Santos

Site-Specific Environmental Authority

Petroleum Lease (PL) (1058) Bearcat

Response to Notice of Information Request

1. Introduction

Santos Limited (Santos) lodged an application for a new site-specific Environmental Authority (EA) with the Department of Environment and Science (DES) on 11th May 2021. Santos received a Notice of Information Request (Notice) on 22nd June 2021 (refer to Appendix A). The Notice outlines the further information requested by DES to assess the application.

Santos provides the following information in response to all of the information requested in the Notice, prior to the end of the information response period of 24th February 2022.

2. Information Request and Response

Sections 2.1 to 2.8 provide the elements of the DES Notice and the Santos response to the request.

2.1. DES Information Request Element (1)

Proposed activities

a. *As described in section 2.2. of the supporting information report, the application is seeking approval for 11 wells, all of which require authorisation for stimulation. It is also discussed that some will be gas wells targeting formations in the Cooper Basin and some will be oil wells targeting the Eromanga Basin. Section 2.3.3.2. states that well stimulation techniques may be used to increase the recovery of resources, in this case, gas.*

   Provide the following information:

   i. *the number of conventional oil wells proposed, and the number of conventional gas wells proposed*
   ii. *confirmation as to whether the stimulation approval is intended for both the gas and oil wells, or just the gas wells, and*
   iii. *if the oil wells are to be stimulated, provide a description on how the process varies from stimulation of gas wells.*

b. *Section 2.3.2 states that each proposed well lease will be between 1 to 1.5 hectares, or 1.65 ha if stimulation is required. The Ecology Assessment has applied a 1.6 ha disturbance area per well pad. Provide confirmation as to what disturbance area is being sought for each of the proposed 11 wells and what the total proposed disturbance for well pads is expected to be. Also provide confirmation on the quantities (i.e., 1, 1.5 or 1.65ha) that have been applied to calculate the prescribed environmental matter disturbances, as considered in section 6.2 of the supporting information report, and hence the accuracy of the disturbances proposed.*

Santos Response to Element 1a(i)

Santos proposes to drill and operate a combination of up to 11 conventional oil and/or gas wells in PL 1058 (comprised of one (1) existing conventional gas well (Bearcat-1) and up to 10 new conventional oil or gas wells). The proportion of oil vs gas wells is unknown at this stage and is subject to further exploration and appraisal. Based on information gained from the Bearcat-1 gas well, primary hydrocarbon targets in PL 1058 are expected to be gas (Cooper Basin). However, the drilling results from Bearcat-1 also identified a potential oil resource, which is to be investigated further by Santos.

The findings of future exploration studies and drilling activities will determine if the proposed new wells target oil or gas (or both) resources in PL 1058 i.e. if a new well is drilled, that successfully intercepts oil, additional oil wells may be drilled to target the same reservoir and so on. On this basis Santos requires flexibility to be able to respond to on-ground findings. Therefore, a determination of the explicit number oil versus gas wells for the tenure is not possible at this stage.

Santos has conservatively modelled cumulative drawdown impacts from oil and gas extraction (from the Cooper and Eromanga basins) from up to 11 gas wells and 13 oil wells (a total of 24 wells) in

PL 1058 (refer to the UWIR in Appendix D and the Golder Technical Memorandum in Appendix E in the application for further information).

The modelling identified that extraction from up to 24 petroleum wells on PL 1058 is not predicted to result in any significant change to the predicted impact to groundwater resources (refer to Section 5.5 of the application for further information). Santos is therefore of the view that the level of risk to the environment as presented in the application is acceptable and largely not influenced as to the number of wells targeting either oil or gas formations. The practices used to extract oil and gas, the mitigation and management measures as well as the risk and hazards described in the application contemplate the extraction of both of these conventional resources.

Santos Response to Element 1a(ii)

For the purposes of this application, it has been assumed stimulation will be required at all well locations, whether they be conventional gas or oil.

Santos Response to Element 1a(iii)

The hydraulic stimulation process, including well design, for both conventional oil and gas development is provided in Section 3, Vol. 1 of the *Stimulation Risk Assessment - Santos Southwest Queensland Tenements* (SRA) (Refer to Appendix B of this RFI Response).

Importantly, all Santos stimulation completions are designed, tested, undertaken, monitored and reported in accordance with the *Code of Practice - For the construction and abandonment of petroleum wells and associated bores in Queensland* (Queensland Government, December 2019) (the Code) including relevant legislative requirements identified in the *Queensland Petroleum and Gas (General Provisions) Regulation 2017*.

Hydraulic stimulation is employed to improve production efficiency of the oil and gas producing wells. This is achieved by increasing the conductivity within the reservoir and by increasing the fracture permeability, which in turn increases the efficient for oil and/or gas to flow to the well.

Conventional oil reservoirs in SWQ are associated with sandstone formations of the Eromanga Basin. As with gas wells, fracture stimulation is used in oil wells to achieve economic flowrates and production volumes. However, the oil-bearing formations in SWQ are less frequently dependent on stimulation to be economically viable compared with gas formations.

Conventional gas in SWQ is produced from sandstone reservoirs within the Toolachee and Patchawarra Formations of the Cooper Basin. The gas within these formations is stored as free gas within the pore spaces of the reservoirs, with much of the porosity as primary intergranular porosity. These sandstone reservoirs often have low permeability, and stimulation is necessary to achieve economic gas flowrates and production volumes.

For the most part, the stimulation process for conventional oil and gas wells is the same. The stimulation fluids currently applied to both oil and gas wells in SWQ is the same. The key difference between gas and oil well stimulations in SWQ relates to target depth and the associated variations in subsurface settings (e.g. pressure, temperature). Oil reservoirs in the Eromanga Basin are located at depths from 700 to 1,200 metres below ground level (mbgl) and gas reservoirs in the Cooper Basin at depths of 1,500 mbgl to greater than 2000 mbgl.

Generally speaking, these differences translate to variances in the scale of equipment required to complete the stimulation. For example, smaller oil reservoir fracturing treatments typically require less pumping horsepower and less fluid and proppant, and therefore require smaller equipment set-up than gas reservoir fracturing treatments (refer to Figure 33 and Appendix D in Volume One of the SRA for a typical equipment set up). Deeper gas reservoirs usually require higher pumping horsepower and therefore a larger equipment set-up.

Production wells may be subject to multiple stimulation events during the stimulation process. As detailed in the SRA, Santos employs methods to selectively isolate and individually fracture each hydrocarbon-bearing zone. A typical gas well will generally have more than one fracturing treatment; the current average is about six fracturing treatments per gas well. The typical Santos oil well will rarely have more than one fracturing treatment, due to the limited number of oil-bearing formations targeted by oil wells in SWQ.

Chemicals that may be used in the stimulation process by Santos in SWQ are detailed in Section 3 of Volume Two of the SRA. At present, the same stimulation fluids are used for both oil and gas stimulation activities in SWQ. Toxicity information is described in Volume Two and detailed Human Health Hazard Summaries and Ecological Information Sheets (Profiles) are provided in Appendix C to Appendix E of Volume Two of the SRA (attached to this RFI response as Appendix B). Relevant safety data and chemical information sheets are provided in Appendices C and F of Vol. 2 and 3 of the SRA, respectively. Chemicals not included in the SRA will be risk assessed prior to their use. This adaptive management is in line with that provided for by the streamlined model conditions (and conditions proposed by Santos in Schedule K, Appendix B (Proposed EA Conditions and Definitions) of the application). Refer to the Santos Response to Element 4h for further information on current chemicals intended to be used in the stimulation process.

Santos Response to Element 1b

Santos is seeking a well lease disturbance area of up to 1.65 ha, with a total combined maximum disturbance of 18.15 ha for well leases.

The ecological assessment (inclusive of the prescribed environmental matter disturbance assessment) undertaken for PL 1058 has been revised to consider the maximum disturbance area per well lease of 1.65 ha. This has resulted in an additional 0.5 ha of disturbance to that described in the submitted application material. This minor increase has resulted in no change to the outcomes of the prescribed environmental matter disturbance assessment. Please refer to Appendix C of this RFI response for the updated ecological assessment.

2.2. DES Information Request Element (2)

c. *The application proposes the inclusion of streamline model condition (SMC) Waste 16, varied to include a commencement date, as outlined in Appendix A of the supporting information report. This proposed condition would authorise the use of mix-bury cover as a method for disposing residual drilling material on site. No information has been provided on what the mix-bury cover method entails and what environmental risks are associated.*

Provide the following information:

i. *confirmation the mix-bury cover method proposed is consistent with the method detailed in the department's SMC for petroleum activities.*
ii. *quality characteristic criteria that are justified for the purpose of demonstrating the method is sustainable and will not cause environmental harm. As required under section 125(l)(i) of the Environmental Protection Act 194 (EP Act), consideration should be made to the site-specific characteristics of the environment i.e., flooding, Channel Country, when assessing the environmental values, emissions or releases, and risks and likely magnitudes of the proposed impacts, and*
iii. *with consideration to the site-specific characteristics of the landscape, demonstrate how the waste management hierarchy has been implemented, consistent with section 125(l)(i)(D) and 125(l)(ii) of the EP Act.*

d. *Section 4.9 of the supporting information report states that produced water may be re-used for the purposes of dust suppression, drilling and hydraulic fracture activities. Section 5.8 states that disposal may be undertaken in accordance with either the mix-bury over method or in accordance with method and quality certified by a suitably qualified third party. To achieve the*

water quality required by the proposed conditions for each of the proposed disposal methods, it is possible that treatment of produced water may be required.
Provide information that describes the water management practices proposed including any treatment methods to be undertaken. Include a copy of the most up to date proposed water management plan.

Santos Response to Element 2c (i to iii)

Residual drilling materials (RDM) will be managed on-site or off-site in accordance with the EA conditions proposed as part of the application, including the approved quality criteria where applicable.

In accordance with these conditions, RDM will be either be lawfully disposed off-site to an appropriately licenced facility or managed on-site either by the standard approved mix-bury-cover methodology, as defined in the proposed EA conditions, or via an alternate certified methodology.

For on-site management, Santos will ensure the sump contents meet the approved quality criteria prescribed in the proposed EA conditions to safely undertake the mix, bury, cover methodology, or alternatively they will be managed via a different method which has been certified by a suitably quality third party to not result in environmental harm and complies with other conditions of the EA e.g. RDM disposal must not result in direct or indirect release of contaminants to any waters. Such a methodology will have to consider the relevant environmental values and conditions of the region to ensure it is appropriate and the risk to the environment remains acceptable.

When RDM is buried at depth and capped with compacted clay rich soil there is no ability for direct interaction between the RDM and surface water should a wellsite become inundated. Moreover, the clay lining of the sump walls minimises risk of any seepage and passage of the wetting front. The compacted fine grey clays used as sump lining and capping material for RDM management have a very low hydraulic conductivity, providing for very limited infiltration potential into the buried RDM. Therefore, during a potential inundation event, there is no potential for dissolution and movement of RDM to surface water.

As discussed in the application, despite being situated in the Channel Country bioregion, PL 1058 is predominantly located in a flat alluvial herbland, with sporadic isolated sand dunes, and minor areas of channel country / wetland areas located at the extremities of the western tenure boundary (refer to Figure 1 at Element 7 below). PL 1058 may therefore be exposed to shallow inundation risk during larger Cooper Creek flood events, however, the land systems present suggest the majority of the tenure is less severely inundated and holds water for shorter periods of time compared with channel country / wetland areas. The minor areas of channel country / wetland areas located near the western tenure boundary will likely flood more frequently and hold water for extended periods. Larger Cooper Creek flood events (with the potential to reach Lake Eyre) occur approximately once in every ten years.

Due to the slow-moving nature of flood waters in the Cooper Creek, if the tenure were exposed to inundation risk, sufficient time (i.e. several weeks to months) is generally available to prepare operational areas for potential flood impacts. This includes prioritising drilling sumps located in low-lying areas for decommissioning following completion of drilling activities.

Whilst the generation of RDM cannot be avoided, the ability to safely manage residual drilling material on-site results in reduced volumes of waste going to landfill. This is preferred in accordance with the waste management hierarchy under the *Waste Reduction and Recycling Act 2011*. Recycling and recovery of RDM for beneficial use is impractical in the region due to the significant transportation requirements and remote location of the activities. Further, beneficial uses of RDM are limited, of low economic benefit, and the material poses a limited risk to the receiving environment when disposed of onsite appropriately.

Santos Response to Element 2d

Santos assumes the reference to the disposal of RDM by mix bury cover method at Element 2 (d) is an error.

No centralised produced water management ponds or petroleum-processing infrastructure are proposed to be constructed/undertaken or located within PL 1058. As specified in Section 2.3.7 of the application supporting information, produced petroleum product (petroleum product and water) may be temporarily stored in above-ground tanks (totalling approximately 100-150 m^3, and less than 500 m^3) in accordance with relevant Australian Standards. Produced total fluids will either be transferred off-tenure via trucking from the above-ground tanks or transferred via pipelines to a centralised processing facilities and water management facilities. Produced total fluids generated on PL 1058 will be transferred to existing Santos facilities such as the Ballera Gas Facility, or potentially Jackson, Watson or Patroclus Oil Facilities.

Consistent with the waste hierarchy, and in accordance with the requirements and outcomes of proposed EA conditions (e.g. I8 and I9), produced water may be re-used on PL 1058 for the purposes of dust suppression, drilling and hydraulic fracture activities. If the water is not of an appropriate quality, it will not be used for these purposes. No on-site water treatment is proposed.

2.3. DES Information Request Element (3)

Waste

e. *Section 2.3.3.1 of the supporting information report states that drilling fluid would be used and continuously circulated through the drill pipe and surface equipment and drilling fluid will be stored using a drilling sump.*

Provide the following information:

- *the types of drilling fluids to be used in the process and whether they are oil-based or synthetic based fluids,*
- *the proposed management practices of waste drilling fluids and cuttings,*
- *the design features of the drilling sumps (i.e., enclosed or open systems, construction details, what materials are used, how impervious the materials are), and*
- *description of the management practices proposed including measures to mitigate and minimise contaminants being released to the environment.*

f. *It is stated in section 4.9 of the supporting information report that, similar to the use of produced water for dust suppression, drilling and hydraulic fracturing activities, hydro-test water may be released to land at the end of the testing for disposal.*

Provide the following information:

- *details as to what constitutes hydro-test water,*
- *a description of the risk and likely magnitude of impacts on the environment as a result of releasing hydro-test water to land, and*
- *details of the management practices proposed to be implemented to prevent or minimise adverse impacts including what the appropriate quality is to release to land.*

Santos Response to Element 3e

Drilling fluids will be water based, and not oil or synthetic based in accordance with proposed EA condition K1 - *Oil based or synthetic based drilling muds must not be used in the carrying out of the petroleum activity(ies).*

Proposed management practices for waste drilling fluids, cuttings and the design of drilling sumps would be undertaken to ensure compliance with proposed EA conditions. Refer to Santos response to Element 2 for further information on proposed management practices for waste drilling fluids and cuttings.

Drilling sumps are designed, constructed and operated in accordance with the following criteria to minimise contaminants being released to the environment:

- contain fluids for no longer than 24 months;
- sump volume is rig / well specific (typically ranges from 600 to 3,000 m^2);
- sump is located on the well lease, which is typically elevated above surrounding landform;
- open sump void with straight sides and sloped front and back;
- sump walls are lined with locally sourced clay to minimise the risk of seepage and passage of the wetting front;
- sump capacity is conservatively calculated assuming 1 m of additional freeboard for expected contents volume – this ensures additional freeboard is provided.
- sump capacity is monitored during drilling activities to ensure appropriate freeboard is maintained;
- fenced to mitigate large fauna entering the sump;

- a low berm is constructed around the perimeter of the sump (to mitigate potential for surface water inflows);
- drilling sumps located in areas subject to potential seasonal inundation or overland flows are prioritised for decommissioning; and
- upon decommissioning, the sump capping material is rolled and compacted using a bulldozer, with an additional volume of compacted material placed on top of the sump (typically 300mm above the surrounding well lease level) in case any minor slumping occurs.

Santos Response to Element 3f

Upon review of proposed activities to be undertaken within PL 1058, Santos no longer proposes to release hydro-test water to land. Instead hydrotest water will be either captured in tanks or lined pits for reuse/recycling or it will be transported to an existing Santos waste facility located outside of PL 1058 for disposal.

Santos proposes to remove condition I14 from proposed EA conditions for PL 1058.

2.4. DES Information Request Element (4)

Hydraulic Fracturing

g. The application is accompanied by Appendix G: SWQ Hydraulic Fracture Risk assessment that contains:

- *Site Setting and Hydraulic Fracturing Process report dated 20 December 2012 and*
- *Human Health and Ecological Risk Assessment – Schlumberger Chemicals dated 5 February 2014.*

i. The documents within Appendix G are generic and broadly covers the activities across South West Queensland, therefore have not been provided specific to the proposed activities to which the application relates. Provide reference to the particular information/sections of these documents that are relevant and are to be considered for this site-specific application.

ii. Noting the dates of the two reports, provide confirmation that these documents provide information that is still current, relevant and accurate for the activities being proposed.

h. It is stated in section 2.3.3.2 of the supporting information report that approximately 99.5% of the material pumped into the well is water and sand, while minor quantities of additives make up the remaining 0.5% of the fluid. The purpose of these additives is explained but what constitutes the fluid is not.

Provide the following information:

- *the chemicals intended to be used in the stimulation/hydraulic fracturing process and the toxicity of the ingredients and mixtures,*
- *an environmental risk assessment for wells to be stimulated,*
- *details of the proposed hydraulic fracturing operations, and*
- *details of any stimulation impact monitoring program.*

Santos Response to Element 4g (i to ii)

The Santos SWQ Hydraulic Fracture Risk Assessment was revised in June 2020 and is attached to this RFI response as Appendix B. The revised version of the risk assessment is referred to as the *Stimulation Risk Assessment - Santos Southwest Queensland Tenements* (SRA). The information provided in the June 2020 SRA is current, relevant and accurate for the activities proposed in the site-specific EA application.

The SRA has been written as a single overarching risk assessment that covers all relevant matters for Santos' operations in SWQ. The SRA has been written to address the regulatory requirements of proposed EA conditions (K6 and K7) as detailed in the Appendix B of the application.

In addition to meeting the regulatory requirements contained with the proposed EA conditions, the SRA, which serves to consolidate a range of internal technical assessments, monitoring and reporting processes completed for each well prior to, during and following completion of stimulation activities into an overarching risk assessment document. In doing so it synthesises the findings of several hydraulic fracturing risk assessments completed to date and includes details of processes and procedures undertaken prior to, during and post stimulation activities occurring, including evaluation of the regional conditions, design and operational processes, constraints planning and evaluation of chemicals used in the hydraulic fracturing process.

Evaluation of these requirements must be considered in the context of other approval and regulatory requirements. As described further in the SRA, the drilling, completion and hydraulic fracturing is conducted in accordance with the *Code of Practice for the Construction and Abandonment of Petroleum Wells and Associated Bores in Queensland* (version 2 December 2019) [Code of Practice], which is overseen by the Department of Resources (DOR). No well can be drilled or hydraulically fractured without completion of DOR's prescribed process and reporting requirements.

The SRA includes an assessment of the nature, extent and potential impact of stimulation activities in SWQ and allows for the proper and efficient management of activities that have the potential to cause environment harm. The SRA also describes the process by which hydraulic fracturing is conducted and monitored.

As all wells have the potential to be hydraulically stimulated at one or more point in time, the single SRA approach is considered appropriate to cover all wells. The document includes information and assessment on all the hydraulic fracturing fluids currently used by Santos in SWQ and provides a framework for inclusion of new fluids systems within the risk assessment as required. To facilitate the assessment and compilation of risk assessments completed on multiple fluid systems, the SRA is presented in two volumes:

- Volume One of the SRA discusses the environmental and geological settings within which Santos' stimulation activities take place, and the general techniques for the drilling, completion and stimulation of wells. The report also discusses why stimulation sis essential in SWQ and outlines Santos's current froward programme for fracture-stimulations (noting that this is frequently reviewed and subject to change).
- Volume Two relates specifically to the stimulation fluids proposes to be used by Santos' service provides on both conventional oil and gas wells in SWQ. The report considers the ecological and human health toxicity of the chemical constituents in the stimulation fluids and includes an exposure pathway assessment and risk characterisations based on a review of complete exposure pathways and controls to mitigate exposure.

Table 1, Section 1.3.2, Volume One of the SRA provides a detailed guide to the sections of the SRA specifically relevant to the site-specific EA application e.g. environmental values of groundwater in the project area, environmental hazard assessment of chemicals used during stimulation (including mixtures and the resultant chemicals formed after stimulation).

The SRA utilises multiple assessment hazard and risk assessment methodologies (in accordance with International Best Practices) to assess the hazards/risks associated with the hydraulic fracturing process and/or posed by hydraulic fracturing fluids / individual chemicals. Through this process it has been demonstrated that through the implementation of the Code of Practice, International Best Practice (for well completions and hydraulic fracturing) and Santos Management controls (which meet

other regulatory requirements and/or were informed by the risk assessment), the probability and consequence of environmental harm from hydraulic fracturing is considered low and acceptable.

The framework of the SRA has been developed to be readily applied to all wells across Santos' SWQ tenures, inconsideration of well specific geological, hydrogeological and environmental settings. As such the SRA, including discussion of processes and procedures required to be implemented on a specific, is applicable to the proposed activities to which the application relates. The area is sparsely developed, and generally comprises remote rural communities and homesteads that are largely engaged in agriculture, such as livestock grazing.

Well specific documentation showing the implementation of management controls detailed within the SRA will be developed once location(s) are finalised. As required by the Code of Practice, and consistent with Santos' reporting requirements to DoR (in accordance with the relevant resource legislation), each stimulation operation is risk assessed and the process is documented prior to execution. This process demonstrates that the well has been specifically designed, and appropriate management controls have been implemented, for the (subsurface) conditions encountered in the relevant well in accordance with the SRA. Well specific documentation is completed via Santos processes - such as subsurface well planning, integrated disturbance planning, well construction planning, formation and hydraulic fracturing design evaluation to:

- support well siting (avoid sub-surface and/or surface areas of concern or areas where Environmental Authorities preclude well installation and/or hydraulic fracturing),
- verify the suitability of well construction (including testing of wells); and
- ensure robust design and testing is completed for all hydraulic fracturing assignments.

Santos Response to Element 4h

Chemicals that may be used in the stimulation process by Santos in SWQ are detailed in Section 3 of Volume Two of the SRA. Toxicity information is described in Volume Two and detailed Human Health Hazard Summaries and Ecological Information Sheets (Profiles) are provided in Appendix C to Appendix E of Volume Two of the SRA (attached to this RFI response as Appendix B).

The SRA has been compiled to ensure its scope adequately assesses risks associated with stimulation operations in all of Santos' SWQ tenures, inclusive of proposed activities in PL 1058. Refer to Santos' response to RFI Element 1a for further information on the stimulation process.

As discussed above, Volume Two of the SRA relates specifically to the stimulation fluids proposed to be used by Santos' service providers on both conventional oil and gas wells in SWQ. The report considers the ecological and human health toxicity of the chemical constituents in the stimulation fluids and includes an exposure pathway assessment and risk characterisations based on a review of complete exposure pathways and controls to mitigate exposure.

Volume Two specifically relates to the stimulation fluids proposed by Santos' current stimulation service provide Halliburton. These are all chemicals that may be used in the stimulation process at this point in time. The document also provides a framework for inclusion of new stimulation fluids within the risk assessment document as required as operations mature. The report details the environmental risk assessment of the fluid systems including:

- an exposure assessment including identification of potential and complete exposure pathways
- detailed description of products including chemical constituents and mass balance calculations
- an aquatic and terrestrial toxicity assessment
- a human health toxicity assessment, and
- risk characterisation.

The SRA has been completed using best practice methodologies. The SRA has been undertaken in general accordance with the *Guideline on Ecological Risk Assessment* (NEPM, Schedule B(5), 2013 and draft guidance prepared by EPA Victoria (Gibson et al., 1997) and national guidelines for risk assessment recommended by enHealth (enHealth-Environmental Health Risk Assessment, *Guidelines for Assessing Human Health Risks from Environment Hazards*, June 2012).

Refer to Section 3, Volume 1 of the SRA (attached to this RFI response as Appendix B) for a detailed description of proposed hydraulic fracturing operations. Hydraulic fracturing operations / methods will only be utilised where necessary, but they are assumed to be required for all wells for the purposes of the application.

Stimulation impact monitoring will be undertaken in accordance with proposed EA conditions K10 to K13, and in accordance with the Santos *South-West Queensland Stimulation Impact Monitoring Program* (SIMP). The SIMP has been compiled to ensure stimulation operations are undertaken in accordance with the monitoring requirements of proposed EA conditions (the SIMP is attached to this RFI response as Appendix D).

Refer to Santos Response to Element 4g above for information on environmental risk assessments undertaken for wells to be stimulated.

2.5. DES Information Request Element (5)

Air Emissions

i. Section 2.3.2 of the supporting information report states that each proposed well lease would be established to accommodate several activities including flares. Throughout section 5 it is described that direct and indirect impacts to certain environmental values may result from ignition sources resulting from activities. However, no assessment has been provided for flaring or ignition in the proposal.

Provide the following information:

- *a description of releases from flaring or ignition activities, including location and expected air emissions (quality and frequency of release),*
- *expected impacts on each of the environmental values of air (as listed in section 4.7 of the supporting information report)*
- *background air quality data that may be source and available from adjacent or local tenure holders (Note: the air quality monitoring data provided cannot be considered since they are not relevant to the proposed site), and*
- *proposed mitigation and management practices to avoid and minimise impacts to environmental values.*

Santos Response to Element 5i

Section 5 of the EA application identifies and assesses potential impacts, mitigation measures (control strategies), and environmental risks to relevant environment values resulting from carrying out proposed activities as required by Section 125 of the EP Act.

Risk assessments for a proposed activity identify a wide range of risks and potential impacts to relevant environmental values as a result of carrying out a proposed activity. This should not be interpreted to assume that all identified potential impacts will occur as a result of carrying out the activities. Once initial unmitigated risks and potential impacts are identified as part of a risk assessment, appropriate control strategies are identified and implemented. Appropriately implemented control strategies will typically mitigate the likelihood of a potential impact from occurring, and/or reduce the severity/consequences of the potential impact.

Santos will not undertake flaring activities in an ongoing basis for petroleum activities located on PL 1058. The utilisation of flaring is not advantageous to Santos and would only be undertaken for the purposes of short-term safety or emergency measures as part of well drilling, stimulation activities and initial production testing operations on PL 1058. Santos preferentially flows gas into tanks or existing gathering infrastructure to capture the resource as opposed to flaring.

The main instance of flaring for proposed activities on PL 1058 will be upon completion of stimulation operations when residual stimulation fluid (in the well and target formations) is flowed back to surface and into a gas-water separator. The water is flowed to a tank or lined pond, and any residual gas is flared as there is no alternative safe disposal method. Flaring in this instance typically occurs over 5-7 days. Where a well can be connected into existing gathering infrastructure, flaring can be avoided as gas can be flowed directly into existing gathering and onto production facilities. However, exploration wells located in remote areas do not typically have nearby gathering infrastructure to easily connect into.

Flaring operations in PL 1058 would be minimised wherever possible, and are localised to the well lease, with a short-term and intermittent frequency. As such, emissions generated by flaring operations are not expected to result in any substantial impacts to air quality environmental values. Where wells are successful, Santos aims to connect them to the greater gathering network as soon as possible to commercialise the resource. Flares will be designed and operated in accordance with relevant petroleum legislation and Australian standards.

Potential air quality impacts from the proposed flaring activities within PL 1058 will be localised and highly unlikely to significantly impact the air quality environmental values of PL 1058. This is primarily due to the very short duration of flaring at any given well. In consideration of this, an additional air quality impact assessment has not been undertaken. The existing risk assessment for the proposed development and as presented in Table 5-1 of the application, remains appropriate for the proposed activities given the small number of temporary new emission sources proposed, the remote nature of the location, the lack of other industry/pollutant sources in the region, and the absence of sensitive receptors. The nearest sensitive receptor is Orientos Pastoral Station homestead, which is located approximately 30 km south-west of PL 1058 boundary.

Ignition sources discussed in Section 5 of the EA application refer to the potential for fires (e.g. bushfires) to occur due to undertaking proposed activities i.e. “fire (ignition sources resulting from activities)”. Although unlikely, bushfires have the potential to occur when undertaking a range of industrial and agricultural activities in natural environments e.g. vehicle exhausts interacting with dry grass can cause bushfires. These events are unlikely to occur as a result of undertaking the proposed activities, and have been mitigated, and risk assessed as such. Management (control) strategies, risk sources, potential impacts and the level of risk associated with the proposed activities are summarised in Table 5-1 in the application. The results of the risk assessment indicate that residual risks to air quality values as a result of the proposed activities are classified as ‘low’.

Existing air quality of PL 1058 is typical of a remote environment influenced by the existing petroleum activities and agricultural industries. Air quality in the region will be very good due to the general lack of urban or industrial development in the region, and the absence of large emissions generating industry located in the broader region. Further, there are no potential sensitive receptors for air located in PL 1058. The closest sensitive receptor is the Orientos Pastoral Station homestead, which is located approximately 30 km south-west of PL 1058 boundary.

There are no ambient air quality monitoring stations (AQMSs) located within the vicinity of PL 1058, and there is no other source of air quality data available to Santos to the best of our knowledge. The closest DES AQMS is located at Moranbah, approximately 900 km northeast of PL 1058. This monitoring station has been operational since 2011 and was established to measure particle levels (particulate matter (PM10 and PM2.5)) from coal mining operations in the community and surrounding

area. The Toowoomba AQMS was the closest station for oxides of nitrogen (NOx) and carbon monoxide (CO) (located approximately 1,000 km east of PL 1058). This station was operational from 2003 to 2010. Consequently, given the urban and/or industrial nature of these regions, Table 4-5 in the EA application provides a very conservative estimate of the background air quality in SWQ. There is an alternative DES AQMS located in south-western Qld (e.g. Miles Airport), but this AQMS is still located ~850 km east of PL 1058 (refer to Table 1 below).

Table 1: Air Quality – Miles Airport, Queensland (Current measurements at 18 January 2022)

Parameter	Measurement	Running average
Particle $PM_{2.5}$	4µg/m³	6.8µg/m³ (24hr avg)
Particle PM_{10}	10µg/m³	22.9µg/m³ (24hr avg)
Carbon monoxide	0.2ppm	0.1ppm (8hr avg)
Nitrogen dioxide	0.001ppm	0.001ppm (1hr avg)

Source: DES Available online at: https://apps.des.qld.gov.au/air-quality/stations/?station=mil

2.6. DES Information Request Element (6)

Blasting

j. It is stated in section 5.7 of the supporting information report that the application is seeking to adopt the department's SMCs for petroleum activities to authorise blasting. However, no information has been provided to describe the frequency, intensity and level of impacts to environmental values from blasting activities.

Provide the following information:
- *details of any emissions or releases likely to be generated from blasting at the proposed site,*
- *an assessment of the risk and likely magnitude of impacts on the environmental values (including protecting the biodiversity of ecosystems) and*
- *details of the management practices proposed to be implemented to prevent or minimise adverse impacts.*

Santos Response to Element 6j

Although unlikely to be required for proposed activities on PL 1058, small-scale blasting activities may be used as part of the proposed petroleum activities for specific purposes such as for blasting large areas of rock encountered when trenching during pipeline construction, or as an alternative energy source for seismic surveys (shot holes). In the rare event blasting is require, these small-scale activities would be very localised, short-term and transient activities only. The blasting will not be associated with the extraction of material for use for other purposes (i.e. quarrying).

Santos would undertake blasting activities in accordance with proposed EA conditions (G4 to G6) and relevant Australian Standards. If blasting is required to be undertaken on PL 1058, Santos would develop a blast management plan in accordance with proposed EA condition G4.

Further, any noise or vibrations generated by the proposed activities is highly unlikely to cause nuisance to the nearest sensitive receptor, which is located approximately 30 km from the boundary of PL 1058.

2.7. DES Information Request Element (7)

Significant Residual Impact (SRI) Assessments

k. The SRI criteria response for regulated vegetation does not reference the Regional Ecosystems (REs) relevant to the disturbance or the expected disturbance infrastructure. Therefore, it is not clearly demonstrated to what extent disturbance will occur within RE areas

and how the applicant will guarantee that the SRI thresholds, in accordance with the 'Queensland Environmental Offsets Policy Significant Residual Impact Guideline, Nature Conservation Act 1992, Environmental Protection Act 1994, Marine Parks Act 2004,' dated December 2014 (SRI Guideline), will not be exceeded. Note: the SRI limits must be determined cumulatively per RE type. For example, clearing other than linear infrastructure within RE 5.6.4. (sparse) must not exceed 2ha of clearing across the project, otherwise a SRI is triggered, and authorisation is required. Provide information on the details considered to determine whether SRI will occur for regulated vegetation matters, including the relevant identified REs and quantities of areas required for linear and non-linear infrastructure. Also, it must be demonstrated how it will be ensured that activities will cumulatively not exceed the SRI limits.

l. *Table 6-6 provides an impact assessment of PL 1058 MSES for wetlands and watercourses. In response to the criteria states "…. areas of the wetland or watercourse being destroyed or artificially modified". The response also states that this is "unlikely." However, 0.9ha of wetland is proposed to be cleared, suggesting that an area of the wetland will be destroyed. It is also not confirmed when revegetation of the area will be guaranteed suggesting that the area will be modified, and for an unknown period.*

   A reassessment of this criteria in Table 6-6 is required that directly addresses whether the proposed activities are destroying or artificially modifying the landscape. Note: Rehabilitation and timing is not a prompted consideration in the SRI guideline, therefore is not relevant to the criteria.

m. *In accordance with section 5.1. of the SRI guideline, an action is likely to have a SRI on endangered or vulnerable wildlife or species of least concern if the activity causes disruption to ecologically significant locations. Examples of such areas include breeding, feeding or nesting sites. The response provided for the grey grasswren and echidna against potential disruption to ecologically significant locations does not satisfy that this requirement is met.*
   For the grey grasswren it is acknowledged that 11.55ha of habitat will be cleared. The reasoning for not causing disruption of ecologically significant locations focusses on the recovery of the species habitat (of which only 3.9ha will be rehabilitated), and the presence of the species habitat within other areas of the petroleum lease. This response does not address how clearing 11.55ha of habitat would not cause disruption to ecologically significant locations.

   In relation to the echidna, the response states that 115.5ha of habitat clearing will likely include breeding, feeding and nesting habitat. The response disregards the criteria to be triggered due to the distribution of the species and long-term population sustainability, which are considerations relevant to other criteria (described in section 5.1. of the SRI guideline) and are not relevant to the disruption to ecologically significant locations (breeding, feeding or nesting sites). Provide a reassessment of the SRI of the grey grasswren and echidna with justification that is specific to each criteria, as outlined in section 5.1 of the SRI guideline.

n. *Throughout the Ecological Assessment report (document reference: QEJ19010_PL 1058_EcoAssessment_Rev2) makes reference to Figure 5 relating to threatened species habitat to be presented on page 17. However, this figure is not contained within the document. Provide a revised copy of the report which contains Figure 5.*

Santos Response to Element 7k

Santos will not exceed the MSES Significant Residual Impact (SRI) disturbance limits for each Regional Ecosystem (RE) that is Regulated Vegetation, as specified in Section 2 "*Significant residual impact test – criteria Table 1*" of the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (2014) (SRI Guideline). Santos has an understanding of the prospective areas for oil and gas within the PL 1058 tenure based on the findings of previous seismic surveys and drilling results. However, Santos does not yet know the precise location of the majority of proposed wells and associated infrastructure to be located within PL 1058.

Conventional petroleum activities typically involve drilling a small number of deep, precisely located wells targeting small-localised accumulations of hydrocarbons (unlike CSG activities, which typically target a relatively shallow broad resource i.e. coal seams). Further, unlike CSG, the precise location of a proposed conventional oil or gas well is typically contingent on detailed assessment of the findings of previous nearby well drilling and seismic survey activities. Once the precise "bottom hole" (BH) location of a well is determined for geological purposes, the surface location may be subject to a range of restrictions and sensitivities, and the well lease (and supporting infrastructure) may need to be shifted to avoid these areas e.g. cultural heritage and environmental sensitivities. In some cases, the well bore may even be "deviated" to avoid surface sensitivities, but still target the BH location.

Therefore, total disturbance within each RE that is Regulated Vegetation cannot be determined until the precise BH location of each proposed well is finalised, and the surface location is assessed for environmental and other sensitivities. Santos will utilise internal pre-activity approval processes and disturbance tracking methodologies to ensure proposed activities do not exceed the SRI limits. Final well locations (and supporting infrastructure) will be subject to site-specific assessment.

The proposed petroleum activities are conservatively estimated to impact up to 116 hectares of remnant native vegetation comprising 'least concern' RE (refer to Santos Response to Element 1b for further information). Least concern RE is not a prescribed environmental matter. Prescribed environmental matters are limited to remnant Endangered and Of Concern REs only. The only place regulated vegetation that is a prescribed environmental matter may be impacted is where the disturbance lies within a mapped wetland, and is within 50 m of the defining bank of the wetland, or within the defined distance of a watercourse, and within 5m of the defining bank.

For the purposes of impact assessment, a large proportion of the proposed disturbance footprint has been located within 'high constraint' areas, where appropriate (refer to Figure 5-1 in the ecological assessment report in Appendix C). As such, the assessment of impacts within the application takes a precautionary approach and simulates a conservative disturbance scenario.

At any point, if the proposed activities were expected to cumulatively exceed SRI disturbance limits for regulated vegetation, Santos would seek appropriate regulatory authorisations i.e. EA amendment.

Santos Response to Element 7l

HES wetlands intersected by PL 1058 are located at the far north-western and south-western tenure boundaries. Only 0.7 % (35.9 ha) of PL 1058 is mapped as a HES wetland. These small HES wetland areas are connected to a significantly broader area of HES (and GES) mapped wetland in the surrounding region (refer to Figure 1 below). This broader area is essentially one large intermittently flooded wetland system i.e. the Cooper Creek drainage basin wetland area. To provide context, there is more than 100,000 ha of interconnected HES wetland mapped within 30 km of PL 1058. The HES wetlands mapped in PL 1058 are not isolated confined wetlands, but rather minor areas of a significantly larger interconnected wetland system (floodplain).

As part of the proposed activities in PL 1058, Santos conservatively estimates 0.9 ha of vegetation located in a HES wetland will require clearing. The clearing of an area of vegetation within a wetland will not necessarily result in the environmental values of the wetland being "destroyed or artificially modified" as the activities are not substantial enough to impact the function of the wetland, particularly given implementation of proposed EA conditions and other mitigation measures outlined in the application. Further, as discussed in the application, proposed petroleum activities will be scheduled to be completed when no surface water is expected to be present within the PL, and outside of flood events/inundation periods.

Moreover, the terms "destroyed" and "artificially modified" are not defined by the SRI Guideline. However, "*Wetland environmental values*" are defined in the SRI Guideline to include the following:

a) the health and biodiversity of the wetland's ecosystem;

b) the wetland's natural state and biological integrity;
c) the presence of distinct or unique features, plants or animals and their habitats, including extinct in the wild wildlife, vulnerable wildlife, near threatened wildlife and least concern wildlife under the *Nature Conservation Act 1992*;
d) the wetland's natural hydrological cycle;
e) the natural interaction of the wetland with other ecosystems, including other wetlands.

Clearing up to 0.9 ha of vegetation in the HES wetland in PL 1058 is unlikely to result in:

a) any of the wetland environmental values listed above from being significantly or substantially negatively affected (given implementation of proposed EA conditions and the mitigation measures discussed in the application); and
b) the Cooper Creek wetland being "destroyed" or "artificially modified".

Further, potential impacts resulting from proposed activities are largely considered to be short-term in nature (e.g. pipeline construction), or will otherwise be mitigated through compliance with proposed EA conditions and mitigation measures discussed in the application.

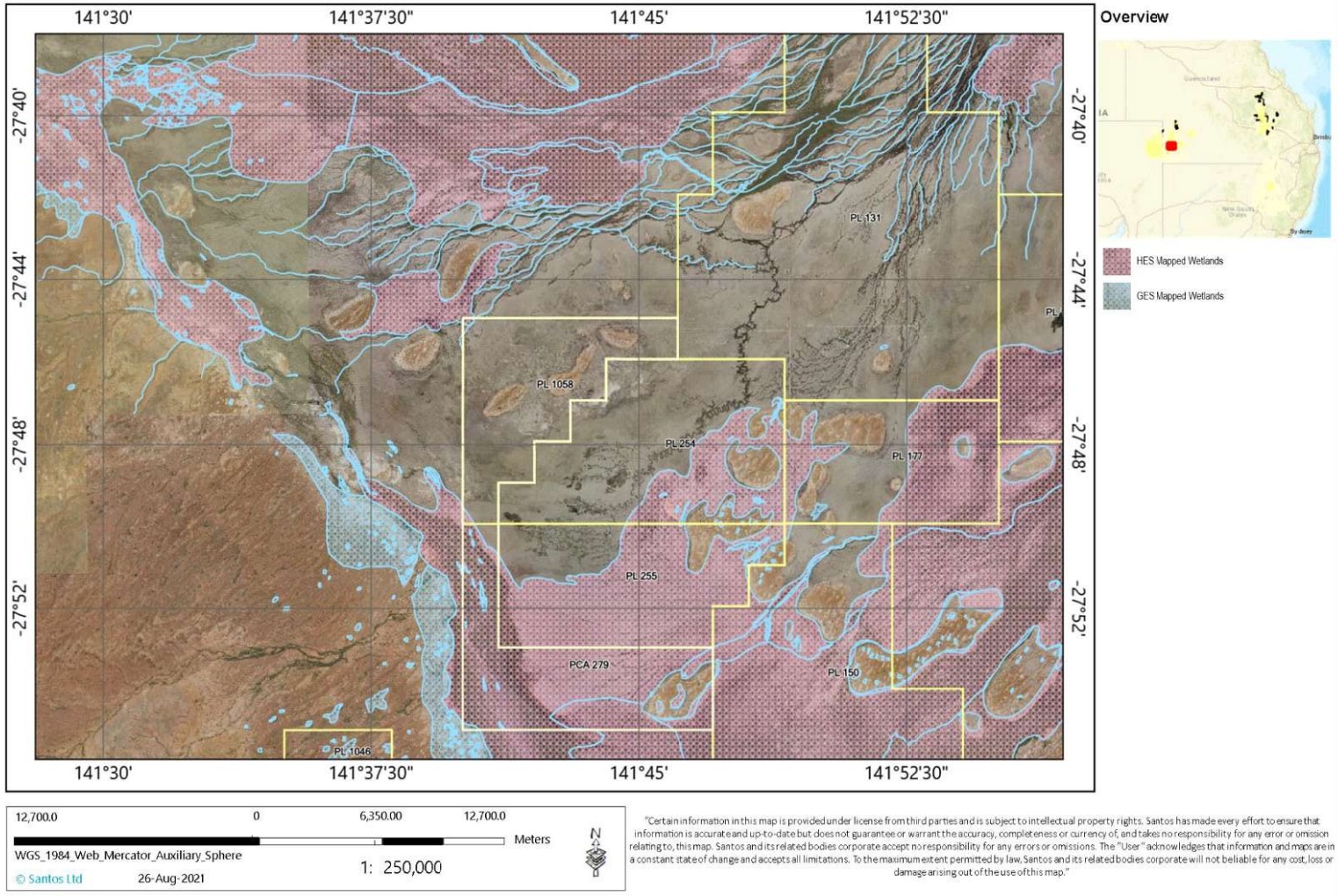
Santos will undertake the proposed activities in accordance with proposed Schedule B 'Water' EA conditions. These conditions appropriately mitigate and minimise disturbance to watercourses and wetlands, for example:

- Proposed condition (B10) and (B11) prohibit activities from changing the existing surface water hydrological regime, impacting on the flow of surface water, impacting on surface water quality and impacting on bank stability within GES and HES wetlands; and
- Activities in floodplains, as required by proposed condition (B17) must be carried in a way that does not concentrate flood flows, divert flood flows from natural drainage paths, alter flow distribution, increase the local duration of floods or increase the risk of detaining flood flows.

In summary, the proposed petroleum activities in PL 1058 are unlikely to cause a significant residual impact to HES wetland values as defined in Section 4 of the SRI Guideline.

Santos

Figure 1: PL 1058 - HES and GES Mapped Wetlands



Santos Response to Element 7m

The term "ecologically significant location" is not defined in the SRI Guideline, but it is stated to include "breeding, feeding, nesting, migration or resting sites" for endangered and vulnerable wildlife, and "breeding, feeding or nesting sites" for special least concern (non-migratory) species. In relation to grey grasswren and echidna, these species have broad areas of occupancy in the region, and relatively broad habitat suitability requirements i.e. breeding, feeding, nesting, migration or resting sites would be present in all suitable vegetation communities for each species in the region. Further, unless a vegetation community is not suitable for either species, it would be very difficult to justify ruling out areas of suitable vegetation as not providing at least one of the ecological significant location attributes in accordance with the SRI Guideline. Due to this, the SRI assessment undertaken by E2M considered that all suitable habitat within PL 1058 for each species represented ecologically significant locations for the species. In the context of listed species that have broad habitat requirements and extensive areas of occupancy, the application of "ecologically significant location" SRI criteria is therefore erroneous.

Further, the proposed activities will not result in disruption to ecologically significant locations for the grey grasswren and echidna because these species have significant widespread suitable breeding, feeding, nesting, migration or resting habitat available in the immediate and broader region surrounding PL 1058. Disruption to very minor areas of habitat for these species in PL 1058 will therefore be insignificant to the size, extent and distribution of the local population of the species. Further justification on why the proposed disturbance would not be significant for grey grasswren and echidna is provided below.

Grey Grasswren

In SWQ, the grey grasswren is known to be present in shrubland vegetation communities dominated by Lignum (*Duma florulenta*), Queensland bluebush (*Chenopodium auricomum*), Swamp canegrass (*Eragrostis australasica*) and *Samphire* spp. Of these vegetation communities, Lignum and Swamp canegrass communities provide suitable foraging and breeding habitat, and *Samphire* spp. and other *Chenopod* spp. communities provide suitable foraging habitat. Within PL 1058 and the surrounding region, these vegetation communities are captured in Regional Ecosystem (RE) mapping descriptions 5.3.7, 5.3.8a, 5.3.13a, 5.3.16a and 5.3.18a. These REs may be classified as ecologically significant areas in accordance with the SRI guideline.

PL 1058 is predominantly mapped as a variable-sparse open herbland vegetation community dominated by REs 5.3.18b, 5.3.19, 5.6.4 and 5.6.8 (83% or 4032 ha of the tenure). These REs do not provide suitable foraging and breeding habitat for grey grasswren i.e. they would not be ecological significant locations in accordance with the SRI Guideline.

For comparison, only 17% (or 818 ha) of the tenure is mapped to be REs 5.3.13a and 5.3.18a, which may represent suitable foraging and breeding habitat for grey grasswren. Of these 2 RE's, only RE 5.3.13a provides highly suitable foraging and breeding habitat (that being Lignum - *Duma florulenta* vegetation) for the species, with RE 5.3.18a providing foraging habitat.

For context, the region immediately surrounding PL 1058 (~20 km radius of the tenure boundary) is DES mapped to contain more than 20,000 ha of REs 5.3.7, 5.3.8a, 5.3.13a, 5.3.16a and 5.3.18a – which represent suitable foraging and breeding habitat for grey grasswren. Further, these REs form a dominant component of the broader Cooper Creek floodplain in the region. For context, the broader region surrounding PL 1058 is DES mapped to support ~200,000 ha of these REs.

Further, Santos will maximise avoidance of disturbance to ground-truthed RE 5.3.13a in PL 1058 as far as reasonably practicable; and implement field and desktop based assessments to preferentially place infrastructure / disturbance outside of areas that are likely to represent Grey Grasswren habitat wherever practicable.

To summarise, PL 1058 contains minor areas of suitable habitat for grey grasswren, whereas the areas surrounding PL 1058 provide extensive suitable breeding and foraging habitat for the species, and Santos will implement mitigation measures to maximise avoidance of disturbance to potential grey grasswren habitat in PL 1058.

As per Section 5.1 of the SRI Guideline, an action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:

- lead to a long-term decrease in the size of a local population; or
- reduce the extent of occurrence of the species; or
- fragment an existing population; or
- result in genetically distinct populations forming as a result of habitat isolation; or
- result in invasive species that are harmful to an endangered or vulnerable species becoming established in the endangered or vulnerable species' habitat; or
- introduce disease that may cause the population to decline, or
- interfere with the recovery of the species; or
- cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.

Given the substantial areas of suitable foraging and breeding habitat in the areas immediately and more broadly surrounding PL 1058, the proposed activities (clearing of up to 11.55 ha of grey grasswren habitat) are highly unlikely to result in any of the abovementioned SRI criteria for the grey grasswren.

Further, the proposed activities will not result in disruption to ecologically significant locations for the grey grasswren because the species has significant widespread suitable breeding, feeding, nesting, migration or resting habitat available in the immediate and broader region surrounding PL 1058. Disruption to 11.5 ha of grey grasswren habitat in PL 1058 will therefore be insignificant to the size, extent and distribution of the local population of the species.

Refer to the ecological assessment report attached as Appendix C to this RFI response for further justification, which is specific to each SRI criteria, on why the proposed activities will not result in an SRI for the species.

Echidna

The echidna is Australia's most widespread native mammal (Archer, 1983).

The species has very broad breeding, feeding and nesting habitat requirements, and it can be found breeding, feeding and nesting in almost every habitat type that occurs across the entirety of the Australian continent (including Tasmania and offshore islands such as Kangaroo Island, King Island and Flinders Island).

The species can be found present (breeding, feeding or nesting) in undisturbed and disturbed deserts, forests, woodlands, shrublands, grasslands, rocky outcrops, agricultural lands, rainforests and alpine areas. The species is widely distributed and has no particular habitat preferences, except for the supply of ants and termites(Van Dyck & Strahan 2008).

As per Section 5.1 of the SRI Guideline, an action is likely to have a significant impact on a special least concern (non-migratory) animal wildlife habitat if it is likely that it will result in:

- a long-term decrease in the size of a local population; or
- a reduced extent of occurrence of the species; or
- fragmentation of an existing population; or
- result in genetically distinct populations forming as a result of habitat isolation; or
- disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species.

The proposed activities (clearing of up to 116 ha of echidna breeding, feeding and nesting habitat) will not result in any of the abovementioned SRI criteria for the echidna. Further, the proposed activities will not result in disruption to ecologically significant locations for the echidna because the species has general and diverse breeding, feeding and nesting habitat requirements i.e. Echidna's have no particular habitat preferences, except for the supply of ants and termites (Van Dyck & Strahan 2008). Further, potential habitat for Echidna is present across the entirety of PL 1058 and/or the entirety of the surrounding bioregion, inclusive of all habitats. Disruption to 116 ha of echidna habitat in PL 1058 will therefore be insignificant to the sustainability, extent, size or distribution of the local population of the species. Further, where threatened species nests are identified to be present, disturbance would be avoided. If disturbance cannot be avoided, clearing of the nest and a surrounding area would be postponed until after the relevant breeding season and/or incubation period.

Refer to the ecological assessment report (attached as Appendix C to this RFI response) for further justification, which is specific to each SRI criteria, on why the proposed activities will not result in an SRI for these species.

References:
Archer. M. (1983). *Mammals in Australia*. Australian Museum. New South Wales, Australia.
Van Dyck. S. and Strahan, R. (2008). *The Mammals of Australia.* New South Wales, Australia.

Santos Response to Element 7n

The ecological assessment report has been amended to include the correct Figure 5 (refer to Appendix C of this RFI response).

2.8. DES Information Request Element (8)

Rehabilitation

o. *Sections 4.10 and 5.9 of the supporting information report address rehabilitation. However, the same information is provided in both sections. Provide confirmation as to whether section 5.9 should provide further information tailored to section 5: potential impacts, mitigation measures and environmental risk assessment.*

Santos Response to Element 8o

The EA amendment application form lists 'rehabilitation' as an "environmental value" that is required to be address by EA amendment applications. To meet the EA application requirements, rehabilitation has been addressed as an environmental value in Section 4 of the application supporting information.

However, "rehabilitation" is not an environmental value that has potential to be impacted by the proposed activities, and therefore it is not a value that can be easily described. For this reason, similar information has been provided in Sections 4.10 and Section 5.9 of the supporting information. The information provided in Sections 4.10 and 5.9 has been compiled to summarise how rehabilitation and decommissioning of disturbed land in PL 1058 will be undertaken in accordance with proposed EA conditions to ensure potential risks and impacts posed to other identified environmental values will be mitigated, and ultimately rehabilitated.

Final rehabilitation of disturbed areas in PL 1058 would be undertaken to achieve the final rehabilitation criteria of proposed EA conditions (refer to Schedule J, Appendix B (Proposed EA Conditions and Definitions) of the application). Information on rehabilitation activities is also included in the risk assessment presented in the application as a control strategy for several potential impacts to identified environmental values. The table below outlines standard methods Santos employs to rehabilitate disturbances associated with various petroleum activities in southwest Queensland.

Standard Rehabilitation Methods

Activity	Summary of rehabilitation methodology	When rehabilitation works will be undertaken	Final land use
Exploration	Seismic: • Replace cuttings and debris from shotholes; seal and level excess materials; install traffic barriers of natural materials at road crossings as required. • Re-establish natural drainage; install diversion berms on long slopes as required. • Create roughened surface by gouging or scarifying; re-spread cut brush and compact with bulldozer if necessary to promote establishment of seed.	The majority of modern seismic survey activities do not typically require active rehabilitation. If small areas of significant disturbance do occur, rehabilitation will be undertaken immediately following the activity.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.
Roads, tracks, laydowns and borrow pits	Roads, tracks and laydowns: • Strip surface gravels (where present) for reuse; remove culverts; re-contour according to end land use; round-off cut slopes to smooth transition; uncompact by ripping (except in gibber plains areas); respread topsoil where available. • Re-establish natural drainage; install diversion berms on long slopes; terraces on cut slopes as required. • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation. Borrow pits: • Re-contour according to end land use; round-off cut slopes to smooth transition; uncompact by ripping as required (except in gibber plains areas); respread topsoil where available. • Install diversion berms and terraces on cut slopes as required. • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation.	Rehabilitated at the end of the asset's life.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.
Camps	• Removal of infrastructure. • Strip surface gravels (where present) for reuse or bury in cut to prevent surface exposure; re-contour according to end land use if necessary; round-off cut slopes to smooth transition; uncompact by ripping (except in gibber plains areas); respread topsoil where available. • Re-establish natural drainage; install diversion berms on long slopes as required. • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation.	Rehabilitated at the end of the asset's life.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.

Activity	Summary of rehabilitation methodology	When rehabilitation works will be undertaken	Final land use
Wells pads and associated infrastructure	• Sumps and pits backfilled and re-contoured consistent with surrounding land contours • Removal of infrastructure. • Strip surface gravels (where present) for reuse or bury in cut to prevent surface exposure; re-contour according to end land use if necessary; round-off cut slopes to smooth transition; uncompact by ripping (except in gibber plains areas); respread topsoil where available. • Re-establish natural drainage; install diversion berms on long slopes as required; terraces on cut slopes as required. • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation.	Rehabilitated at the end of the asset's life.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.
Pipelines	• Decommissioning of pipelines. • Remove aboveground pipelines. • Backfill trenches and compact; mound to allow for settling; grade as required; install traffic barriers of natural materials at road crossings as required; respread topsoil. • Re-establish natural drainage; install diversion berms on long slopes as required • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation.	Pipeline right of ways are rehabilitated following construction. Pipeline removal or decommissioning will occur at the end of the asset's life.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.
Other Non-Linear Disturbances (i.e. Production Facility)	• Removal of infrastructure. • Strip surface gravels (where present) for reuse or bury in cut to prevent surface exposure; re-contour according to end land use if necessary; round-off cut slopes to smooth transition; uncompact by ripping (except in gibber plains areas); respread topsoil where available. • Re-establish natural drainage; install diversion berms on long slopes as required. • Create roughened surface by gouging or scarifying to promote natural establishment of vegetation.	Rehabilitated at the end of the asset's life.	Grazing natural vegetation unless otherwise agreed with the landowner and DES.