

Towrie (PL 1059)

Rehabilitation Monitoring Plan

November 2021

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Abbreviations

ATP	Authority to Prospect
CCA	Conduct and Compensation Agreement
CG	Coordinator-General
DAMP	Decommissioning and Abandonment Management Plan
EA	Environmental Authority
ESA	Environmentally Sensitive Area
ESC	Erosion and Sediment Control
FRC	Final Rehabilitation Criteria
FRCA	Final Rehabilitation Criteria plus additional
GFD Project	Gas Field Development Project
GLM	Grazing Land Management
GLNG	Gladstone Liquefied Natural Gas
LNG	Liquefied Natural Gas
NC Act	<i>Nature Conservation Act 1992</i>
PL	Petroleum Lease
PPL	Petroleum Pipeline Licence
RE	Regional Ecosystem
RoW	Right of Way (Pipelines)
Santos	Santos GLNG Pty Ltd
the Project	Santos GLNG Gas Field Development Project
TRC	Transitional Rehabilitation Criteria

1 Introduction

1.1 Background

Santos CSG Pty Ltd (Santos), PAPL (Upstream) Pty Limited, Total E&P Australia III, KGLNG E&P Pty Ltd, and Australian Pacific LNG (CSG) Pty Limited have applied for a new resource authority – Petroleum Lease (PL) 1059 (under assessment). An Environmental Authority (EA), P-EA-1001309995, has been granted for PL1059.

PL 1059, known as Towrie, is located in the Surat / Bowen Basins of Eastern Queensland, approximately 60 kilometres north north-east of Injune. The tenure is located immediately west of the existing Arcadia field, operated by a joint venture between Santos GLNG Pty Ltd (Santos), PAPL (Upstream II) Pty Ltd, Total GLNG Australia (TOTAL) and KGLNG Liquefaction Pty Ltd (KOGAS), known as GLNG Operations. GLNG Operations have approval to deliver coal seam gas (CSG) from the CSG fields in Central Queensland (including Arcadia, Fairview, Roma and Scotia) to a liquefied natural gas (LNG) facility on Curtis Island.

This Rehabilitation Plan has been prepared by Santos Onshore Environment Team to address condition I1 of EA P-EA-1001309995. It is based on the certified and approved Upstream Rehabilitation Monitoring Plan (3380-GLNG-4-1.3-0202) for the Fairview Arcadia, Roma, Roma East, Scotia and Maisey project areas within GLNG Operations.

1.2 Scope

The content of this Plan has been written to meet and/or exceed the final rehabilitation requirements under EA P-EA-1001309995 for PL1059. This Plan covers all petroleum activities authorised to occur under EA P-EA-1001309995 whether or not they are planned to occur during the Plan of Operations period for the first phase of activities (16 December 2021 to 15 December 2026).

Rehabilitation conditions, and references to where each is addressed, are identified in Table 1.

Table 1 Environmental Authority Rehabilitation Schedule Conditions

EA P-EA-1001309995 Condition		Section addressed
I1	<p>A Rehabilitation Plan must be developed by a suitably qualified person and must include the:</p> <ul style="list-style-type: none">(a) rehabilitation goals; and(b) procedures to be undertaken for rehabilitation that will:<ul style="list-style-type: none">(i). achieve the requirements of conditions (I2) to (I8) inclusive; and(ii). provide for appropriate monitoring and maintenance.	This plan
I2	<p>Transitional Rehabilitation</p> <p>Significantly disturbed areas that are no longer required for the on-going petroleum activities, must be rehabilitated within 12 months (unless an exceptional circumstance in the area to be rehabilitated (e.g. a flood event) prevents this timeframe being met) and be maintained to meet the following acceptance criteria:</p> <ul style="list-style-type: none">(a) contaminated land resulting from petroleum activities is remediated and rehabilitated;(b) the areas are:<ul style="list-style-type: none">(i). non-polluting;(ii). a stable landform;(iii). re-profiled to contours consistent with the surrounding landform	Section 6.1

EA P-EA-1001309995 Condition		Section addressed
	<ul style="list-style-type: none"> (c) surface drainage lines are re-established; (d) top soil is reinstated; and (e) either: <ul style="list-style-type: none"> (i). groundcover, that is not prohibited or restricted pest species, is growing; or (ii). an alternative soil stabilisation methodology that achieves effective stabilisation is implemented and maintained. 	
13	<p>Remaining Dams</p> <p>Where there is a dam, (including a low consequence dam) that is being or intended to be used by the landholder or overlapping tenure holder, the dam must be decommissioned to no longer accept inflow from the petroleum activity(ies) and the contained water must be of a quality suitable for the intended ongoing uses(s) by the landholder or overlapping tenure holder.</p>	Section 6.1
14	<p>Pipeline Activities</p> <p>Pipeline trenches must be backfilled, and topsoils reinstated within three months after pipe laying.</p>	Section 5.1
15	<p>Reinstatement and revegetation of the pipeline right of way must commence within 6 months after cessation of petroleum activities for the purpose of pipeline construction.</p>	Section 5.1
16	<p>Backfilled, reinstated, and revegetated pipeline trenches and right of ways must be:</p> <ul style="list-style-type: none"> (a) a stable landform; (b) re-profiled to a level consistent with surrounding soils; (c) re-profiled to original contours and established drainage lines; and (d) vegetated with groundcover which is not a prohibited or restricted pest species, and which is established and growing. 	Section 5.1
17	<p>Final Rehabilitation Acceptance Criteria</p> <p>All significantly disturbed areas caused by petroleum activities which are not being or intended to be utilised by the landholder or overlapping tenure holder, must be rehabilitated to meet the following final acceptance criteria measured either against the highest ecological value adjacent land use or the pre-disturbed land use:</p> <ul style="list-style-type: none"> (a) greater than or equal to 70 per cent of native ground cover species richness (b) greater than or equal to the total per cent ground cover (c) less than or equal to the per cent species richness of prohibited or restricted pest species (d) where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then: <ul style="list-style-type: none"> (i). at least one Regional Ecosystem(s) from the same broad vegetation group, as demonstrated by the predominant species in the ecologically dominant layer, must be present; and, (ii). the Regional Ecosystem present in (17)(d)(i) must possess an equivalent or higher conservation value (biodiversity status) than the Regional ecosystem(s) in either the adjacent land or pre-disturbed land. 	Section 6.2
18	<p>Final Rehabilitation Acceptance Criteria in Environmentally Sensitive Areas</p>	Section 6.3

EA P-EA-1001309995 Condition	Section addressed
<p>Where significant disturbance to land has occurred in an environmentally sensitive area, the following final rehabilitation criteria as measured against the pre-disturbance biodiversity values assessment (required by conditions (D1) and (D2)) must be met:</p> <ul style="list-style-type: none"> (a) greater than or equal to 70% of native ground cover species richness; (b) greater than or equal to the total per cent ground cover; (c) less than or equal to the per cent species richness of Prohibited or restricted pest species; (d) greater than or equal to 50% of organic litter cover; (e) greater than or equal to 50% of total density of coarse woody material; and (f) all predominant species in the ecologically dominant layer, that define the pre-disturbance regional ecosystem(s) are present. 	

1.3 Limitations

It should be noted that prior to formal decommissioning, transitional rehabilitated areas have the potential to be required again and hence disturbed several times as part of staged field development activities.

This plan 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 plan. Conduct and Compensation Agreements (CCAs) between Santos and landholders can also stipulate the retention and transfer of ownership of assets to the landholder once operations have ceased. This plan does not consider the rehabilitation of transferred assets but does ensure the asset is safe, stable and non-polluting.

2 Roles and Responsibilities

Santos GLNG Operations 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 as outlined in the *Environmental Protection Act 1994* (Qld) (EP Act). Section 319 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.”

3 Existing environment

3.1 Land use

The tenure encompasses freehold, leasehold, and a small local council reserve in the north-east corner of the tenure. The majority of freehold tenure within the area is for the purposes of pastoral activities (i.e. agriculture or grazing).

Key industries within the wider region surrounding Towrie include agriculture, forestry, recreation and tourism, coal exploration and mining, and oil and gas exploration and production. The traditional industry base for the region has been agricultural, however in more recent times the oil and gas industry has become a more significant contributor to the region's economy.

PL 1059 is wholly overlapped by Exploration Permit – Coal (EPC) 1772 held by Tri-star Coal Company.

3.2 Climate

Injune Post Office (site number 043015) is the closest Bureau of Meteorology (BOM) weather station to Towrie. Monthly climate statistics from this weather station indicate that Injune has a warm, sub-tropical environment receiving an average of 631.6 millimetres of rain per year (BOM 2020). While rainfall occurs throughout the year, the highest rainfall occurs from October to March. Mean minimum and maximum temperature range from 3.3–20.2 °C in July to 19.8–33.8 °C in January.

3.3 Landform and soils

Towrie is located within the Brigalow Belt bioregion and straddles the Carnarvon Ranges and Arcadia subregions. The Carnarvon Ranges subregion is an extensive belt of predominantly coarse sandstones that form the north-eastern margin of the Great Artesian Basin. These have been partly dissected to form an undulating to hilly surface with areas of deep valleys and gorges. Soils are predominantly coarse, with deep sands or with deep sandy-surfaced texture contrast soils on less steep areas.

The Arcadia subregion is formed primarily on Triassic sediments of the Bowen Basin with minor areas of Permian sediments in the east. Eastern, southern and western areas are predominantly rugged on coarse sandstones while the central and northern areas are more undulating and largely contained within a broad valley. Soils include clay and shallow texture-contrast.

There are two distinct landscapes present in Arcadia—a well-defined north-south valley that is visually defined by prominent ridge lines along its eastern and western edges, and a visually prominent mountain range east of the valley comprising a system of deeply incised valleys draining to the east. Towrie is situated in the valley, with a small section comprising the ridgeline. Elevation within PL 1059 ranges from approximately 310 metres Australian height datum (m AHD) in the east to 640 m AHD in the west. The valley section comprises a large portion of PL 1059 which has been significantly disturbed by blade ploughing, vegetation clearing, and agricultural activities.

The Atlas of Australian Soils maps five soil landscapes within PL 1059 (Northcote et al, 1960-68). These are described in Table 2.

Table 2: Description of Topography and Soils within Towrie

Soil landscape unit	Unit description	Dominant soil types
Oa4	Moderately undulating lands with some low hills	Dominant are red and loamy duplex soils.
MM7	Low hilly to hilly terrain on volcanic rocks and appearing as open valleys in steep hilly to mountainous land, gentle to moderate side slopes to shallow streams with significant flats	Chief soils are neutral, dark and yellow friable earths with friable brown soils.
Rf6	Level or very gently undulating alluvial plains fringing drainage-ways	Loams with weakly developed brown clay subsoils.

Soil landscape unit	Unit description	Dominant soil types
Rf3	Moderately undulating lands with some rounded low hills and occasional higher closely dissected hilly areas	Dominant soils are brown loamy duplex soils with associated loamy red soils.
Bz1	High hilly to mountainous strongly dissected sandstone ranges & plateaux with strong scarps & often deep narrow ravines	Rudosols, with dark sandy or loamy-surfaced duplex soils on valley floors.

3.4 Vegetation

Biodiversity values within Towrie reflect the historical agricultural land use of the area. Around 84% of the project area has previously been cleared of native vegetation and is currently mapped by DES as non-remnant.

The extent, condition, dominant species and conservation significance of each vegetation communities within the project area are identified in Table 3.

Table 3: Vegetation communities within the Project Area assessed by AECOM

Vegetation Community	RE	Extent within project area	BD ¹ / VM Act ² Status	Area (ha)
Brigalow low open forest on alluvial plains	HVR 11.3.1	This vegetation community occurs on undulating plains, along shallow and narrow drainage lines within the Survey Area. In the wider Project Area it is also mapped in the northern central area of 2TR13 and eastern extent of 2SP200046.	E / E	63.94
Brigalow open forest on alluvial plains	11.3.1	This vegetation community was field-validated to occur in the Public Reserve and in patch along the unnamed tributary of Station Creek (eastern extent of Project Area). In the wider Project Area, scattered patches are considered to occur within 2TR13 while large connected tracts occur within 2SP200046, generally in association with mapped VM Act watercourses.	E / E	200.43
<i>Eucalyptus populnea</i> +/- <i>Eucalyptus melanophloia</i> open forest on alluvial plains	11.3.2	This vegetation community was confirmed along a shallow drainage line on low undulating plains at one location within the Survey Area. Within the wider Project Area, it is considered to also occur in two large patches on the eastern boundary and in six patches along a mapped watercourse in 2SP200046.	OC / OC	26.86
<i>Eucalyptus camaldulensis</i> riparian woodland	11.3.25	This vegetation community occurs along the unnamed tributary of Station Creek that traverses the Project Area in the east. It is also considered to occur along Arcadia Creek, in the north east of the Project Area.	OC / LC	26.51
SEVT with brigalow understorey	11.9.4a	Within the Survey Area this vegetation community was confirmed on a steep low hill just north of Middle Hill. In the wider Project Area.	E / OC	0.71
SEVT	11.9.4	This community was confirmed within the western ridgeline during the field survey, and identified within Middle Hill by Terrestria.	E / OC	613.20

Vegetation Community	RE	Extent within project area	BD ¹ / VM Act ² Status	Area (ha)
SEVT regrowth	HVR 11.9.4	This community occurs on the exterior and lower slopes of the western ridgeline and Middle Hill. Outside of these areas, an additional four small patches are mapped to the north in 2TR13. A review of historical aerial imagery indicates that historical clearing has occurred in these areas, and as such the vegetation is likely to be in HVR condition.	E / OC	48.21
Brigalow low open forest on sedimentary rock	HVR 11.9.5	This vegetation community was confirmed to occur in scattered patches on low hills within the Survey Area. In the wider Project Area, scattered patches are also mapped to occur in the western extent, especially within the 2SP200046 property south of Middle Hill.	E / E	45.37
Brigalow low open forest with SEVT understorey	HVR 11.9.5a	This community was not encountered during the field survey however is expected to occur as small discrete patches in the northern Project Area, based on the findings of the aerial imagery and LiDAR assessment.	E / E	3.01
Brigalow open forest on sedimentary rock	11.9.5	This community was not encountered during the field survey however is expected to occur as scattered patches across the Project Area, primarily in the western extent of 2SP200046 based on the findings of the aerial imagery and LiDAR assessment.	E / E	48.15
<i>Corymbia citriodora</i> woodland on coarse-grained sedimentary rocks	11.10.1	This community was not encountered during the field survey however is expected to occur within Middle Hill based on the findings of the Terrestria assessment and State vegetation mapping.	NCAP / LC	2.52
<i>Eucalyptus decorticans</i> open forest on sedimentary rock	11.10.4	This vegetation community occurs within the Project Area on fine-grained sedimentary rocks along the steep hill slopes of the western ridgeline.	NCAP / LC	795.34
Regrowth	-	Small patches of regrowth vegetation were observed across the Survey Area, largely beside tracks and along drainage lines.	NA/NR	406.46
Cleared exotic pasture	-	Large portions of the Survey Area comprise historically cleared pasture dominated by exotic buffel grass. Cover in many areas was dense due to the restricted access to cattle.	NA/NR	6,097.44

1 Biodiversity (BD) status of the RE based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem. NCAP=No Concern at Present; OC=Of Concern; E=Endangered

2 Conservation status of the RE under the VM Act; NR=Non-remnant; LC=Least Concern; OC=Of Concern; E=Endangered.

3.5 Environmentally sensitive areas

The ecology within Towrie supports limited areas of remnant and regrowth endangered and of concern vegetation – comprising Category B and C Environmentally Sensitive Areas (ESAs). No Category A ESAs are present within the tenure. The assessed extent of ESAs are listed in Table 4.

Table 4: Environmentally Sensitive Areas

ESA Category	ESA Type	Assessed extent (ha)
Category A	Not present	0
Category B	<i>Endangered Regional Ecosystem</i>	1023.02

ESA Category	ESA Type	Assessed extent (ha)
Category C	<i>Of Concern Remnant Regional Ecosystem</i>	53.37

4 Rehabilitation techniques

There are a number of techniques available to Santos to carry out rehabilitation works, where required, to achieve the requirements of the conditions listed in Table 1. Regardless of the technique employed, monitoring is key to understanding the success of rehabilitation across the asset lifecycle.

4.1 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.

4.2 Sodic Soil Amelioration

Sodic soils when encountered will be blended with an appropriate soil ameliorant (i.e. gypsum, lime) 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.

4.3 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.

4.4 Contaminated Land

Where there is a risk of contaminated land occurring, a site-specific contaminated land assessment and subsequent management plan may be developed for each asset. The scale and type of contamination will determine the chosen management strategy. Small volumes may be disposed offsite via facilities licenced to accept the waste whereas larger volumes may be managed on site using landfarming techniques.

4.5 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.

4.6 Landform Management

Sites will be reprofiled to a safe and stable landform, with surface drainage lines and topsoil profile reinstated. Where practical, sites will be reprofiled to contours consistent with the surrounding landform. However, where this is not practical (ie cut and fill operations on slopes, or within highly dispersive soils), 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.

4.7 Revegetation

Active seeding will be completed on all areas of disturbance where revegetation is required to ensure stability during operations or to meet transitional and/or final rehabilitation criteria. Within areas of native vegetation, a combination of tube-stock and seeding may be implemented. Tube-stock will be used for canopy and shrub species, while a combination of tube-stock 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.

4.8 Mulching and Placement of Vegetation

Vegetation cleared during construction phases, will be retained on-site for use during stabilisation and/or rehabilitation activities. Mulch and vegetation may be respread over the site as required. This will assist in site stabilisation, revegetation efforts and suppressing weed growth.

4.9 Weed Management

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. Weed control requiring chemicals will be undertaken by licenced contractors under the *Agricultural Chemicals Distribution Control Act 1966*. All chemical application will be carried out in strict accordance with registered labels and SDS requirements and considering any Minor Use Permit PER11463 requirements as issued by the Australian Pesticides and Veterinary Medicines Authority for ground-based herbicide application in non-agricultural areas (ie, bushland areas).

4.10 Pest and Livestock Management

Where livestock occur within areas undergoing rehabilitation, temporary stock fencing may be erected to ensure cattle/pigs etc cannot damage rehabilitation works. Fencing will be erected primarily to well pads, laydowns etc where there is a localised disturbance footprint. Rehabilitation of linear infrastructure is more difficult to fence and will require detailed planning to ensure cattle remain off site for as long as practicable.

5 Disturbance Lifecycle and Maintenance Monitoring

The disturbance lifecycle can be defined by three distinct stages: construction, operation and final rehabilitation. Regardless of the stage, all works aim to achieve a safe, stable, and non-polluting landform. All new disturbance works are planned, approved, and recorded in a GIS database.

During the construction stage, works are undertaken using standardised designs. These designs include both temporary (construction) and long-term erosion and sediment controls (ESC).

During the operational stage, a risk-based inspection program is implemented to ensure installed ESC is functioning and disturbed areas are stabilising through vegetation growth. Maintenance actions will be implemented where monitoring identifies that performance criteria are not being met. Maintenance repairs are scheduled and prioritised using a risk-based approach.

The final rehabilitation stage is undertaken once an asset is assessed to be no longer required for the petroleum activity and are not assets being retained by the landholder. Sections 6-7 provide specific details outlining the final rehabilitation process and ensuring all EA conditions are met.

5.1 Pipelines

Pipeline right-of-ways (RoW's) are cleared, pipelines installed, and land reinstated in quick succession. This methodology reduces exposure of unprotected subsoils, preserves topsoil characteristics e.g. structure, native seed bank etc, and minimises potential impacts from significant rainfall events.

As per the EA conditions, reinstatement is undertaken to ensure:

- (a) a stable landform
- (b) re-profiled to a level consistent with surrounding soils
- (c) re-profiled to original contours and established drainage lines; and
- (d) vegetated with groundcover which is not a declared pest species, and which is established and growing.

In addition, RoW's (including ancillary infrastructure i.e. temporary laydowns) are reinstated immediately following pipeline construction (within 3 months) with considerations made for a range of factors including ESC, soil amelioration, fertiliser and seeding. These considerations are applied to ensure timely (within 6 months) revegetation of the pipeline right of way.

Santos has standardised watercourse reinstatement designs that are assigned to crossings based the site-specific risk profile. Watercourses are assessed as part of the planning phase and designs advised for each crossing based on several inputs e.g. soil type, catchment, modelled flows, bank profiles. There are five key options for reinstatement, three standard reinstatement designs (low, medium and high), a fourth site-specific design and a fifth where standard pipeline reinstatement is deemed adequate.

Annual desktop assessments are undertaken using up-to-date aerial imagery to identify potential ESC and integrity issues. The locations are inspected onsite and maintenance repairs prioritised based on risk. In addition to the annual assessments, issues identified during standard work schedules are recorded within a central database to capture, monitor, maintain and/or repair issues as they arise.

5.2 Well Pads

Santos has developed a catalogue of standardised construction designs that focus on long-term stability for the operational life of the well, generally greater than 20 years. Using standardised designs Santos achieves consistent and high-quality execution whilst minimising future disturbances. Where standard designs are deemed not fit for purpose, site specific designs are developed.

All wells are monitored throughout operations using a risk-based inspection program. The program establishes inspection frequencies using attributes such as soil type, slope, and proximity to sensitive receptors. In practice, a higher risk site e.g. cut/fill well pad in poor soils within an Environmentally

Sensitive Area (ESA), has a higher inspection frequency than a low risk site e.g. low impact well pad on grazing land.

Inspections target a range of environmental aspects which are weighted 0 to 2 (0 being low risk and 2 high risk). The sum of all aspects provides the final inspection score. Maintenance works are then prioritised based on the final inspection score e.g. well pads with high inspection scores hold the most environmental risk and are prioritised for maintenance. This allows maintenance works to be prioritised using the most up-to-date data and ensures Santos' environmental risk is the lowest possible at any given time.

5.3 Facilities

These assets typically cover a large disturbance footprint whereby the risk of erosion and sediment issues is elevated. To reduce risk and ensure long-term stability, all facilities (compressor stations, water treatment plants, laydowns etc) are constructed using site specific designs that are prepared during the early planning phase.

Post-construction, environmental inspections are scheduled annually and assessed against rehabilitation and stability criteria. Any identified issues are recorded with a central database to monitor, maintain and/or repair.

5.4 Roads and tracks

For unsealed roads and tracks the key techniques to minimise erosion and damage are good shaping (camber, elevation etc) and good drainage. These techniques are imbedded in the standardised construction designs.

Watercourse crossings are assessed as part of the early planning phase and designs advised for each crossing based on several inputs e.g. soil type, catchment, modelled flows, bank profiles. In some instances, the standardised design is deemed unsuitable and a site-specific design will be developed.

When planning for roads, considerations are made for existing and/or proposed adjacent infrastructure. Where construction occurs alongside adjacent infrastructure, the erosion and sediment controls marry into both pieces of infrastructure so as to not cause unwanted drainage or erosion impacts from one to the other i.e. surface waters are controlled across the entire disturbance footprint.

Roads will undergo routine maintenance grades throughout the life of the infrastructure. These will typically follow high vehicle traffic and/or wet weather. In addition to the routine maintenance, any unforeseen issues are captured and stored within a central database for priority maintenance.

Once roads are no longer required for petroleum activities, they will be offered to the landholder as an asset. Any roads unwanted by the landholder will be rehabilitated. This will include removal of any gravel, ripping, levelling and re-profiling to reinstate natural contours of the land (including any watercourses) and revegetating to match the surrounding land-use.

6 Rehabilitation acceptance requirements

Final rehabilitation requirements apply when assets that are no longer required for ongoing petroleum activities and are not assets being retained by the landholder. The transfer of infrastructure assets to landholders will be undertaken in compliance with the Department of Environment and Science Guideline for Petroleum Activities (ESR/2020/5403) before the surrender of the environmental authority or petroleum tenure. Areas classified as Environmentally Sensitive Areas (ESA) are excluded from being transferred to landholders.

For the purposes of this plan, assets being retained by the landholder are not subject to final rehabilitation.

To meet final rehabilitation for relinquishment all other assets must first meet the transitional rehabilitation criteria as shown in Figure 1.

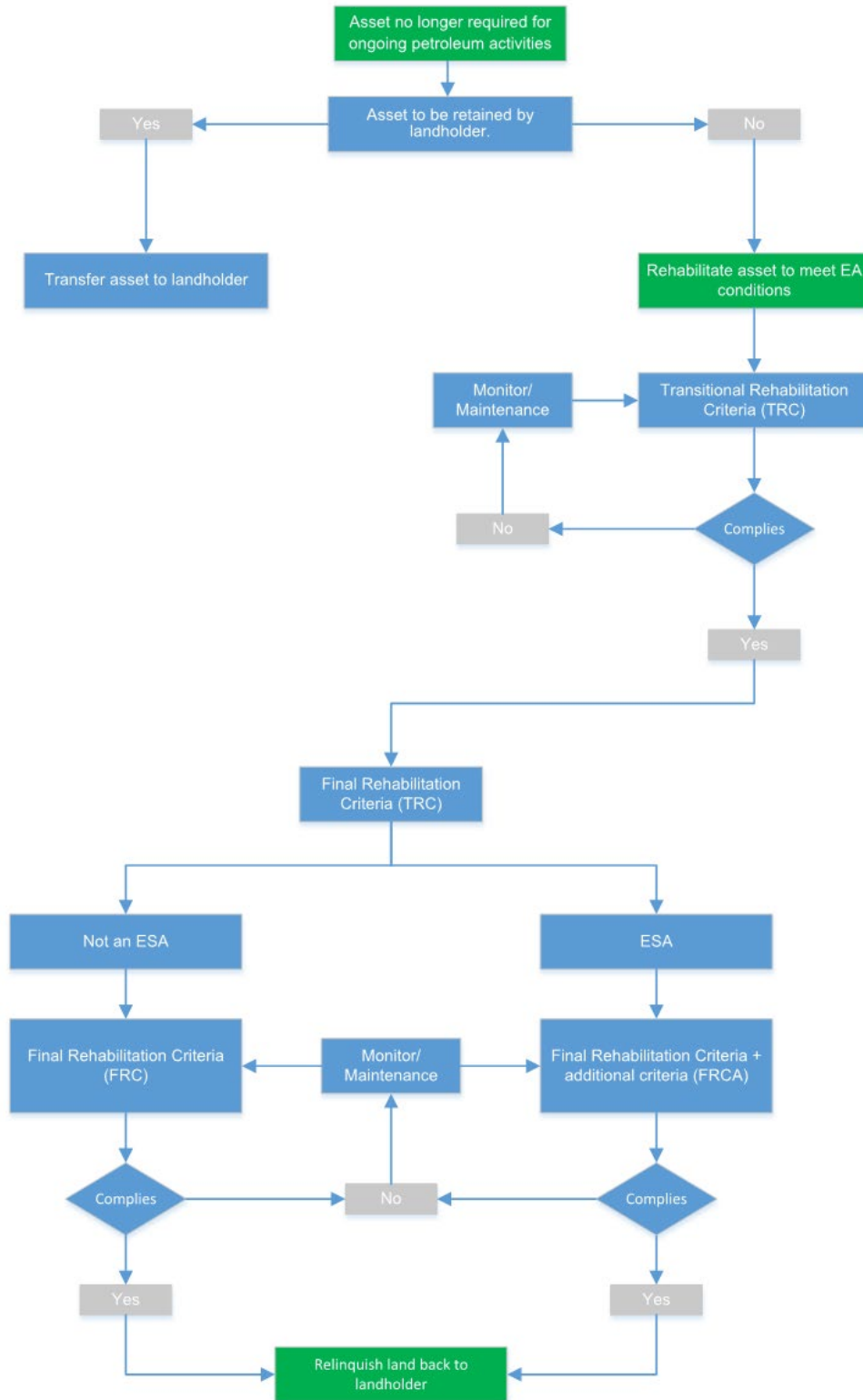


Figure 1 Final Rehabilitation Flowchart

6.1 Transitional Rehabilitation Monitoring

For the purposes of this plan, transitional rehabilitation is defined as the minimum rehabilitation criteria to which each disturbed area must comply within 12 months of decommissioning/abandonment. The transitional rehabilitation criteria (TRC) are:

- (a) contaminated land resulting from petroleum activities is remediated and rehabilitated

- (b) the areas are:
 - (i) non-polluting;
 - (ii) a stable landform;
 - (iii) re-profiled to contours consistent with the surrounding landform
- (c) surface drainage lines are re-established;
- (d) topsoil is reinstated; and
- (e) either:
 - (i) groundcover, that is not a declared pest species, is growing; or
 - (ii) an alternative soil stabilisation methodology that achieves effective stabilisation is implemented and maintained.

Transitional rehabilitation activities are to be undertaken within 12 months following decommissioning/abandonment activities. Immediately upon decommissioning sites will be monitored for compliance against the transitional rehabilitation criteria and may require a combination of techniques as described in Section 4.

6.1.1 Reprofiling and topsoil

Where reprofiling and topsoil has been demonstrated as stable (has constructed drainage, rock reinforcement, stable cover and/or no evidence of erosion) data and geo-located photos should be gathered during monitoring. Areas which have not been reprofiled and demonstrated as stable will need to be maintained or reworked according to the extent of instability.

If problematic soils are identified, remediation actions will be required to decrease the area of bare ground. This may include reworking, capping/reburial of poor substrates or the improvement of soils using suitable materials.

6.1.2 Groundcover

In areas of poor groundcover assessments should be made to determine if the soil needs improvement and possible re-seeding.

6.1.3 Erosion

Where erosion has been identified the area may require rework and maintenance. Erosion should be monitored to ensure that any rehabilitated area is stable. If erosion monitoring shows that the erosion is unstable and continuing to get worse, the area will need to be maintained or reworked depending on the extent of the instability. If erosion is unchanging and has good vegetation cover the area may not need any further maintenance or re-work, especially if it has been identified in well-established rehabilitation.

When a site is assessed as compliant with the TRC it can then progress to the final rehabilitation stage.

6.2 Final Rehabilitation Acceptance Criteria (FRC)

Once areas are assessed as meeting the transitional rehabilitation criteria, they are to be rehabilitated to meet the following final acceptance criteria measured either against the highest ecological value adjacent land use or the pre-disturbed land use:

- (a) greater than or equal to 70 per cent of native ground cover species richness
- (b) greater than or equal to the total per cent ground cover
- (c) less than or equal to the per cent species richness of declared plant pest species
- (d) where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then:
 - a. at least one Regional Ecosystem(s) (RE) from the same broad vegetation group, as demonstrated by the predominant species in the ecologically dominant layer, must be present; and,
 - b. the Regional Ecosystem present must possess an equivalent or higher conservation value (biodiversity status) than the Regional Ecosystem(s) in either the adjacent land or pre-disturbed land

All rehabilitation during the FRC stage will be undertaken in accordance to the site specific requirements.

6.2.1 Groundcover

The area may require direct seeding and/or planting of ground layer, shrub and tree species depending on the final post-disturbance land use. Weed control methods may also be required.

6.2.2 Revegetation

The selection of species to be used in rehabilitation where native vegetation is the final land use should consider structural and floristic composition of the or the pre-disturbed land use or the highest ecological value adjacent land use.

6.3 Environmentally Sensitive areas

Environmentally Sensitive Areas (ESAs) in PL 1059 include 'Endangered' and 'Of Concern' Regional Ecosystems.

Where petroleum activities have resulted in significant disturbance to land in an ESA, the following final additional rehabilitation criteria as measured against the pre-disturbance biodiversity values assessment must be met:

- (a) greater than or equal to 50 per cent of organic litter cover;
- (b) greater than or equal to 50 per cent of total density of coarse woody material; and
- (c) all predominant species in the ecologically dominant layer, that define the pre-disturbance Regional Ecosystem(s) are present.

7 Rehabilitation Monitoring Requirements

Monitoring will inform rehabilitation decisions in relation to remediation of non-conformances relating to transitional criteria. Where required, data will be compared to the pre-disturbed land use data or an analogue site in the highest ecological value adjacent land use.

7.1 Final Rehabilitation Register

A Final Rehabilitation Register (FRR) will capture the results of rehabilitation against the set compliance conditions. All monitoring data will be captured in a GIS database and a “traffic light report” will be generated to understand the progress of rehabilitation using a risk-based assessment methodology.

7.2 Risk based methodology

Upon decommissioning/abandonment, a risk-based approach will be used to proactively identify the compliance risk level based on the intended final land use and progress towards the FRC. A site may contain a combination of the below risk profiles.

7.2.1 High risk areas – rework/rectify

High risk areas are classified as areas requiring rework or rectification in order to meet the TRC and/or FRC.

High risk areas (rework/rectification) may require a combination of stabilisation works, reprofiling and/or reseeded/revegetation works on decommissioning/abandonment. An area that is deemed high risk will require a review of the rehabilitation works based on the final land use requirements. Fencing, where practical, should remain intact until FRC are met.

7.2.2 Medium risk areas – maintain/monitor

Medium risk areas are those areas meeting the TRC but require time and potentially maintenance to meet the FRC. Fencing, where practical, should remain intact until FRC are met.

7.2.3 Low risk areas – site relinquishment

Low risk areas are defined as rehabilitated areas meeting the TRC and FRC and are ready for final acceptance and site relinquishment.

7.3 Monitoring

On decommissioning/abandonment, formal monitoring should be undertaken against the TRC and FRC. The status of sites should be entered into the FRR along with any recommended rehabilitation requirements. Based on this initial assessment, formal monitoring frequency will be assessed on a case by case basis and may depend on weather conditions and predicted time to meet the rehabilitation criteria. As a guide the following formal monitoring schedule is proposed as a minimum to inform rehabilitation requirements.

Table 5 Proposed formal monitoring frequency

Risk rating	Rehabilitation Status	Monitoring frequency	Method
High risk areas	Rework/Rectify	Annually	Remote sensing / ground survey/ sampling
Medium risk areas	Maintain/monitor	Annually (pending weather conditions)	Remote sensing / ground survey/ sampling
Low risk areas	Ready for site Relinquishment	Based on previously collected data	On-ground Third Party Rehabilitation Assessment & Reporting

7.3.1 Data capture

Monitoring data indicators for Transitional Rehabilitation Criteria (TRC) and Final Rehabilitation Criteria (FRC) and shown in Tables 6 and 7 respectively.

Table 6 TRC Monitoring parameters

Land use	TRC	Monitoring data indicators
All	Contaminated land resulting from petroleum activities is remediated and rehabilitated	Where there is a risk, or records confirming contaminated land (i.e. hydrocarbon/chemicals) occurring from petroleum activities, remediate to meet legislative requirements.
	Stable landform, non-polluting and re-profiled to contours consistent with the surrounding landform	No run-off or subsidence caused by the decommissioning of petroleum activities. Erosion no more that surrounding landscape. Re-profiled to natural landform or where not practical reprofiled to ensure stability and ESC.
	Surface drainage lines are re-established	No evidence of ponding, landform reinstated to be consistent with drainage in surrounding landscape
	Topsoil is reinstated	Where disturbed during decommissioning, reinstated topsoil is consistent with surrounding soil profile of the site. No evidence of soil profile mixing or compaction.
	Groundcover, that is not a declared pest species, is growing OR an alternative soil stabilisation methodology that achieves effective stabilisation is implemented and maintained	No restricted species present on site. Ground cover stable across site.

Table 7 FRC Monitoring parameters

Land use	FRC	Monitoring data indicators/ methodology
All	Greater than or equal to 70 per cent of native ground cover species richness	<p>Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use</p> <p>The 50x10m plot method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.</p>
	Greater than or equal to the total per cent ground cover	<p>Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use</p> <p>The 1x1m quadrats method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.</p> <p>Per cent ground cover will be categorised into gradients of <19%, 19-39%, 40-59%, 60-79%, 80-100%</p>
	Less than or equal to the per cent species richness of declared plant pest species	<p>Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use</p> <p>The 50x10m plot method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.</p>
Non ESA areas only	<p>Where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then:</p> <p>(i) at least one Regional Ecosystem(s) from the same broad vegetation group, as demonstrated by the predominant species in the ecologically dominant layer, must be present; and,</p> <p>(ii) the Regional Ecosystem present in (I3/J7/J11)(d)(i) must possess an equivalent or higher conservation value (biodiversity status) than the Regional Ecosystem(s) in either the adjacent land or pre-disturbed land</p>	<p>Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use</p> <p>Regional Ecosystem delineation following the "Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.0." (Neldner <i>et al.</i>, 2019) or any subsequent updated version of this methodology.</p> <p>Once Regional Ecosystem has been confirmed it will require confirmation of its Broad Vegetation Group, as well as the Biodiversity status.</p>

Land use	FRC	Monitoring data indicators/ methodology
ESA only	Greater than or equal to 50 per cent of organic litter cover	Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use The 1x1m quadrats method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.
	Greater than or equal to 50 per cent of total density of coarse woody material	Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use The 50x20m plot method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.
	All predominant species in the ecologically dominant layer, that define the pre-disturbance Regional Ecosystem(s) are present	Comparison with analogue site in either the highest ecological value adjacent land use or the pre-disturbed land use The 100x50m plot method of the BioCondition Assessment methodology V2.2 as per Eyre <i>et al.</i> (2015) or any subsequent updated version is to be used in the rehabilitated area in comparison to the analogue site.

Where plot sizes are reduced, adjustments to calculations will be required to adequately scale up data from plots to hectare rates.

7.4 Final acceptance reporting

When an area is meeting the final rehabilitation acceptance criteria (deemed low risk), landholders will be requested to formally accept the return of land as part of the asset relinquishment process. A final acceptance report will be completed by a suitably qualified third party in preparation for relinquishment to the landholder.

8 Reference

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2019) *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.0. Updated March 2019*. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane

Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2015). *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2*. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Department of Environment and Science (effective 16 Sept 2020), *Guideline Petroleum Activities - Transferring petroleum infrastructure to landholders*, <https://environment.des.qld.gov.au/management/activities/non-mining/community-landholder/transfer-infrastructure>