenity of a variety of receptors across a variety of landscapes
Moderate	The GFD Project activity is visible, replicated across large areas and may intrude upon the visual amenity of high sensitivity receptors across a variety of landscapes
Low	The GFD Project activity is visible but limited in number and is not replicated within viewsheds of receptors

The magnitude of potential impact is assessed according to the criteria provided in Table 3-5. The magnitude of visual impacts of the GFD Project will differ according to the visual nature of the GFD Project component. The magnitude of each component is assessed in Section 5.

Table 3-5 Magnitude criteria

Magnitude	Description
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the environmental value. Avoidance through appropriate design responses or the implementation of location-specific environmental management controls are required to address the impact.
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the GFD Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls.
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.

The visual significance of an impact in this assessment is based on the interaction between the magnitude of the impact and the sensitivity (in this case the potential for exposure based on the frequency in which the GFD Project component will occur), as shown in Table 3-7.

Table 3-6 Significance matrix

Magnitude	Sensitivity		
	High	Moderate	Low
High	Major	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Negligible

The significance classifications used in Table 3-6 (major, high, moderate, low and negligible) are defined in Table 3-7.

Table 3-7 Significance classifications

Significance	Description
Major	Arises when an impact will potentially cause irreversible or widespread harm to an environmental value that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.
High	Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the environmental value. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status.
Moderate	Results in degradation of the environmental value due to the scale of the impact or its susceptibility to further change even though it may be reasonably resilient to change. The abundance of the environmental value ensures it is adequately represented in the region, and that replacement, if required, is achievable.
Low	Occurs where an environmental value is of local importance and temporary or transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
Negligible	Does not result in any noticeable change and hence the proposed activities will have negligible effect on environmental values. This typically occurs where the activities are located in already disturbed areas.

3.3 Stage 3: Evaluation and mitigation of potential impacts

Avoidance, mitigation and management measures were applied to reduce the level of impact identified during the assessment process. These measures aim to protect the identified values and to achieve established objectives. Mitigation and management measures will be applied, as appropriate, during the planning and design, construction, operation, decommissioning and rehabilitation phases of the GFD Project.

The mitigation and management measures applied have been based on the existing measures contained within the approved environmental management framework that Santos GLNG has already developed and implemented for the GLNG Project.

4 Landscape and visual amenity values

4.1 Existing landscape character of the GFD Project area

The landscape within the GFD Project area encompasses broad flat plains and river valleys, undulating hills, rugged ridges, narrow valleys and plateaux. The general character is that of rural broad acre agricultural and grazing area, interspersed with commercial forestry and relatively undisturbed woodland. Within this landscape are regional service centre townships, rural residential homesteads and small-scale industrial activities such as sawmills and resource extraction.

Agricultural utility vehicles, cattle trucks, tourist vehicles and campervan, buses and general vehicles use the road networks within the GFD Project area. Traffic volumes are typically light, increasing in volume closer to regional centres such as Roma.

The resident and visitor experience a low key rural landscape with a mix of broad long distance vistas, mountain ranges, natural forests and woodlands, rural roads and small townships. For ease of assessment, the landscape within the GFD Project area has been characterised into LCZs as described in the section below.

When considering the existing landscape character it should be noted that oil and gas extraction and production are an established land use within the GFD Project area, particularly in the region surrounding Roma. Oil fields have operated in this area since discovery in the early 20th century.

4.2 Landscape character zones

The landscapes in the GFD Project area have been classified into LCZs, which were established in the 2009 EIS (URS, 2009). LCZs, as stated in Section 3.2.2, contain unique landscapes by definition of their topography, vegetation and land use. These LCZs are described per gas field in Figure 4-1 and the following sections.

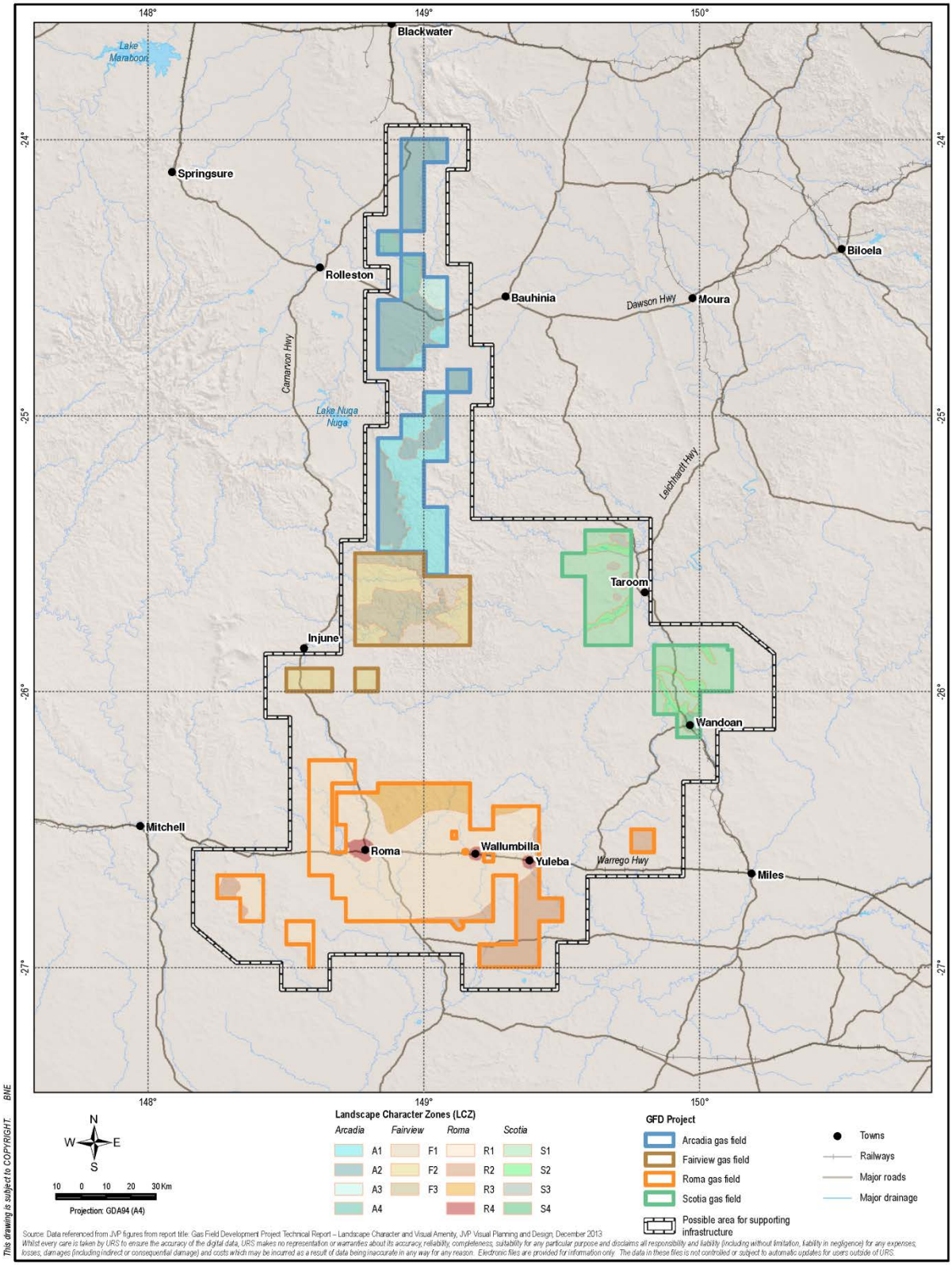
Character of surrounding areas

GFD Project activities may extend beyond the tenure boundaries as required to develop supporting infrastructure. Understanding these surrounding landscape characters is relevant to providing a comprehensive visual assessment of GFD Project activities in a broader regional sense.

Key landscape character elements of surrounding areas consist of:

- East: Expedition National Park, grazing, croplands
- South: grazing, croplands, forestry
- West: Carnarvon National Park, forestry, highlands in the northern parts, grazing and cropping to the south
- North: Blackdown Tableland National Park, grazing and mining.

Figure 4-1 GFD Project landscape character zones



Source: URS, 2013: File No. 42627064-g-1057b.mxd

4.2.1 Visual absorption capacity

Visual absorption capacity is the ability of the existing environment (i.e. land use, topography and vegetation) to visually integrate (or screen) introduced GFD Project activities. Different topographies and vegetation patterns will act to screen GFD Project activities, or offer different alternatives for integrating these activities into the landscape. The visual absorption capacity of the LCZs of each GFD Project gas field (as identified in Figure 4-1) is provided in:

- Table 4-1 for contributing topographic features
- Table 4-2 for vegetation types
- Table 4-3 for types of receptors.

Table 4-1 Landscape character zones – topography visual absorption capacity

GAS FIELD	TOPOGRAPHY															
	Creekline	Broad valleys		Flat	Undulating	Hills and slopes		Steep hills		Ridges	Plateaus		Narrow valleys			
		Lower slope	Upper slopes			Lower to mid	Upper	Lower to mid	Upper		Plateau edges	Plateau tops	Lower to mid	Upper		
Arcadia																
LCZ A1							H	H	H							
LCZ A2		M	M					M	L	L	M	H	H	M		
LCZ A3					M	M	M									
LCZ A4	M	L	L	L												
Fairview																
LCZ F1						M	M	M	L				H	M		
LCZ F2			M			M	M			L						
LCZ F3										L	M	H	H	M		
Scotia																
LCZ S1	M	L	M	L	L	M	L									
LCZ S2	M	L	M	L												
LCZ S3	M					M	L	M	L	L						
LCZ S4	M			L	L											
Roma																
LCZ R1	M	L	M	L	L											
LCZ R2					L	M	L									
LCZ R3	M	L	M		L	M	L									
LCZ R4	M			L	L											

High - (H) Med - (M) Low - (L)

Table 4-2 Landscape character zones – vegetation visual absorption capacity

GAS FIELD	VEGETATION							
	Riparian	Dry grassland	Cropping	Scattered trees	Scattered woodland	Open woodland	Closed woodland	Closed forest
Arcadia								
LCZ A1						M-H	H	
LCZ A2		L				M-H	H	
LCZ A3		L		L-M				
LCZ A4	M	L	L		M-H			
Fairview								
LCZ F1		L		M		M-H	H	H
LCZ F2		L		L-M	M-H	M-H		
LCZ F3		L		L-M	M-H	M-H		
Scotia								
LCZ S1	M	L-M	L	M	M-H	M-H		
LCZ S2	M			M				H
LCZ S3	M	L-M	L	M	M-H	M-H	H	
LCZ S4	M							
Roma								
LCZ R1		L	L	L-M	M-H	M-H	H	H
LCZ R2		L-M					H	H
LCZ R3	M	L-M		L-M	M-H	M-H		
LCZ R4	M			L-M				

High - (H) Med - (M) Low - (L)

Table 4-3 Landscape character zones – receptors visual absorption sensitivity

GAS FIELD	RECEPTOR									
	Houses and homesteads	Tourist / recreational area	Designated tourist routes	Rail line	Main roads/ regional roads	Local roads	Grazing	Cropping	Industrial	State forests
Arcadia										
LCZ A1		H	H		M	L				L
LCZ A2	H	H	H		M	L	L	L		L
LCZ A3							L			L
LCZ A4	H		H		M		L	L		
Fairview										
LCZ F1		H								L
LCZ F2	H									
LCZ F3						L	L			L
Scotia										
LCZ S1	H		H		M	L	L	L		
LCZ S2	H	H				L	L	L		
LCZ S3		H				L	L			
LCZ S4	H	H	H			L			L	
Roma										
LCZ R1	H	H	H	M	M	L	L	L		L
LCZ R2	H					L	L			L
LCZ R3						L	L			
LCZ R4	H	H	H	M	M	L			L	

High - (H) Med - (M) Low - (L)

4.2.2 Arcadia gas field

The Arcadia gas field has four defined LCZs, which are shown in Figure 4-1 and discussed below. Beyond the GFD Project area, the region is characterised by the presence of the Blackdown Tablelands National Park, mining areas and townships along the Capricorn Highway.

4.2.2.1 LCZ A1 Steep hills and mountains

Hills and mountains, primarily associated within the Blackdown Tableland National Park, dominate the eastern half of Arcadia gas field and generate features in the open landscape. These hills and mountains are a feature of the view in the distance, while riparian areas (land that adjoins, directly influences, or is influenced by a body of water) and associated lower slopes feature in the middle distance and foreground, as shown in Plate 4-1.

Mountains are generally outside the GFD Project tenure and are represented by isolated knolls that create a feature in the landscape, an example of which is shown in Plate 4-2.

A large proportion of this LCZ is covered by the Expedition National Park, with the balance covered by State forests and remnant forest on private land.

Visual absorption capacity

This LCZ has a high visual absorption capacity that is particularly associated with the closed woodland and forest that feature across the zone. This vegetation provides an ideal mix of visual absorption capacity and limited environmental modification required for GFD Project activities such as well leases. Open woodland would require less tree vegetation clearing than forest, which has the potential to create a large visual effect. Despite this, both vegetation types have a strong capacity to screen GFD Project activities and limit the visual impact upon receptors.

Plate 4-1 LCZ A1 Steep hills and mountains of the Blackdown Tableland National Park

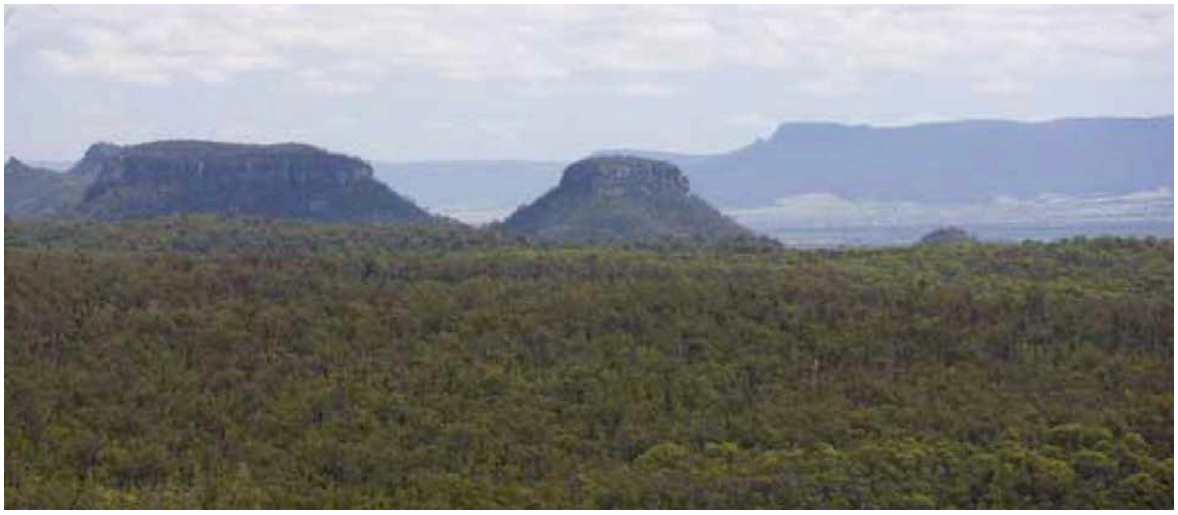


Plate 4-2 LCZ A1 Mesas

4.2.2.2 LCZ A2 Valleys

This LCZ contains three valleys, the largest of which is the Arcadia Valley. The LCZ is visually defined by prominent forest covered ridges on the skyline, particularly those along the eastern and western edges of the Arcadia Valley, as shown in Plate 4-3. The valleys typically contain extensive areas of grassland that is often used for grazing, with trees scattering the landscape. Arcadia Creek drains the valley to the north into Lake Nuga Nuga.

Visual absorption capacity

The extensive grassland that covers much of this zone offers limited visual absorption capacity, as the landscape pattern is often sparse with few interrupting features. Due to its openness, receptors are provided with long views, where skyline features dominate. However, the vertical elements of vegetation and small rises in topography can provide integration or blending effects to GFD Project activities. The exception to this is the riparian area associated with the Arcadia Creek, whose tree cover has the potential to screen receptors from GFD Project activities.

Plate 4-3 LCZ A2 Prominent ridgelines within Arcadia gas field

4.2.2.3 LCZ A3 Undulating hills

This LCZ features undulating hills that are dominated by cleared grassland with clusters of trees typically focused along drainage lines and lower slopes, an example of which is shown in Plate 4-4.

Visual absorption capacity

The extensive grassland that covers much of this zone offers limited visual absorption capacity, as the landscape pattern is often sparse with few interrupting features. Due to its openness, receptors are provided with long views, where skyline features dominate. However, the small rises in topography can provide integration to GFD Project activities (integration effect), in addition to the presence of tree clusters, which would offer screening potential.

Plate 4-4 LCZ A3 Undulating hills to east of Arcadia gas field

4.2.2.4 LCZ A4 Riparian areas and associated lower slopes

The riparian areas across the Arcadia gas field support varying levels of tree cover, which especially along drainage lines restrict visibility, as shown in Plate 4-5. This LCZ also includes gentle lower slopes and floodplains, both of which support pasture and cropping activities (Plate 4-6). Flood plains in some areas of the LCZ support dense red gum forests.

Visual absorption capacity

Riparian areas and drainage lines may act as a visual barrier to inward views from roads or other sensitive receptors. With adequate set back from road reserves, the riparian vegetation band would screen views to GFD Project activities.

Plate 4-5 LCZ A4 Riparian areas and lower slopes within the Arcadia gas field

Plate 4-6 LCZ A4 Views towards the east within Arcadia gas field

4.2.3 Fairview gas field

The Fairview gas field has three defined LCZs, which are shown on Figure 4-1 and discussed below. Beyond the Fairview gas field, the region is characterised by the presence of the Carnarvon National Park to the northwest, Nuga Nuga National Park to the north and Expedition National Park to the northeast. These are interspersed with grazing and croplands, reflecting the strong agricultural history of the region.

4.2.3.1 LCZ F1 Forests

The zone is characterised by visually prominent hills and deeply incised drainage lines. The northeast of the Fairview gas field features the forest covered hills in Expedition National Park and private land, while the Hallet State forest is found in the southeast. This zone also includes isolated patches of grassland that have limited tree cover.

Plate 4-7 LCZ F1 View of mixed Eucalypt/Cypress Pine forest within Hallett State Forest

Visual absorption capacity

Visual absorption capacity varies across this landscape. It is limited in the areas of grassland, primary due to the lack of tree cover found, which would offer a greater level of visual absorption capacity due to its screening capacity. However, the areas of closed woodland and forest offer high visual absorption capacity. Open woodland is preferable vegetation for locating GFD Project activities, as this vegetation requires less tree vegetation clearing than forest, which has the potential to create a large visual effect in itself. Despite this, both vegetation types have a strong capacity to screen GFD Project activities and limit the visual impact upon receptors.

4.2.3.2 LCZ F2 Broad valleys

This LCZ includes wide east-west valleys that generate visually prominent hills and ridges, coupled with extensive areas of grassland and remnant tree cover. Local roads located within the grazing areas of southern tenures of Fairview gas field are typically tree lined, which limits broader views, as shown in Plate 4-8. Views from within the valleys of this zone generally take in the grassland area between trees, with forest covered ridges visible on the skyline.

Plate 4-8 LCZ F2 Tree lined local roads

Visual absorption capacity

As with LCZ F1, the visual absorption capacity of this zone varies. Visual absorption capacity is limited across open grassland, however increases in areas that feature scattered trees and woodlands. The local roads present throughout this zone would likely be screened effectively from GFD Project activities, particularly where tree cover is dense, as it is in Plate 4-8.

4.2.3.3 LCZ F3 Hills and valleys

This LCZ is a strongly dissected landform, with steep sided valleys interspersed with plateaus. The plateaus across the LCZ are generally covered by grassland; however, scattered tree cover and small areas of remnant woodland feature across the landscape, particularly on steep slopes and along creeks. The strength of the landforms in this zone results in long distance views from ridge tops, which themselves are prominent within the valleys, as shown in Plate 4-9.

Visual absorption capacity

As with LCZ F1 and F2, the visual absorption capacity of this zone varies. Visual absorption capacity is limited across open grassland, however increases in areas that feature scattered trees and woodlands.

Plate 4-9 LCZ F3 Extensive broad valley grassland and cattle grazing

4.2.4 Roma gas field

The Roma gas field has four defined LCZs, which are shown on Figure 4-1 and discussed below. Beyond the gas fields, the landscape is dominated by agricultural land uses, with cropland and forestry featuring strongly.

4.2.4.1 LCZ R1 Roma / Wallumbilla agricultural areas

This LCZ covers a variety of agricultural land, including land that supports irrigated cropping lands, dryland cropping lands and grazing lands. These grazing lands include grassland with scattered trees, open woodland areas and dense woodland and forest areas, particularly in drainage corridors and road reserves, as shown in Plate 4-10 and Plate 4-11. The topography is typically flat to gently rolling, which allows for extensive views; however, view sheds may be restricted by vegetation and localised topography.

There is considerable variation in landscape values from year to year, based on rainfall and crop rotations. Bare soil is visible after cultivation, followed by the green of growing crops, then yellow/straw colours of mature crops.

Visual absorption capacity

The grassland and cropping land that covers much of this zone offers poor visual absorption capacity; while they require little environmental modification in terms of vegetation clearing and well lease establishment, they have low visual absorption capacity and GFD Project activities may be highly visible. However, the riparian and woodland areas offer higher visual absorption capacity, with tree cover offering screening potential. As stated earlier, there is a balance to be had between the visual impact of vegetation clearing in dense woodland and forest and the screening potential it offers. Overall, open woodland provides similar screening potential with reduced visual effect of vegetation clearing.

Plate 4-10 LCZ R1 Irrigated croplands and grazing lands

Plate 4-11 LCZ R1 Remnant woodland

4.2.4.2 R2 Hill slopes with grazing land uses

This LCZ contains moderately undulating hills, which drain by a system of creeks into the Bungil and Wallumbilla Creeks. Patches of grassland used for grazing alternate with extensive areas of State forest and smaller areas of remnant woodland. Views from public roads vary and include open long-distance views as well as short-distance views where roadside vegetation is present Plate 4-12.

Visual absorption capacity

Although the grassland areas across this zone offer limited visual absorption capacity, the areas of closed woodland and forest offer considerable screening potential with high visual absorption capacity.

Plate 4-12 LCZ R2 Hills slopes, grazing land and remnant woodland

4.2.4.3 LCZ R3 Hills / valleys with grazing and forestry land uses

This LCZ consists of rolling hills and small valleys that are used for grazing. They generally support some scattered trees, tree clumps or open woodland areas with well-established continuous tree cover along the creeks and some road easements (Plate 4-13). Long distance views from ridge tops showcase grazing and forestry land uses with scattered rocky outcrops that dominate this LCZ, as shown in Plate 4-14. There is a system of hills and valleys that are established at a higher elevation area than the rest of the zone, which features in the north of the Roma gas field.

Visual absorption capacity

The vegetation across the zone offers medium to high visual absorption capacity. The least visual absorption capacity is offered by riparian zones along creek systems at medium. The strength of tree cover across the zone offers considerable screening potential. However, vegetation clearing in areas of dense tree cover has the potential to create strong localised visual effects.

Plate 4-13 LCZ R3 Tree cover along road easements

Plate 4-14 LCZ R3 Rolling grazing lands to distinctive rocky outcrops and ridgelines

4.2.4.4 LCZ – R4 Roma and Wallumbilla townships

These townships are an obvious contrast to their surrounding landscapes. Both are situated on the Warrego Highway and spread north and south from that thoroughfare. They contain an agglomeration of residential land use, small businesses including hotels, retail, automotive service centres. Roma also is the centre for regional airlines.

Generally, these townships are flat with broad tree-lined streets and one to three storey buildings (Plate 4-15). The tallest built elements within each town are telecommunications tower, water tower and grain silos. Both have flood prone creeks within the town boundaries.

Visual absorption capacity

Visual absorption capacity has not been calculated for townships, as these areas have been declared Priority Living Areas (PLAs) under the *Darling Downs Regional Plan.* The plan provides for council to determine the appropriateness of potential resource activity within PLAs. Any application for a resource extraction activity within a PLA needs to include consideration of community expectations as determined by the relevant local council and articulated in the local planning scheme.

Should GFD Project development activities be planned within a PLA, Santos GLNG will consult with the council and consider relevant requirements of the planning scheme.

Plate 4-15 LCZ R4 Wallumbilla along on the Warrego Highway

4.2.5 Scotia gas field

The Scotia gas field has four defined LCZs, which are shown on Figure 4-1 and discussed below. Beyond the gas fields, cropping and grazing dominates as a land-use, although State Forest is present to the southeast, and the Carnarvon National Park is located to the northwest.

4.2.5.1 LCZ – S1 Undulating hills | rural areas – Juandah Creek

This LCZ is characterised by a mixture of gently undulating hills, and flat grasslands with limited remnant tree cover. The hills are generally used for cropping as shown in Plate 4-16, and the grasslands are generally used for grazing as shown in Plate 4-17. Tree cover across the zone generally limits distant views, particularly from certain local roads.

Visual absorption capacity

Visual absorption capacity across the entire zone is medium. The areas of grassland and cropping land offer limited visual absorption capacity; however, the presence of riparian zones and scattered and open woodland across the zone offers medium visual absorption capacity, with the potential for screening.

Plate 4-16 LCZ S1 Undulating hills and contour cropping

Plate 4-17 LCZ S1 Broad flat grasslands with scattered trees

4.2.5.2 LCZ S2 Watercourses and riparian areas

The broader Scotia gas field area is interlaced with the catchments of two creeks: Roche Creek to the southwest near Wandoan and Juandah Creek further to the north and west of the Leichhardt Highway.

The creeks are sinuous linear elements that incise the rural landscape in both open rural areas and wooded or undulating sloped areas. Watercourses are typically lined with vegetation; shrubs, grasses and trees that may overhang the creeklines, creating a shady green corridor, as shown in Plate 4-18. The creek banks range from steep and incised to broadly spreading.

The watercourses can be viewed on bridges over creek crossings. In some locations there are opportunities for travellers to pull into a creek crossing for recreation. These watercourses are potentially used by recreational fishermen.

Visual absorption capacity

Riparian vegetation offers a high level of visual absorption capacity. However, if the GFD Project activities were in open land with the vegetation as a backdrop, visual absorption capacity is reduced.

Plate 4-18 LCZ S2 Views along Juandah Creek from Roma – Taroom Road

4.2.5.3 LCZ S3 Steep hills and mountains

This LCZ contains two areas that contain isolated groups of steep hills and ridges (Plate 4-19), which are located within northern parts of Scotia gas field. These formations are surrounded by open grassland, which in the north is used for cropping.

Visual absorption capacity

The visual absorption capacity of this landscape zone can differ dramatically depending on the location of the GFD Project component and that of the receptor. As with other zones, the areas of grass and cropping land offer limited visual absorption capacity. However, riparian zones, and portions of open and closed woodland offer medium to high levels of visual absorption capacity due to their screening potential.

Plate 4-19 LCZ S3 Isolated vegetated hills

4.2.5.4 LCZ S4 Wandoan township

Wandoan is a town of under 500 people and contains regional facilities including council and sporting infrastructure. Wandoan is flanked by the Leichhardt Highway to the western side of the town (Plate 4-20). This side of town supports the main commercial activities including the main street with residential areas to the east, as shown in Plate 4-21. The town's buildings are generally inward looking with little in terms of major views outward from the town. The showground is a short distance out of town to the east but it also is inward looking and surrounded by woodland.

Visual absorption capacity

Visual absorption capacity has not been calculated for townships as Wandoan have been declared a PLA under the *Darling Downs Regional Plan.* The plan provides for council to determine the appropriateness of potential resource activity within PLAs. Any application for a resource extraction activity within a PLA needs to include consideration of community expectations as determined by the relevant local council and articulated in the local planning scheme.

Should GFD Project development activities be planned within a PLA, Santos GLNG will consult with the council and consider relevant requirements of the planning scheme.

Plate 4-20 LCZ S4 Wandoan township approach view from west

Plate 4-21 LCZ S4 Wandoan township - streetscape

5 Potential impacts

The visual impacts of the GFD Project are a product of various GFD Project activities and the establishment of permanent infrastructure, which create a contrast in the landscape. These activities and infrastructure may alter the visual amenity of the landscape, depending on the sensitivity of receptors, the value of the landscape and the visual absorption capacity of this landscape. As the visual impact will alter considerably according to the visual character of the GFD Project component, impacts are discussed and assessed according to the GFD Project component.

Visual impacts will be generated by GFD Project activities and infrastructure, which create a contrast in the landscape. The extent to which these activities and infrastructure alter the visual amenity of landscapes depends on the magnitude and duration and GFD Project inputs and the sensitivity of receptors, the landscape and the visual adsorption capacity of that landscape.

The GFD Project infrastructure that may generate an impact on visual amenity includes:

- Primary infrastructure:
  - Production wells
  - Gas and water gathering lines and transmission pipelines (within or between tenures and gas fields)
  - Gas compression facilities
  - Water storage and water management facilities.
- Supporting infrastructure:
  - Accommodation facilities, including sewage treatment, for construction and operations staff
  - Access roads and tracks
  - Fuel storage, workshops and laydown/storage/maintenance areas
  - Borrow pits and quarries
  - Power lines and communications.

Each of these GFD Project activities has associated activities that have the potential to impact visual amenity, including:

- Clearing, comprising removal of vegetation and topsoil
- Construction / decommissioning activities (including earthworks)
- Traffic
- Night lighting (including lighting from vehicles)
- Operating activities (presence of GFD Project component).

Like other natural gas and oil production developments, the commercial development of gas fields occurs incrementally, and can be divided into three stages:

- Construction
- Operations
- Decommissioning and rehabilitation.

The impacts associated with each of these activities will be at their highest during construction; thereafter, the visual effects are expected to reduce. For example, the footprint required for each component during construction reduces (often considerably) during operation, as is discussed per infrastructure component in the remainder of this section. Similarly, night lighting is most often required during the construction phase, with the exception of certain infrastructure, such as accommodation facilities.

During the operations phase, the visual effect of GFD Project infrastructure will extend from their establishment (signalling the end of the construction phase) to decommissioning. The exception to this is power lines and communications infrastructure, which is likely to increase over time and gas extraction occurs in more remote areas.

5.1 Primary infrastructure

5.1.1 Wells

Construction

The construction of a well requires a well lease of up to 1.5 ha for single well and up to 2.5 ha for multi-well leases. Well construction requires vegetation clearance and earthworks that will result in colour contrast. In addition there will be a range of construction and support vehicles and equipment moving on and to the lease. Access roads may also need to be established, which will create a localised visual impact. A typical example of well lease construction is shown in Plate 5-1.

The construction of wells, including night lighting, can create a high visual effect up to a distance of 500 m and potential visual impact up to a distance of 1 km during construction. This effect and impact however are short lived, impacting an area for a three to four week period.

Plate 5-1 Well lease construction

Operation

Wells are generally integrated with their surrounding landscape, by virtue of their position and scale, an example of which is shown in Plate 5-2.

Wells have the potential to create an elevated visual impact for distances up to 300 m. Beyond this distance; the magnitude of the impact reduces.

Plate 5-2 Example of production well located within woodland areas

Decommissioning and rehabilitation

At the end of a well's life, the surface infrastructure of a well lease is removed, which may require a variety of equipment, including vehicles. The well lease is then remediated to conditions similar to those prior to the establishment of the well.

The visual effect of decommissioning for a short period will be elevated while equipment is used to dismantle wells. Completion of the decommissioning process will see reduced visual impacts.

5.1.2 Gas and water gathering lines and transmission pipelines

Construction

Installing gas and water gathering lines and transmission pipelines involves the removal of vegetation and topsoil to create a right of way, creating a colour contrast to the surrounding landscape. The construction footprint ranges from 1–2.5 ha per kilometre for gathering lines and 2.5–5 ha per kilometre for transmission pipelines.

Constructing these GFD Project activities will involve a range of construction machinery and transport vehicles, examples of which are shown in Plate 5–3 and Plate 5-4. The visual effect generated by installing the gathering lines and pipelines will be greater if viewed parallel in forested areas, and in elevated locations where the construction location is not screened.

The visual impact will be elevated up to one kilometre from the construction location for periods under three weeks.

Plate 5-3 Construction of gathering lines

Plate 5-4 Construction of transmission pipeline

Operations

Gas and water gathering lines and transmission pipelines have limited surface activities, with the exception of safety signs, as shown in Plate 5-5 and low point drains and high point vents. Visual impacts associated with the gathering lines and transmission pipelines is a result of vegetation clearing undertaken for construction and safety signs placed above the lines. Pipeline safety marker signs are placed on either side of road, tracks, and railway and watercourse crossings, at property fence lines, at utility crossings, at minimum separation distances along the pipeline and at each change of direction are small but visually persistent elements that are inconsistent with rural landscape character. In addition, there may be locations where the linear easement requires creation of cuttings across topographic features. The visual impacts of the landscape modifications here will be more long term.

The level of contrast in the landscape will depend on the existing landscape. For example, in areas of open grassland and grazing land, the gathering line corridor will not create a strong visual effect; however, in woodland and forest areas, vegetation clearing will create a localised visual contrast that reduces considerably with distance.

The maintenance of these activities will generate a low level of traffic; gathering lines are required to be checked quarterly, while transmission lines require ongoing maintenance.

Plate 5-5 Gas gathering line corridor post-construction

Decommissioning and rehabilitation

To minimise further disturbance, gathering lines and transmission pipelines will be left in place after being isolated and drained of water or gas according to regulatory requirements. Safety signs will be removed and access tracks will be rehabilitated.

5.1.3 Gas compression facilities

Construction

Gas compression are the largest infrastructure within the GFD Project, and have the largest associated footprints of between 20 and 40 ha each. An example of the construction footprint of this GFD Project component is shown in Plate 5-6.

Gas compression facilities will be constructed using modular structures and processing units wherever practicable to minimise construction activities, shorten the construction schedule, and limit the presence of construction workforce on tenure. The construction period for each facility is expected to be between two and three years and may require considerable earthworks, workforces and transportation. An example of activities being undertaken during the construction of a gas compression facility is shown in Plate 5-7.

Plate 5-6 Construction footprint of a gas compression facility for the GLNG Project

Plate 5-7 Construction of gas compression and water management facility in Fairview gas field

Operation

Although gas compression facilities are the largest visual component of the GFD Project in terms of infrastructure size, they are the least frequent. A typical facility is a large scale (operations footprint 10–15 ha) industrial element and would contrast strongly in visual shape, form, colour and line values of the surrounding rural landscapes. The gas compression facility would be typically light in colour, causing higher colour contrast with the landscape. While the gas compression facility is made up of a number of activities including large turbines, tanks, piping, flare and other industrial activities, from a distance they present as simple large sheds and structures.

An existing gas compression facility is shown in Plate 5-8 and is typical of gas compression facilities proposed for the GFD Project. This is indicative only and does not necessarily reflect the final layout, paint finishes, or the acoustic treatment or vegetation screening that may be used. Traffic in and around the facilities is expected to be minimal, accounting for the movements of about 25 staff in the worst case scenario; however, most gas compression facilities will be operated on a continuous basis and will be fully automated.

Plate 5-8 Example of a gas compression facility

Once established, the gas compression facilities are lit to allow for safe pedestrian movement. Gas compression facilities are generally not lit to a high intensity on a regular basis. Only if there is a requirement to carry out an emergency maintenance or repair task will stronger illumination be required.

Gas flares can be a bright source of direct light; however gas flaring is limited in Santos GLNG operations, and only occurs in situations where it is mandated as a safety measure.

Once the facility is established and during the operations phase, the contrasting visual expression values (form, shape line and colour) of the gas compression facilities will be markedly different to those values in the surrounding landscape. The gas compression facilities will be located away from sensitive receptors such as homes and homesteads, and tourist roads.

Decommissioning and rehabilitation

Upon closure of gas compression facilities, structures and equipment will be decommissioned and removed. Landforms are generally reinstated and the land rehabilitated to be consistent with surrounding land cover, except in instances where landholders request to retain these (if acceptable to regulatory authorities). As the largest GFD Project component in size, decommissioning of these facilities will likely result in earthworks and the presence of a reasonable size transportation and workforce. No night lighting is expected.

5.1.4 Water management facilities

Construction

Facilities to manage water produced from the gas wells will be required across the four gas fields. Where possible, Santos GLNG will use existing pipelines, dams and water management facilities to assist in the management of water produced by the GFD Project. However, the GFD Project will also require the construction of new water management infrastructure, including:

- Water treatment facilities, which may incorporate:
  - Desalination plants (e.g. reverse osmosis, ion exchange)
  - Water amendment facilities, which uses chemical dosing to amend pH and ionic balance of the water prior to use
  - Water storage prior to or post-treatment.

- Fluid storage for the concentrated waste produced by desalination.

Water management facilities will be constructed using modular structures and processing units wherever practicable to minimise construction activities, shorten the construction schedule, and limit the presence of construction workforce on tenure. The modules will be assembled at specially prepared locations and then the piping, electrical controls and instrumentation wiring will be installed. Earthworks and vegetation clearing will be required to establish the facilities, with footprints of approximately 5–10 ha.

Where the storage of water is required, dams and/or tanks will be constructed to store water in the gas field or prior to entering water management facilities or following treatment. These dams will be earthen, constructed from material sourced locally and have clearance foot prints of up to 16 ha.

In addition tanks that have clearance footprints of up to 1 ha may be required.

Operations

Following construction of the water management facility, the ongoing visual effect is a result of views of the buildings in the visual landscape. They will create contrasting form, shape, line and colour in the rural landscape; however, they are generally limited in size with small footprints (2–5 ha) and sit relatively low in the landscape, as shown in Plate 5-9. Traffic in and around the facilities is expected to be minimal, accounting for the movements of about 25 staff in the maximum case scenario; however, Santos GLNG is investigating the opportunity for remote control. Night lighting may be required at water management facilities; however, it will be directed inward towards the facilities.

Plate 5-9 Example of GLNG Project water management facilities

Water storage, particularly dams, will create semi-natural water body shapes in the landscape that borrow from the line and enclosing form of the surrounding topography. Dam walls will borrow from the existing landscape minimising visual effect and potential impact levels (Plate 5-10). The potential impacts could be even lower, depending on the naturalness of the water body shapes and finishes on the dam walls and water edges.

Tanks create a greater contrast to the landscape; however, they too are common to rural landscapes.

Plate 5-10 Example of GLNG Project water storage dams

Decommissioning and rehabilitation

Water management facilities are removed when no longer needed. Following removal of equipment and infrastructure, gravel hardstand areas are regraded and reseeded. The accumulated sediment, liner and spill detection systems are removed and removed for disposal.

Water storages that cannot be reused for ongoing land uses will be decommissioned. However, the dams may be retained by landholders as long-term water storage structures. Where dams are decommissioned, the water stored and liners will be removed and earthen embankments recontoured.

Both activities will require moderate earthworks and traffic.

5.2 Supporting infrastructure

5.2.1.1 Accommodation facilities

Construction

To accommodate the projected workforce, Santos GLNG will develop accommodation facilities within the GFD Project area to supplement the existing accommodation, services and amenities. Field development planning processes will be used to design the size and locations of these accommodation facilities.

Accommodation facilities will be modular structures that will accommodate one or two workers per unit. In general, the facilities will comprise three alternative forms:

- Small temporary facilities (also called drill camps) will be modular and relocatable facilities, less than 1 ha in area, and will provide basic amenities for up to 20 people for short-term activities such as drilling or installation of gathering lines.
- Larger semi-permanent facilities will be built to support construction of large GFD Project activities (e.g. hub gas compression facilities). They will require a construction footprint of 1–20 ha and will be adjacent to work areas and designed to provide more extensive services and facilities to larger workforces (up to 600 people) for more long-term construction activities (2–3 years).
- Permanent operations accommodation facilities will be designed to provide accommodation for operations personnel for the duration of the GFD Project and will accommodate 60 to 100 people.

At a minimum, accommodation facilities will include accommodation units, kitchen, dining, ablutions, and laundry facilities. At larger more permanent camps, facilities will also include water supply (bores, tanks and treatment), sewage treatment and disposal, power generation (if not connected to the grid supply) and back-up power generators, fuel and materials storage areas, recreational facilities, offices and car parking.

Construction of accommodation facilities and associated infrastructure will take six to nine months and will create visual impact associated with vegetation clearing, regrading and earthworks. The building activities will introduce clusters of contrasting built form to rural areas, though the scale is consistent with many farm structures. Increased movement of construction and transport vehicles will contribute to the visual effect created during the construction phase.

Operation

Example layouts of existing GLNG Project construction (semi-permanent) and operation (permanent) accommodation facilities are shown in Plate 5-11 and Plate 5-12 respectively. Accommodation facilities for the GFD Project will be similar to these.

The building activities will appear as clusters of contrasting built form to rural areas, though the scale is consistent with many farm structures. The operations accommodation facilities are likely to have a much smaller footprint than that required for construction, reducing from 1–20 ha to 0.5–10 ha.

There will be intermittent vehicle movement associated with transport of workers to and from work areas, although volumes will be reduced in comparison to the construction phase.

Night lighting will be provided for safety and security within the accommodation facilities. Exterior night lights are typically hooded to minimise glare escaping beyond the immediate area. The glow from accommodation facilities will be evident for a limited distance depending on atmospheric conditions.

Plate 5-11 GLNG Project semi-permanent construction accommodation facility layout

Plate 5-12 GLNG Project operations accommodation facility layout

Decommissioning and rehabilitation

The decommissioning of the accommodation facilities will involve decommissioning of infrastructure, dismantling of reusable items and demolition of slabs and hard surfaces. There will be an increase in traffic and movement on roads during this phase. Re-grading of terrain profiles and rehabilitation will return the cleared areas to previous visual character.

5.2.1.2 Access roads and tracks

Construction

Roads and access tracks will be required for construction and operations activities. Access roads will be built to allow servicing of well leases and access to other infrastructure (e.g. gas compression facilities, accommodation facility, etc.). The construction of these GFD activities requires 1.5–3.0 ha of vegetation clearing per kilometre of road infrastructure. Wherever practicable, the GFD Project will use existing tracks, including existing access roads and tracks used by the GLNG Project, or already disturbed areas such as pipeline easements and corridors.

The construction of access roads creates a strong visual effect as vegetation removal and exposure of earth creates contrast with surrounding vegetation and to a lesser extent, landform. The visual effect of construction machinery would compound this. The visual effect and potential impact would decrease when the road is complete and road verges and batters are restored. While an increase in vehicles would be necessitated during construction, the traffic increase will be minimal.

Operation

Roads and tracks are an existing part of the rural landscape. Access tracks associated with the GFD Project will be similar to those already used by landholders, limiting their visual impact. Their scale

(operations footprint 0.8–1.5 ha per km) will be limited; tracks will conform to topography and avoid vegetation where practicable (Plate 5-13). Ongoing works, such as grading may be required across the GFD Project life.

Plate 5-13 Existing access road for the GLNG Project

Decommissioning and rehabilitation

If not required by the landholder, roads and tracks will be decommissioned and associated land rehabilitated. Rehabilitation will include reshaping natural ground profiles and re-establishing vegetation cover consistent with preconstruction conditions. This will involve an increased presence of transport vehicles and construction machinery and associated earthworks.

5.2.1.3 Fuel storage, workshops and laydown/storage/maintenance areas

Construction

Fuel storage, workshops and laydown, storage and maintenance areas will be constructed concurrently with major facilities centres including accommodation camps, gas compression facilities, and water management facilities. There will be vegetation clearing, stockpiling and some earthworks associated with their development. The construction footprint can be 5–40 ha.

General storage, maintenance and laydown yards will be established to support construction activities. These areas will be used for storage of materials and equipment necessary for construction activities. These laydown yards will vary in size from less than 0.5 ha (drill camp laydown yards) to 25 ha (yards supporting development of a major gas compression facility).

A typical facility is industrial in character and would contrast strongly in visual shape, form, colour and line values of the surrounding rural landscapes. The construction of such facilities would be part of the composite visual effect and potential impact created by them and the associated GFD Project component they are servicing. An existing GLNG Project laydown area is shown in Plate 5-14.

Plate 5-14 GLNG Project laydown area

Operation

During operations, fuel storage, workshops and maintenance areas will have small to medium sized sheds to accommodate activities. There may also be temporary modular offices for workers. There will be concentrated vehicular traffic (fuel tankers, trucks, earth moving equipment and cars) within these areas for the life of the facilities. During operations, a smaller number of laydown and stockpile areas will be required to support ongoing operations activities. An equipment store will be located within the gas compression facilities to house critical spare parts.

These GFD Project activities will have a low vertical profile, industrial in character. The footprint of built elements and intensity of vehicular movement will contribute to visual effect but may appear continuous with associated facilities. Existing vegetation and topography may limit views and therefore potential impacts. The operations footprint of these areas is minimal and counted within the footprint of the primary GFD Project component that they support.

Decommissioning and rehabilitation

The majority of laydown areas will only be required during the construction period of specific infrastructure. On completion of the construction period the laydown areas would be decommissioned. Other hardware will be removed, including equipment sheds and fences. As required, landforms will be restored so that they do not compromise ongoing land use activities. Ground and vegetation cover will also be restored similar to the existing surroundings.

Fuel storage and workshop facilities are removed when no longer needed. Following removal of equipment and infrastructure, gravel hardstand areas are regraded and reseeded. These waste materials removed for disposal. Landforms will be restored so that they do not compromise ongoing land use activities. Ground and vegetation cover will also be restored similar to the existing surroundings.

5.2.1.4 Borrow pits and quarries

Construction

Borrow pits will be required to source sand, gravel and other materials that are needed for the field development program. The locations and methods of extraction for each borrow pit will be determined as the needs arise. The footprint allowed for borrow pits and quarries in this EIS extends from 5–50 ha as the worst case scenario.

Potential impacts result from the visual contrast created by vegetation clearing and earth works. The level of visual effect is dependent upon the topography in pit location. A borrow pit in steeper terrain will have much higher potential visibility. The impact of the vegetation clearing will be localised; however, considerable earthworks may be required. If cut and fill batters are required for the pit, the potential for visual impact is greater, due to the visual contrast these create.

A moderate level of construction and transportation traffic is expected.

Operation

The borrow pits are typically used intensively during the construction phase and most are rehabilitated at the end of construction. However, a number may be maintained to provide sand and gravel for ongoing road and maintenance activities during operations.

Borrow pits require limited maintenance during operations, although earth moving equipment may be used for short durations to obtain fill materials.

There are limited operations and maintenance requirements at borrow pits; earth moving equipment is typically mobilised for short durations to obtain fill materials.

Decommissioning

Rehabilitation of the borrow pits typically involves regrading of the borrow area to stable landforms that blend with the existing topography, placement of stockpiled overburden, and topsoil and final grading and seeding of the area.

5.2.1.5 Power lines and communications

Construction

Power lines

Where connection to the grid is required to source power for GFD Project electrical demands, construction of transmission lines and other associated infrastructure may be required. This may be via a combination of above and below ground power lines co-located with other linear infrastructure.

Below ground construction visual effects and potential impacts will be similar to other linear infrastructure. Refer to Section 5.1.2.

The construction of aboveground power lines has the potential to alter the character of the landscape through vegetation clearing. In woodland or forest vegetated areas, vegetation clearing may also increase the level of contrast between the existing landscape and that of the transmission line easement, creating a strong visual effect. This effect is enduring as the clearance is maintained as directed by fire safety and maintenance guidelines and regulations until decommissioned. However,

such effects are limited to potential views from roadsides and elevated locations. Careful management of roadside landscape settings can prevent views along these easements mitigating visual effects.

Earth moving equipment, excavators and other machinery used for construction will also be visible for a short period during the installation of pylons. However, the visual impact of construction will be relatively short. There will be locations where the linear easement requires creation of cuttings across topographic features. The visual impacts of the landscape modifications here will be higher as the visual contrast will be exacerbated by greater degrees of visibility to the construction activity.

Potential visual effects arising from construction activities will be localised.

Communications

Data and voice network services and telemetry services will be deployed to construction areas.

Communications and telemetry towers will generally be positioned on elevated locations so as to provide the greatest area of signal coverage and will generally not exceed 10 m in height.

Construction activities for telemetry and telecommunication towers will be limited to foundation installation and construction of a standard kitset tower. The disturbance area for the tower however should not exceed 25 square metres.

Other disturbances associated with communications are typically within the existing footprint of disturbances at existing or proposed facilities or proposed gas gathering or transmission lines but include access tracks.

The removal of vegetation and topsoil, and the establishment of cut and fill batters required to create a small level pad for the tower and activities will create a colour contrast with adjoining undisturbed landscape. However, due to the elevated location of towers, disturbance to the ground surface will not be highly visible. Vegetation removal is required for the facility and guy wires.

Potential visual effects arising from construction activities such as traffic and the use of heavy machinery will be temporary.

Operation

Power lines

The visual effect of transmission towers will largely be created by the contrast of the tower and to a lesser extent by the multiple lines attached to the poles, as shown in Plate 5-15 and Plate 5-16. The towers will have low visual integration and high contrast because they sit above the landscape and are more often than not silhouetted against the sky. If however, in some limited situations where the towers are viewed with a landscape background with varied shapes, form, line and colour the towers will be better integrated. Of more concern would be the tower being on a treeless hill where the tower silhouettes against the sky.

Each component of GFD Project power supply has a number of operations elements that will contribute to the visual character of the GFD Project. Diesel generators are relatively small scale and will sit within the context of other comparably sized industrial objects in the field. As a result, the potential visual effects are limited by viewing distance, and intervening vegetation and topography.

Gas turbine alternators will be situated within larger gas compression facilities. They will blend into the context of those gas compression facilities, thereby limiting the visual effect specific to the alternators.

Plate 5-15 Current 33 kV above ground power lines

Plate 5-16 Current 11 kV above ground power lines

Communications

Communication towers create a simple, vertical element in the landscape with a strong linear form that supports one or more microwave dishes. The materials that communications towers are constructed of could be highly reflective when new, causing strong visual contrast between the towers and the background landscape. This contrast will soften as the galvanised steel weathers. The contrast of line and shape of the tower to the landscape on which they are placed will remain.

Decommissioning and rehabilitation

Decommissioning of external infrastructure will involve the removal of infrastructure as soon as it is not required. Other hardware will be removed, including equipment sheds and fences. As required, landforms will be restored so that they do not compromise ongoing land use activities. Ground and vegetation cover will also be restored similar to the existing surroundings. This will involve a limited increase in traffic and earthworks associated with the removal of infrastructure and restoration of land forms.

5.3 Management and mitigation

As identified in Sections 2.2 and 3.2.1, Santos GLNG has developed an effective management framework to be implemented during field planning and development. Santos GLNG's corporate environmental, health, safety and community policies are supported by the Environment, Health, and Safety Management System and the Constraints protocol.

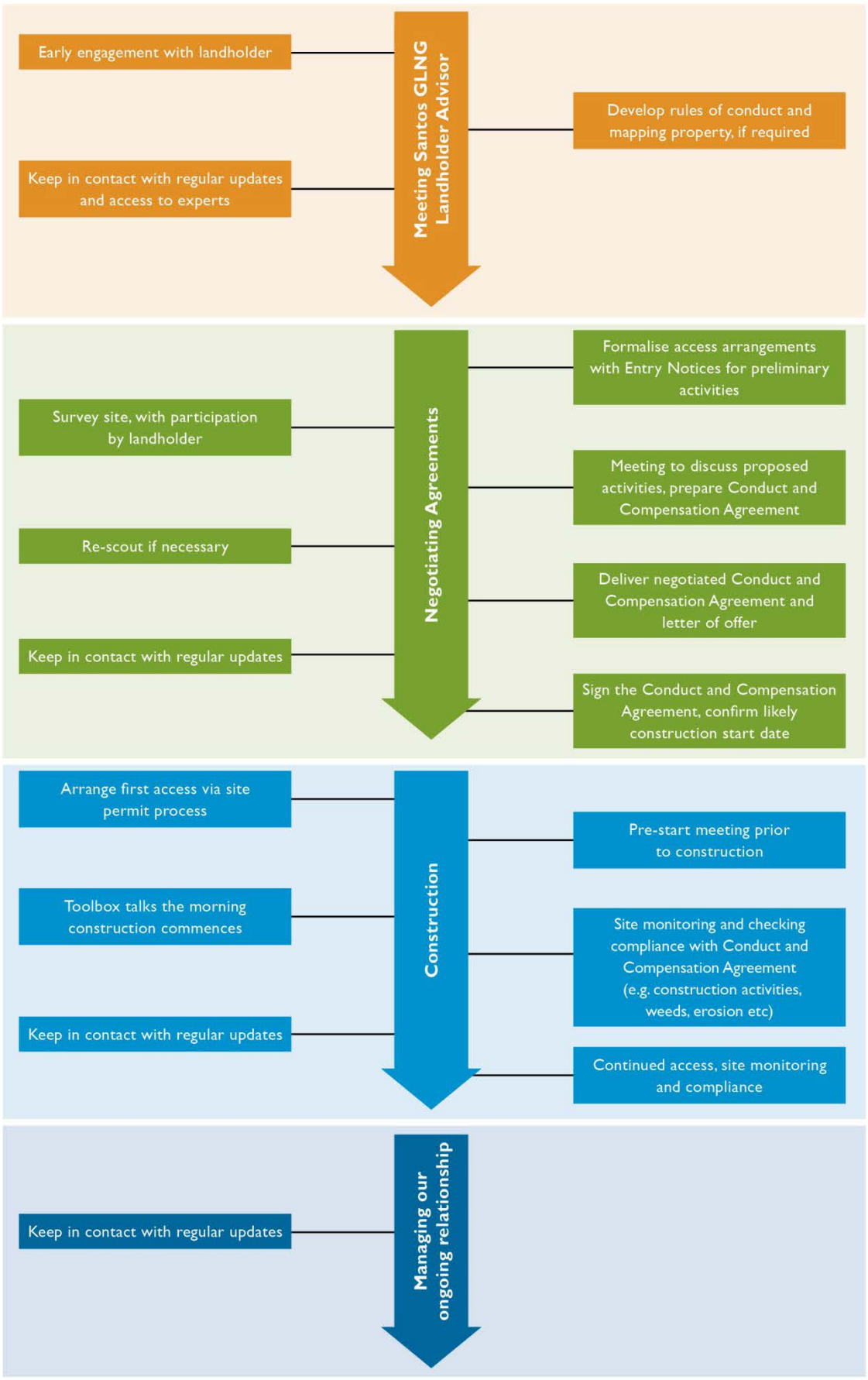
Management standards within the Environment, Health, and Safety Management System outline the requirements necessary to ensure that environmental, health, safety risks are systematically managed. Standards applicable to landscape character and visual amenity include:

- *EHS01 Biodiversity and land disturbance*

- *EHSMS07 Consultation and communication*

The primary mechanisms to protect visual amenity is the adoption of the Constraints protocol during field planning and location selection accordance with the understanding visual sensitivity of receptors as outlined in Table 3-3. Where GFD Project activities will be located on landholder's property, Santos GLNG will engage with the landholder to determine the location of infrastructure and visual mitigation as necessary, as per EHSMS07 and Santos GLNG's early engagement with landholders, in accordance with the *Land Access Code* (Department of Employment, Economic Development and Innovation, 2010). The early engagement process with landholders is summarised in Figure 5-1. Santos GLNG also has existing agreements with landholders in place and processes to adapt them where required.

Figure 5-1 Landholder engagement process



The management measures that apply to the way in which visual amenity will be protected are outlined in Table 5-1.

Table 5-1 Management measures

Management plan	Plan summary	Applicability to managing visual impacts
GFD Project environmental protocol for constraints planning and field development (Constraints protocol)	The Constraints protocol applies to all gas field related activities. The scope of the Constraints protocol is to: • Enable Santos GLNG to comply with all relevant State and Federal statutory approvals and legislation • Support Santos GLNG's environmental policies and the General Environmental Duty (GED) as outlined in the EP Act • Promote the avoidance, minimisation, mitigation and management of direct and indirect adverse environmental impacts associated with land disturbances • Minimise cumulative impacts on environmental values. The Constraints protocol will be implemented to guide placement of infrastructure which adopts the following management principles: • Avoidance — avoiding direct and indirect impacts • Minimisation - minimise potential impacts • Mitigation — Implement mitigation and management • Remediation and rehabilitation — actively remediate and rehabilitate impacted • Offset — offset residual adverse impacts in accordance with regulatory requirements. The Constraints protocol enables the systematic identification and assessment of environmental values and the application of development constraints to effectively avoid and / or manage environmental impacts.	The Constraints protocol acts as the primary means for managing visual impacts by identifying those areas not appropriate for development or the level of environmental management required based on the underlying environmental values of the location. The Constraints protocol for the GFD Project reduces the potential for high visual impact by preventing development in a number of landscapes that are sensitive, including national parks.
Draft environmental management Plan (Draft EM Plan)	The Draft EM Plan identifies the environmental values potentially affected by the GFD Project and proposes measures to manage the risk of potential adverse impact to these environmental values. The Draft EM Plan comprises: • Environmental values potentially affected by the GFD Project • Environmental management objectives and associated management measures • Environmental monitoring and reporting • Coal seam water management • Proposed conditions.	Impacts associated with night lighting will be managed and mitigated in through the Draft EM Plan. Lighting disturbances will be minimised where practicable by: • Directing lighting away from sensitive receptors, including houses, homesteads, tourists roads and recreational areas • Engineering solutions to limit light spillage where practicable.

Management plan	Plan summary	Applicability to managing visual impacts
Land access and landholder engagement strategy	Santos GLNG has adopted an early engagement strategy where landholders that may be affected by GFD Project activities are able to discuss the potential location, timing and impacts of infrastructure on their property or business, and how Santos GLNG can help to minimise those impacts. This early engagement strategy has been developed in accordance with the *Land Access Code* (Department of Employment, Economic Development and Innovation, 2010). Santos GLNG will negotiate a conduct and compensation agreement (CCA) under the P&G Act with landholders on whose land the petroleum activities will be carried out. The locations of wells, gathering lines, and access tracks will be finalised in consultation with the landholder as part of the negotiations.	The Land access and landholder engagement strategy will reduce the impact on individual landholders as the most common sensitive receptor by negotiating the location of infrastructure and activities with them directly.
Decommissioning and abandonment management plan (DAMP)	The DAMP describes the management framework associated with the cessation of petroleum activities. The objectives of the plan are to: • Undertake decommissioning and rehabilitation of assets in a manner that complies with regulatory requirements and minimises the risk of environmental harm • Undertake decommissioning and rehabilitation activities in a manner that meets stakeholder expectations • Leave a landform that is stable, compatible with the intended post-closure land use • Provide for the retention and beneficial reuse of infrastructure constructed by Santos GLNG to third parties (e.g. landholders or local authorities) where an appropriate agreement has been signed by both parties and regulatory authorities are satisfied.	The DAMP will reduce and manage visual impacts during the decommissioning and rehabilitation phase through commitments to rehabilitating the landscapes impacted by the GFD Project.
Rehabilitation management plan	The Rehabilitation management plan outlines the rehabilitation objectives for Project-related disturbances within the GFD Project Area. This includes the phasing of rehabilitation to first achieve stabilisation and subsequently final rehabilitation for disturbances to land (i.e. ground surface). The Rehabilitation management plan: • Describes Santos GLNG's approach to rehabilitation • Identifies key rehabilitation objectives and criteria to deem rehabilitation success • Outlines general rehabilitation actions to be undertaken by Santos GLNG when rehabilitation a disturbance • Provides an overview of monitoring and maintenance actions to be conducted on rehabilitated areas.	The Rehabilitation management plan provides a range of commitments that will reduce visual impact associated with the land vegetation clearing and siting of GFD Project activities, including guidance on progressively rehabilitating disturbed areas with existing vegetation where practicable.

Management plan	Plan summary	Applicability to managing visual impacts
Road-use management plan	The Road-use management plan was developed for to manage the impact associated with the implementation of the Santos GLNG Project. It will be adapted to manage the potential impacts of the GFD Project. The objectives of the plan include: • Manage the efficiency of the road network impacted including State-controlled roads and local government roads • Ensure user safety and safe operation of GFD Project vehicles • Minimise impacts on road infrastructure condition • Minimise traffic related complaints and incidents to maintain community amenity.	The Road-use management plan will provide strategies for minimising impacts on transport infrastructure, including traffic volumes and hours of peak traffic flow.
Social impact management plan (SIMP)	The SIMP established for the GLNG Project will be implemented across the GFD Project. The plan outlines the roles, responsibilities and rights of Santos GLNG, the government, impacted communities and other stakeholders in relation to the GFD Project. In particular, it outlines the framework for community engagement, management strategies to avoid, mitigate or minimise potential impacts and to maximise opportunities and benefits arising throughout the life of the GFD Project, as well as a monitoring and reporting process. The GLNG Project SIMP will be supplemented by issue action plans relating to the GFD Project that focus on the following key areas as agreed with the Coordinated Project Delivery Division of the Coordinator-General's office: • Water and environment • Community safety • Social infrastructure • Community wellbeing and liveability • Local industry participation and training • Aboriginal engagement and participation. The SIMP is an operational document that is updated to reflect the ongoing needs of Santos GLNG and the communities it operates in. It is available on the web at: http://www.santosglng.com/resource-library/community/social-impact-management-plan-community-handbook.aspx	The SIMP provides the framework for managing the social and community impacts of the GFD Project. In regards to visual impacts, the SIMP provides the process that Santos GLNG will follow in resolving disputes and community complaints.

5.4 Impact assessment

The significance assessment for potential visual impacts, mitigation measures and residual risk are shown in Table 5-2. The pre-mitigated significance assessment presented in Table 5-2provides the impact significance rating following application of the Constraints Protocol. The post mitigation significance takes into account other available mitigation measures (Table 5-1) to determine the residual significance.

5.5 Residual impacts

Implementing the avoidance and management plans discussed in the previous section is expected to reduce the majority of potential visual impacts of the GFD Project to low significance, with some GFD Project activities remaining with a significance potential rating of moderate.

By and large, the greatest level of visual impact is expected across GFD Project activities during the construction phase, wherein vegetation clearing, earthworks and traffic have the greatest potential to generate contrast in the landscape. These impacts will be managed through a variety of measures that are designed to:

- Avoid sensitive areas, and therefore receptors
- Reduce the footprint of GFD Project activities, and therefore vegetation clearing
- Reduce the number of vehicles required to transport the workforce, and therefore the magnitude of vehicles required
- Retain vegetation in the areas of the GFD Project infrastructure, and therefore reducing vegetation clearing and retaining the visual absorption capacity potential of vegetation.

Despite this, some visual effect will remain until decommissioning and rehabilitation phase, especially in instances where GFD Project activities are located in areas of dense vegetation. Similarly, it is possible that the traffic required during the construction of the largest activities will remain at moderate levels during the operations phase. JVP notes that the larger GFD Project activities are likely to be located in remote areas, which will limit the exposure of sensitive receptors to the increased traffic during this period.

The residual impact of night lighting is expected to pose a potential significance rating of low, largely based on the limited nature of night lighting for the GFD Project, its distance from sensitive receptors and the range of management commitments that have proven effective in the implementation of the GLNG Project.

The ongoing visual impact of the infrastructure will endure across its operating life. Many GFD Project activities are likely to have low residual impacts, primarily based on their size and structure characteristics, which will allow them to be easily visually integrated into the existing landscape. However, larger GFD Project activities will have the potential to generate a moderate visual impact on the environment across the life of the GFD Project. Where this impact is of elevated significance, landscape treatments can increase screening/integration and thereby reduce visual impact.

Table 5-2 Visual impact and management summary

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
Vegetation clearing	Wells	Construction	Moderate	Moderate	Moderate	In addition to the Constraints protocol the potential for visual impacts from vegetation clearing and earthworks will be managed and mitigated through the EHS01, the Land Access and landholder engagement strategy, Rehabilitation management plan and DAMP. Areas will be cleared in accordance with EHS01, with the intent of minimising disturbance. Methods include: • Considering post-construction land use during planning and design • Keeping to marked roads and access tracks • Minimising area of impact (e.g. lease seize, road or pipeline width) • Using common or adjacent easements for pipelines, roads or seismic lines • Using previously disturbed areas. Through the adoption of the Land access and landholder engagement strategy, Santos GLNG will engage from an early stage with the landholders that may be affected by GFD Project activities to discuss the potential location, timing and impacts of infrastructure on their property or business, and how Santos GLNG can help to minimise those impacts. Decommissioning of cleared land will adhere to the DAMP and objectives of the Rehabilitation management plan. Decommissioning and rehabilitation will be undertaken as soon as practicable in accordance with the relevant statutory requirements and approvals, unless an agreement is in place with the relevant administering authority and relevant landholder. This agreement may allow the disturbance to be re-used e.g. farm dams, roads, etc.	Low	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Gathering lines / transmission pipelines	Construction	High	Low	Moderate		Low	Moderate
		Operations		Low	Moderate		Low	Moderate
		Decommissioning		Low	Moderate		Low	Moderate
	Gas compression facilities	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Negligible		Low	Negligible
	Water management facilities	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		Low	Negligible		Low	Negligible
	Accommodation	Construction	Low	Moderate	Low		Moderate	Low

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
	facilities	Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Access roads and tracks	Construction	Moderate	Moderate	Moderate		Low	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Fuel storage, workshops and laydown /storage/ maintenance areas	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Borrow pits and quarries	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Moderate	Low		Moderate	Low
		Decommissioning		Low	Low		Low	Low
	Power lines and communications	Construction	High	Low	Moderate		Low	Moderate
		Operations		Low	Moderate		Low	Moderate
		Decommissioning		Low	Moderate		Low	Moderate
Construction / decommissioning activities (including earthworks)	Wells	Construction	Moderate	Moderate	Moderate	Santos GLNG will ensure that post-closure activities have minimum impact on the environment. Complaints concerning earthworks and vegetation clearing will be managed according to the dispute resolution process outlined within the SIMP.	Low	Low
		Operations		NA	NA		NA	NA
		Decommissioning		Low	Low		Low	Low
	Gathering lines / transmission pipelines	Construction	High	Low	Moderate		Low	Moderate
		Operations		NA	NA		NA	NA
		Decommissioning		NA	NA		NA	NA
	Gas compression facilities	Construction	Low	High	Moderate		Moderate	Low
		Operations		NA	NA		NA	NA
		Decommissioning		Moderate	Low		Low	Low
	Water management facilities	Construction	Low	Moderate	Low		Moderate	Low
		Operations		NA	NA		NA	NA
		Decommissioning		Moderate	Low		Low	Low
	Accommodation	Construction	Low	Moderate	Low		Moderate	Low

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
	facilities	Operations		NA	NA		NA	NA
		Decommissioning		Moderate	Moderate		Low	Low
	Access roads and tracks	Construction	Moderate	Low	Low		Low	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Fuel storage, workshops and laydown/ storage maintenance areas	Construction	Low	Moderate	Low		Low	Low
		Operations		NA	NA		NA	NA
		Decommissioning		Moderate	Low		NA	Low
	Borrow pits and quarries	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Moderate	Low		Moderate	Low
		Decommissioning		Low	Negligible		Low	Negligible
	Power lines and communications	Construction	Moderate	Moderate	Moderate		Low	Low
		Operations		NA	NA		NA	NA
		Decommissioning		Low	Low		Low	Low
Traffic	Wells	Construction	Moderate	Moderate	Moderate	Santos GLNG will minimise the visual impacts associated with traffic and transportation in accordance with the Road-use management plan, and SIMP. The Road-use management plan developed for the GLNG Project will be expanded or a new plan developed to include the following: • Haul roads will be well maintained • Traffic speeds on unsealed surfaces, adjacent or close to sensitive receptors will be limited to minimise dust generation • The transport of oversize loads will be restricted to non-peak periods • Car-pooling and bus services will be implemented where practicable to minimise worker journeys. Complaints concerning traffic and transportation will be managed according to the dispute resolution process outlined within the SIMP.	Low	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Gathering lines / transmission pipelines	Construction	Low	Moderate	Moderate		Low	Negligible
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		Low	Negligible		Low	Negligible
	Gas compression facilities	Construction	Low	High	Moderate		Moderate	Low
		Operations		Low	Negligible		Moderate	Low
		Decommissioning		Moderate	Low		Low	Negligible
	Water management facilities	Construction	Low	Moderate	Low		Moderate	Low
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		Moderate	Low		Low	Negligible
	Accommodation	Construction	Moderate	Moderate	Moderate		Moderate	Moderate

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
	facilities	Operations		Moderate	Moderate		Moderate	Moderate
		Decommissioning		Low	Low		Low	Low
	Access roads and tracks	Construction	Moderate	Low	Low		Low	Low
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Fuel storage, workshops and laydown/ storage/ maintenance areas	Construction	Moderate	Moderate	Moderate		Moderate	Moderate
		Operations		Low	Low		Low	Low
		Decommissioning		Low	Low		Low	Low
	Borrow pits and quarries	Construction	Low	Moderate	Low		Low	Low
		Operations		Low	Negligible		Low	Negligible/A
		Decommissioning		Low	Negligible		Low	Negligible
	Power lines and communications	Construction	Low	Low	Negligible		Low	Negligible
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		Low	Negligible		Low	Negligible
Night lighting	Wells	Construction	Moderate	Moderate	Moderate	Impacts associated with night lighting will be managed and mitigated through the Draft environmental management plan and the SIMP. In accordance with the Draft environmental management plan, lighting disturbances will be minimised where practicable by: • Directing lighting away from sensitive receptors, including houses, homesteads, tourists roads and recreational areas • Engineering solutions to limit light spillage where practicable. Complaints concerning night lighting will be managed according to the dispute resolution process outlined within the SIMP.	Low	Low
		Operations		NA	NA		NA	NA
		Decommissioning		NA	NA		NA	NA
	Gas compression facilities	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Water management facilities	Construction	Low	NA	NA		NA	NA
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Accommodation facilities	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Access roads and	Construction	Low	Low	Negligible		Low	Negligible

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
	tracks	Operations		NA	NA		NA	NA
		Decommissioning		NA	NA		NA	NA
	Fuel storage, workshops and laydown/ storage/ maintenance areas	Construction	Low	Moderate	Low		Low	Negligible
		Operations		Low	Low		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Borrow pits and quarries	Construction	Low	Moderate	Low		Low	Negligible
		Operations		NA	NA		NA	NA
		Decommissioning		NA	NA		NA	NA
Operating infrastructure (presence of component)	Wells	Construction	Moderate	NA	NA	The primary means of managing the visual impacts associated with infrastructure is through avoiding impacts to sensitive receptors during field planning and location selection. Santos GLNG will engage with the landholder to determine the siting of infrastructure and visual mitigation as agreed, this may include the use of vegetation screening. Complaints concerning the placement of infrastructure will be managed according to the dispute resolution process outlined within the SIMP.	NA	NA
		Operations		Low	Low		Low	Low
		Decommissioning		NA	NA		NA	NA
	Gathering lines / transmission pipelines	Construction	Moderate	NA	NA		NA	NA
		Operations		Low	Low		Low	Low
		Decommissioning		NA	NA		NA	NA
	Gas compression facilities	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Moderate	Low
		Decommissioning		NA	NA		NA	NA
	Water management facilities (water treatment)	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Moderate	Low
		Decommissioning		NA	NA		NA	NA
	Water management facilities (water storage)	Construction	Low	NA	NA		NA	NA
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Accommodation facilities	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Moderate	Low
		Decommissioning		NA	NA		NA	NA
	Access roads and	Construction	Moderate	NA	NA		NA	NA

Impact	Infrastructure	Phase	Pre-mitigated significance			Mitigation	Residual significance	
			Sensitivity#	Magnitude	Significance		Magnitude	Significance
	tracks	Operations		Low	Low		Low	Low
		Decommissioning		NA	NA		NA	NA
	Fuel storage, workshops and laydown/ storage/ maintenance areas	Construction	Low	NA	NA		NA	NA
		Operations		Moderate	Low		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Borrow pits and quarries	Construction	Low	Low	Negligible		Low	Negligible
		Operations		Low	Negligible		Low	Negligible
		Decommissioning		NA	NA		NA	NA
	Power lines and communications	Construction	High	NA	NA		NA	NA
		Operations		Moderate	High		Moderate	High
		Decommissioning		NA	NA		NA	NA

As a result of the varying sensitivity of the existing landscape and receptor values, this impact assessment has assessed sensitivity based on the nature of GFD Project activities and frequency at which they occur within the landscape to potentially alter the visual amenity values of a receptor i.e.

High: The GFD Project component is clearly visible, it is numerous, continuous and widespread and likely to intrude upon the visual amenity of a variety of receptors across a variety of landscapes.

Moderate: The GFD Project activity is visible, is numerous replicated across large areas and may intrude upon the visual amenity of high sensitivity receptors across a variety of landscapes.

Low: The GFD Project activity is visible but limited in number and is not replicated within viewsheds of receptors.

6 Cumulative impacts

Cumulative visual impacts relate to how people move through the landscape and how they view it, and how they may view changes. Such impacts relate to 'trips' through the landscape be they for work, recreation or related to daily life activities, e.g. shopping, school, etc. On such 'trips' people see a range of landscapes and changes to it potentially contribute to cumulative visual impacts. Such impacts could be experienced repeatedly as one travels the various routes for work, living or recreational purposes.

6.1 Methodology

Cumulative impacts have been assessed as a product of:

- The stand-alone residual impacts of the GFD Project using existing baseline conditions (as per Section 5.5)
- The residual impacts associated with the other projects to be considered in the cumulative impact assessment (Figure 6-1).

The potential consequence of these has been assessed based on the relevance factors provided in Table 6-1 and the impact significance matrix detailed in Table 6-2.

Table 6-1 Relevance factors for assessing cumulative impact

Aspect	Relevance factors		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/ intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

Table 6-2 Impact significance for assessing cumulative impact

Impact significance	Sum of relevance factors	Consequences
Low	1-5	Negative impacts need to be managed by standard environmental management practices. Special approval conditions unlikely to be necessary. Monitoring to be part of general project monitoring program.
Medium	6-9	Mitigation measure likely to be necessary and specific management practices to be applied. Specific approval conditions are likely. Targeted monitoring program required.
High	10-12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Specific approval conditions required. Targeted monitoring program necessary.

6.2 Cumulative impact area and project inclusion

The region within which cumulative visual impacts are considered is illustrated in Figure 6-1. This figure includes projects within a 50 km buffer of the GFD Project area.

The projects that have been considered in the assessment of cumulative visual impacts are shown in Figure 6-1 and detailed in Table 6-4. These projects are considered to have the capacity to contribute to cumulative impacts by virtue of their location within a 50 km buffer of the GFD Project tenures and the criteria shown in Table 6-3.

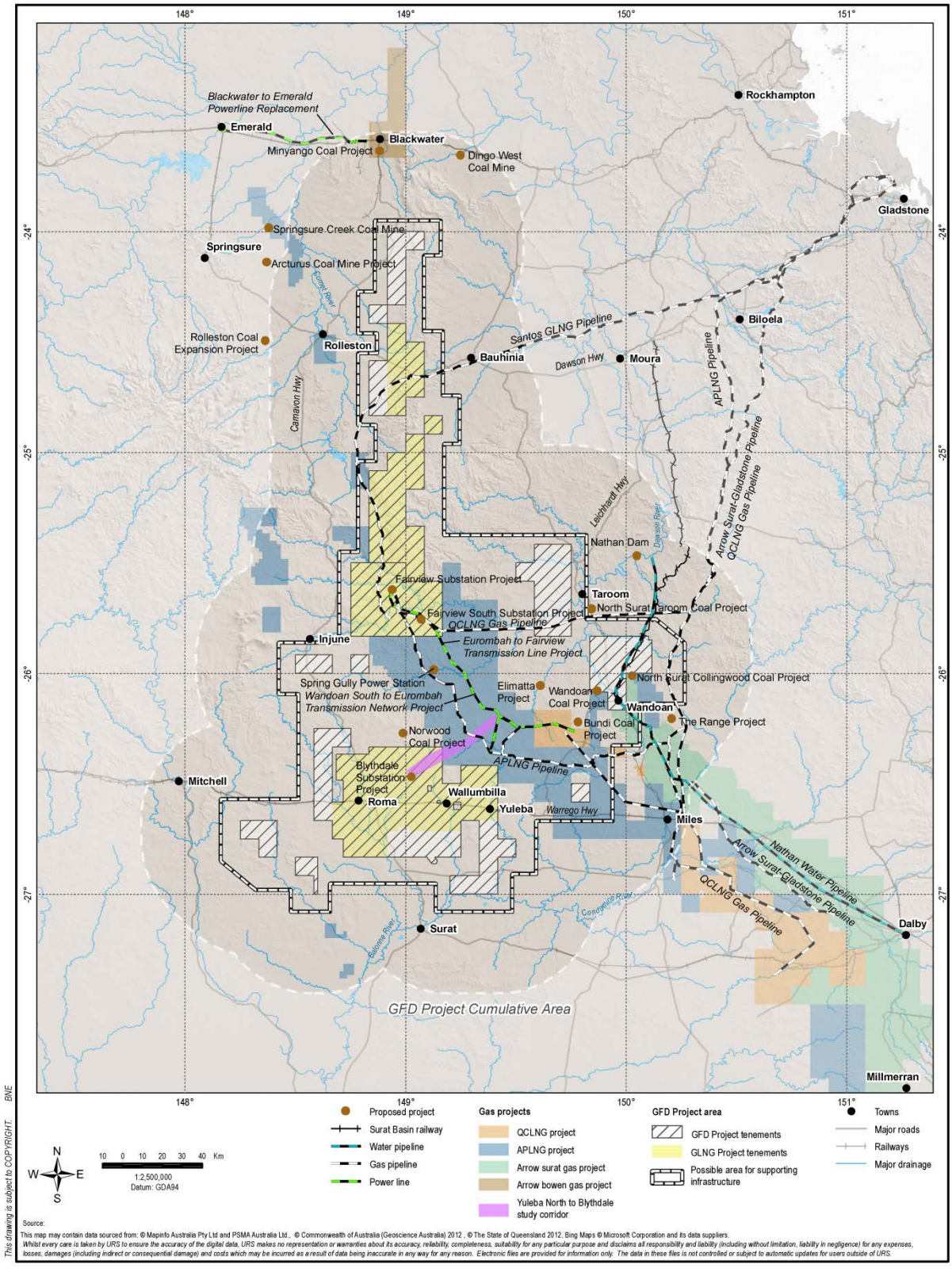
Table 6-3 Project inclusion criteria – cumulative impact assessment

No.	Criteria
a)	Are currently being assessed under Part 1 of the Chapter 3 of the EP Act and as a minimum, an Initial Advice Statement (is available on the Queensland Department of Environment and Heritage Protection website.
b)	Have been declared a 'coordinated project' by the Coordinator-General under the *Sustainable Development and Public Works Organisation Act 1971* (Qld) and an EIS is currently being prepared or is complete and as a minimum, an g assessed under Part 1 of the Chapter 3 of the EP Act and as a minimum, an IAS is available on the Queensland Department of State Development, Infrastructure and Planning website.
c)	Will, or may, use resources located within the region (including materials, groundwater, road networks or workforces) that are the same as those to be used by the GFD Project.
d)	Could potentially compound residual impacts that the GFD Project may have on environmental or social values.

Projects that are excluded from the GFD Project's cumulative impact assessment are:

- Existing or historic projects within the GFD Project area and surrounding buffers that are considered to constitute part of the baseline environment
- Projects that have not been developed to the point that their environmental assessment process has been made public.

Figure 6-1 Projects within 50 km of the GFD Project



Source: URS, 2014; File No: 42627064-g-1073.mxd

Table 6-4 Projects included in the cumulative impact assessment

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
Australia Pacific LNG (APLNG) *Origin Energy and Conoco Phillips*	Integrated LNG project. Development of ~10,000 gas wells over ~5,700 km^2. 450 km gas transmission pipeline. LNG plant and export facility (4 trains with a total capacity of up to 18 Mtpa of LNG)	Gas fields: 2010 to 2027 Pipeline: mid-2012 to late-2013. LNG facility: 2011 to 2014	Gas fields: 2,100 Pipeline: 800 LNG facility: 2,100	Gas fields: 700 Pipeline: 20 LNG facility: 100 for 1 train and 75 for each additional train.	30	APLNG tenures lay north-west to south-east within 50 km buffer area. Gas fields development periods will overlap. This project has potential to increase intensity and or frequency of receptors views of gas to LNG infrastructure.	b)
Arcturus Coal Mine Project *Springsure Creek Coal*	Open cut and underground mine and associated infrastructure.	Unknown	300	150	30	Located ~50 km west of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Blackwater to Emerald Power line Replacement *Ergon Energy*	Upgrade the existing aged power line from Blackwater to Emerald to 66kV or 132kV dual circuit concrete pole line.	2014	Unknown	Unknown	30-40	Northwest of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	c)
Blythedale, Fairview and Fairview South Substations Project *Powerlink*	Three 132kV substations are proposed to supply future gas compression facilities at Santos GLNG's Roma and Fairview gas fields.	2014	Unknown	Unknown	40-50	Located near and will supply electricity to facilities within Roma and Fairview gas fields. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	c)

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
Bowen Gas Project *Arrow Energy*	Gas project. 6,625 gas wells and associated infrastructure over ~8,000 km^2	Commence construction of facilities 2015, initial well drilling from 2016, and production from 2017.	1,540	597	40	ATP 1025 is located ~40 km north of Arcadia gas field. Gas field development period will overlap. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Bundi Coal Project *Metro Coal*	Underground coal mine and associated infrastructure. 5 Mt/y of product coal.	Commence construction 2013, with operations to commence 2015.	300	150	20	Located ~20 km south of Scotia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Dingo West Coal Mine *Dingo West Coal*	Open cut coal mine. 1 Mt/y of product coal	Unknown	220	120	30	Located ~45 km north-east of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Elimatta Project *Taroom Coal*	Open cut coal mine. 5 Mt/y product coal	Commence construction mid-2013 to mid-2015	500	300	40	Located ~25 km west of Scotia and ~25 km south of Scotia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
Eurombah to Fairview Transmission Line Project *Powerlink*	Two proposed transmission lines to supply power to proposed substations at Fairview and Fairview South to supply power to future gas processing facilities.	2014	Unknown	Unknown	30-40	Located near and will supply power to facilities within Roma and Fairview gas fields. Components of this project have the potential to be seen in context of GFD Project activities.	c)
Gladstone LNG Project *Santos GLNG*	Development of ~2,650 wells over ~6,900 km^2. 435 km gas transmission pipeline. LNG facility of ~10 Mtpa capacity	Commence construction 2010 to 2022	Gas fields: 960 Pipeline: 1,000	Gas fields: 820 Pipeline: 20	25	Makes up approved development area of GFD Project. Gas field development periods will overlap.	b)
Minyango Coal Project *Blackwater Coal*	Underground coal mine. 7.5 Mt/y of product coal	Information not available	Information not available	Information not available	40	Located 40-45 km north of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Nathan Dam and Pipelines *Sunwater*	888,000 ML dam, with an annual yield of 66,000 ML. 260 km trunk pipeline	Commence construction July 2013 to June 2016.	425	5	100	Dam: Located 30 km east of Scotia gas field. Pipeline: runs from dam, through Scotia gas field to Dalby.	b)
Norwood Coal Project *Metro Coal*	Underground coal mine. 5 Mt/y of product coal	Commence construction 2015, with operations commencing 2017	300	150	20	Located 5 to 10 km north of Roma and 45 km south of Fairview gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
North Surat - Collingwood Coal Project *Cockatoo Coal*	Open cut coal mine. 6 Mtpa thermal coal.	Commence construction Q2 2014 to Q4 2015	1,000	400	20	Located immediately east of Scotia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	b)
North Surat Taroom Coal Project *Cockatoo Coal Limited*	Open cut coal mine. 8 Mt/y thermal coal.	Commence construction Q4 2013 to Q2 2015	1,000	550	25	Located 10 km east of Scotia gas field.	b)
Queensland Curtis LNG (QCLNG) *Queensland Gas Company*	Development of ~6,000 wells over ~4,700 km^2. 380 km of gas transmission pipeline. LNG facility on Curtis Island with operating capacity of 12 Mtpa.	Commence construction Q2 2010 to Q3 2013.	4,000	1,000	20	Located ~30 km south-west of Scotia gas field and ~25 km north-east of Roma gas field. Gas field development period will overlap. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	b)
Rolleston Coal Expansion Project *Rolleston Coal Joint Venture*	Expansion of existing Rolleston Coal mine. 10 open cut pits Expansion from 10 Mt/y to 20 Mt/y.	Information not available	Information not available	Information not available	Information not available	Located ~50 km west of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
Spring Gully Power Station *Origin Energy Power Limited*	A 1,000 MW combined-cycle gas-fired power station, constructed in two 500 MW stages	Unknown	400	17	Information not available	Located ~25 km south of Fairview gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	b)
Springsure Creek Coal Project *Springsure Creek Coal*	Underground coal mine. 9 Mtpa of Run of Mine (ROM) coal	Unknown	350	585	30	Located ~50 km north-west of Arcadia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project components may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Surat Gas Project *Arrow Energy*	Natural gas project. 7,500 production wells and associated infrastructure over ~8,600 km^2.	Commence construction 2013 to 2035	1,000	400	35	Located immediately adjacent to Scotia gas field and extends south-east towards Dalby. Gas field development period will overlap. Components of this project have the potential to be seen in context of GFD Project activities.	a)
Surat Basin Railway *Surat Basin Rail*	A 214 km railway in the Surat Basin that will connect the Western Railway system to the Moura Railway system.	Unknown	1,000	-	50	Rail line commences in the southern portion of Scotia gas field and runs north-east through Scotia gas field. Components of this project have the potential to be seen in context of GFD Project activities.	b)
Surat to Gladstone Pipeline Project *Arrow Energy*	470 km long pipeline from Dalby to Gladstone.	Unknown	300	10	40	Located ~5 to 10 km east of Scotia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)

Project	Description	Proposed construction dates	Estimated construction jobs	Estimated operations jobs	Lifespan (years)	Relationship to GFD Project	Criteria
'The Range' Project *Stanmore Coal*	Open cut coal mine. 7 Mt/y product coal	Unknown	300	500	25	Located ~25 km south-east of Scotia gas field. Localised impact not seen in context of GFD Project activities. However, there is a low probability that project activities may be seen in sequence in a car trip changing the receptors' overall experience of the landscape.	a)
Wandoan Coal Project *Wandoan Joint Venture*	Open cut thermal coal mine. 30 Mt/y.	Unknown	1,375	50	30	Located in south-west corner of Scotia gas field. Components of this project have the potential to be seen in context of GFD Project activities.	b)
Wandoan South to Eurombah Transmission Network Project *Powerlink*	Yuleba North Substation and a 275kV transmission line from the proposed substation to Powerlink's substations at Wandoan, Clifford Creek and Eurombah.	2014	Unknown	Unknown	30-40	Located near Scotia gas field. Components of this project have the potential to be seen in context of GFD Project activities.	c)
Yuleba North to Blythedale Transmission Line Project *Powerlink*	Proposed 132/275kV transmission line to supply power to future gas processing facilities.	2015	Unknown	Unknown	30-40 years	Located near and will supply power to facilities within Roma and Fairview gas fields. Components of this project have the potential to be seen in context of GFD Project activities.	c)

6.3 Cumulative impact assessment

Cumulative impacts to the visual amenity of the GFD Project area (+50 km buffer) will be a product of the residual visual impact of the following project activities:

- Transport and workforce presence, which presents the highest potential for cumulative visual impact across all project types
- GFD Project infrastructure occurring in the viewshed of sensitive receptors. The potential for this to occur is greater for projects whose infrastructure has limited ability to integrate into the landscape, either through height such as power lines or overall size such as mines
- Night lighting.

The potential for cumulative visual impacts from transport and workforce presence is highest where construction periods overlap (Table 6-4), and reduces considerably during operations. Based on currently published information, the greatest level of construction overlap is projected around the Scotia and Arcadia gas fields. Generally, the overlap in construction phase will be limited in the case of all project types except for other gas projects, which are expected to be developed incrementally and therefore have extended construction phases. During the operations phase of these projects, viewsheds in the Scotia gas field are again expected to have the potential to experience the greatest cumulative visual impact from the presence of traffic and workforces.

The potential for GFD Project and another project's activities to appear in the viewshed of sensitive receptors is generally considered to be low, due to the fact that the activities will be broad spread out over vast areas. The visual impact of power lines supplying the GFD Project has been assessed in the primary visual impact assessment, in Section 5 of this report. In instances where infrastructure such as above ground power lines servicing the GFD Project and those of other projects interact, there is potential for high visual impact.

Where there is the possibility of viewing linear corridors in a sequence (such as views along gas transmission pipeline and transmission lines easements from roads) the potential for cumulative impacts increases.

Night lighting from other projects will be localised and relate to production facilities as well as accommodation facilities and vehicle movement. The contribution of these sources to cumulative impact will depend on their location in relation to static viewsheds, such as homesteads and major road corridors. As the GFD Project's night lighting is limited, the potential for the GFD Project's to interact with night lighting of another project is therefore limited. However, it is possible that previously lightless landscapes will have an increase in small focal light sources. Lights may be visible up to distances of three kilometres tempered by topography and vegetation.

The overall cumulative visual impact in the region is likely to be low. The reason for this relates to the limited extent of sensitive visual receptors in the GFD Project area, with the exception of homesteads. The consequence of the cumulative residual impacts in the GFD Project area and surrounds are summarised in Table 6-5.

Table 6-5 Significance of cumulative residual impacts

Key residual impacts	Consequence
Increase in frequency of views to project components	Low
Increase in road traffic and heavy vehicles	Moderate
Increase in night lighting	Low

The most effective visual impact mitigation strategy for minimising cumulative visual impact remains to be avoidance through location selection during the planning and field development phase. Effective placement of GFD Project infrastructure away from the viewsheds of sensitive receptors such as roads will reduce impact and the cumulative visual impact.

Most visual impact mitigation strategies have already been implemented and are part of existing standard environmental operations procedure. They include:

- Avoiding unnecessary disturbance
- Co-locating linear elements to minimise easement clearances
- Limiting the extent of vegetation clearing
- Rehabilitating disturbed areas (e.g. land form contouring and revegetation) as soon as practical.

In addition and as needed ‘at viewing point’ treatments in high exposure areas can reduce visual impact, achieving a reduction in overall impact.

7 Conclusion

The GFD Project is an extension of the approved GLNG Project gas field development and will involve the construction, operations, decommissioning and rehabilitation of wells and the associated supporting infrastructure needed to provide additional gas over more than 30 years. It is spread over a large regional area within four local government areas namely, Banana Shire and Central Highlands, Maranoa and Western Downs regional councils.

The visual effect and potential impacts of the GFD Project depends on the interaction between the GFD Project component and the sensitivity of the landscape in which it will occur – in this case, sensitivity comprises the frequency that it will occur in a landscape, the underlying visual absorption capacity of the landscape and the line of sight of sensitive receptors.

The majority of the GFD Project activities are industrial in nature and therefore have the potential to contrast strongly with the existing rural landscapes. GFD Project activities have the potential to create a visual effect and impact during the construction phase, especially on local settings. However, this reduces at the end of construction depending on the size and scale of the activities, rehabilitation works undertaken.

The most frequent and numerous GFD Project activities, such as wells and power lines, are relatively small scale and occupy only small parts of the view. Consequentially, their visual impact decreases over shorter distances than the relatively larger GFD Project activities, such as the gas compression facilities.

In addition to scale considerations, some GFD Project activities borrow visual character from the existing landscape, drastically reducing contrast and visual effect. This is the case with most of the pipelines in the GFD Project area, the exception being pipelines in forest vegetated areas. Similarly, water management facilities, particularly water storage, are similar in visual character to agricultural infrastructure and integrate well into the visual environment.

With the implementation of avoidance strategies, such as the Constraints protocol and appropriate impact mitigation strategies, it is possible to minimise significant visual impact of individual GFD Project activities as well as the cumulative impacts of the GFD Project as a whole. None the less, if the visual effect and impact on such a view were unavoidable and considered to be significant, treatments should be considered and incorporated into the design as part of the GFD Project environmental management framework.

It is possible to visually integrate GFD Project elements into the landscape, with colour and placement of production wells being a significant tool in mitigation of impacts. Larger facilities should ideally be situated outside the view sheds of residences. But again, if they are within view sheds of these sensitive receptors, visual effects can be reduced by screening and or visual integration landscape treatments at the facility and or at the point of viewing.

8 References

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