Varanus Island Total Plant Shutdown Bridging Document

Bridging Document to the VI Hub Operations EP (State Waters) (EA-60-RI-00186)

PROJECT / FACILITY	Varanus Island Hub
REVIEW INTERVAL (MONTHS)	No Review Required
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer	Approver
	Project Manager	**Environment Coordinator**	**Production Manager – Gas Assets**
0	Marc Stephan 21/09/21	Patrick Becker	p.p. Lin, Rickie (Rickie) Digitally signed by Lin, Rickie (Rickie) DN: dc=com, dc=santos, ou=Windows, ou=Users, cn=Lin, Rickie (Rickie) Date: 2021.09.22 15:41:46 +08'00'

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Rev	Rev Date	Author / Editor	Amendment
A	31/08/2021	Advisian	Issued for Review
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1 Purpose

1.1 Introduction

Santos WA Northwest Pty Ltd (Santos) operates the Varanus Island (VI) Hub oil and gas facilities on the Northwest Shelf, Western Australia (WA). VI forms the central gathering and processing hub for the Santos oil and gas production facilities in the area. Gas and liquids from the offshore facilities are processed on the island.

A ten-day Total Plant Shutdown (TPSD) of the VI Hub facilities has been scheduled for November 2021 for critical maintenance and integrity work. For efficiency, pipeline maintenance works are proposed to coincide with this scheduled TPSD. The purpose of this activity is to maintain integrity standards.

To complete this scope in a safe, timely and efficient manner, temporary 24-hour operations will require additional lighting.

Due to limited duration of the shutdown (ten days), and the extent of work required, the work scope will need to be completed on a 24-hr shift.

1.2 Purpose of the Bridging Document

Santos herewith submits a Bridging Document (BD) to the Varanus Island Hub Operations Environment Plan (VI Hub Operations EP) (EA-60-RI-00186), Revision 9.1, in line with the Petroleum Pipelines Act 1969 and Petroleum Pipelines (Environment) Regulations 2012 as part of the ongoing operations on VI. Under this BD, as part of operational activities undertaken on PL12, Santos proposes to dismantle and replace fuel gas pipeline (FG711-50-AA2) and process liquid pipeline (PL703-50-BA2) in which additional temporary worksite lighting is required. Control measure (VI-SW-CM-04) of the EP stipulates that a BD is required when additional lighting is utilised during sensitive periods.

2 Regulatory Approvals

2.1 Varanus Island Hub Operations Environment Plan

The VI Hub Operations EP (Revision 9.1) is the EP that covers the proposed activity and additional lighting during the TPSD. Revision 9 of the EP was accepted by DMIRS on 25th September 2020, and an internal revision (Revision 9.1) was completed to undertake editorial changes (such as unhighlighting text and removing strikethrough text) which were in the submitted version prior to DMIRS acceptance.

Section 6.2 of the accepted EP (Light Emissions) details the light emissions and control measures required for lighting management.

Control measure VI-SW-CM-04 of the accepted EP requires that:

A Bridging Document or Written Notification will be submitted for acceptance by DMIRS if during the peak turtle and Wedge-tailed Shearwater nesting period (1 October – 30 April) the following may occur (unless required in an emergency):

- *night-time operations are planned for more than 1 consecutive night AND within 3 km of a known turtle or shearwater nesting beach/rookery; or*
- *Direct or indirect light spill on a known turtle nesting beach or Wedge-tailed Shearwater rookery for more than 1 consecutive night.*

This BD has been prepared to meet Control Measure VI-SW-CM-04 as the activity requires additional lighting for more than 1 consecutive night in November and is within 3 km of a known turtle nesting beach and shearwater rookery.

In addition, control measure VI-SW-CM-04 requires that:

Additional artificial lighting required between 1 October and 30 April will be managed in accordance with the Lighting Management Plan.

This is discussed in Section **2.2** below.

2.2 VI Lease Conditions

In addition to the EP, Santos operates on Department of Biodiversity, Conservation and Attractions (DBCA) Leases 1902 and 2064. Clause 24(a)(c) of the lease conditions require that a Lighting Management Plan (LMP) is developed and accepted by DBCA for managing external lights on VI.

The DBCA accepted and in force VI LMP (EA-60-RI-00153) requires the development and use of an activity specific illumination plan (refer Section 7.2.4) for activities undertaken between 1 October and 30 April needing additional lighting. Therefore, the VI Total Shutdown Illumination Plan (7902-220-EMP-0001) has also been developed for this activity.

3 Operator

3.1 Details of Operator

Santos is the operator of production licence PL/12.

Operator details are:

Name:	Santos WA Northwest Pty Ltd
ABN/ACN:	58 009 140 854/ 009 140 854
Business address:	Level 7, 100 St Georges Terrace, Perth, WA, 6000
Telephone number:	(08) 6218 7100
Fax number:	(08) 6218 7200
Email address:	Offshore.environment.admin@santos.com

3.1.1 Details of the Nominated Liaison Person

Details for Santos' nominated liaison person for the activity are:

Name:	Patrick Becker
Business address:	Level 7, 100 St Georges Terrace, Perth, WA 6000
Telephone number:	(08) 6218 7100
Email address:	Offshore.environment.admin@santos.com

4 Activity Details

4.1 Activity Description

As part of the total plant shutdown, Santos proposes to dismantle and replace select sections of fuel gas pipe (FG711-50-AA2) and process liquid pipeline (PL703-50-BA2) during the TPSD. All the proposed activities within the scope of this BD are considered to be covered in the VI Hub Operations EP.

Preparations for the work activity will incorporate scaffold erection and equipment laydown. All activity will occur within the pre-disturbed lease area and no vegetation clearing is required.

Painting and leak testing will be completed post installation of new sections. The installation of both the scaffolding and pipework will be scheduled for execution over 24hour operations and may require a crane operator which will be restricted to day operations only.

4.1.1 Lighting Requirements

Additional lighting is required for the pipeline maintenance works proposed during TPSD to enable 24 hour operations in order to complete the works within the scheduled shutdown period.

Two LED directional lighting towers (with 6 x 480W LED lamps) selected for preferential amber colour (least disruptive wavelength) will be used, that can extend to a maximum height (elevation) of 11 m. The amber colour lights have a wavelength of 588 nm. Each lighting tower will be powered by diesel engines. The lighting towers will illuminate the work area around the pipelines to allow 24 hr operations.

The lights will be positioned to meet the lighting objectives of illuminating the work area whilst also preventing light spill outside the work area. Therefore, they will also be:

- Elevated to the lowest practicable height;
- Directed down at the work area; and
- Positioned so that they are facing away from the nearest shearwater rookeries and turtle nesting beaches.

4.2 Location

The location of the proposed activity and lighting tower position is located within the lease area on VI and is shown in **Figure 4-1.**

Figure 4-1: Pipeline maintenance work area and proposed location of lighting towers

4.3 End of activity

Activity is deemed completed when the proposed pipeline maintenance is completed and the associated scope equipment is demobilised from the work area.

5 Indicative Timing

The activity is proposed to commence on 1st November 2021 for a period of ten days. During this period 24-hour operations are proposed requiring additional site specific lighting. Activities are expected to be completed by 10th November 2021.

6 Description of the Environment

Information on the location of VI and the environment is included in Section 4 of the VI Hub Operations EP with relevant details summarised below.

Varanus Island Hub is located on the North-West Shelf of Western Australia, in the Shire of Ashburton, off the Pilbara Coast. The proximity of the island to other key coastal or mainland features are provided in **Table 6-1**.

Table 6-1: Key Coastal or Mainland Features in Proximity to Varanus Island

Features	Varanus Island
State/Commonwealth waters boundary	20 km west
Montebello Commonwealth Marine Reserve boundary	20 km west
Montebello Islands Marine Conservation Reserve	10 km north
Barrow Island	11 km southwest
Barrow Island Marine Management Area	25 km south
Barrow Island Marine Park	23 km southwest
Australian Mainland	58 km southeast

The island provides nesting habitat for several seabirds, particularly the wedge-tailed shearwater and also marine turtles as displayed in Error! Reference source not found.. The work area is wholly contained w ithin the lease boundary and does not physically interact within any protected areas including mangroves, seabird rookeries or turtle nesting sites.

The work area is in close proximity to known turtle nesting beaches and shearwater rookeries, with the approximate distances displayed in **Figure 6-1**.

6.1 Turtles on Varanus Island

The most common species of turtle nesting on VI are the hawksbill and flatback turtles. Green turtles nest less frequently and in lower numbers.

The nesting beaches in proximity to the area where the proposed works are include Mangrove Beach and Pipeline Beach, which are approximately 90 m, and 79 m from the work area respectively (**Figure 6-1**). Mangrove Beach is used by nesting flatback turtles (Pendoley Environmental, 2020a), however, to date, there has been very low nesting activity recorded at this location. Pipeline beach is also used regularly by flatback and hawksbill turtles. Historically, hawksbill turtle nesting is expected to peak in October/November and flatback turtle nesting peaking in December/January. Peak hatchling emergence occurs after the ~60 day incubation period in December for hawksbill turtles and February for flatback turtles. Therefore, adult hawksbill turtles may potentially be nesting during the scheduled project works, however the activities will be completed prior to peak flatback nesting or peak hatchling emergence of either species.

6.2 Shearwater rookeries on Varanus Island

Shearwaters nest in burrows that are excavated or renovated by the breeding pairs at the start of each nesting season. On islands of the NWS, wedge-tailed shearwaters usually return to their colony areas to resume courtship and re-excavate burrows in August each year. On VI, rookeries for the wedge-tailed shearwater are located in the eastern, western and southern sides of the lease area. Infrastructure on VI is currently and historically illuminated 24 hours a day. Despite this, migratory birds continue to breed successfully and consistently as evidenced in annual seabird monitoring (Pendoley Environmental 2020b). This would indicate that lighting has a negligible impact on migratory birds utilising VI for roosting and nesting activities.

The proposed TPSD activities are approximately 41 m from the closest shearwater rookery (**Figure 6-1)**

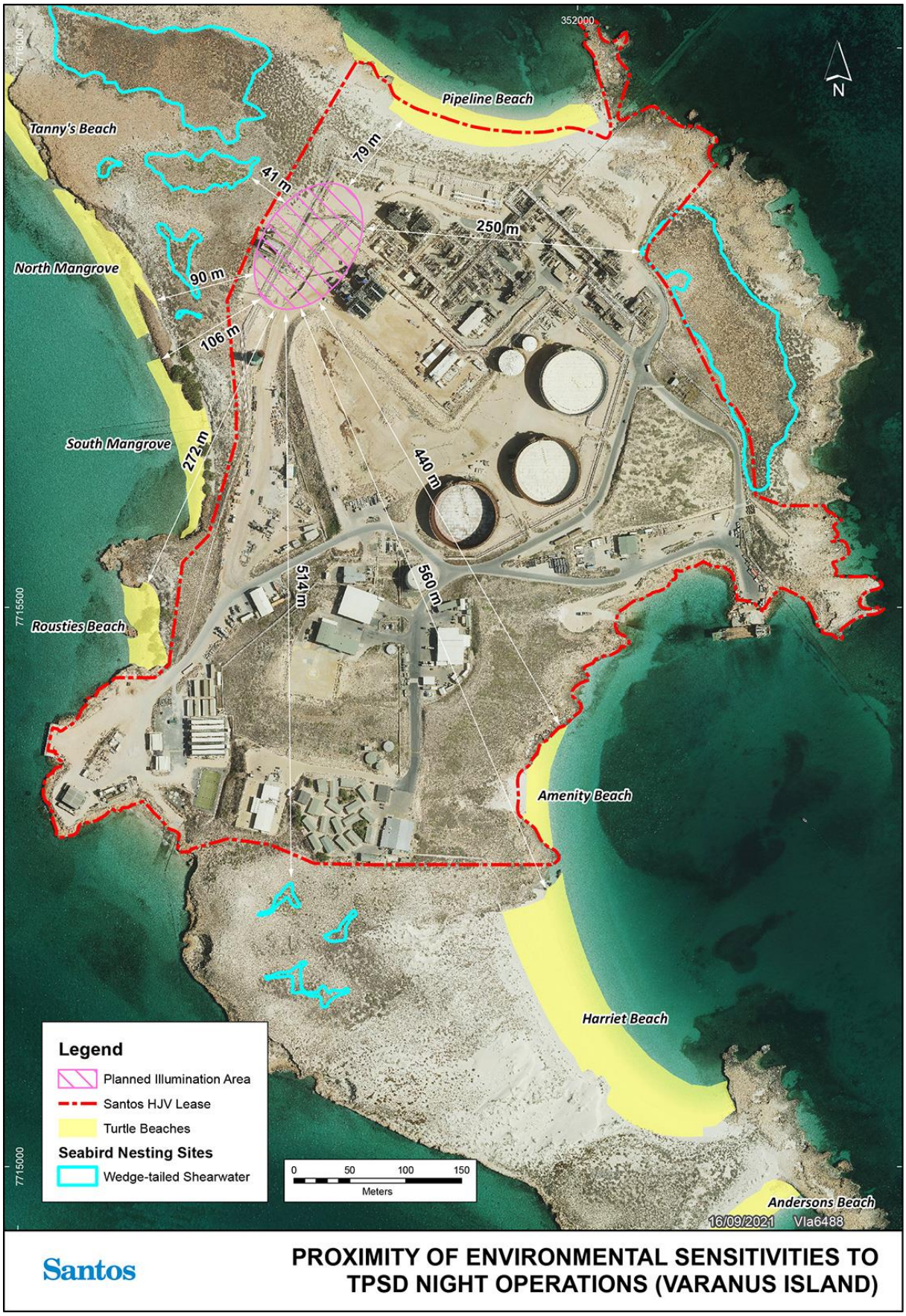

Figure 6-1: Location of environmental sensitivities

7 Risk Assessment

7.1 Risk Assessment Process

Environmental risks were assessed by reviewing the activities and events that may or may not occur during the activity. Identified risks were subsequently assessed against those described within the VI Hub Operations EP and environmental management gaps, such as new or increased risks and impacts or the need for any new or revised control measures, were identified.

The risks identified as being potentially increased above those identified in the accepted EP are:

- Lighting impacts on sensitive fauna (turtles and seabirds)

The identified gaps are described and addressed in **Section 7.2** of this BD.

7.2 Direct light spill onto sensitive environments

7.2.1 Description of Event

During this proposed activity, there is the potential for additional light emissions to be visible from surrounding waters, turtle nesting beaches, coastal vegetation, and bird nesting habitat. The environmental hazard, extent and duration of the proposed activity is detailed in **Table 7-1**.

Table 7-1: Summary of Potential Impact – Light Emissions

Description of the Event	
Environmental Hazard	Artificial light from temporary lighting towers affecting fauna specifically nesting turtles and seabirds (including shearwaters).
Extent	Potential for direct light spill on north-western wedge-tailed shearwater nesting habitat displayed in **Figure 6-1**. Potential for additional sky glow visible from turtle nesting beaches displayed in **Figure 6-1**.
Duration	For the duration of the activity (10 days)

7.2.2 Nature and Scale of Environmental Impacts

Potential Receptors: Threatened/migratory fauna (marine turtles and seabirds).

Continuous lighting emanating from the same location for an extended period of time may result in alterations to fauna behaviour. The combination of colour, intensity, closeness, direction and persistence of a light source are key factors in determining the magnitude of environmental impact (EPA, 2010). Disturbance may include:

- Nocturnal seabirds may also avoid nesting habitat that is illuminated at night.
- Turtles and turtle hatchlings may be misoriented and disoriented by lights.

Threatened / Migratory Fauna

Marine Turtles

Light pollution reaching turtle nesting beaches is widely considered detrimental owing to its ability to alter important nocturnal activities including choice of nesting sites and orientation/navigation to the sea by post-nesting females and hatchlings (Witherington and Martin, 2003). Light pollution is also highlighted in the Recovery Plan for Marine Turtles in Australia as a factor requiring management for successful marine turtle nesting (DoEE, 2017). The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests, although breeding adult turtles can also be disoriented (Rich and Longcore, 2006 in EPA 2010). Once in the ocean, hatchlings are thought to remain close to the surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. During

this period, light spill from coastal infrastructure may `entrap' hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon et al., 1992).

According to the Recovery Plan for Marine Turtles in Australia: 2017-2027 (DoEE, 2017) the operational area intersects an internesting area identified as habitat critical to the survival of the species for loggerhead, flatback, green and hawksbill turtles. This internesting area is defined as a 60 km radius around Barrow Island between October and March for flatback turtles, 20 km radius around Barrow Island between November and March for green turtles and 20 km radius around Montebello Island for hawksbill turtles.

The North-west Marine Bioregion supports globally significant breeding populations of green (Chelonia mydas), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and flatback (*Natator depressus*) turtles (DSEWPaC, 2012).. The Recovery Plan for Marine Turtles in Australia: 2017-2027 states that light pollution is of high risk to hawksbill (WA genetic stock) turtles, flatback (Pilbara genetic stock) turtles and green (North West Shelf genetic stock) turtles (DoEE, 2017). Physical habitat modification is of high risk to flatback (Pilbara genetic stock) and green turtles (Scott Reef-Browse Island genetic stock) (DoEE, 2017).

The Recovery Plan for Marine Turtles in Australia: 2017-2027 (DoEE, 2017) highlights artificial light as one of several threats to marine turtles. Specifically, the plan indicates that artificial light may reduce the overall reproductive output of a stock, and therefore recovery of the species, by:

- Inhibiting nesting by females;
- Disrupting hatchling orientation and sea finding behaviour; and
- Creating pools of light that attract swimming hatchlings and increase their risk of predation.

All three species nesting on VI are classified as threatened under the EPBC Act 1999 and the WA Biodiversity Conservation Act 2016. On a regional scale, VI is not a key flatback or green turtle rookery. However, it is considered one of only a few hawksbill rookeries in Western Australia.

For marine turtle (and seabird) species, light pollution along, or adjacent to, nesting beaches or rookeries may cause alterations to critical behaviours, such as foraging at sea, the selection of nesting sites and the passage of emerging turtle hatchlings from the beach to the sea (Limpus, 2008). The impacts of these changes include a decrease in nesting success, beach avoidance by nesting females and disorientation, leading to increased mortality through predation, roadkill or dehydration (Limpus, 2008; Witherington & Martin, 2000 as cited in DSEWPaC, 2012).

Generally, turtles are most sensitive to the shorter wavelengths (< 600 nm), meaning they perceive the violet, blue and green end of the light spectrum more so than the yellow, orange or red end. Typically, the lights used in industrial and offshore applications are fluorescent and halogen lights, falling within the wavelength range that is visible to turtles. Light monitoring on VI has shown that fixed artificial light (direct light and light glow) is visible from some turtle nesting beaches; however, levels are not uniform.

Based on published scientific studies and experimental work carried out on turtle hatchling emergence and attraction to lights on Barrow Island is that low wattage, low pressure sodium vapour lights are the least “attractive” to turtles, followed by a low wattage light with a yellow filter. High pressure sodium vapour lights and fluorescent white light were the most attractive and therefore the least desirable in terms of reducing impact on turtle behaviour (Pendoley, 2011). Light spill onto nesting beaches has the potential to disorientate adult turtles and the sea bearing/finding behaviour of turtle hatchlings. This has been the recent focus of lighting studies on marine turtle populations (Pendoley and Kamrowski, 2015).

The potential impacts of light emissions to flatback, hawksbill, loggerhead and green turtles from the activity are expected to be restricted to localised attraction and temporary disorientation but with no long-term or residual impact. Turtles have been recorded successfully breeding on VI over the last 20 years with an estimated survival probability of over 94% (Prince and Chaloupka, 2011). Furthermore, based on the 2019/20 VI turtle monitoring results, there has been no detectable impact to the nesting

population of flatback and hawksbill turtles on Varanus Island that could be attributed to operations (Pendoley Environmental, 2020). This would indicate that the industrial uses on VI, inclusive of the introduction of artificial light sources, have had little to no measurable impact on adult turtles nesting on VI and to date have not shown to have led to a long-term decrease in the size of the adult marine turtle nesting population.

Birds (Seabirds / Shorebirds)

Infrastructure on VI is currently and historically illuminated 24-hours a day. Increased light levels may cause local disruption of seabird behaviour patterns, for example Wedge-tailed Shearwater breeding/nesting activity or disorientation of their offspring. Despite this, migratory birds continue to breed successfully and consistently as evidenced in annual seabird monitoring. This would indicate that lighting has a negligible impact on migratory birds utilising VI for roosting and nesting activities.

Light potentially impacts breeding seabirds on VI in much the same way as it does marine turtles. A study into light impacts upon nocturnally migrating birds on the North Sea found that birds were disoriented and attracted by red and white light (containing visible long-wavelength radiation), whereas they were clearly less disoriented by blue and green light (containing less or no visible long wavelength radiation) (Poot et al., 2008). In addition, disoriented adult birds may not be able to return to their burrows to relieve their mates or feed their young. Fledglings are particularly vulnerable to light through misorientation and disorientation when departing the colony for the first time. A number of migratory bird species breed on VI, including the wedge-tailed shearwater, bridled tern and lesser crested tern, however the shearwater rookery is the closest to the TPSD work area.

7.2.3 In-force EP Risk Ranking

Section 6.2 of the VI Hub Operations EP highlights the potential impact to sensitive fauna due to artificial lights.

The risk ranking in the VI Hub Operations EP is classified as Negligible as summarised in **Table 7-2** due to the potential outcome only effecting short term behavioural impacts to small proportions of local populations (if at all).

Table 7-2: In-Force EP risk ranking – Disturbance to marine fauna from artificial lighting

EP Section	Planned event	Consequence	
6.2	Light Emissions	A - Negligible	Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease.

7.2.4 Measurement of Environmental Performance

To ensure the potential impacts of additional lighting on sensitive fauna is managed, additional scope specific control measures have been proposed. The control measures and associated environmental performance standards and measurement criteria are provided in **Table 7-3.**

Table 7-3: Additional control measures, environmental performance standards and measurement criteria

Environmental Impact	Artificial light from temporary lighting fixtures affecting fauna, specifically breeding turtles and seabirds (including shearwaters).		
Performance Objective (in accepted EP)	Activity lighting minimised where practicable, while still achieving navigational and safety requirements (EPO-VI-SW-02)		
Management controls	**Performance standard**	**Measurement criteria**	**Responsible**
Additional artificial lighting required between 1 October and 15 April will be managed in accordance with the Varanus Island Lighting Management Plan (EA-60-RI-00153)	An activity specific illumination plan (7902-220-EMP-0001) is developed for the activity in accordance with the Varanus Island Lighting Management Plan (EA-60-RI-00153) The Illumination Plan covers matters such as + Activity description + Environmental consideration + Lighting specifications + Lighting management principles + Seasonal biological activity table; and + Implementation Checklist and includes controls as listed below.	Assurance activity specific Illumination Plan in place and communicated in the Site Induction.	Project Co-ordinator
Additional lighting to be switched off when not in use	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms non-emergency lights are turned off when not in use.	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	Project Co-ordinator
Lighting towers will be orientated away from the west shearwater rookery and nearby sensitive receptors	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms lighting	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant	Project Co-ordinator

	specifications and positioning	Implementation Checklist item (Attachment 4)	
Lighting towers will be positioned to face downwards to illuminate the work area and reduce reflection off plant infrastructure and reduce sky glow to ALARP	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms lighting specifications and positioning	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	Project Co-ordinator
Lighting tower light fittings will be elevated as low as possible while meeting lighting objectives	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms lighting specifications and positioning	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4	Project Co-ordinator
Lighting tower spectral characteristics will be between 500-700nm (amber lamps)	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms lighting specifications and positioning	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	Project Co-ordinator
Activity specific site surveys will be undertaken looking back from Pipeline Beach, Mangrove Beach and the western lease boundary. If an unacceptable lighting profile is detected, adaptive management controls will be implemented.	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms an 'as-built' survey of where lights or glow are visible from nesting locations during the initial work site preparation stage.	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	HSE Advisors
Adaptive Management Controls			
If light is directly visible, orientation of lighting towers will be modified to reduce as far as practicable	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-	Project Co-ordinator

	plan (7902-220-EMP-0001) confirms that efforts were made to reduce light spill. Photographic evidence will demonstrate no impacts	0001) is in place and compliant Implementation Checklist item (Attachment 4)	
If light spill is detected, orientation of lighting towers will be modified.	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms that efforts were made to reduce light spill. Photographic evidence will demonstrate no impacts	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	Project Co-ordinator
If light spill is detected after reorientation, additional shielding will be erected.	Illumination plan - Implementation Checklist (Attachment 4 of the activity specific illumination plan (7902-220-EMP-0001) confirms that efforts were made to reduce light spill. Photographic evidence will demonstrate no impacts	Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001) is in place and compliant Implementation Checklist item (Attachment 4)	Project Co-ordinator

7.2.5 BD Risk ranking for the activity

With the proposed controls (**Table 7-3**) to manage the additional lighting for this activity, the consequence assessment of the lighting was determined to be Negligible (**Table 7-4**) in accordance with the environmental impact and risk assessment process described in the VI Hub Operations EP.

Table 7-4: BD risk ranking - Artificial light spill on sensitive fauna

EP Section 6.2.4 - Light Emissions	
Key Receptors	Consequence Level
Light Emissions	
Disturbance to marine fauna from artificial lighting	
Threatened / migratory fauna	Wedge-tailed shearwaters and turtles are the priority threatened / migratory fauna that have been identified as potentially being disturbed by the additional artificial lighting towers. A risk ranking has been provided for each species. **<u>Wedge-tail Shearwaters</u>** + The timing of the activity overlaps with the time period of adults returning to the colony, excavating burrows and courtship. No fledglings will be present during this period. Adults may show behavioural responses, such as avoidance of lit areas during the short duration of the activity but are not as vulnerable to impacts when compared to fledglings. + Direct impacts from attraction or grounding of individual shearwaters in response to additional light is unlikely. The lights will be directed away from the nesting habitat and direct light spill will be avoided reducing the potential for impacts to colony attendance. Should colony attendance be affected, the short time frame (10 days) of the activity reduces the likelihood of any negative effects of breeding participation, and the absence of chicks prevents any negative effects to breeding success + Although adults can be attracted to artificial light, fledglings are most vulnerable (Rodriguez et al 2017). On VI shearwater fledging is highly synchronized, occurring in the first two weeks of April. The proposed TPSD activities will overlap with the courtship and mating periods when no fledgling will be present. + In summary, light emissions may cause short term behavioural impacts only to a small proportion of the local population but there will be no loss/disruption of habitat critical to survival of the species and, given the short duration of the activity, no disruption to the breeding cycle or area of occupancy. The consequence is considered to be **Negligible.** **<u>Marine Turtles</u>** + The activity is proposed outside peak hatchling emergence periods. Though impacts to adult turtles from light spill have been reported, they are much less at risk of disorientation due to artificial light when compared with hatchlings. The timing of the activity means that only

	hawkbill females nesting on Pipeline Beach may have direct visibility of the additional lighting + Following implementation of mitigation measures (lights directed downwards and away from beaches), light spill onto beaches and point source visibility from beaches will not occur, reducing the potential of impacts to nesting females. + The potential light emissions from the lighting towers on marine turtles (green turtle, flatback turtle, hawksbill turtle) has been considered to be **Negligible,** as light spill will potentially cause short-term behavioural impacts only to a small number of individuals during the very limited duration of the activities (10 days). Additionally, it is unlikely that there will be any loss/disturbance of habitat critical to the survival of marine turtles. Due to extensive current and proposed management controls (see **Table 7-3**) and conclusions of ecological studies undertaken on VI, the artificial lighting associated with proposed activity is considered unlikely to significantly impact turtles and seabirds, including the breeding success of seabird and marine turtle populations.
Physical environment/ habitat	Not applicable – light will not impact the physical environment itself; the only potential impact would be towards the species using it.
Threatened ecological communities	Not applicable – no threatened ecological communities identified in the area over which light spill are expected.
Protected areas	VI is part of the Lowendal group of islands which is vested as a C class nature reserve (protected area) managed by DBCA. Within this nature reserve the wedge-tailed shearwater rookeries and marine turtle nesting beaches have been identified as protected areas which may be impacted by the light spill from the additional lighting. The highest impact of the light spill on these protected species has been considered to be **Negligible.**
Socio-economic receptors	Not applicable – lighting is not expected to cause an impact to socio-economic receptors.
Overall worst-case consequence level	**A - Negligible** Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease.

7.2.6 Demonstration of ALARP

With the described controls, the consequence of artificial light on marine fauna (specifically wedge-tailed shearwaters and marine turtles) is considered to be negligible with short term behavioural impacts only to a small proportion of the population.

When developing the suite of controls for the management of the artificial lighting required for the pipeline maintenance works, the EAG (13) Guidelines for Protecting Marine Turtles from Light Impacts and National Light Pollution Guidelines for Wildlife were considered where possible when developing the activity specific illumination plan including, keeping light off the beach; reducing intensity; and selecting appropriate wavelengths. With these control measures in place the impact of artificial lighting to the receiving environment is considered ALARP.

There are no safe alternatives to the use of artificial lighting on the offshore facilities. Artificial lighting is required on a 24-hour basis to maintain operational integrity. Given the short duration of the activity and the controls proposed to minimise the impact of the lighting, the impacts of using 24-hour artificial lighting at an intensity to allow work to proceed are ALARP.

7.2.7 Acceptability Evaluation

Santos considers the impacts and risks associated with the activity to be acceptable because the acceptability criteria are met as described in **Table 7-5**.

Table 7-5: BD Acceptability Evaluation

Is the risk ranked between Negligible or Minor?	Yes – residual risk is ranked as Negligible
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available
Are risks and impacts consistent with the principles of ESD?	Yes – activity evaluated in accordance with Santos WA's Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are performance standards consistent with industry standards, legal and regulatory requirements, including protected matters?	Yes – Management consistent with the intent of the Recovery Plan for Marine Turtles in Australia (2017) and EAG (13) Guidelines for Protecting Marine Turtles from Light Impacts. Consistent with VI Lease.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – Aligns with Santos Environmental Management Policy
Are risks and impacts consistent with stakeholder expectations?	Yes – No relevant stakeholders were identified to be impacted by the proposed activity other than DMIRS for regulatory purposes
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

8 Stakeholder Consultation

Following review, relevant stakeholders for this activity are deemed to be restricted to government authorities responsible for management of the petroleum industry and the environment.

Section 10 (Stakeholder Consultation) of the VI Hub Operations EP (State Waters) (EA-60-RI-00186, revision 9.1) was reviewed in the preparation of this BD. Relevant stakeholders were identified as DMIRS. DMIRS consultation is required under VI lighting emission control measure VI-SW-CM-04, through submission of this BD.

No other stakeholders were considered relevant to this activity and scope and no further consultation was therefore required.

9 Management Approach

The change out of fuel gas pipeline (FG711-50-AA2) and process liquid pipeline (PL703-50-BA2) will be managed in accordance with the VI Hub Operations EP (EA-60-RI-00186) accepted by DMIRS.

The proposed activities are not considered a significant modification to the operational details described within the VI Hub Operations EP (EA-60-RI-00186) as they pose no significant new risks or significant increase in existing risks.

Lighting will be managed in accordance with Varanus Island Total Plant Shutdown Illumination Plan (7902-220-EMP-0001).

Environmental recordable and reportable incidents will be reported to DMIRS, and other regulators as required.

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