

Draft environmental management plan
Rehabilitation management plan



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Santos GLNG Upstream Rehabilitation Management Plan

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Abbreviations and Units

Acronym	Description
AS	Australian Standard
ATP	Authority to Prospect
CSG	Coal Seam Gas
DAMP	Decommissioning and Abandonment Plan
EA	Environmental Authority
EHS	Environment, Health and Safety
EHSMS	Environment, Health and Safety Management System
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
ESA	Environmentally Sensitive Area
ESCMP	Erosion and Sediment Control Management Plan
GED	General Environmental Duty
GFD Project	Gas Field Development Project
GLNG	Gladstone Liquefied Natural Gas
ha	hectares
ISO	International Organisation for Standardisation
m	metres
m ²	Square metres
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	<i>Nature Conservation Act 1992</i>
NZS	Standards New Zealand
PWMP	Pest and Weed Management Plan
Qld	Queensland
RE	Regional Ecosystem
RMP	Rehabilitation Management Plan
SDPWOA	<i>State Development and Public Works Organisation Act 1971</i>
SSMP	Significant Species Management Plan
TEC	Threatened Ecological Community

1.0 Introduction

Santos GLNG is developing Coal Seam Gas (CSG) resources in the Surat and Bowen Basins in Queensland. Santos GLNG currently has approval to develop 2,650 production wells and associated infrastructure across a number of tenements within the Santos GLNG gas fields of Roma, Fairview and Arcadia. The Santos GLNG Gas Field Development Project (the GFD Project) is an expansion of the existing approved Santos GLNG Project and will involve the construction, operation, decommissioning and rehabilitation of additional production wells, and associated supporting infrastructure that will provide additional gas over a project life exceeding 30 years.

The GFD Project will expand the Santos GLNG Project's gas fields from 6,887 km² to 10,676 km² and develop an additional 6,100 production wells beyond the currently authorised 2,650 production wells; resulting in a maximum of 8,750 wells. Starting in 2016, the GFD Project will progressively develop wells and associated supporting infrastructure across 35 Santos GLNG petroleum tenements, which includes the existing project area and surrounding tenures located in the Arcadia, Fairview, Roma and Scotia gas fields. These areas combined are referred to as the Santos GLNG Upstream Project Area.

Project activities will result in disturbances to land and associated environmental values, including vegetation communities, Environmentally Sensitive Areas (ESAs), Matters of National Environmental Significance (MNES), soils and fauna habitat. These disturbances may be temporary or long-term, dependent on the petroleum activity resulting in the disturbed area.

Santos GLNG has developed a comprehensive approach to environmental management designed to avoid, manage and mitigate impacts. Rehabilitation in conjunction with offsetting form the key components of Santos GLNG's long-term strategy for mitigating disturbances to land. To minimise long-term impacts to environmental values, Santos GLNG will rehabilitate disturbances in accordance with regulatory requirements and in consultation with landholders, throughout the Project lifetime. This Rehabilitation Management Plan (RMP) provides an overview of Santos GLNG's approach to rehabilitation of Project-related disturbances within the Santos GLNG Upstream Project Area.

1.1 Purpose and Scope of the RMP

1.1.1 Purpose

Santos GLNG has a legal responsibility and responsibility to landholders to restore and/or rehabilitate Project-related disturbances. This RMP has been prepared to ensure these responsibilities are satisfied and to complement the overarching Santos Environment, Health and Safety Management System (EHSMS).

The objectives of the RMP are to:

- Facilitate compliance with relevant Commonwealth and State legislation, regulations and approvals;
- Support the Santos *Environmental Hazard Standard 01 – Biodiversity and Land Disturbance* (EHS01); and
- Provide a framework for Santos GLNG to determine rehabilitation objectives for Project-related disturbances within the Santos GLNG Upstream Project Area.

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1.1.2 Scope

This RMP has been prepared to outline the rehabilitation objectives for Project-related disturbances within the Santos GLNG Upstream Project Area. This includes the phasing of rehabilitation to first achieve stabilisation and subsequently final rehabilitation for disturbances to land (i.e. ground surface).

Specifically, this RMP:

- 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; and
- Provides an overview of monitoring and maintenance actions to be conducted on rehabilitated areas.

The RMP does not address the decommissioning, demolition or abandonment of infrastructure at the cessation of Project activities as identified in the Santos GLNG *Decommissioning and Abandonment Management Plan* (DAMP). Decisions for infrastructure to remain or be abandoned in-situ described in the DAMP includes consideration of the feasibility and likely success of rehabilitation outcomes outlined as part of this RMP. Conduct and Compensation Agreements between Santos and landholders can also stipulate the retention and transfer of ownership of assets to the landholder once operations have ceased. The RMP does not consider the rehabilitation of transferred assets.

The RMP is to be implemented by all Santos GLNG Project personnel responsible for rehabilitation works throughout the Project lifetime.

This RMP applies to activities carried out within the Santos GLNG Upstream Project Area. The Santos GLNG Upstream Project Area consists of Santos GLNG petroleum tenements comprising the Arcadia, Fairview, Roma and Scotia gas fields and as illustrated in Figure 1.

2.0 Roles and Responsibilities

Santos GLNG Project personnel are responsible for the environmental performance of their activities, for complying with relevant approval / permit requirements and for ensuring that all environmental objectives associated with the work are achieved. Santos GLNG Project personnel must also be mindful of the General Environmental Duty (GED) as outlined in the *Environmental Protection Act 1994* (Qld) (EP Act). Section 319(1) of the EP Act states that “a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm.”

Roles, responsibilities and accountability under the RMP will be assigned in accordance with the *Santos EHSMS05 – Responsibility and Accountability*.

3.0 Legal and Other Requirements

3.1 Legal Requirements

Santos GLNG must comply with all relevant Commonwealth and Queensland legislation and approvals. A summary of primary legislation considered in the development of the RMP is presented in Table 1.

Table 1: Summary of Applicable Legislation

Act or Strategy	Summary of Act or Strategy
<i>Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	The EPBC Act is the Commonwealth Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important fauna species and ecological communities. The EPBC Act focuses Commonwealth Government interests on the protection of Matters of National Environmental Significance (MNES), with the states and territories having responsibility for matters of state and local significance. MNES includes listed migratory species as well as threatened species and communities.
<i>Environmental Protection Act 1994 (EP Act)</i> <i>Environmental Protection Regulation 2008 (EP Reg)</i>	The EP Act provides for environmental management practices and environmental safeguards. The EP Act is applicable to the GFD Project in regards to Environmental Authorities (EAs). Each stage of the development of a gas lease requires an EA before the issue of a license. The EP Act details the process of environmental assessment for the granting of EAs. Conditions of EAs will stipulate rehabilitation outcomes for Project disturbances. Rehabilitation is a requirement under the EP Act. Further, EAs cannot be surrendered until rehabilitation of all project disturbances is deemed successful. The EP Act provides a mechanism for Santos GLNG to give landholders infrastructure by agreement.
<i>State Development and Public Works Organisation Act 1971 (SDPWOA)</i>	Under Section 35 of SDPWOA the Coordinator-General must prepare the Coordinator-General's report for an Environmental Impact Statement. In evaluating the Environmental Impact Statement, the Coordinator-General may state conditions and make recommendations. Conditions relevant to rehabilitation in the Santos GLNG gas fields will be provided in the Coordinator-General's evaluation report for the GFD Project EIS.
<i>Nature Conservation Act 1992 (NC Act)</i> <i>Nature Conservation (Wildlife Management) Regulation 2006 (Qld) (NC Regulation)</i>	The primary purpose of the NC Act is to conserve biodiversity by protecting wildlife and its habitat. Under the NC Act, permits are required for the taking and/or relocation of protected flora and fauna under this Act. Rehabilitation is a commitment made to minimise impacts to these species and is usually a requirement of approval.

3.2 Santos Environment, Health and Safety Management System

The Santos EHSMS provides a framework for environmental and safety practices across Santos operations worldwide. The framework is consistent with *AS 4801:2000 Occupational Health and Safety Management Systems* and *AS/NZS ISO 14001:2004 Environmental Management Systems*.

This RMP complements the requirements of the EHSMS, in particular, the Santos Environmental Hazard Standard *EHS01 Biodiversity and Land Disturbance*. This standard defines the requirements to minimise environmental impacts associated with disturbance to biodiversity and/or land during oil

and gas exploration, production, processing and rehabilitation activities. An additional relevant EHSMS standard is *EHS06 – Environmental Impact Assessment and Approvals*. This standard discusses both external and internal approval requirements necessary prior to conducting disturbances to land.

This RMP specifically addresses unique features and requirements relating to the Santos GLNG Project. GLNG specific documentation is based on identified environmental and reputational risks and accounts for Santos GLNG’s legal and other obligations, commitments made by the Santos GLNG Project and Santos GLNG’s Social Licence to Operate.

In this context, the RMP also provides additional guidance for the management of environmental issues and support the development of asset / activity / department-based guidelines and work instructions, in order to secure compliance with legal requirements as well as deliver on company environmental standards.

The Santos approach to environmental management is illustrated in Figure 2.



Figure 2: The Santos Approach to Environmental Management

There are a number of key Santos GLNG documents relevant to rehabilitation objectives and management within the Santos GLNG Upstream Project Area. These are summarised in the following sections.

3.2.1 Decommissioning and Abandonment Plan (DAMP)

The DAMP describes the proposed decommissioning and abandonment of specific Project assets in the Santos GLNG Upstream Project Area and also identifies infrastructure types that will be abandoned in-situ (i.e. not removed from site). Assets abandoned in-situ will not be subject to the rehabilitation measures outlined in this RMP.

3.2.2 Erosion and Sediment Control Plan (ESCMP)

The ESCMP describes Santos GLNG’s approach to the management of erosion and sediment control for Project activities. The appropriate use and management of erosion and sediment control measures during rehabilitation works will be critical to the success of rehabilitation.

3.2.3 Pest and Weed Management Plan (PWMP)

The PWMP outlines Santos GLNG's approach to pest and weed management in the gas fields. The plan introduces measures to address the four key pest and weed management concepts of Identify, Avoid, Minimise / Mitigate and Control. The management of pests and weeds during rehabilitation activities will be critical in achieving rehabilitation success.

3.2.4 Environmental Offsets Strategy

The *Santos GFD Project Environmental Offsets Strategy* is an approach to provide environmental benefits to counterbalance the impacts that remain after avoidance, minimisation, mitigation and remediation measures. Where required, Santos GLNG will provide suitable offsets for activities that result in a significant residual adverse impact to MNES and Matters of State Environmental Significance (MSES).

The RMP describes different rehabilitation objectives for disturbances in natural areas that have been offset compared to all other natural areas.

4.0 Santos GLNG Approach to Rehabilitation

Rehabilitation activities within the Santos GLNG Upstream Project Area are designed to meet three overarching objectives. These are to:

- Ensure sites are left as safe, stable, non-polluting landform for humans, native fauna, and livestock;
- Minimise loss of land capability within agricultural areas;
- Assist in the minimisation of long-term impacts to:
 - Environmentally Sensitive Areas (ESAs);
 - Regional Ecosystems (REs) (other than ESAs); and
 - Matters of National Environmental Significance (MNES), including:
 - Threatened Ecological Communities (TEC); and
 - Significant species (flora and fauna) habitat.

An overview of the lifecycle of disturbances within the Santos GLNG Upstream Project Area is illustrated in Figure 3. Within the disturbance life-cycle, there are two distinct stages of rehabilitation works that are carried out by Santos GLNG for Project-related disturbances:

- **Stage 1 – Stabilisation** - Stabilisation works are completed post-construction within construction footprints of operational assets. Areas are stabilised to enable the safe and effective operation of assets, to minimise the risk of on-going environmental issues such as erosion, soil loss and weed invasion and to return areas to the host use (such as productive grazing) wherever possible. Santos GLNG will look to promote stabilisation and reduce the footprint size of the disturbances where practical.
- **Stage 2 - Rehabilitation** - Disturbance footprints that are no longer required for operational purposes are returned to the previous land use, or to a land use in accordance with landholder needs and regulatory requirements. Alternatively, this may involve providing an offset or creating an environment conducive to returning pre-disturbance biodiversity values.

These two rehabilitation stages are discussed further in the following Sections.

4.1 Stage 1 – Stabilisation

Stabilisation works are carried out on significantly disturbed areas of land associated with construction activities that surround or are adjacent to operational assets. The stabilised area may not be regularly utilised in day-to-day operational activities, however, it may still be required for the safe operation of the asset (e.g. safety buffer) or future additional construction / maintenance works (e.g. well work-over). In-line with Santos GLNG's rehabilitation objectives, stabilisation aims to achieve a landform which is safe, non-polluting and stable. Stabilisation works involve the following activities:

- Remediating areas of contaminated land resulting from petroleum activities (where required and in accordance with the *Santos EHS08-Contaminated Sites*);
- Re-establishing surface drainage lines;
- Re-profiling of contours for operational use;
- Reinstating the top soil;
- Soil amelioration through the appropriate assessment and treatment of soils where required; and

- Stabilising soils by methods such as amelioration (where required), promoting establishment of groundcover vegetation (that is not a declared weed) or through use of other techniques such as spreading mulch or gravel or utilisation of geotextiles or other engineered materials.

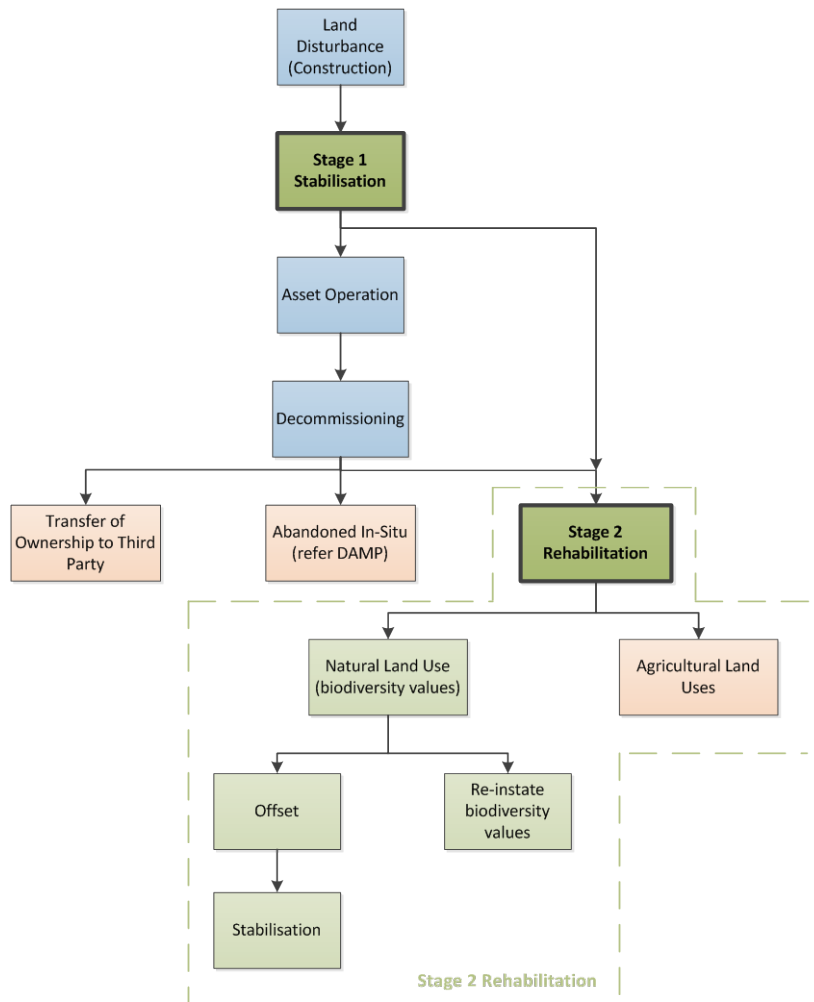


Figure 3: Disturbance Lifecycle

Stabilisation works are to commence at the completion of construction activities, with the aim of being able to demonstrate the successful completion of the above works within 12 months of the time that the area is no longer required for day-to-day activities.

The most prevalent examples of disturbances required to undergo stabilisation works in the Santos GLNG Upstream Project Area are extended areas of operational well leases and operational pipeline and flowline easements. Other examples may include the perimeter of assets, road verges and fire breaks.

4.1.1 Well Leases

Following the completion of a gas well, stabilisation works within a portion of the well lease will occur. The size of the well pad hardstand area will be reduced to an appropriate size for operational use that will remain for the well's operational life (Refer Figure 4). Works involve the filling of sumps and voids, compaction relief and the installation of erosion and sediment controls in addition to those activities listed in Section 4.1.

The stabilised area of the well typically must stay in place for the operational life of the well, which is generally greater than 20 years. This area cannot undergo Stage 2 rehabilitation for two principal reasons:

1. The area may be required intermittently throughout the well lifetime for well work-overs / stimulation events; and
2. The area acts as a firebreak.

Stage 2 rehabilitation may be able to occur on land that is not required for on-going operational use and may be able to be returned to an agricultural land use such as grazing or cropping. These land uses present a low risk to the asset and the area can be disturbed again and rehabilitated at low expense (compared to disturbing a re-vegetated site). In this context, the green area shown in Figure 4 may satisfy Stage 2 Rehabilitation criteria. While stage 2 rehabilitation is the preferred option, it is important to note that rehabilitation is conducted on a case by case basis and is subject to operational constraints such as access tracks.

In all other instances, Stage 2 rehabilitation will occur following decommissioning and abandonment of the well.

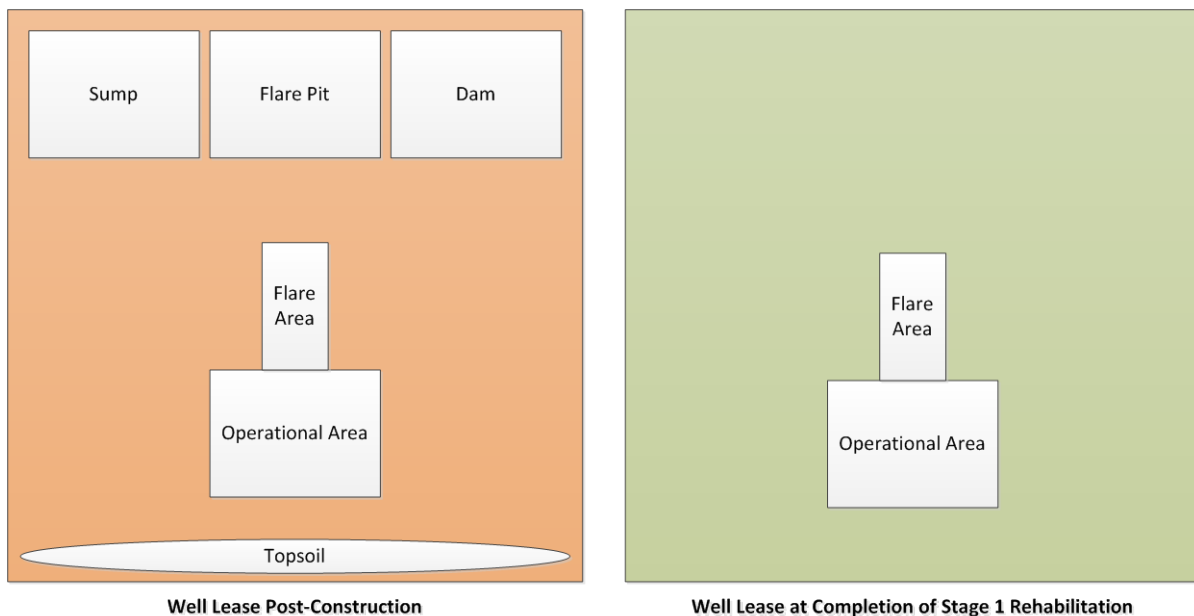


Figure 4: Well Lease Post Construction vs Stage 1 Rehabilitation

4.1.2 Pipeline and Flowline Easements

Following the completion of construction of a pipeline, the operational pipeline easement undergoes stabilisation works. The operational easement will vary in width dependent on how much infrastructure is located within the easement (e.g. co-located water and gas pipelines, powerlines, fibre optic cable etc). This section of the easement cannot undergo Stage 2 rehabilitation as it must remain free of significant vegetation to maintain the pipeline's integrity. The pipeline may also be subject to maintenance throughout its lifetime, which may require disturbance to the easement.

Stage 2 rehabilitation will occur in areas outside of the operational easement (Refer Figure 5). Where the pipeline is located within agricultural land uses, Stage 2 rehabilitation is often able to occur across the entire easement (subject to landholder agreements).

Following pipeline decommissioning, Stage 2 rehabilitation will occur across the entire easement to reinstate a natural landform and associated vegetation, or to re-establish pasture (as appropriate).

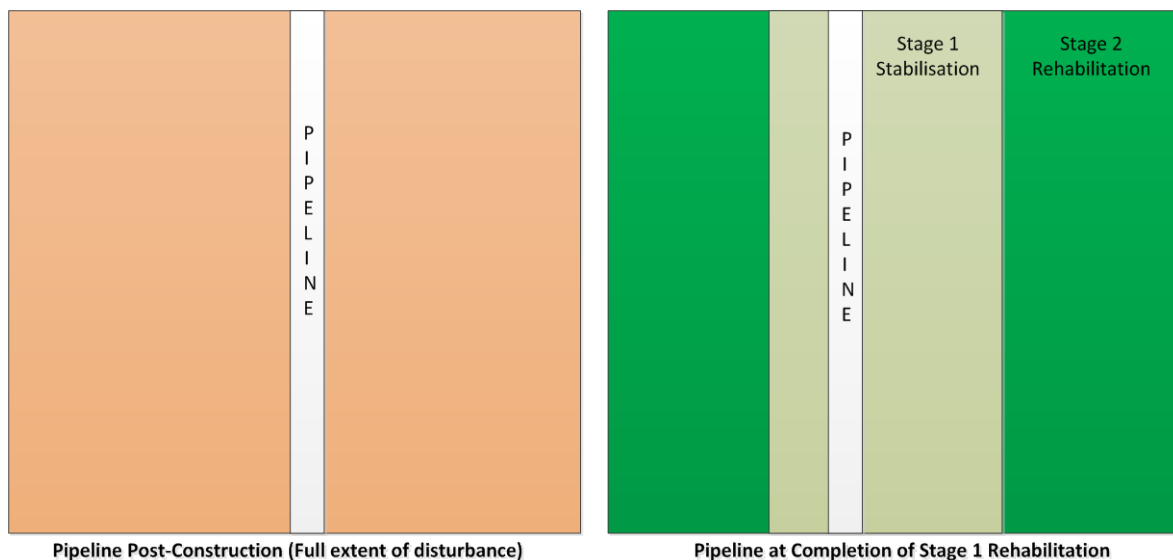


Figure 5: Pipeline Easement Post Construction vs Stage 1 Rehabilitation

4.2 Stage 2 - Rehabilitation

Stage 2 rehabilitation is carried out on significantly disturbed areas that are no longer required for operational use. This may occur post-construction (e.g. disturbed construction footprint not required for operations) or post-decommissioning (e.g. closure of temporary camps and laydown areas, well leases, pipelines etc.)

Stage 2 rehabilitation works carried out by Santos GLNG aim to achieve a final landform and land use. In most instances, this will be returning the land to its pre-disturbance state or providing the foundations for the land to return to its pre-disturbance state. Figure 6 provides an overview of the rehabilitation framework and objectives dependent on the land use for which Santos GLNG is aiming to return the land. Agricultural land uses, in the form of grazing and cropping, or natural areas, comprising MNES (TEC / Threatened species), ESAs and other forms of vegetation, are the two most common environmental values or pre-disturbance land uses that Santos GLNG will aim to rehabilitate.

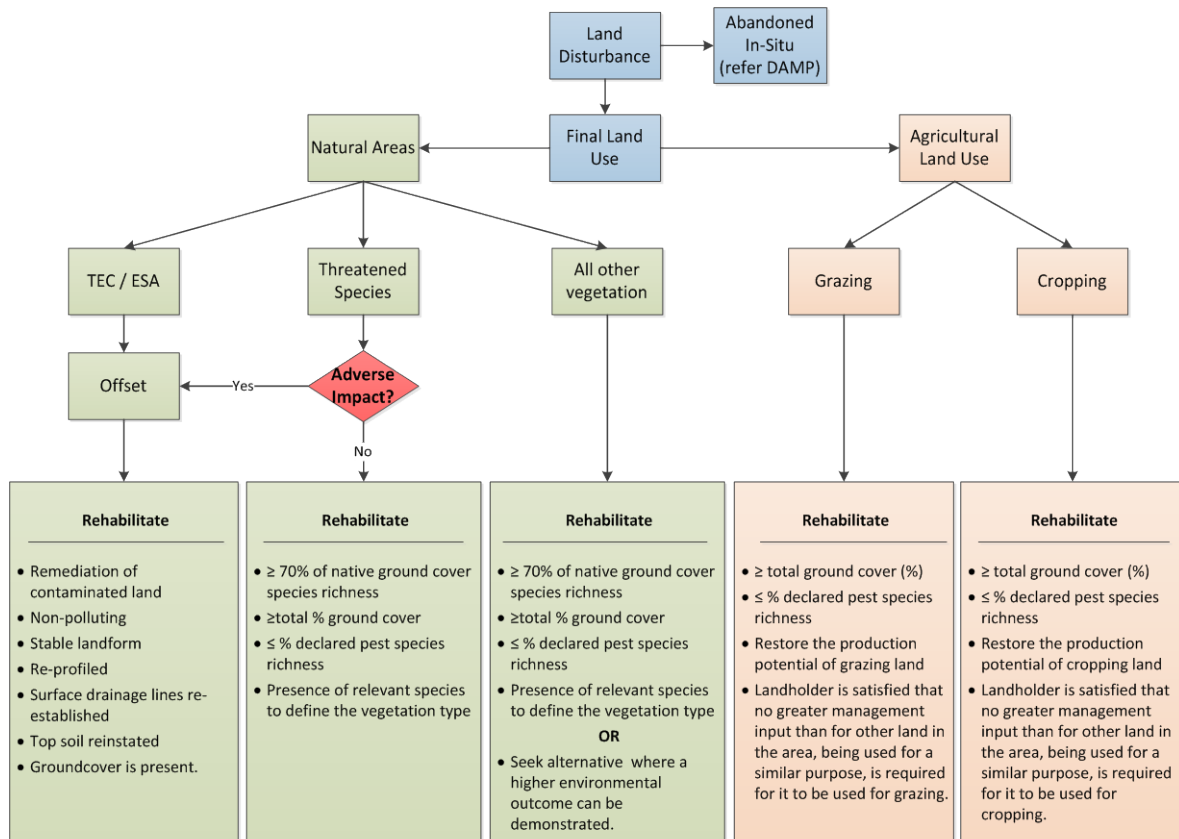


Figure 6: Stage 2 - Rehabilitation Framework and Objectives

Regardless of the end land use, all Stage 2 rehabilitation works will aim to achieve a safe, non-polluting and stable landform, incorporating the following:

- Remediation of contaminated land resulting from petroleum activities (where required and in accordance with the *Santos EHS08 – Contaminated Sites*);
- Re-established surface drainage lines;
- Re-profiled contours to be consistent with the surrounding landform;
- Safe landform to humans and livestock in areas of significant cut and fill;
- Reinstated top soil where it has been stripped; and
- Stable soil structure comparable to natural soils in the area.

Rehabilitation objectives beyond those listed above for agricultural land uses and natural areas are outlined in Sections 4.2.1 to 4.2.2.3 below.

For Santos GLNG activities involving significant cut and fill operations, in particular borrow pits and quarries, the above criteria are the complete rehabilitation objectives for the disturbance area. These areas will not be rehabilitated to the pre-existing or adjacent land use as this is not a practical or achievable outcome. Instead, the area will undergo landform management, to ensure the final landform is stable, non-polluting and safe to humans, livestock and wildlife through the use of methods such as benching, surface re-profiling, contouring and stormwater diversion.

4.2.1 Agricultural Land Use

Within the Santos GLNG Upstream Project Area, agricultural land is most commonly comprised of grazing activities and to a smaller extent cropping (irrigated or dry land uses) and forestry. Rehabilitation works within these areas will concentrate on restoring the productive potential of the land, through considered soil and weed management. This is particularly relevant for disturbances located within Strategic Cropping Areas. Works will consider seasonal growth factors and other variables like topography, soil type, existing vegetation and availability of topsoil. All rehabilitation works will be completed in consultation with the landholder.

The rehabilitation objective for agricultural land uses (in addition to those listed in Section 4.2) is to be able to demonstrate that the:

- Percentage ground cover within the rehabilitated area is equal to or greater than the surrounding undisturbed area;
- Percentage of declared species richness is less than or equal to the surrounding undisturbed area; and
- Landholder is satisfied that the rehabilitated land has no greater management input than for other surrounding land that is being used for a similar purpose (i.e. cropping or grazing).

Santos GLNG will conduct regular monitoring of a representative selection of rehabilitated areas to demonstrate that works are on the appropriate trajectory to meet the rehabilitation criteria and objectives. Where required, maintenance measures will be implemented. It is anticipated that successful Stage 2 rehabilitation within agricultural areas should be able to be attained within 3-5 years, but will be climate dependent. At this time, landholders will be requested to formally approve the rehabilitation to demonstrate their satisfaction of the completed works.

4.2.2 Natural Areas (Biodiversity Values)

Natural areas within the Santos GLNG Upstream Project Area have been categorised into three groups:

- TECs and ESAs (Endangered and Of Concern RE)
- Threatened Species (flora and fauna); and
- All other REs.

As illustrated in Figure 6, each category of natural area has slightly different rehabilitation criteria. This is primarily in recognition of the other significant contributions that Santos GLNG has made to minimise / mitigate impacts to these values in the form of offsets.

4.2.2.1 TECs and ESAs

TECs and ESAs are one of the highest biodiversity values present within the Santos GLNG Upstream Project Area. Accordingly, impact on these areas is governed by significant regulation. Santos GLNG is required to offset each disturbance to counterbalance any significant residual adverse impact caused by the petroleum activity (at a ratio far in excess of 1:1). As such, the values associated with the significant residual adverse impact have effectively been replaced through provision of the offset.

Santos GLNG will not rehabilitate disturbances in these areas to the pre-disturbance value. Instead, Santos GLNG will rehabilitate to a feasible level to achieve a safe, stable and non-polluting landform, by conducting the activities described in Section 4.2. Groundcover will be returned to ensure that the site is stable. These foundations should be sufficient to enable natural regeneration of the area to

occur over time. At this time, Santos will seek to bring to a close its responsibility for rehabilitation works.

4.2.2.2 Threatened Species

Similar to TECs and ESAs, threatened species and their habitats are significant biodiversity values subject to substantial regulation and offset requirements. Santos GLNG will offset significant residual adverse impacts to these species or their habitats, caused by Santos GLNG activities. The significant residual adverse impact is dependent on the disturbance type and the adaptability of the species in question. This may be the equivalent of, or less than, the area that is disturbed by the petroleum activity.

Where an offset is provided for a significant residual adverse impact, the equivalent area will be rehabilitated to satisfy the same objectives for TECs and ESAs as discussed in Section 4.2.2.1. Where disturbances have not resulted in a significant residual adverse impact, the disturbed area will be rehabilitated with the objective of returning the land to match the values of the adjacent land use at the time of commencement of the rehabilitation works.

Where the adjacent land use is natural, Santos GLNG will seek to return the biodiversity values of the area. Because this can be a very lengthy process due to the complexity of aged vegetation communities (in excess of 90 years for some communities), Santos GLNG propose to measure rehabilitation success by ensuring the following criteria are met:

- A landform that is stable, non-polluting and safe to humans and wildlife (as per Section 4.2);
- Greater than or equal to 70% of native groundcover species richness of the adjacent land use;
- Greater than or equal to 50% ground cover of the adjacent land use;
- Less than or equal to the declared pest species richness of the adjacent land use; and
- The presence of relevant species that will form the ecologically dominant layer and define the target vegetation group.

By satisfying the above criteria, Santos GLNG will have provided a stable landform with cover that is sufficiently diverse to prevent significant weed encroachment and support natural succession and regenerative processes. The land should not require further management. At this time, Santos GLNG will seek to bring to a close its responsibility for rehabilitation works.

4.2.2.3 All other REs

All other REs that do not comprise a TEC, ESA or threatened species habitat (e.g. not of concern vegetation and regrowth) have lower conservation status and accordingly a wider range of rehabilitation options are available:

1. Carryout rehabilitation works with the objective of returning the land to match the biodiversity values of the adjacent land use. The rehabilitation criteria to be met is in line with those described in Section 4.2.2.2.
2. Seek an alternative outcome to rehabilitation where a greater environmental benefit can be obtained. This will be adopted for regional ecosystems where it is thought unlikely that rehabilitation criteria in (1) can be achieved due to reasons such as community complexity, localised conditions or feasibility and reasonability. Instead, Santos GLNG may identify opportunities where money can be better invested to obtain a greater net environmental benefit. Examples include voluntary offsets or the delivery of green infrastructure such as improved riparian corridors or better linkages between significant remnant vegetation patches in a

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landscape. The decision to invest in such strategies will be made on a case-by-case basis. Where this approach is adopted, Santos GLNG would return the disturbed area to reflect the stable, non-polluting and safe landform principles described in Section 4.2.

Santos GLNG will conduct regular monitoring of a representative selection of rehabilitated areas to demonstrate that works are on the appropriate trajectory to meet the rehabilitation criteria and objectives. Where required, maintenance measures will be implemented. The anticipated timeframe for successful Stage 2 rehabilitation within natural areas is unknown, as it will be dependent on numerous factors, many of which will be outside of Santos GLNG's control (such as weather). At the time rehabilitation is considered successful by Santos GLNG, landholders will be requested to formally advise their satisfaction of the completed works as a component of regulated EA Surrender processes.

5.0 Rehabilitation Actions

There are a number of methods available to Santos GLNG to carry out rehabilitation works. Table 2 summarises key rehabilitation actions that Santos GLNG will utilise, where required, to achieve the rehabilitation objectives and outcomes described in Section 4.0.

Table 2: Key Rehabilitation Actions

Rehabilitation Action	Description
Topsoil Management	Topsoil that is stripped and stored as part of construction activities is to be re-spread as part of stabilisation and rehabilitation activities. Correctly preserved topsoil resources can provide viable sources of seed-stock, biological life and nutrient conditions that assist with soil productivity and fertility, and thereby vegetation establishment.
Sodic Soil Amelioration	Sodic soils when encountered will be blended with an appropriate soil amelioratant (i.e. gypsum, a calcium based ameliorant) during rehabilitation processes to reduce dispersiveness. A good layer of topsoil will be placed on top of sodic soils during rehabilitation works. Amelioration with gypsum and/or lime or addition of organic mulch can improve soil structure, infiltration and soil aeration can promote vegetation establishment.
Soil Compaction	For long-term disturbances such as well leases, it is likely that the soil will have become compacted over time. Where necessary, the soil will be treated (i.e. deep ripped) to alleviate the soil compaction. This will occur prior to reshaping the upper layers of the soil stratum.
Contaminated Land	Where there is a risk of contaminated land occurring, such as brine ponds, dams and storage facilities, or other areas where significant hydrocarbons have been stored, a site specific contaminated land assessment and subsequent management plan may be developed for each asset. The contaminated land assessments will be developed in accordance with the <i>Santos EHS 08 – Contaminated Sites</i> and the <i>Queensland Guideline for Contaminated Land Professionals</i> (EHP 2012) and will be contained within an asset / site specific decommissioning and demolition plan.
Watercourse Crossings	Where clearing of riparian vegetation is unavoidable, the objective will be to reinstate the creek banks and riparian vegetation, as soon as practical post-construction. To minimise erosion and destabilisation of creek banks, erosion controls will be constructed or installed, where necessary. The surface will typically be lightly scarified before spreading the topsoil, to promote regeneration of native vegetation and prevent loss of topsoil.
Landform Management	Sites will be re-shaped to a safe and stable landform, with surface drainage lines and topsoil profile re-instated. Where practical, sites will be reshaped to a natural landform. However, it is not practical to reshape sites where cut and fill operations have occurred on slopes, or within highly dispersive soils. In these instances a stable landform will be reinstated by surface re-profiling, contouring or benching. Methods to reshape the landform will vary depending on the level of disturbance.
Revegetation	<u>Natural Regeneration</u> - Natural regeneration is the preferred method for re-instating native vegetation where short-term disturbances are proposed (less than 18 months) and a viable native seed bank is available. Natural regeneration is advantageous over assisted revegetation, as the seedlings are more likely to establish and grow rapidly with less mortality than planted individuals, as they are adapted to the local environment. Where natural regeneration is ineffective assisted revegetation will be undertaken.

Rehabilitation Action	Description
	<p><u>Assisted Revegetation</u> - In areas where long-term disturbances have occurred or where natural regeneration is deemed as ineffective, assisted revegetation will be required to ensure that disturbed areas are rehabilitated with species richness representative of the adjacent land use or natural area.</p> <p>Within areas of native vegetation, a combination of tubestock and seeding may be implemented. Tubestock will be used for canopy and shrub species, while a combination of tubestock and seeding is appropriate for herbs, forbs and grasses. Species will be selected based on assessments of the adjacent vegetation community composition and other appropriate benchmark guidelines.</p>
<p>Mulching and Placement of Vegetation</p>	<p>Vegetation cleared during construction phases, will be retained on-site for use during stabilisation and/or rehabilitation activities in the form of:</p> <ul style="list-style-type: none"> • Mulch; or • Felled timber and large logs (for habitat recreation). <p>Mulch and vegetation may be respread over the site as required where practical. This will assist in site stabilisation, revegetation efforts and suppressing weed growth</p>
<p>Weed Management</p>	<p>Where required, the PWMP will be implemented as part of site rehabilitation activities. Pest and weed management will be required to enable the regeneration of pre-disturbance land uses and to ensure that the disturbance does not allow for the introduction of new species to an area or increase the localised population of a species.</p>
<p>Livestock Management</p>	<p>Where livestock occur within areas undergoing rehabilitation, temporary stock fencing will be erected to ensure cattle cannot damage rehabilitation works in accordance with Santos EHSMS standards.</p>

6.0 Monitoring, Maintenance and Corrective Actions

6.1 Monitoring

Regular monitoring up to a 5 year period will be required at the completion of most rehabilitation works to ensure that the rehabilitation objectives will be achieved. Monitoring periods will be determined on a case-by-case basis and will be dependent on the success of rehabilitation, season or natural disasters impeding rehabilitation efforts. Sites will be monitored until such time the rehabilitation criteria discussed in Section 4.0 can be demonstrated.

Monitoring will occur at a representative selection of rehabilitated sites and will consist of vegetation surveys and photo monitoring. Monitoring locations are to be determined by a suitably qualified person and where possible, established within the core of rehabilitation areas to avoid edge effects.

Within a three year period it is expected that the progression and improvement of key rehabilitation indicators such as species composition, weed cover, and plant densities will be evident.

6.2 Maintenance Actions

Where monitoring identifies that performance criteria are not being met, maintenance actions will be implemented including replanting, weed removal, stabilisation and erosion and sediment control measures. Where rehabilitation areas require maintenance at the completion of the monitoring timeframes, due to ineffective rehabilitation activities or natural disasters, the monitoring and maintenance schedule will be extended until the rehabilitation area meets the performance criteria.

A summary of monitoring and maintenance actions is provided in Table 3.

Table 3: Maintenance and Monitoring Actions for Rehabilitated Areas

Time	Management Actions	Monitoring
Commencement of rehabilitation	<ul style="list-style-type: none"> Reshaping of landform (where applicable); Installation of erosion and sediment control measures in accordance with ESCP; Respreading of topsoil; Weed control in accordance with PWMP; Revegetation (where applicable): Fertilise (where required); Rehabilitated areas are protected from livestock by fencing; Spread mulch around planted stock as required; Watering as required; Assist natural regeneration (where applicable): Respreading of cleared vegetation; Re-instate fauna habitat features such as woody material and rocks (where available). 	<ul style="list-style-type: none"> N/A
Ongoing monitoring (at regular intervals)	<ul style="list-style-type: none"> Weed control; Replacement of plant mortalities (as required); Where natural regeneration is deemed unsuccessful, replanting with tubestock. Watering as required; Reinstatement of erosion and sediment control measures (as required); Maintain fencing (as required). Additional management actions will be undertaken on an as needed basis, to be determined as part of each monitoring period. 	<ul style="list-style-type: none"> Photo monitoring; Vegetation surveys; Erosion and sediment control effectiveness Survival of planted threatened flora; Evidence of threatened fauna habitat features (e.g. food sources, woody material & rocks).

7.0 Evaluation and Review

7.1 Evaluation

The implementation and effectiveness of this management plan and any associated procedures will be regularly assessed to ensure:

- Santos GLNG is demonstrating compliance with legal and landholder obligations;
- The overall management strategy remains relevant and up to date; and
- The plan and procedures adequately manage the environmental issue.

Effectiveness can be assessed by a number of methods as shown in Table 4.

Table 4: Methods to Assess Legal and Procedural Effectiveness

Assessment Tool	Description
Checklists – Santos GLNG Compliance Management System	<ul style="list-style-type: none"> • Checklists, developed to reflect legal and procedural requirements / outcomes will be used by individual Santos GLNG Departments to assess and manage compliance. The results of the checklists will be evaluated for trending non-compliances that may be resolved through procedural change or by implementing another measure or process.
Audits	<ul style="list-style-type: none"> • Conduct internal and third party audits to formally assess the level of compliance with both regulatory requirements and with Santos GLNG procedures. • Audit outcomes are used to develop corrective actions which may include changes to this plan and/or procedures.
Review of Incidents	<ul style="list-style-type: none"> • A review of internal incidents, near misses or hazards will be undertaken to identify recurrences of similar incident types. This may highlight a requirement for a change in the existing plan and/or procedure, require the development of a new procedure or by implementation of another measure or process to address the recurring issue.
Review of Data	<ul style="list-style-type: none"> • Analyse all relevant data collected for negative and/or undesirable trends that may be prevented by procedural changes or by implementing another measure or process.

7.2 Review

The RMP is a living document and shall be reviewed at least every three years or sooner if any of the following occur:

- The plan is not adequately managing the issue (refer Section 7.1);
- Legislative requirements change;
- The area of activity changes; and/or
- New procedures relating to rehabilitation are developed.

Reviews and changes to the RMP are to be communicated to relevant Santos GLNG Project personnel.

8.0 Definitions

Term	Definition
Checklist	Checklists assist in assessing the implementation of a Procedure. Checklists contain a list of key items required, things to be done, or points to be considered and are a tool to assess compliance with a Procedure.
Environmentally Sensitive Areas	Environmentally Sensitive Areas are areas possessing important environmental and social values as prescribed by the Queensland Government. Category A and B Environmentally Sensitive Areas as defined in Schedule 12 of the <i>Environmental Protection Regulation 2008</i> . Category C ESAs are defined in the relevant Environmental Authority appropriate to the area of land to be disturbed.
Management Plan	Management Plans are specific to an environmental issue and/or topic. They primarily serve to provide a high level overview of the legislative and approval requirements and the Santos GLNG management strategy in place for the relevant environmental issue. Management Plans are also suitable for providing environmental regulators an overview of Santos GLNG environmental management, and in many cases, may be a direct requirements of an environmental approval.
Procedure	Procedures are designed to assist in the implementation of the Management Plan, by prescribing a series of processes and actions for a specific topic.
Santos GLNG Upstream Project Area	Comprises all Santos GLNG exploration and production tenements of the Arcadia, Fairview, Roma and Scotia gas fields.
Significant Disturbance	The meaning of significantly disturbed land is as per Schedule 12 of the <i>Environmental Protection Regulation 2008</i> .
Stabilisation	Stabilisation is as per Section 4.1 of this management plan.
Rehabilitation	Rehabilitation is as per Section 4.2 of this management plan.

9.0 References

Department of Environment and Heritage Protection. 2012. "*Queensland Guideline for Contaminated Land Professionals.*" Queensland Government, Brisbane.

Santos GLNG (2014) *Upstream Management Plans Library* <http://teams-bne.santos.com/sites/USSUS/ENV/PlansProcedures/Forms/AllItems.aspx>

Santos Limited (2013) *Environment, Health and Safety Management System Library* <http://teams.santos.com/sites/ehsadministration-00401-c/sitepages/home.aspx>

Standards Association of Australia (2000) *AS 4801:2000 Occupational Health and Safety Management System*

Standards Association of Australia (2004) *AS/NZS ISO 14001:2004 Environmental Management Systems*