Santos

BAROSSA GAS PROJECT

Subsea Infrastructure Installation and Pre-commissioning Activity Information Booklet

Santos is continuing its Barossa Gas Project consultation efforts to further ascertain, understand and assess values and sensitivities of the environment that may be affected by our proposed activities, and potential environmental impacts and risks. There may be information Santos is not yet aware of but needs to properly understand to assess potential activity impacts and risks. Consultation may inform this. It may also inform what control measures are to be proposed to reduce environmental impacts and risks to as low as reasonably practicable and to an acceptable level.

This consultation material specifically relates to the Subsea Infrastructure Installation Environment Plan (SURF EP).

Overview

Santos is a global energy company committed to helping the world decarbonise to reach net-zero emissions through reliable and affordable energy. For more than 65 years, Santos has been working in partnership with local communities, providing local jobs and business opportunities, safely developing its natural gas resources, and powering industries and households.

The Santos-operated Barossa Gas Project is an offshore gas and condensate project that proposes to provide a new source of gas to the existing Darwin liquified natural gas (DLNG) facility in the Northern Territory. Natural gas would be extracted from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-north west from Darwin, and transported via a gas pipeline (Gas Export Pipeline (GEP) and Darwin Pipeline Duplication (DPD)) to the existing DLNG facility, with first gas targeted for 2025.

Project infrastructure would comprise a Floating Production Storage and Offloading (FPSO) facility, a subsea production system, supporting in-field subsea infrastructure, the GEP and the DPD.

Santos plans to drill six (6) subsea development wells at three (3) drill centres, with contingency plans for an additional two (2) wells. Gas and condensate would be gathered from the wells through the subsea production system and then brought to the FPSO facility via a network of subsea infrastructure.

Initial processing would occur at the FPSO facility, to separate the natural gas, water and condensate extracted from the Barossa field. The dry natural gas would be transported through the gas pipeline for onshore processing at the DLNG facility. Condensate would be transferred from the FPSO to specialised tankers for export.

Environmental approvals

The Commonwealth Government's independent expert regulator for offshore oil and gas development, the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), accepted the Barossa Offshore Project Proposal (OPP) in March 2018.

Acceptance of the OPP is the government's project-level environmental approval for offshore projects, with construction and operations subject to further acceptance of activity-level environment plans (EPs).

To be accepted by NOPSEMA, an EP must meet the requirements set out in *the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS Environment Regulations).

The OPGGS Environment Regulations set out that an EP must (among other things):

+ comprehensively describe the activity to be carried out under the EP
+ describe the environment that may be affected by the activity, including the values and sensitivities of that environment
+ detail and evaluate the environmental impacts and risks for the relevant activity
+ demonstrate that the impacts and risks of the activity will be reduced to as low as reasonably practicable and an acceptable level (and detail the control measures to be used to achieve this)
+ demonstrate that Santos has consulted, in accordance with regulatory requirements, with each relevant person, including those whose functions, interests or activities may be affected by the activities to be carried out under the EP
+ demonstrate that the measures (if any) that Santos has adopted, or proposes to adopt, because of the consultations are appropriate.

Santos is currently preparing an environment plan (the SURF EP) in respect of a part of the Barossa Gas Project relating to the Subsea Umbilicals, Risers and Flowlines (SURF), manifolds and FPSO moorings installation (collectively referred to as 'subsea infrastructure installation') and pre-commissioning activity. This is more simply referred to as the 'SURF activity'.

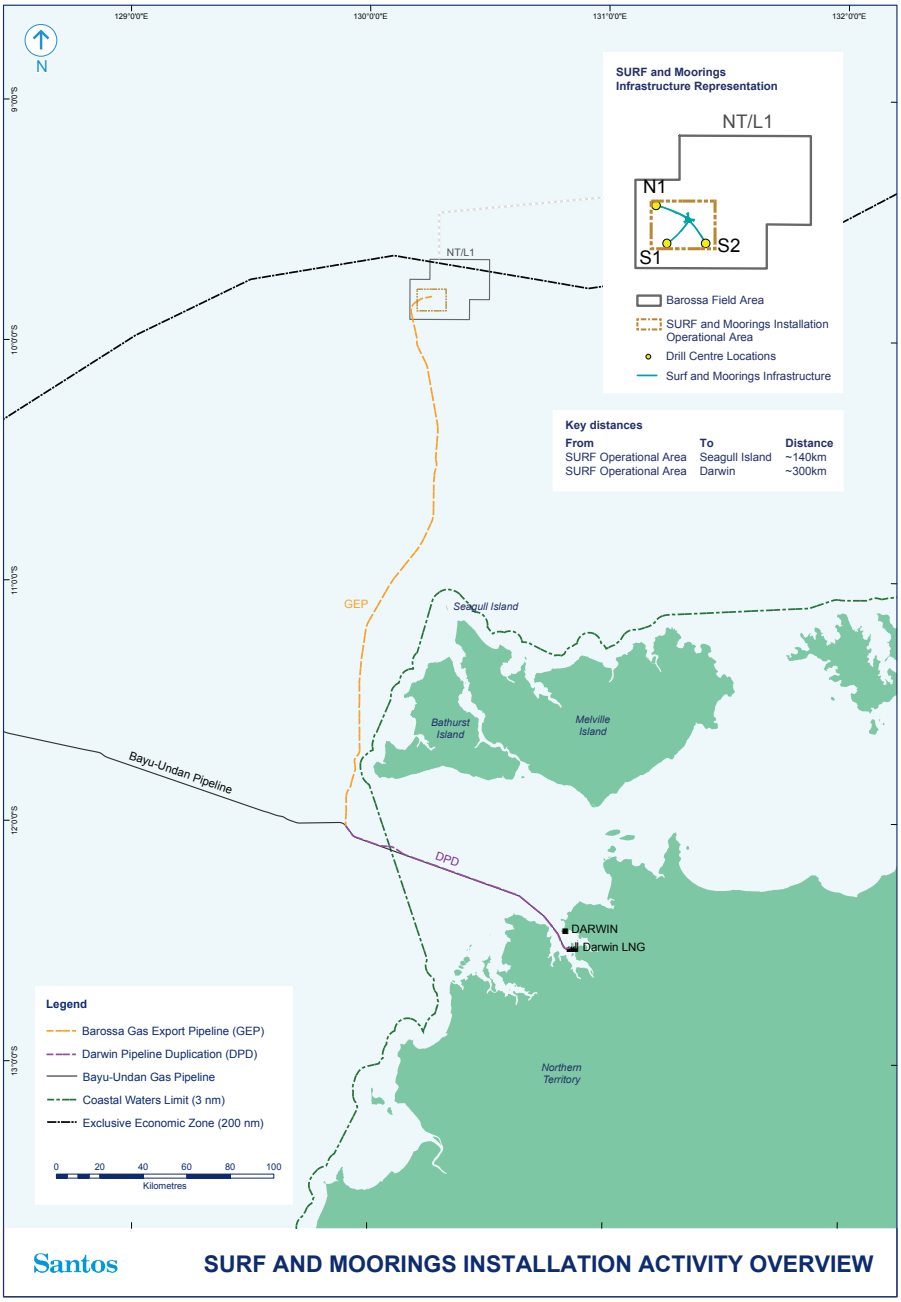


Figure 1 – Barossa overview and SURF environment plan operational area

Activity and location

The SURF EP provides for the Barossa SURF and moorings installation and pre-commissioning activities, which comprise the key infrastructure shown in Figure 2. The SURF and moorings infrastructure has been designed to support the connection of six (6) subsea production wells to the FPSO. Drilling of the wells, and use of the FPSO, are dealt with under separate EPs. The SURF and moorings installation and pre-commissioning campaign (SURF campaign) will be undertaken within Commonwealth waters within the boundaries of Commonwealth Petroleum Production Licence NT/L1, which is approximately 300 kilometres north-north west of Darwin, NT. The operational area is approximately 140 kilometres north of the Tiwi Islands, NT and approximately 44 kilometres north of the Oceanic Shoals Marine Park (Figure 1 and Figure 9).

The total duration of the SURF campaign is estimated to be approximately nine months, subject to factors including vessel availability, operational efficiencies and weather conditions. This campaign is currently planned to commence between Q1 2024 and Q4 2025, subject to obtaining regulatory approvals. The preservation phase commences on completion of installation of key infrastructure and pre-commissioning activities. The preservation phase is designed to maintain the integrity of the infrastructure. The preservation phase for the subsea infrastructure will last up until commissioning, i.e. upon the commencement of activities under the Barossa Production Operations Environment Plan.

The operational area covered under this EP is the area within which all planned activities will occur. The operational area is defined as approximately 10 kilometres by 13.5 kilometres. Figure 1 shows the proposed location and operational area of the SURF Activity.

Activity vessels and helicopters within the operational area are considered part of the activity under the SURF EP.

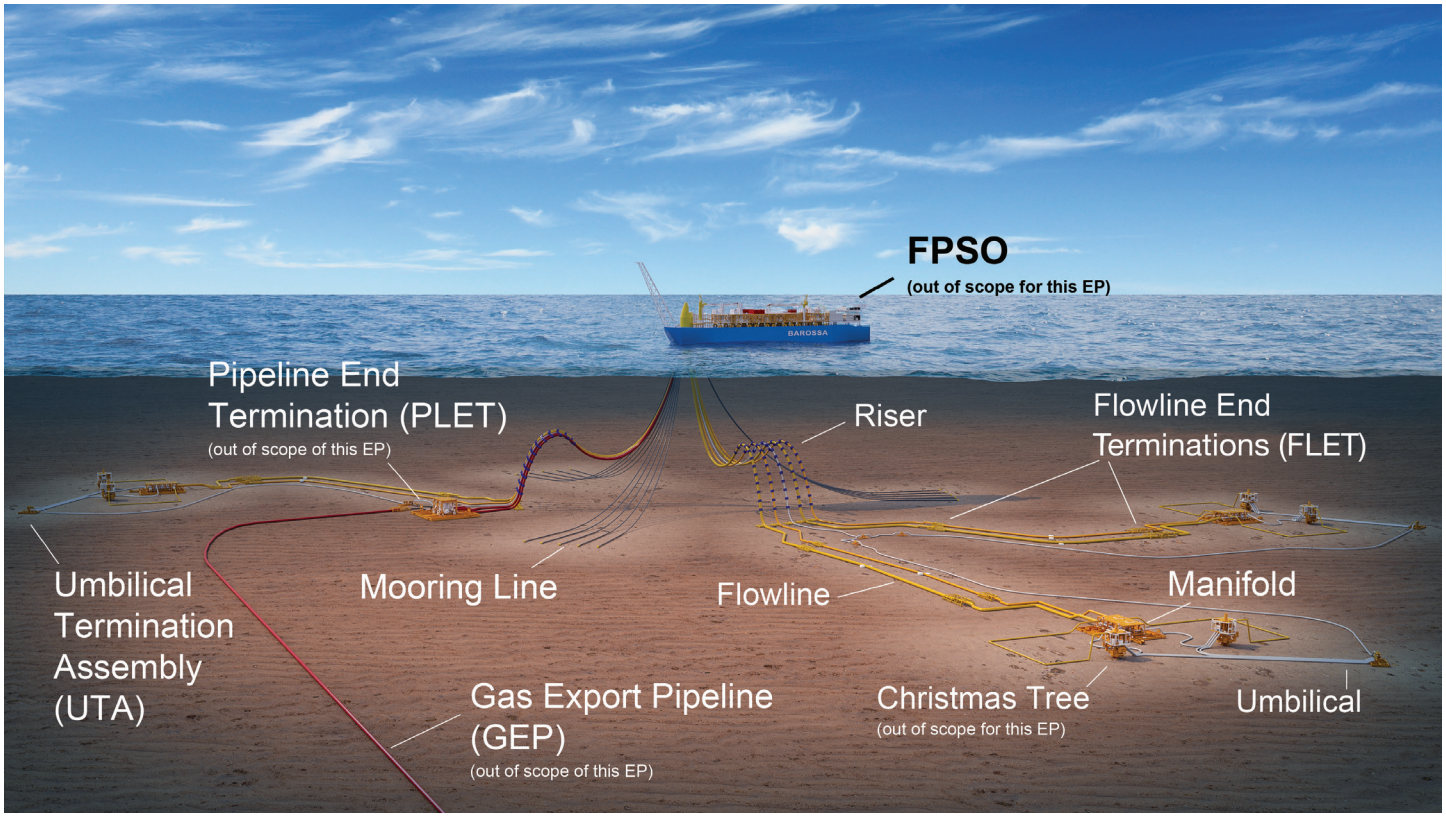


Figure 2 – Graphical representation of the Barossa field layout

Overview of proposed activities under SURF EP

The key installation activities proposed under the SURF EP include the following:

Underwater acoustic positioning

Installation of the subsea infrastructure requires accurate positioning on the seabed and therefore long baseline (LBL) and/or ultra short baseline (USBL) acoustic positioning may be required. These systems provide accuracy up to one metre. LBL and USBL systems work by emitting short pulses of medium to high-frequency sound. Transmissions are not continuous but comprise short 'chirps'. Typically, for USBL positioning, transponders are attached to subsea equipment and recovered once the equipment is correctly positioned on the seabed. For LBL, transponders are typically fixed to seabed frames, which are deployed and then fully recovered once the subsea equipment is correctly positioned.

Underwater surveys

An initial pre-lay survey is planned to be undertaken before flowline, umbilical and other infrastructure installation activities commence. An explanation of activities is provided below. These pre-lay surveys identify debris, seabed features or obstructions along the flowline and umbilical routes, or other areas where infrastructure is to be installed. It is not a full geophysical survey. The survey methods do not disturb the seabed but instead primarily include multibeam echo sounder (MBES), side-scan sonar (SSS) and magnetometer. An allowance of 50m on either side of the flowline and umbilical routes allows for localised rerouting if any significant obstructions or potential areas of spanning (where a gap may be present between the flowline or umbilical and the seabed) are identified during the pre-lay survey. Site surveys have already been undertaken for the flowline route and no debris was identified that would need to be removed before installation. However, if debris is identified during the pre-lay survey, the debris will be assessed using the Barossa Unexpected Finds Protocol to minimise potential impacts to any heritage and cultural objects and values.

As-laid, as-built and as-constructed surveys will also be progressively undertaken throughout the SURF campaign. The data from these surveys will be used to determine the final subsea infrastructure position.

Moorings installation

The floating production storage and offloading unit (FPSO), which is a vessel that will be used for the production, processing of hydrocarbons and the storage of gas (and which is not within the scope of the SURF EP), will be secured through a mooring system. The mooring system uses mooring lines, suction anchors and a Submerged Turret Production (STP) Buoy. Suction anchors are steel cylindrical structures that anchor mooring lines to the FPSO to keep it in position (Figure 3). The suction anchors have been designed to suit the local seabed's geotechnical properties. Fifteen suction anchors will be installed, one for each mooring line. The expected total footprint is less than 2 hectares. Suction anchors with short anchor chain segments pre-attached to each anchor's padeye (i.e. attachment point) will be installed using either the reel-lay or the construction vessel, which are explained below in the section on installation vessels. The vessel crane will lift the suction anchors from a barge deck to the seabed, then a Remotely Operated Vehicle (ROV) will help position and orientate the anchors. The suction anchor will penetrate the seabed under its own weight up to a self-penetration depth; further penetration to full depth will be achieved when the ROV docks onto the anchor top and pumps out the sea water within the suction anchor. Mooring lines will then be installed to attach the suction anchor to the STP Buoy (Figure 4), which secures the FPSO to the mooring system and will eventually be attached to the FPSO.

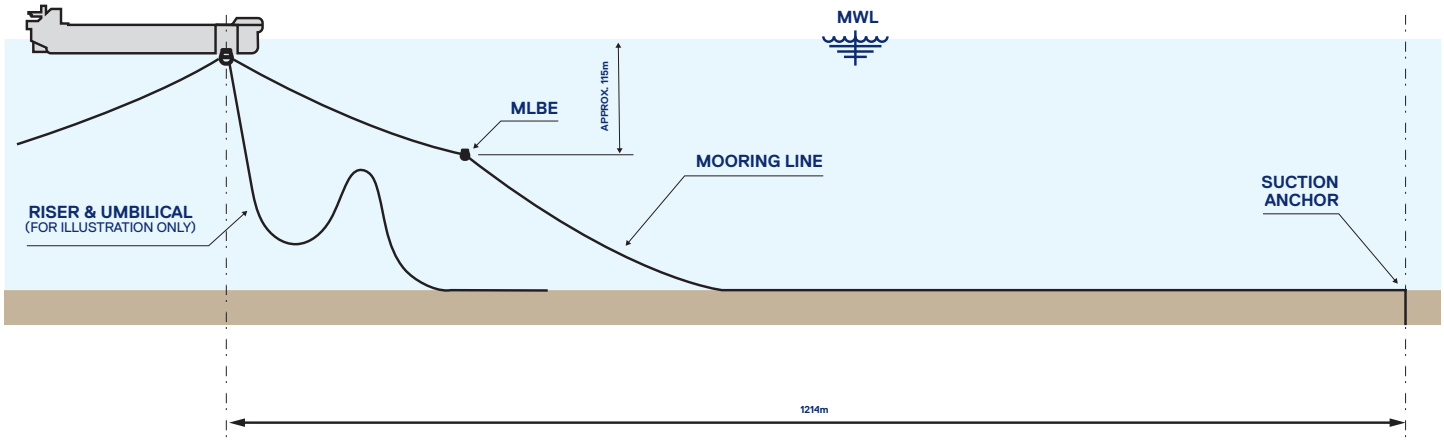


Figure 3 – Arrangement of suction anchors and mooring lines

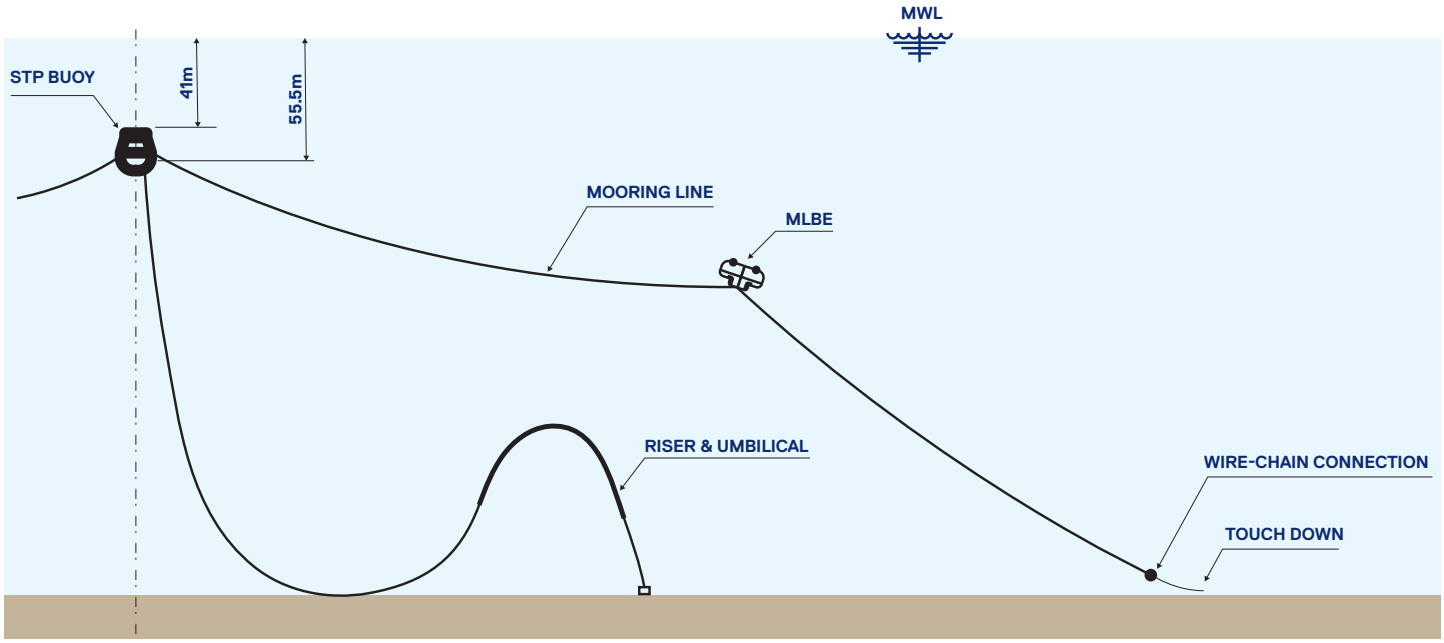


Figure 4 – Connection of the mooring line to the STP Buoy

Flowline lay

Flowlines are pipelines that will carry gas and condensate extracted from the wells to the FPSO. There will be three 14" production and three 6" service flowlines ranging from approximately 5,000– 7,000 metres long (nominally). Each flowline will have corrosion coating. The reel-lay vessel will install the flowlines using a reel-lay installation method (explained below). These flowlines will be prefabricated (welded) then reeled and stored on a large diameter reel on the vessel's deck. The vessel sails to the operational area and the flowlines are laid (or un-wound) off the reel and carefully positioned along their designed route on the seabed. Tie-in welds for Flow Line End Termination (FLET) connections will be welded on the vessel. The vessel may carry more than one flowline at a time.

The reel-lay vessel may be required to reload with flowlines during the campaign and this will likely take place outside the operational area. Lay direction may be from the FPSO location towards the drill centre or vice versa, depending on operational requirements. The production flowlines will be installed empty (air-filled), while the service flowlines will be installed pre-flooded.

The flowline goes through a straightening process and passes through the vessel's tensioners in a lay tower at the vessel's stern—the tower angle is adjusted for water depth and bottom pipe tension.

Tension is applied to the flowline by the reel-lay vessel's tensioners and forward Dynamic Positioning (DP) thrust to maintain the appropriate catenary (the shape the flowline takes when suspended from the reel-lay vessel to the seabed) and prevent the flowline from buckling as it is lowered to the seabed. The reel-lay vessel will proceed forwards at a pre-determined speed. Each flowline will be laid over the displacement initiators and touchdown mattresses and then scour protection will be installed as required.

Manifold installation

Manifolds are installed to assist with gathering and controlling the flow of gas and condensate safely between the wells and the FPSO. Production and riser base manifold foundations are steel structures that provide long-term support for manifolds and are designed to suit the local seabed's geotechnical properties. Four manifold foundations will be installed (one for each manifold). Production manifold foundations (with scour protection) are expected to have a footprint of approximately 500m2. The manifold foundations and manifolds will be installed by the construction vessel. The manifolds will arrive pre-flooded with monoethylene glycol (MEG). MEG is a widely used hydrate inhibitor in the oil and gas industry to reduce the risk of hydrate formation in infrastructure that could cause a blockage. The vessel crane will lift the manifold foundations and manifolds from the barge's deck to the seabed where an ROV may be used to position and orientate the structures. Once in place, the manifolds sit on the foundations and do not add to the seabed disturbance footprint. See Figure 5 for an image of a manifold.

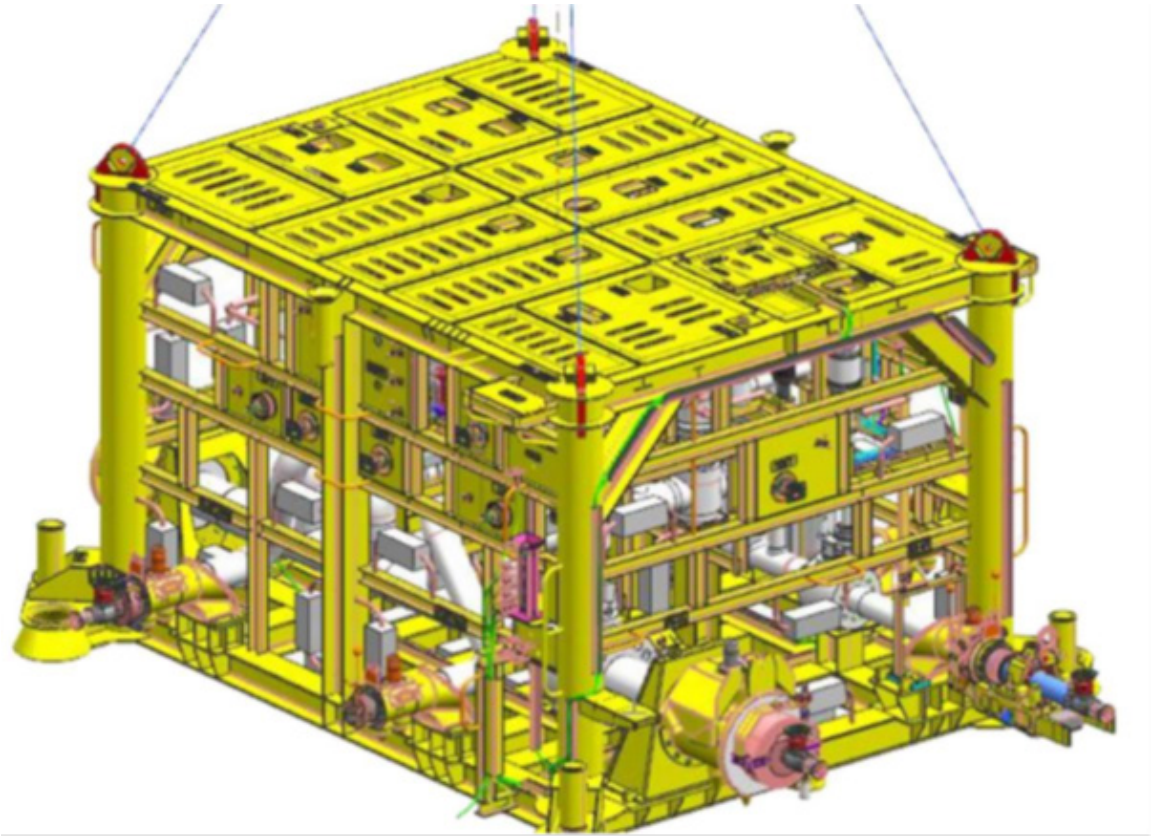


Figure 5 – Subsea manifold

Riser installation

Risers are flexible pipes that connect the flowlines to the FPSO. Risers are designed to allow for safe flexibility to cater for FPSO movement as it floats on the sea. Three 12" production, two 12" export and three 6" service risers of approximately 1 kilometre in length will be installed between the STP buoy and subsea infrastructure. The risers will arrive pre-flooded with MEG. The risers will be installed by deploying the first end topside termination and hanging it on the underside of the STP Buoy. The risers will then be progressively laid out as the construction vessel moves away from the STP Buoy and towards the pre-installed FLET/riser base manifold. During installation, ancillary equipment, including buoyancy modules and a tether clamp are attached to the riser. A temporary clump weight is attached to the riser to offset the buoyancy and enable the riser to be lowered near to the seabed. At this point, the tether is connected to the pre-installed riser tether base to allow the riser to be pulled into the riser base and connected.

Umbilical and flying lead installation

Umbilicals are cables and tubing that allow for communication and control of subsea infrastructure from the FPSO (e.g. valves). Three static umbilicals ranging from approximately 5,000–7,000 metres long with Umbilical Termination Assemblies (UTA) will be installed during the umbilical installation operations. The umbilicals are progressively lowered from the moving construction vessel to the seabed, until the UTA/umbilical assembly lands on the pre-installed UTA foundation. Once in place, the UTA structures sit on the UTA foundations and do not add to the seabed disturbance footprint. Two dynamic umbilicals (approximately 1 kilometre long) will be pulled in and hung off from the STP buoy. Each umbilical will be progressively lowered to the seabed as the construction vessel moves towards the pre-installed UTA foundation. Ancillary equipment including buoyancy modules, tether clamp and tether are attached during the lowering operation. A temporary clump weight is attached to assist the lowering operation and enable the tether to be attached to the pre-installed tether base. From the tether base to the UTA foundation the umbilical is laid on the seabed until the UTA/umbilical assembly lands on the pre-installed UTA foundation. Umbilicals and steel tube flying leads will be installed with the lines filled with either MEG or water-based hydraulic control fluid. Steel tube, optical and electrical flying leads will be installed to connect the UTAs to other subsea infrastructure. Some of the flying leads will be stabilised using sand or grout bags (approximately 20 kilograms) at various points along their length. Temporary clump weights or turning bollards may be used to help install the steel tube flying leads.

Installation vessels

Multiple vessel types will be required to complete the activities within the operational area to support the SURF campaign and interim preservation period. Vessels and the indicative activities they will undertake are as follows:

Reel-lay vessel

The Barossa flowlines and flowline end termination connections (FLETs) will be installed using a specialised reel-lay vessel, such as the Seven Oceans (Figure 6).

Indicative activities include:

+ install temporary initiation anchors
+ install the Barossa flowlines and FLETs
+ bunkering

Optional scope includes:

+ survey (pre-lay)
+ install riser tether bases
+ install displacement initiators
+ install suction anchors
+ install scour protection

Figure 6 – Reel-lay vessel

Figure 7 – Construction vessel

Construction vessels

The Barossa subsea infrastructure will be installed using specialised construction vessels, such as the Seven Oceanic (Figure 7).

Indicative activities include:

+ surveys (pre-lay, during and post-lay)
+ flowline span rectification work
+ install supporting structures (foundations, manifolds, suction anchors, buckle initiators)
+ flowline, riser and umbilical support activities (touchdown/ROV monitoring, subsea positioning)
+ mooring wire and Mooring (or mid) Line Buoyancy Element (MLBE) installation
+ STP buoy positioning and hook-up to mooring lines
+ riser, umbilical and flying lead installation
+ local stabilisation of flying leads (could include mattresses)
+ spool and well jumper installation and testing
+ install scour protection
+ pre-commissioning activities
+ STP Buoy deballasting
+ bunkering
+ MEG transfers

Other support vessels, ROVs and helicopters will also be used to complete support activities under the SURF EP.

Pre-commissioning activities

Once the key infrastructure is installed, pre-commissioning activities will be carried out to verify the integrity and connections of the infrastructure. These pre-commissioning activities include flood, clean, gauge and pressure testing (FCGT), dewatering, preconditioning, nitrogen packing, flushing and hydrostatic leak testing (leak testing). The pre-commissioning fluids that will be discharged to the sea include treated freshwater, treated sea water and MEG. Treated freshwater or treated sea water is freshwater or sea water conditioned with a hydrotest mixture comprising biocide, oxygen scavenger, corrosion inhibitor and leak detection dye. This is completed using products similar to Hydrosure or Roemex Hydro 4 and dosage rates will depend on the length of the preservation period. The hydrotest mixture is typically a mixture of biocides (to prevent biofouling on the internal surfaces), an oxygen scavenger and corrosion inhibitor (to control corrosion of the pipeline) and a dye (allows for leaks to be detected through visual inspections).

Unplanned and non-routine inspection, maintenance and repairs

The preservation period is the interim period from completing the pre-commissioning activities until the activities covered under the Barossa Production Operations EP commence. During the preservation period, no planned inspection, maintenance and repair (IMR) activities of the subsea infrastructure will occur. However, non-routine IMR activities of the subsea infrastructure may be required during the preservation period due to unplanned events (e.g. unstable seabed conditions, significant earthquake, cyclone events, anchor strike, dropped objects, and trawl gear interference) that could physically damage and affect the integrity of the Barossa subsea infrastructure, possibly triggering the requirement for an inspection. During the preservation period, these unplanned events are not expected to occur, however, non-routine IMR activities will be included in the SURF EP in the very unlikely event that they are required. Inspection activities that may occur on subsea infrastructure (e.g. cathodic protection surveys and general visual

inspections) are typically undertaken from an IMR vessel equipped with autonomos underwater vehicles (AUVs) and ROVs.

Typical maintenance and repairs undertaken include:

+ anode replacement
+ cathodic protection system maintenance
+ flowline, riser, umbilical, well jumper and spool repairs
+ restabilisation
+ subsea infrastructure servicing (including leak testing)
+ marine growth removal
+ fishing nets or other marine debris removal
+ recommissioning.

In the unlikely event of flowline failure, the flowline may need to be recovered and a new section of flowline installed in a similar manner to the initial installation.

More detail about the specific activities proposed to be carried out under the SURF EP can also be provided during consultation. If you have questions or would like further information about the detail of the activities listed above or what they involve, please ask us. Visit **santos.com/barossa**, phone **1800 267 600**, email **offshore.consultation@santos.com**

Regional existing environment summary

EMBA – environment that may be affected

In the preparation and assessment of EPs, each of the following is considered part of the 'environment' (under regulation 4 of the OPGGS Environment Regulations):

+ ecosystems and their constituent parts, including people and communities
+ natural and physical resources
+ the qualities and characteristics of locations, places and areas
+ the heritage value of places.

The 'Environment' includes the social, economic and cultural features of each of the above.

Santos recognises the region's various environmental values and sensitivities. In an EP, it is common to present a geographically defined area of the environment that may be affected (EMBA) by an offshore activity, primarily from the worst case hydrocarbon spill associated with the activity.

The EMBA was defined by overlaying hundreds of individual hypothetical spill model simulations into a single map using the low threshold exposure values (which can equate to approximately 1 millilitre of hydrocarbon per 1000 litres of sea water) to identify the full geographical extent of the environment that might be contacted by hydrocarbons. This also provides the basis for assessing the range of potential socio-economic risks and establishes a planning area for scientific monitoring.

The entirety of an EMBA is not considered to be representative of biological impact, but is used for identifying the full geographical extent of the environment that could potentially be affected (including where the effect may not constitute a significant impact).

As EMBA threshold values are very low, the Moderate Exposure Value (MEVA) thresholds (which equate to approximately 10 millilitres of hydrocarbon per 1000 litres of sea water) is used to inform environmental assessment, identify potential environmental consequences, and develop spill response plans. The EMBA and MEVA are illustrated in Figure 8 below.

It should be noted that an actual spill is more accurately represented by only one of the simulations from the modelling, meaning a much smaller geographical area would be affected in the event of an actual spill.

To learn more about spill modelling, exposure values and spill responses, see NOPSEMA Spill Modelling Video.

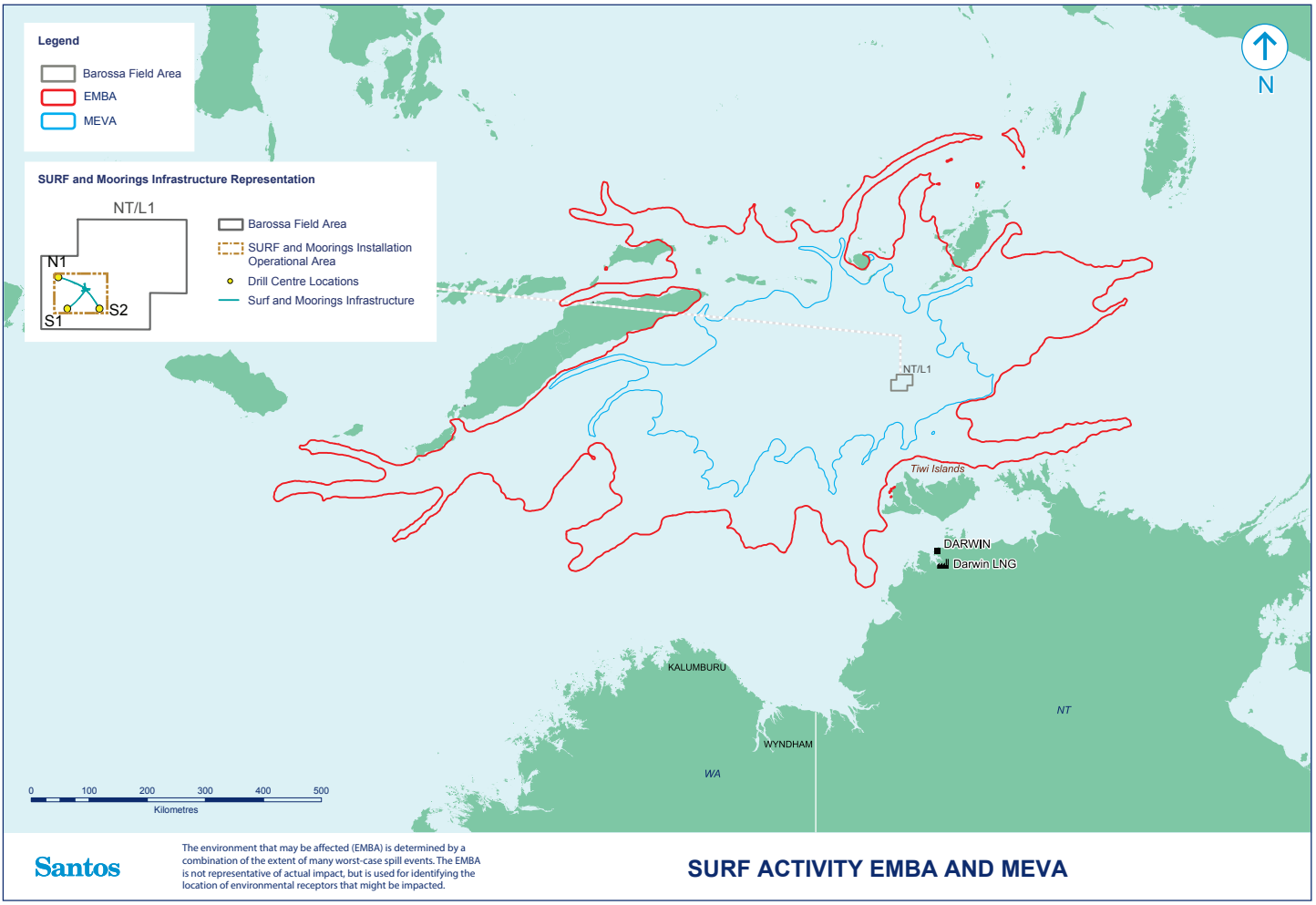


Figure 8 – The EMBA and MEVA

Regional protected and significant areas

Figures 9 and 10 illustrate the boundaries and zonings of regional marine parks and reserves, and key ecological features (KEFs) respectively.

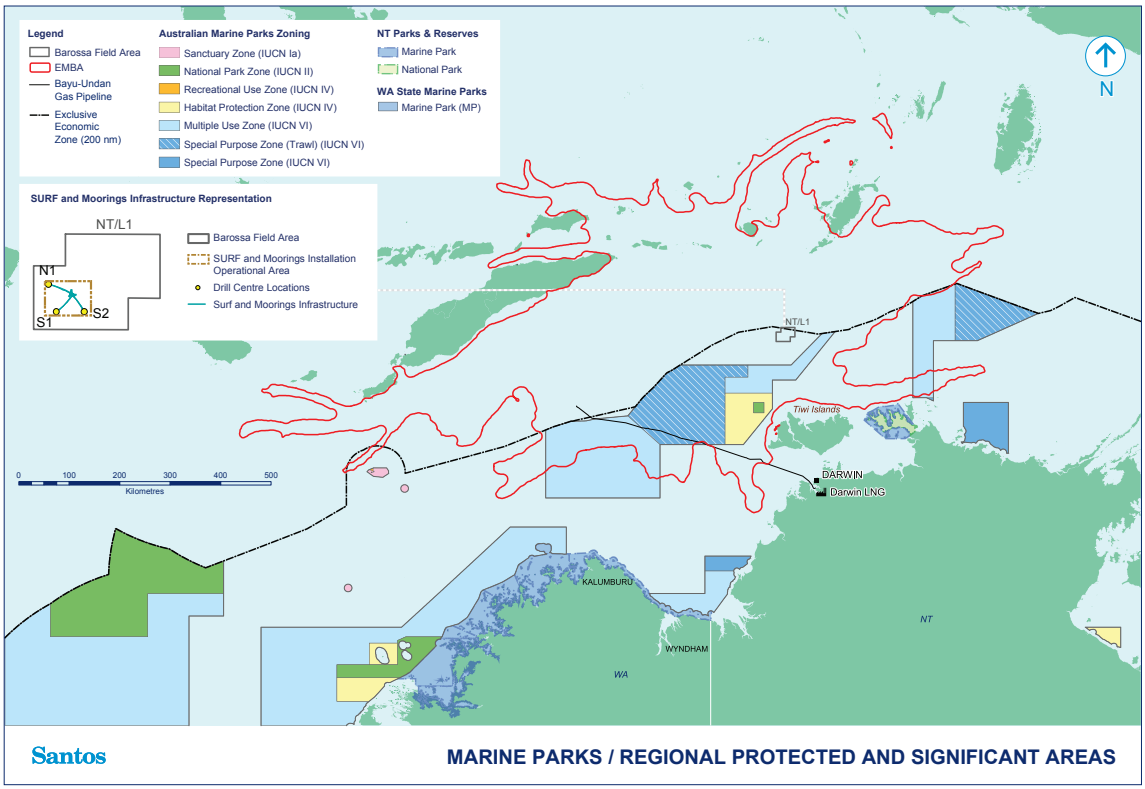


Figure 9 – Regional protected and significant areas

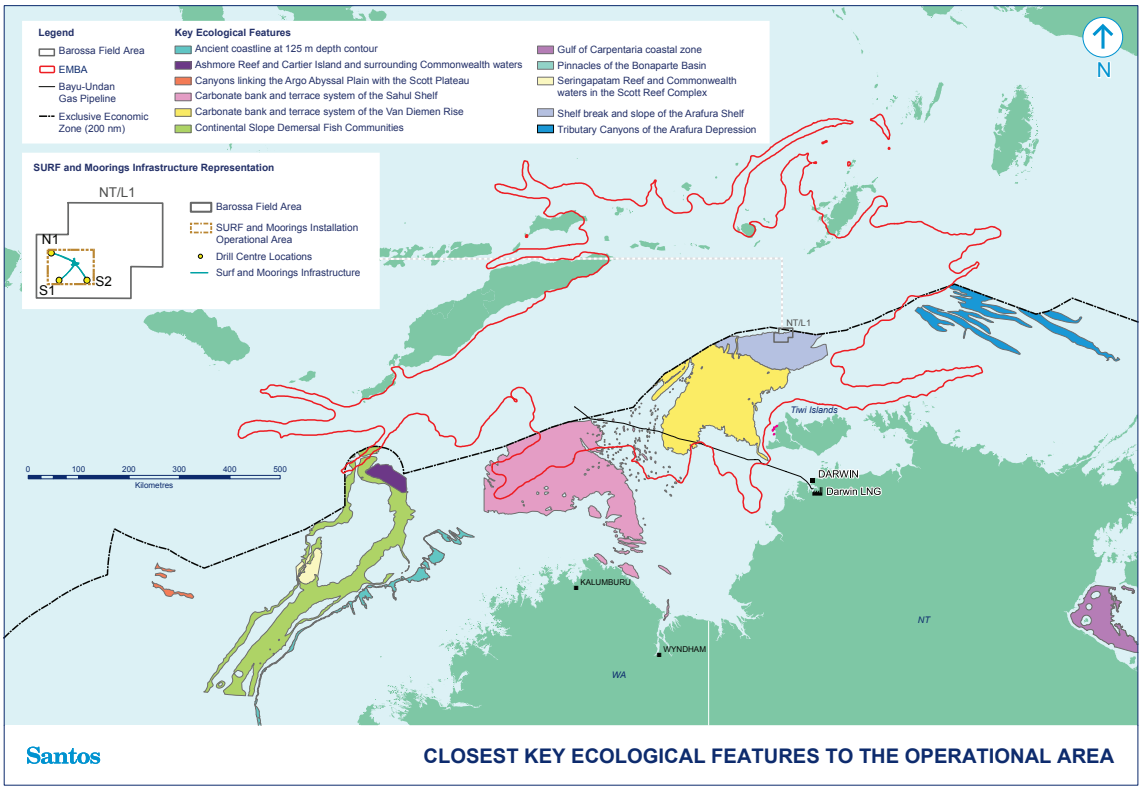


Figure 10 – Closest key ecological features to the operational area and EMBA

Table 1 contains a summary of known values and significant areas within the EMBA recognised under relevant environmental legislation.

Protected and significant areas	Summary of known values and significant areas	Operational area	EMBA	Distance to operational area (km)
Australian marine parks				
Oceanic Shoals Marine Park	The values within this Marine Park include: + ecosystems representative of the Northwest Shelf Transition + 4 KEFs: - carbonate bank and terrace systems of the Van Diemen Rise - carbonate bank and terrace systems of the Sahul Shelf - pinnacles of the Bonaparte Basin - shelf break and slope of the Arafura Shelf + a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act + BIAs that include foraging nesting and internesting habitat for marine turtles This area may also contain cultural and natural values, including sea country.	✗	✓	**44**
Arafura Marine Park	This area may contain cultural and natural values, including sea country. Ecosystems representative of the Northern Shelf Province, Timor Transition and Tributary canyons of the Arafura Depression key ecological feature. There are turtle and seabird biologically important areas within the marine park.	✗	✓	**250**

Protected and significant areas	Summary of known values and significant areas	Operational area	EMBA	Distance to operational area (km)
Key ecological features				
North Marine Region				
Carbonate bank and terrace system of the Van Diemen Rise	Unique seafloor features characterised by terrace, banks, channels and valleys. Supports rich sponge gardens, corals and diversity of fish life. Foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales and sawfish. Regionally important due to enhancing productivity relative to their surrounds.	✗	✓	**55**
Pinnacles of the Bonaparte Basin	Unique seafloor features characterised by the largest concentration of pinnacles along the Australian margin. Recognised as a sponge biodiversity hotspot and regionally important due to biodiversity value.	✗	✓	**195**
Shelf break and slope of the Arafura Shelf	Unique seafloor features characterised by continental slope, patch reefs, hard substrate pinnacles. An important ecological feature that enhances biological productivity and attracts pelagic organisms.	Yes, however, surveys confirm that the values associated with the key ecological feature are not within or proximal to the operational area.	✓	**0**
Tributary canyons of the Arafura Depression	Tributary canyons are seabed features that are approximately 80-100m metres deep and 20km wide. Nationally and regionally important due to high productivity, high levels of biodiversity and endemism.	✗	✓	**264**
North-West Marine Region				
Carbonate bank and terrace system of the Sahul Shelf	Unique seafloor features characterised by terrace, banks, channels and valleys. Foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales and green sawfish.	✗	✓	**326**
Continental slope demersal fish communities	High diversity of demersal fish assemblages. The EMBA covers about 50% of the total area of this key ecological feature.	✗	✓	**776**
Pinnacles of the Bonaparte Basin	Unique seafloor features characterised by the largest concentration of pinnacles along the Australian margin. Recognised as a sponge biodiversity hotspot and regionally important due to biodiversity value.	✗	✓	**195**

Table 1 Regional protected and significant areas

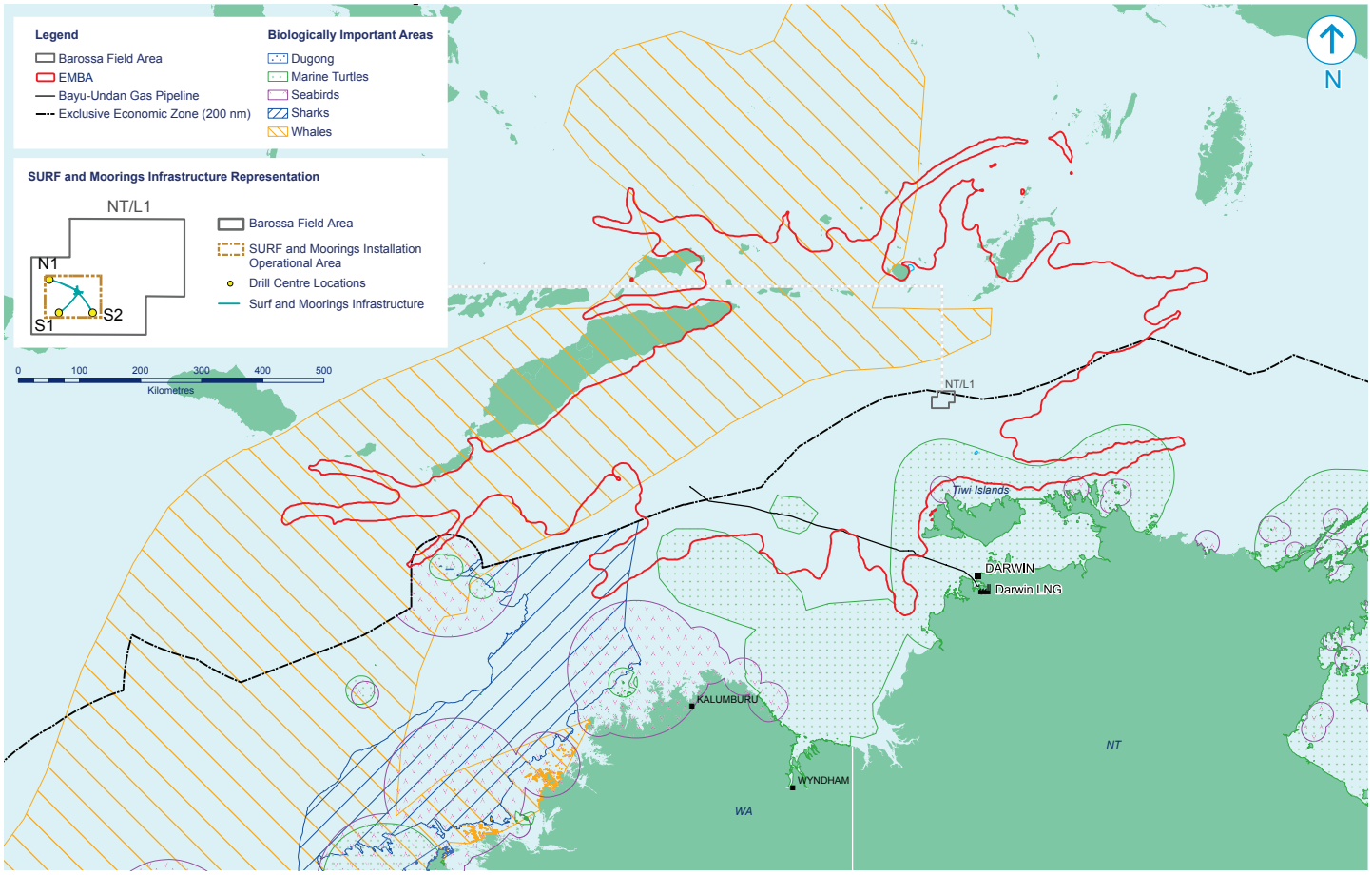


Figure 11 – Biologically Important Areas near the operational area and EMBA

Marine fauna and biologically important areas

The Australian Government has not defined any biologically important areas or habitat critical to the survival of any species under the *Environment Protection and Biodiversity Conservation Act 1999* within or close to the operational area. Within the EMBA there are biologically important areas for whale sharks, blue whales, dugongs, turtles and birds (Figure 11).

SURF and moorings installation activities will be conducted in water depths ranging from 230-280 metres where there is a variety of highly mobile marine fauna with a wide distribution that may transit the area in low numbers, such as:

+ blue, fin and sei whales
+ olive ridley, loggerhead, leatherback and flatback turtles
+ whale sharks
+ seasnakes
+ seabirds and migratory shorebirds
+ fish and sharks.

Santos has considered government guidance, including wildlife management plans, recovery plans, conservation advice and threat abatement plans in the development of the EP and to develop control measures to reduce impacts and risks to marine fauna and biologically important areas to as low as reasonably possible and to an acceptable level.

Regional socio-economic summary

Socio-economic activities that may occur within the operational area and the EMBA include commercial, recreational and traditional fishing, aquaculture, tourism, petroleum industry activities, defence, shipping and, to a lesser extent in the deeper offshore waters, recreational fishing and tourism. Maritime heritage and cultural values may also exist across the region. Due to the water depth and the remote offshore location of the operational area, the most likely marine users in the vicinity will be commercial fishing and shipping.

Nearest population centres

The operational area is located approximately 140 kilometres from Seagull Island which is part of the Tiwi Islands, Northern Territory (NT) with 2,348 residents reported during the 2021 Australian Bureau of Statistics census. Darwin, NT, is the closest city, located approximately 300 kilometres from the operational area, with a population of 148,801 residents. Darwin will be the logistics hub and supply base for the SURF activity, bringing employment and economic benefits to the local community.

Summary of other uses within the EMBA

Santos' understanding of the uses and values of the area and its strategies to reduce impacts or risks to these uses and values will be informed by consultation. Santos has set out in the list below a summary of the uses and values of the area of which it has knowledge based on existing information or previous consultation. Santos welcomes further information and encourages relevant persons to raise any further uses with Santos.

Commercial fishing

Santos recognises the presence and rights of commercial fishers within the operational area and EMBA. While the operational area is remote and water depths preclude most commercial fishing, the Timor Reef Fishery operates throughout the year. Low-level fishing effort for scampi also occurs in December and January each year in the north of the operational area. Other Commonwealth and NT managed fisheries provide rights to fish in the operational area but activity has not recently occurred within the operational area and is considered highly unlikely due to the water depth, remoteness, distribution of targeted species and concentration of effort near coastal areas. Santos has been consulting with the relevant fisheries representative associations, licence-holders and government over many years.

Tourism, recreational fishing and traditional fishing

The operational area is located in offshore waters that are not likely to be accessed for tourism activities (e.g. charter boat operations) or recreational fishing, as these tend to be centred around nearshore waters, islands and coastal areas. However, previous consultation has identified one fishing charter operator who may on occasions conduct tours near Evans Shoal, approximately 62km west of the operational area. There are several shoals and banks within the EMBA and some of these may be visited by small numbers of recreational fishers/charter vessels targeting fish that inhabit these shallower features. Indonesian and Timorese traditional fishers, as well as Australian recreational fishers, are expected to transit and fish in the EMBA. Some fishers may transit the operational area when travelling between sites. Santos continues to consult regarding recreational and traditional fishing and hunting within the EMBA.

Shipping

The Darwin Port is Australia's nearest port to Asia and the nation's 'northern gateway' for Australasian trade. It is the only port between Townsville (Queensland) and Fremantle (Western Australia) with full access to multi-modal transport services. The types of trading vessels include barges, rig tenders, LNG vessels, bunkers, livestock carriers, liquid bulk carriers and other types of vessels, with 1,510 trading vessel calls to port from 2021 to 2022. In addition to trading vessels, Darwin Port also services cruise ships and naval and fishing vessels.

There is also a port, Port Melville, located at Garden Point, Tiwi Islands, NT. Port Melville is a multi-user facility supporting the Northern Territory oil & gas industry, marine transport industry and local Tiwi community through the provision of a port facility and ancillary services (such as laydown areas and accommodation).

Defence Activities

No designated military/defence exercise areas are located within or near the operational area. However, the EMBA intersects a practice area of north Australian exercise area, a maritime military zone administered by the Department of Defence, which comprises practice and training areas used for offshore naval exercises and onshore weapons-firing training. The Australian Border Force also undertakes civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which includes the Australian EEZ. During their surveillance, Australian Border Force vessels may transit through the operational area and the EMBA.

Petroleum industry

The closest operational offshore production facility is the Santos-operated Bayu–Undan platform located approximately 410km southwest of the operational area. The Bayu–Undan field produces natural gas that is exported via pipeline to the DLNG facility. Petroleum retention lease area and exploration permit leases within the region are currently held by various oil and gas operators (and subsidiaries), including Carnarvon Petroleum Limited, Woodside Energy Ltd, Shell Development (Australia) Pty Ltd, Osaka Gas Australia Pty Ltd, Eni Australia Limited, Origin Energy, and Timor Sea Oil & Gas Australia Pty Ltd.

Heritage

There are no world heritage properties, national heritage places or Commonwealth heritage places within the operational area and the EMBA. There are no recorded Aboriginal heritage sites or Australian Marine Parks within the operational area. Under the Commonwealth Underwater Cultural Heritage Act 2018, Australia's underwater cultural heritage (such as shipwrecks, sunken aircraft and other types) is protected. Multiple known shipwrecks, sunken aircraft and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA. In the Timor Sea are 10 unlocated historic aircraft wrecks from the Second World War (associated with the Japanese and Australian air forces) and one unlocated modern Indonesian fishing vessel that sank in 1997. The historic aircraft wrecks are subject to automatic protection under the Commonwealth Underwater Cultural Heritage Act 2018. These unlocated wrecks could fall within the boundaries of the operational area or EMBA.

Santos contracted consultants to complete additional assessments and interpretation of historical and survey data to identify potential sites of maritime heritage significance within the operational area. No significant structures were identified within 500 metres of the proposed infrastructure location.

Cultural values

Santos has been alerted to Indigenous people's connections with Sea Country. Santos is seeking to identify cultural features and values within the EMBA, including through consultation with Indigenous people and their relevant representative bodies.

There are currently no native title claims or determinations within the EMBA.

Summary of environmental impacts and risks

Environmental impact and risk assessment is the process by which planned and unplanned events (that will or may occur during an activity) are assessed for their impacts (consequences) on the environment (physical, biological, and socio-economic). In addition, unplanned events are assessed based on their potential impact (consequence) and likelihood of occurrence, which informs the associated risk level.

An environmental assessment workshop was held in April 2022 to consider the potential environmental impacts of proposed activities under the SURF EP. The workshop involved participants from various Santos departments (health, safety and environment; SURF delivery team and operations) and specialist environmental consultants. Outcomes from the workshop are summarised below.

The identification of potential impacts and risks, and the controls proposed to reduce these impacts and risks, may be developed as a result of the consultation process. This includes consultation to inform Santos' understanding and assessment of potential impacts and risks in light of cultural values within the EMBA and any appropriate control measures if needed.

Planned activities

The Santos environmental assessment identified the following main potential impacts or risks associated with the planned activities:

- NOISE SOURCES
- LIGHT SOURCES
- SEABED DISTURBANCE
- INTERACTIONS WITH OTHER MARINE USERS
- AIR EMISSIONS
- DISCHARGES

Santos proposes to adopt a suite of Santos and contractor systems, procedures and standard control measures to reduce impacts and risks associated with these planned activities to a level that results in a minor or negligible environmental consequence. These consequence levels are considered by Santos to be acceptable and as low as reasonably practicable.

Santos continues to consult on the proposed activities under the SURF EP to inform its understanding of environmental and cultural values and sensitivities and the assessment of associated impacts, risks and control measures.

NOISE SOURCES

During the activity, noise will be generated by the vessels and helicopters, as well as ROVs and acoustic positioning systems. The vessels will generate noise from propellers in the water, use of thrusters and water flowing past the hull. The majority of the noise sources involved in the activity are lower pressure and not subject to sharp increases or decreases and will therefore be typical of other marine noise in the region (commercial, shipping, fishing etc). Noise from helicopters, acoustic positioning systems and ROVs is expected to be intermittent during the activity and underwater received levels will be comparable to or less than that of activity vessels.

What impacts are expected?

Santos engaged subject matter experts to conduct several underwater noise assessments.

Studies supporting the risk assessment indicated potential temporary impacts to marine fauna are expected to be confined to 12 kilometres from the noise sources, with no significant impacts at the species population level. Some noise from the thrusters may be audible above ambient noise levels up to 20 kilometres from the source. Santos uses this 20 kilometre range as the conservative distance for noise impact assessment.

There are no known significant feeding, breeding or aggregation areas for any fauna within the operational area or the 20 kilometre noise assessment boundary. The closest biologically important areas are for the pygmy blue whale and marine turtles, which are greater than 50 kilometres away. Although no biologically important area is within the 20 kilometre noise assessment boundary, or close to the operational area, individual noise-sensitive fauna (including whales and turtles) may transit the area.

The activities will be conducted over a limited timeframe in a remote offshore location where there is a relatively low probability of encountering significant numbers of noise-sensitive fauna. Transiting marine fauna are expected to demonstrate short-term avoidance behaviour within the operational area. Therefore, noise impacts are predicted to be minor, localised and temporary.

The marine fauna impacts are predicted to be limited due to the short-term nature of the activities under the SURF EP and the low sound levels generated by activity vessel noise. Noise levels from activity vessels that may cause behavioural responses in marine fauna are generally expected to be confined to the operational area and concentrated within a radius of ~12 kilometres to a few hundred metres of the noise source, depending upon the noise sources and operations. No BIAs occur within the operational area. Noise effects to fish of potential commercial value would be restricted to within hundreds of metres of the noise source. No effects to benthic invertebrates are expected, including those of commercial value (e.g., scampi which are targeted in waters deeper than 250 metres).

How will Santos manage impacts?

Vessels are required to comply with Santos's Protected Marine Fauna Interaction and Sighting Procedure which requires compliance with regulatory requirements for managing noise impacts to fauna. Compliance with vessel Marine Assurance Standards is to be required met and Planned Maintenance is to be completed in order to manage excessive noise from vessels.

LIGHT SOURCES

Artificial lighting is required for operational and navigational safety during the activity. Light sources include:

+ safety and navigational lighting on vessels (24 hours per day)
+ spot lighting when needed, such as when deploying or retrieving equipment
+ spot lighting when ROVs are working underwater.

What impacts are expected?

Light may impact threatened, migratory or local fauna (e.g. marine mammals, marine turtles, sharks, rays, other fish and seabirds) and socio-economic receptors (cultural features).

The vessels are expected to produce similar light levels to other marine vessels in the region. A 20 kilometre light assessment boundary has been used from the outer boundary of the operational area. The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests by light spill on beaches, although breeding adult turtles can also be disoriented. The nearest turtle nesting beaches are approximately 140 kilometres from the operational area. While seabird species such as wedge-tailed shearwaters may be present within the operational area, the nearest wedge-tailed shearwater BIA is located more than 700km from the operational area, and the nearest breeding colony further still. Lighting is, therefore, expected to have a negligible impact on breeding or hatchling turtles and seabirds.

Light modelling completed indicates that light from the reel-lay and construction vessels is predicted to reduce to below ambient levels at approximately 10.9 km and have the potential for behavioural impacts to turtles within 2.5 kilometres. However, no nesting habitat or BIAs occur within these vessels' distance. The closest turtle BIA (an internesting buffer for flatback turtles) is approximately 54 kilometres from the operational area.

Fish and seabirds may be attracted to artificial light leading to a short-term localised increase in fauna activity. The activity is assessed as unlikely to impact species abundance or distribution. Marine mammals are not known to be attracted to light sources at sea. Whales predominantly use acoustic senses rather than visual cues.

How will Santos manage impacts?

The vessels are expected to produce similar light levels to other marine vessels in the region. Lighting is to be limited to that required for safe operations and compliance with maritime regulations.

AIR EMISSIONS

Air emissions will occur from:

+ fuel combustion to operate vessels and helicopters
+ operation of vessel incinerators.

What impacts are expected?

The potential impacts of air emissions identified include:

+ deterioration of local air quality
+ contribution to national greenhouse gas (GHG) levels.

Air emissions may result in a temporary, localised reduction of air quality. In the offshore environment, air emissions rapidly dissipate into the surrounding atmosphere. Impacts are very localised and not significant. Seabirds and migratory shorebirds are unlikely to be impacted by the localised and temporary reduction in air quality.

Detectable environmental impacts are not predicted from GHG emissions during activities under the SURF EP.

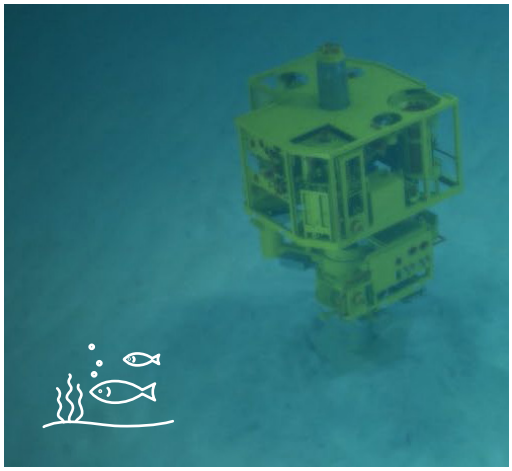
The estimated direct GHG emissions associated with the proposed activities under the SURF EP are 21,240 tonnes of CO2-e, which is less than 0.0043% of the total 2022 annual Australian GHG emissions.

No indirect GHG emissions are associated with this proposed activity as there is no ability to extract, produce or transport the natural gas. The future Barossa Production Operations EP will assess indirect GHG emissions for the Barossa Gas Project associated with end use combustion of Barossa natural gas and condensate products.

How will Santos manage impacts?

Santos proposes to adopt numerous control measures to manage vessel emissions, including requiring contractor vessels' compliance with MARPOL requirements for low-sulphur fuel and air pollution prevention certifications. ('MARPOL' is a reference to the International Convention for the Prevention of Pollution from Ships). The control measures to be adopted are designed to be consistent with maritime regulations and petroleum industry standards.

Santos has a climate transition strategy and action plan to become a net-zero emissions energy and fuels business by 2040.



SEABED DISTURBANCE

Seabed disturbance will occur because of:

+ permanent placement of subsea infrastructure on the seabed (e.g. flowlines, manifolds, span rectification, mooring suction anchors)
+ temporary placement and set down of equipment on the seabed (e.g. clump weights, ROV)
+ temporary disturbance and sediment disturbance during installation.

Seabed disturbance may also cause a temporary increase in water turbidity.

The activity will involve equipment directly contacting the sea floor and will result in localised impact to benthic habitat (and associated fauna) in the operational area.

Table 2 below includes estimates of the seabed disturbance associated with the installation of the proposed SURF and moorings infrastructure.

Subsea infrastructure	Seabed footprint	Description
FPSO mooring system installation	1.93 ha	Includes suction anchors, mooring chains and a section of mooring wire that may contact the seabed, and temporary clump weights used during installation.
Flowline supporting structures installation	1.62 ha	Includes displacement initiators, FLET foundations, scour protection, support mattresses, flowline walking mitigation and LBL transponder frames.
Flowline installation	1.28 ha	Calculated based on the length of the flowlines multiplied by the diameter of the flowline (with corrosion coating included). It also includes the footprint for the temporary initiation anchors and wire.
Manifolds, spools and well jumpers installation	0.41 ha	Includes manifold foundations, spools, well jumpers, scour mitigation, support mattresses and installation aids.
Riser installation	0.22 ha	Includes footprint of the risers in contact with seabed, supporting riser tether base structures with scour protection and temporary clump weights used during installation.
Umbilical installation	0.39 ha	Includes static umbilicals and footprint of the dynamic umbilicals in contact with seabed, supporting riser tether base structures with scour protection, flying leads with stabilisation and temporary clump weights used during installation.
20% contingency	1.17 ha	To address potential footprint increase for structures and optimisation (subject to detailed design) as well as contingency span rectification / infrastructure repositioning (if required).
Estimated total seabed footprint 7.02 ha		

Table 2 Estimates of the seabed disturbance associated with the installation of the proposed SURF and moorings infrastructure

What impacts are expected?

The activity may cause a temporary increase in water turbidity and will involve equipment directly contacting the sea floor resulting in localised impact to benthic habitat (and associated fauna). Significant impacts to marine fauna as a result seabed disturbance are not expected. Total estimated seabed footprint is approximately seven (7) hectares, slightly larger than the area of a football field (the MCG playing surface is about four (4) hectares). This seabed disturbance represents a very small portion of the operational area.

Extensive marine studies have been completed within the operational area to inform the impact assessment.

The seabed within the area is generally flat, and devoid of any significant bathymetric features. Benthic habitats and fauna assemblages expected to be impacted are considered widespread throughout the region.

The 'Shelf break and slope of the Arafura Shelf' key ecological feature (KEF) overlaps a portion of the operational area. The estimated seabed disturbance represents a very small portion of this KEF (<0.002%). This key ecological feature is valued for its sea floor, which features the shelf break and patch reefs, hard substrate pinnacles and submerged reefs of the shelf slope. The sea floor features related to this key ecological feature have not been observed within the operational area.

There is no biologically important area for any marine fauna species within the operational area. Given the small scale of seabed disturbance and knowledge of the existing environment, significant impacts to marine fauna as a result seabed disturbance are not expected to occur.

There are no known heritage sites within the operational area. Studies indicate that no maritime heritage artifacts are present within the disturbance footprint. A 2023 survey revealed sonar anomalies within the operational area including one which may be the remains of a small shipwreck. The survey concluded that the anomalies identified as potentially holding cultural value are unlikely to be impacted by activities under the SURF EP.

Cultural values within the operational area and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies, so that these can also be assessed.

Seabed disturbance is not expected to impact commercial fisheries based on the small size of disturbance compared with the large available fishing area.

How will Santos manage the impacts?

Santos' vessel planned maintenance system is designed to enable safe and accurate placement of infrastructure whilst vessels are on dynamic positioning. Santos also intends to maintain an inventory of all installed equipment to enable collection of all equipment during decommissioning (and thus removal of structures to limit ongoing impacts to the seabed). Santos continues to consider risks and impacts to cultural values and additional control measures may be adopted following consultation.

INTERACTIONS WITH OTHER MARINE USERS

Other marine users that may be in the vicinity of the Barossa field include commercial fishing, shipping and other incidental marine traffic. Tourism and recreational fishing vessels are not expected in the operational area given the water depth and distance offshore.

Around each wellhead there is an existing petroleum safety zone (PSZ). A PSZ is a circular zone with a 500-metre radius which limits access to other marine users. Activity vessels will also have a 500-metre radius cautionary zone. Santos plans to establish cautionary zones within the operational area to provide clarity and minimal inconvenience to other marine users.

Helicopter operations will be infrequent and at high altitude and unlikely to interfere with other marine users. Helicopters will not fly over the Tiwi Islands or Seagull Island unless in the case of an emergency.

What impacts may occur?

The area that other marine users will be excluded from is small when compared to the large area available for their use. Marine users have coexisted with previous Barossa petroleum activities (e.g., exploration drilling) and other nearby maritime activities (e.g., military exercises). Communication before and during the activity with other marine users is designed to reduce the likelihood of unplanned interactions.

How will Santos manage impacts?

Santos is to communicate with other marine users before, during and at the end of the activity. Standard maritime notifications (e.g., Notice to Mariners) are designed to inform other marine users of the activity.

The vessels are to use automatic identification systems to aid in their detection at sea. Support vessels are to actively communicate with third-party vessels to inform them of the activities under the SURF EP. Infrastructure locations are to be marked on nautical charts. These proposed control measures are designed to be consistent with maritime regulations and industry practices.

DISCHARGES

Discharges will occur from the SURF and moorings installation reel lay, construction and support vessels during activities.

Vessel discharges

The types of discharges are typical of most offshore commercial vessels and include deck runoff, treated sewage and grey water, machinery cooling water, bilge water (treated via the oily water system), ballast water, macerated food scraps and brine (from water making). These discharges will be small in volume and released into surface waters.

Activity discharges

Potential impacts may occur in the operational area from activity discharges from:

+ FCGT, dewatering, flushing and leak testing:
  - treated (see below) freshwater or sea water from production and service flowlines
  - MEG from production and service flowlines, risers, production and riser manifolds, spools and well jumpers
  - treatment chemicals including biocides, oxygen scavengers, corrosion inhibitors, MEG and dyes.
+ treated sea water from the STP Buoy deballasting
+ minor releases of microplastics to the sea from corrosion of sinter coating during flowline lay
+ Santos has included a contingency measure to use grout bags to stabilise infrastructure if needed (span rectification). If this stabilisation method is required, some grout may be discharged as part of the process. If grout bags are required, grout discharges may

occur. Grout consists of cement, sand and water and is not considered to be toxic in any way release of small volumes of microplastics from corrosion protection layers on flowlines (sinter coating).

What impacts are expected?

Vessel discharges

The small volumes of vessel discharges may cause localised nutrient enrichment, organic and particulate loading, ecotoxicological effects, and increased water temperature and salinity around discharge points and in the direction of the prevailing current. The environment that may be affected by vessel discharges will likely be within approximately 50m of the activity vessel and likely to be contained within the operational area, based on dispersion modelling.

Potential receptors include the physical environment (water quality, benthic habitats including KEF), threatened, migratory or local fauna (marine mammals, marine turtles, rays, sharks and other pelagic fish, and seabirds) and socioeconomic (cultural features).

Vessel discharges will be localised and limited to surface waters. Machinery cooling water discharge will be continuous, but all other operational discharges will be intermittent and of short duration (minutes to hours). The discharges are expected to be dispersed and diluted rapidly within the offshore waters. Discharges may cause short-term changes to behaviour in marine fauna (avoidance or attraction). For example, fish and seabirds may be attracted to macerated food scraps discharged by vessels.

Activity discharges

Potential receptors include physical environment (water quality, benthic habitat, KEF), threatened, migratory or local fauna and socioeconomic receptors (cultural features).

Activity discharges are expected to disperse rapidly and be diluted within the operational area. Water quality changes are expected to recover within hours to days following cessation of discharges.

How will Santos manage impacts?

Vessel discharges are to be managed to acceptable levels as regulated by maritime laws and conventions (e.g. management of sewage treatment systems and oily water systems), such as MARPOL and relevant Marine Orders. Santos also intends to implement management measures including waste management procedures and chemical management and selection procedures.

Activity discharges are to be managed through the application of Santos' Chemical Selection Process, designed so that only environmentally acceptable chemicals (which are likely to be discharged) are selected and used.

The release of small amounts of sinter coating (as microplastics) is unavoidable due to the installation process where corrosion protection and insulation must be maintained for flowline integrity.

These control measures are designed to reduce the environmental consequences to minor and as low as reasonably practicable.

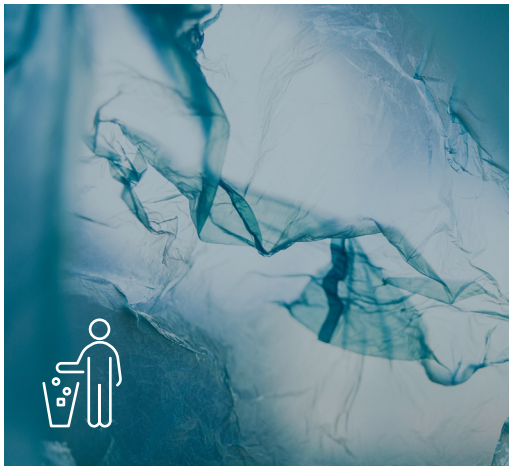
Unplanned events

Santos uses an environmental assessment guideline to identify, analyse and evaluate incident scenarios (unplanned events). Potential unplanned events have been identified and considered and the associated potential environmental consequences and the event likelihoods (i.e., the risks) have been assessed. Based on the assessment undertaken prior to preparation of the SURF EP, the following unplanned environmental risks have been identified for this activity:

+ dropped objects
+ introduction of invasive marine species
+ interaction with marine fauna
+ non-hydrocarbon liquid release
+ marine diesel spill.

Santos proposes to adopt a suite of Santos and contractor systems, procedures and standard control measures to seek to reduce the impacts and risks associated with these unplanned events to a level that results in a minor or negligible environmental consequence. These consequence levels are considered by Santos to be acceptable and as low as reasonably practicable.

Santos continues to consult on the activities under the SURF EP to inform its understanding of environmental and cultural values and sensitivities, and the assessment of associated impacts, risks and control measures.



DROPPED OBJECTS

Objects that could be accidentally released to the marine environment from vessels or during installation activities include:

+ non-hazardous solid wastes, such as paper, plastics and packaging
+ hazardous solid wastes, such as batteries, fluorescent tubes, medical wastes and aerosol cans
+ equipment and materials, such as supplies, hard hats, tools or infrastructure parts or installation aids
+ Polypropylene (PP) particles from breakdown of PP coating on flowlines (dropped onto the vessel deck and accidentally released overboard).

Release of these objects may occur as a result of the following:

+ overfull or uncovered bins
+ incorrectly disposed items
+ incidents during transfers of waste or supplies
+ accidentally dropped objects/lost equipment.

What environmental impacts could occur?

All non-buoyant objects are expected to sink to the seabed and remain within the operational area.

In the event of a dropped object, there will be localised and short-term damage to the seabed. The extent of the impact should be limited to the size of the object and given the size of the equipment used, any impact is expected to be very small. No significant seabed features or biota have been identified in the operational area. Therefore, it is highly unlikely that any object dropped during the activity would cause a significant impact to the ecological values associated with the seabed or benthic habitats.

Buoyant objects could potentially move beyond the operational area. In relevant recovery plans and conservation advice, marine debris (including plastics and microplastics) is listed

as a potential threat to several marine fauna species. Depending on debris size of the dropped object, there is potential for entanglement or ingestion by marine fauna, including turtles and vertebrate wildlife, which could result in injury or death. However, given the limited quantities, impacts to fauna would be limited to individuals and are not expected to result in a decrease of the local population size.

The release of microplastic particles (small plastic particles generally five millimetres or less in size) can occur due to the degradation of PP corrosive and topcoat coating. The release of microplastics from PP has the potential to contribute to the overall amount of marine microplastics in the ocean, which can have various impacts on marine fauna as they are absorbed by plants and animals and accumulate in the food chain. However, given the small maximum volume released, the overall impact marine microplastic pollution is relatively limited.

Release of hazardous solids may result in the pollution of the immediate environment, leading to detrimental health impacts to marine fauna (including potential injury or death)..

How will Santos manage the risk?

Santos has numerous control measures to reduce the risk of dropped objects, lost equipment or releasing waste to the environment. These measures include:

+ safety standards and procedures to reduce the risk of tools and other equipment being dropped during lifting operations
+ waste management procedures to reduce the risk of windblown waste entering the marine environment
+ implementation of chemical selection processes and the International Maritime Dangerous Goods Code
+ environmental implementation plan and subsea infrastructure inventory mitigate the risk of PP particles and debris release through measures such as monitoring, disposal methods, inspections and maintenance
+ dropped objects, regardless of size, must be reported and attempts made to recover the object according to safety and environment criteria.

These control measures are designed to comply with maritime legislation. In addition, these control measures are consistent with applicable actions described in the relevant fauna recovery plans and conservation advice, reducing the residual risk to low.

INTRODUCTION OF INVASIVE MARINE SPECIES

Invasive marine species (IMS) are marine flora and fauna that have been introduced into a region that is beyond their natural range but have the ability to survive, and possibly thrive. The majority of climatically compatible IMS to northern Australia are found in south-east Asian countries.

Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism. The risk of introducing IMS is common for all maritime activities. The introduction of IMS may occur due to the following:

+ biofouling on vessels, external/internal niches (such as sea chests and sea water systems) and routinely submerged equipment
+ discharge of STP Buoy ballast water
+ discharge of high-risk ballast water.

What environmental impacts could occur?

If successfully established, IMS can:

+ outcompete native species for food or space
+ prey on native species
+ impact fisheries or aquaculture
+ impact on human health through released toxins

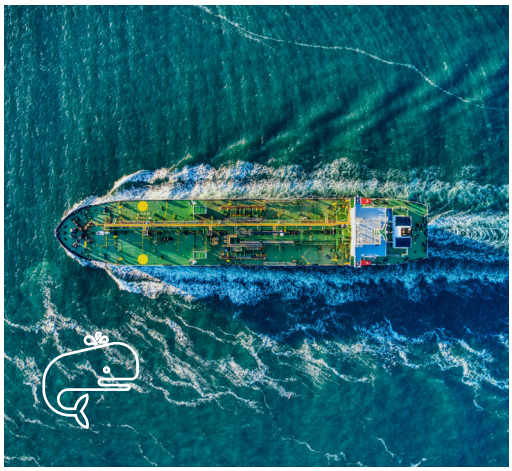
+ reduce coastal aesthetics
+ cause damage to marine and industrial equipment and infrastructure.

The above impacts can result in flow-on detrimental effects to marine parks, tourism and recreation.

The ability of invasive marine species to colonise a habitat depends on several environmental conditions. For example, highly disturbed environments (such as marinas) or shallower areas are more susceptible to colonisation than open-water environments. The operational area provides an unfavourable habitat for IMS due to water depths exceeding 200 metres and the vast distance to the coast. These conditions limit light availability and have low habitat biodiversity with sparse epibiota, therefore, it is highly unlikely that IMS would be able to survive or colonise.

How will Santos manage the risk?

The pathways and vessel mitigation measures for IMS introduction are well understood and known. Vessels contracted to Santos, and vessel ballast, are to be managed according to control measures that comply with maritime regulations, industry practices, and the Biosecurity Act 2015. Vessels will also have ballast water management, vessel biofouling management and anti-fouling systems in place. With these control measures adopted, the residual risk of introducing an IMS is assessed as being reduced to low and as low as reasonably practicable.



INTERACTION WITH MARINE FAUNA

How could interactions with marine fauna occur?

There is the potential for activity vessels, equipment (e.g. ROVs) or helicopters to unintentionally interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality. Vessel and helicopter movements between the operational area and Darwin are expected to be at a frequency of approximately 1-2 per day. There is also a potential for fauna to be caught during the process of collecting sea water for Flood, Clean, Gauge and Test (FCGT) activities. Seabirds and migratory birds may opportunistically rest on a vessel and may be attracted to activity vessels due to lighting and vessel discharges such as macerated food waste.

What environmental impacts could occur?

Marine fauna in surface waters that are most at risk from vessel collision include marine mammals, marine turtles and whale sharks. Some of these species are threatened, and some marine fauna may have cultural significance. The operational area does not intersect any biologically important areas or habitat critical to survival of any marine fauna species. Vessel or human caused disturbances are identified as potential threats to several marine species in relevant recovery plans and conservation advices.

It is possible that fauna may be caught while sea water is collected for FCGT activities. Santos intends to prevent this by installing screening/mesh protection barriers. Marine fauna interactions would be recorded and reported by Santos.

While injury or death to individual animals would be highly undesirable, this would represent a small proportion of any local population and not beyond any natural variation in population size.

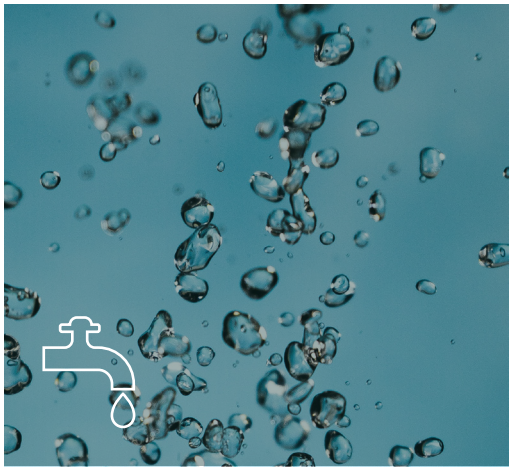
Disturbance from human activities to shorebirds may compromise energy reserved for migration, and attraction of seabirds to activity vessels due to increased feeding opportunities, could result in behavioural changes. However, these are unlikely to alter population dynamics or significantly change the habitat use of birds due to the short duration of the Barossa SURF and moorings installation campaign..

How will Santos manage the risk?

The likelihood of marine fauna interaction resulting in injury or death is considered unlikely given the proposed implementation of the following control measures:

+ Santos' procedure for interacting with marine fauna, which is designed to align with the *Environment Protection and Biodiversity Conservation Regulations 2000*. This procedure limits marine fauna approach distances and speed, allowing marine fauna to be avoided or to move away.
+ vessel speed restrictions
+ vessel standard operating procedure
+ contractor FCGT procedure.

The control measures are designed to align with management actions outlined in government-published fauna recovery plans and conservation advice. The risk of interactions with marine fauna is assessed as very low and reduced to as low as reasonably practicable and acceptable. The risk is no higher than for any other regional maritime or aviation activity.



NON-HYDROCARBON LIQUID RELEASE

How could non-hydrocarbon liquids be released?

Non-hydrocarbon liquids including miscellaneous chemicals and waste are used or stored on vessels during the activity. Examples of non-hydrocarbon liquids include water treatment chemicals, MEG for pre-commissioning activities, brine, cleaning and cooling agents, stored or spent chemicals and leftover paint materials. An example of the use of non-hydrocarbon liquids or chemicals during the activity is the transfer of MEG from a supply vessel to the construction vessel, which will occur via a floating hose.

An accidental release of chemicals and other non-hydrocarbon liquids into the marine environment has the potential to occur from:

+ transferring, storing or using bulk products (e.g. water treatment chemicals)
+ mechanical failure of equipment, such as tank or pipework failure
+ handling and storage spills and leaks due to insufficient fastening or inadequate bunding
+ floating hose failure or rupture, coupling failure or tank overfilling
+ lifting and incorrect handling (e.g. dropped objects damaging liquid vessels (containers))
+ firefighting foam during an unplanned incident.

A release of non-hydrocarbon liquids or chemicals may result in impacts to water quality and hence sensitive environmental receptors.

What environmental impacts could occur?

The maximum volume of non-hydrocarbon liquids or chemicals that could be released during routine operations is likely to be small and limited to the volume of individual containers. Hydrotest mixture chemical storage tank on the construction vessel, and intermediate bulk containers (IBCs) or drums stored on vessel decks.

Dilution from discharges in open waters is rapid, with one in 1,000 dilution usually occurring within 30 minutes. If the spill is not contained on deck, a release to the marine environment would likely disperse rapidly within the operational area.

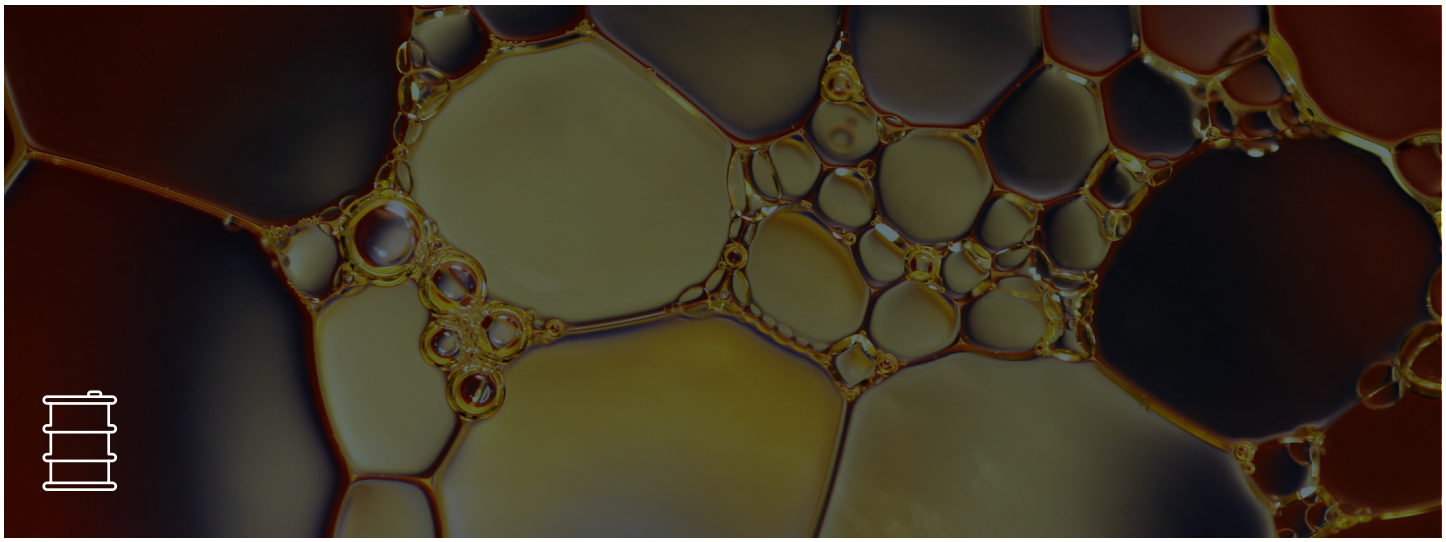
The environment that may be affected for non-hydrocarbon liquids or chemical release resulting in a decrease in water quality is likely to be restricted to around the vessel and contained within the operational area.

Potential receptors include the physical environment (e.g. water and sediment quality, benthic habitats), threatened, migratory or local fauna (e.g. marine mammals, marine reptiles, sharks and rays, other fish, and birds) and socioeconomic features of the environment (including cultural features).

How will Santos manage the risk?

Santos has a suite of procedures to manage the selection, storage, handling and clean-up of chemicals and other non-hydrocarbon liquids. In addition, vessels have spill response plans. The Santos chemical selection procedure is designed so that only environmentally acceptable chemicals are used for leak testing and pre-commissioning activities. These procedures assist to minimise the likelihood of non-hydrocarbon liquid spills, and subsequent environmental consequences should they occur.

The control measures proposed to be adopted are designed to be consistent with maritime and petroleum industry standards and appropriate to manage the residual risks to as low as reasonably practicable and acceptable levels.



MARINE DIESEL SPILL

How could a marine diesel spill occur?

A credible worst-case release scenario of marine diesel oil (MDO) to the marine environment could result from a collision between two activity vessels or an activity vessel and third party. Such a collision could rupture a fuel tank at the sea surface resulting in the release of MDO to sea. A vessel collision could occur due to factors such as human error, poor navigation, vessel equipment failure or poor weather. The worst-case spill volume has conservatively been modelled as approximately 500 cubic metres, consistent with the largest tank size on proposed installation vessels.

Santos has also considered a much smaller volume refuelling incident (fuel hose failure or rupture, coupling failure or tank overfilling) where vessel or helicopter fuel bunkering would need to be stopped manually. Fuel released before pumping stops and fuel remaining in the transfer line may be released to the environment. Worst-case spill volumes were determined from transfer hose inventory and spill prevention measures including 'dry-break' or 'breakaway' couplings, rapid shutdown of fuel pumps and spill response preparedness, with 10 cubic metres considered to be the maximum volume that could be released from the hose before shutdown.

What environmental impacts could occur?

MDO is characterised by a high percentage of volatile components (95 per cent), which will evaporate when on the sea surface over several days. It also contains five per cent persistent hydrocarbons, which will not evaporate, though will decay over time. The heavier components of MDO tend to become entrained into the upper water column as oil droplets in the presence of waves but can refloat to the surface if wave energies abate. Entrained MDO is largely concentrated in surface waters (0–10 metres deep).

Spill trajectory modelling indicated that there was some probability of a 500 cubic metres MDO release (using the moderate exposure value) extending as follows:

+ shoreline accumulation was not predicted to occur
+ surface oil was predicted to occur within approximately 136 kilometres of the release location
+ entrained oil (one-hour time-step, high threshold) was predicted to occur within approximately 591 kilometres of the release location
+ dissolved hydrocarbons (one-hour time-step) were predicted within 116 kilometres of the release location.

The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill.

A 500 cubic metre release of MDO was modelled for a release over one hour, replicating the potential duration of a release arising from a significant collision. Hydrocarbons would persist within the environment for a longer period, although MDO is expected to weather quickly through evaporation and dispersion. The results from the modelling can be seen in Figure 3 above.

Potential receptors include physical environment (water quality, shoals and banks, benthic habitats), threatened or migratory fauna (marine mammals, marine reptiles, fish (including sharks and rays) and birds), protected and

significant areas (KEFs), socioeconomic receptors (fisheries, tourism, recreation, cultural features and other third-party operators).

A hydrocarbon release will cause a decline in water quality and may cause chemical (e.g. toxicity) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon release depends on the magnitude of the release (i.e. extent, duration) and sensitivity of the receptor. The nature and scale of a hydrocarbon release is described throughout this section for a vessel collision scenario, given smaller hydrocarbon releases (from refuelling) will impact a smaller area than a vessel collision.

Physical environment or habitat

Water quality changes would be temporary and localised due to the rapid MDO weathering and dispersion.

MDO will be limited to the upper water column (sea surface to 30 metres deep). Shallow water shoals and banks present at (less than 30 metres water depth) within the MEVA may be impacted. Potential impacts include sub-lethal stress and mortality of sensitive benthic organisms (e.g. corals) and the early life stages of resident fish and invertebrates.

Threatened or migratory fauna

A MDO spill from a vessel collision may impact marine fauna, including fauna which may have cultural significance.

Seabirds may contact surface MDO whilst foraging, potentially causing secondary effects through ingestion from eating oiled fish or after preening. The MEVA does not impact any bird breeding or foraging biologically important areas; hence potential impacts will be limited to individuals transiting the area.

Although there are no known significant feeding, breeding or aggregation areas for the pygmy blue whale within the MEVA, there is a biologically important area for distribution range and migration. Potential impacts to the pygmy blue whale and other whales are likely to be limited to individuals transiting through the area with the potential for coating of baleen (in whales), ingestion of oiled prey (plankton or fish) and behavioural impacts. No population-level impacts are expected.

No MDO is expected to contact shoreline or turtle nesting beaches at impact thresholds (there is some accumulation at low threshold levels on the Tiwi Islands). There are two BIAs for the flatback and olive ridley turtles and habitats critical to the survival of the flatback turtle that have been identified to intersect the outer extent of the MEVA. Turtles may occur in the MEVA but their presence is limited to transiting in deeper water. These turtles transiting through the area could be affected, but population-scale impacts are unlikely. Sea snakes may also be present. Sea snakes may be vulnerable to hydrocarbon spills due to their need to surface to breathe and may spend time at the sea surface to bask in the sun. The short-nosed sea snake and other species may occur in the limited shallow (up to 10 metres deep) banks and shoals within the MEVA. Therefore only low numbers are expected to be at risk of impact.

Protected areas

The MEVA intersects the Oceanic Shoals marine park. A hydrocarbon spill has the potential to impact water quality and a range of biological receptors. These environmental values are contained within the Oceanic Shoals marine park in Commonwealth waters. Impacts to the values of the marine park are anticipated to be temporary and localised due to the rapid evaporation rates of the volatile components of MDO and its rapid natural degradation and dispersion in the open ocean.

Socio-economic receptors

A vessel collision resulting in an MDO spill may temporarily disrupt fishing activities if it spreads to fishing areas. However, due to the high MDO evaporation rate any impacts are predicted to be localised. Other marine users that may be disrupted include regional oil and gas operations, military exercises and commercial shipping.

In the remote chance that a vessel collision does occur and results in an MDO spill, there is a low probability (0.33 per cent at low threshold) that MDO could accumulate on the west coast of the Tiwi Islands. As a result, the EMBA may overlap. EMBA may overlap cultural values such as sea country, songlines and totemic species. Cultural values within the EMBA and associated potential risks and impacts will continue to be identified, including through consultation with Indigenous people and their representative bodies.

How will Santos manage the risk?

Santos is to communicate with other marine users before and during the activity. Standard maritime notifications (e.g. notice to mariners) are designed to inform other marine users of the activity and relevant cautionary or exclusion zones. The vessels are to have automatic identification systems and minimum navigational lighting to aid in their detection at sea. Support vessels are to actively communicate with third-party vessels to inform them of the marine activities.

Operational procedures and equipment maintenance practices should minimise spills resulting from damaged or malfunctioning equipment and refuelling incidents.

Spill response plans will be in place and regular exercises conducted (including vessel specific spill response plans and the OPEP).

Santos has made a commitment to use MDO rather than heavier fuel oils on all SURF and moorings installation activity vessels.

These control measures are designed to comply with maritime regulations and standard industry practices. The risk of a MDO spill is low and has been reduced to as low as reasonably practicable.

CONTINGENCY SPILL RESPONSE OPERATIONS

In the event of a hydrocarbon spill, response strategies will be implemented to reduce environmental impacts to as low as reasonably practicable. The selection of strategies will be undertaken using the Net Environmental Benefits Assessment (NEBA) process. Spill response will be under the direction of the relevant control agency, as defined in the SURF and moorings installation oil pollution emergency plan (OPEP), which may be Santos, another agency or both. In all instances, Santos will undertake a 'first-strike' spill response and will act as the control agency until the designated control agency assumes control. The response strategies considered to be appropriate for the worst-case spill scenarios identified for the activity are detailed in the OPEP and comprise:

+ source control
+ monitor and evaluate
+ mechanical dispersion
+ oiled wildlife response
+ scientific monitoring
+ waste management.

Response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, but poorly planned and coordinated response activities can result in a lack of, or inadequate, information being available, upon which poor decisions can be made, exacerbating or causing further environmental harm. An inadequate level of training and guidance when implementing spill response strategies can also result in environmental harm beyond that caused by the spill.

What impacts are expected?

Spill response operations may be required at any location within the EMBA. Potential environmental impacts include:

Noise emissions

+ Spill response operations will involve aircraft and vessels, which will generate noise both offshore and in nearshore locations within the EMBA.
+ Underwater noise from vessels may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals.
+ Cetaceans have been identified as the key concern for vessel noise, with the pygmy blue whale distribution and migration BIA intersecting the EMBA.

Light emissions

+ Spill response operations will involve vessels which are required, at a minimum, to display navigational lighting. Vessels may operate near shoreline areas during spill response operations.
+ Spill response activities may also involve onshore operations including vehicle use and temporary camps, both of which may require lighting.
+ Lighting may cause behavioural changes to fish, mammals, birds and marine turtles that can have a heightened consequence during key life cycle activities, such as turtle nesting and hatching. Turtles and birds, which includes threatened and migratory fauna, have been identified as key fauna susceptible to lighting impacts.

Atmospheric emissions

+ Using fuels to power vessel engines, generators and mobile equipment during spill response operations will result in emissions of GHGs, such as CO2, CH4 and N2O, along with non-GHGs such as sulfur oxides (SOx) and nitrogen oxides (NOx). Emissions will result in a localised decrease in air quality.
+ Atmospheric emissions from spill response equipment are expected to be localised, and using mobile equipment, vessels and vehicles is not considered to create emissions on a scale where noticeable impacts would be predicted.

Operational discharges and waste

+ Operational discharges include routine discharges from vessels used during spill response, such as:
  - deck drainage
  - putrescible waste and sewage
  - cooling water from operating engines
  - bilge water
  - ballast water
  - brine discharge
+ Other specific spill response discharges and waste creation may occur, including:
  - cleaning of oily equipment, vessels and vehicles
  - sewage and putrescible and municipal waste at offshore staging sites
  - creation, storage, transport and disposal of oily waste and contaminated organics
+ Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, and temperature and salinity increases. Discharge could potentially occur adjacent to marine communities,

such as corals, seagrass and macroalgae, and in protected areas (i.e. receptors anywhere within the EMBA), which support a more diverse faunal community; however, discharges are still expected to be localised and temporary.

+ Cleaning of oil-contaminated equipment, vehicles and vessels has the potential to spread oil from contaminated areas to areas not impacted by a spill, potentially spreading the impact area, and moving oil into a more sensitive environment.
+ Sewage and putrescible and non-putrescible waste will be generated from offshore activities at temporary staging/mooring areas, which may include toilet and washing facilities. These wastes have the potential to impact water quality, impact habitats, and reduce the aesthetic value of the environment, which may be within protected areas.

Physical presence and disturbance

+ Moving and operating vessels during spill response operations has the potential to disturb the physical environment and marine habitats and fauna (e.g. vessel strike, behavioural changes), which may occur within protected areas. Disturbance may also impact socioeconomic values of an area. Vessel movement could potentially introduce IMS (attached as biofouling) to nearshore areas, while vehicle and equipment movement could spread non-indigenous flora and fauna.
+ Oiled wildlife response activities may also involve deliberately disturbing (hazing), capturing, handling, cleaning, rehabilitating, transporting and releasing wildlife, which could lead to additional impacts to wildlife.

Disruption to other marine users, coastal areas and townships

+ Spill response operations may involve using vessels and equipment in areas used by the general public or industry in affected areas. Mobilising spill response personnel into forward operating bases may also place increased demands on local accommodation and other businesses.
+ Using vessels in the offshore environment and undertaking spill response operations may exclude the general public and industry from using the affected environment. As well as impacting recreational activities (e.g. recreational fishing) of the general public, this may impact revenue with respect to industries such as commercial fishing. Mobilising personnel to regional communities has the potential to affect the local community through demands on local accommodation and business, reducing the availability of services to members of the public.

How will Santos manage the risk?

Santos will rely primarily on the implementation of the SURF and moorings installation OPEP to manage the potential impacts associated with a spill response event. Other control measures that would be implemented include:

+ procedure for interacting with marine fauna
+ chemical selection process
+ minimum lighting to meet maritime safety and navigation requirements
+ air pollution prevention certification
+ sewage and oily water treatment systems on vessels
+ consultation with relevant persons.

The implementation of spill response activities to reduce the potential impacts from a spill are required by legislation. The spill response options selected have been demonstrated to show a net environmental benefit, are standard industry practice and are consistent with relevant standards and guidelines, including the National Plan for Maritime Environmental Emergencies. The controls proposed are intended to reduce the consequences of the potential impacts to minor and as low as reasonably practicable and an acceptable level.

Summary of the risk management strategy

Santos has a management system that includes specific measures, to be used for the duration of the activities under the SURF EP, which seek to confirm that:

+ environmental impacts and risks continue to be identified for the duration of the activity are reduced to as low as reasonably practicable and acceptable levels
+ control measures are effective in reducing environmental impacts and risks to as low as reasonably practicable and acceptable levels
+ environmental performance outcomes and standards set out in the EP are being met
+ there will be ongoing appropriate consultation with relevant authorities and other relevant interested persons or organisations
+ the roles, accountabilities and responsibilities are defined and understood
+ workforce training is completed and competencies assured
+ emergency preparedness and response arrangements are in place
+ incident reporting, investigation and follow-up is monitored
+ audits, inspections, reporting and notifications and document management are appropriately undertaken.

Your feedback and what's next

In preparing an environment plan for submission to NOPSEMA, a titleholder must consult with each 'relevant person', including relevant Commonwealth, State and Northern Territory departments or agencies and persons (or organisations) whose functions, interests or activities may be affected by the activity proposed to be carried out under an environment plan.

Examples of 'functions, interests or activities' that may be affected by the activities to be carried out under an EP may include those arising in relation to a spiritual or cultural connection to land or to sea country, tourism, recreational and commercial fishing and local communities (though these are merely illustrative examples and not an exhaustive list). The information contained in this information booklet may assist your consideration of whether you are a relevant person.

More information about 'relevant persons' can be found on our website at **www.santos.com/barossa/relevant-persons**

Relevant persons being consulted on environment plans under the OPGGS Environment Regulations should note that they:

+ are entitled to be given sufficient information to allow them to make an informed assessment of the possible consequences of the activity on their functions, interests or activities
+ are entitled to be allowed a reasonable period for the consultation
+ may request particular information provided in consultation not be published. If you do ask this, Santos will respect that and the information will not be published under the relevant regulations. Information we need to give to NOPSEMA to assess our plan will be provided in a separate report (rather than in the published EP).

Your feedback and input is important to Santos. Santos wants to understand the appropriate consultation processes for different relevant persons. Santos also wants to provide information for people in an appropriate and accessible manner so that relevant persons may make informed assessments of the possible consequences of the proposed SURF activity for them, so that they can provide feedback to inform the environment plan.

We welcome input from relevant persons about additional information they seek and how they wish to be consulted. Such input may be provided by:

+ phone on **1800 267 600**
+ email at **offshore.consultation@santos.com**
+ or by scanning the QR code below.

If you think you, your organisation or another person or organisation you know of may be a relevant person for the purposes of one of Santos's proposed activities, and we have not already contacted you (or the other person or organisation) in that capacity, please contact Santos to seek to be included in consultations and to provide feedback on how you would like to be consulted (if a relevant person). If you suggest other potential relevant persons to Santos and provide information as to how those relevant persons may be reached, we may also contact those persons or organisations and provide copies of this information. Santos also welcomes you to encourage other potential relevant persons to get in touch with Santos at the above contact details.

SCAN ME

Santos

santos.com