Santos

INFORMATION BOOKLET

BAROSSA PRODUCTION OPERATIONS ACTIVITY

INTRODUCTION

The activities described in this booklet relate to the extraction, processing, and distribution of gas and condensate from the Barossa Field.

The Barossa Development facilities used in these activities consist of a Floating Production Storage and Offloading (FPSO) facility, subsea production wells, supporting in-field subsea infrastructure **(Figure 1)**, a 285 km Gas Export Pipeline (GEP) in Commonwealth waters, and an 8.26 km section of the GEP in Northern Territory (NT) coastal waters; collectively termed in this booklet as "Production Operations Activity".

As part of obtaining authorisation for this activity, Santos is undertaking consultation for the following regulatory approvals:

- The Production Operations Environment Plan (EP) relating to the arrival and operations of the FPSO, operation of a subsea production system and supporting subsea infrastructure, and operation of a 285km section of the GEP located in Commonwealth waters where offshore petroleum activities are regulated under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)* (OPGGS Act).
- The Operations Environmental Management Plan (OEMP) which includes the:
  - 8.26 km section of the GEP in NT coastal waters covered by the *Petroleum (Submerged Lands Act) 1981 (NT)* (PSL Act); and
  - ~92km section of the GEP inshore of NT waters covered by the *Energy Pipelines Act 1981 (NT)* (Energy Pipelines Act).

The term 'GEP' refers to the Gas Export Pipeline through which Barossa gas will be transported from the Barossa field to Darwin LNG. However, the scope of the GEP covered in this booklet, is limited to the 8.26 km section of the GEP located in NT coastal waters.

The activities, environmental impacts, and risks for the GEP in NT waters (~92km) are broadly similar to those for the GEP in Commonwealth waters (described in this booklet). The activities, environmental impacts and risks specific to the GEP in NT waters, not covered in this booklet, will be provided in a separate factsheet.

The estimated life of the Barossa Development is 25 years, and the Production Operations EP and the OEMP will be reviewed every five years following initial regulator authorisation. This booklet provides a summary of the credible environmental impacts and risks associated with the first five years (also known as Barossa Phase 1) of the Production Operations Activity.

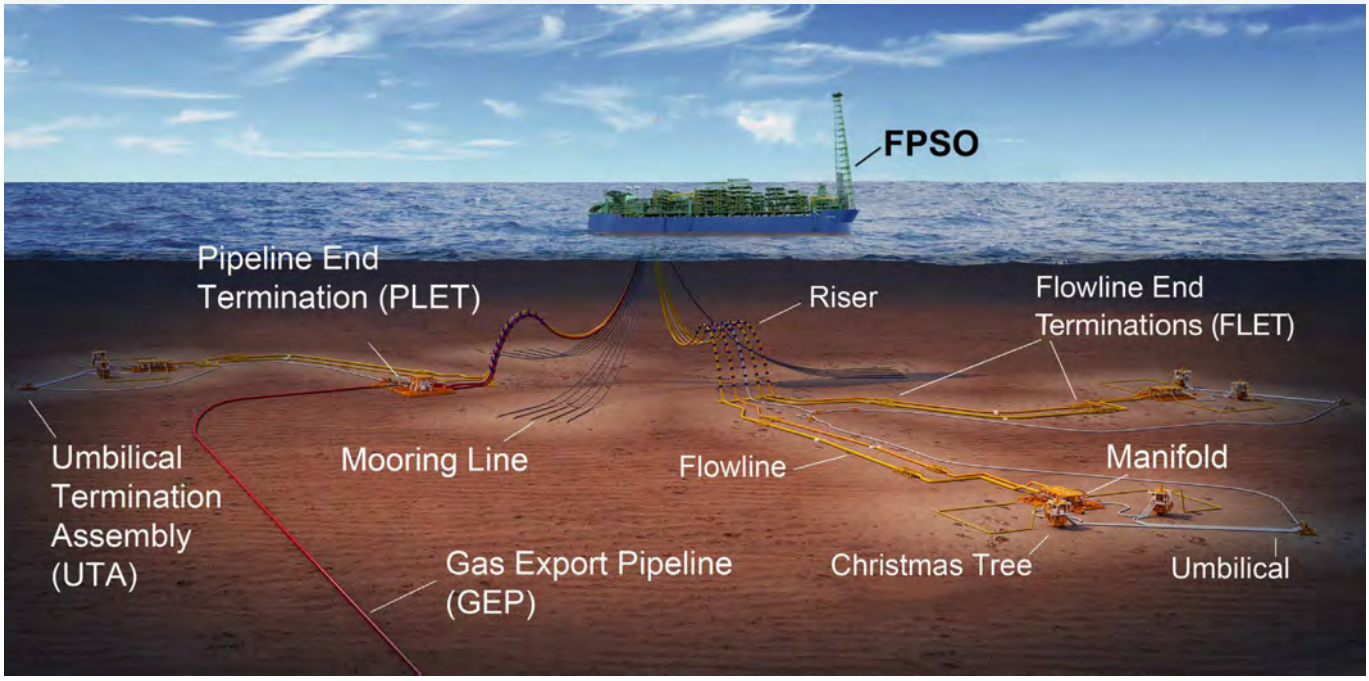


Figure 1: Schematic of the Barossa Field Subsea production system and infrastructure, and FPSO

BAROSSA GAS PROJECT OVERVIEW

The Santos-operated Barossa Gas Project is an offshore gas and condensate project with the purpose of providing a new source of gas to the existing Darwin liquified natural gas (DLNG) facility at Wickham Point in the NT. It is intended that natural gas and condensate would be extracted from the Barossa field, located in Commonwealth waters approximately 285 kilometres offshore north-northwest from Darwin. Initial processing would occur at the FPSO, to separate the natural gas, water and condensate. The dry natural gas would be transported through the GEP for onshore processing at the DLNG facility. The condensate would be transferred from the FPSO facility to purpose-built tankers for international export.

DLNG facility at Wickham Point where Barossa gas will be sent for onshore processing.

ACTIVITY LOCATION

The planned Production Operation Activity is confined to two key operational areas. These areas are simply termed Operational Area 1 (OA1) and Operational Area 2 (OA2) **(Figure 2)**.

OA1: The Barossa field. This is the area in which the FPSO, subsea production system, and supporting subsea infrastructure will be used to process gas and condensate extracted from the Barossa wells. The area is confined to Commonwealth waters, approximately 285 km north-north-west of Darwin (the closest major populated centre), approximately 210 km north-west of the mainland NT coastline, and approximately 130 km north of the Tiwi Islands at the closest point (Seagull Island).

OA2: The 285 km section of the GEP from OA1 to the Commonwealth waters/ NT waters boundary; and the 8.26 km section of the GEP situated in NT coastal waters between the Commonwealth waters/NT coastal waters boundary and the Territorial Sea Baseline (TSB). Not included in this section is the remaining GEP in NT waters (~92 kms). Information on this is covered elsewhere.

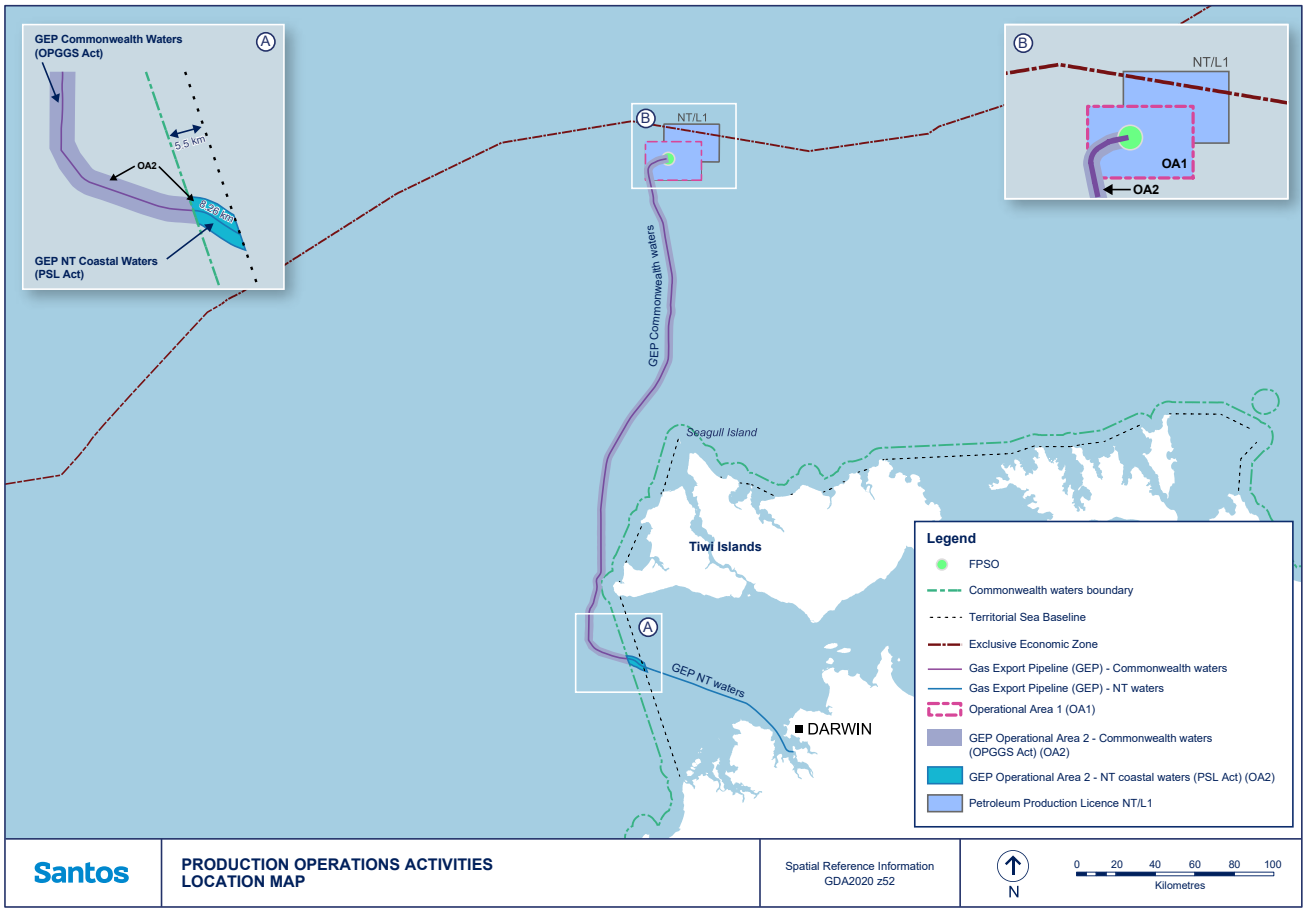


Figure 2: Location of the Barossa Operational Area 1 (OA1) in Commonwealth waters (OPPGS Act) and Operational Area 2 (OA2) in Commonwealth waters and NT coastal waters (PSL Act).

SUMMARY OF ACTIVITIES

The Barossa FPSO, which will be known as BW Opal, is a permanently moored vessel which is able to freely rotate with the strongest wind direction and remain connected to subsea facilities. The operational design life for all Barossa facilities is 25 years. **Figures 3 and 4** depict key features of the FPSO and utilities/marine systems.

Gas and condensate extracted from the Barossa field will be processed on the FPSO to separate the natural gas and condensate (a light liquid hydrocarbon, straw coloured and flammable). The dry gas will be exported to the DLNG facility via the GEP, and the condensate will be transferred from the FPSO to offtake tankers for export approximately four to five times per year. The key activities proposed under the Production Operations EP are detailed below.

Most of the below activities are only applicable to OA1 as this is where the FPSO and subsea infrastructure is located, and the condensate offtakes will occur. The main activity in OA2 will be inspection, maintenance, monitoring, and repair (IMMR) of the GEP.

- **FPSO arrival in the field:** connection of the FPSO to the mooring buoy; equipment and systems testing (also termed commissioning), start-up operations.
- **FPSO operations:** process gas and condensate from the Barossa field. The gas and condensate separation and treatment systems have a gas export capacity of approximately 635 million standard cubic feet per day (a little over 7000 Olympic-size swimming pools) with a condensate processing capacity of approximately 11,000 barrels per day (a little more than half an Olympic-size swimming pool) and a produced water processing maximum capacity of 20,000 barrels per day (over one Olympic-size swimming pool). Under normal operating conditions produced water discharge rates will be approximately a quarter (~5,000 barrels per day) of the maximum discharge capacity (~1/4 of an Olympic-size swimming pool). The FPSO generates its own electricity using Barossa production gas, and potable water supply. Living quarters are provided for the operations workforce.
- **Gas export to DLNG:** dry natural gas will be transported through the GEP for onshore processing at the DLNG facility.
- **Storage and Offtake operations:** storage of condensate onboard the FPSO and offloading of condensate to offtake tankers. Approximately 650,000 barrels (~ 40 Olympic-size swimming pools) will be offloaded approximately once every two to three months (four to five times per year).

- **Support operations:** offshore support vessels periodically visit the FPSO to resupply materials (such as stores, consumables, chemicals and fuel) and return surplus goods and wastes to the Australian mainland for disposal or recycling. Helicopters will be used to transport the operations workforce to and from operations facilities.
- **Subsea system and GEP inspection, maintenance, monitoring and repair (IMMR):** visual inspection of subsea infrastructure and/or the GEP using Remotely Operated Vehicles (a submersible craft used to perform underwater visual inspections operated from a vessel). This activity will be performed according to a planned inspection and maintenance schedule, or at other intervals if unplanned inspections or repairs are required.

Figure 3: FPSO key features

1 Condensate Offloading System
2 Aft Service Crane
3 Communications & Radar
4 Aft Pedestal Crane
5 Thermal Oxidiser
6 Helideck Parking Area
7 Forward Pedestal Crane
8 Power Generation Exhaust
9 Midship Pedestal Crane
10 Helideck Landing Area
11 Daughter Craft
12 Freefall Lifeboats
13 Engine Room Exhaust

Figure 4: FPSO utilities and marine systems

REGIONAL EXISTING ENVIRONMENT SUMMARY

Environment that may be affected (EMBA)

Santos recognises the region's various environmental values and sensitivities. In an EP, although planned activity occurs in OA1 and OA2, it is common to present a geographically defined area of the environment that may be affected (EMBA) by an offshore activity e.g. an unplanned hydrocarbon spill.

In the case of the Production Operations Activity, the broadest extent of the EMBA, is determined by a potential loss of heavy fuel oil from a condensate offtake tanker due to impact from another vessel. Potential loss of heavy fuel oil is a risk associated with any large marine vessel and is managed through established maritime laws and safeguards. Barossa condensate offtake operations are a low frequency activity (four to five times a year) which further reduces the likelihood of such an event, which is already a very low probability of occurring.

Figure 5 depicts operational areas OA1 and OA2 and the EMBA (blue line). The EMBA is generated by modelling and represents the greatest geographical extent that could be affected by 300 individual hydrocarbon spill scenarios occurring simultaneously across the full range of seasonal conditions. It should be noted that an actual spill event is more accurately represented by only one of the 300 simulations from the modelling, meaning a much smaller geographical area would be affected in the event of an actual spill; and the EMBA does not take account of spill response mitigations which would reduce the extent of an unplanned spill. The primary purpose of the EMBA is to assist with spill response planning and preparedness in the unlikely event of a hydrocarbon spill. The EMBA also provides the basis for assessing the range of potential socio-economic impacts and establishes a planning area for scientific monitoring during an unplanned spill event.

The Moderate Exposure Value (MEVA) (pink line) represents the predicted extent of ecological impacts and is used to inform the environmental impact assessment and spill response plans. Beyond the MEVA, impacts to ecological receptors are not expected.

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

Regional protected and significant areas

Figures 6, 7, and 8 illustrate the boundaries and zonings of regional marine parks and reserves, key ecological features, wetlands, EMBA, the MEVA and the OAs. **Figure 9** illustrates the shoals and banks in relation to the OAs.

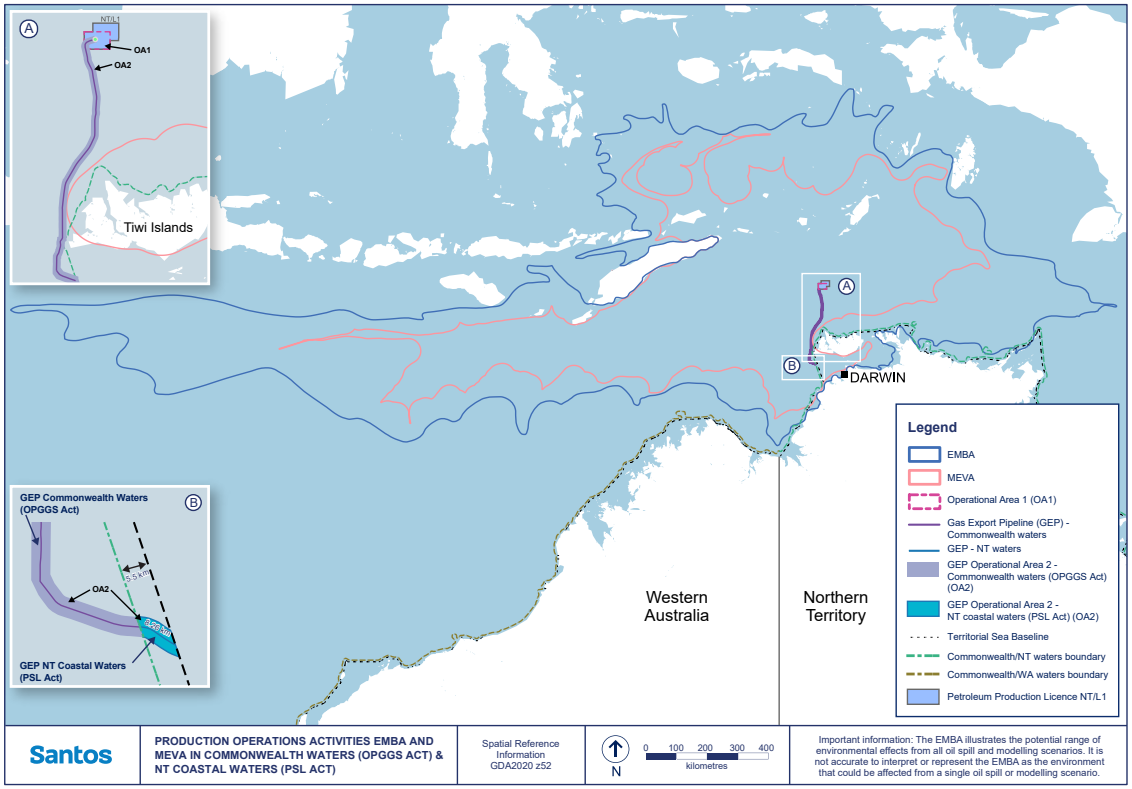


Figure 5: Production Operations Activities EMBA and MEVA in Commonwealth waters (OPGGS Act) and NT coastal waters (PSL Act)

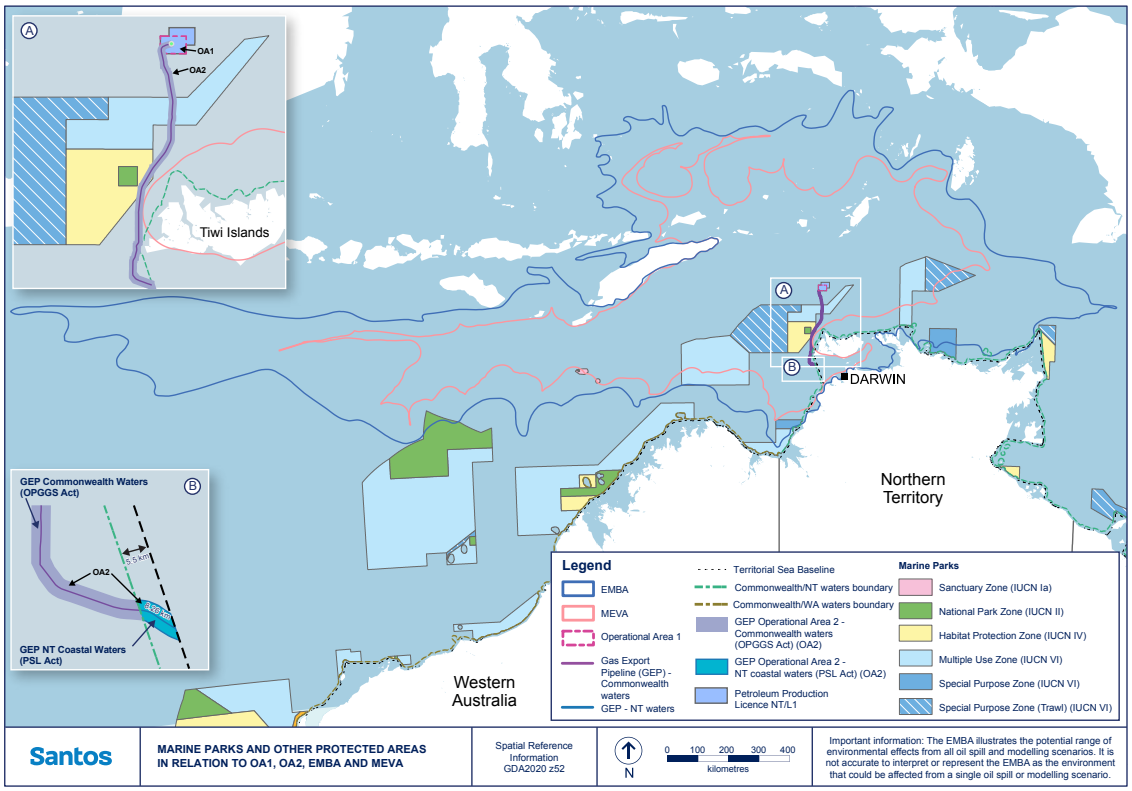


Figure 6: Marine Parks and Other Protected Areas in relation to OA1, OA2, EMBA and MEVA

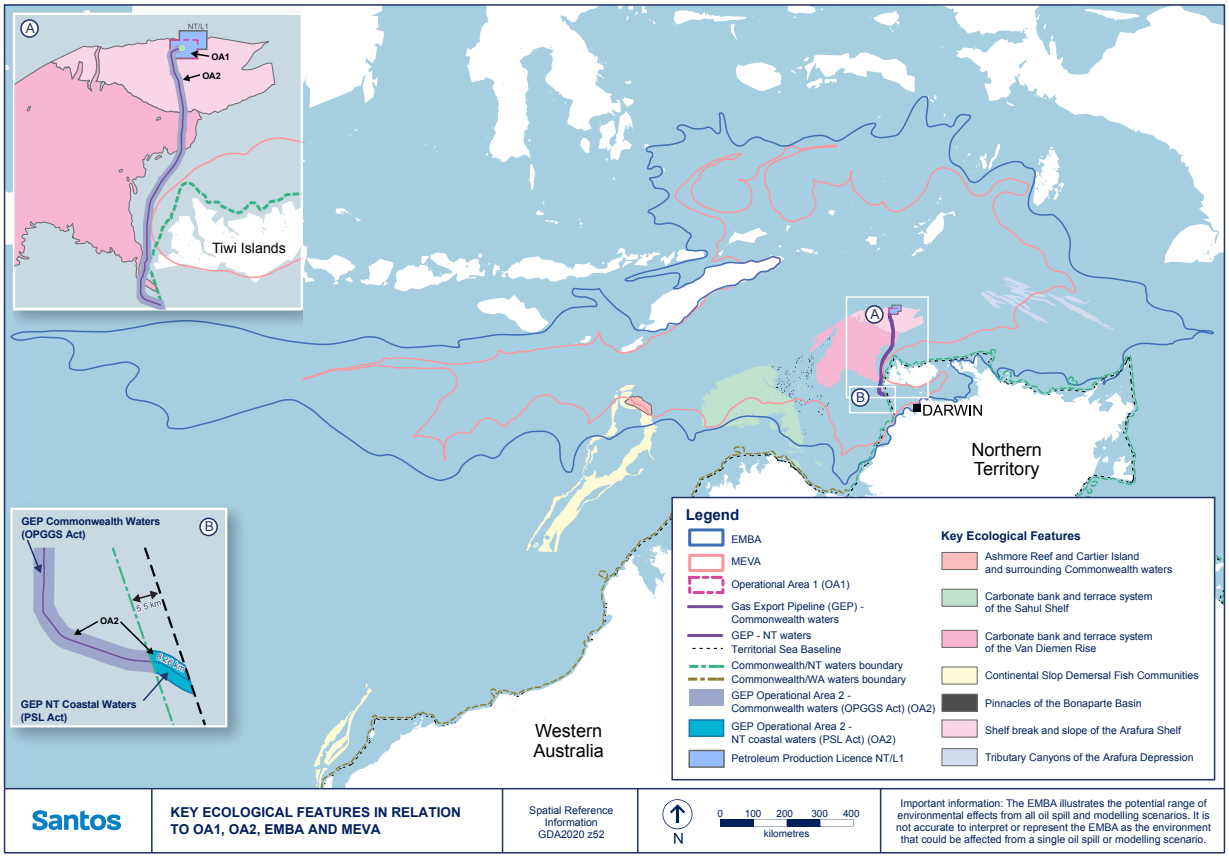


Figure 7: Key Ecological Features in relation to OA1, OA2, EMBA and MEVA

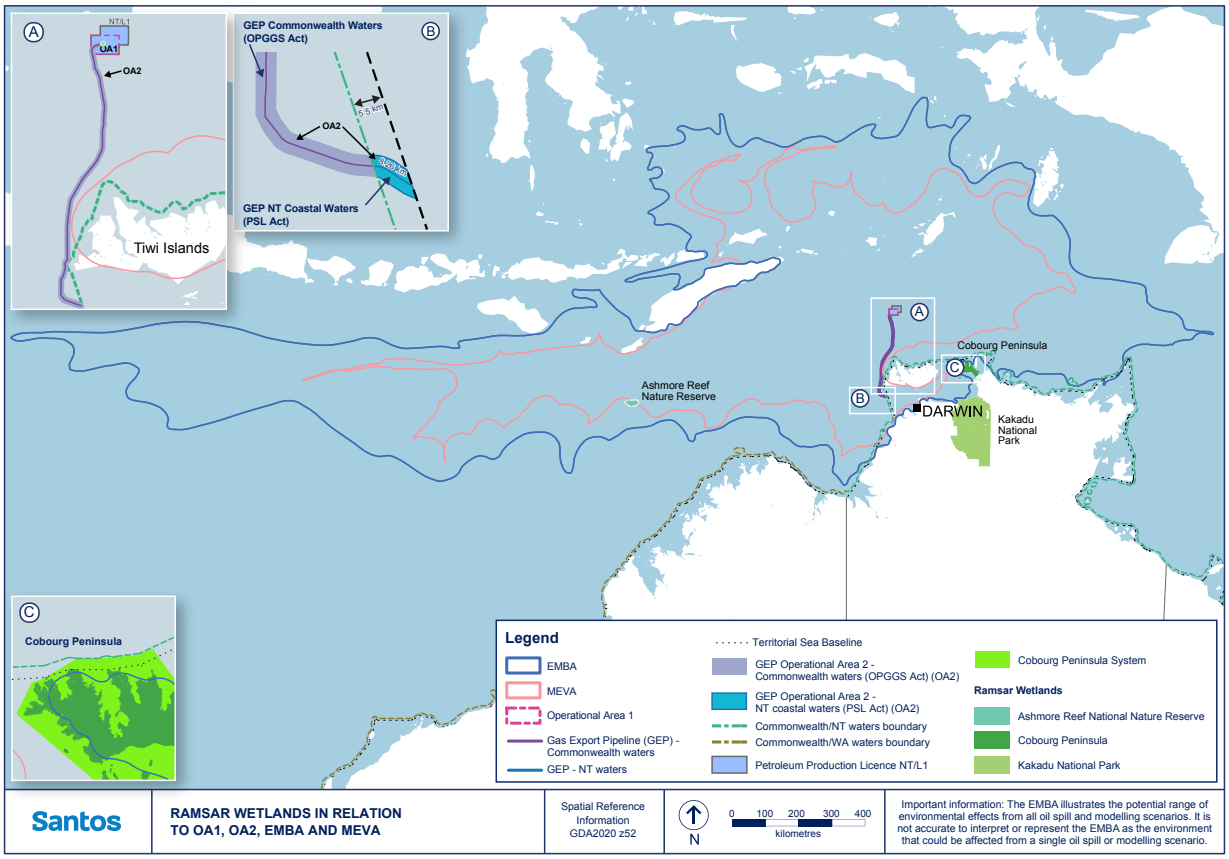


Figure 8: RAMSAR wetlands in relation to OA1, OA2, EMBA and MEVA

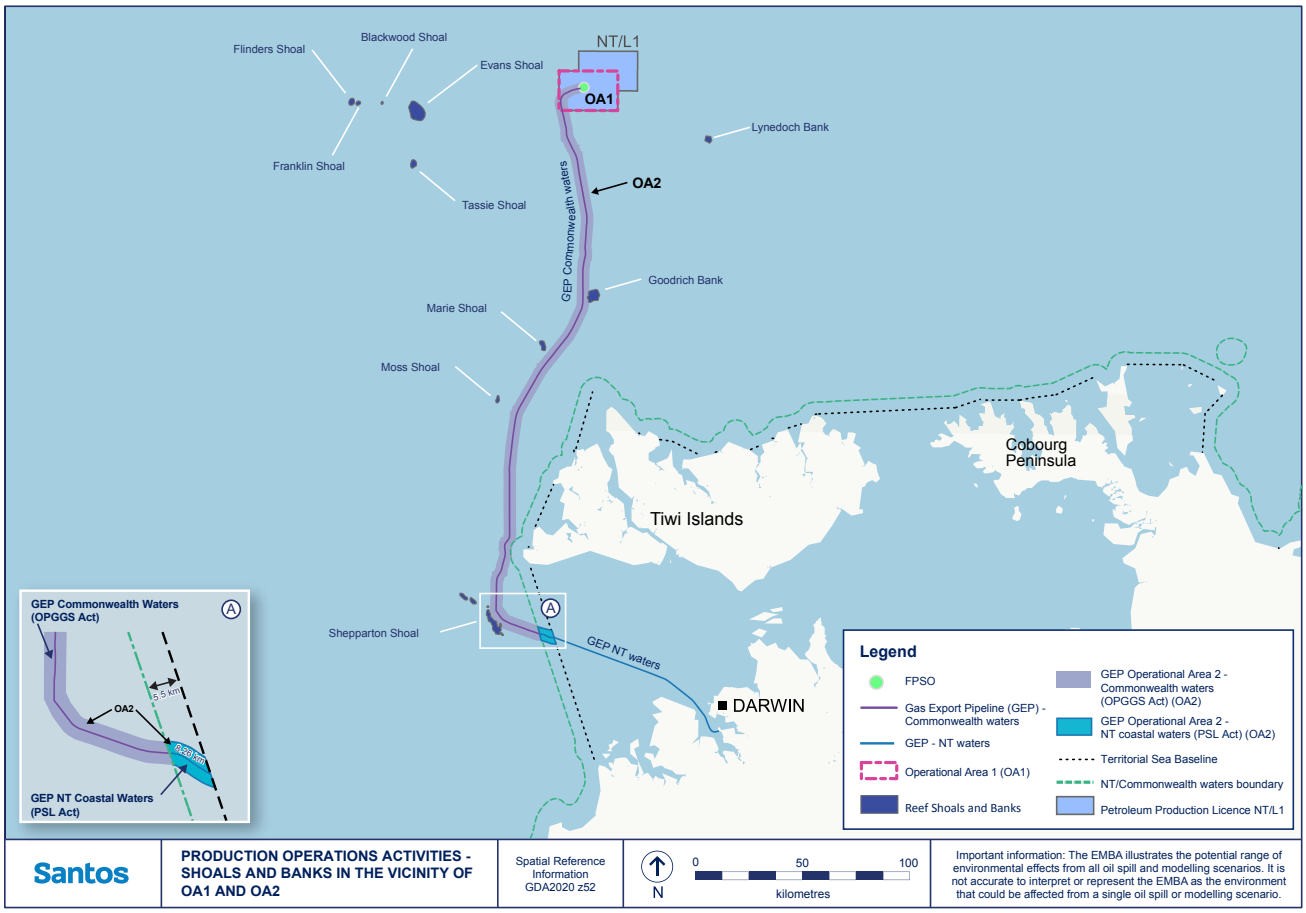


Figure 9: Shoals and Banks in the vicinity of OA1 and OA2

Marine fauna and biologically important areas

Biologically important areas (BIAs) are areas used by protected marine species for carrying out critical life functions, such as reproduction, feeding, migration or resting. BIAs are areas that contain habitat crucial to the survival of protected species and are defined by the Australian Government under the Environment Protection and Biodiversity Conservation Act 2009 (EPBC Act). As shown in Figure 10, some BIAs occur within the EMBA. These areas are known to include protected marine species such as whale sharks, pygmy blue whales, dugongs, olive ridley turtles, loggerhead turtles, green turtles, hawksbill turtles, flatback turtles, and 12 types of seabirds and shorebirds. In addition, the EMBA overlaps the spawning grounds for southern bluefin tuna, a listed species under the EPBC Act, between northern Western Australia and Java.

The BIAs for flatback turtles overlap with OA2. There are no BIAs within OA1. Two turtle species, the flatback turtle and olive ridley turtle, have critical habitat that overlap with OA2.

Activities in OA1 will be conducted in water depths ranging from approximately 220 – 280 m. There are a variety of highly mobile marine fauna that may transit OA1 in low numbers, such as:

- Bryde's, blue, fin, humpback, sperm and sei whales
- orcas, Australian snubfin dolphin and spotted bottlenose dolphin
- dugongs (mostly in shallow waters)
- olive ridley, green, loggerhead, hawksbill, leatherback and flatback turtles
- sea snakes
- whale sharks
- migratory seabirds and shorebirds
- fishes, sharks, rays and sawfish.

An additional three species – the grey nurse shark, Omura's whale and the turtle-headed sea snake have been included as they were observed within or near OA1 and OA2 during the Barossa Marine Studies Program.

Santos recognises the region's various environmental values and sensitivities and has considered government guidance, including protected species management plans, recovery plans, conservation advice and threat abatement plans in the development of the Production Operations and OEMP, and has developed control measures to reduce impacts and risks to marine fauna and biologically important areas to as low as reasonably practicable and acceptable levels.

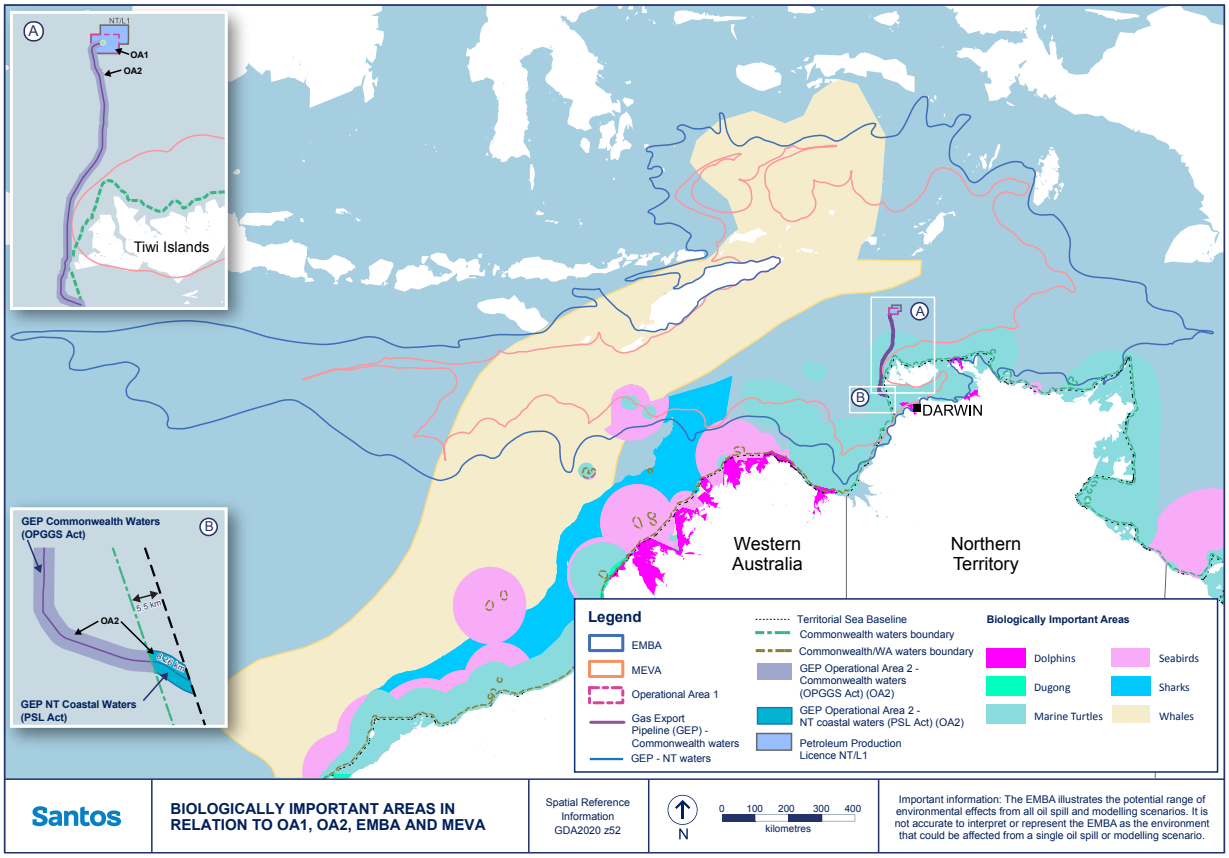


Figure 10: Biologically important areas in relation to OA1, OA2, EMBA and MEVA.

REGIONAL SOCIO-ECONOMIC SUMMARY

Socioeconomic activities that may occur within the OAs or EMBA might include commercial, recreational and traditional (subsistence) fishing, aquaculture, tourism, petroleum industry activities, defence activities, shipping and to a lesser extent in the deeper offshore waters, recreational fishing and tourism.

Underwater cultural heritage and cultural values may also exist across the region. Darwin will be the logistics hub and supply base for the capitals when stating Production Operations Activity bringing employment and economic benefits to the local community.

Nearest population centres

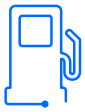
OA2, at its closest point, is located approximately seven kilometres from Bathurst Island, which is part of the Tiwi Islands. Darwin is the closest regional city, which approximately 285 km north-north-west of OA1.

Summary of other uses within the EMBA

Santos' existing understanding of the uses and values of the area and its strategies to reduce impacts or risks to these uses and values, will be supplemented with any new information obtained during consultation. Santos has set out in the list below a summary of the uses and values of the area based on existing information or previous consultation. Santos welcomes further information that may be provided during consultation to inform the Production Operations EP and OEMP.

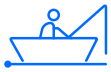
Commercial fishing

Santos recognises the presence and rights of commercial fishers within the operational area and EMBA. Within the OAs, interaction with some commercial fishing is possible. These fisheries include Northern Prawn, Spanish Mackerel, Pearl Oyster, Offshore Net and Line, and Demersal. Santos has been consulting with the relevant fisheries representative associations, licence-holders and government over many years.



Petroleum industry

Several oil and gas companies hold petroleum permits near the OAs; however, no established oil and gas operations are located within or in the immediate surrounds. The closest operational offshore production facilities and in-field subsea infrastructure are associated with the Santos-operated Bayu-Undan platform, located approximately 400km to the southwest of OA1 and west of OA2.



Tourism, recreational fishing and traditional fishing

The OA1 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 on a different Barossa Gas Project EP has identified one fishing charter operator who may on occasions conduct tours near Evans Shoal, approximately 62km west of OA1. Tourism activities may occur within OA2, but they are likely to be limited to vessels transiting the area to access other destinations within the region e.g. islands, shoals, and shipwrecks. Indonesian and Timorese traditional fishers, as well as Australian recreational fishers, are expected to transit and fish in the EMBA. Santos continues to consult regarding recreational and traditional fishing and hunting within the EMBA.

Defence Activities

Several oil and gas companies hold petroleum permits near the OAs; however, no established oil and gas operations are located within or in the immediate surrounds. The closest operational offshore production facilities and in-field subsea infrastructure are associated with the Santos-operated Bayu-Undan platform, located approximately 400km to the southwest of OA1 and west of OA2.

Telecommunications cables

The North-West Cable System (NWCS) is a submarine telecommunication fibre cable system located within the EMBA and crosses the GEP in the southern portion of OA1. It is located approximately 230 km and 30 km south of OA1 and OA2. Extending 2100 km from Darwin to Port Hedland, the NWCS connects Australia's remote northern and western regions, including offshore oil and gas facilities, with onshore locations.

Listed Heritage

There are no world heritage properties, national heritage places or Commonwealth heritage places within the OAs; however, the EMBA (including the MEVA) overlaps the Ashmore Reef Marine Park, a Commonwealth heritage place. The closest World Heritage Property is the Kakadu National Park, located onshore in the NT. A small portion of the coastal edge overlaps the EMBA. **(Figure 8)**

There are no recorded Aboriginal heritage sites within the OAs. The Tiwi Islands are a declared Aboriginal reserve and a number of protected sacred sites under the Aboriginal Sacred Sites Act 1989 (NT) have been recorded on the Islands.

Under the Commonwealth Underwater Cultural Heritage Act 2018, Australia's underwater cultural heritage is protected in Commonwealth waters, such as shipwrecks, sunken aircraft and other types of underwater cultural heritage including Australia's Aboriginal and Torres Strait Islander underwater cultural heritage. No known shipwrecks are located within the OAs. Multiple known shipwrecks, sunken aircrafts, historic aircrafts and shipwrecks (greater than 75 years old) and other sites occur within the EMBA. Some unlocated wrecks could fall within the boundaries of the OAs or EMBA.

In the course of preparing the Barossa Drilling and Completions EP, SURF EP and commencing works under the GEP EP, Santos engaged independent consultants to investigate potential for underwater cultural heritage within OA1. First Nations underwater cultural heritage is not relevant to OA1 due to its location in water depths beyond the extent of the ancient coastline at the 125 m water depth contour. A 262km section of the GEP within OA2 has been surveyed for both First Nations and other underwater cultural heritage

The results of those surveys concluded there are no specific underwater cultural heritage places along the Barossa GEP to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the activities covered by the GEP Environment Plan. Further similar surveys are planned for the remainder of OA2 in 2024.

Shipping

The closest port to the OAs is Darwin Port, which is approximately 290km away from OA1 and 116km away from OA2. No designated shipping fairways overlap the OAs, however the southern end of OA2 is an area of high shipping activity.

Cultural Values

Traditional hunting and fishing continue to occur on the Tiwi Islands, although typically these occur within 3 nm of the shoreline.

Mapping exercises and workshops conducted on the Tiwi Islands have identified Aboriginal heritage sites along the northern, western and southern coastlines of the Tiwi Islands, including areas used for food collection, sacred sites, camping sites and a dreaming site. These coastlines are within the EMBA but outside the OAs.

Santos has identified that the Croker Island native title determination (DCD1998/001) partially overlaps the EMBA. The native title holders within the Croker Island native title determination are the Yuwurrumu members of the Mandilarri-Ildugij, the Mangalara, the Murran, the GaduraMinaga and the Ngaynjaharr clans. The Larrakia native title determination (DCD2006/001) also partially overlaps the EMBA. This determination found that native title does not exist within the claim area.

Mapping exercises and workshops conducted on the Tiwi Islands have identified Aboriginal heritage sites along the northern, western and southern coastlines of the Tiwi Islands, including areas used for food collection, sacred sites, camping sites and a dreaming site. These coastlines are within the EMBA but outside the OAs.

Santos acknowledges coastal First Nations peoples' connection with culture through Sea Country and is seeking to improve knowledge and understanding of cultural features within the EMBA, including through consultation with First Nations people and their relevant representative bodies.

SUMMARY OF ENVIRONMENTAL IMPACTS AND RISKS

Environmental impact and risk assessment is the process by which proposed activities are assessed for their impacts (consequences) on the environment (physical, biological, socio-economic and cultural). For the purposes of assessing impacts and risks, proposed activities are divided into planned activities and unplanned events.

Planned activities occur within OA 1 and OA 2 can have unavoidable impacts, such as light, noise and atmospheric emissions, seabed disturbance, discharges to the marine environment, and interactions with other marine users. Unplanned events are not expected to occur but are considered so that contingency measures are in place should they ever eventuate. Unplanned events include dropped objects, introduction of invasive marine species, interactions with marine fauna, accidental discharges, or spills.

Planned activities are assessed based on consequence of impact. Unplanned events are assessed based on their potential impact (consequence) and likelihood of occurrence, which informs the associated risk level.

Santos has conducted an environmental assessment in order to consider the potential environmental impacts and risks associated with activities under this EP. The identification of potential impacts and risks, and the measures proposed to reduce these impacts and risks, may be revised and amended as a result of the consultation process. This includes information obtained during consultation to improve Santos' understanding of potential impacts and risks in regards to cultural values within the EMBA and adoption of any appropriate measures.

PLANNED ACTIVITIES

Santos proposes to adopt a suite of control measures to reduce impacts and risks associated with 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 to have been reduced to as low as reasonably practicable (ALARP). **Figure 11** shows several emissions and discharges from planned activities associated with the operation of the FPSO.

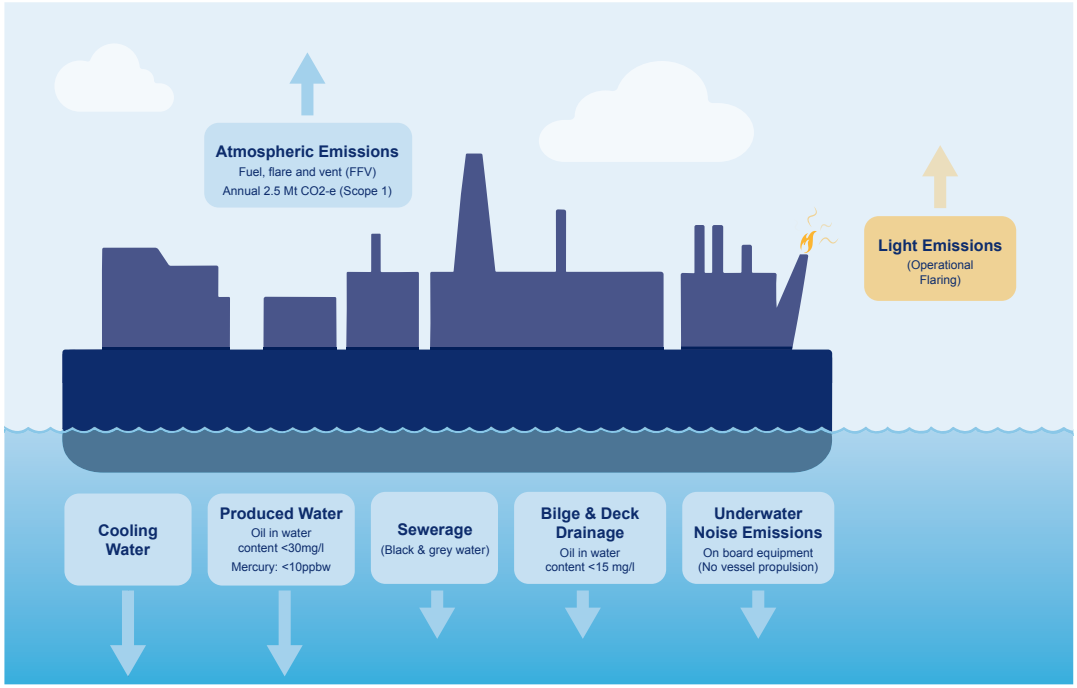


Figure 11: Emissions and discharges from planned activities associated with the operation of the Floating Storage and Offloading (FPSO) facility.

GHG EMISSIONS

The Production Operations EP will consider the contribution of emissions from the Barossa Development to national and global emissions and the potential indirect impacts of climate change on the Australian environment, noting that as a result of the complex nature of the global emissions system, climate change impacts cannot be meaningfully linked to any one activity or emissions source.

GHG emissions can be categorised into Scope 1, Scope 2 and Scope 3.

- Scope 1 - direct emissions from sources that Santos owns or controls, due to fuel combustion, flaring, venting, CO2 removal and fugitive emissions.
- Scope 2 - Indirect emissions from the generation of energy that Santos purchases for its operations including electricity purchased for ancillary activities such as office buildings.
- Scope 3 - includes all indirect emissions not included in Scope 2. The vast majority of Scope 3 emissions from Santos' activities are emissions from the use of sold products.

The Production Operations Activity will not produce scope 2 emissions as it does not consume externally generated electricity or other forms of externally generated energy.

Total annual Barossa Scope 1 emissions are estimated to be 2.5 Mt CO2e (carbon dioxide equivalent), and total annual Scope 3 emissions are estimated to be 12.7 Mt CO2e.

What impacts are expected?

Barossa GHG emissions (Scope 1 and 3) estimates account for approximately 0.86% of annual Australian GHG emissions (Department of Climate Change, Energy, the Environment and Water, 2022).

The GHG emissions attributable to the Barossa Development are not expected to be significant relative to national and international GHG emissions and are considered to be low risk.

How will Santos manage impacts?

Scope 1 emissions from Barossa are managed under Australian regulations and scope 3 emissions are managed using control measures consistent with the UN Paris Agreement, to which the Australian Government is a signatory. Key proposed control measures include:

Scope 1 emissions:

- Barossa will comply with Safeguard Mechanism obligations, including surrendering carbon credit units for any emissions above the Safeguard baseline for the assessment year.
- Barossa will implement a GHG management plan that minimises GHG emissions to ALARP and acceptable levels over the life of the field operations.
- Barossa facilities design has been optimised to reduce fuel, flare and vent (FFV) emissions, and to enable the possibility of future export of reservoir CO2 to a Carbon Capture and Storage (CCS) project.

Scope 3 emissions:

- Products generated from the Barossa Development will only be sold to customers from countries that are signatories to the Paris Agreement (or that have policies for reducing greenhouse gas emissions that are equivalent to policies required by the Paris Agreement), as at the date of the relevant contract of sale.

ATMOSPHERIC EMISSIONS

Fuel consumption, flaring and venting excess gas is required to process gas and condensate which results in the release of air pollutants, such as sulphur oxides (SOX), nitrogen oxides (NOX) and volatile organic compounds (VOCs) to the atmosphere. This mix of continuous and infrequent (e.g. flaring of excess gas) sources of atmospheric emissions associated with operating the Barossa facilities may result in a temporary, localised reduction in air quality.

Intermittent flaring is expected to be of short duration during initial start-up operations and unplanned process trips/upsets during steady-state operations.

Atmospheric emissions will also be generated from support vessel and helicopter operations.

All activities described above that may result in air emissions could be expected within OA1, however only emissions associated with vessel activities would be expected in OA2. In the offshore environment, air emissions quickly dissipate into the surrounding airshed.

What impacts are expected?

Impacts are considered very localised and not significant. Seabirds and migratory shorebirds are unlikely to be impacted by the localised and temporary reduction in air quality.

The potential impact from the release of air emissions includes the decrease in air quality of the local airshed.

Behavioural impacts, such as avoidance, could be expected if seabirds fly in the vicinity of OA1. Impacts to threatened, migratory or local fauna (seabirds) are considered to be minor.

As Barossa's operational activities occur in remote offshore waters, Production Operations Activity emissions will not impact air quality in coastal towns. Atmospheric emissions will quickly dissipate into the surrounding atmosphere and are not considered to be a potential source of impact for protected areas or threatened ecological communities.

How will Santos manage impacts?

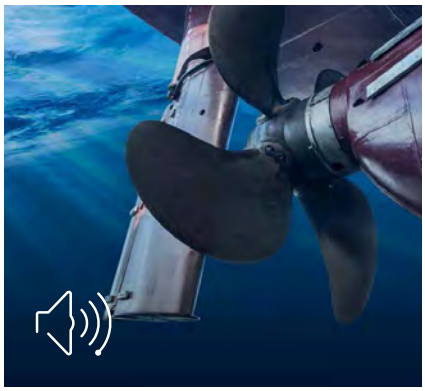
The FPSO power generation system reduces emissions to the atmosphere by primarily using production gas as fuel. Combined-cycle gas turbines (CCGT) will also be used to improve fuel use efficiency. CCGT are highly efficient and best practice resulting in reduced pollution. The steam turbines use low NOx burners, which significantly reduces NOx emissions.

Further FPSO facility design measures to reduce atmospheric emissions include:

- surplus waste gas burned to completely remove methane (minimal flaring)
- vapor recovery instead of releasing to atmosphere
- ozone Depleting Substances (ODS) are not used as refrigerants.

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.



NOISE SOURCES

In OA1 the main FPSO noise sources are intermittent and short-term flaring during initial start-up operations and unplanned process trips/upsets during steady-state operations. FPSO power and processing equipment will also generate a continuous source of noise. Other noise sources include:

- support vessels;
- helicopters;
- ROVs, acoustic positioning systems and survey equipment
- operation of subsea infrastructure such as wellheads, flowlines and valves.

In OA2 the types of noise generated by these activities can be categorised as either: impulsive (brief, high intensity) e.g. from operation of survey equipment or, non-impulsive noises (ongoing or continuous) e.g., from vessel engines. Noise emitted from activities in OA1 and OA2 are expected to be at low levels, similar to ambient noise levels in the region.

What impacts are expected?

Santos has engaged subject matter experts to conduct the underwater noise assessments for the activities.

Noise emissions from the FPSO, helicopters, survey equipment and vessels may result in marine mammals (e.g. whales) changing their behaviour (e.g. avoidance or diving to avoid noise). This change in behaviour is expected to be localised (within the area of the noise source in OA1 or OA2) and short term (e.g. periods of minimal flaring in OA1). Noise emissions are not expected to cause long term population impacts (e.g. distribution & abundance).

Low level noise can occur from the operation of the pipeline which will dissipate to background levels within 100m of the pipeline. The GEP route (OA2) crosses two small areas of important turtle habitat and impacts to marine turtles in these areas are expected to be limited to behavioural (e.g. avoidance). Impacts to marine turtles from any infrequent survey equipment use is also expected to result only in temporary and localised behavioural changes, given the low level of noise. Vessels will be moving when undertaking surveys and it is highly unlikely any individual would remain near the noise source for any length of time.

Other protected species of marine reptiles (such as sea snakes), seabirds and fish (such as sharks and sawfish) are not expected to be affected at the population level, given their wide distribution (in the case of sea snakes and sharks), distances to seabird breeding colonies, and preference for shallow coastal habitats (sawfish).

Noise emissions could result in behavioural changes in marine fauna within the Oceanic Shoals Marine Park, as OA2 is located in this area **(Figure 4)**.

Noise is not expected to impact socio-economic receptors, including commercial fisheries, due to low noise levels and low socio-economic activity levels within and near the Operation Areas. Behavioural impacts to fish of potential commercial value would be restricted to within hundreds of metres of the noise source, a very small portion of the total available fishing area.

How will Santos manage impacts?

A source of significant underwater noise has been eliminated from the FPSO facility by designing the facility to be permanently moored without the use of a propulsion system.

Vapour recovery on the flare system reduces the frequency at which flaring occurs during operations and therefore reduces the amount of noise emitted during routine operations.

Activity vessels are required to comply with Santos's Protected Marine Fauna Interaction and Sighting Procedure to comply with regulatory requirements for managing fauna noise impacts. Marine assurance standards and planned vessel maintenance will minimise noise generated from vessels by ensuring contracted vessels are operated, maintained and crewed in accordance with industry standards and regulatory requirements.

LIGHT SOURCES

Artificial lighting is required for operational and navigational safety during the activity. Light sources include safety and navigational lighting on vessels, campaign-specific lighting when needed, such as deploying or retrieving equipment or when ROVs are working underwater, and intermittent flaring from the FPSO.

What impacts are expected?

Permanent safety and navigational lighting on the FPSO and intermittent flaring will result in light emissions in OA1. Light emissions are not expected to have an effect on adult turtles or hatchlings, given the offshore location and distance from the nearest turtles nesting beaches.

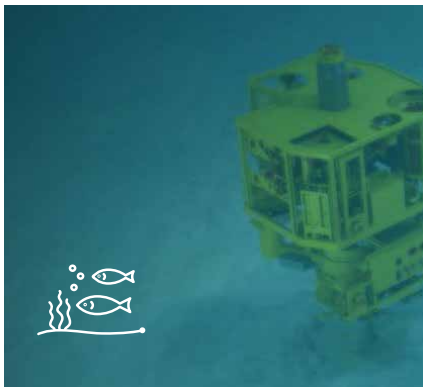
OA2 overlaps BIAs for marine turtles surrounding the Tiwi Islands. The closest turtle nesting beach is Cape Fourcroy, on the Tiwi Islands. Lighting emissions in OA2 will only occur from infrequent vessel inspection and maintenance activities in this location, which are of short durations. Vessel activities in OA2 are expected to produce similar light levels to other marine vessel activities in the region.

Impact to nesting females or hatchlings is not expected to occur. There is potential for hatchlings at sea to be attracted to light emissions if they are carried by currents to within approximately 3.3 km of an IMMR vessel. In the unlikely event hatchlings are attracted to vessel light, the proportion impacted is considered negligible when compared to the total number of hatchlings emerging from Bathurst Island beaches across the year. It will also be a temporary phenomenon, occurring during hours of darkness only. After sunrise, hatchling dispersal behaviour will resume. Displacement of individuals from critical habitat areas is therefore not a credible outcome.

Fish, sharks and birds have been shown to be attracted to artificial light sources, leading to a short-term localised increase in fauna activity, however large-scale changes in species abundance or distribution are unlikely.

How will Santos manage impacts?

The FPSO facility is equipped with a centralised battery system providing an uninterrupted power supply to the FPSO LED lighting which also allows for dimming and controlling in individual areas. Lighting is to be limited to that required for safe operations and navigation and will be compliant with maritime regulations (similar to other commercial vessels operating in the region).



SEABED DISTURBANCE

Seabed disturbance will occur because of:

- physical presence of installed subsea infrastructure and GEP on the seabed
- temporary placement and set down of equipment and subsea infrastructure on the seabed used during IMMR activities

What impacts are expected?

Seabed disturbance resulting from IMMR activities will be confined to the OAs and might result in localised disturbance under the subsea infrastructure and GEP. Seabed disturbance resulting from a subsea repair or replacement will be localised with a potential footprint of approximately 50 m^2 up to 1,600 m^2.

Given the nature and relatively small scale of seabed disturbance, it is not expected to cause a decrease in local population size, area of occupancy of species, loss or disruption of critical habitat, or disruption to the breeding cycle of any protected marine fauna.

Given localised disturbance is restricted to the OAs, which is mostly bare sediment and does not contain any significant habitat features, the consequence level for the physical environment or habitat is negligible. Impacts to the seabed within the Oceanic Shoals Marine Park or overlapping key ecological features (KEFs) (Carbonate bank and terrace system of the Van Diemen Rise KEF and the Shelf break and slope of the Arafura Shelf KEF) are considered to be minor.

While OA1 does not overlap any marine turtle BIAs, the southern end of OA2 traverses internesting buffer habitat critical to survival for flatback and olive ridley turtles, overlaps a portion of the the internesting BIA for flatback turtles, and is adjacent to the internesting BIA for olive ridley turtles. Considering the water depth along the pipeline route in OA2 is greater than the maximum turtle interesting depth of 30 m , it is unlikely the species will be present in significant numbers or for significant periods. Any impact to marine turtles from seabed disturbance or resultant turbidity in both OA1 and OA2 would likely be temporary and negligible, based on the nature and scale of impact.

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

How will Santos manage impacts?

During IMMR activities Santos' vessels will undertake safe and accurate placement of infrastructure using dynamic positioning to minimise seabed disturbance during placement. Santos will also maintain a comprehensive inventory of all installed equipment to enable recovery of all equipment during decommissioning to limit impacts to the seabed.

INTERACTIONS WITH OTHER MARINE USERS

Other marine users will be displaced from part of OA1 over the life of Barossa operations, and temporarily restricted within parts of OA2 during IMMR. In OA2, the GEP may present a hazard to marine users due to the potential for snagging.

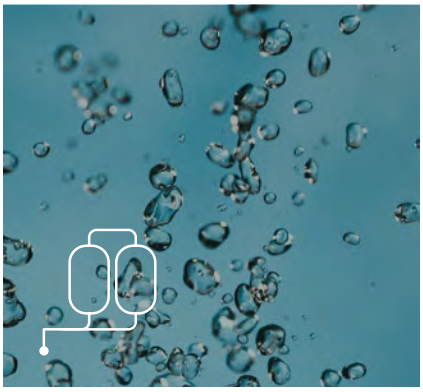
What impacts are expected?

Other marine users will have restricted access within petroleum safety zones (PSZ). A permanent 500m exclusion PSZ will extend around the outer edge of the Barossa Production Operations wells, the subsea infrastructure and mooring system in OA1. During IMMR activities along the GEP IN OA2, a temporary 500m PSZ will be maintained around vessel operations.

Commercial fishing, shipping, military exercises and other incidental marine traffic in the OAs are expected to be low frequency. The area marine users will be excluded from is small when compared to the large area available for their use.

How will Santos manage impacts?

Santos will notify and communicate with other marine users using standard maritime notifications (e.g. Notice to Mariners) before, during and at the end of IMMR activities. Infrastructure locations will be marked on nautical charts. These proposed control measures are consistent with maritime regulations and industry practices.



PRODUCED WATER DISCHARGES

Produced water is naturally occurring water that is extracted from the seabed along with hydrocarbons (condensate and gas in the case of the Barossa field). It is separated from the hydrocarbon components during processing and treated before being discharged to the marine environment from a pipe at least 10 m below the sea surface on the FPSO. This produced water consists of naturally occurring formation water (from the body of rock below the hydrocarbon formation), condensed water (water vapour present within the produced hydrocarbons which condenses when brought to the surface) as well as introduced water-soluble chemicals and other contaminants. While produced water treatment is performed before discharge, the effluent may contain residual inorganic (such as chemicals used for production) and organic (such as oil) contaminants.

The produced water treatment system is divided into two stages - removal of hydrocarbons through a filtration system and designed to handle 20,000 barrels per day (over one Olympic-size swimming pool). During operations the produced water discharge will vary from 3,500 to 5,000 barrels per day (bbl/day), or a quarter to a third of an Olympic-size swimming pool, with a peak rate after 11 years estimated up to 16,500 bbl/day (one Olympic-size swimming pool). Best available technology has been selected to remove oil-in-water concentrations to as low as reasonably practicable (ALARP) and the treatment system will operate well below its design capacity over the majority of the field life.

What impacts are expected?

Water quality may be impacted at the discharge point while the produced water is discharged **(Figure 12)**. Discharge modelling has been undertaken for a conservative maximum discharge rate of 20,000 bbl/day (over one Olympic-size swimming pool). Under normal operating conditions produced water discharge rates will be approximately a quarter (~5,000 bbl/day) of the modelled maximum discharge rate. Modelling results indicated that species protection thresholds for waterborne contaminants is achieved at approximately 6 km from the FPSO. As a result, predicted impacts will be localised and considered minor.

Marine turtles may occur within the produced water mixing zone. It is possible individual turtles may traverse the mixing zone; however significant impacts are not expected to occur, and large numbers of animals are not expected to be exposed. That is because the discharge water depth and discharge location are not within the proximity of internesting turtle habitat, and there is minimal reef habitat in the mixing zone. Given marine turtles are transient through the produced water mixing zone, they will not be exposed to the produced water for enough time for contaminants to accumulate within their body. Behavioural impacts (such as avoidance) may occur to a small proportion (individuals) of a local population close to the produced water discharge.

Like turtles, produced water exposure to plankton, fish, invertebrates and sharks is expected to be brief due to the transient nature of these animals.

Potential impacts to fishery resources are unlikely to result in changes in distribution and abundance of fish species outside the produced water mixing zone.

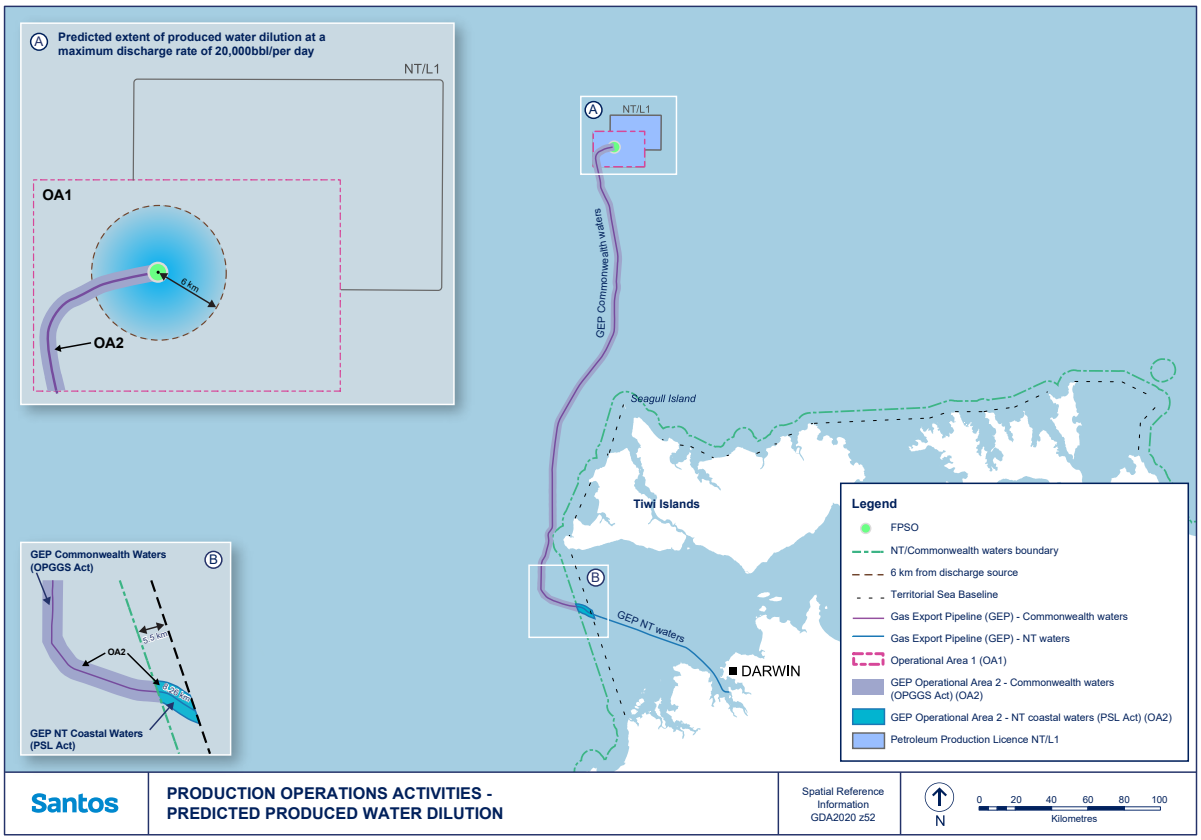


Figure 12: Predicted extent of the produced water dilution at a maximum discharge rate of 20,000 bbl/day.

How will Santos manage impacts?

Activity discharges are to be managed through the application of Santos' Chemical Selection Process, designed so that environmentally acceptable process chemicals (which are likely to be mixed with produced water discharge) are used. Additives have been selected and optimised for biodegradability as well as low aquatic toxicity and bioaccumulation potential.

The produced water discharge will be continuously monitored for oil-in-water content and any reading over the limit of 30 mg/l over any 24-hour period, will be diverted to a dedicated storage tank and returned to the produced water treatment system until suitable for discharge. Strict protocols will be in place for taking regular water samples and perform laboratory testing to ensure the produced water is within acceptable levels before disposing into the marine environment. The Production Operations Environment Plan will include a produced water adaptive management plan that prescribes a water quality monitoring regime which enables the detection of potential impacts of produced water discharge on the marine environment and if remedial actions are necessary to retain the discharge within acceptable limits.

OPERATIONAL DISCHARGES

Operational discharges associated with the activities may cause localised impacts to water quality in the direction of the prevailing current. The environment that may be affected by operational discharges will likely be contained within the OAs. Water quality conditions will return to normal within minutes to hours once discharging stops.

FPSO facility and subsea system discharges

Operational discharges from the FPSO in OA1 will occur each day resulting in localised changes to water quality. Discharges of warm cooling water will include low concentrations of chlorine which break down quickly in the environment and is non-toxic at low concentrations. Minor discharges of water based hydraulic fluid used in the subsea system are classified by the offshore chemical notification scheme as being environmentally acceptable.

Vessel discharges

The types of anticipated discharges in OA1 and OA2 are typical of most offshore commercial vessels and include deck runoff, treated sewage, 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.

What impacts are expected?

Sensitive receptors that may be impacted include plankton, fish, seabirds, marine turtles and mammals. Impacts to water quality will be localised and temporary occurring only during discharge.

Some fish and oceanic seabirds may be attracted to the FPSO by the discharge of food scraps. However, given the small quantities, intermittent nature of disposal and swift currents, any attraction is likely to be minor and is not anticipated to result in adverse impacts at an ecosystem or population level. Given the controls in place to manage the FPSO discharges in OA1 in accordance with regulatory requirements, impacts to commercial fish species are not predicted.

Operational discharges in OA1 are predicted to quickly dilute and disperse in the offshore environment. Water quality changes will be localised and will occur only when the discharges occur. Given the temporary nature of activities within OA2 (limited to vessel based IMMR) and the relatively deep offshore environment with significant current and tidal action, impacts to water quality will be localised and will occur only for the duration of the discharge.

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.

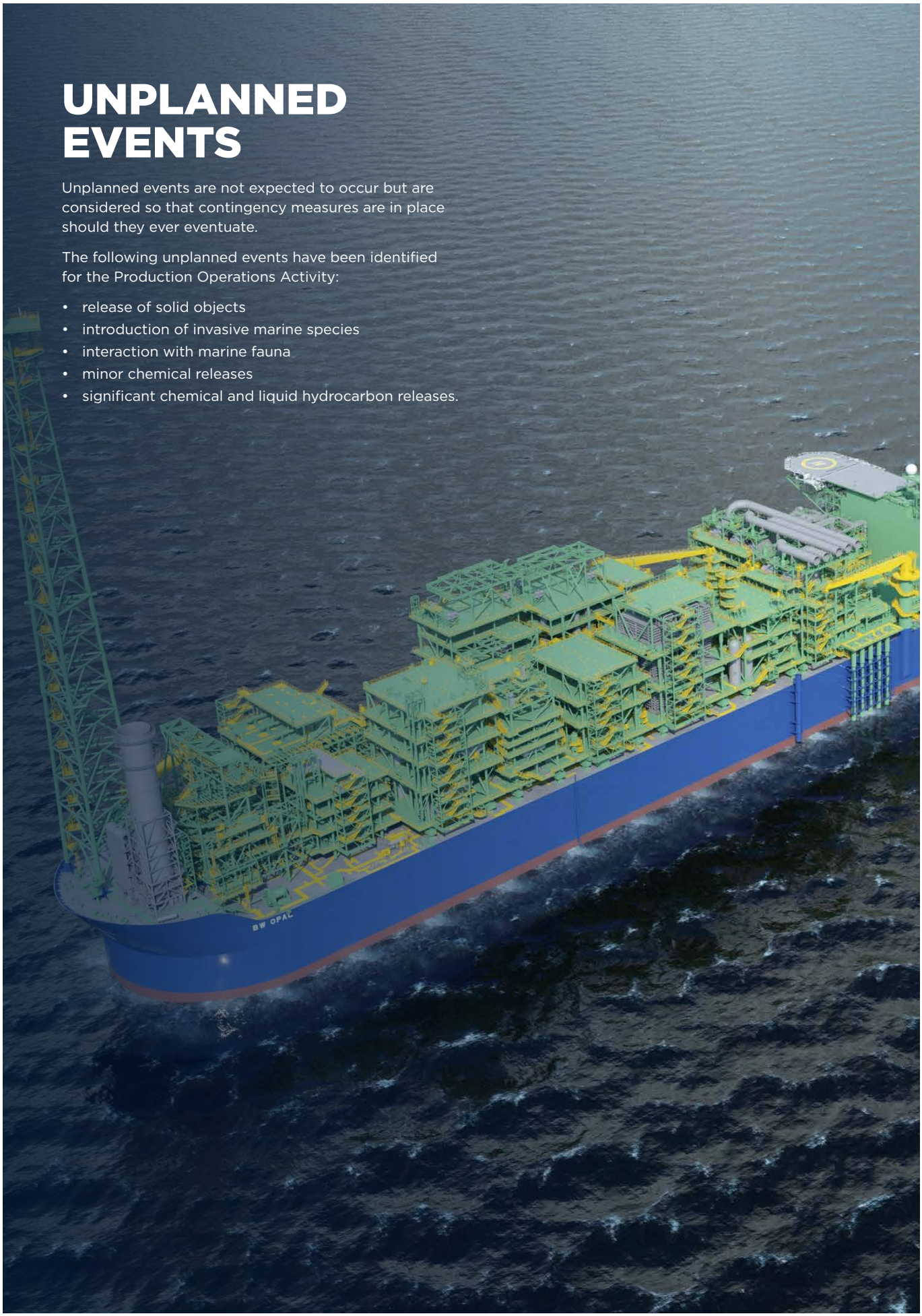
Santos procedures require that all operational chemicals used on the FPSO and chemicals potentially discharged to sea are risk assessed. Santos also implements general chemical management procedures to reduce the risk of accidental discharges.

UNPLANNED EVENTS

Unplanned events are not expected to occur but are considered so that contingency measures are in place should they ever eventuate.

The following unplanned events have been identified for the Production Operations Activity:

- release of solid objects
- introduction of invasive marine species
- interaction with marine fauna
- minor chemical releases
- significant chemical and liquid hydrocarbon releases.



DROPPED OBJECTS

How could dropped objects occur?

There is the potential for objects to be accidentally released to the marine environment from support vessels during steady state operations in OA1 or during IMMR activities in OA2. Dropped objects may be non-hazardous solid waste (e.g. paper, packaging materials), hazardous waste (e.g. batteries, aerosol cans etc.). A dropped object event could result from overfilling waste containers, unsecured objects during lifting operations or failed sea fastening.

What environmental impacts could occur?

Objects that float could potentially move beyond the OAs. All non-buoyant objects are expected to sink to the seabed and remain within the OAs. This could cause localised and short-term damage to the seabed.

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 that might be dropped, impacts to fauna would be limited.

Considering the low frequency of such an unplanned event, even in a worst-case release of a solid object, impacts to fauna would be very localised and limited to individuals, and are not expected to result in impacts to the local population.

How will Santos manage the risk?

Santos has numerous control measures to prevent dropped objects, and to mitigate consequence of impacts of an event does occur. These measures include:

- safety standards and procedures to reduce the likelihood of tools and other equipment being dropped during lifting operations
- waste management procedures to reduce the likelihood of windblown waste entering the marine environment
- implementation of chemical selection processes and the International Maritime Dangerous Goods Code to limit the environmental impact of chemicals if lost overboard
- 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.

INVASIVE MARINE SPECIES

What are IMS?

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.

How might IMS be introduced?

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 FPSO and vessels, external/internal niches (such as sea chests and sea water systems) and routinely submerged equipment
- discharge of FPSO ballast water when the FPSO first transits from the international shipyard to the Barossa field
- discharge of high-risk ballast water where vessels have transited from international destinations.

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.

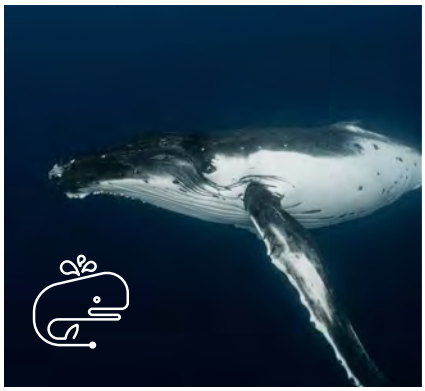
The above impacts can result in flow-on detrimental effects to marine parks, tourism and recreation.

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 (OA2 is 33 metres deep at its shallowest point and not considered sufficiently shallow to be conducive for IMS colonisation). OA1 provides an unfavourable habitat for IMS due to water depth (over 200 metres) and the long 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 in OA1.

How will Santos manage the risk?

The pathways and vessel mitigation measures for IMS introduction are well established. The offtake tankers used for condensate export and specialised IMMR vessel(s) (if required) are sourced internationally, whilst the regular support vessels to and from the FPSO are sourced domestically. 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. The FPSO and support 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 IMS is assessed as low and reduced to as low as reasonably practicable.

The initial mobilisation of the FPSO out of Singapore to the Barossa gas field will be managed under a quarantine management plan including arrangements for invasive species, biofouling and ballast water exchange.



INTERACTION WITH MARINE FAUNA

How could interactions with marine fauna occur?

During the Production Operations Activity, approximately two vessels per week will travel between the Barossa field and Darwin servicing the FPSO, which is a minor increase relative to the existing levels of regional marine vessel traffic.

The highest potential for interactions with marine fauna, including potential accidental strike or collision resulting in injury or mortality, will be during IMMR vessel operations in OA2 where there is higher likelihood of marine fauna presence. In OA1, where marine fauna presence is of a lower likelihood, the FPSO will remain stationary once on location in position and support vessel movements within the operational area are limited and slow-moving, hence marine fauna interactions are not anticipated and are expected to be minimal.

Marine fauna such as marine mammals (such as whales and dolphins), marine turtles and whale sharks that swim at or near the water surface are most at risk from vessel collisions. Some of these species are threatened, and some marine fauna may have cultural significance.

Marine mammals (such as whales and dolphins) and whale sharks may transit through the OAs but are expected to be in low numbers in OA1 **(Figure 10)**. Considering the relatively slow vessel speeds, short duration of activities, and the mobility of these species, it is unlikely that activity vessels will adversely interact with any individuals.

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' Protected Marine Fauna Interaction and Sighting Procedure, which aligns 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.
- Operational area vessel speed restrictions

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 levels. The risk is no higher than for any other regional maritime activity.

NON-HYDROCARBON LIQUID RELEASE

How could non-hydrocarbon liquids be released?

Non-hydrocarbon liquids including miscellaneous chemicals for use during the Production Operations Activity and waste by-products are transferred to and from supply vessels to the FPSO in OA1. Examples of non-hydrocarbon liquids include chemicals used in the production process, domestic products used in the living quarters for cleaning and general maintenance products such as greases and paints.

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

- transferring, storing or using bulk products (e.g. production chemicals)
- mechanical failure of equipment, such as a 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 storage containers)
- firefighting foam during an emergency response incident.

What environmental impacts could occur?

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

The maximum volume of non-hydrocarbon liquids that could be released during routine operations is likely to be small and limited to the volume of individual storage containers. Individual containers stored on the FPSO include process chemicals and lube oil storage tanks (approximately 4.5 m^3).

If the spill is not contained on deck, a release to the marine environment would likely disperse rapidly, with one in 1,000 dilution usually occurring within 30 minutes.

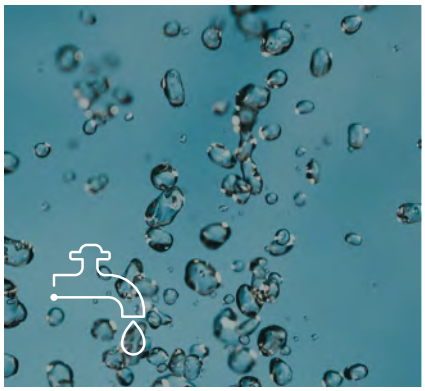
The environment that may be affected for non-hydrocarbon liquids releases resulting in a decrease in water quality is likely to be restricted to the immediate vicinity of the FPSO or support vessel and contained within the OAs.

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 non-hydrocarbon liquids releases. Vessels also have spill response plans. All chemicals are reviewed and accepted for use, and any chemical that might be discharged to the environment is assessed under the Santos chemical selection procedure to ensure environmental acceptability. These procedures will 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.



MINOR LIQUID HYRDOCARBON RELEASES

How could a minor liquid hydrocarbon release occur?

Minor releases refer to relatively small volumes of hydrocarbons from storage containers, transfer equipment and pipework on the FPSO or support vessels, that enters the marine environment. Typically, such spills occur as a result of human error during tank filling or storage container transfers. Most of these types of release occur within bunded deck areas, and are less than 1m3, however it remains possible for such spills to enter the marine environment.

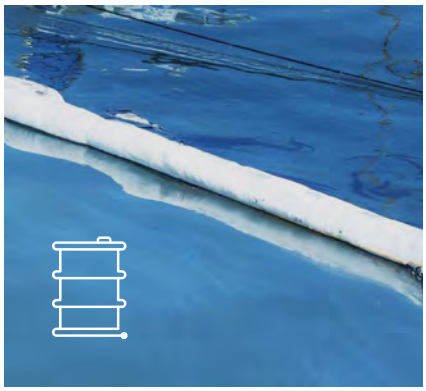
What environmental impacts could occur?

A localised decrease in water quality may occur, however due to the relatively small volumes impacts are expected to be short term as the hydrocarbon would rapidly dilute and dissolve into the ocean. Marine fauna may transit through the OAs and come into contact with the release. However it is expected impacts to fauna would be short term and result in behavioural changes, as they move away from the area where the spill occurred.

How will Santos manage the risk?

A suite of procedures will be in place to manage the handling and transfer of hydrocarbons on both support vessels and the FPSO. Response procedures such as stopping the source of the of the release and cleaning it up on deck to prevent it entering the ocean will be in place to manage minor releases 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.



LARGER HYDROCARBON RELEASES

Larger volumes of hydrocarbons may accidentally be released during production operations. These include accidental spills from support vessels or the FPSO, as well as from subsea equipment (e.g. wells and flowlines). A range of different types of hydrocarbons that may be accidentally released are discussed below.

MARINE DIESEL OIL OR MARINE GAS OIL

How could a marine diesel or gas release occur?

Marine vessel fuels (marine diesel oil or marine gas oil) could be released to the environment if there is a collision event between two vessels. An accidental collision could occur due to factors such as human error, poor navigation, vessel equipment failure or poor weather. If a marine vessel collided with the FPSO, the vessel or FPSO hull may rupture and release fuel to the marine environment.

If a vessel fuel tank is ruptured a fuel called marine diesel could be released. The FPSO uses a lighter fuel for some of its power requirements called marine gas oil which could be released if a fuel tank is ruptured.

Although the risk is higher in OA1 than OA2, it should be noted that it is considered unlikely that a vessel collision would occur that would result in releasing fuel to the environment. A sequence of events would need to occur for a vessel collision to escalate to a large volume of fuel released to the environment, including:

1. the vessel must be involved in a collision
2. collision must occur with enough force to rupture a fuel tank
3. rupture must be of such a nature that the fuel can be released into the environment.

What environmental impacts could occur?

Marine diesel oil and marine gas oil fuels are typically characterised by a high percentage of volatile components (typically >95%), which will evaporate when on the sea surface over several days. A small fraction (typically <5%) of persistent hydrocarbons remains, which will not evaporate, and will decay over time. The heavier components of the fuels tend to become entrained in the upper water column as droplets in the presence of waves but can refloat to the surface if wave energies abate. Both marine diesel oil and marine gas oil fuels are expected to weather quickly through evaporation and dispersion and are unlikely to persist in the environment for a significant period.

Such releases will cause a decline in water quality and may cause chemical (e.g. toxicity) and physical impacts to marine species (e.g. ingestion of hydrocarbons). The severity of the impact depends on the magnitude of the release (i.e. extent, duration) and sensitivity of the receptor, however, may include impacts to the physical environment, threatened or migratory marine fauna, protected and significant areas and socioeconomic receptors (fisheries, tourism, recreation, cultural features and other oil and gas operators).

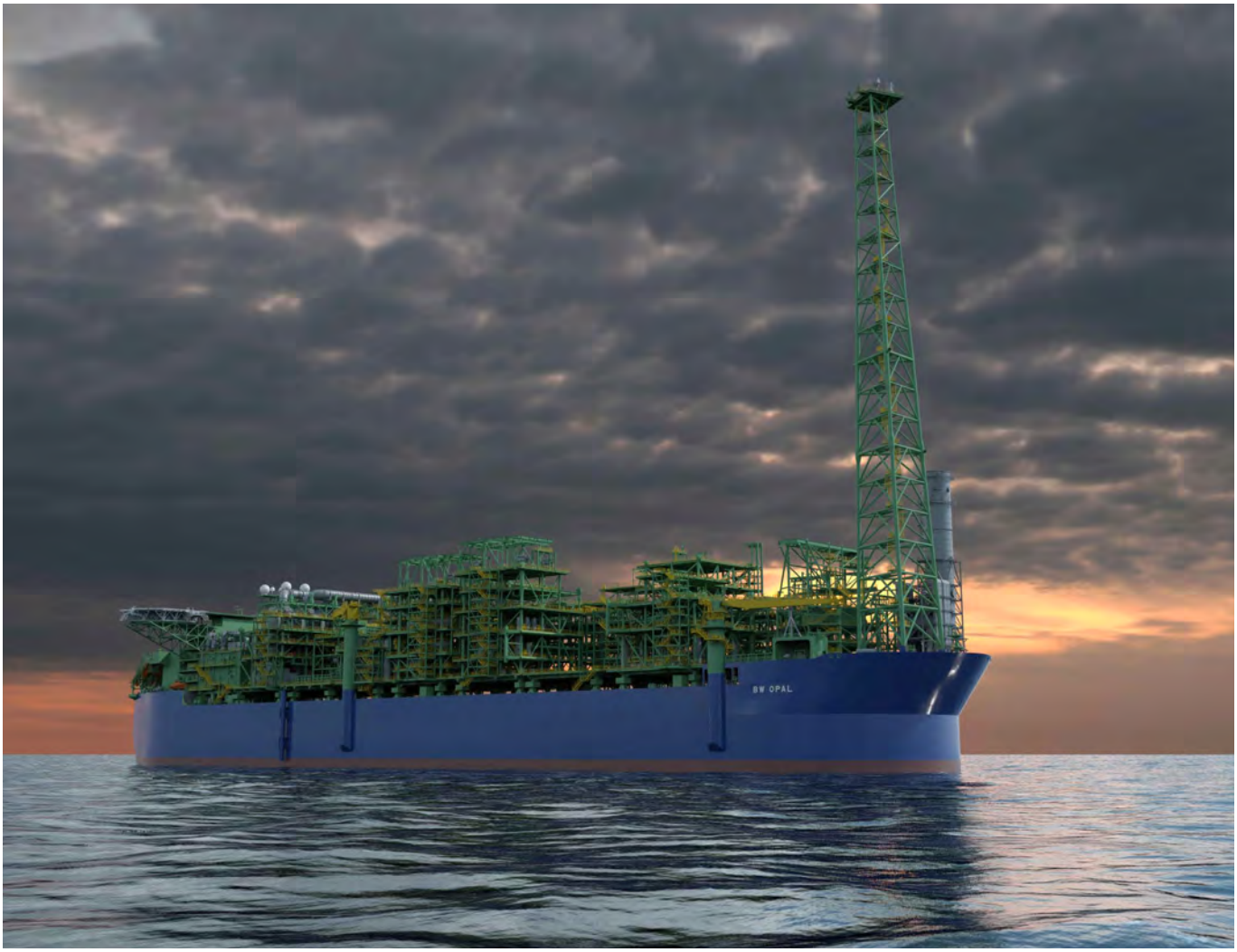
How will Santos manage the risk?

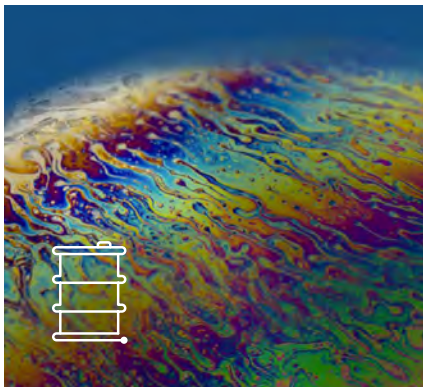
The FPSO in OA1 is fitted with a collision avoidance radar so it appears on the display of the triggering radars, providing range, bearing and identification information, alerting vessels to its presence. Santos has also designed the FPSO hull to be double-sided and double-bottomed, which provides two physical barriers between the fuel tanks and the marine environment for side impact, reducing the likelihood of fuel release in the event of a collision.

A petroleum safety zone (PSZ) will be established alerting other marine users to the presence of the FPSO in OA1 which includes precautions for marine activities (e.g. reduced speed limits, communication protocols and automatic identification systems to aid in their detection at sea). Third party vessels are not permitted to enter a PSZ, thereby reducing the likelihood of other interactions with the FPSO and support vessels. In OA2 during IMMR activities a similar exclusion zone will also be established restricting access to other marine users.

The Production Operations Activity facilities in OA1 & OA2 will be included on navigational charts making other vessels aware of the presence of Barossa facilities. Santos will also provide maritime notifications to relevant departments to ensure marine users are informed of vessel movements.

Santos has also developed response plans which will detail the actions to take to control the release and manage the cleanup activities in the event of a release.





CONDENSATE

How could a condensate release occur?

Barossa condensate has the potential to be released to the marine environment under several scenarios. Of those scenarios, three worst-case events are summarised below.

1. In the event of a vessel collision (e.g. those described above for marine diesel oil or marine gas oil) which ruptures the FPSO condensate storage tank.
2. In the event of an impact to, or failure of the subsea hydrocarbon containing equipment.
3. In the event of an impact to, or failure of multiple production well barriers.

Other scenarios exist that may result in other smaller condensate releases to the marine environment. All scenarios are very low probability of occurring.

What environmental impacts could occur?

Condensate, being a lighter hydrocarbon behaves in a similar fashion to marine diesel when released to the marine environment. The fate of the condensate will depend greatly on the proportion on the surface, which will be transported by prevailing currents and wind and can evaporate readily. Condensate that entrains or dissolves in the water column will be transported by prevailing current and, hence, will follow a different path.

As with the marine diesel oil, the heavier components contained in the condensate will have a strong tendency to physically entrain into the upper water column but can re-float to the surface if these energies abate.

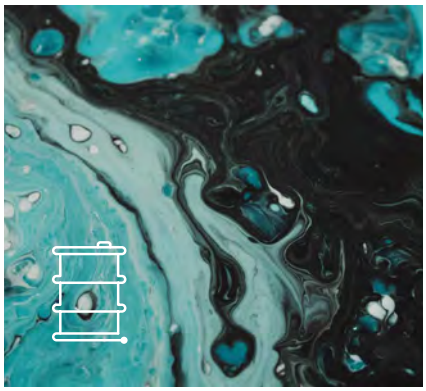
Such releases will impact the marine environment much in the same way as marine diesel oil and marine gas oils, described above. However, in the event of a subsea condensate release, more entrainment of hydrocarbons in the water column could occur, rather than being present on the sea-surface.

How will Santos manage the risk?

In the unlikely event a vessel collision occurs which ruptures an FPSO condensate tank, Santos will manage the risk in accordance with the accepted Production Operations Oil Pollution Emergency Plan.

In the unlikely event of a subsea release in the OA1 area from subsea flowlines or wells, Santos has a range of operating procedures and plans to ensure that the integrity of the subsea infrastructure is maintained and well barriers are in place. Santos will submit a well operations management plan (WOMP) to NOPSEMA that will contain the full details of systems in place to ensure well design and integrity is managed for the well lifecycle. All production wells must be in compliance with the NOPSEMA accepted WOMP at all times. Hydrocarbon containing subsea infrastructure is also within a petroleum safety zone (PSZ), which third party vessels are not permitted to enter, subsequently reducing any interaction with this infrastructure.

Santos is developing response plans which will detail the actions to take to control a release and manage cleanup activities in the unlikely event of a release.



HEAVY FUEL OIL

How could a heavy fuel oil release occur?

Heavy fuel oil is only used as fuel for offtake tankers who enter the Barossa field periodically (approximately once every three months) to load condensate from the FPSO. The only scenario that could lead to a release of heavy fuel oil is in the unlikely event of a vessel collision (described above for marine diesel oil or marine gas oil), where the offtake tanker hull and heavy fuel oil tank is ruptured.

What environmental impacts could occur?

Heavy fuel oil is heavier and more persistent than marine diesel oils, marine gas oils and condensates. The fuel is often characterised by a very high density and a high dynamic viscosity, which does not evaporate as quickly as other lighter fuels. As the fuel has a high residual component, a portion is expected to become semi-solid and can persist in the marine environment for extended periods.

Such releases will cause a decline in water quality and may cause chemical (e.g. toxicity) and physical impacts to marine species (e.g. ingestion of hydrocarbons, physical coating). The severity of the impact depends on the magnitude of the release (i.e. extent, duration) and sensitivity of the receptor, however, may include those to the physical environment, threatened or migratory marine fauna, protected and significant areas and socioeconomic receptors (fisheries, tourism, recreation, cultural features and other oil and gas operators). Given the persistent and sticky nature of heavy fuel oil, there is a higher risk of coating of the physical environment (e.g. shorelines) and marine fauna compared to the lighter fuels such as marine diesel oil and marine gas oil.

How will Santos manage the risk?

Offtake tankers are third-party operated vessels. They are vetted following Santos' marine assurance procedure and international guidelines before acceptance for condensate offtake operations at the Barossa field. The use of tankers with double hulls and fully segregated ballast tanks is not only a requirement of the vetting process; it is a MARPOL requirement that is monitored by way of regular statutory inspections.

All offtake loading events are planned in advance, occur within a petroleum safety zone (PSZ), and are performed under strict operational procedures.

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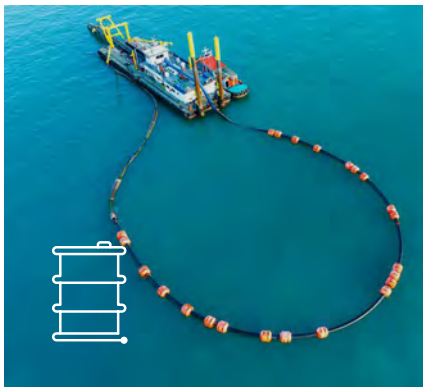

CONTINGENCY SPILL RESPONSE OPERATIONS

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 Production Operations 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 (blowout preventer, relief well)
- monitor and evaluate
- mechanical dispersion
- shoreline protection and clean up
- 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.

What impacts are expected?

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

- Noise and light emissions – generated by response vessels and equipment which may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals.
- Atmospheric emissions – generated from response equipment and vessels are expected to be localised and are not considered to create emissions on a scale where noticeable impacts would be predicted.
- Operational discharges and waste - generated from response equipment and vessels are expected to be consistent with those of normal commercial vessel operations and may create a localised and temporary reduction in marine water quality. Cleaning of hydrocarbon-contaminated equipment, vehicles and vessels has the potential to spread hydrocarbons from contaminated areas to areas not impacted by a spill. Sewage and other 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 - 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) or cause disruption to other marine users, coastal areas, townships and commercial fishing.

How will Santos manage the risk?

Santos will rely primarily on the implementation of the Production Operations 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
- notify agreed stakeholders.

The implementation of spill response activities to reduce the potential impacts from a spill are required by legislation. The spill response options selected will be 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 SANTOS' RISK MANAGEMENT STRATEGY

Santos has a management system that includes specific measures, to be used for the duration of the Production Operations Activity, which seek to confirm that:

- environmental impacts and risks continue to be identified for the duration of the activity and 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 and OEMP 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.

APPROVALS PROCESS

Production Operations Activities detailed in this booklet require a number of regulatory approvals. Primary environmental approvals required for Production Operations Activities are outlined below:

- An Offshore Project Proposal (the Barossa Offshore Project Proposal (OPP)) was developed for the Commonwealth waters component the Barossa Project and was accepted by NOPSEMA in March 2018. The Barossa OPP, at the time of submission, excluded approximately 23 km of GEP in Commonwealth waters which is subject to a separate EPBC Act approval process (refer below).
- A referral under the EPBC Act, covering the installation, operation and decommissioning of the remaining approximately 23 km of GEP in Commonwealth waters and the 100 km section of GEP in NT waters (inclusive of the 8.26 km in NT coastal waters) was submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for assessment. The activity (referred to as the Darwin Pipeline Duplication Project) was determined to be a 'controlled action' under the EPBC Act and is currently being assessed on preliminary documentation.
- A referral under the *NT Environment Protection Act 2019* (EP Act) for the construction, operation and decommissioning of the 100 km section of GEP in NT waters (part of the Darwin Pipeline Duplication Project) was submitted to the NT Environment Protection Authority (EPA) and was subsequently assessed by way of Supplementary Environmental Report. On 22 December 2023, the NT Minister for Environment, Climate Change and Water Security approved the action the subject of the referral, on the recommendation of the NT EPA.

In addition to the primary environmental approvals outlined above, activity-specific Environmental Plans (EPs) meeting the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Cth) (OPGGS Environment Regulations) are required. For Production Operations activities, the OPGGS Environment Regulations apply to the activities within OA1 in Commonwealth waters and OA2, spanning both Commonwealth waters (285 km) and coastal waters of the NT (8.26 km).

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 the Production Operations EP for submission to NOPSEMA, covering Commonwealth waters Production Operations activities in OA1 and OA2.

Santos is also preparing an Operations Environmental Management Plan (OEMP) to cover the operation of the GEP in NT waters for submission to DITT. The OEMP will also cover the operation of the 8.26km GEP in NT coastal waters, under the PSL Act and OPGGS Environment Regulations and operation of the remaining ~92km GEP covered under the Energy Pipelines Act.

In order to meet its proposed schedule for the Barossa Gas Project, Santos is aiming to submit the Productions Operation EP to NOPSEMA and the OEMP to DITT in 2024 and, subject to regulatory acceptance, commence activities in 2025. The timeline for consultation has been developed by Santos to meet this objective, while still providing a reasonable period for meaningful consultation with relevant persons, having regard to Santos's regulatory obligations and to feedback from relevant persons.

SEEKING INFORMATION AND WHAT'S NEXT

Santos is continuing its Barossa Gas Project consultation efforts to further learn, 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.

Santos is consulting on both the Production Operations EP (Commonwealth waters) and OEMP (NT waters) at the same time.

Scan this QR Code for more information on Barossa Production Operations Activity:

YOUR INPUT IS IMPORTANT TO SANTOS:

In preparing an EP 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 EP.

Relevant persons being consulted on EPs under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (Cth) (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; and
- may request particular information provided in consultation not be published.

If you request particular information not to be published, Santos will respect and abide by your request. Any information not to be published will be provided to NOPSEMA in a confidential report, separate from the published EP.

Your input is important to Santos:

- so that we can understand the environmental values in the OAs and the environment that may be affected, the environmental impacts and risks associated with the activity, to inform development of the Productions Operations EP (Commonwealth waters) and OEMP (NT waters);
- to inform how consultation processes may need to be adapted for different relevant persons; and
- to ensure that we provide information to relevant persons in an appropriate and accessible manner.

If you think you may be a relevant person for the purposes of one of Santos' proposed activities, please contact Santos on: **1800 267 600** or email **offshore.consultation@santos.com** to seek to be included in consultations and to provide feedback on how you would like to be consulted (if a relevant person).

This can also be done using the form available by scanning the QR Code below:

Visit **www.santos.com/barossa** for more information on the Barossa Gas Project.