



Environmental and Social Impact Assessment for the Venus Development (Offshore PEL0056/Block 2913B), Namibia

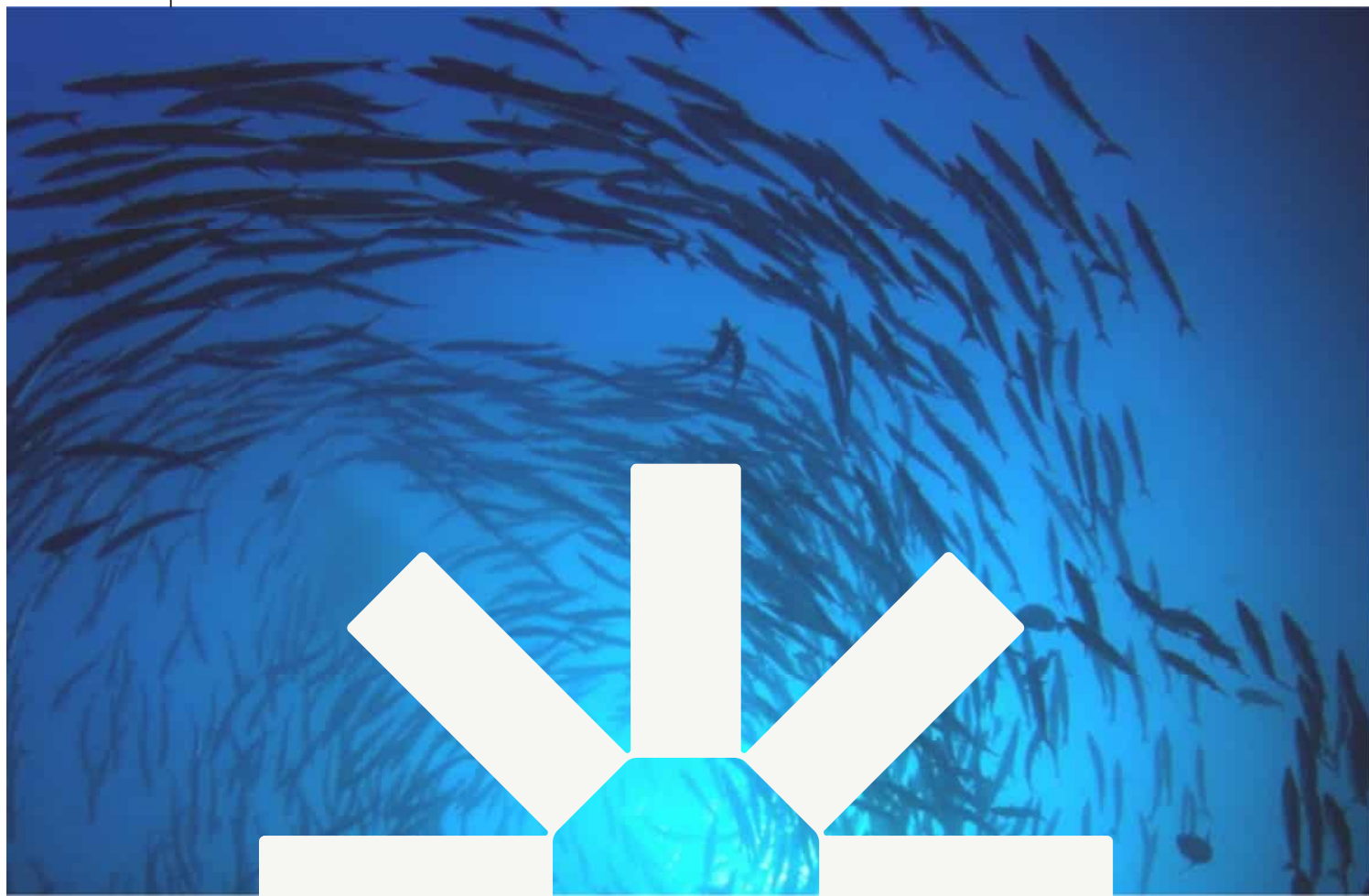
Final Environmental and Social Impact Assessment Report: Volume 1 – Main Report

FOR: TotalEnergies EP Namibia B.V. and the Joint Venture Partners

SLR Project No.: 713.000024.00001

Revision: 0

19 December 2025



Environmental and Social Impact Assessment for the Venus Development (Offshore PEL0056/Block 2913B), Namibia

Final Environmental and Social Impact Assessment Report: Volume 1 – Main Report

TotalEnergies EP Namibia B.V. and the Joint Venture Partners



Prepared by:

SLR Environmental Consulting (Namibia) (Proprietary) Limited

8 General Murtala Muhammed Ave, Eros,
Windhoek

SLR Project No.: 713.000024.00001

Authority Reference No: APP - 005431

19 December 2025



Title	Environmental and Social Impact Assessment for the Venus Development (Offshore PEL0056/Block 2913B), Namibia: Final ESIA Report – Volume 1: Main Report
Project Managers	Alice McGrath and Melissa Schulze
Reviewers	Jeremy Blood and Sue Reuther
Keywords	TotalEnergies, TEEPNA, Namibia, Venus field, Block 2913B, Offshore, Oil and Gas, Development, Production, FPSO
Status	Final for decision-making
SLR Company	SLR Environmental Consulting (Namibia) (Pty) Ltd
Authority Reference No.:	APP - 005431

Environmental Assessment Practitioner: SLR Environmental Consulting (Namibia) (Pty) Ltd	Proponent: TotalEnergies EP Namibia B.V. and its Joint Venture (JV) partners (at present Impact Oil & Gas, NAMCOR and QatarEnergy)
Contact Person: Robyn Christians	Contact Person: Mariam Kane-Garcia
Telephone: +264 (0)61 231 287	Telephone: +264 (0)83 338 0100
Address: PO Box 86386, Windhoek, Namibia	Address: PO Box 4223, Windhoek, Namibia
Email: rchristians@slrconsulting.com	E-mail: mariam.kane- garcia@totalenergies.com



EAP Signature



Proponent Signature



Declaration of Authorship

Application Number: APP - 005431

Project Title: Environmental and Social Impact Assessment for the Venus Development
(Offshore PEL0056/Block 2913B), Namibia

I, **Robyn Christians**, understand and agree that the information I have furnished in this submission will be reviewed by the Office of the Environmental Commissioner (OEC). I accept that the Environmental Commissioner, will hold me accountable in terms of Section 43(1)(b) of the *Environmental Management Act*, Act No. 7 of 2007 for any inaccurate or misleading information knowingly provided in the following documentation.

Tick the box (es) applicable to your submission:

- ☐ Pro Forma Environmental Contract for Mining Claim(s)
- ☐ Environmental Questionnaire For Mining
- ☐ Scoping report
- ☒ Environmental Impact Assessment (EIA)
- ☒ Environmental Management Plan (EMP),
- ☐ Consent from Relevant Authority

I certify and acknowledge that the provision of such information will impede the lawful carrying out of the duties, responsibilities and functions of the Environmental Commissioner. I declare that the information submitted is my own work. All direct or indirect sources used are acknowledged as references.

Consultancy Name: SLR Environmental Consulting (Namibia) (Proprietary) Limited



EAP Signature:

Date: 19 December 2025



Volumes of this ESIA Report

Volume 1: Main Report

Final ESIA Report

- Appendix A: Curricula Vitae of the SLR ESIA Project Team
- Appendix B: Acceptance of Final Scoping Report
- Appendix C: SAIEA Independent Review Report
- Appendix D: Method for Assessing Impact Significance
- Appendix E: Public Participation Documents
 - Appendix E.1: Stakeholder Database
 - Appendix E.2: Advertisements
 - Appendix E.3: Site Notices
 - Appendix E.4: Radio Announcements
 - Appendix E.5: I&AP Notification Letters and Emails
 - Appendix E.6: Non-Technical Summary
 - Appendix E.7: Public Consultation Pamphlet
 - Appendix E.8: Public Meeting Presentation
 - Appendix E.9: Posters
 - Appendix E.10: Meeting Minutes and Photographs
 - Appendix E.11: I&AP Correspondence
 - Appendix E.12: Comments and Responses Report

Volume 2: Environmental and Social Management Plan

- Appendix F: Environmental and Social Management Plan

Volume 3: Technical Studies

- Appendix G: Underwater Noise Modelling
- Appendix H: Drilling Discharge Modelling
- Appendix I: Commissioning Effluent Modelling
- Appendix J: Produced Water Modelling
- Appendix K: Oil Spill Modelling

Volume 4: Specialist Studies

- Appendix L: Marine Ecology Impact Assessment
- Appendix M: Fisheries Impact Assessment
- Appendix N: Socio-Economic Impact Assessment
- Appendix O: Cultural Heritage Impact Assessment
- Appendix P: Air Quality Impact Assessment
- Appendix Q: Climate Change Risk Assessment
- Appendix R: Waste Management Study
- Appendix S: Conceptual Decommissioning and Closure Strategy



Basis of Report

This document has been prepared by an SLR Group company with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with TotalEnergies EP Namibia B.V. (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.



Environmental and Social Impact Assessment for the Proposed Venus Development (Offshore PEL0056/Block 2913B), Namibia



Executive Summary



1.0 Introduction

In 2022, TotalEnergies EP Namibia B.V. (TEEPNA), together with its Joint Venture (JV) partners (Impact Oil and Gas, NAMCOR and Qatar Energy), discovered hydrocarbons in PEL0056/Block 2913B offshore Namibia, referred to as the Venus field. Based on previous exploration and appraisal activities and associated outcomes, TEEPNA and its JV partners are studying the feasibility to develop the offshore Venus field to produce crude light oil. This field is situated offshore southern Namibia, ~300 km from Oranjemund, ~320 km from Lüderitz and ~700 km from Walvis Bay, in deep water (~3 000 m) (Figure 1).

In summary, the project includes the following key activities:

- Drill up to 40 subsea development wells into the reservoir (including 20 oil producing wells and 20 gas injection wells).
- Extract hydrocarbons from the oil producing wells and separate the fluids (made up of oil, gas and water) on an offshore production facility, called a Floating Production, Storage and Offloading (FPSO) vessel, which will be moored in the Venus offshore project area.
- Re-inject the gas back into the reservoir through the dedicated gas injection wells.

- Offload the oil from the FPSO to a shuttle tanker, called a Dynamic Positioning Shuttle Tanker (DPST), which will sail to a nearshore transshipment area where the oil will be transferred to a conventional tanker (the operation is similar to the transfer of imported refined oil at same location). The nearshore transshipment area is located ~5 km from the coast, ~20 km north of Walvis Bay.
- The conventional tanker will then transport the oil to its final destination.

Onshore, marine and aviation support operations will use available infrastructures.

Before the proposed development, it must obtain an Environmental Clearance Certificate (ECC) from the Ministry of Environment, Forestry and Tourism (MEFT), which requires the undertaking of an Environmental and Social Impact Assessment (ESIA).

The compilation of the Final ESIA Report has been informed by comments received from Interested and Affected Parties (I&APs) following the distribution of the draft report for review and comment from 3 November to 3 December 2025 and those raised during public engagements, as well as from online focus group and public meetings. It should be noted that all significant changes to the Draft ESIA Report are underlined and in a different font (Times New Roman) to the rest of the text.

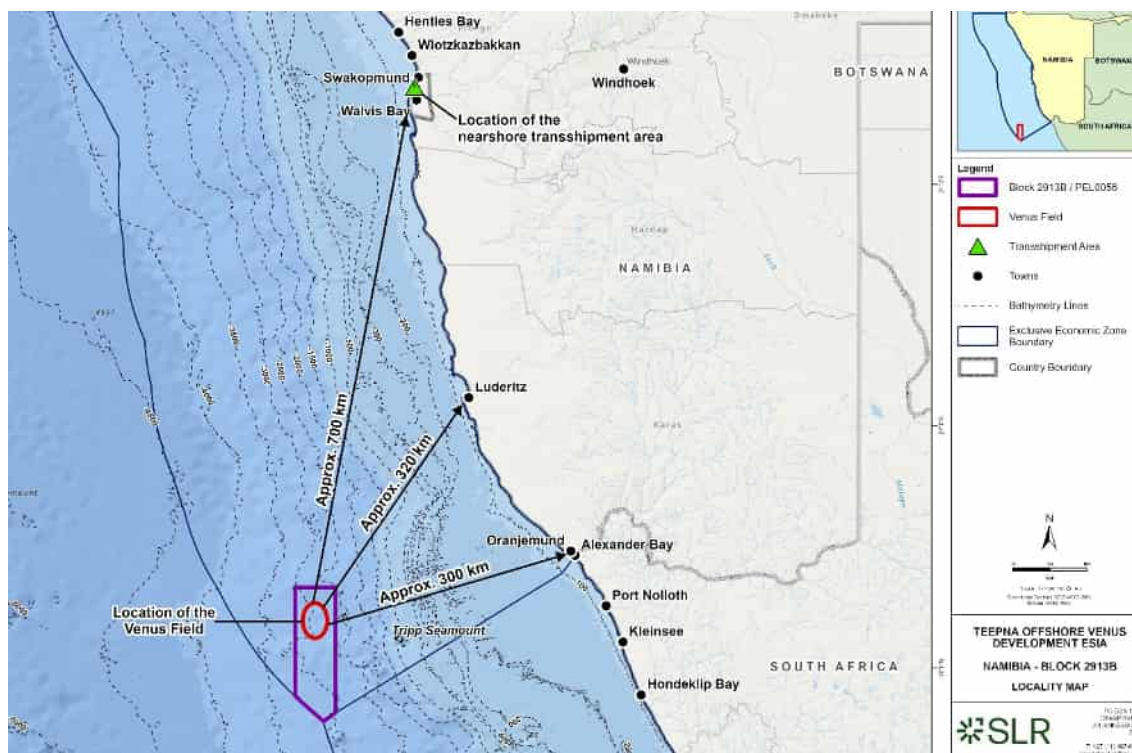


Figure 1: Locality Map of the Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle)

2.0 ESIA and Public Participation Process

An ESIA helps plan and make decisions about a project. It identifies and assesses the potential positive and negative biophysical, cultural, and socio-economic impacts of proposed activities. It also identifies management measures to reduce impacts of a project (where required) and enhance benefits.

The ESIA process is defined in the Namibian Environmental Impact Assessment EIA Regulations (2012) and consists of two main phases (Figure 2):

1. **Scoping Phase:** SLR and Urban Dynamics Africa gathered information about the environment and then identified how the project might affect the environment and society, and how to study these impacts. This was written up in the Scoping Report.
The Draft Scoping Report was released for a public review and comment period (2 April to 13 May 2025). The Final Scoping Report was then submitted to MEFT on 30 May 2025 and subsequently accepted by MEFT on 7 August 2025.
2. **Impact Assessment Phase:** Specialists investigated potential impacts of the project and suggested ways to reduce negative impacts and increase positive impacts. This was written up in the ESIA Report.

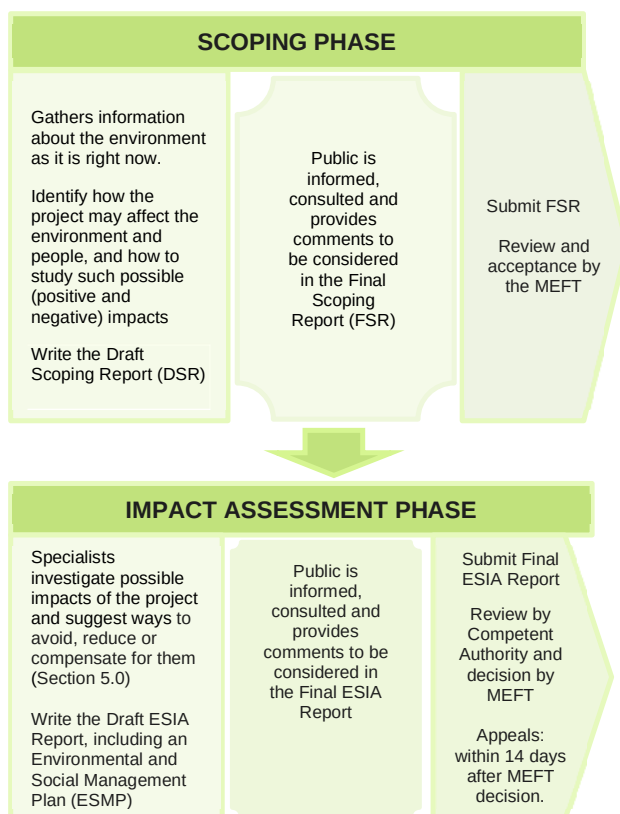


Figure 2: ESIA process phases and steps

Public consultation is a very important part of the ESIA process. The purpose is to:

- Notify I&APs of the proposed activities.
- Share information on the proposed activities and PPP.
- Provide I&APs the opportunity to ask questions and raise concerns regarding the proposed activities.

In October and-November 2025, the public were made aware of the proposed project and ESIA process, the availability of the Draft ESIA Report for comment (between 3 November to 3 December 2025) and public open house / meetings through site notices, newspaper advertisements, radio announcements, social media posts and notification letters/emails sent to all registered I&APs on the project database.

I&APs could review and comment on the Draft ESIA Report and Non-Technical Summary (available in English, Afrikaans, Oshiwambo, Otjiherero and Nama/Damara), which was made available from 3 November and 3 December 2025, both online for download and at various public locations.

I&APs were also invited to attend public open houses and public meetings between 3 and 21 November 2025. These public engagement sessions were held in Keetmanshoop, Bethanie, Lüderitz, Oranjemund, Windhoek, Henties Bay, Swakopmund and Walvis Bay, where I&APs could learn more about the proposed project, the ESIA findings and provide their feedback.

Online meetings were also held to accommodate I&APs who were not been able to attend the open houses and face-to-face meetings. Furthermore, focus group meetings were held with key stakeholder groups (e.g. artisanal fisheries, women and youth, tourism and business, traditional authorities, regional and national authorities, etc.).

All comments received during the public comment period (3 November to 3 December) were recorded and responded to in the Comments and Response Report (see Appendix E.11).

Way forward: After MEFT has made a decision on the ECC application, the decision will be uploaded onto the SLR website for review. All registered I&APs will be notified of the issuing of the decision and of the formal appeal process to be followed in terms of Section 50 of the Environmental Management Act, 2007 and Regulation 25 of the EIA Regulations 2012.

3.0 Description of Proposed Activities

The JV is currently studying the feasibility to develop the offshore Venus field to produce crude light oil. Key project activities are described below.

3.1 Drilling

Up to 40 subsea wells will be drilled by up to three drilling units (see example in Figure 3). Twenty (20) wells will be used



for oil production, while the other 20 will be used for gas re-injection.

A well is created by drilling a hole into the seabed using a cutting tool ("drill bit") attached to a rotating tube ("drill string"), which crushes the rock into small particles, called "cuttings". Depending on the stage of drilling, these cuttings are either:

1. discharged onto the seafloor next to the hole ("riserless drill stage" in Figure 4); or
2. brought up to the drilling unit through a riser (pipe/tube) where they are cleaned to reduce the oil content prior to discharge from the drilling unit into the sea ("riser drill stage" in Figure 4).

Steel pipes are inserted and cemented into the hole to ensure it is stable and that the different geological formations are isolated.

Once the target depth is reached, some of the wells may be tested to improve the understanding of the reservoir characteristics.

Drilling operations are expected to commence ~18 months after Final Investment Decision (FID) and are planned to last for up to four years

3.2 Installation

Subsea equipment is required to connect the subsea wells to the FPSO (Figure 5). Subsea equipment will comprise of flowlines (pipeline laid on the seabed that transports reservoir fluids between subsea wells and other subsea facilities), Christmas trees (equipment that controls the flow of hydrocarbons from a well), umbilicals (specialised cables or hoses designed to transfer power, fluids and control signals), jumpers (short, rigid pipes) and risers (pipes that transfer fluids from the seabed up to the surface facility). In addition, anchors and mooring lines will be installed prior to FPSO arrival in the Venus offshore project area.

The Venus field development project occupies an area of ~165 km² on the seabed, with the footprint extending ~20 km in a NW-SE direction and ~15 km in a E-W direction.

Offshore installation is expected to commence ~1 year after FID and will take place during two Southern Hemisphere summer periods due to metocean condition constraints (that constitutes a unique campaign).

A mooring buoy will also be installed in the nearshore transshipment area, ~5 km from the coast, ~20 km north of Walvis Bay.



Figure 3 - Drill Ship

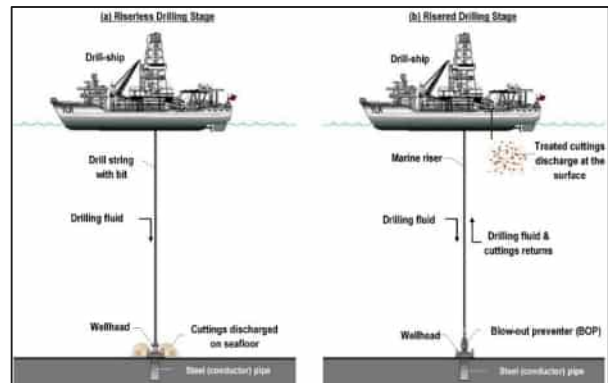


Figure 4 - Drilling Stages



Figure 5: Example of FPSO vessel

3.3 Production

Production will take place of an estimated period of 21 years, with the option of extending production by an additional 10 years

Venus Offshore project area:

During production, reservoir fluids (composed of oil, gas and water) will be extracted from the subsea wells and transported via the flowlines to the FPSO, where they are separated:

- Oil will be stored within the FPSO hull prior to offloading to a DPST (approximately once a week during peak operations).
- Gas will be re-injected back into dedicated gas injection wells via flowlines. A portion of the gas

will, however, be used for power generation on the FPSO.

- Water will be treated and discharged into the sea.

The offshore production approach is shown in Figure 6 and Figure 6. *These figures are a schematic and do not aim at representing the number of wells and subsea equipment for this Project.*

Nearshore transshipment area:

After offloading the oil from the FPSO to the DPST, it will sail to a nearshore transshipment area (Figure 8) where it will transfer the oil to a conventional tanker for onward transport to the buyer.

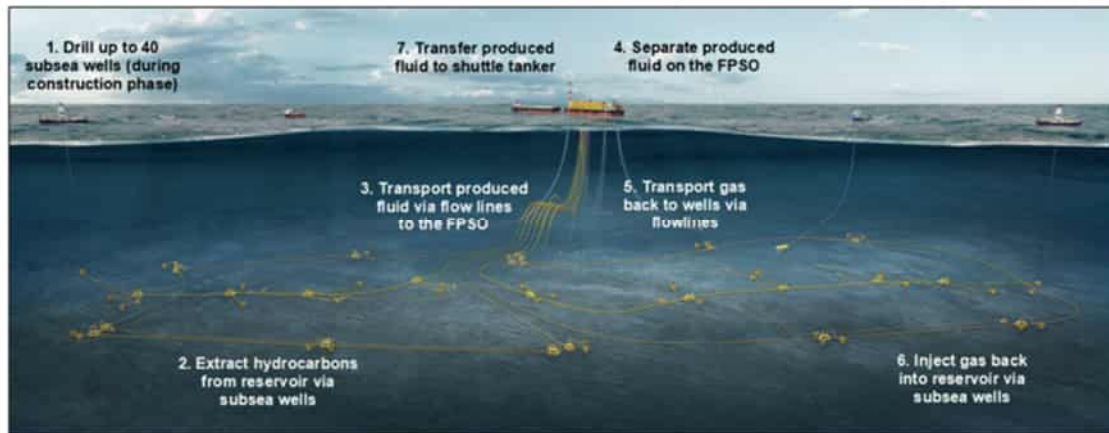


Figure 6: Concept of oil production at the Venus offshore project area (not to scale)

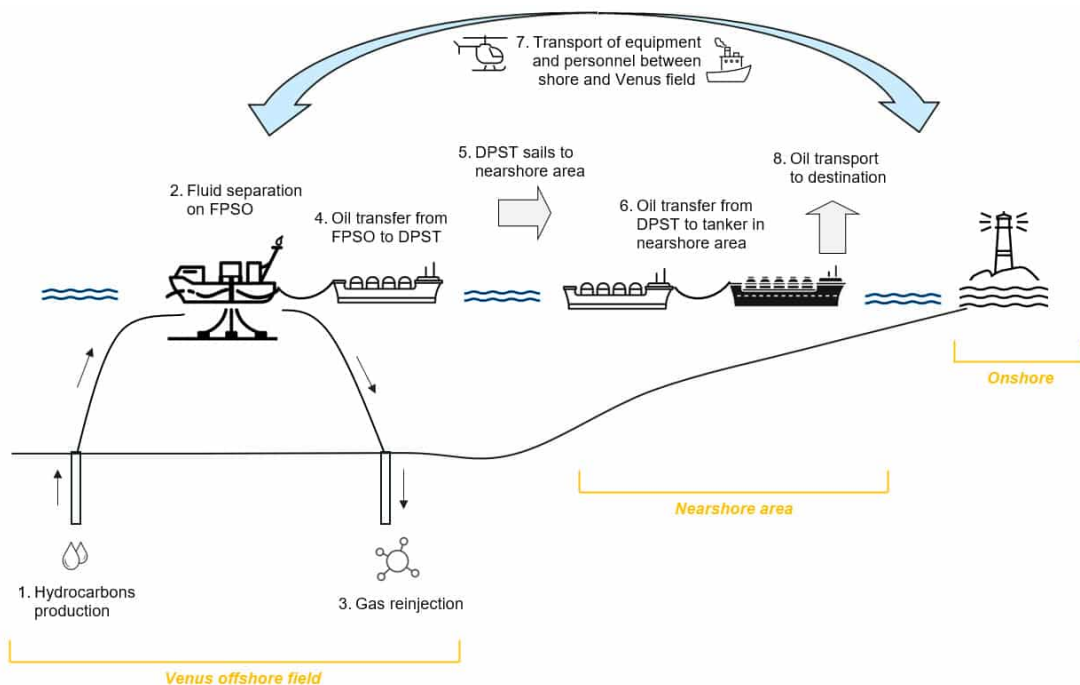


Figure 7: A conceptual schematic of oil production for the Venus Development

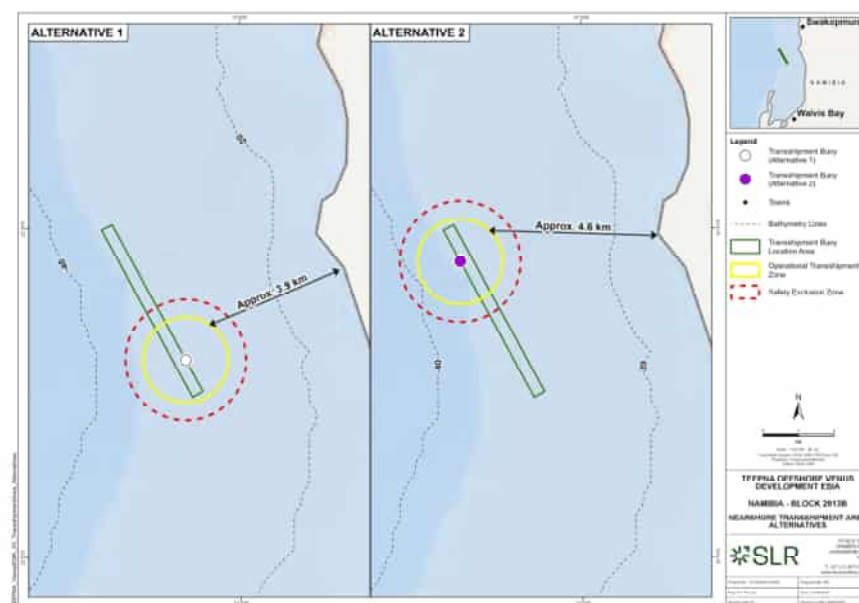


Figure 8: Locality map of the transshipment buoy location area (green rectangle) showing two potential locations to illustrate the safety exclusion zone and operational zone

3.4 Decommissioning

The Venus Project facilities will be decommissioned at the end of field life. Before production operations end, the JV will prepare a detailed decommissioning plan based on a Net Environmental Benefit Analysis (NEBA). The conceptual Decommissioning and Closure Strategy includes the following activities.

- Flush and clean subsea network.
- Disconnect the FPSO from the mooring system, recover top chains and mooring lines. Bottom chain and mooring piles may remain in the seabed. The FPSO unit will then be towed to an approved recycling facility for cleaning and recycling if it cannot be re-used
- Removal of underwater / seabed installations, including risers, flowline and In line tees (ILT) / flowline end termination (FLET), jumpers, Christmas trees and umbilicals, shall be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed.
- Plug and abandonment of development wells following standard procedures. Wellheads will not be recovered.
- Removal of the nearshore transshipment buoy.

Decommissioning phase is expected to last approximately 1.5 years at Venus offshore project area, with a few days required to remove nearshore transshipment buoy.

3.5 Support and Logistics

Onshore logistics will be provided from Lüderitz (which is closest) and Walvis Bay (where main construction facilities are located) to support offshore operations during the drilling, installation, production and decommissioning phases.

Support and supply vessels (Figure 9) will travel between those ports and the Venus offshore project area carrying supplies and equipment during construction, drilling, installation, production and decommissioning.

Personnel working offshore will be transported by helicopter from existing airport facilities, mainly Lüderitz.

All vessels will comply with international standards for operations and the management and discharge of waste and other effluents. When offshore treatment is not possible, waste will be disposed or recycled at licenced onshore waste sites.



Figure 9: Example of supply vessel

4.0 Receiving Environment

Various offshore environmental and geophysical surveys have been undertaken by the JV which have increased the understanding of the receiving environment within the Venus offshore project area. This section provides a brief description of the attributes of the receiving environment within the Project's Area of Influence.

An understanding of the environmental and social context and sensitivity within which the proposed activities would be located is important to understanding the potential impacts.

4.1 Geophysical Environment

4.1.1 Venus Offshore Project Area



The Venus offshore project area is located on the lower continental shelf with water depths varying between 2 828 m in the east and 3 114 m in the west (a variance of ~286 m across the offshore project area).

Photos from environmental surveys show that the seabed in the offshore project area is typically homogeneous, devoid of features as it consists of a smooth, mostly 'sandy mud,' seabed (see Figure 10).



Figure 10: Seafloor at 3000 m water depth with sandy mud habitat at Venus project area

4.1.2 Nearshore Transshipment Area

The nearshore transshipment area (see location in Figure 1) is located in shallow waters (<40 m deep) along the inner continental shelf, approximately 5 km from shore, with sediments expected to consist largely of sand. The transshipment operations are similar to the transfer of imported refined oil which occurs in the vicinity already.

4.2 Biological Environment

4.2.1 Venus Offshore Project Area

PEL0056/Block 2913B is located in the large Benguela Current Large Marine Ecosystem (BCLME), with cold surface water, high biological productivity and changing physical, chemical and biological conditions. This system supports a wide variety of marine species including fish, whales, dolphins, seals and seabirds.

Benthic (seabed) plants and animals differ depending on the type of ocean floor and depth. In deeper water, such as in the Venus offshore project area, the seafloor is largely mud with few plants and animals. Worms, starfish, sea pens, urchins, anemones and sea cucumbers are expected to live in/on the seabed. No colony forming corals and structural features (e.g., rocky outcrops) have been identified in the Venus offshore project.

Demersal fish (those that live and feed on or near the seabed) off the Namibian Coast include hake, kingklip, sharks, rays and skates, though many live in water shallower than 1 000 m (outside of the Venus offshore project area, which is located at 3000 m deep).

Pelagic animals (those that live and feed in the open water column) include:

- Plankton – This is expected to be *low* in the Venus offshore project area.
- Fish eggs and larvae – The Venus offshore project area does *not overlap* with the areas where eggs and larvae of commercially important fish (e.g. hake, sardine, anchovy) are located.
- Fish – Large migratory species (tunas, billfish, pelagic sharks) may travel *through* the project area. Smaller species (snoek, sardine / pilchard, anchovy, chub and horse mackerel and round herring) mainly occur in shallower waters and are *not* expected in the Venus offshore project area.
- Turtles – Some turtles may *occasionally* be found in the Venus offshore project area, most likely Leatherback turtles.
- Seabirds – The Venus offshore project area does *not overlap* with Penguin or Cape Gannet feeding and breeding areas.
- Marine mammals – Long-finned pilot whale, sperm whale and humpback whale are most likely in the Venus offshore project area *at certain times*. Many whales migrate from the southern African west coast to Antarctica or Subantarctic.

snoek, and chub mackerel may occur in the shallow waters of the transshipment area.

- Turtles - Encounters with turtles during nearshore transshipment operations may occur in the coastal waters offshore Walvis Bay, however the likelihood is low, with species largely encountered south of Walvis Bay, offshore Lüderitz, in deeper waters.
- Seabirds - The nearshore transshipment zone lies in proximity to two Ramsar-listed wetlands (Walvis Bay Lagoon and Sandwich Harbour). In addition, Walvis Bay is recognized as an Important Bird Area (IBAs). The area supports high numbers of migratory and resident birds.
- Marine mammals – Several species may occur in the nearshore waters off Walvis Bay, including Sei, Fin, Bryde's, and Humpback whales, as well as various dolphin species.

4.3 Fishing Activity

4.3.1 Venus Offshore Project Area



Several commercial fisheries operate off the Namibian Coast. However, the large pelagic longlines sector is the only Namibian commercial fishing sector that overlaps with the Venus offshore project area though with low effort activities (Figure 14).

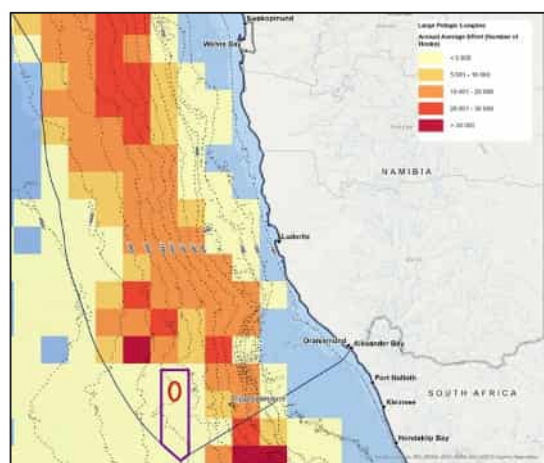


Figure 14: Pelagic Longline effort (2013-2023) mapping versus Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon)

4.3.2 Nearshore Transshipment Area

Nearshore transshipment operations may overlap with the linefish (Figure 15) and small-scale fisheries

sectors, as well as small pelagic purse-seine fisheries, should this sector reopen.

Overlap with other commercial fishing activities is unlikely, as most operate in deeper waters, ranging from 200 m to 850 m deep, and thus offshore of the transshipment area.

Namibia promotes mariculture, particularly in Lüderitz's nutrient-rich waters and sheltered Walvis Bay waters, with allocated plots for various seafood cultivation. The nearshore transshipment area partially overlaps with a designated mariculture area, (although this area is currently not in use) and lies within an area that is currently being used for commercial oil transfer activities to and from the Walvis Bay harbour and from ship to ship.

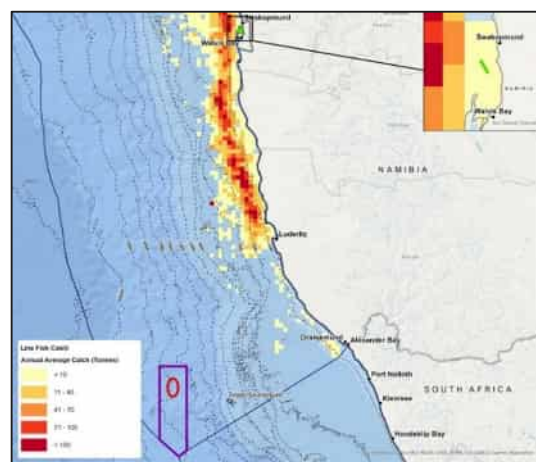


Figure 15: Linefish catch (2007-2020) mapping versus Venus offshore project area (red circle) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle)

4.4 Socio-Economic Environment

The Namibian coastline from Walvis Bay in the north to Oranjemund in the south is broadly considered the project's potential area of influence.



Lüderitz, located in the //Karas Region, is a port town primarily supporting the fishing, mining and offshore oil and gas exploration sectors. Industrial development is limited, and most parts of the town consist of residential neighbourhoods.

Walvis Bay, located in the Erongo Region, is Namibia's third largest town and the country's largest commercial port. This port handles container imports and exports, transshipments, bulk commodities, and offshore oil and gas support activities. Industrial development extends into the desert, and the fishing industry plays an important role in the local economy.

The Venus offshore project area lies within the shipping route around southern Africa (Figure 16) an area already known for anthropogenic disturbance.

Five submarine cables pass through Namibian waters. The Venus offshore project area lies between the West Africa Cable System and Equiano submarine cables (Figure 17). The nearshore transshipment area lies to the south of the Equiano and WACS subsea cables, with the proposed location not impacting any subsea telecommunication cables (Figure 18).

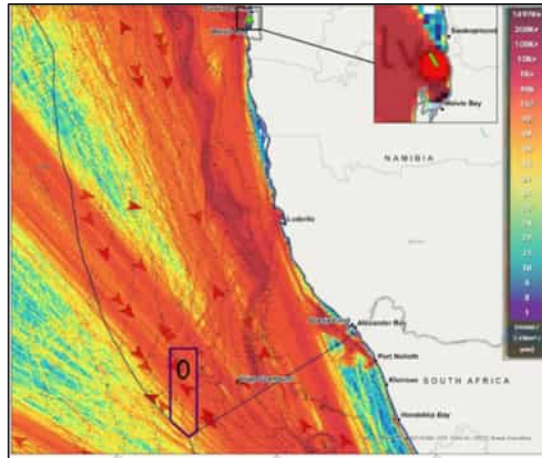


Figure 16: Shipping traffic density versus Venus offshore project area (red circle) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle)

The coastal region south of Lüderitz is a restricted diamond mining area, which limits public access. Marine diamond mining is currently limited to the southern half of the Namibian offshore to depths of 150 m (Figure 17).

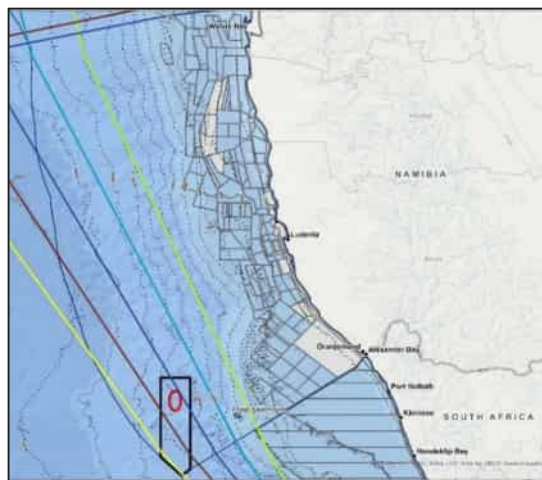


Figure 17: Mining areas and submarine cables versus Venus offshore project area (red ellipse) within PEL0056/Block 2913B (black polygon)

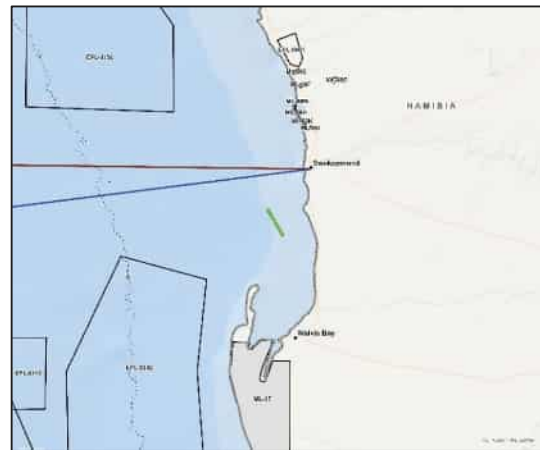


Figure 18: The mining areas and submarine cables vs the nearshore transshipment area

4.5 Heritage

Numerous shipwrecks are located along the Namibian coastline. No wrecks are known to occur in PEL0056/Block 2913B based on available information and that from environmental and geophysical surveys undertaken within the block. Additionally, no wrecks have been reported within the nearshore transshipment area, between Walvis Bay and Swakopmund. The possibility of identifying new shipwrecks is low.

Intangible Cultural Heritage includes ritual and spiritual practices influenced by the histories of the San, Ovahimba, Herero, Ovambo and Topnaar peoples, with rare connection with the ocean or sea displayed. More information can be found in the Final ESIA and Cultural Heritage Impact Assessment reports.

5.0 Impact Assessment

During the Scoping Phase, SLR compared project activities with the existing environment and identified potentially significant impacts – these were assessed by specialists, with input from I&APs.

5.1 Assessment of Identified Impacts

Table 1 lists the specialist studies that were undertaken to assess the potentially significant impacts of the project. Specialists also identified measures to reduce negative impacts to acceptable levels and enhance any benefits (positive impacts).

Table 1: ESIA specialist studies

Study	Purpose
Technical Studies	
Underwater Noise Modelling	These studies provided models that predict how far noise and discharges may travel in the sea from the operation site.
Drill Cuttings Discharge Modelling	
Liquid effluent discharges modelling	These distances were used by other specialists to assess the potential ecological, fisheries, cultural and socio-economic impacts of the project.
Oil Spill Modelling (unplanned event – <i>if</i> there was an oil spill)	
Specialist Studies	
Marine Ecology	These studies used relevant information (including the model outcomes above) to identify and assess potential impacts of the proposed project on receptors (such as people or animals).
Fisheries	
Socio-Economic	
Cultural Heritage	
Air Quality	Specialists also recommended measures to reduce negative impacts and enhance positive impacts of the project.
Climate Change	
Waste Management	This study provided a waste baseline inventory and waste management options plan to be used in the development of a project specific waste management plan.
Human Rights	Human Rights specialists worked with other specialists to ensure Human Rights are considered in assessments.

5.2 Impacts of Normal Operations

Table 2 shows the significance¹ of each impact that was rated (on a scale of Very Low to Very High, positive or negative, or Negligible where no significant impact is expected). Impact significance is shown for the project phase that generates the highest impact and after the application of mitigation measures included in the Environmental and Social Management Plan (ESMP).

Table 2: Summary of impacts' significance of normal operations, post-mitigation, and associated project phase. Negative (-) and positive (+) impacts

Potential project impact	Post-mitigation significance
Marine Ecology	
Smothering and disturbance of benthic (seabed) animals	Very Low - (Drilling & installation)
Effects on seabed animals due to turbidity, toxicity and hypoxic effects	Negligible (Drilling & installation)
Change of seabed habitat due to presence of infrastructure on seabed	Very Low - (All phases)
Effects on pelagic and demersal animals due to turbidity, toxicity and hypoxic effects	Very Low - (Drilling & installation + Production)
Behavioural changes in marine mammals	Low - (Production)
Behavioural changes in fish	Low - (Production)
Behavioural changes in turtles	Very Low - (All phases)
Behavioural changes in seabirds	Low - (Production)
Injury to marine mammals	Low - (All phases)
Injury to fish and ichthyoplankton	Very Low - (Drilling & installation + Production)
Injury to turtles	Low - (All phases)
Fisheries	
Impact on catch of Large Pelagic Longline sector	Very Low - (All phases)
Impact on catch of the Linefish sector	Very Low - (Production)
Impact on catch of Small-Scale Fishing sector	Very Low - (Production)
Socio-economic	
Contribution to GDP	High + (All Phases)
Contribution to exports and trade balance	High + (Production)
Contribution to government revenue	High + (Production)

¹ Significance / significant effect means having, or likely to have a consequential qualitative or quantitative impact on the environment, including changes in ecological, aesthetic, cultural, historic, economic and social factors, whether directly or indirectly, individually or collectively

Potential project impact	Post-mitigation significance
Employment and income generation	High + (All phases)
Development of skills	High + (All Phases)
Reduction in fishing livelihoods	Very Low - (All Phases)
Disruption of shipping	Very Low - (All Phases)
Deterioration of community health and safety	Low - (All phases)
Governance risks and conflict	Very Low - (All phases)
Pressure on coastal towns	Low - (All phases)
Reduction of employment and income at decommissioning	Low - (Decommissioning)
Cultural Heritage	
Deterioration of cultural heritage links to the sea	Negligible (All phases)
Air Quality and Climate	
Increase in ambient air pollutant concentrations at Venus Offshore Project Area	Negligible (All phases)
Increase in ambient air pollutant concentrations due to nearshore transshipment operations	Low - (All phases)
Contribution to GHG emissions	Medium – High (based on EBRD ² criteria)

Sections 5.2.1 to 5.2.5 summarise the nature of potential impacts listed in Table 2.

5.2.1 Marine Ecology Impacts

Smothering and disturbance of seabed animals:

During the drilling and installation of equipment on the seabed, some marine animals that live in or on the ocean floor (called benthic fauna) may be disturbed or covered by discharges from the drilling process. However, the impact is expected to be limited in extent, with the deposition of drill cuttings >6.5 mm thickness modelled to be located 270 m from wells. Most of the seabed in the project area is made up of soft sand and mud, which is home to fast-growing species that can recover quickly after

being disturbed. Over time, the affected areas are expected to recover naturally.

Effects on seabed animals due to turbidity, toxicity and hypoxic effects:

During drilling activities in the Venus offshore project area, some marine animals that live in soft seabed sediments may be affected by mud and chemicals released into the water. The mud and drill cuttings can make the water cloudy (turbid), which may affect how some animals feed or breathe, and chemicals in the mud can reduce oxygen levels in the seabed over time. However, these effects are expected to be limited in extent, with recovery expected over the long-term.

Change of seabed habitat due to infrastructure on the seabed:

The installation and presence of subsea infrastructure – such as pipelines, anchors, and wellheads – on the seabed can change the natural habitat of benthic fauna, especially in areas with soft, unconsolidated sediments. Due to the water depth in the project area there are relatively few animals living there, and the project area is small in comparison to similar seabed habitat.

Effects on pelagic and demersal fauna due to turbidity, toxicity and hypoxic effects:

During the drilling and production phases of the Venus offshore project, substances such as drill cuttings, mud, and treated water are discharged into the ocean, potentially affecting pelagic fauna—marine species that live in the open water. However, the intensity of these impacts is considered low due to several factors: the deep offshore location (approximately 3,000 m), the rapid dilution and dispersion of discharge plumes, and the high mobility of pelagic species, which allows them to avoid affected areas, with no overlap with key spawning zones or sensitive habitats like Tripp Seamount.

Behavioural changes in marine mammals: Marine mammals may change their behaviour in the short-term if exposed to higher underwater noise from vessels, drilling operations, and vertical seismic profiling (VSP), as well as increased lighting and occasional helicopter flyovers. These impacts are expected to be of low to medium intensity, dependant on the location of project activities (i.e. nearshore transshipment area versus Venus offshore project area). These impact durations vary from short-term events to the full project lifespan for certain activities. Once the activity ceases, the associated noise levels will rapidly dissipate. Marine mammals are highly mobile, allowing them to avoid disturbance.

² EBRD – European Bank for Reconstruction and Development, an international financial institution whose environmental and social framework defines the significance of greenhouse gas (GHG) emissions based on annual emission volumes compared against established thresholds

Behavioural changes in fish: Noise from drilling and vessel operations may cause the fish to avoid the affected area in the short-term, while lighting could attract fish and increase their chances of becoming prey. These effects are generally localised, with impact zones ranging from a few hundred metres to a few kilometres, and durations varying from short-term events to the full project lifespan.

Behavioural changes in turtles: Underwater noise from drilling and vessel operations is not expected to reach levels that cause behavioural disturbance, and lighting impacts are limited to the immediate vicinity of vessels and equipment. Because turtles are highly mobile and the project area is very far from nesting beaches in Angola and South Africa, the impacts are considered to be of low intensity.

Behavioural changes in seabirds: Seabirds may change their behaviour in the short-term if exposed to helicopter noise and artificial lighting, particularly near breeding colonies along the Namibian coast and offshore islands. However, these impacts are considered relatively limited.

Injury to marine mammals: Underwater noise from drilling and vessel operations may cause temporary hearing effects in marine mammals, but these are generally short-lived and limited to areas close to the sound source. The risk of more permanent hearing impacts due to underwater noise mostly applies to baleen whales (e.g. humpback whales), which are sensitive to certain sound frequencies. Vessel collisions and entanglement with mooring lines / chains pose a risk for collision, but these impacts are expected to be rare and reversible over time.

Injury to fish and ichthyoplankton: Underwater noise from VSP may cause injury or mortality to fish and ichthyoplankton, but only within close range (<60 m from the source), with impacts short-term. Marine Mammal Observers will keep watch and use Passive Acoustic Monitoring to check whether sensitive animals are present during VSP and stop the activity if necessary. Non-impulsive noise from vessels and drilling equipment is not expected to cause physiological harm. During production, seawater abstraction may trap small fish and plankton, but the intensity is considered very low, with impacts confined to the immediate area and unlikely to affect population-level dynamics. The offshore location is very far from key spawning areas and drift pathways.

Injury to turtles: Temporary hearing effects may occur within 1.6 km of offshore operations during peak /concurrent offshore drilling and installation operation but would reduce to 500-600 m based on drilling and transshipment / transfer activities only. Permanent injury due to increased underwater noise

is not expected. Vessel collisions and entanglement with mooring lines pose a risk, though such events are expected to be rare.

5.2.2 Fisheries Impacts

Impact on catch of Large Pelagic Longline sector:

Fishing vessels must stay outside the safety zones (e.g. maritime exclusion and/or restricted area) around the FPSO and subsea infrastructure. For large pelagic longline this area is likely further (>30 km) to prevent entanglement with longlines used by the sector. However, the overlap of safety zones with important large pelagic fishing grounds is very small. Increased underwater noise and discharges may cause minor behavioural changes in fish, but these effects occur within the exclusion zones that are not accessible to other vessels.

Impact on catch of Linefish sector: The implementation of a restricted area of ~9 km² around the nearshore buoy may result in localized disturbances to the linefish sector. However, these impacts are expected to be minimal, as the overlap of the restricted area with active line-fish fishing grounds is very small. Underwater noise generated during transshipment operations may temporarily influence fish behaviour, but these effects are confined to a small area and occur within an already busy marine traffic route.

Impact on catch of Small-Scale Fishing sector:

Nearshore transshipment operations may have a limited impact on the small-scale fisheries (SSF) in the Walvis Bay area. The proposed restricted area has a very small overlap with active SSF grounds, which are mostly limited to intertidal shellfish collection and shallow water seaweed harvesting – these activities occur well outside the transshipment area. Boat-based fishing in the restricted area is minimal.

5.2.3 Socio-Economic Impacts

The produced crude oil will be sold by the JV partners on global markets, where prices change frequently. The prices, as well as actual oil production volumes, will influence the contribution to GDP, export value and government revenue discussed below.

Contribution to GDP: The project generates economic activity through procurement of a portion of goods and services in Namibia. Based on conservative assumptions (as many goods and services are not produced or provided in Namibia), the project will contribute between ~13% to 18% of GDP in early high-production years, and ~2% to 7% in later years when production is lower. The project is estimated to contribute between ~N\$ 536 billion and

N\$ 800 billion to Namibia's GDP for the anticipated minimum 25-year project lifetime.

Contribution to exports and trade balance: JV members will sell their share of the crude oil produced at the Venus Development to global markets. The oil will thus be a new Namibian export commodity. The value of oil exports depends on volume and oil prices and could amount to ~10% to 40% of total Namibian export value during most of the production timeline. The total oil export value is estimated at ~N\$ 593 billion to N\$ 888 billion for the anticipated minimum a 25-year project lifetime.

Contribution to government revenue: The project pays money to the government through taxes, levies and other direct or indirect payments. Revenues from oil production are expected to contribute as much as ~8% to 14% of total government revenue at peak, and ~2% to 5% throughout most of the project lifetime. Total government revenue may total ~N\$ 127 billion to N\$ 229 billion considering a 25-year project timeframe.

Potential project impacts and benefits associated with the use of government revenue, inflation, Dutch disease³, NAMCOR and the Social Cost of Carbon are discussed but not formally rated, as they depend on government decisions and performance of other economic sectors.

Employment and income generation: Drilling and installation is expected to generate some 5 000 jobs (500 direct (employees), 2 000 indirect (suppliers) and 2 500 induced (wider economy)). During production, an estimated 7 000 jobs will be created (600 direct, 600 indirect and 5 800 induced). Jobs will be distributed in various parts of Namibia, and are important compared to the high demand for jobs especially in coastal towns.

Development of skills: The project creates demand for skilled people who can work in the oil and gas industry and other industries. The JV is already committed to upskilling Namibians, which will continue during all project phases.

Reduction in fishing livelihoods: Fishing and mariculture cannot take place within project safety zones. However, the overlaps between safety zones and active fishing and mariculture areas in the offshore and nearshore areas is very limited. The expected impact on livelihoods associated with those fisheries is thus also very limited.

Disturbance of shipping traffic: Vessels must avoid project safety zones and may thus need to amend their normal routes. However, although the project is located in a busy shipping zone, the safety zones are very small in relation to shipping routes, and will not materially impact the duration of vessels at sea. COLREG protocols ensure safe avoidance.

Deterioration of community health and safety: The project is likely to attract people to towns with existing onshore bases, notably Lüderitz and Walvis Bay, where poverty levels and incidence of some social ills are high. A larger and more diverse population may intensify any competition for employment and resources in those towns, as well as social ills associated with transient populations.

Governance and conflict: New revenue sources can create risks in relation to governance and conflict. Namibia has a long history of resource extraction and generally avoided large-scale negative outcomes. Regulatory frameworks are being strengthened in anticipation of oil and gas development. Citizens and civil society have a keen interest in the management of the sector and high expectations as a result of increased revenue.

Pressure on coastal towns: Both Lüderitz and Walvis Bay currently struggle to keep up with the supply of land and services for their growing populations. While the Venus Project itself will not require many workers to settle in these towns (since offshore personnel will return home after their shifts) there may be some in-migration linked to indirect economic activities, service industries that develop in support of the project and/or people looking for work. This places additional pressure on municipal services, and pro-active municipal management thereof is required.

Reduction of employment and income at decommissioning: Direct employment at the JV and supplier contract opportunities will decline and then stop during decommissioning, reducing job and income opportunities. This is a natural part of resource extraction and foreseeable, and can thus be planned for appropriately.

5.2.4 Key Cultural Heritage Impacts

Deterioration of cultural heritage links to the sea: Any impact on the integrity of the coastal and marine ecosystem through disturbance, pollution, noise, etc. could impact various aspects which makes up people's intangible cultural heritage, including

³ Dutch Disease: the potential weakening of other productive sectors such as agriculture, manufacturing, and tourism that could result from exchange rate appreciation and resource dependence following a boom in the oil and gas sector.

ancestral / spiritual aspects, cultural activities such as fishing and recreation, sense of place, archaeological resources and natural heritage areas. However, most cultural links were reported with onshore or coastal features, which are not affected by the project.

5.2.5 Key Air Quality and Climate Impacts

Increase in ambient air pollution at Venus

Offshore Project area: Vessels will release air pollutants associated with fuel use, power generation and (non-routine, i.e. occasional) flaring. Pollutants released offshore will disperse rapidly under prevailing metocean conditions. Since winds in the project area predominantly blow seaward and onshore winds are rare (less than 8% of the time), emissions are expected to dissipate away from the coast without affecting Namibian air quality. **Increase in ambient air pollution at nearshore transshipment area:** Air emissions from vessel fuel use and oil transfer result in short-term increases in air pollution while vessels are at the nearshore transshipment area. Pollution levels are expected to stay within international public health guidelines.

Contribution to National GHG emissions: The project GHG emissions would reduce the remaining *global* carbon budget (from the beginning of 2020) by 0.05% and *Namibia's* net sink capacity by up to 1.21%. The project's GHG emissions *intensity* is expected to be lower than the 2015 weighted-average GHG emissions intensity of crude oil production from 10 major producers. Emissions fall within the Medium-High category applied by the European Bank for Reconstruction and Development (EBRD) for project investment decisions, which was referenced for this project.

5.3 Unplanned Events

Potential risks associated with key unplanned events were also considered. Unplanned events are accidents or incidents that are not expected to happen as part of normal operations, that are very rare and for which measures are in place to actively prevent them from happening.

The key unplanned events that were assessed, and the potential significant impacts associated with each of them, are listed in Table 3. The significance ratings in Table 3 assume that the unplanned event occurs (which is very unlikely). Therefore one cannot directly compare the impact significances in Table 2 (impacts are expected to happen) with those in Table 3 (impacts would only happen in a very rare worst-case accident scenario).

Consideration of unplanned events is, however, important to inform prevention and response preparation and to determine whether any

irreplaceable resources would be lost in the event of a major incident.

Table 3: Summary of impacts from unplanned events

Potential impact if unplanned event occurs	Post-mitigation significance
Major oil spill from a well blow-out at offshore area (5 912 m³/day of oil continuously for 13 days)	
Impact on marine ecology / environment	Very High -
Impact on fisheries / mariculture	Medium -
Impact on fishing livelihoods	Very Low -
Impact on intangible cultural heritage	Negligible
Impact on air quality and health	Negligible
Impact on GHG emissions	~1.3x average annual Venus project emissions
Marine diesel spill at offshore area (5 000 m³ once off)	
Impact on marine ecology/ environment	Medium -
Impact on fisheries / mariculture	Low -
Impact on fishing livelihoods	Very Low -
Impact on intangible cultural heritage	Negligible
Impact on air quality and health	Negligible
Gas injection line rupture at offshore area (up to 267 000 m³ gas once off)	
Impact on Marine Ecology / Environment	Very Low -
Impact on fisheries / mariculture	Low -
Hydrocarbon spill at nearshore transshipment area (1 000 m³ oil / 300 m³ diesel once off)	
Impact on marine ecology/ environment	Very High -
Impact on fisheries / mariculture	High -
Impact on fishing and tourism livelihoods	Medium -
Impact on Intangible cultural heritage	Very Low -
Impact on air quality and health	Negligible

The unplanned events with the most significant impacts are 1) a major well blowout at the offshore project area that results in sustained release of oil at the seabed for up to 13 days until the well is sealed – since this results in the release of large volumes of oil into the sea – and 2) oil spill during oil transfer between tankers at the nearshore transshipment area – since this spill would occur near the shore.

Major well blowout at offshore project area:

Modelling indicates that the oil from a major well blowout at the offshore project area would drift in a predominantly north-westerly direction – out to the

high sea and away from the sensitive coast, EBZA and coastal fishing, spawning and fish recruitment areas. No oil is predicted to reach the coast or affect coastal activities.

Oil in and on the water can affect the health of animals in contact with the oil, and fishing. The area where oil is *most* likely to reach (90% likelihood) overlaps with only 0.13% of the large pelagic longline fisheries. The area where oil is *least* likely to reach (1% likelihood) overlaps with ~15% of the large pelagic longline, tuna pole and deep-water trawl fisheries, and ~2% of the demersal trawl and longline fisheries (Figure 19). As such, impacts on the marine ecology are most significant in this event.

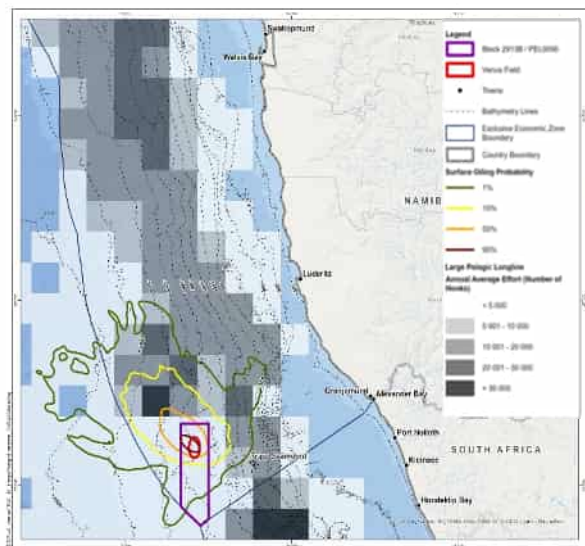


Figure 19: Probability of surface oiling relative to large pelagic longline fishery

Marine diesel spill at offshore project area:

Modelling indicates that the area affected by a diesel spill would be much smaller than for a well blowout.

Diesel in and on the water can affect the health of animals in contact with the diesel, and fishing. The area where oil is *most* likely to reach (90% likelihood) does not overlap with key fishing grounds. The area where oil is *least* likely to reach (1% likelihood) overlaps with ~1.4% of the large pelagic longline fisheries (Figure 20). As such, impacts on the marine ecology are most significant in this event.

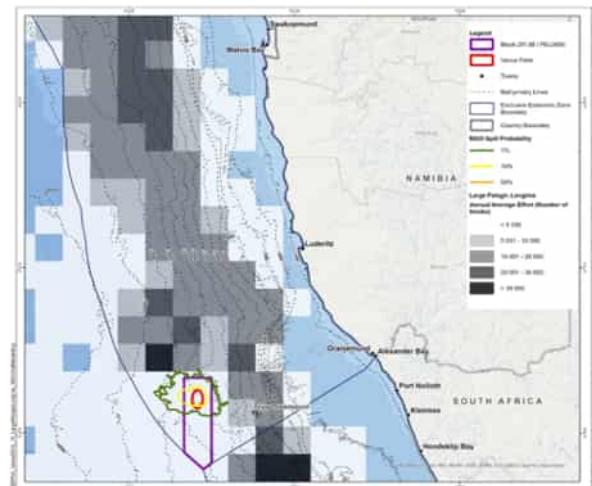


Figure 20: Probability of surface diesel relative to large pelagic longline fishery

Gas injection line rupture at offshore project area:

A major gas release into the water column can affect the health of animals in contact with the plume, and fishing. Based on the release point and short-term effects, any impacts are deemed minimal.

Hydrocarbon spill at nearshore transshipment area:

Modelling results show that oil or diesel would reach the shore within ~2 hours and affect the coast for up to ~263 km north and ~26 km south of Walvis Bay (Figure 21). Oil on the water surface can extend for up to ~100 km (Figure 22) and would evaporate within ~1 day but may remain longer in the water column.

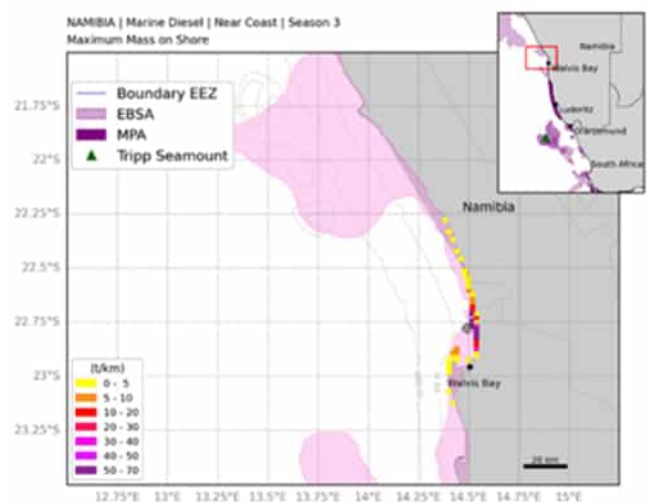


Figure 21: Shoreline oiling from nearshore spill

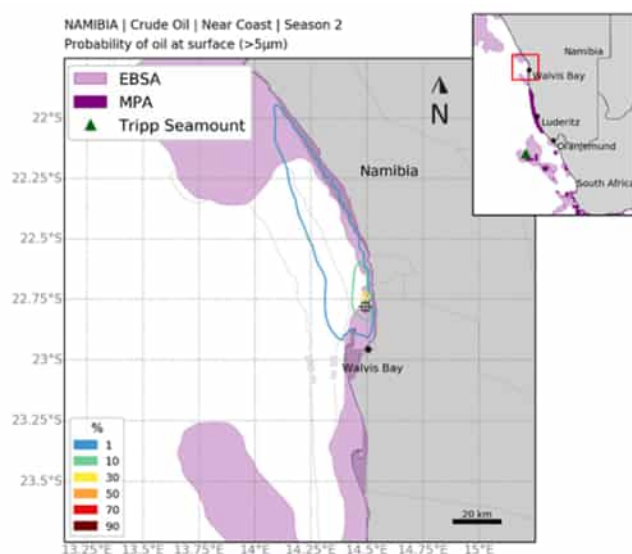


Figure 22: Probability of surface oil from nearshore spill

Oil / diesel in and on the water can affect the health of animals in contact with the substance, and coastal and pelagic seabirds, fish, turtles, and cetaceans are highly sensitive to hydrocarbon spills. Nearshore fisheries, coastal mariculture and traditional SSF would need to avoid affected areas, which would temporarily affect livelihoods. Linefish areas are less affected, as the largest modelled oil spill extent overlapped with only 3% of linefish areas. Tourism activities focussed on the coast and associated income would also be temporarily depressed. As such, impacts on the marine ecology, fishing and coastal livelihoods would be significant in this event.

5.4 Emergency Response Plan

All vessels and offshore installations will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill discharges would be managed under an Oil Spill Contingency Plan (OSCP), based on the Tiered response principle, which the Operator will be required to develop and share with relevant Authorities prior to offshore activities.

All vessel owners will have emergency procedures in place identifying accident scenarios and responses.

Specific coordination documents will be established between the various vessels and operators to define roles and responsibilities in the event of emergency.

5.5 No-Go Alternative

The “No-Go” option means not going ahead with development and production of oil. If this option is chosen, the area will stay the same, except for

natural changes and other human activities like fishing and shipping.

Choosing the No-Go option means none of the impacts from the proposed Project will occur, and the risks of accidents are avoided, but potential positive socio-economic benefits would also not be realised.

6.0 Need and Desirability

An analysis of the Namibian policy landscape shows that it aims to progressively reduce GHG emissions while, at the same time, ensuring a stable and sufficient energy supply and enabling just and inclusive economic growth, in part through exploitation of its petroleum resources.

Production of local hydrocarbon resources is in principle compliant with and in direct or indirect furtherance of several energy, economy and resource-related policies and plans. Most recently, Namibia's Sixth National Development Plan (NDP6) recognises petroleum development as a potential catalyst for economic diversification, industrialisation, and state revenue.

Energy is fundamental to economic activity and growth, which contribute to Namibia's long-term development and social stability. In the context of ongoing global changes and uncertainties, which can affect Namibian economic activity and energy supply, it is determined to be suitable to diversify national income sources, economic activity and energy sources.

Data shows that oil and gas are very important for the global and Namibian energy supply at present. Globally, current trends and forecasts indicate that oil and gas will likely remain an important source of energy for many years to come, even (and in parallel) with intense efforts to develop alternative low- or no-carbon energy sources, because of high growth in global energy demand. The production from existing fields reduces over time, and new discoveries of oil and gas are required to maintain today's production levels for the foreseeable future.

Even if a project aligns with Namibian policies, the need and desirability of a particular activity (or project) is also determined by whether environmental and social impacts are acceptable, because that indicates the sustainability of a project, an important criterion of policy.

All assessed residual negative impacts of normal operations are deemed to be of Low to Negligible significance. Project impacts are thus deemed environmentally and socially acceptable and sustainable – they do not threaten the viability of any populations or habitats. The project is expected to

have high significance economic benefits, making it desirable from that perspective.

It is very likely that GHG emissions, the key negative impact of the project, would be generated by production in other countries if the project did not go ahead: oil is traded globally, global oil demand depends on the availability and cost of alternative energy sources, and oil is also produced in other countries (global supply does not depend on the Venus project). Therefore, the project's GHG emissions on their own do not necessarily make the project undesirable.

While some impacts associated with assessed unplanned events are of Very High (negative) significance, they are not normal operational scenarios. Measures will (and must) be put in place to 1) actively prevent these events from occurring and 2) response to any events (if they occur) to reduce any impact to significance levels well below those assessed in this ESIA. No irreplaceable resources would be lost in the event of a major incident as assessed.

This analysis shows that:

- The project type is compatible with key needs and desires identified in policy
- Benefits expected from the project are highly significant and respond to needs and desires identified in policy
- Negative impacts can be mitigated to tolerable levels
- GHG emission, the key negative impact, would likely be generated by production elsewhere if the project did not go ahead

7.0 Conclusion

The assessment shows that the proposed Venus Offshore Development Project aligns with Namibia's key national and energy policies (including the 6th National Development Plan), which seek to balance economic growth and GHG emissions reduction.

The project's predicted residual (post-mitigation) negative environmental impacts are assessed as **Low to Negligible significance** under normal operating conditions, except the contribution to GHG, which is assessed as a **Medium – High negative** impact based on EBRD criteria. These GHG emissions will be controlled, through an Energy and Carbon Management Plan, and reported by the Operator during the project-life. The decision to proceed with the project will need to balance its GHG emissions against broader policy objectives—such as climate commitments, economic growth, and

project's overall benefits—rather than evaluating it solely at the project level.

For socio-economic and cultural aspects, during normal operations, certain negative impacts (e.g. reduction in fishing livelihood, maritime traffic and community health and safety) are rated as **Low to Negligible significance**, whereas other aspects, such as contribution to GDP, contribution to exports and trade balance, contribution to government revenue or employment are expected to be highly beneficial in the context of Namibia's current economic activity level and unemployment characteristics, and are assessed to be of **High positive significance**.

Although unplanned events could result in higher-magnitude impacts (**High to Very High negative significance** for a nearshore oil spill), these are considered very unlikely to occur. Prevention and response measures, consistent with the national framework and international best practices, will be implemented to avoid and reduce negative impacts, as described in the Final ESIA Report.

With appropriate safeguards and mitigation measures in place and implemented throughout the project lifecycle, the proposed Venus Offshore Development is considered environmentally acceptable and overall beneficial in terms of socio-economic impact.

This is a Non-Technical Executive Summary of the Final ESIA Report, which contains a lot more detail. If in doubt, information in the Final ESIA Report will prevail.

Table of Contents

1.0 Introduction	1
1.1 Background and Location.....	1
1.2 Objective and Purpose of this Report	4
1.3 Structure of this Report.....	5
2.0 Administrative and Legal Framework	7
2.1 Namibian Institutional and Administrative Framework Applicable to this ESIA.....	7
2.1.1 Ministry of Environment, Forestry and Tourism	7
2.1.2 Ministry of Industries, Mines and Energy	7
2.1.3 Ministry of Works and Transport.....	7
2.1.4 Namibian Ports Authority.....	8
2.1.5 Ministry of Agriculture, Fisheries, Water and Land Reform	8
2.2 Namibian Laws and Policies Applicable to the Environmental Assessment of Oil and Gas Projects.....	8
2.2.1 Policy and Legal Framework for ESIA	8
2.2.2 Legal and Policy Framework for Oil and Gas Projects	11
2.2.3 Selected Other Laws and Policies Relevant to Oil and Gas Development Projects	13
2.3 Key Relevant Namibian Policy and Planning Frameworks.....	16
2.3.1 Energy-Related Plans and Policies.....	16
2.3.2 Economy-Related Policies.....	18
2.3.3 Biodiversity-Related Policies	21
2.3.4 Climate Change-Related Policies	22
2.4 Relevant International Laws and Conventions.....	24
2.5 TotalEnergies Commitments and Policies on Health, Security, Safety, Environment and Social Performance	30
2.5.1 Project Standards for Development Activities	30
2.5.2 General Specifications for ESIAs.....	31
2.5.3 HSE Policies and Social Corporate Commitments.....	31
2.5.4 TotalEnergies Sustainability Approach	33
3.0 ESIA Approach and Process	39
3.1 ESIA Project Team.....	39
3.2 ESIA Assumptions and Limitations.....	42
3.3 ESIA Objectives	43
3.4 ESIA Process	43
3.4.1 Scoping Phase	43
3.4.2 Impact Assessment Phase	46
3.5 Public Consultation Process.....	50



3.5.1 Principles.....	50
3.5.2 Scoping Phase	50
3.5.3 Impact Assessment Phase	58
4.0 Description of the Proposed Activities	65
4.1 Project Overview	65
4.1.1 Field and Resource Characteristics	65
4.1.2 Production Approach.....	65
4.1.3 Project Timeline.....	70
4.1.4 Explanation of Key Terms	70
4.1.5 Rationale for Proposed Production Approach.....	77
4.1.6 Offshore Exclusion and Restriction Areas.....	77
4.2 Development Drilling	79
4.2.1 Overall Drilling Approach.....	79
4.2.2 Description of Drilling Equipment and Bases.....	81
4.2.3 Mobilisation for Drilling	83
4.2.4 Description of Well Drilling.....	83
4.2.5 Drilling Fluids or Muds	89
4.2.6 Resource Requirements.....	92
4.2.7 Discharges, Emissions and Wastes.....	93
4.2.8 Emergency Prevention and Response	98
4.3 Facilities Installation and Commissioning	102
4.3.1 Description of the Subsea Production System.....	102
4.3.2 Installation of the Subsea Production System.....	103
4.3.3 FPSO	106
4.3.4 Commissioning of Flowlines	111
4.3.5 Nearshore Transshipment	111
4.3.6 Resource Requirements.....	112
4.3.7 Discharges, Emissions and Wastes.....	115
4.3.8 Emergency Prevention and Response	118
4.4 Production	118
4.4.1 Production Profile	118
4.4.2 Subsea Production System Operation and Maintenance.....	118
4.4.1 Processing on the FPSO	119
4.4.2 Transfer and Transport of Produced Fluids	121
4.4.3 Resource Requirements.....	123
4.4.4 Discharges, Emissions and Wastes.....	124
4.4.5 Emergency Prevention and Response	127



4.5	Decommissioning	128
4.5.1	Overall Decommissioning Approach.....	128
4.5.2	Resource Requirements.....	130
4.5.3	Discharges, Emissions and Wastes.....	130
4.6	Project Financing.....	131
4.7	Project Alternatives	131
5.0	Description of the Receiving Environment.....	137
5.1	Area of Influence	137
5.2	Previous Offshore Environmental and Geophysical Surveys	137
5.2.1	Environmental Surveys.....	138
5.2.2	Geophysical surveys	139
5.3	Geophysical Characteristics	147
5.3.1	Bathymetry	147
5.3.2	Shelf Geology and Seabed Geomorphology.....	147
5.3.3	Sedimentary Phosphates	152
5.4	Biophysical Characteristics.....	153
5.4.1	Climate	153
5.4.2	Wind Patterns.....	153
5.4.3	Large Scale Circulation and Currents	157
5.4.4	Waves and Tides.....	159
5.4.5	Water Characteristics	160
5.4.6	Upwelling and Plankton Production	161
5.4.7	Turbidity	163
5.4.8	Low Oxygen and Hypoxic Events	164
5.4.9	Organic Inputs.....	164
5.4.10	Natural Hydrocarbon Seeps.....	165
5.5	Biological Characteristics	165
5.5.1	Demersal Communities	169
5.5.2	Seamount Communities	175
5.5.3	Pelagic (Water Column) Communities.....	176
5.5.4	Coastal Communities	206
5.6	Conservation and Sensitive Areas.....	215
5.6.1	National Parks	215
5.6.2	Ramsar Sites.....	215
5.6.3	Important Bird and Biodiversity Areas.....	216
5.6.4	Sensitive Areas	220
5.7	Socio-Economic Environment.....	229



5.7.1 Geographic and Administrative Overview	229
5.7.2 Socio-Economic Characteristics of the Study Area.....	233
5.7.3 Heritage	254
5.7.4 Human Rights Profile	255
5.7.5 Fisheries	260
5.7.6 Other Human Uses.....	287
6.0 Environmental and Socio-Economic Screening of Key Impacts	297
6.1 Environmental and Socio-Economic Interaction Matrix	297
6.2 Aspects and Impacts Register	303
6.3 Minor Screened Out Impacts	303
6.3.1 Availability of Services Supplying the Proposed Activities	303
6.3.2 Ecological Effects due to Routine Discharges to Sea from Vessels	310
6.3.3 Introduction of Invasive Aliens due to Ballast Water Discharge	311
6.3.4 Disturbance of Archaeological Material	312
6.3.5 Release of Radioactive Material	312
6.3.6 Alteration of the Sense of Place / Disturbance of Coastal Towns due to Helicopter Operations.....	313
6.3.7 Ecological, Human Health and Fishing Impacts from Vessel Transit to and from Venus offshore Project Area.....	313
6.3.8 Human Health Effects due to Air Emissions from Helicopters during Transit to and from Venus Offshore Project Area	314
6.3.9 Human Health Effects due to Discharges to Sea in Nearshore Transshipment Area	314
6.3.10 Accidental Loss of Equipment at Sea	315
6.3.11 Hydrocarbon Leak from Plugged Well.....	316
7.0 Impact Assessment of Normal Operations.....	317
7.1 Summary of Modelling Results	317
7.1.1 Underwater Noise Modelling	317
7.1.2 Drill Cuttings Discharge Modelling	322
7.1.3 Commissioning Fluid Modelling	334
7.1.4 Produced Water Modelling	339
7.1.5 Air Quality Modelling	343
7.2 Marine Ecology Impacts	347
7.2.1 Seabed and Benthic Fauna Effects	347
7.2.2 Water Column Effects	372
7.2.3 Marine Fauna Behavioural Disturbance Effects.....	384
7.2.4 Marine Fauna Physical and/or Physiological Injury Effects.....	418
7.3 Fisheries Impacts	440
7.3.1 Impacts to Fisheries and /or Mariculture Operations.....	440



7.4 Socio-Economic Impacts	462
7.4.1 Contribution to GDP	462
7.4.2 Contribution to Exports and Trade Balance	468
7.4.3 Contribution to Government Revenue	471
7.4.4 Potential Benefits from Utilisation of Government Revenue.....	475
7.4.5 Impact on Inflation	476
7.4.6 Dutch Disease	477
7.4.7 Financing of NAMCOR.....	477
7.4.8 Social Cost of Carbon	478
7.4.9 Generation of Employment Opportunities and Income from Local Procurement.....	479
7.4.10 Impact on Skill Levels and Skills Development	484
7.4.11 Impacts on Livelihoods in the Fishing Industry.....	487
7.4.12 Impact on Shipping Traffic	490
7.4.13 Impacts on Community Health and Safety	492
7.4.14 Impact on Governance and Conflict.....	495
7.4.15 Impacts on Coastal Towns.....	498
7.4.16 Impact of Decommissioning on Income and Livelihoods.....	500
7.5 Cultural Heritage Impacts	502
7.5.1 Deterioration of Cultural Heritage	502
7.6 Human Rights Impacts	506
7.6.1 Human Rights Related to Fisheries and Tourism Livelihoods	508
7.6.2 Human Rights Related to Cultural Heritage and Indigenous People	509
7.6.3 Human Rights Related to Community Health and Safety.....	509
7.6.4 Human Rights Related to Climate Change and GHG Emissions	511
7.6.5 Human Rights Related to Governance and Conflict.....	512
7.6.6 Human Rights Related to Meaningful Participation and Access to Information	512
7.6.7 Human Rights Related to Access to Remedy	513
7.6.8 Human Rights Related to National and International Supply Chains: Forced Labour, Modern Slavery, Human Trafficking and Child Labour.....	514
7.6.9 Human Rights Related to Worker Health and Safety	515
7.6.10 Human Rights Related to Workplace Equality, Inclusivity, Discrimination, Harassment and Gender-Based Violence	515
7.6.11 Human Rights Related to Security and Conflict	516
7.6.12 Human Rights Related to Human Rights Defenders	517
7.7 Atmospheric Emissions Impacts.....	518
7.7.1 Increase in Atmospheric Pollutants and Associated Health Risks.....	518
7.7.2 Contribution to Green House Gas Emissions	525
7.7.3 Climate Risks and Opportunities	530



7.8	Transboundary Impacts.....	532
7.8.1	Marine Ecology	532
7.8.2	Socio-Economic	532
7.8.3	Atmospheric Emissions	533
7.9	Cumulative Impacts Assessment.....	533
7.9.1	Introduction	533
7.9.2	Activities Potentially Generating Cumulative Impacts with the Project	534
7.9.3	Potential Biophysical Cumulative Impacts	542
7.9.4	Potential Cumulative Impact on Fisheries.....	545
7.9.5	Potential Socio-Economic Cumulative Impacts.....	546
7.9.6	Cumulative Impact on Cultural Heritage	547
7.9.7	Cumulative Impact on Atmospheric Pollutants and GHG.....	548
8.0	Impact Assessment of Unplanned Events.....	549
8.1	Summary of Modelling Results	549
8.1.1	Oil Spill Dispersion Modelling	549
8.1.2	Air Quality Modelling for nearshore crude oil spill	560
8.2	Offshore Surface Hydrocarbon Spill (Marine Diesel and/or Crude Oil).....	561
8.2.1	Source of Impact	561
8.2.2	Impact on Marine Ecology / Environment	562
8.2.3	Impacts on Fisheries	566
8.2.4	Impacts on Fishing Livelihoods.....	569
8.2.5	Impact on Cultural Heritage	572
8.2.6	Impact on Atmospheric pollutants Emissions.....	572
8.3	Major Oil Spill (Well Blow-Out) in the Venus Offshore Project Area.....	572
8.3.1	Source of Impact	573
8.3.2	Impact on Marine Ecology / Environment	574
8.3.3	Impacts on Fisheries	585
8.3.4	Impact on Fishing Livelihoods	590
8.3.5	Impact on Cultural Heritage	591
8.3.6	Impact on Atmospheric Pollutants and GHG Emissions	593
8.4	Gas Injection Line Rupture in the Venus Project Area	596
8.4.1	Source of Impact	596
8.4.2	Impact on Marine Ecology / Environment	597
8.4.3	Impacts on Fisheries	601
8.5	Nearshore Surface Hydrocarbon (Marine Diesel and / or Crude Oil) Spill.....	603
8.5.1	Source of Impact	603
8.5.2	Impact on Marine Ecology / Environment	604



8.5.3 Impacts on Fisheries and Mariculture	610
8.5.4 Impacts on Fishing and Tourism Livelihoods	613
8.5.5 Impact on Cultural Heritage	617
8.5.6 Increase in Atmospheric Pollutants and Associated Health Risks	619
8.6 Transboundary Impacts	623
9.0 Need and Desirability	625
9.1 Fit of Petroleum Production with the Namibian Planning Framework	625
9.1.1 Energy-Related Plans and Policies	625
9.1.2 Economy-Related Plans and Policies	626
9.1.3 Climate Change-Related Plans and Policies	626
9.2 Broader Context of Petroleum Exploration and Production	627
9.2.1 Context of GHG Emissions	628
9.2.2 Current Energy, Oil and Gas Consumption	634
9.2.4 Outlook for Oil and Gas Consumption and Energy Supply	645
9.2.5 Other Considerations	653
9.3 Conclusion on Need and Desirability	654
10.0 Conclusions and Recommendations	657
10.1 Summary and Evaluation of Impacts from Normal Operations	657
10.1.1 Marine Ecology Impacts	657
10.1.2 Fisheries Impacts	659
10.1.3 Socio-Economic Impacts	660
10.1.4 Cultural Heritage Impacts	662
10.1.5 Human Rights Impacts	662
10.1.6 Air Quality and Climate Impacts	662
10.2 Summary and Evaluation of Potential Impacts from Unplanned Events	673
10.2.1 Hydrocarbon Spill at Venus Offshore Project Area	673
10.2.2 Major Well Blow-Out at Offshore Project Area	674
10.2.3 Gas Injection Line Rupture at Offshore Project Area	674
10.2.4 Hydrocarbon Spill at Nearshore Transshipment Area	675
10.3 Cumulative Impacts	679
10.3.1 Cumulative Biophysical Impacts	679
10.3.2 Cumulative Fisheries Impacts	680
10.3.3 Cumulative Socio-Economic Impacts	680
10.3.4 Cumulative Cultural Heritage Impacts	681
10.3.5 Cumulative Air Quality and GHG Impacts	681
10.4 Implications of the No-Go Alternative	681
10.5 Evaluation and Concluding Statement	682



11.0 References..... 685

Tables

Table 1-1:	Structure and content of the ESIA Report.....	5
Table 2-1:	List of applicable activities that require an ECC in terms of the EIA Regulations 2012.	9
Table 2-2:	Selected Sectorial Laws and Regulation.	13
Table 2-3:	Ratified International Conventions and Treaties	24
Table 3-1:	Details of the ESIA project team and specialists.....	39
Table 3-2:	Requirements of an ESIA Report in terms of Section 15(2) of the EIA Regulations 2012.	47
Table 3-3 :	Proposed Management of Change Procedure.....	49
Table 3-4:	Scoping Phase Public Open House and Meeting Details	55
Table 3-5:	Scoping Phase Focus Group Discussions Details.	56
Table 3-6:	Scoping Phase Dedicated Meeting Details.	57
Table 3-7:	Public locations at which the Draft ESIA Report and Non-Technical Summary were made available.....	59
Table 3-8:	Impact Assessment Phase Public Open House and Meeting Details.....	61
Table 3-9:	Impact Assessment Phase Focus Group Discussion and Dedicated Meetings Details.	62
Table 3-10:	Impact Assessment Phase Online Meeting Details.	64
Table 4-1:	Maritime Exclusion, Restricted and Surveillance Areas for Venus Offshore.	77
Table 4-2:	Example of Well architecture.....	80
Table 4-3:	Main chemicals used in a non-aqueous drilling fluid.	91
Table 4-4:	Estimated fuel consumption for drilling campaign.....	92
Table 4-5:	Estimated sources of anticipated discharges to sea.	93
Table 4-6:	Estimated drilling cuttings and mud discharges.	95
Table 4-7:	Estimated total waste associated with well drilling.....	97
Table 4-8:	Key FPSO characteristics.....	107
Table 4-9:	Estimated fuel consumption for facilities installation and commissioning.	115
Table 4-10:	Estimated sources of anticipated discharges to sea from project utilities installation and commissioning.	116
Table 4-11:	Waste types and management associated with installation and commissioning.	118
Table 4-12:	Estimated fuel consumption during production.	124
Table 4-13:	Estimated sources of anticipated discharges to sea	125
Table 4-14:	Waste types and management associated with production.	126
Table 4-15:	Estimated fuel consumption for decommissioning.	130
Table 4-16:	Summary of key project alternatives considered to date.....	131



Table 5-1:	Summary of the Environmental Surveys undertaken in PEL0056/Block 2913B.	138
Table 5-2:	Ecosystem types, threat status and size for marine ecosystem types on the Namibian coast (adapted from Holness et al. 2014).	166
Table 5-3:	Demersal cartilaginous species found on the continental slope along the southern African west coast and their IUCN (International Union for the Conservation of Nature) conservation status.	174
Table 5-4:	Some of the more important large migratory pelagic fish likely to occur in the offshore regions of Namibian waters and their Global IUCN Conservation Status.	181
Table 5-5:	Important linefish species likely to occur off Central Namibia. The Global IUCN Conservation Status are also provided.	182
Table 5-6:	Global and regional conservation status of the turtles occurring off the southern African coastline.	186
Table 5-7:	Namibian breeding seabird species with their Namibian and global IUCN classification.	188
Table 5-8:	Other bird species that occur in Namibia, with their Namibian and global IUCN classification.	191
Table 5-9:	Cetaceans occurrence off the southern Namibian Coast, their seasonality, likely encounter frequency in PEL0056/Block 2913B and South Africa (Child et al. 2016) and Global IUCN conservation status.	194
Table 5-10:	Seasonality of baleen whales in the broader project area of influence based on data from multiple sources, predominantly commercial catches and data from stranding events.	196
Table 5-11:	Threat status of coastal ecosystem types in the broader project area	207
Table 5-12:	List of coastal Ramsar sites inshore of PEL0056/Block 2913B and the nearshore transshipment area.	215
Table 5-13:	Average Annual Rates of population Growth between 2011 and 2023.	234
Table 5-14:	Lifetime Migration for the Khomas, //Kharas and Erongo Regions.	235
Table 5-15:	Unemployment and Youth Unemployment	248
Table 5-16:	Basic services profile by constituency.	253
Table 5-17:	Profile of private and public services and facilities.	253
Table 5-18:	Ratified Human Rights Treaties.	255
Table 5-19:	List of fisheries that operate within Namibian waters, targeted species and gear types.	261
Table 5-20:	Total Allowable Catches (tonnes) from 2009/10 to 2024/25 (MFMR, 2024).	262
Table 5-21:	Key target species of the large pelagic longline fishery.	266
Table 5-22:	Annual average large pelagic longline catch (tonnes) and effort (hooks) within PEL0056/Block 2913B and the offshore Marine Restricted Area reported as a percentage of the national totals.	268
Table 5-23:	Key target species of the small pelagic purse-seine fishery.	270
Table 5-24:	Key target and bycatch (grey shading) species of the demersal trawl fishery.	274



Table 5-25:	Key target and bycatch (grey shading) species of the tuna pole fishery.....	278
Table 5-26:	Annual average linefish catch (tonnes) and effort (hooks) reported within the nearshore transshipment area reported as a percentage of the national totals. 280	
Table 5-27:	Key target and bycatch species of the linefish fishery.....	281
Table 5-28:	Overview of key Oil and Gas activities in the Southern Benguela region (southern Namibia) since 2007.....	291
Table 6-1:	Environmental and Social Interaction Matrix.....	298
Table 6-2:	Aspects and Impacts Register.....	304
Table 7-1:	Hearing capabilities of marine fauna groups based on composite audiograms	318
Table 7-2:	Modelling scenarios assessed and relevant noise sources.....	318
Table 7-3:	Maximum exposure impact zones for a VSP source scenario (impulsive noise)	320
Table 7-4:	Maximum exposure impact zones for multiple concurrent vessel DPS scenarios (non-impulsive continuous noise)	321
Table 7-5:	Summary of Drilling Discharge Modelling Results	324
Table 7-6:	Summary of Commissioning Effluent Modelling Results.....	336
Table 7-7:	Summary of Produced Water Modelling Results	340
Table 7-8:	Discrete sensitive receptors within 20 km of the nearshore transshipment area (Alternative 1).....	344
Table 7-9:	Impact rating for smothering and disturbance of benthic fauna on unconsolidated sediment.....	363
Table 7-10:	Impact rating for toxicity and hypoxic effects on benthic fauna on unconsolidated sediment.....	367
Table 7-11:	Impact rating for modification of benthic habitat due to presence of subsea infrastructures.	370
Table 7-12:	Mitigation to reduce impacts on benthic fauna from smothering and disturbance of the sediment	371
Table 7-13:	Mitigation to reduce impacts on benthic fauna from reduced sediment quality and/or potential toxicity, and hypoxia due to drilling operations (and associated discharges).....	372
Table 7-14:	Impact rating for bioaccumulation, turbidity and toxicity effects on pelagic and demersal fauna.	382
Table 7-15:	Mitigation to reduce impacts related to reduced water quality.....	383
Table 7-16:	Impact rating for behavioural disturbance to marine mammals.....	397
Table 7-17:	Impact rating for behavioural disturbance to fish.	404
Table 7-18:	Impact rating for behavioural disturbance to turtles	409
Table 7-19:	Impact rating for behavioural disturbance to seabirds.....	415
Table 7-20:	Mitigation to reduce behavioural disturbance impacts related to increased underwater noise from vessel and drilling unit operations across all phases both offshore and nearshore (non-impulsive).	415



Table 7-21:	Mitigation to reduce behavioural disturbance impacts related to underwater noise from VSP operations (impulsive).....	416
Table 7-22:	Mitigation to reduce behavioural impacts related to lighting from drilling and vessel operations (at Venus offshore project and nearshore transshipment area) and non-routine flaring.	417
Table 7-23:	Mitigation to reduce behavioural impacts related to atmospheric and underwater noise from helicopters across all phases.	418
Table 7-24:	Impact rating for physical and/or physiological injury and/or mortality to marine mammals	429
Table 7-25:	Impact rating for physical and/or physiological injury and/or mortality to fish and ichthyoplankton	432
Table 7-26:	Impact rating for physical and/or physiological injury and/or mortality to turtles 438	
Table 7-27:	Mitigation to reduce impacts of vessel collisions with marine fauna.....	439
Table 7-28:	Mitigation to reduce impacts of seawater abstraction offshore.....	439
Table 7-29:	Overview of vessel types and operations associated with each phase of the Project.....	441
Table 7-30:	Average annual catch and effort for large pelagic longline fisheries (2014-2023) recorded within the maritime restricted area and effective exclusion zone reported as a total and a percentage of the national totals.....	447
Table 7-31:	Summary assessment for the overall impact to the large pelagic longline fishery	454
Table 7-32:	Annual average linefish catch reported within larger nearshore transshipment area reported as a percentage of the national totals.....	456
Table 7-33:	Assessment for the overall impact to the linefish fishery.....	458
Table 7-34:	Assessment for the overall impact to the small-scale fishery during the production phase.....	460
Table 7-35:	Recommended measures to mitigate the impact of displacement of fishing operations.	461
Table 7-36:	Estimated Venus project-related share of GDP relative to total estimated GDP in N\$ million, assuming FID in 2026	465
Table 7-37:	Impact rating for the project impact on Namibia's GDP.....	467
Table 7-38:	Estimated value of exports related to the Venus development relative to estimated overall exports.....	469
Table 7-39:	Impact rating for the project impact on Namibia's exports and trade balance 471	
Table 7-40:	Estimated government revenue from the Venus project relative to estimated total revenue assuming FID in 2026	474
Table 7-41:	Impact rating for the project impact on Namibia's government revenue.....	475
Table 7-42:	Impact summary: generation of employment opportunities and income from local procurement.....	482
Table 7-43:	Impact summary: impact on skill levels and skills development.....	487
Table 7-44:	Impact summary: impacts of safety zones on fishing and disruption of the industry	489



Table 7-45:	Impact summary: impact on shipping traffic and disruption of the industry .	492
Table 7-46:	Impact summary: community health and safety impacts.....	494
Table 7-47:	Impact summary: governance and conflict	497
Table 7-48:	Impact summary: impact on coastal towns	499
Table 7-49:	Impact summary: impact of decommissioning on income and livelihoods...	501
Table 7-50:	Normal operations impacts on cultural heritage.....	505
Table 7-51:	Mitigation and management measures to reduce the impact on cultural heritage	506
Table 7-52:	Impact significance ratings for emissions from PEL0056/Block 2913B activities	521
Table 7-53:	Impact significance ratings for emissions from PEL0056/Block 2913B activities	523
Table 7-54:	Mitigation, monitoring and data management recommendations to reduce project related air emissions.....	524
Table 7-55:	Summary of the Project's calculated GHG emissions (25 years)	527
Table 7-56:	Calculation of the additional GHG emissions associated with a potential 10-year extension of the production phase.....	528
Table 7-57:	Thresholds for assessing the significance of a Project's GHG emissions (EBRD 2010).....	529
Table 7-58:	Impact footprints / magnitude of project activities	536
Table 8-1:	Summary of Oil Spill Modelling Results.....	552
Table 8-2:	Ambient pollutant concentrations associated with emissions from an accidental crude oil spill at nearshore transshipment area.....	560
Table 8-3:	Impact rating for an offshore surface hydrocarbon spill (marine diesel and/or crude oil) on marine ecology / environment.....	565
Table 8-4:	Mitigation to reduce impacts for an offshore surface hydrocarbon spill (marine diesel and/or crude oil).	565
Table 8-5:	Summary of potential oil spill contamination of fishing grounds (km ²) based on stochastic modelling results (release position L1, Season 3).....	567
Table 8-6:	Impact to Fisheries and Mariculture from an offshore Hydrocarbon (Marine Diesel and/or Crude Oil Spill).	569
Table 8-7:	Catch and values of the pelagic bait boat and longline fisheries.....	570
Table 8-8:	Impact rating for impact of major offshore hydrocarbon (marine diesel and/or crude oil spill) on fisheries livelihoods.....	571
Table 8-9:	Impact rating for ecological impacts due to a major offshore spill following a well blow-out (worst case scenario).	584
Table 8-10:	Mitigation to reduce impacts of a major oil spill offshore.....	584
Table 8-11:	Summary of potential oil spill contamination of fishing grounds (km ²) based on stochastic modelling results (release position L1, season 3).	588
Table 8-12:	Impact to fisheries and mariculture from a major oil spill following a well blow-out (worst case scenario).	589



Table 8-13:	Impact rating for impact of due to a major offshore spill following a well blow-out (worst case scenario) on fisheries livelihoods.....	591
Table 8-14:	Impact rating for deterioration of cultural heritage links to the sea due to a major offshore spill following a well blow-out (worst case scenario).....	592
Table 8-15:	Evaporative pollutants emissions for well blow-out, and marine diesel spill scenarios.....	594
Table 8-16:	Impact significance ratings for pollutant emissions due to Major Offshore Oil Spill (Well Blow-Out) in Venus Offshore Project Area.....	595
Table 8-17:	Impact rating for ecological effects from a subsea gas injection line rupture. 600	
Table 8-18:	Recommended measures to mitigate the impact of a gas injection line rupture. 600	
Table 8-19:	Impact to fisheries and mariculture from a gas injection line rupture.....	603
Table 8-20:	Impact rating for nearshore hydrocarbon spill	609
Table 8-21:	Mitigation to reduce impacts of a nearshore hydrocarbon spill.	609
Table 8-22:	Summary of potential oil spill contamination of fishing grounds (km ²) based on stochastic modelling results (release position L2, Season 2, crude oil spill). 612	
Table 8-23:	Impact to fisheries and mariculture from a nearshore hydrocarbon spill.	612
Table 8-24:	Predominant Catches for Coastal SSFs	614
Table 8-25:	Coastal SSF Organisations in 2021.....	615
Table 8-26:	Estimate of the value of Namibia's Coastal SSF sector	615
Table 8-27:	Impact rating for impact of nearshore hydrocarbon spill on livelihoods	617
Table 8-28:	Impact rating for deterioration of cultural heritage links to the sea due to nearshore hydrocarbon spill.	619
Table 8-29:	Evaporative pollutant emissions for crude oil and marine diesel spill scenarios 620	
Table 8-30:	Impact of increased ambient air pollutant concentrations from a nearshore hydrocarbon spill	621
Table 9-1:	Total CO ₂ emissions by region from 1750 to 2023, in million t CO ₂	630
Table 9-2:	Total GHG emissions by region from 1850 to 2023, in million t CO ₂ -equivalent	631
Table 9-3:	Namibian total CO ₂ and GHG emissions in million t CO ₂ -e	632
Table 9-4:	CO ₂ emissions by fuel or industry type – World and Namibia, 2023 (in million t CO ₂)	634
Table 9-5:	Energy sources globally 2022 – 2023, in Exajoules.....	635
Table 9-6:	Share of fossil, renewable and low-carbon energy sources by region in 2023	635
Table 9-7:	List of 20 largest oil consumers in 2023.....	638
Table 9-8:	List of 20 largest gas consumers in 2023	638
Table 9-9:	Energy sources Namibia 2021 – 2022 in Exajoules.....	639
Table 9-10:	List of 20 largest oil producers in 2023	641



Table 9-11:	List of 20 largest gas producers in 2023	642
Table 10-1:	Summary of the potential impact significance associated with normal operations	664
Table 10-2:	Summary of the potential impact significance associated with unplanned events <i>if they occur</i>	676

Figures

Figure 1-1:	Locality Map of the Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon), off the southern coast of Namibia, and the proposed nearshore transshipment area near Walvis Bay (green triangle).	2
Figure 2-1:	The axes of TotalEnergies Sustainability Approach.	34
Figure 3-1:	Illustration of ESIA Process phases and steps.	44
Figure 4-1:	Provisional Subsea Production System layout showing the oil production, gas injection, umbilical and mooring lines layout.	67
Figure 4-2:	Concept of oil production at the Venus offshore project area.	68
Figure 4-3:	Schematic of oil production for Venus development.	69
Figure 4-4:	Conceptual design of a Xmas Tree and wellhead.	71
Figure 4-5:	Example of a Flow Line End Termination module.	72
Figure 4-6:	Insertion of a “pig” into a pipeline (left) and a wire brush cleaning pig (right).	73
Figure 4-7:	Applications for offshore pipeline pigging.	73
Figure 4-8:	Conceptual design of a Steel Lazy Wave Risers.	74
Figure 4-9:	Examples of umbilicals.	75
Figure 4-10:	Example of an FPSO.	76
Figure 4-11:	Maritime Exclusion, Restricted and Surveillance Areas for Venus offshore. .	78
Figure 4-12:	Example of a drilling unit (drill ship).	81
Figure 4-13:	Examples of platform supply vessels.	82
Figure 4-14:	Simplified view of well drilling stages.	84
Figure 4-15:	Drilling stages: (A) Riserless drilling stage; and (B) Risered drilling stage. ...	84
Figure 4-16:	Simplified illustration of a mud circulating system.	85
Figure 4-17:	Potential lower and upper well completion design.	88
Figure 4-18:	Schematic of a typical subsea BOP stack.	99
Figure 4-19:	Example of an OSRL Capping Stack.	101
Figure 4-20:	Example of a typical subsea system elements.	103
Figure 4-21:	J-lay pipeline installation method and vessel example.	105
Figure 4-22:	Example of a subsea construction vessel.	106
Figure 4-23:	Example of a flex-lay vessel.	106
Figure 4-24:	Potential FPSO layout (example only).	107
Figure 4-25:	Illustration of FPSO orientation heading.	109
Figure 4-26:	Example of a suction pile.	110
Figure 4-27:	Process to install a suction pile.	110
Figure 4-28:	Locality map of the nearshore transshipment buoy location area.	113
Figure 4-29:	Locality map of the transshipment buoy location area showing two potential locations to illustrate the safety exclusion zone and operational zone.	114



Figure 4-30:	DPST bow loading arrangement.....	122
Figure 4-31:	Possible configurations for transfer from DPST to CT.	123
Figure 4-32:	Pipeline system failure rates over time.	128
Figure 5-1:	Environmental surveys sampling locations, 2018- 2022.	138
Figure 5-2:	Location of the geophysical survey covering the Venus offshore project area.	140
Figure 5-3:	Bathymetry of the northern (top) and southern (bottom) survey areas.	142
Figure 5-4:	Slope gradients in the northern (top) and southern (bottom) survey areas.	143
Figure 5-5:	Seafloor features in the northern (top) and southern (bottom) survey areas.	144
Figure 5-6:	Isolated depressions across the southern survey area.	145
Figure 5-7:	Examples of objects identified on the seafloor highlighting the clarity of the survey imagery.....	146
Figure 5-8:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and the nearshore transshipment area (green triangle) in relation to seabed geomorphic features off Namibia.	149
Figure 5-9:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and the nearshore transshipment area (green triangle) in relation to the marine geology of the Namibian continental shelf.....	150
Figure 5-10:	Example images from pre- and post-drilling video surveys of the Venus 1X area, with evidence of biogenic activity (bioturbation).....	151
Figure 5-11:	Satellite image of aerosol plumes blown offshore during a northeast 'berg' wind with the estimated position of Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon).	154
Figure 5-12:	Wind data by month for a grid point (13°15'37"E; 29°28'37"S) within PEL0056/Block 2913B.	155
Figure 5-13:	Wind data by month for nearshore transshipment area (14°29'06"E; 22°47'00"S).	156
Figure 5-14:	PEL0056/Block 2913B (purple polygon) in relation to major features of the predominant circulation patterns and volume flows in the Benguela System	157
Figure 5-15:	Surface (-5 m) (top) and seabed (- 3 000 m) (bottom) annual current data for years 1993 to 2012 for a grid point (29° 26' 24" S 13° 16' 48") within PEL0056/Block 2913B.	158
Figure 5-16:	Surface annual current data for years 1994 to 2015 for nearshore transshipment area (14°29'06"E; 22°47'00"S).	159
Figure 5-17:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to chlorophyll-a levels off West Coast for June 2021 (top) and January 2022 (bottom).....	162
Figure 5-18:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (yellow triangle) in relation to the Namibian marine biozones and adjacent South African marine ecoregions.	167
Figure 5-19:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the	



	Namibian benthic and coastal ecosystem types and adjacent South African substratum types.....	168
Figure 5-20:	Examples of benthic macroinvertebrate specimens recorded within PEL0056/Block 2913B	172
Figure 5-21:	Phytoplankton (left) and zooplankton (right) associated with upwelling cells.	176
Figure 5-22:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to major spawning areas in the Benguela region.	178
Figure 5-23:	Cape fur seal preying on a shoal of sardine (left). School of horse mackerel (right).....	180
Figure 5-24:	Leatherback (left) and loggerhead turtles (right) occur in Namibian waters.	183
Figure 5-25:	Movements of two green (orange and green lines) and loggerhead (purple and red lines) turtles recorded by telemetry (2025).....	183
Figure 5-26:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to migration corridors of leatherback turtles in the south-western Indian Ocean.	184
Figure 5-27:	Dispersal maps showing trajectories of 5000 virtual, hatchling particles released from the respective nesting sites (iSimangaliso Wetland Park, East Coast of South Africa; white circles) in March 2018 for loggerheads (top) and leatherbacks (bottom).....	185
Figure 5-28:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to seabird breeding colonies and Cape Fur seal colonies and haul out sites. .	187
Figure 5-29:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to GPS tracks recorded for 93 Cape Gannets foraging off four breeding colonies on southern African west coast.	189
Figure 5-30:	Cape Gannets <i>Morus capensis</i> (left) and African Penguins <i>Spheniscus demersus</i> (right) breed primarily on the offshore islands.	189
Figure 5-31:	Utilisation distribution of incubating Black-browed Albatross from Bird Island, South Georgia.	190
Figure 5-32:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the distribution of marine fauna sighted by MMOs within the Namibian EEZ, collated between 2001 and 2024.....	193
Figure 5-33:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to foraging trips of females (left) and males (right) of Cape fur seals at the Cape Frio, Cape Cross and Atlas Bay colonies.	206
Figure 5-34:	Nearshore transshipment area in relation to coastal ecosystem types.....	208
Figure 5-35:	Simplified Network Diagram Indicating the Interaction Between the Key Ecosystem Components off the southern Benguela system.	212
Figure 5-36:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to National Parks and Marine Protected Areas in Namibia and South Africa. .	217
Figure 5-37:	Nearshore transshipment area in relation to Ramsar sites.	218



Figure 5-38:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to confirmed, proposed and candidate IBAs along the coast of Namibia.	219
Figure 5-39:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to threat status (top) and protection levels (bottom) of benthic and coastal ecosystems.	221
Figure 5-40:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to threat status (top) and protection levels (bottom) of pelagic ecosystems. ...	222
Figure 5-41:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to Ecologically and Biologically Significant Areas (EBSAs) and the Ecological Support Areas (ESAs).	226
Figure 5-42:	Namibian Coastline with Protected Areas and Regions in relation to PEL0056/Block 2913B.	230
Figure 5-43:	The //Kharas Region and its Constituencies and Towns.	232
Figure 5-44:	The Erongo Region and Its constituencies and Towns.	233
Figure 5-45:	Population number per region (2023)	234
Figure 5-46:	Population Density and Distribution.	236
Figure 5-47:	Age Composition for Namibia and the //Kharas and Erongo Regions.	237
Figure 5-48:	Age and Sex Pyramids for the //Kharas and Erongo regions and the associated main towns.	237
Figure 5-49:	Type of Dwelling by Area in Erongo Region.	238
Figure 5-50:	Type of Dwelling by Area in //Kharas Region.	239
Figure 5-51:	Mean Household Sizes in the two Regions and its Constituencies in 2023.	240
Figure 5-52:	Growth in Number of Learners by Region.	240
Figure 5-53:	Literacy Rate by Region.	241
Figure 5-54:	Highest level of education population over the age of 15.	242
Figure 5-55:	Namibian GDP Growth 2018 – 2023.	244
Figure 5-56:	Breakdown of GDP by Sector in 2024.	245
Figure 5-57:	Namibian Labour Force.	247
Figure 5-58:	Levels of Unemployment (Strict Definition)	248
Figure 5-59:	Distribution of Health Facilities in the //Kharas Region.	250
Figure 5-60:	Distribution of Health Facilities in the Erongo Region.	251
Figure 5-61:	Annual longline catch (nominal tonnes) of large pelagic species between 2000 and 2022.	267
Figure 5-62:	Monthly average catch (bars) and effort (line) recorded by the large pelagic longline sector within Namibian waters (2004 – 2023).	267
Figure 5-63:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort recorded by the large pelagic longline fisheries offshore Namibia (2013-2023).	268
Figure 5-64:	Schematic diagram of gear typically used by the pelagic longline fishery ...	269
Figure 5-65:	Photographs showing marker buoys (left), radio buoys (centre) and monofilament branch lines (right).	269



Figure 5-66:	Schematic of typical purse-seine gear deployment in the "small" pelagic fishery.	270
Figure 5-67:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the spatial distribution of the annual average catch recorded by the small pelagic purse-seine fishery in Namibia.	271
Figure 5-68:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to the spatial distribution of annual average catch recorded by the mid-water trawl fishery offshore Namibia (2000 – 2022). ...	272
Figure 5-69:	Typical configuration of mid-water trawl gear.....	273
Figure 5-70:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort (no. of trawls) recorded by the demersal trawl fishery offshore Namibia (2012 -2021).....	275
Figure 5-71:	Trawl gear typically used by demersal trawlers targeting hake.	275
Figure 5-72:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort recorded by the demersal longline fishery offshore Namibia (2014-2023).	277
Figure 5-73:	Typical configuration of demersal (bottom-set) hake longline gear.	277
Figure 5-74:	Total nominal pole-line catch (tonnes) within Namibian waters reported to ICCAT from 2000 to 2022 (Namibian (light green) and South African (dark green) flagged vessels).	278
Figure 5-75:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of the annual average catch recorded by the pole-line fishery offshore Namibia (2013-2022).....	279
Figure 5-76:	Typical tuna pole and line operations.	280
Figure 5-77:	Venus offshore project area (red circle) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the spatial distribution of the annual average catch recorded by the linefish fishery offshore Namibia (2007-2020).	281
Figure 5-78:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to deep-water trawl areas.....	282
Figure 5-79:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B and Walvis Bay in relation to the spatial distribution of annual average catch recorded by the deep-sea crab fishery offshore Namibia (2000-2022).....	283
Figure 5-80:	The nearshore transshipment area in relation to mariculture development areas.....	286
Figure 5-81:	Venus offshore project area (black ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to shipping density around southern Africa.	288
Figure 5-82:	2D seismic surveys undertaken in Namibia's offshore EEZ.	290
Figure 5-83:	PEL0056/Block 2913B (red polygon) in relation to Petroleum Exploration and Production Licence Blocks.	291



Figure 5-84:	Venus offshore project area (red ellipse) within PEL0056/Block 2913B (black polygon) in relation to active marine diamond mining concessions and Exclusive Prospecting Mining Licences and telecommunications cables....	294
Figure 5-85:	Nearshore transshipment area (green rectangle) in relation to active marine diamond mining concessions and Exclusive Prospecting Mining Licences and telecommunications cables.	295
Figure 7-1:	Location of the offshore drilling discharge modelling release points for seabed and water column simulations	323
Figure 7-2:	Location of the offshore commissioning effluent modelling release point....	335
Figure 7-3:	Location of the offshore produced water modelling release point from the FPSO	339
Figure 7-4:	Model domain, Alternative 1 modelling location and discrete sensitive receptor locations.....	343
Figure 7-5:	Transfer - P99 24-hour SO ₂ (µg/m ³)	345
Figure 7-6:	Transfer - P99 1-hour NO ₂ (µg/m ³)	346
Figure 7-7:	Transfer - P99 24-hour PM (µg/m ³)	346
Figure 7-8:	Hypothetical dispersion and fates of treated cuttings (from riser sections) following discharge to the ocean from a drilling unit (adapted from Neff 2005).	355
Figure 7-9:	Maximum behavioural impact zone to marine mammals (in blue) during drilling and installation activities (Underwater Noise Modelling Scenario UC-2).	389
Figure 7-10:	Maximum behavioural impact zones during production phase (offshore transshipment operations) (underwater noise modelling scenario UP-1). ...	394
Figure 7-11:	Maximum behavioural impact zone to fish during drilling and installation activities (underwater noise modelling Scenario UC-2).....	448
Figure 7-12:	Maximum behavioural impact zone to fish (underwater noise modelling scenario UP-2) and nearshore transshipment exclusion zone during transshipment operations.	457
Figure 7-13:	Namibian GDP in N\$ million assuming FID in 2026 and oil price of US\$50 per barrel.....	464
Figure 7-14:	Namibian GDP in N\$ million assuming FID in 2026 and an oil price of US\$75 per barrel.....	464
Figure 7-15:	Contributions to GDP in N\$ million by sector in 2023 compared to peak contribution to GDP by Venus project at US\$50 and US\$75 per bbl (approx. 5 years after FO)	466
Figure 7-16:	Goods exports in N\$ million assuming FID in 2026 and oil price at US\$50 per barrel.....	468
Figure 7-17:	Goods exports in N\$ million assuming FID in 2026 and oil price at US\$75 per barrel.....	469
Figure 7-18:	Government revenue in N\$ million assuming FID in 2026 and oil price at US\$50 per barrel.....	473
Figure 7-19:	Government revenue in N\$ million assuming FID in 2026 and oil price at US\$75 per barrel.....	473
Figure 7-20:	Supply Chains offering quick wins for Namibia.	480



Figure 7-21:	Direct, indirect and induced employment by Venus versus employment by sector in 2023.....	481
Figure 7-22:	Local Availability of Qualifications.....	485
Figure 7-23:	Vessel positions on 3 July 2025 along the Namibian Coast.....	490
Figure 7-24:	Benchmarking the Project GHG emissions production phase intensity against the 2015 average GHG emissions intensity of crude oil production for selected countries	530
Figure 8-1:	Location of oil spill modelling release points: L1 in the Venus offshore project area and Point L2 in the Nearshore Transshipment Area	551
Figure 8-2:	Probability of surface oiling as estimated by stochastic oil spill modelling in relation to effort expended by the large pelagic longline fishery (release position L1, Season 3).....	568
Figure 8-3:	A) The weathering processes acting on spilled crude oil, and B) the fate of a typical medium crude oil under moderate sea conditions - the width of each band indicates the importance of the process (ITOPF 2002).	576
Figure 8-4:	Conceptual figure illustrating the biological effects of the Deepwater Horizon oil spill	577
Figure 8-5:	Probability of surface oiling as estimated by stochastic oil spill modelling in relation to effort expended by the large pelagic longline fishery (release position L1, Season 3).....	588
Figure 9-1:	Global change in temperatures in the period of June 2017-June 2022 compared to the period of 1951-1980 (in °C).....	628
Figure 9-2:	Annual CO ₂ emissions by region, in absolute volumes	629
Figure 9-3:	Annual GHG emissions by region, in absolute volumes	631
Figure 9-4:	Namibian annual CO ₂ and GHG emissions in million t CO ₂ -e	632
Figure 9-5:	Namibian and African CO ₂ emissions 1884 – 2023	633
Figure 9-6:	CO ₂ emissions by fuel or industry type – World and Namibia	633
Figure 9-7:	Global energy sources 2000-2023, in Exajoules.....	636
Figure 9-8:	New generation capacity installed globally (percent), 2007-21	636
Figure 9-9:	Energy sources per region in 2022 (absolute and relative)	636
Figure 9-10:	Global oil and gas consumption 1965 to 2023.....	637
Figure 9-11:	Year on year growth rate of oil and gas consumption globally	637
Figure 9-12:	Year on year growth rate of oil and gas production globally.....	640
Figure 9-13:	Global oil and gas production 1965 / 1970 to 2022.....	641
Figure 9-14:	Global oil and gas production 2013 to 2023 in the four largest producers...	642
Figure 9-15:	Volume of conventional oil and gas discoveries since 1900	643
Figure 9-16:	Location and volume of oil and gas discoveries since 2000.....	643
Figure 9-17:	High impact well drilling activity 2020 – 2025.....	644
Figure 9-18:	Expected high impact well drilling focus in 2025.....	644
Figure 9-19:	Predicted outlook for global population, GDP per capita, energy intensity and energy-related carbon intensity to 2050.....	647
Figure 9-20:	Outlook for global primary energy use to 2050	647
Figure 9-21:	Outlook for the global primary energy mix for different scenarios in 2050...	648
Figure 9-22:	Projection for electric vehicle penetration in selected regions by 2025	649
Figure 9-23:	Projection for change in global electricity generating capacity (2050).....	649
Figure 9-24:	Possible technologies trajectories in selected regions 2020 – 2050	649



Figure 9-25: Outlook for natural gas trade 2020 – 2050	650
Figure 9-26: Projected development of energy demand to 2050.....	651
Figure 9-27: Projected development of oil and gas demand to 2050	651
Figure 9-28: Predicted oil demand vs proven reserves, and required investment.....	652
Figure 9-29: Predicted LNG demand growth	652



Appendices

Volume 1:

- Appendix A: Curricula Vitae of the SLR ESIA Project Team
- Appendix B: Acceptance of Final Scoping Report
- Appendix C: SAIEA Independent Review Report
- Appendix D: Method for Assessing Impact Significance
- Appendix E: Public Participation Documents
 - Appendix E.1: Stakeholder Database
 - Appendix E.2: Advertisements
 - Appendix E.3: Site Notices
 - Appendix E.4: Radio Announcements
 - Appendix E.5: I&AP Notification Letters and Emails
 - Appendix E.6: Non-Technical Summary
 - Appendix E.7: Public Consultation Pamphlet
 - Appendix E.8: Public Meeting Presentation
 - Appendix E.9: Posters
 - Appendix E.10: Meeting Minutes and Photographs
 - Appendix E.11: I&AP Correspondence
 - Appendix E.12: Comments and Responses Report

Volume 2:

- Appendix F: Environmental and Social Management Plan

Volume 3:

- Appendix G: Underwater Noise Modelling
- Appendix H: Drilling Discharge Modelling
- Appendix I: Commissioning Effluent Modelling
- Appendix J: Produced Water Modelling
- Appendix K: Oil Spill Modelling

Volume 4:

- Appendix L: Marine Ecology Impact Assessment
- Appendix M: Fisheries Impact Assessment
- Appendix N: Socio-Economic Impact Assessment
- Appendix O: Cultural Heritage Impact Assessment
- Appendix P: Air Quality Impact Assessment
- Appendix Q: Climate Change Risk Assessment
- Appendix R: Waste Management Study
- Appendix S: Conceptual Decommissioning and Closure Study



Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AFEP	Association Française des Entreprises Privées
AFOLU	Agriculture, Forestry and Other Land Use
ARO	Asset Retirement Obligation
AIS	Automatic Identification System
BAT	Best Available Techniques
BCC	Benguela Current Convention
BCLME	Benguela Current Large Marine Ecosystem
BID	Background Information Document
BOCP	Blow-Out Contingency Plan
BOD	Biological Oxygen Demand
BOP	Blow-Out Preventer
Btu	British thermal units
CAPEX	Capital Expenditure
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CERD	Convention on the Elimination of All Forms of Racial Discrimination
CITES	Convention on International Trade of Wild Fauna and Flora Endangered Species
CLC	Convention on Civil Liability for Oil Pollution Damage
CMS	Convention on Migratory Species
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CRR	Comments and Responses Report
CSR	Corporate Social Responsibility
CT	Conventional Tanker
DEA	Directorate of Environmental Affairs
DPST	Dynamic Positioned Shuttle Tanker
DSR	Draft Scoping Report
DST	Drill Stem Test
FSR	Final Scoping Report
EBSA	Ecologically or Biologically Significant Area
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EDP	Emergency Disconnect Package
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative
EPL	Exclusive Prospecting Licence
ERC	Erongo Regional Council
ESA	Ecological Support Area
ESG	Environmental, Social and Governance
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAQ	Frequently Asked Questions
FEED	End Engineering Designs
FID	Final Investment Decision
FLETs	Flow Line End Terminations
FNCC	Franco Namibian Cultural Centre
FPSO	Floating Production Storage and Offloading
FSO	Floating Storage and Offloading
FSR	Final Scoping Report
GHG	Greenhouse Gases
GI	Gas Injection
GIIP	Good International Industry Practice



Acronym/ Abbreviation	Definition
GN	Government Notice
GRI	Global Reporting Initiative
HAFA	Hanganeni Artisanal Fishing Association
HP	High-Pressure
HPP	Harambee Prosperity Plan
HSE	Health, Safety and Environment
I&APs	Interested and Affected Parties
ICCAT	International Convention for the Conservation of Atlantic Tunas
ICESCR	International Covenant on Economic, Social and Cultural Rights
ICSS	Integrated Control and Safety System
IEA	International Energy Agency
ILO	International Labour Organisation
ILTs	Line Tees
IMO	International Maritime Organisation
IPIECA	International Petroleum Industry Environmental Conservation Association
IOGP	International Association of Oil and Gas Producers
IPPU	Industrial Processes and Product Use
JV	Joint Venture composed of TotalEnergies EP Namibia B.V., Impact Oil & Gas Namibia (Pty) Ltd (“Impact Oil & Gas”), NAMCOR, QatarEnergy International E&P LLC (“QatarEnergy”), all holding the PEL 0056 for Block 2913B
JV Operator	TotalEnergies EP Namibia B.V.
LLP	Low-Low-Pressure
LNG	Liquefied Natural Gas
LP	Low-Pressure
LRP	Lower Riser Package
LUCORC	Lüderitz upwelling cell – Orange River Cone
LWD	Logging While Drilling
MAFWLR	Ministry of Agriculture, Fisheries, Water and Land Reform
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
MEA	Maritime Exclusion Area
MEFT	Ministry of Environment, Forestry and Tourism
MEG	Monoethylene Glycol
MFMR	Ministry of Fisheries and Marine Resources
MGO	Marine Gas Oil
MHAISS	Ministry of Home Affairs, Immigration, Safety and Security
MIME	Ministry of Industries, Mines and Energy
MIRT	Ministry of International Relations and Trade
MOC	Management of Change
MoU	Memorandum of Understanding
MP	Medium-Pressure
MPA	Marine Protected Area
MSDS	Material Safety Data Sheet
MRA	Maritime Restricted Area
MSA	Maritime Surveillance Area
MSDS	Material Safety Data Sheet
MSP	Marine Spatial Planning
MTI	Ministry of Trade and Industry
MURD	Ministry of Urban and Rural Development
MWT	Ministry of Works and Transport
NABM	Non-Aqueous Based Mud
NADF	Non-Aqueous Drilling Fluid
NAMPORT	Namibia Ports Authority
NBSAP	National Biodiversity Strategy and Action Plan



Acronym/ Abbreviation	Definition
NCCC	National Climate Change Committee
NCCP	National Climate Change Policy
NCCSAP	National Climate Change Strategy and Action Plan
NCE	Namibian Chamber of Environment
NDC	Nationally Determined Contribution
NDP6	Sixth National Development Plan
NID	National Inventory Document
NIPDB	Namibia Investment Promotion and Development Board
NEBA	Net Environmental Benefit Analysis
NIMPA	Namibian Islands' Marine Protected Area
NIRP	National Integrated Resource Plan
NMVOC	Non-Methane Volatile Organic Compounds
NNF	Namibia Nature Foundation
NTLA	Nama Traditional Leaders Association
OECD	Organisation for Economic Co-operation and Development
OGDC	Oil and Gas Decarbonization Charter
OOC	Oil on Cuttings
OP	Oil Producer
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
PAH	Polycyclic Aromatic Hydrocarbon
PCS	Process Control System
PEL	Petroleum Exploration Licence
PIT	Petroleum Income Tax
PM	Particulate Matter
ROV	Remote Operating Vehicle
SAN	South African Navy
SAS	Stand Alone Screens
SASB	Sustainability Accounting Standards Board
SAIEA	Southern African Institute for Environmental Assessment
SCR	Steel Catenary Riser
SDG	Sustainable Development Goals
SEP	Stakeholder Engagement Plan
SEPLA	Suction Embedded Plate Anchor
SIA	Socio-Economic Impact Assessment
SIS	Safety Instrumented System
SLR	SLR Environmental Consulting (Namibia) (Pty) Ltd
SLWR	Steel Lazy Wave Risers
SME	Small and Medium Enterprise
SMMEs	Small, Medium and Micro Enterprises
SOLAS	International Convention for the Safety of Life at Sea, 1974
SOPEP	Shipboard Oil Pollution Emergency Plans
SRFP	Ship Recycling Facility Plan
TB	Tuberculosis
TCEQ AEGL-1	Texas Commission on Environmental Quality Acute Exposure Guideline Level-1
TEEPNA	TotalEnergies EP Namibia B.V.
TCFD	Task Force on Climate-related Financial Disclosures
TDP	Touch Down Point
TIV	Tubing Isolation Valve
TPH	Total Petroleum Hydrocarbon
TR-SCSSV	Tubing Retrievable Surface Controlled Subsurface Safety Valve
TVDSS	True Vertical Depth Subsea
UCT	University of Cape Town



Acronym/ Abbreviation	Definition
UN	United Nations
UNAM	University of Namibia
UNCBD	United Nations Convention on Biological Diversity
UNCLOS	United Nations Law of the Sea Convention
UDHR	Universal Declaration of Human Rights
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VLA	Vertical Load Anchors
VOC	Volatile Organic Compounds
VPSHR	Voluntary Principles on Security and Human Rights
VSP	Vertical Seismic Profiling
WBM	Water-Based Mud
WHO AQG	World Health Organisation Air Quality Guidelines
WHRU	Waste Heat Recovery Units
YOSPIN	Youth Oil Spill Preparedness Initiative Namibia



General Terminology

Terms	Definition
Activity	An “activity” is defined as a distinct process or risk undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation.
Area of Influence	The IFC Performance Standard 1 defines the area of influence as: • The area likely to be affected by: (i) the project and the client’s activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities’ livelihoods are dependent. • Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable. • Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted In practical terms, the area of influence indicates where and to what extent the Operator should focus its efforts on analysing, mitigating and compensating for the direct and indirect impacts of the proposed project.
Area of Interest	The Area on Interest is the area within the licence block that the operator has identified, based on available data, for the proposed activities.
Aspect	An environmental or social ‘aspect’ is an element of an organisation’s activities, products and services which can interact with the natural and social environment. The interaction of an aspect with the natural and social environment may result in an impact.
Baseline	A description of the physical, biological and socio-economic environment based on data and information from the pre-project conditions that provides a reference against which any future changes associated with a project can be assessed, and which provides information for subsequent monitoring of biodiversity performance. The baseline should identify and describe the attributes of the physical, biological, socio-economic and cultural receiving environment both in the immediate and wider area around a project site.
Cumulative Impact	Impacts that in combination with other impacts from the same project or other existing or planned (but reasonably foreseeable) projects affect the same environmental or social resources and/or receptors as the Project. They may be of two types: • Additive - impacts that may result from the combined or incremental effects of future planned activities (i.e. those developments currently in planning and not included as part of the existing baseline conditions); or • In-combination - impacts where individual project-related impacts are likely to affect the same environmental or socioeconomic feature (e.g., a combined effect of noise and drill cutting on a receptor acting together in space and time could result in increased effects greater than the individual effects in isolation).
Effect	Effect is a change in a variable or parameter caused or influenced by a project activity, but where no judgement or evaluation is made about the consequence of this change on a receptor. Effects are typically related to abiotic or physico-chemical changes (e.g., change in water quality, air quality or noise) (see ‘Impact’ below)



Terms	Definition
Embedded or Project Controls	The physical or procedural measures that are built into the design or operation of a project and required by law or standard for good international industry practice and which serves to mitigate potential consequences on the environment (e.g., application of MARPOL standards; installation of air quality scrubbers on smoke stacks). These measures are typically incorporated into the project description and should not be considered additional mitigation measures in the evaluation of post-mitigation impact significance.
Footprint	The area directly affected by a project usually through physical disturbance such as land clearance and placement of infrastructure and which falls within the direct area of influence of the project.
Joint Venture partner(s)	A Joint Venture partner(s) is a party/company that collaborates with others to share resources, expertise, and costs to achieve a project's goals.
Impact	Impact is a change resulting from an aspect acting on a natural or environmental and socio-economic receptor (e.g., impact of air quality change on nearby settlement or impact of water quality change on instream biota etc.). Impacts are evaluated in an ESIA process using an agreed impact assessment methodology taking into account aspects such as receptor sensitivity, intensity, extent and duration. Impacts can be direct, indirect, induced, or cumulative.
Mitigation Hierarchy	A process of sequentially prioritising the application of measures to avoid, mitigate, restore and offset impacts to minimise impacts to as low as reasonably possible (ALARP).
Offset	Measures taken to compensate for any significant residual, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve no net loss or preferably a net gain of biodiversity.
Operator	An Operator, in the oil and gas industry, is the entity responsible for managing and controlling the operations within an offshore licence block, including drilling, production, and maintenance activities.
Planned Impact	An impact that is expected as a result of a Project's planned activity (e.g., generation of drill cuttings during drilling), i.e. impacts related to normal operations. Planned impacts would include a standard or normal occurrence that may arise during routine project activities (including small uncontrolled discharges during normal operations), as opposed to an unplanned event (such as well blow out, tanker collision, dam break etc.).
Pre-Mitigation	The assessment of impact significance <u>before</u> mitigation has been applied but which includes the implementation of embedded control measures.
Project	The Project includes all the infrastructure components and activities which form part of the development, including all related and ancillary facilities or infrastructure (e.g., power and water supply, roads, waste services etc.) without which the Project cannot proceed. It also includes any other developments or activities which follow as a necessary consequence of the project. The IFC Performance Standard 1 defines the term “project” as a set of business activities, including those where specific physical elements, aspects, and facilities likely to generate risks and impacts, have yet to be identified. Where applicable, this could include aspects from the early developmental stages through the entire life cycle (design, construction, commissioning, operation, decommissioning, closure or, where applicable, post-closure) of a physical asset.
Residual impact	The assessment of impact significance <u>after</u> additional technically feasible and agreed mitigation has been applied in accordance with the mitigation hierarchy (including the implementation of embedded control measures).



Terms	Definition
Receptor	Receptors are environmental components, people and cultural heritage assets that may be affected (adversely or beneficially) by the proposed project. They can be categorised into three types: • Physical marine environment (i.e. non-living (abiotic) environmental components, e.g., water and air quality, marine sediments, geology, noise, etc.). • Biological environment (i.e. terrestrial, coastal and marine habitats, flora and fauna, protected areas, etc.). • Socio-economic (i.e. local economy, people, settlements, livelihoods (e.g., resource users), and cultural heritage, etc.).
Scoping	Scoping is the process of defining the range of issues and alternatives to be considered and the approach to be followed in an ESIA process. It is typically designed to focus the ESIA on significant issues including those perceived as important by stakeholders.
Sensitivity	A term used to denote the importance or value or vulnerability of a receptor to an impact. Sensitivity ratings are defined specific to different receptor types.
Screening	Screening is a process to determine whether a proposed activity requires an environmental assessment, as well as the type and level of assessment required and is typically undertaken prior to commissioning an ESIA process. The term may also be used as a high-level assessment of potential impacts that may arise, for example, through the use of an activity- impact interaction matrix.
Unplanned Impact	Impacts that result from an unplanned or non-routine event and which are not reasonably foreseeable or expected during the Project. The probability or likelihood of occurrence is described when assessing unplanned impacts but is not used to influence the significance rating. Unplanned events include a fuel/oil spill during drilling operations but does not include routine spills during normal operations.



1.0 Introduction

This chapter provides the background and location of the proposed project, and describes the objectives, purpose and structure of this report.

1.1 Background and Location

TotalEnergies EP Namibia B.V.(TEEPNA) and its Joint Venture (JV) partners (at present Impact Oil & Gas, NAMCOR and QatarEnergy)¹ are the joint holders of a Petroleum Exploration Licence (PEL0056) over Block 2913B, located off the southern coast of Namibia (see Figure 1-1). PEL0056/Block 2913B covers an area of 8 215 km² in extent and is located approximately 300 km from Oranjemund, 320 km from Lüderitz and 700 km from Walvis Bay, in water depths ranging from 2 600 to 3 300 m. TEEPNA is currently the JV Operator of PEL0056/Block 2913B.

As part of the process of applying for offshore exploration and appraisal drilling activities in the PEL0056/Block 2913B, an Environmental and Social Impact Assessment (ESIA) process was undertaken, which culminated in the Ministry of Environment, Forestry and Tourism (MEFT) issuing an Environmental Clearance Certificate (ECC) for the proposed drilling activities on 19 September 2019 (MEFT Ref No. ECC-00134). The ECC was issued for an initial period of three years, expiring on 19 September 2022, which was then renewed for an additional two periods of three years, expiring on 28 July 2028 (ECC-2502750).

In addition to the above exploration and appraisal drilling activities, 3D seismic surveys were conducted in PEL0091/Block 2912 and PEL0056/Block 2913B under ECC-01475 (Seismic Survey Programme). This seismic ECC was issued for an initial period of three years, expiring on 29 June 2024, and was renewed for an additional three year, expiring on 27 August 2027 (ECC-2401779).

To date, the JV has undertaken the following key exploration and appraisal activities in PEL0056/Block 2913B related to Venus field:

- Drilled Venus-1X exploration well between November 2021 and March 2022, resulting in a significant discovery of light oil with associated gas;
- Conducted seismic surveys (also partially on PEL91/Block 2912) from December 2022 to February 2023 and from December 2023 to February 2024;
- Drilled Venus-1A appraisal well between March and June 2023;
- Re-entered Venus-1X well and undertook a Drill Stem Test (DST²) between June and September 2023 to investigate the ability to flow hydrocarbons from the Venus-1X well;
- Re-entered Venus-1A well and undertook a DST between September and December 2023;
- Drilled Venus-2A appraisal well and undertook a DST between December 2023 and April 2024; and
- Performed geophysical and geotechnical survey in Venus offshore project area from May 2024 to March 2025.

End of operations close-out reports were delivered to MEFT for each activity performed as part of the above-mentioned ECCs' Terms and Conditions. .

¹ Partners and their respective shares (participation interests) can change over the course of a project.

² Drill stem tests are typically performed on exploration wells, and are often the key to determining whether a well has discovered a commercial hydrocarbon reservoir. These tests most typically consist of alternating flow and buildup periods to determine reservoir pressure, permeability thickness and flow potential.



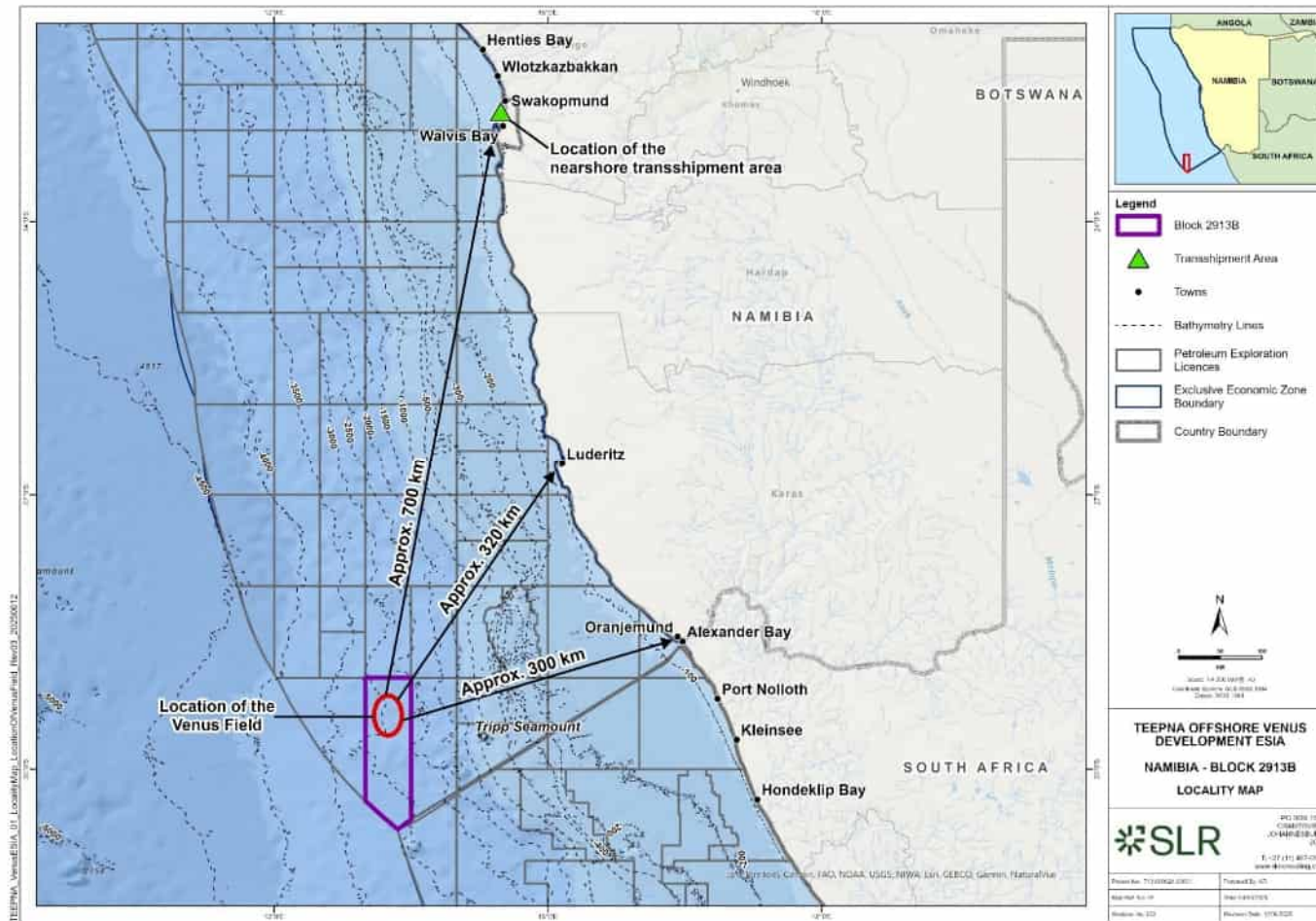


Figure 1-1: Locality Map of the Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon), off the southern coast of Namibia, and the proposed nearshore transshipment area near Walvis Bay (green triangle).



Based on the exploration and appraisal results, as well as ongoing development studies, TEEPNA and its JV partners are studying the feasibility to develop the offshore Venus field, located in PEL0056/Block 2913B, to produce crude light oil for commercialisation. The Venus offshore project area is located in the northern portion of the PEL0056/Block 2913B, on an area of ~165 km² on the seabed in a water depth of ~3 000 m (see Figure 1-1). The development footprint extends ~20 km in a NW-SE direction and ~15 km in an E-W direction.

The proposed offshore development programme includes the following activities:

- Construction (drilling and installation) activities (approximately 4 years):
 - o Drilling of up to 40 development wells, including 20 Oil Producer (OP) wells and 20 Gas Injection (GI) wells. Before completion, some wells may be tested to refine the knowledge of the reservoir characteristics;
 - o Installation and commissioning of subsea infrastructure, which includes all equipment located on or below the seabed used to extract hydrocarbons from the reservoir and connect the wells to the Floating Production, Storage, and Offloading unit (FPSO), including wellhead, Christmas (Xmas) trees, flow line tie-ins and end-points, and Subsea Umbilicals, Risers, and Flowlines (SURF);
 - o Mobilisation, mooring and commissioning of the FPSO;
 - o Installation of a mooring buoy in a nearshore transshipment area³, ~5 km from the coast, located ~20 km north of Walvis Bay, to support oil transshipment operations; and
 - o Onshore, marine and aviation support operations using available facilities.
- Production (operation) activities (21 years, with the option of extending production by an additional 10 years):
 - o Offshore production operations, including the activities of the Dynamically Positioning Shuttle Tankers (DPST), which will be used to offload the produced oil from the FPSO;
 - o Nearshore transshipment operations in an area ~5 km from the coast located ~20 km north of Walvis Bay, where the DPST will offload the produced oil to a conventional tanker, which will then transport the oil to its final destination; and
 - o Onshore, marine and aviation support operations using available facilities.
- Decommissioning activities (approximately 1.5 years)⁴:
 - o Flush and clean subsea network;
 - o Disconnect the FPSO from the mooring system, recover top chains and mooring lines. Bottom chain and mooring piles may remain in the seabed. The FPSO will then be towed to an approved recycling facility for cleaning and recycling if it cannot be re-used;
 - o Removal of underwater / seabed installations, including risers, flowline and In line tees (ILT) / flowline end termination (FLET), jumpers, Xmas trees and

³ The final location of the mooring buoy will be within the proposed transshipment area.

⁴ Decommissioning planning is in the early conceptual phase where preliminary estimates and plans are made to inform initial budgets and assess feasibility. In this regard, a Conceptual Decommissioning and Closure Strategy has been compiled as part of the ESIA. This plan, to be approved by Authorities, will be refined and updated during the operational phase, which will determine the final outcome with respect to the removal of infrastructure and equipment from the seabed, stakeholder engagement and ongoing research within the industry.



umbilicals, shall be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed;

- o Plug and abandonment of development wells following standard procedures. Wellheads will not be recovered;
- o Removal of the nearshore transshipment buoy; and
- o Onshore, marine and aviation support operations using available facilities.

The proposed project triggers a number of listed activities in terms of the Environmental Impact Assessment (EIA) Regulations 2012, and as such requires an ECC before these activities can commence.

SLR Environmental Consulting (Namibia) (Pty) Ltd (SLR) was appointed as the independent Environmental Assessment Practitioner (EAP) to manage the ECC application and to undertake a Scoping and EIA process for the proposed development and production activities (hereafter collectively referred to as “Environmental and Social Impact Assessment” or “ESIA” process). SLR, in turn, appointed Urban Dynamics Africa (Urban Dynamics) to manage the Stakeholder Engagement process.

1.2 Objective and Purpose of this Report

This Final ESIA Report has been prepared in compliance with Section 15(2) of the EIA Regulations 2012, as part of the ESIA process that is being undertaken for the application by the JV for the proposed development of the Venus field in offshore PEL0056/Block 2913B. The key objective of this report is to identify, assess and report on potential impacts the proposed project may have on the receiving environment considering both normal operations and unplanned events. This ESIA Report describes and analyses what the consequences of the project activities will be in terms of potential impacts on the biophysical and socio-economic environment and, by applying the Mitigation Hierarchy, identifies how negative impacts can, as far as possible, be avoided or mitigated and controlled, and how positive impacts can be enhanced.

The compilation of this Final ESIA Report has been informed by comments received from Interested and Affected Parties (I&APs) following the distribution of the draft report for review and comment from 3 November to 3 December 2025 and those raised during public engagements held in Bethanie, Keetmanshoop, Lüderitz, Oranjemund, Windhoek, Swakopmund, Henties Bay and Walvis Bay, as well as from online focus group and public meetings. Written comments received by SLR and/or Urban Dynamics during this period, including those received after the comment period closed, are recorded and responded to in a Comments and Responses Report (see Appendix E.12). **It should be noted that all significant changes to the Draft ESIA Report are underlined and in a different font (Times New Roman) to the rest of the text.**

This report is submitted to MEFT: Directorate of Environmental Affairs (DEA), as well as the Ministry of Industries, Mines and Energy (MIME): Directorate of Petroleum Affairs, Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR) and Ministry of Works and Transport (MWT) for consideration and review. In terms of Section 32 of the Environmental Management Act, 2007 (No. 7 of 2007), MIME is required to make a recommendation on the acceptance or rejection of the report to the MEFT: DEA, who will make the final decision on the ECC application.



1.3 Structure of this Report

This report has been prepared in compliance with Section 15(2) of the EIA Regulations 2012 (see Table 3-2). An overview of the structure and content of this report is given in Table 1-1 below.

Table 1-1: Structure and content of the ESIA Report.

Section	Contents
VOLUME 1	MAIN REPORT
Executive Summary	Provides a synopsis of the ESIA Report.
Chapter 1	Introduction Provides the background and location of the proposed activity, and describes the objectives, purpose and the structure of this report.
Chapter 2	Administrative and Legal Framework Outlines the Namibian administrative framework, key legislative requirements and other relevant local legislation and international conventions applicable to the proposed activities and ESIA process.
Chapter 3	ESIA Approach and Process Presents the ESIA project team, ESIA assumptions and limitations, and outlines the approach and process followed during the ESIA, including public participation aspects.
Chapter 4	Description of the Proposed Activities Provides general information and a detailed description of the proposed activities and associated alternatives.
Chapter 5	Description of the Receiving Environment Describes the existing physical, biological, socio-economic and cultural environment that could potentially be affected by the proposed development and production activities.
Chapter 6	Environmental and Socio-Economic Screening of Key Impacts Provides a high-level screening of the interaction between project activities and the receiving environment and a project-specific Aspects and Impacts Register to ensure that all environmental and social aspects of the proposed activities and the associated impacts were identified; and presents those impacts that are considered to be insignificant impacts that were screened out for further consideration during the Scoping Phase.
Chapter 7	Impact Assessment of Normal Operations Describes and assesses the potential impacts related to normal operations (e.g., drilling operations, discharge of wastes, production, transshipment, etc.) on the receiving environment. Mitigation/management measures are also presented.
Chapter 8	Impact Assessment of Unplanned Events Describes and assesses the potential impacts related to unplanned activities (e.g., operational spills, blow-outs, etc.) on the receiving environment. Mitigation/management measures are also presented.
Chapter 9	Need and Desirability Provides an overview of the national policies informing the need and desirability for the project and analyses the need for and desirability of the proposed development project based on its 'fit' with the policy and planning framework adopted by the Namibian administration.



Section	Contents
Chapter 10	Conclusions Provides conclusions to the ESIA and the acceptability of residual environmental and social impacts of the proposed activities and provides a recommendation and conclusion regarding the issuing of an ECC.
Chapter 11	References Provides a list of the references used in compiling this report.
Appendices A - E	Appendix A: Curricula Vitae of the SLR ESIA Project Team Appendix B: Acceptance of Final Scoping Report Appendix C: SAIEA Independent Review Report Appendix D: Method for Assessing Impact Significance Appendix E: Public Participation Documents <u>Appendix E.1: Stakeholder Database</u> <u>Appendix E.2: Newspaper Advertisements</u> <u>Appendix E.3: Site Notices</u> <u>Appendix E.4: Radio Announcements</u> <u>Appendix E.5: I&AP Notification Letters and Emails</u> <u>Appendix E.6: Non-Technical Summary</u> <u>Appendix E.7: Public Consultation Pamphlet</u> <u>Appendix E.8: Public Meeting Presentation</u> <u>Appendix E.9: Posters</u> <u>Appendix E.10: Meeting Minutes and Photographs</u> <u>Appendix E.11: I&AP Correspondence</u> <u>Appendix E.12: Comments and Responses Report</u>
VOLUME 2	ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN
Appendix F	Environmental and Social Management Plan (ESMP) Presents the ESMP prepared for the proposed project, which sets out the implementation, management and control of the mitigation measures, as well as the monitoring and reporting requirements.
VOLUME 3	TECHNICAL STUDIES
Appendices G-K	Appendix G: Underwater Noise Modelling Appendix H: Drilling Discharge Modelling Appendix I: Commissioning Effluent Modelling Appendix J: Produced Water Modelling Appendix K: Oil Spill Modelling
VOLUME 4	SPECIALIST STUDIES
Appendices K-R	Appendix L: Marine Ecology Impact Assessment Appendix M: Fisheries Impact Assessment Appendix N: Socio-Economic Impact Assessment Appendix O: Cultural Heritage Impact Assessment Appendix P: Air Quality Impact Assessment Appendix Q: Climate Change Risk Assessment Appendix R: Waste Management Study Appendix S: Conceptual Decommissioning and Closure Strategy



2.0 Administrative and Legal Framework

This chapter outlines the Namibian administrative framework, key legislative requirements and other relevant local legislation and international policy and planning framework applicable to the proposed activities and ESIA process.

2.1 Namibian Institutional and Administrative Framework Applicable to this ESIA

2.1.1 Ministry of Environment, Forestry and Tourism

MEFT is the custodian of Namibia's natural environment, and its mission is to "*promote biodiversity conservation in the Namibian environment through the sustainable utilisation of natural resources and tourism development for the maximum social and economic benefit of its citizens*". MEFT develops, administers and enforces environmental legislation and policy.

The Ministry comprises six directorates; one of which is the DEA. DEA gives effect to Article 95L of the Constitution by promoting environmental sustainability. The Environmental Commissioner serves as head of the DEA. The DEA administers ESIA processes undertaken in terms of the Environmental Management Act, 2007 and the EIA Regulations 2012 and will be responsible for issuing a decision on the ESIA and ECC application with input from MIME. If approved, the DEA will issue an ECC for the proposed project.

2.1.2 Ministry of Industries, Mines and Energy

MIME is responsible for promoting and regulating the development and use of Namibia's (non-living) natural resources. The Ministry comprises seven directorates; one of which is the Directorate of Petroleum Affairs.

The Directorate of Petroleum Affairs regulates the petroleum industry and is administered by the Petroleum Commissioner. It issues licences for petroleum exploration and production under Sections 38 and 46 of the Petroleum (Exploration and Production) Act, 1991, respectively. As noted in Section 1.1, the JV partners jointly hold a Petroleum Exploration Licence (PEL0056) over Block 2913B. A Petroleum Production Licence (PPL) is, however, required from MIME in terms of Section 9 of the Petroleum (Exploration and Production) Act, 1991 prior to the commencement of any production activities.

As noted previously, an ECC is also required prior to the commencement of production activities, as per the Environmental Management Act, 2007 and EIA Regulations 2012. MEFT requires that ECC applications related to oil and gas developments must be submitted to MIME, as the Competent Authority, with responsibility assigned to the Petroleum Commissioner. On conclusion of the ESIA process, MIME will make a recommendation on the ECC application to MEFT, who in turn makes the final decision on the application for ECC.

2.1.3 Ministry of Works and Transport

The MWT is responsible for infrastructure development and setting transport policy and regulation. MWT comprises four departments, one of which is the Department of Transport.

The Directorate of Maritime Affairs falls under the Department of Transport. This Directorate is responsible for ensuring the safety of life and property at sea; the prevention and combat of pollution of the marine environment by ships; and promotion of Namibia's maritime interests. MWT: Directorate of Maritime Affairs is also responsible for sending out Marine Circular(s) notifying other offshore users of any navigation warnings required during project implementation (e.g. drilling and FPSO operations).



2.1.4 Namibian Ports Authority

The Namibian Ports Authority (Namport) is a public entity that reports to MWT. The National Ports Authority Act, 1994 (No. 2 of 1994) gives Namport the responsibility of protecting the environment within harbour areas. Namport manages both the Port of Walvis Bay and the Port of Lüderitz.

2.1.5 Ministry of Agriculture, Fisheries, Water and Land Reform

The MAFWLR is responsible for, inter alia, the management and development of fisheries and aquaculture in Namibia.

The Directorate of Fisheries is responsible for managing and developing the country's fisheries sector, including scientific research and providing advice on the state of commercially important marine fish stocks and recommending catch quotas. It is also responsible for managing and regulating species fish size limits, dates of closed fishing seasons, declaring Marine Protected Areas (MPAs), areas closed to fishing and determining fishing gear use.

The Directorate of Fisheries is also responsible for monitoring, controlling and surveillance of fishing-related activities both at sea and onshore.

2.2 Namibian Laws and Policies Applicable to the Environmental Assessment of Oil and Gas Projects

The Republic of Namibia has five tiers of law, namely:

- The Constitution;
- Statutory law;
- Common law;
- Customary law; and
- International law.

The Constitution of the Republic of Namibia (1990) sets founding principles which govern Namibian law. Article 95 (L) of the Constitution commits the State to promote sustainable development by *“maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians both present and future...”*.

The key policy and legislative requirements and guiding principles underpinning the ESIA process are outlined below (see Chapter 3.0 for information on the ESIA process itself).

2.2.1 Policy and Legal Framework for ESIA

2.2.1.1 Environmental Assessment Policy for Sustainable Development and Environmental Conservation, 1995

Namibia's Environmental Assessment Policy was published in 1995 and promotes sustainable development and economic growth while protecting the environment in the long-term. The government recognises that EIA (termed Environmental Assessment in the Policy) is a key tool to further the implementation of a sound Environmental Policy that strives to achieve Integrated Environmental Management. EIAs ensure the consequences of development projects are considered and incorporated into the planning process. Marine petroleum exploration and production are listed as an activity that requires an EIA. Importantly, the term “environment” is defined broadly, to also include society and thus social aspects.



Implications for this project: This ESIA process is undertaken in furtherance of this Policy.

2.2.1.2 Environmental Management Act, 2007

The Environmental Management Act, 2007 (No. 7 of 2007) was promulgated in December 2007 and came into effect on 6 February 2012. The main objectives of this Act are to ensure that:

- Significant effects of activities on the environment are considered carefully and timeously;
- There are opportunities for timeous participation by I&APs throughout the assessment process; and
- Findings are considered before any decision is made in respect of activities.

Section 3(2) of the Act provides a set of principles which give effect to the provisions of the Constitution for integrated environmental management. Decision-makers must take these principles into account when deciding on a proposed project or activity. This Act stipulates that no party, whether private or governmental, can conduct a listed activity without an ECC obtained from the Environmental Commissioner.

Implications for this project: As the proposed project triggers a number of listed activities, it requires an ECC prior to these activities being undertaken. An ECC registration application was submitted to MIME and uploaded onto MEFT's EIA online portal (see Section 3.4). This ESIA process is being undertaken to inform MIME's and MEFT's consideration of the ECC application. The Final ESIA Report, inclusive of public commentary, technical / specialist studies and an Environmental and Social Management Plan (ESMP), is submitted to MIME and MEFT: DEA for a Record of Decision (RoD) by MEFT: DEA.

2.2.1.3 EIA Regulations 2012

The EIA Regulations 2012, promulgated on 6 February 2012 in terms of Section 56 of the Environmental Management Act, 2007 (Government Notice [GN] No. 30) provides for the control of certain listed activities. These listed activities are provided in GN No. 29 and are prohibited until an ECC has been obtained from MEFT. Such ECCs, which may be granted subject to conditions, will only be considered once there has been compliance with the EIA Regulations 2012. GN No. 30 sets out the procedures and documentation that need to be complied with in undertaking an EIA process.

Implications for this project: The proposed development project triggers listed activities that may not be undertaken without an ECC (see Table 2-1), and this ESIA process is being undertaken to inform MIME's and MEFT's consideration of the ECC application.

Table 2-1: List of applicable activities that require an ECC in terms of the EIA Regulations 2012.

Activity	Comment
2. Waste management, treatment, handling and disposal activities	
2.3 <i>The import, processing, use and recycling, temporary storage, transit or export of waste.</i>	Waste would be generated during the development drilling, facilities installation, production and decommissioning phases, mainly associated with the drilling units, FPSO, DPST and support vessels. Various non-hazardous and hazardous wastes will be temporarily stored on vessels and transported to shore for onshore treatment, recycling and / or disposal by authorised waste management contractors.



Activity	Comment
3. Mining and quarrying activities	
3.2 Other forms of mining or extraction of any natural resources whether regulated by law or not.	The objective of the proposed development relates to the extraction of a resource (hydrocarbons) from below the seabed in the licence area. Reservoir fluids (oil, gas and water) will be extracted via production wells and separated and processed to required specifications on the FPSO. Once treated, the processed crude light oil will be stored onboard the FPSO prior to transfer to DPSTs for transport to the nearshore transshipment area, where it will be offloaded to a conventional tanker, which will then transport the oil to its final destination. Once treated, the produced gas will be re-injected to the reservoir, while the produced water, after treatment, will be discharged overboard. More detail is provided in the project description (Chapter 4.0).
3.3 Resource extraction, manipulation, conservation and related activities.	
3.4 The extraction or processing of gas from natural and non-natural resources, ...	
8. Water resource development	
8.12 The release of brine back into the ocean by desalination plants.	Seawater will be desalinated on the FPSO, drilling unit and some support vessels for fresh water and other purposes (e.g. hydrostatic test fluids). The waste stream from the desalination plant is brine (concentrated salt), which is produced in the reverse osmosis process. The brine stream will be discharged overboard.
9. Hazardous substance treatment, handling and storage	
9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974	The objective of the proposed development relates to the extraction of a resource (hydrocarbons) from below the seafloor in the Venus offshore project area. Hydrocarbons and Non-Aqueous Drilling Fluid (NADF) are not specifically defined in the Hazardous Substances Ordinance, 1974. This activity has, however, been included, as hydrocarbons and NADFs could be considered to have hazardous properties.
9.2 Any process or activity which requires a permit, licence or other form of authorisation, ... in terms of a law governing the generation or release of emissions, pollution, effluent or waste.	Effluent discharges (e.g. brine, commissioning effluent and produced water) from the FPSO, drilling unit and some support vessels may require an Effluent Discharge permit. The requirement for an Effluent Discharge permit will be confirmed in consultation with MAFWLR: Department of Water Affairs.
9.3 The bulk transportation of dangerous goods using pipeline, funiculars or conveyors with a throughput capacity of 50 tons or 50 m³ or more per day.	The proposed development would make use of infrastructure, which would convey oil and gas from the geological structure (reservoir) to the drilling unit at the surface during well testing and to the production platform (FPSO) during resource extraction and re-injection of gas back into the reservoir. The throughput capacity of hydrocarbons will be greater than 50 m³ per day.
9.4 The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 m³ at any one location.	The FPSO has production capacity up to ~160 000 barrels (25 437 m³) of oil per day at plateau and ~2 million barrels (317 975 m³) of oil storage. Oil from the FPSO will be transferred to the DPST for transport to the transshipment area, where it will be offloaded to a conventional tanker, which will then transport the oil to its final destination. The transfer of one



Activity	Comment
	~1 Mbbl (~160 000 m ³) load in both the Venus offshore project area and nearshore transshipment area will take up to ~24 hours each (continuous transfer). Detail is provided in the project description (Chapter 4.0).
10. Infrastructure	
10.1 <i>The construction of (e) any structure below the high-water mark of the sea;</i>	The proposed development would result in the placement of drilling equipment (wellheads) and production infrastructure (e.g. SPS, SURF, pipelines, Xmas trees, in line tee, flow line end terminations, mooring lines and anchors, etc.) on the seabed / below the high-water mark in the Venus offshore project area. A mooring buoy will also be installed at the nearshore transshipment area ~ 5 km from the coast, located ~20 km north of Walvis Bay, to support oil transshipment operations.

2.2.2 Legal and Policy Framework for Oil and Gas Projects

Regulation of the Namibian oil and gas industry is the mandate of MIME. The fiscal regime is outlined in the Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991), the Petroleum (Taxation) Act, 1991 (No. 3 of 1991) and the Petroleum Laws Amendment Act, 1998 (No. 24 of 1998). Administrative provisions are also provided in the Income Tax Act, 1981 (No. 24 of 1981).

2.2.2.1 Petroleum (Exploration and Production) Act, 1991

The Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991) governs oil and gas exploration and production in Namibia. Section 9 of this Act requires a licence is obtained from the MIME before any reconnaissance, exploration or production operations for petroleum can be undertaken. Prior to the granting of an Exploration or Production Licence, a Petroleum Agreement must be entered into between the Minister and the potential licence in terms of Section 13 of the Act. The Petroleum Agreement (in addition to the relevant environmental legislation referred to in Section 2.3.3 above) prescribes that all companies must undertake ESIA's for production activities. Section 38 and Section 53 of the Act prescribe the obligations of the holder of an exploration and a production licence, respectively. Section 46 prescribes the requirements for a Production Licence application.

In terms of Section 17(1) of the Act, a holder of a licence shall not drill a well less than 1 000 m from the boundary of the area to which the licence relates, except with the approval in writing, of the Minister.

Implications for this project: TEEPNA and its JV partners currently hold a Petroleum Exploration License for PEL0056/Block 2913B and are investigating the feasibility of developing the Venus field located within PEL0056/Block 2913B. If the JV partners decide to proceed with the development, this would *inter alia* require a PPL and an ECC. The current ESIA process is being undertaken to inform MIME's and MEFT's consideration of the ECC application (see Section 3.4).

Taking cognisance of Section 17(1) of the Act, it is confirmed that no wells will be drilled less than 1 000 m from the boundary of the area to which the licence will relate, namely PEL0056/Block 2913B.

In terms of Section 53 read together with Section 38(1)(d) and (e) of the Act, an operator shall *"remove ... all structures, equipment and other goods not used or intended to be used in connection with such [production] operations"* and *"take reasonable steps to warn persons ... of any such structures, equipment or other goods of the possible hazards resulting*



therefrom". Furthermore, in terms of Section 38(2)(g), an operator must prior to the drilling provide the Commissioner *"a report containing particulars of the technique to be employed, an estimate of the time to be taken, the material to be used and the safety measures to be employed in the drilling of such well"*.

2.2.2.2 Petroleum (Exploration and Production) Act Regulations, 1999

The Petroleum (Exploration and Production) Act Regulations, 1999, promulgated under Section 76A of the Petroleum (Exploration and Production) Act, 1991, sets out the obligations of the operator, some of which are listed below:

- Take all such precautions as may be necessary to protect the environment and natural resources;
- Provide funds and take measures to ensure the health, safety and welfare of employees and the protection of other persons, property, the environment and natural resources from hazards arising from petroleum activities;
- Undertake ESIA studies;
- Register the installation and ensure that it has a certificate of fitness;
- Report the location of the installation to the Petroleum Commissioner and ensure that it is published in a "Notice to Mariners";
- Ensure the installation is properly marked (see International Regulations for Preventing Collisions at Sea as incorporated into the Merchant Shipping Act, 1951);
- Equip the installation with equipment to record environmental data as may be necessary to exercise control over any petroleum activities;
- Ensure hazardous substances are properly transported, handled and stored;
- Ensure an Emergency Preparedness Plan is in place and updated as necessary;
- Establish an appropriate safety zone⁵ and communicate it to the Petroleum Commissioner, and ensure it is published in the "Notice to Mariners"; and
- Communicate any emergency to the Petroleum Commissioner immediately.

Implications for this project: Operator must comply with applicable obligations during all phases of the proposed development project. The current ESIA process is undertaken to inform MIME's and MEFT's consideration of the ECC application and reflects key applicable obligations in the ESMP.

Both the Venus offshore project area and nearshore transshipment area will be subject to certain exclusion and restrictions. The exclusion and restrictions relevant to the Venus offshore project area are described in Section 4.1.6. The nearshore transshipment buoy will be subject to a 500 m safety exclusion zone around the operational zone, resulting in a total exclusion area of 1.7 km radius around the transshipment buoy.

⁵ The outer boundary of the safety zone must be at a point 500 m from the end of each anchor or the outer edges of the installation and determined with due regard to (1) mining, fishing, tourism and other activities and interests that will be affected and (2) the nature of, and the functions performed by or at that installation (Petroleum (Exploration and Production) Act Regulations, 1999).



2.2.2.3 Minerals Policy of Namibia, 2004

The Policy sets out guiding principles for the development of the “mining” sector (which includes mining, energy and oil / gas), to ensure it operates within environmentally acceptable limits. One of the objectives of the Policy is ensuring compliance with national environmental policy and other relevant policies to develop a sustainable mining industry.

The Policy commits MIME to ensuring that:

- The development of the industry proceeds on an environmentally sustainable basis;
- Mineral / resource development in proclaimed protected areas commences only when rehabilitation is guaranteed; investigating the establishment of financial mechanisms (environmental trust funds or bonds) for environmental rehabilitation and aftercare in other areas; and
- The development of national waste management standards and guidelines in consultation with the mining industry.

The provisions of this policy have been given effect through the enactment of the Petroleum (Exploration and Production), 1991 and Regulations.

MIME is in the process of drafting a new National Minerals Policy, the “draft National Minerals Policy, 2018”. This Policy notes that minerals are valuable natural resources being the vital raw material for the core sectors of the economy, and that mining must be carried out in an environmentally sustainable manner.

Implications for this project: One purpose of the ESIA is to determine the environmental acceptability of the proposed project. Refer to Chapter 10.0 for a summary of the findings of the ESIA. It is also confirmed that the Venus offshore project area and nearshore transshipment area do not overlap with any proclaimed protected areas (e.g. MPAs).

2.2.3 Selected Other Laws and Policies Relevant to Oil and Gas Development Projects

Selected other legislation relevant to the proposed activities are summarised in Table 2-2 below. **It should be noted that not all items listed are relevant to the ESIA process, and other legislation may also apply.**

Table 2-2: Selected Sectorial Laws and Regulation.

Aspect	Law	Key Provisions
Petroleum sector	Petroleum Products and Energy Act (No. 13 of 1990) and relevant regulations	This Act provides for the application of environmental standards and the avoidance of environmental harm caused by the keeping, handling, conveying, using and disposing of petroleum products.
	Petroleum Taxation Act (No. 3 of 1991)	This Act provides for the levying and collection of petroleum income tax and additional profits tax on income related to exploration, development, and production operations in Namibia. It also addresses incidental matters related to these activities.
	Petroleum Laws Amendment Act (No. 24 of 1998)	This Act amends the Petroleum (Exploration and Production) Act, 1991 so as to, <i>inter alia</i> , make provision for: • the extension of the duration of exploration licences; • the submission of decommissioning plans together with applications for production licences;



Aspect	Law	Key Provisions
		the decommissioning of facilities on the cessation of production operation.
Transport and Maritime sector	Civil Aviation Act (No. 6 of 2016) and associated regulations	This Act consolidates the laws relating to civil aviation and civil aviation offences.
	Merchant Shipping Act (No. 57 of 1951)	This Act regulates, <i>inter alia</i> , the nature and variety of goods to be shipped and the safety of ships and life at sea.
	Namibian Ports Authority Act (No. 2 of 1994) and Port Regulations	The Act provides for the establishment of the Namibian Ports Authority, which is charged with the management and control of ports and lighthouses in Namibia and the provision of facilities and services related thereto.
	Road Traffic and Transport Act (No. 22 of 1999)	This Act provides for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, and the control and regulation of road transport across Namibia's borders.
	Territorial Sea and Exclusive Economic Zone of Namibia Act (No. 3 of 1990)	This act claims the various maritime zones to which Namibia is entitled under international law (in this case United Nations Law of the Sea Convention, UNCLOS).
	Territorial Sea and Exclusive Economic Zone of Namibia Amendment Act (No. 30 of 1991)	This Act changes the extent of the territorial zone to 24 miles from the low water mark.
	Wreck and Salvage Act (No. 4 of 2004)	This Act provides for the salvage of ships, aircraft and life and the protection of the marine environment.
Pollution	Atmospheric Pollution Prevention Ordinance (Ordinance 11 of 1976)	This Ordinance provides for the prevention of the pollution of the atmosphere. It deals with the control of noxious or offensive gases, atmospheric pollution by smoke, dust control, motor vehicle emissions and general provisions for enforcement. Part II (Control of Noxious or Offensive Gases) provides for the declaration of controlled areas where scheduled processes, listed in Schedule 2, must be registered and regulated. The proposed activities will not operate any scheduled processes, nor are they located within declared controlled areas. As such, registration is not required. Part III (Atmospheric Pollution by Smoke) outlines provisions for the control of emissions from fuel burning appliances and smoke nuisance. These regulations apply only within the municipal boundaries of Walvis Bay and Windhoek and are, therefore, not applicable to the proposed project. Moreover, the regulations govern the “installation” of appliances at fixed “premises” and do not extend to vessels operating in the offshore and nearshore project areas.
	Dumping at Sea Control Act (No. 73 of 1980)	This Act provides for the control of dumping of substances in the sea within 12 NM of the low water mark.



Aspect	Law	Key Provisions
	International Convention for the Prevention of Pollution from Ships Act (No. 2 of 1986)	This Act provides for the application of the MARPOL 73/78.
	International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties Act (No. 64 of 1987)	This Act provides for the application of the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties.
	Prevention and Combating of Pollution of Sea by Oil Act (No. 6 of 1981 as amended by No. 5 of 2019) and associated Regulations	This Act provides for the prevention and combating of pollution of the sea by oil and determines liability in certain respects for loss and damage caused by the discharge of oil from ships, tankers and offshore installations. The provisions relating to offshore installations only apply to such installations as are situated within 50 NM of the low water mark. In addition, the amended Act prohibits oil transfers within designated Namibian “Prohibited Area” unless permission is granted by the MWT for each such operation under the guidance of Marine Notice No. 2 of 2017.
	Marine Notice (No. 2 of 2012): Transfer of Oil Outside Harbours	This notice sets out the requirements to transfer oil within Namibian waters.
Environmental/ Conservation	Marine Resources Act (No. 27 of 2000) and Regulations relating to the Namibian Islands’ Marine Protected Area (NIMPA)	This Act provides for the conservation of the marine ecosystem and the responsible utilisation, conservation, protection and promotion of marine resources on a sustainable basis. The Regulations relating to the NIMPA provide with respect to the protection of resources of the Namibian Islands Marine Reserve. The Regulations delineate the protected areas, give coordinates of the All-encompassing buffer zone of the NIMPA, and places restrictions on various activities in the protected area and the buffer zone. These restrictions are not relevant to the proposed project, as the Venus offshore project area and the nearshore transshipment location are located outside of the NIMPA.
	Nature Conservation Ordinance (No. 4 of 1975)	This Ordinance consolidates and amends the laws relating to the conservation of nature; the establishment of game parks and nature reserves; and the control of problem animals (e.g., animals, declared as such by the Minister, which pose a threat to human activities, agriculture or other wildlife).
	Nature Conservation Amendment Act (No. 5 of 1996)	This Act amends the Nature Conservation Ordinance, 1975, so as to insert and substitute certain definitions; to provide for a proper administrative, legal and procedural framework for tourism concessions in protected areas and other State land; to control the import and export of live game or animal, and to increase the penalties; and to provide for incidental matters.



Aspect	Law	Key Provisions
	National Heritage Act (No. 27 of 2004)	This Act provides for, inter alia, the protection and conservation of places and objects of heritage significance. The Act also outlines procedures for declaring and registering heritage places and objects, issuing permits for activities affecting heritage resources, and ensuring their sustainable use.
	Water Resources Management Act (No. 11 of 2013)	This Act provides for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes and for the control of certain activities on or in water in certain areas.
Hazardous Substances	Hazardous Substances Ordinance (Ordinance 14 of 1974)	These provide for the control of toxic substances which may cause injury, ill health or death of human beings.
	The Hazardous Substances Ordinance 14 of 1974: Group I Hazardous Substances	
Radiation Sources / Substances	Atomic Energy and Radiation Protection Act (No. 5 of 2005)	These provide for the control of production, handling and safe disposal of radioactive waste/materials to protect human health and the environment from harmful radiation effects.
	Radiation Protection and Waste Disposal Regulations (GN 221-2011 of 2011)	
Labour	Labour Act (No. 11 of 2007)	This Act sets out the fundamental rights of workers and basic conditions for work.
Health	Public and Environmental Health Act (No. 1 of 2015)	This Act provides a framework for a structured uniform public and environmental health system in Namibia. Its objective is to promote public health and wellbeing, prevent injuries and protect individual and communities from public health risks.
	Regulations relating to the health and safety of employees at work (GN 156 of 1997)	These Regulations establish health and safety regulations for the workplace.

2.3 Key Relevant Namibian Policy and Planning Frameworks

Key relevant planning and policy documents are discussed below and inform the analysis of the project's need and desirability in Chapter 8.6.

2.3.1 Energy-Related Plans and Policies

2.3.1.1 White Paper on the Energy Policy 1998

The White Paper on the Energy Policy (1998) is the overarching policy which guides planning in the energy sector. This White Paper embodies a new, comprehensive energy policy aimed at achieving security of supply, social upliftment, effective governance, investment and growth, economic competitiveness, economic efficiency and sustainability. The legislative framework governing upstream oil and gas is well developed, and the White Paper merely clarifies an accepted policy framework which seeks to optimise national benefits while achieving the necessary balance of interests to attract investment. The focus of the White Paper is on creating a policy and legislative framework, which attracts initial



investment into the sector, while maintaining options for competition in the future and the fair distribution of economic rents.

2.3.1.2 Namibia's National Energy Policy 2017

The National Energy Policy spells out the Government of Namibia's intent, direction and undertakings regarding the development and future of the Namibian energy sector (MIME, 2017).

For the electricity sector, the key policy thrusts are the development of local generation capacity to improve security of supply through appropriate planning at national level, reviewing the present electricity market model, ensuring the on-going viability and development of the transmission and distribution networks, strengthening the regulatory framework, and shaping the electricity mix of the future (MIME, 2017).

For the upstream oil and gas sector, the policy expressly promotes exploration and production and notes that the *“commercial discovery of oil and gas resources would significantly contribute to the Namibian economy, the attainment of national development goals, and improve the livelihoods of present and future generations. It is, therefore, essential for the Government to promote the country's exploration potential and attract local and foreign investment in the sector. Since independence, the [MIME] and NAMCOR have actively promoted the country's exploration, development and production potential, and have attracted major oil industry players, resulting in investments in the Namibian oil and gas industry, which are estimated at N\$ 25 billion. Government is cognisant of the challenges of the oil and gas industry, including its capital intensive and high-risk nature, the lack of exploration successes, and the recent fall in the oil prices. Therefore, a conducive and internationally competitive investment framework that attracts reputable oil and gas companies is critically important. “Government will therefore continue to market and promote exploration activities actively and sustainably by attracting local and foreign investment to the sector”.*

The Government resolves to:

- Strengthen the national investment climate, to ensure certainty, stability and competitiveness through favourable commercial, legal and fiscal terms.
- Facilitate private sector investments and support the development of necessary expertise in the exploration and development of the country's oil and gas resources.
- Continue to promote investments in the oil and gas sector at international, regional and national events.
- Encourage collaboration between existing licence holders to carry out joint exploration programmes (MIME, 2017).

2.3.1.3 National Integrated Resource Plan 2022

Namibia's National Integrated Resource Plan (NIRP) 2022 is an updated strategic framework for the country's electricity supply industry. It is a 20-year development plan outlining the country's energy goals and the steps needed to achieve covering the period from 2022 to 2042:

- Renewable Energy Commitments: The plan includes commitments to add 2 850 MW of renewable energy generation capacity and 650 MW of battery energy storage by 2040.
- Load Forecasting and Supply/Demand Balance: Updated projections for electricity demand and supply, ensuring that future energy needs are met efficiently.



- Policy Scenarios and Investment Choices: Various scenarios and investment options are evaluated to determine the most cost-effective and sustainable energy solutions.
- Integration of Renewable Energy: Continued focus on integrating solar and wind energy into the national grid.

The NIRP 2022 aims to ensure a reliable, sustainable, and cost-effective energy supply for Namibia, aligning with national policy goals and environmental standards. The Plan specifically notes that it is desirable to make appropriate use of indigenous energy resources in supplying the electricity demand in Namibia.

2.3.2 Economy-Related Policies

2.3.2.1 Draft National Upstream Petroleum Local Content Policy 2025

The Policy, still at a draft stage in December 2025, aims to ensure the full participation of all Namibians in the petroleum sector. In order to maximise the benefit to the country and its population, the policy emphasises the procurement of local suppliers and Namibian citizens across the value chain. It is to be noted that Petroleum Agreement and the policy gives effect to Section 14 of the Petroleum (Exploration and Production) Act, 1991, which calls for Petroleum Agreements and licence holders to prioritise Namibian citizens in the execution of their licence and agreement.

2.3.2.2 Namibia Vision 2030

In 2004, Namibia adopted Vision 2030, which outlines the country's development programmes and strategies to achieve its national objectives. One of the major objectives of Vision 2030 is to *“ensure the development of Namibia's ‘natural capital’ and its sustainable utilisation, for the benefit of the country's social, economic and ecological well-being”*.

The vision for non-renewable resources is that Namibia's mineral resources are strategically exploited and optimally benefited, while ensuring that environmental impacts are minimised. Vision 2030 acknowledges that poorly planned or badly managed mining can result in a great variety of impacts that threaten human health and environmental integrity. Vision 2030 further notes that with EIAs applied during the planning phase and the implementation of ESMPs during operational phase, operations are increasingly better planned and negative impacts can usually be mitigated and localised.

2.3.2.3 Harambee Prosperity Plan (2021-2025)

The Harambee Prosperity Plan (HPP) (2021-2025) is a targeted action plan by the Namibian government aimed at accelerating development in key priority areas to achieve prosperity for all Namibians. It complements the long-term goals of the National Development Plans and Vision 2030 by focusing on effective governance, economic advancement, social progression, infrastructure development, and subscription international relations. The plan seeks to enhance service delivery, contribute to economic recovery, and promote inclusive growth.

2.3.2.4 Sixth National Development Plan 2025/26 – 2029/30

Vision 2030 is being implemented through a series of five-year National Development Plans. The Sixth National Development Plan 2025/26 – 2029/30 (NDP6) sets out the guide to Namibia achieving the Vision 2030 objectives, with the aim of transforming Namibia into a developed and industrialized nation. The plan focuses on economic growth, human development, environmental sustainability, and good governance, across four integrated pillars:

- Economic Growth, Transformation and Resilience;



- Human Development and Community Resilience;
- Environmental Sustainability; and
- Effective Governance and Public Service Delivery.

NDP6 recognises the use of Namibia's natural resources in achieving its goal of economic growth, transformation and resilience. In this regard it identifies the oil and gas sector as a focus area to assist in "*consolidating growth from current sources and boosting new sources of economic growth and employment*". Proposed strategies to achieve this goal include the strengthening of legal and policy framework, promotion of the sustainable development of the sectors to support a 'Just Energy Transition', development of infrastructure and promotion of investment growth as well as the strengthening of skills development, research and innovation (NDP6, 2025).

It also plans to achieve economic progression by enhancing value addition to mineral resources, transforming the tourism and gaming sector and developing the Micro, Small and Medium Enterprises (MSME) through innovative business support and sustainable capacity development (NDP6, 2025).

According to the NDP6 booklet, the targeted outcome for oil and gas development is to increase oil production from zero to 150 million barrels of oil equivalent (mmboe) by 2030.

2.3.2.5 Strategic Plan, 2017/2018 – 2021/2022

In order to achieve the objectives in Vision 2030, the HPP and the Fifth National Development Plan 2017/18 – 2021/22 (NDP5⁶), MIME developed the Strategic Plan (2017/2018 – 2021/2022) with the aim to ensure the development of Namibia's natural capital and its sustainable utilisation for the benefit of the country's social, economic and ecological well-being.

Specifically, the MIME's mission is to effectively regulate activities within the mining and energy sector through the formulation of legislation and policies, to provide services to stimulate sustainable economic development through investment for the benefit of all Namibians, and to generate knowledge and information on natural resources.

Four strategic focus areas, each with key performance indicators and targets, are identified with the plan:

- Socio-economic progression;
- Environmental sustainability;
- Stakeholder relations and cooperation; and
- Good governance.

This plan serves as a blueprint, providing strategic direction to the MIME to achieve its Mandate, Vision, Mission and Strategic Objectives.

2.3.2.6 Namibia's Industrial Policy, 2012 / 2015

In 2012, the then Ministry of Trade and Industry (MTI) developed Namibia's Industrial Policy. Three years after drafting the Industrial Policy, the MTI produced an execution strategy for industrialisation in 2015 called "Growth at Home" (MTI, 2015).

⁶ NDP5 has now been replaced by NDP6 (see Section 2.3.2.4).



The strategy advocates a targeted approach towards industrialisation. In the first phase of “Growth at Home”, sectors in which Namibia already has some sort of comparative advantage will be targeted (MTI, 2015). Mining (and other extraction) is identified as one of a number of particular sectors to be targeted. The strategy sets out a broad outline of how downstream industries should be developed to ensure that the job creation and socio-economic benefits which stem directly and indirectly from primary production are maximised (MTI, 2015).

2.3.2.7 Local and Regional Socio-Economic Policy

With respect to regional planning, the socio-economic development objectives of the **Erongo Region** (central-western coast with key coastal towns of Walvis Bay, Swakopmund and Henties Bay) have a special focus on uplifting the standard of living within the region (ERC, 2015). They include the following:

- Ensuring regional and rural economic development;
- Creating employment opportunities;
- Improving infrastructure, with the delivery of basic services to rural areas a priority;
- Co-ordinating training of community members in entrepreneurial skills; and
- Educating the community with regard to the prevalence of HIV/Aids and Tuberculosis (TB) cases.

Similarly, the Erongo Regional Council (ERC) Strategic Plan for 2017/18-2021/22 lists the following strategic objectives, developed in line with the Government aspirations outlined in Vision 2030:

- Enhance organizational performance;
- Enhance infrastructure development and maintenance;
- Strengthen disaster risk management;
- Accelerate delivery and service of land and housing;
- Facilitate access to improved sanitation; and
- Coordinate economic development.

The strategic socio-economic development objectives for the **//Kharas Region** (Namibia's southern most region with key coastal town of Lüderitz) (KRC, 2017) include the following:

- Enhancing spatial planning;
- Improving key infrastructure;
- Providing basic services and housing;
- Enhancing food security;
- Promoting economic opportunities; and
- Ensuring inclusive and equitable quality education for all.

Notably in the July 2025 //Kharas regional development update, the Regional Governor noted that the *“//Kharas region is rich in natural resources, including minerals, which are key drivers for economic growth. The full realization of the region's potential will significantly contribute to Namibia's industrialization goals by leveraging its natural resources, developing infrastructure, and promoting sustainable energy projects.”* It was further noted that *“economic progress in the //Kharas Region stands as a cornerstone of our regional development agenda, firmly aligned with national imperatives outlined in Vision 2030, the Harambee Prosperity Plan II, and the Sixth National Development Plan (NDP6). When it*



comes to building a more robust economy, increasing economic recovery, and fostering inclusive growth, the ||Kharas region continues to be a major player with projects such as Green Hydrogen, Oil and Gas and the 2nd Phase of the Neckartal Dam.”

The **local authorities of both Lüderitz and Walvis Bay** seek to ensure that their economies are well diversified. The Walvis Bay Town Council has pointed out that Walvis Bay, with its deep-water port, ship repair and logistics handling facilities, is particularly well placed to serve an oil extraction industry which could develop in the wake of a significant oil discovery (WBTC, 2017).

2.3.3 Biodiversity-Related Policies

2.3.3.1 National Biodiversity Strategy and Action Plan 1 and 2 (2013-2022)

The National Biodiversity Strategy and Action Plan (NBSAP) 1 and 2 is the key national level implementing instrument of the objectives of the United Nations (UN) Convention on Biological Diversity. NBSAP2 sets out the vision for Namibia’s biodiversity to be healthy and resilient to threats, and the conservation and sustainable use are key drivers of poverty alleviation and equitable economic growth, particularly in rural areas.

NBSAP2 has five key strategic objectives, each of which has a number of targets to be achieved by 2022. These objectives are to:

- Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;
- Reduce the direct pressures on biodiversity and promote the sustainable use of biological resources;
- Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;
- Enhance the benefits to all from biodiversity and ecosystem services; and
- Enhance implementation of NBSAP2 through participatory planning, knowledge management and capacity building.

At the time of preparing this report, Namibia did not currently have a formally released NBSAP 3 publicly available, but it is in the process of updating its strategy to align with the global Kunming-Montreal Global Biodiversity Framework.

2.3.3.2 National Policy on Prospecting and Mining in Protected Areas (2018-2022)

The National Policy on Prospecting and Mining in Protected Areas, 2018, aims to balance Namibia’s economic development with the conservation of its rich biodiversity. This policy addresses the management and regulation of mining and prospecting activities within the country’s protected areas, which include national parks, nature reserves, and other conservation areas. The policy provides guidelines for decision-making regarding exploration and mining activities within protected areas, ensuring that such activities are conducted in a manner that minimizes environmental impact, protects critical habitats, and maintains the integrity of ecosystems.



2.3.4 Climate Change-Related Policies

2.3.4.1 Namibia's Climate Change Policy Framework 2021

Namibia has a policy framework in place to deal with climate change. The key milestones in Namibia's Climate Change Policy Framework are listed below:

- In 1995 Namibia ratified the United Nations Framework Convention on Climate Change (UNFCCC). The ultimate objective of the Convention is the stabilisation of greenhouse gas (GHG) concentrations in the atmosphere.
- Namibia established the National Climate Change Committee (NCCC) in 2001.
- Namibia developed their National Climate Change Policy in 2010-2011. This document presents information about the main expected impacts of climate change in Namibia and about those most vulnerable. The document also proposes objectives that the Government will aim to achieve through an effective and efficient response to climate change.
- Namibia published a National Disaster Risk Management Plan in 2011. This Plan aims to provide guidance and strengthen national capacity for disaster risk management and to provide a framework for sectoral and regional disaster risk management in Namibia.
- The National Climate Change Strategy and Action Plan (NCCSAP, 2013-2020) lays out the guiding principles responsive to climate change that is effective, efficient and practical. It further identifies priority action areas for adaptation and mitigation.
- A new climate action plan (Intended Nationally Determined Contribution) was submitted to the UNFCCC in September 2015, ahead of the 2015 Paris Agreement. It was converted to a Nationally Determined Contribution in 2016.
- In April 2016 the president of the Republic of Namibia signed the Paris Agreement and followed that up in September 2016 by ratifying the Agreement (see Table 2-3).
- Most recently, in December 2024, Namibia submitted its First Biennial Transparency Report as well as first National Inventory Document (NID) to the UNFCCC and the Paris Agreement, which contains information on Namibia's emissions and commitments (Government of Namibia, 2024).

2.3.4.2 National Climate Change Policy for Namibia 2010-2011

The National Climate Change Policy (NCCP) for Namibia was published in October 2011 (Republic of Namibia, 2010). The purpose of the NCCP is to provide a legal framework and overarching national strategy for the development, implementation, monitoring, and evaluation of climate change mitigation and adaptation activities.

The NCCP seeks to increase the resilience of livelihoods to disasters and climate change. The specific objectives of the NCCSAP are set up as:

1. To reduce climate change impacts on Namibia's key sectors and vulnerable communities.
2. To integrate climate change issues (adaptation and mitigation) into sectoral policies, and national development planning at all levels.
3. To develop and enhance capacities at all levels and strengthen institutions to ensure successful implementation of climate change response activities.
4. To facilitate funding resources for effective mitigation and adaptation investments necessary for the effective implementation of the NCCP.



5. To provide an institutional framework to guide international and national climate financing modalities and support climate readiness (linking to Namibia's Climate Finance Readiness Strategy).

Although the NCCP does not have any specific requirements for the proposed project, the extent to which the project aligns with the country's national climate change commitments is assessed in Section 9.1.3.

2.3.4.3 National Climate Change Strategy & Action Plan 2013 – 2020

Namibia's National Climate Change Strategy & Action Plan 2013 – 2020 (NCCSAP) was published in 2013. The purpose of the NCCSAP is to provide a holistic and integrated approach to implementing the NCCP (Republic of Namibia 2015) and address climate risks to the nation's social, environmental, and economic development. It focuses on three components: (1) Adaptation (reducing vulnerability in food, water, health, and infrastructure), (2) Mitigation (promoting renewable energy and fuel efficiency in power and transport), and (3) Cross-Cutting Issues (strengthening institutional capacity, public awareness, and international cooperation). The plan aims to foster a low-carbon, resource-efficient and climate-resilient economy through stakeholder engagement and a cross-sectoral approach.

Although the NCCSAP does not have any specific requirements for the proposed project, the extent to which the proposed project aligns with the country's national climate change commitments is assessed in Section 9.1.3.

2.3.4.4 Namibia's Second Updated Nationally Determined Contribution, 2023

Namibia's second Updated Nationally Determined Contribution (NDC) was submitted to the secretariat of the UNFCCC on 17 January 2024 (Republic of Namibia 2023). The purpose of the NDC is to provide an update on the latest policies, measures and actions that will drive significant GHG emission reductions whilst promoting a climate-resilient Namibia.

Namibia aims at reducing its direct GHG emissions by 24% compared to the Business-As-Usual (BAU) scenario by the year 2030 from its base year (2010) levels, keeping an ambitious target which will concurrently also maintain the country's sink status.

Under the BAU scenario, the national GHG inventory is projected to decline further, reaching ~90.713 MtCO₂e by 2030. This is despite anticipated increases in emissions from the energy sector (rising from 2.98 to 6.3 MtCO₂e), Industrial Processes and Product Use (IPPU) (from 0.138 to 1.39 MtCO₂e) and waste sector (from 0.166 to 0.36 MtCO₂e). The continued reduction is primarily due to an enhanced carbon sink effect from the Agriculture, Forestry and Other Land Use (AFOLU) sector, which is expected to absorb 98.75 MtCO₂e.

In the mitigation scenario, the national GHG inventory is projected to decrease even further to ~102.615 MtCO₂e by 2030, compared to the BAU scenario. This additional reduction is attributed to lower emissions across the energy (~3.61 MtCO₂e), IPPU (~0.178 MtCO₂e), and waste (~0.125 MtCO₂e) sectors, and an increased carbon sink from AFOLU (~7.99 MtCO₂e).

Namibia's Updated NDC outlines a clear path toward decarbonisation, with a strong focus on renewable energy, land use and sustainable development. However, the document does not explicitly address offshore oil and gas activities, including the development of the Kudu Gas Field, which is mentioned in the NIRP 2022 (See Section 2.3.1.3) as being desirable for use as an indigenous energy resources in supplying the electricity demand in Namibia, and recent exploration activities in the Orange Basin offshore southern Namibia.



2.4 Relevant International Laws and Conventions

Relevant international conventions and treaties which have been ratified by the Namibian Government, and which have become law through promulgation of national legislation are listed in Table 2-3 below.

Table 2-3: Ratified International Conventions and Treaties

Conventions and Treaties	Summary of legislative provisions
Air and Atmosphere	
Kyoto Protocol on the Framework Convention on Climate Change, 1997	This Protocol was the key instrument on which the 1992 United National Framework Convention on Climate Change is based.
Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	This Protocol lays down a timetable for the reduction of controlled substances that deplete the ozone layer and have adverse effects on health and the environment.
Paris Agreement (United Nations Framework Convention on Climate Change), 2015	The Paris Agreement is a comprehensive framework that aims to guide international efforts to limit GHG emissions and to meet challenges posed by climate change. The Paris Agreement was adopted on 12 December 2015 at the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC CoP21). The agreement was signed by Namibia in April 2016. The long-term goals of the Paris Agreement are: • Limit the global temperature increase to below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. • Increasing countries' ability to adapt to the effects of climate change and to foster climate resilience. • Encouraging low GHG emissions development that does not compromise food production. • Making finance flows consistent with a pathway towards low GHG emissions and climate resilient development. • Reaching a peak in GHG emissions 'as soon as possible', while recognising that the timeframes for achieving this will differ between developed and developing countries. • Achieving carbon neutrality from 2050 onwards. Each individual country is responsible for determining their contribution (referred to as the "nationally determined contribution") in reaching this goal. The Agreement requires that these contributions should be "ambitious" and "represent a progression over time". The contributions should be reported every five years and are to be registered by the UNFCCC Secretariat. Namibia signed the Paris Agreement on 22 April 2016 and it entered into force on the 4 November 2016. As a signatory to the Agreement, Namibia must adopt the agreement within its own legal systems, through ratification, acceptance, approval or accession. Refer to Section 2.3.4.4 for Namibia's second Updated NDC. Under the Agreement, Namibia must also investigate alternatives to existing industries which have high carbon-emissions. A shift away from coal-based energy production within the energy sector



Conventions and Treaties	Summary of legislative provisions
	and increased reliance on alternative energy sources, including natural gas as a bridging fuel, is therefore anticipated ⁷ .
United Nations Framework Convention on Climate Change (UNFCCC), 1992	The Convention objective is to stabilise greenhouse gas concentrations in the atmosphere. The framework sets non-binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms.
Vienna Convention for the Protection of the Ozone Layer, 1985	The Convention is the first global agreement that recognised that the ozone was a serious enough problem to warrant international regulation.
Chemicals and Waste	
Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)	This Convention was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. The convention was ratified by Namibia in 1995.
Stockholm Convention on Persistent Organic Pollutants, 2001	This Convention is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment.
Flora, Fauna and Protected Areas	
African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968) and the revised version (Maputo, 2003)	The objectives of this Convention are to enhance environmental protection, to foster the conservation and sustainable use of natural resources, and to harmonise and coordinate policies in these fields.
Benguela Current Convention (BCC)	This Convention is a multi-sectoral inter-governmental, initiative of Angola, Namibia and South Africa. The objective of this Convention is to promote a coordinated regional approach to the long-term conservation, protection, rehabilitation, enhancement and sustainable use of the Benguela Current Large Marine Ecosystem (BCLME), to provide economic, environmental and social benefits. The BCC applies to “<i>all human activities, aircrafts and ships under jurisdiction or control of a Party to the extent that these activities or operations of such aircraft or ship result in or are likely to result in adverse impacts</i>”. Under the Convention Namibia is obliged to “<i>take all possible steps to prevent, abate and minimise pollution and take the necessary measures to protect the marine ecosystem against any adverse impacts</i>”, such as conducting an ESIA, identifying risks and implementing mitigation measures aimed at preventing pollution or, where such pollution arises, to combat and control those measures.
Convention on the Conservation of Migratory Species of Wild Animals, also known as the Convention on Migratory Species (CMS) or the Bonn Convention, 1983	This Convention is an international agreement that aims to conserve migratory species within their migratory ranges. CMS covers a great diversity of migratory species. The Appendices of CMS include many mammals, including land mammals, marine mammals and bats; birds; fish; reptiles and one insect.

⁷ King & Spalding state that “Natural gas, and in particular liquefied natural gas, has potential to play a role for Africa as a rich and reliable source of energy, which can serve as a bridging fuel on the path to the carbon-neutral goal of the Paris Agreement” (<https://www.kslaw.com/blog-posts/the-paris-agreement-on-climate-change-implications-for-africa>).



Conventions and Treaties	Summary of legislative provisions
Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000	This Protocol is an international agreement on biosafety as a supplement to the Convention on Biological Diversity effective since 2003. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology.
United Nations Convention on Biological Diversity (UNCBD), 1992	This Convention has three main goals: (1) the conservation of biological diversity (or biodiversity); (2) the sustainable use of its components; and (3) the fair and equitable sharing of benefits arising from genetic resources. The convention was ratified by Namibian in 1997.
Convention on International Trade of Wild Fauna and Flora Endangered Species (CITES), 1975	This Convention is a multilateral treaty to protect endangered plants and animals.
Convention on Wetlands of International Importance (Ramsar Convention), 1971	This Convention is an international treaty for the conservation and sustainable use of wetlands.
International Convention for the Conservation of Atlantic Tunas (ICCAT)	This Convention provides for the management and conservation of tuna and tuna-like species in the Atlantic Ocean and adjacent seas.
Memorandum of Understanding (MoU) concerning Conservation Measures of Marine Turtles of the Atlantic Coast of Africa, 1999	This MoU focuses on the protection of six marine turtle species that are estimated to have rapidly declined in numbers along the Atlantic Coast of Africa.
UN Convention to Combat Desertification in those Countries Experiencing serious Drought and/or Desertification, particularly in Africa, 1994	This is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.
Marine Pollution	
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78)	MARPOL 73/78 was developed by the International Maritime Organization (IMO) with an objective to minimise pollution of the oceans and seas, including dumping, oil and air pollution. MARPOL is divided into Annexes according to various categories of pollutants, each of which deals with the regulation of a particular group of ship emissions: • Annex I: Prevention of pollution by oil and oily water; • Annex II: Control of pollution by noxious liquid substances in bulk; • Annex III: Prevention of pollution by harmful substances carried by sea in packaged form; • Annex IV: Pollution by sewage from ships; • Annex V: Pollution by garbage from ships; and • Annex VI: Prevention of air pollution from ships. All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail and member nations are responsible for vessels registered on their national ship registry.



Conventions and Treaties	Summary of legislative provisions
International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969 and its protocol (Amends the 1969 Convention with regard to the method of calculation for the limitation of liability)	This Convention provides for a compensation fund for clean-up costs and environmental damage subject to certain conditions and ceilings.
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)	This Convention is an international maritime convention establishing measures for dealing with marine oil pollution incidents nationally and in co-operation with other countries.
International Convention on the establishment of an International Fund for Compensation for Oil Pollution Damage (The Fund Convention), 1971	This is an international maritime treaty, which was drawn up as an enhancement to CLC meant to relieve ship owners from unfair liabilities due to unforeseeable circumstances and remove liability caps that some member states thought were too low. The fund is obliged to pay victims of pollution when damages exceed the ship owner's liability, when there is no liable ship owner, or when the ship owner is unable to pay its liability.
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and 1996 Protocol	The 1996 Protocol deals with the incineration and dumping of waste at sea, including the disposal of exploration / production platforms and dredged material.
International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties, 1969	This Convention is an international maritime convention affirming the right of a coastal State to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate danger to their coastline or related interests from pollution or threat of pollution of the sea by oil, following upon a maritime casualty or acts related to such a casualty.
Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil, 1973	This Protocol provides for taking such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution by substances other than oil following upon a maritime casualty or acts related to such a casualty, which may reasonably be expected to result in major harmful consequences.
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2017	This Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. The discharge of ballast water is subject to the requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments, (specifically Regulation D2 which requires water to be treated through an approved ballast water treatment system).
Marine Safety	
Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972	This Convention sets an international standard for shipping and navigation. It deals with safety at sea issues and prescribes international standards for shipping, particularly to reduce the risk of collisions at sea. The rules for the prevention of collisions at sea apply to all vessels using the high seas.



Conventions and Treaties	Summary of legislative provisions
International Convention for the Safety of Life at Sea, 1974 (SOLAS) with its protocol of 1978	This Convention is an international maritime treaty which requires signatory flag states to ensure that ships flagged by them comply with minimum safety standards in construction, equipment and operation.
The International Convention on Load Lines, 1966 and its protocol of 1988	This Protocol was adopted to harmonise the survey and certification requirement of the 1966 Convention with those contained in SOLAS and MARPOL 73/78. All assigned load lines must be marked amidships on each side of the ships engaged in international voyages.
International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978	This Convention sets qualification standards for masters, officers and watch personnel on seagoing merchant ships.
Marine Resources	
Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central and Southern African Region (Abidjan Convention), 1984	The objective of this Convention is to protect the marine environment, coastal zones and related internal waters falling within the jurisdiction of the States of the West and Central African region. <u>Article 13(2) provides that “each contracting party shall endeavour to include an assessment of the potential environmental effects in any planning activity entailing projects within its territory, particularly in the coastal areas, that may cause substantial pollution of, or significant and harmful changes to, the convention area”. The convention is of course limited to the specific convention area and is not a general obligation extending to international waters.</u>
Convention of the International Maritime Organisation (IMO), 1948	This Conventions deals with the establishment of the IMO, which is a specialist UN agency dealing with maritime issues, including development of all the marine pollution control conventions.
United Nations Law of the Sea Convention (UNCLOS), 1982	This Convention seeks to establish a comprehensive legal regime to regulate activities on and in relation to the world’s oceans and seas, i.e. requiring states to adopt legislation to reduce marine pollution from seabed activities in the Exclusive Economic Zone (EEZ) and on the continental shelf. The convention was ratified by Namibia in 1994. <u>Article 206 of the Convention provides that “[w]hen states have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effect of such activities on the marine environment ...”.</u>
Archaeology and Cultural Heritage	
Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	This Convention provides for the identification, protection and conservation of the cultural and natural heritage for future generations.
UN Convention on the Protection of the Underwater Cultural Heritage, 2001	This Convention is intended to protect all traces of human existence having a cultural, historical or archaeological character, which have been under water for over 100 years. This extends to the protection of shipwrecks, sunken cities, prehistoric artwork, treasures that may be looted, sacrificial and burial sites, and old ports that cover the oceans’ floors.



Conventions and Treaties	Summary of legislative provisions
Convention for the Safeguarding of the Intangible Cultural Heritage, 2003	This Convention aims to protect practices, representations, expressions, knowledge, and skills that communities recognise as part of their cultural heritage. It emphasises community participation, respect for cultural diversity, and sustainable development in safeguarding living heritage. The Convention also established mechanisms for international cooperation, including the Representative List of the Intangible Cultural Heritage of Humanity. The convention was ratified by Namibia in 2007.
UN Declaration on the Rights of Indigenous Peoples (UNDRIP)	This Declaration affirms the rights of Indigenous peoples to maintain their cultural identity, traditions, and institutions. Namibia ratified this Declaration in 2007.
Fishing	
Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, 1993	This Agreement promotes compliance with international conservation and management measures by fishing vessels on the high seas.
Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean, 2001	This Convention provides for the long-term conservation and sustainable use of the fishery resources in the Southeast Atlantic Ocean.
Human Rights	
International Labour Organisation (ILO) Convention No. 98 on Right to Organise and Collective Bargaining Convention	This Convention aims to protect workers against anti-union discrimination and ensure their right to organize and bargain collectively. It promotes the establishment of machinery for voluntary negotiation between employers and workers' organizations to regulate employment terms through collective agreements.
ILO Convention 87 on Freedom of Association and Protection of the Right to Organize, 1995	This Convention ensures that workers and employers can freely form and join organizations of their choice without prior authorization. It protects their right to organize, manage their activities, and affiliate with international organizations, free from interference by public authorities.
ILO Convention 29 on Forced Labor	This Convention aims to eliminate all forms of forced or compulsory labour. It defines forced labour as any work or service exacted from a person under the threat of a penalty and for which the person has not voluntarily offered themselves. Namibia ratified this Convention in 2000.
ILO Convention 111 on Discrimination (Employment and Occupation)	This Convention aims to eliminate discrimination in employment and occupation based on race, colour, sex, religion, political opinion, national extraction, or social origin. It promotes equality of opportunity and treatment in access to vocational training, employment, and terms and conditions of employment. Namibia ratified this Convention in 2001.
UN Convention on the Rights of the Child, Article 32.1	This Convention aims to protect children from economic exploitation and hazardous work. It ensures that children are not engaged in work that could harm their health, development, or interfere with their education.
The Right to Work, Article 23 of the Universal Declaration of Human Rights (UDHR)	Article 23 of this Declaration establishes the right of everyone to work, to free choice of employment, to just and favourable conditions of work, and to protection against unemployment. It promotes equality of opportunity and treatment in employment, ensuring equal pay for equal work without discrimination.



Conventions and Treaties	Summary of legislative provisions
	Additionally, it recognizes the right to form and join trade unions for the protection of one's interest.
Convention on the Elimination of All Forms of Racial Discrimination (CERD)	The Convention aims to eliminate racial discrimination in all its forms and manifestations. It promotes equality and condemns any doctrine of racial superiority. The convention requires states to take measures to prevent and combat racial discrimination and to promote understanding among all races.
Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)	The Convention aims to eliminate discrimination against women in all areas of life. It promotes gender equality and empowers women by ensuring their rights in political, economic, social, cultural, and civil spheres. CEDAW remains a fundamental instrument for advancing women's rights globally.
International Covenant on Economic, Social and Cultural Rights (ICESCR), 1976	This Covenant, which entered into force in 1976, seeks to uphold the dignity and well-being of all individuals. It guarantees rights related to work, education, health, social security, and an adequate standard of living, recognizing that "in accordance with the Universal Declaration of Human Rights, the ideal of free human beings enjoying freedom from fear and want can only be achieved if conditions are created whereby everyone may enjoy his economic, social and cultural rights, as well as his civil and political rights". Namibia acceded to the ICESCR in 1994.

2.5 TotalEnergies Commitments and Policies on Health, Security, Safety, Environment and Social Performance

The below information has been supplied by TEEPNA, derived from their global policies and procedures. The documents form part of the "TotalEnergies referential", which refers to a comprehensive set of internal standards, guidelines, procedures and frameworks the company uses to ensure consistent and compliant practices across its global operations. These documents cover various aspects of the business, including safety, environmental practices, human rights, anti-corruption measures, data quality and contractor management, guiding the company's employees and partners in their day-to-day actions and strategic decisions.

2.5.1 Project Standards for Development Activities

Apart from the requirement to comply with the national legislation described in Section 2.1 above and the conditions of an ECC issued by MEFT: DEA, TEEPNA complies with a set of corporate specifications regulating environmental and social procedures and reporting requirements for undertaking ESIs on its projects. The proposed project will comply with the General Specification on Environmental Requirements for Project Design and Exploration and Production Activities (GS EP ENV 001).

To reduce any potentially significant impacts of proposed future activities, mitigation measures shall be identified and selected according to the Best Available Techniques (BAT) concept and approved by the Company⁸.

This specification deals with: Environmental Footprint; Flaring and Air Emissions; Fuel Gas and Energy Use; Management of Liquid Effluents; Waste Management; Drill Fluids and Cuttings; Chemicals; Noise; Dust, Odours and Lighting; Spill Response Equipment; and Decommissioning of Installations.

⁸ "Company" refers to TotalEnergies.



With respect to Oil Spill Contingency Planning and the management of responses related to unplanned events (e.g., well blowout and oil spills), including the assessment of economic effects and related compensation, TotalEnergies subscribes to the International Petroleum Industry Environmental Conservation Association (IPIECA) - International Association of Oil and Gas Producers (IOGP) Good Practice Guide Series. The primary reference document in this regard is the “Economic assessment and compensation for marine oil releases” (2015). TEEPNA would thus plan for and implement responses in terms of this guideline document.

2.5.2 General Specifications for ESIA

This ESIA has been conducted within the framework of Corporate General Specifications for ESIA, implemented by TEEPNA, including:

- *General Specification for Environmental and Social Impact Assessment Study of Industrial Projects Activities (i.e., GS-GR-HSE-410)*: This document defines the processes and requirements to be implemented for conducting an ESIA. It recognises that the purpose of the ESIA is to ensure that the natural and social environment is given full and proper consideration in the decision-making process with respect to potential activities having possible negative and positive consequences. It outlines the minimum standard required by the Company to assess impacts on the natural and social environment and is adapted to the type and nature of a given project to define the Scope of Work.
- *General Specification for Social Performance – Social Baseline Study (SBS) (i.e., GS EP SDV 101)*: This specification defines the Company requirements for establishing an SBS whose results are integrated in the Social Impact Assessment. This GS specifies the requirements for the content of the baseline studies, phases and expected results. The specification requires local laws and rules to be respected, and for further specific conditions to be added, if necessary.
- *General Specification for Sustainable Development – Human Rights Impact Assessment (HRIA) (i.e., GS EP SDV 103)*: This specification defines the Company guidelines for conducting an HRIA on projects where human rights issues are a potential concern. Where relevant, it requires identification of and engagement with stakeholders who are vulnerable to Human Rights abuses and the assessment of human rights impacts resulting from the Company’s activities and potential mitigation measures. A Human Rights Screening was undertaken as part of the current ESIA to identify potential human rights issues areas related to the Project. The assessment of the potential impacts of the Project’s activities on human rights has been addressed, in collaboration with the other specialist studies, through integration into the ESIA Report itself– as such, refer to Section 7.0 for a summary of the potential human rights impacts.

2.5.3 HSE Policies and Social Corporate Commitments

TotalEnergies is committed to upholding a number of global policies and principles on its projects. These include the Voluntary Principles for Security and Human Rights, the ILO Conventions, UDHR, the UN Guiding Principles on Business and Human Rights, Partnering Against Corruption Initiative and sustainable performance reporting, amongst others.

TotalEnergies also has a Code of Conduct for its staff and supply chain governing health, safety, security, bribery and corruption, and respect for human rights. In Namibia, TEEPNA is committed to conducting its business in a sustainable manner, which provides for and maintains a safe working environment, which is without risk to the wellbeing of its employees, contractors and stakeholders, and which furthermore will have a limiting impact on the surrounding environment. TEEPNA takes the responsibility to apply, drive and sustain the principles listed in its Health, Safety and Environment (HSE) policy (Box 2-1) in order to ensure continued improvement of our HSE performance and impact.



The TotalEnergies Charter of Principles and Guidelines regarding Indigenous and Tribal Peoples⁹ sets out its commitment to respect the culture, values and lifestyle of the local communities, and contributes to its economic development while carrying out its business. As such, TotalEnergies endeavours to honour the principles of the charter together with applicable legal standards, while dealing with Indigenous and Tribal Peoples.

Box 2-1: TEEPNA's HSE Policy



TOTALENERGIES EP NAMIBIA B.V.
EXPLORATION & PRODUCTION

HEALTH, SAFETY & ENVIRONMENT POLICY

TotalEnergies EP Namibia B.V. is committed to conduct its business in a sustainable manner, which provides for and maintains a safe working environment for its employees, contractors, and stakeholders, and which furthermore will have a limiting impact on the surrounding environment.

The Management of TotalEnergies EP Namibia B.V. takes the responsibility to apply, drive and sustain the principles listed in this policy in order to ensure continued improvement of our HSE performance and impact. All TEEPNA employees and contractors are expected to take ownership of the HSE performance by adhering to the principles set in the policy.

IT IS OUR POLICY TO:

- Encourage and promote a positive HSE work culture throughout the organisation, by demonstrating strong visible leadership from management and supervision, and to involve the workforce, to take personal ownership, responsibility and accountability for Health, Safety, and the Environment in the workplace.
- Continuously communicate with and consult all personnel, contractors, and stakeholders on any HSE related matters.
- Comply with all Local and International Laws and Regulations, as well as all Corporate Policies and Specifications applicable to our operations.
- Incorporate and plan for effective HSE management methods in all ongoing engineering and operations activities.
- Pro-actively identify and implement continuous improvement initiatives by setting measurable HSE targets and objectives and regularly review our actual performance against these targets and objectives.
- Ensure all people are trained and competent for any task they perform and ensure that such work is performed under the supervision of a person who has been trained to acknowledge the related hazards and has the authority to implement precautionary measures.
- Ensure that all risks associated with our operations are continuously identified, monitored, and reviewed in order to mitigate and maintain our risk profiles as low as reasonably possible.
- Provide for appropriate and sufficient resources, including training, in order to achieve targeted performance levels.
- Evaluate the Environmental impact of our activities and implement appropriate mitigation measures to minimize the impact.
- Work and partner with those industrial and commercial partners who demonstrate a similar commitment to our own HSE visions.
- Ensure monitoring of the health of all employees on a regular basis to ensure that they are not affected by the workplace adversity.
- Implement periodic reviews, internal audits and facilitate external Audits to identify areas for improvement.
- Ensure periodic evaluation of Contractors HSE performance with respect to specifications, technical standards, and industry best practices.
- Implement, maintain, and regularly test emergency response and contingency plans.
- Ensure that there is a scheme in place to recognise and reward those who contribute to improved HSE performance.
- Ensure recommendations from documented lessons learned, and feedback are implemented to avoid recurrence.

Each and every employee, contractor and person acting on behalf of the company, has the responsibility to prevent harm to themselves, others and the surrounding environment, which may be affected by their acts or omissions.

TotalEnergies EP Namibia B.V. is committed to ensure that our resources, organisational strategies and processes are aligned with the goals and objectives as set out in this policy, in order to satisfy our stakeholder's needs.

Mariam KANE-GARCIA
General Manager

TEEPNA/1/POL/HSE/01/01/1

December 2025

⁹ TotalEnergies' submission to the Corporate Human Rights Benchmark disclosure platform - Business & Human Rights Resource Centre



2.5.4 TotalEnergies Sustainability Approach

Aspects from TotalEnergies' sustainability approach are described below.

A process of continuous improvement linked to the sustainable development goals

As part of its transition strategy to achieve its **2050 Net Zero Ambition, together with society**, TotalEnergies has placed **Sustainability at the heart of its strategy, its projects and its operations**. Based on **the values defined in our Code of Conduct**, TotalEnergies' **sustainable development approach** is structured around 4 axes.

TotalEnergies has placed sustainable development in all its dimensions at the heart of its strategy, projects and operations, in order to contribute to the well-being of the planet's populations, and it wants to set the standard in terms of commitment to the Sustainable Development Goals (SDG), adopted in 2015 by the United Nations and its Member States and to which TotalEnergies has committed to contribute since 2016.

TotalEnergies has structured its sustainability approach for conducting its activities so as to contribute to the achievement of the United Nations SDGs.

As part of its determination to strengthen its efforts in the segments in which it can act with most authority as an integrated multi-energy Company, TotalEnergies involves its employees in identifying the SDGs on which it can have the greatest impact, in connection with its ambition to reach carbon neutrality (net zero emissions) by 2050, together with society.

TotalEnergies' sustainability approach is based on four pillars summarised in Figure 2-1:

- *Climate and sustainable energy: leading the transformation of the energy model to contribute to the fight against climate change and meet the needs of populations;*
- *People's well-being: being a reference as an employer and responsible operator.* TotalEnergies intends on promoting a work environment that combines performance and conviviality and ensuring compliance with human rights in the workplace, both within the Company and among its partners, but also the safety and health of people;
- *Care for the environment: to be exemplary in the management of the environment and the use of the planet's natural resources.* TotalEnergies intends on ensuring that the environmental impacts of all its operations are managed according to the Avoid-Reduce-Offset approach, thereby helping to preserve the environment, biodiversity and freshwater resources. To this end, TotalEnergies promotes the circular economy; and
- *Positive impact for stakeholders: generating shared prosperity across regions.* TotalEnergies aims to be a creator and a driver of positive change for the communities in its host regions.

TotalEnergies actively works on each of its sustainability pillars in order to make its development a vehicle of progress that benefits as many people as possible and to be a factor of positive change for the societies and regions where it is present. TotalEnergies' purpose is to supply to as many people as possible a more affordable, more available and cleaner energy. As a supporting component of society's evolutions, energy is a fundamental resource for economic, social and human development, which currently faces a twofold challenge: (1) satisfying the energy needs of an ever-growing world population, while (2) reducing global warming. TotalEnergies' intention in becoming a broad energy company is to help meet that challenge in a responsible way, in line with its support of the SDGs since 2016.



Main pillars of this strategy are introduced below. For further information on TotalEnergies' commitments, refer to its website¹⁰.



Figure 2-1: The axes of TotalEnergies Sustainability Approach.

Support to global initiatives

TotalEnergies is committed to various international initiatives such as the fight against climate change, promotion of social dialogue, preservation of biodiversity, transparency in the conduct of business.

TotalEnergies abides by the principles of the UN Global Compact, a voluntary initiative that encourages businesses worldwide to adopt sustainable and socially responsible policies, focusing on human rights, labour, the environment, and anti-corruption. TotalEnergies is

¹⁰ https://totalenergies.com/system/files/documents/totalenergies_sustainability-climate-2025-progress-report_2025_en.pdf



committed to respecting internationally recognized human rights, wherever it operates, especially the Universal Declaration of Human Rights, the Fundamental Conventions of the ILO, the UN Guiding Principles on Business and Human Rights, the OECD Guidelines for Multinational Enterprises and the Voluntary Principles on Security and Human Rights (VPSHR).

TotalEnergies is also a signatory of the Oil and Gas Decarbonization Charter (OGDC), a commitment aimed at reducing emissions from oil and gas operations and aiming for zero methane emissions by 2030.

Transparency, a principle of action

TotalEnergies believes that transparency is an essential principle of action in building a trust-based relationship with its stakeholders and enables a path of continuous improvement.

Pending the adoption of an international, standardised non-financial reporting framework, TotalEnergies ensures it is accountable for its performance on the basis of the various commonly used Environmental, Social and Governance (ESG) reporting frameworks. As such, TotalEnergies refers to the Global Reporting Initiative (GRI) standards and those of the Sustainability Accounting Standards Board (SASB), for which detailed tables of correspondence are available on its website. TotalEnergies' reporting includes the World Economic Forum's core indicators¹¹. Furthermore, TotalEnergies follows the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) for its climate reporting. TotalEnergies provides additional information on its website in pages specifically dedicated to its sustainability development approach.

TotalEnergies' sustainability approach is recognised: in 2021, TotalEnergies was confirmed as a LEAD Company by the UN Global Compact for its full commitment to Corporate Social Responsibility (CSR).

As a permanent member of the Extractive Industries Transparency Initiative (EITI) since its formation in 2003, TotalEnergies fully supports initiatives for greater transparency and accountability. The EITI is a global standard for promoting transparency and accountability in the oil, gas, and mining sectors. It requires countries to disclose information along the extractive industry value chain, from the point of extraction to revenue allocation and its contribution to the economy.

As part of EITI, governments are encouraged to ensure that the tax reporting obligations they will impose upon multinational groups are consistent, coordinated and proportionate.

TotalEnergies publishes an annual report covering the payments made by its extractive affiliates to governments and the full list of its consolidated entities, together with its countries of incorporation and of operations in its Universal Registration Document¹².

TotalEnergies also issues a tax transparency report¹³, which provides additional information on the taxes paid in its main countries of operations on a country-by-country basis. This report aims to offer more detailed information on TotalEnergies' tax position.

¹¹ Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation, white paper, September 2020.

¹² https://totalenergies.com/system/files/documents/totalenergies_universal-registration-document-2024_2025_en.pdf

¹³ https://totalenergies.com/sites/g/files/nytnzq121/files/documents/totalenergies_tax-transparency-report-2023_2025_en_pdf.pdf



Energy Transition

TotalEnergies' ambition is to become a world-class player in the energy transition. TotalEnergies' Two-Pillar Multi-Energy Strategy consists of developing an integrated and balanced multi-energy transition strategy by profitably growing its energy production, particularly from liquefied natural gas (LNG) and electricity, the two fastest growing energy markets, to create long-term value for its shareholders. In the next decade until 2030, TotalEnergies' sales of oil products are expected to diminish by almost 30% and its sales mix will become 30% oil products, 5% biofuels, 50% natural gas and 15% electricity, primarily of renewable origin. As a result, oil will account for no more than 30% of its total sales, compared to 53% in 2019.

Climate and carbon neutrality ambition

TotalEnergies supports the objectives of the Paris Agreement, which calls for the reduction in greenhouse gas emissions and its goal of limiting the average rise in planetary temperatures to well below 2°C from pre-industrial levels.

TotalEnergies also supports the objective set out in the Paris Agreement of achieving global carbon neutrality – i.e., net zero emissions, which is the balance between GHG emissions and anthropogenic removals in the form of sinks and reservoirs, such as forests, carbon capture and storage facilities.

TotalEnergies aims to reduce direct emissions across its operated facilities and achieve carbon neutrality with society by 2050, with an intermediate target to reduce scope 1+2 emissions by 40% by 2030, compared with 2015 levels. This target is consistent with the roadmap set out in the European Union's "Fit-for-55" package and the IEA's 2023 Net Zero Emission scenario. To make this happen, TotalEnergies is deploying cutting-edge technology to stop routine flaring, gradually eliminate methane emissions and improve energy efficiency. As far as methane is concerned, United Nations Environment Programme (UNEP) has confirmed TotalEnergies' OGMP 2.0 Gold Standard status in 2023, for the 3rd year in a row.

The reduction in direct emissions to be achieved through the following interventions:

- Eliminating routine flaring.
- Aiming for zero methane emissions in existing operations by 2030.
- Improving energy efficiency.
- Reducing our emissions with geological CO₂ storage.
- Developing Nature-Based Solutions to offset our residual emissions.

For further information on TotalEnergies strategy for reducing direct emissions refer to its website¹⁴.

Sustainable value creation

TotalEnergies' model of value creation is based on integration across the energy value chain, from exploration and production of oil, gas and electricity (including renewables) to energy distribution to the end customer, and including refining, liquefaction, petrochemicals, trading, and energy transportation and storage. This integrated business model enables TotalEnergies to capitalise on synergies among the various businesses, while responding to volatility in feedstock prices. With this integration of its operations across the entire value chain, TotalEnergies can manage the bottom of the cycle more effectively and capture margins when the market improves. This transition will cement the durability and resilience

¹⁴ <https://totalenergies.com/sustainability/climate-and-sustainability-energy/reducing-our-scope-1-and-2-emissions>



of TotalEnergies' value creation model and bolster its ambition of getting to Net Zero (net zero emission).

Preservation of the Environment

TotalEnergies considers the respect for the environment to be a priority and, therefore, strives to minimise the footprint of its activities by controlling its energy consumption, its emissions in natural environments (water, air, soil), its residual waste production, its use of natural resources and its impact on biodiversity. Prevention and management of accidental pollution risk are covered by a strong policies framework. In 2020, TotalEnergies set itself a new biodiversity ambition to coincide with the preparation of the United Nations' global biodiversity plan, which is based on four core principles, including voluntary exclusion zones on more sensitive areas such as UNESCO World Cultural Heritage sites and Arctic sea-ice regions. Regarding the "circular economy", since 2017, TotalEnergies has focused on waste reduction and valorisation (i.e., increase in the value of), including developing polymers from recycled plastics. In addition, in January 2022, TotalEnergies set a new target for the freshwater resource protection for 2030. The ambition of the Company is to reduce by 20% its freshwater withdrawal in water stress area between 2021 and 2030.

TotalEnergies actively supports several environmental and biodiversity initiatives, including Act4Nature International, the CEO Water Mandate, the Circular Economy Commitment by Association Française des Entreprises Privées (AFEP), and the UN Global Compact Ocean Stewardship Coalition.

Business ethics

TotalEnergies operates in many different countries with disparate and complex economic, social and cultural environments, where governments and civil society have especially high expectations of TotalEnergies as an exemplar. Within this context, TotalEnergies strives to act as an agent for positive change in society by helping to promote ethical principles in every region where it operates. Accordingly, TotalEnergies is committed to respecting internationally recognised human rights wherever it operates. TotalEnergies is also fully committed to fighting corruption and has adopted a policy of zero tolerance in that area.

Participative Stakeholder Engagement

Transparency is an essential factor in building a trust-based relationship with stakeholders and ensuring that a company or project is on a path of continuous improvement.

Dialogue with TotalEnergies external stakeholders is essential for the company to conduct its business responsibly and integrate the long-term challenges of sustainable development in the company's strategy and policies. This dialogue informs TotalEnergies' decision-making, by, in addition to specific studies, helping it identify the non-technical risks and impacts of its operations, including the Human Rights component and, more generally, by providing greater insight into changing societal patterns and expectations.





3.0 ESIA Approach and Process

This chapter provides the details of the ESIA Project Team and outlines the ESIA assumptions, limitations, approach and process.

3.1 ESIA Project Team

The project team and specialists appointed to undertake the ESIA process are presented in Table 3-1. The CVs for the SLR ESIA project team are attached in Appendix A. SLR, Urban Dynamics and specialist consultants have no vested interest in the proposed project other than fair payment for consulting services rendered as part of the ESIA process.

Furthermore, SLR has appointed Dr Peter Tarr of the Southern African Institute for Environmental Assessment (SAIEA) to undertake an independent peer review of the ESIA process, Scoping Report, ESIA Report and ESMP.

Table 3-1: Details of the ESIA project team and specialists.

Company	Name	Qualifications	Experience (years)	Role
ESIA Project Team				
SLR Namibia / Africa	Sue Reuther	MPhil (Environmental Management), University of Cape Town (UCT) BSc Hons (Economics), University College London	20	Project Director and QA/QC
	Alice McGrath	MSc (Biological Sciences), UCT BSc Hons (Ocean & Atmosphere Science), UCT	8	Project Manager and report compilation.
	Melissa Schulze	MSc (Zoology) University of Stellenbosch BSc Hons (Biodiversity & Ecology), University of Stellenbosch	6	Project Manager and report compilation
	Jeremy Blood	MSc (Conservation Ecology), University of Stellenbosch BSc Hons (Biology), Rhodes University	24	Technical advisor and report review
	Robyn Christians	BSc. Murdoch University, Perth LLB, UCT	9	Deputy Project Manager In-country project support, report compilation and liaison with authorities, public consultation
	Lester Harker	BA Environment and Development, University of Stellenbosch Dipl. Environmental Health and Safety Management (FEDE – Uniathena)	13	Stakeholder Engagement Management
	Njabulo Mzilikazi	BSc Hons (Geography), University of the Witwatersrand	8	



Company	Name	Qualifications	Experience (years)	Role
	Kerry Schwarz	BA (Geography), University of Leeds	28	GIS data management and mapping
	Kamogelo Rakale	BSc (Hons) Geography, University of the Witwatersrand	10	
Urban Dynamics	Ernst Simon	Masters in Urban and Regional Planning, University of the Free State	37	Stakeholder Engagement
	Heidri Bindemann Nel	Masters in Town and Regional Planning, University of Pretoria	15	
	Jonas Heita	Masters in environmental planning and management, UNESCO-IHE, Netherlands	18	
	Tresia Amwaalwa	Honours in Town and Regional Planning, University of Science and Technology	14	
Specialist Team				
CLS Brasil	Marcelo Cabral	PhD (Coastal and Oceanic Eng.), University de Rio de Janeiro, Brazil	26	Drilling discharge, produced water discharge, commissioning effluent discharge and oil spill modelling
	Ingrid Trindade	Oceanographer, State University of Rio de Janeiro, Brazil	4	
	Jonatan Nascimento	MSc (Oceanography in State University of Rio de Janeiro, Brazil)	3	
	Ana Boechat	MSc (Computational Modelling in Environmental Engineering, Federal University of Rio de Janeiro, Brazil)	15	
	João Deboni	Oceanographer, Federal University of Espírito Santo, Brazil	3	
	Bruno Barreto	Oceanographer, State University of Rio de Janeiro, Brazil	1	
SLR Canada	Jonathan Vallarta	PhD (Underwater Acoustics), Heriot-Watt University	20	Underwater Noise Modelling
	Justin Eickmeier	PhD (Physical Oceanography), University of Delaware, MS (Ocean Engineering), Florida Institute of Technology	10	
SLR Namibia / Africa	Alice McGrath	MSc (Biological Sciences), UCT BSc Hons (Ocean & Atmosphere Science), UCT	8	Marine Ecology Impact & Fisheries Impact Assessment
	Melissa Schulze	MSc (Zoology) University of Stellenbosch BSc Hons (Biodiversity & Ecology), University of Stellenbosch	6	



Company	Name	Qualifications	Experience (years)	Role
	Michael van Niekerk	MSc (Environmental Science), University of KwaZulu-Natal	17	Climate Change Risk Assessment
	Dave Mercer	CEng and BEng (Energy Engineering), University of Leeds, UK	35	Energy Management Plan
	Lisa Ramsay	MPhil and PhD, University of Cambridge	18	Air Emissions Impact Assessment
	Loren Dyer	BsocSci Hons (Geography & Environmental Management), University of KwaZulu-Natal	16	
	Natalie Kohler	BSc Hons (Cell and Environmental Biology) University of KwaZulu-Natal	20	Waste Management Study
	Danie Otto	MSc (Biogeomorphology) University of Johannesburg	30	Closure and Decommissioning Study
	Brett Coutts	BSc Hons (Plant and Environmental Science), University of the Witwatersrand	16	
	Tumelo Morapi	BSc Hons (Geography, Environmental and Resource Studies), University of Limpopo	6	
Pisces Environmental Services	Andrea Pulfrich	PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany	29	Marine Ecology Impact Assessment
Fisheries and Oceanographic Support Services	Dave Japp	MSc. (Ichthyology and Fisheries Science), Rhodes University	37	Fisheries Impact Assessment
LM Environmental Consulting	Lima Maartens	PhD (Fisheries Science), Rhodes University	32	
Synergy Global Consulting	Edward O'Keefe	Master of Arts in Rural Development (University of East Anglia)	30	Human Rights Screening / Assessment
	Gina Snyman	LLM, (Human Rights), University of Pretoria,	15	
	Xholiswa Khumalo	Masters of Sociology (MA), University of Johannesburg	10	
Namibia Environmental Legal Consulting	Michaela Clayton	BA LLB, University of Cape Town	30	
Independent	Robin Sherbourne	MSc Economics, London School of Economics, UK	30	Economics Impact Assessment
Urban Dynamics	Ernst Simon	Masters in Urban and Regional Planning, University of the Free State	37	Social Impact Assessment
	Heidri Bindemann Nel	Masters in Town and Regional Planning, University of Pretoria	15	



Company	Name	Qualifications	Experience (years)	Role
Nelson Mandela University	Rose Boswell	PhD Anthropology, Vrije Universiteit Amsterdam	28	Cultural Heritage Impact Assessment
EXCEED Energy	Paul Welding	BSc (Mechanical Engineering), University of Aberdeen	29	O&G Engineering Advisor
Southern African Institute for Environmental Assessment	Peter Tarr	PhD (Environmental Management and Planning), University of Aberdeen	+30	Independent peer review of the ESIA process and ESIA reports.

3.2 ESIA Assumptions and Limitations

The assumptions and limitations pertaining to this ESIA are listed below:

- SLR assumes that all relevant information has been provided by the applicant and is correct and valid at the time of conducting the ESIA.
- The ESIA is based on an indicative production well and subsea infrastructure layout. This preliminary layout may, however, be adjusted slightly within the geophysical survey area (see Section 5.2.2) when the final design is determined based on detailed engineering. Thus, the ESIA assesses generic (representative or reasonable worst-case) locations within the Venus offshore project area and nearshore transshipment area considering, for example, proximity to sensitive receptors (including protected areas, communities, etc.). This ensures that the impact assessment assesses a representative or reasonable worst-case layout within the Venus offshore project area or nearshore location. Thus, any slight adjustment to the layout is unlikely to affect the findings of the ESIA.
- The indicative technical specifications for the various components and infrastructure are based on generic industry information, previous similar projects and analysis of site-specific exploration data from the Venus offshore project area. It is assumed that the technical specifications on which this ESIA is based are representative to that which will be used during the proposed development.
- This ESIA considers potential impacts of the proposed activities on the biophysical and social environments that have been identified (during the Scoping Phase) within the activities' area of influence, which encompasses areas affected by:
 - o Activities and facilities that are directly owned, operated or managed by the applicant (including contractors and sub-contractors) as part of the proposed activities;
 - o Indirect impacts on biodiversity or ecosystem services upon which potential affected communities' livelihoods depend; and
 - o Potential unplanned events, which are unintended but may occur as a result of accidents or abnormal operating conditions.
- No significant changes to the project description or surrounding environment that could substantially influence findings and recommendations with respect to mitigation and management will occur between the submission of the Final ESIA Report and implementation of the proposed project.
- The applicant (including contractors and sub-contractors) will undertake the proposed project in line with Namibian Legislation, international regulations and best practices,



as well as the applicable TotalEnergies' standards and the ESMP compiled as part of the ESIA Report (see Appendix F).

These assumptions and limitations are in line with typical assumptions and limitations for (predictive) impact assessments and are not expected to materially affect the confidence in the ESIA results.

3.3 ESIA Objectives

The ESIA process has the following objectives:

- Identify the key environmental and social issues and potential impacts that could result from the proposed activities and the approach to be followed in addressing these issues and potential impacts (during the Scoping Phase).
- Identify feasible alternatives related to the proposed activities (during the Scoping Phase).
- Assess potential impacts of the proposed activities and alternatives during the different project phases (during the Impact Assessment Phase).
- Define feasible mitigation or optimisation measures to avoid or minimise potential impacts or enhance potential benefits (during the Impact Assessment Phase).
- Provide the opportunity for I&APs to comment and make input into the ESIA process (during both the Scoping and Impact Assessment phases).
- Through the above, enable informed, transparent and accountable decision-making by the relevant authorities, as well as the presentation of the findings to the public.

3.4 ESIA Process

As per the Environmental Management Act, 2007 and accompanying Regulations 2012, the ESIA process consists of two phases: Scoping Phase and Impact Assessment Phase (see Figure 3-1). **This ESIA process is currently in the Impact Assessment Phase.**

3.4.1 Scoping Phase

The objectives of the Scoping Phase were to:

- Confirm the ESIA process to be followed;
- Identify the opportunities for I&AP engagement and comment;
- Clarify the scope of the proposed activities;
- Identify and confirm the activities, technologies employed and alternatives;
- Identify and confirm the area of interest for the activities;
- Identify the key issues and potential impacts to be addressed in the impact assessment phase and the approach to be followed in addressing these issues and potential impacts; and
- Confirm the level of assessment to be undertaken during the ESIA.

The Scoping Phase involved a process of:

- Notifying I&APs of the proposed activities and the steps in the ESIA process;
- Creating an opportunity for I&APs to interact with the ESIA project team; and
- Providing information for I&APs to ensure that all key environmental and social issues are identified.



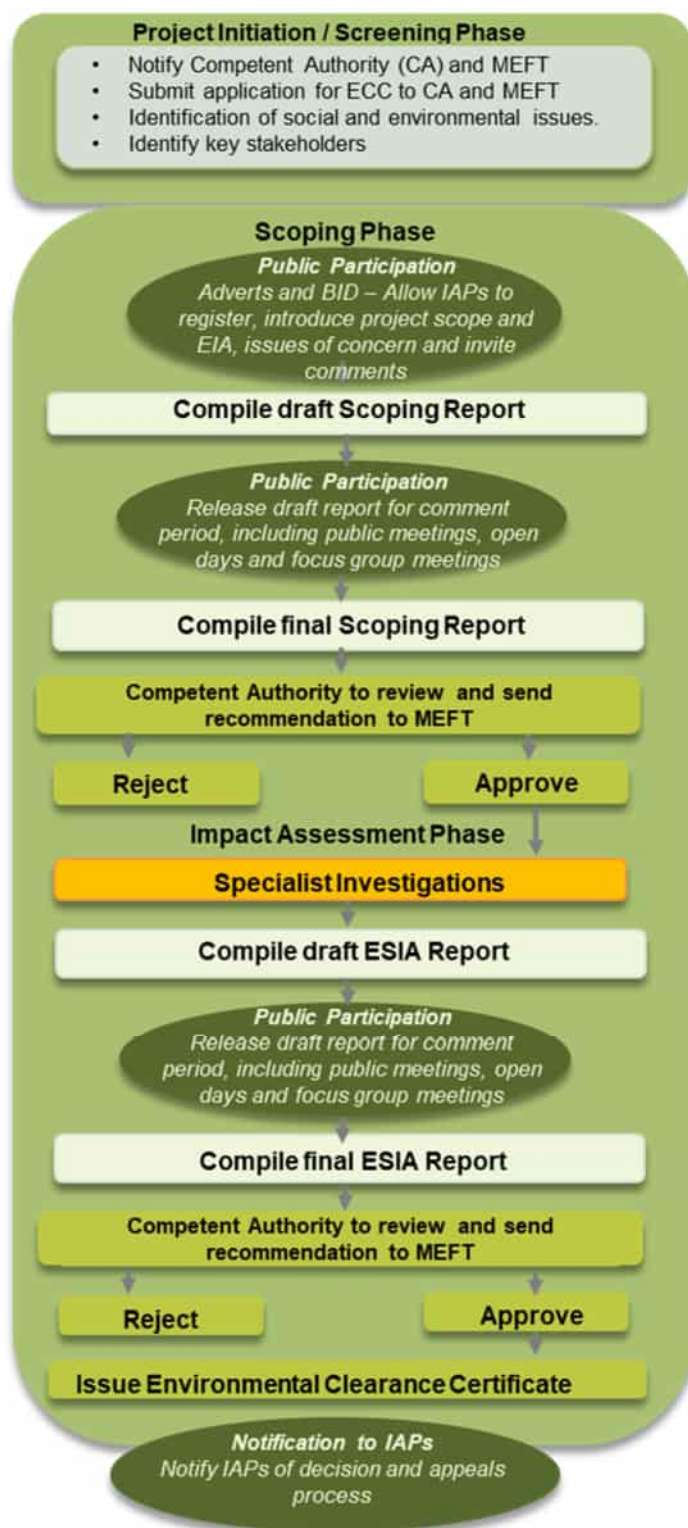


Figure 3-1: Illustration of ESIA Process phases and steps.

Note: The Competent Authority is the Ministry of Industries, Mines and Energy (MIME).



Key steps (excluding public consultation) of the Scoping Phase are summarised below. The public consultation process is summarised in Section 3.5.

3.4.1.1 Project Initiation and Regulatory Engagement

An Application for ECC was compiled and uploaded onto MEFT's online portal. On 25 February 2025 MEFT acknowledged that the application had been registered with application number **(APP-005431)**. The Application for ECC was also submitted to the Petroleum Commissioner (MIME) on 25 February 2025.

3.4.1.2 Baseline Information Collection

As part of the preparation of the Scoping Report, to screen for sensitive habitats / receptors and identify potential issues and impacts of the project, SLR commissioned several specialists' studies such as marine ecology, fisheries, climate change, air quality, socio-economic, cultural heritage and human rights to describe the receiving environment.

3.4.1.3 Compilation and Review of Draft Scoping Report

A Draft Scoping Report (DSR) was prepared in compliance with Section 8 of the EIA Regulations 2012. The Regulations make provision for the Scoping Report to include an assessment of impacts and an ESMP, if sufficient information is available at the Scoping Phase. However, for the proposed project an assessment at the Scoping Phase was not yet possible due to the scale of the project and as several technical modelling and specialist studies needed to be completed to assess the key issues identified. It was also not possible to compile the ESMP at that stage, as the recommended management and mitigation measures will be based on the findings and recommendations of the specialist studies.

The preparation of the DSR was informed by specialist baseline inputs, an Environmental Baseline Survey (EBS) conducted during previous exploration activities in the Venus field (see Section 5.2.1) and a review of previous marine seismic and well-drilling ESIA's undertaken for offshore projects in southern Namibia and the South African West Coast, as well as other development ESIA's undertaken by the proponent.

The DSR included a high-level screening of the interaction between the proposed project activities and the receiving environment (see Section 6.1) and Aspects and Impacts Register (see Section 6.2), which have been further updated in this ESIA Report. These were used as a framework to ensure that all project activities, environmental and social aspects, potential impacts and interactions were identified and understood. This information provided the basis on which the specialist studies and associated terms of references were determined. Impacts of little magnitude (consequence) that were screened out during the Scoping Phase are presented in Section 6.3.

An independent review of the DSR was undertaken by Dr Peter Tarr of SAIEA, which concluded that the report was complete and / or acceptable for all review criteria. A copy of the review report was appended to the Final Scoping Report (FSR) as Appendix B.11.

The DSR was released for a public review and comment period (2 April to 13 May 2025). Steps undertaken as part of the DSR public review process are summarised in Section 3.5.2.

3.4.1.4 Compilation of the Final Scoping Report

The FSR also complied with the requirements of Section 8 of the EIA Regulations and was informed by written comments received on the DSR and issues raised during public meetings and focus group discussions. A summary of the issues and concerns raised is provided in Section 3.5.2.3.



All written submissions were collated, and responded to, in a Comments and Responses Report, which was appended to the FSR¹⁵. The FSR was submitted to MEFT on 30 May 2025 for review and acceptance.

3.4.1.5 Completion of the Scoping Phase and Acceptance of FSR

The FSR was accepted by MEFT on 7 August 2025 (see Appendix B). The acceptance confirmed that the FSR provided adequate identification of significant impacts and that SLR may proceed with the detailed assessment in accordance with Regulation 14 and 15 of the EIA Regulations 2012.

3.4.2 Impact Assessment Phase

3.4.2.1 Specialist Studies

Five technical modelling studies and eight specialist studies were commissioned to address the key issues that required further investigation and detailed assessment. These included:

- Technical Modelling Studies:
 - o Underwater Sound Transmission Loss Modelling (Underwater Noise).
 - o Drilling Discharge Modelling.
 - o Liquid Effluent Discharges Modelling:
 - Commissioning fluid modelling.
 - Produced water modelling.
 - o Oil Spill Modelling.
- Specialist Studies / Assessments:
 - o Marine Ecology Impact Assessment.
 - o Fisheries Impact Assessment.
 - o Socio-economic Impact Assessment.
 - o Cultural Heritage Impact Assessment.
 - o Air Quality Impact Assessment.
 - o Climate Change Risk Assessment.
 - o Waste Management Study.
 - o Conceptual Decommissioning and Closure Strategy.

The terms of reference for these technical modelling and specialist studies were presented and accepted as part of the FSR. The technical modelling studies predict the potential extent of outputs from the proposed development and associated operations and informed specialist impact assessments. Similarly, the waste management and closure and decommissioning studies provide outputs to inform the other specialist studies.

The specialists reviewed the Aspects and Impacts Register (see Section 6.2), the modelling output and secondary data (including data collected during the EBS and geophysical survey – see Section 5.2) to identify and assess potential environmental impacts that may occur as a result of the proposed development activities. These impacts were assessed according to pre-defined rating scales (see Appendix D). Specialists recommended appropriate mitigation

¹⁵ Note that confirmation of the receipts and administrative requests were not included in the Comments and Responses Report but were actioned by Urban Dynamics and/or SLR.



measures to avoid and / or minimise potential impacts or optimisation measures to enhance potential benefits.

Further to the above, Synergy Global Consulting (Synergy) was contracted to undertake a Human Rights Screening to identify potential human rights issues areas. The screening concluded that assessment of potential issues could be addressed, in collaboration with the other specialist studies, through integration into the ESIA Report itself, rather than through a separate Human Rights Impact Assessment (HRIA) – as such, refer to Section 7.0 for a summary of the potential human rights impacts.

3.4.2.2 Compilation and Review of Draft ESIA Report

The technical modelling and specialist study findings and other relevant information were been integrated into this Draft ESIA Report (including an ESMP), in compliance with Section 15(2) of the EIA Regulations 2012 (see Table 3-2). Technical and specialist studies are included as appendices to this report (see Appendix G to Appendix R).

An independent review of the Draft ESIA Report was undertaken by Dr Peter Tarr of SAIEA, which concluded that the report was complete and / or acceptable for all review criteria (see Appendix C).

The Draft ESIA Report (including ESMP) was made available for a review and comment period from 3 November to 3 December 2025 (see Section 3.5.3). The objective of the review and comment period was to ensure that I&APs were notified about the proposed project and given a reasonable opportunity to provide comments on the findings of the ESIA process. Steps included as part of this review and comment process are summarised in Section 3.5.3.

Table 3-2: Requirements of an ESIA Report in terms of Section 15(2) of the EIA Regulations 2012.

Section 15(2)	Content of ESIA Report	Completed (Y/N)	Section in this report
(a)	The curriculum vitae of the EAP who compiled the report;	Y	Appendix A
(b)	A detailed description of the proposed listed activity;	Y	Chapter 4.0
(c)	A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;	Y	Chapters 5.0, 7.0 and 8.0
(d)	A description of the need and desirability of the proposed listed activity and identified potential alternatives to the proposed listed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;	Y	Section 4.7 and Chapters 8.6 and 10.0
(e)	An indication of the methodology used in determining the significance of potential effects;	Y	Appendix D
(f)	A description and comparative assessment of all alternatives identified during the assessment process;	Y	Section 4.7
(g)	A description of all environmental issues that were identified during the assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;	Y	Chapters 7.0 and 8.0



Section 15(2)	Content of ESIA Report	Completed (Y/N)	Section in this report
(h)	An assessment of each identified potentially significant effect, including:	Y	Chapters 7.0 and 8.0
	(aa) cumulative effects;		
	(bb) the nature of the effects;		
	(cc) the extent and duration of the effects;		
	(dd) the probability of the effects occurring;		
	(ee) the degree to which the effects can be reversed;		
	(ff) the degree to which the effects may cause irreplaceable loss of resources; and		
	(gg) the degree to which the effects can be mitigated;		
(i)	A description of any assumptions, uncertainties and gaps in knowledge;		Section 3.2
(j)	An opinion as to whether the proposed listed activity must or may not be authorised, and if the opinion is that it must be authorised, any conditions that must be made in respect of that authorisation; and	Y	Chapter 10.0
(k)	A non-technical summary of the information.	Y	Executive Summary & Appendix E.6.

3.4.2.3 Compilation of the Final ESIA Report

This Final ESIA Report (including ESMP) also Section 15(2) of the EIA Regulations 2012 (see Table 3-2) and has been informed by comments received from I&APs following the distribution of the draft report for review and comment from 3 November to 3 December 2025 and those raised during public engagements, as well as from online focus group and public meetings.

All written submissions received have been incorporated, and responded to, in a Comments and Responses Report¹⁶ (see Appendix E.12).

3.4.2.4 Completion of the Impact Assessment Phase

The Final ESIA Report is submitted to MEFT: DEA, as well as MIME, MAFWLR and MWT for consideration and review. In terms of Section 32 of the Environmental Management Act, 2007 (No. 7 of 2007), MIME is required to make a recommendation on the acceptance or rejection of the report to the MEFT: DEA, who will make the final decision on the ECC application. The decision taken by MEFT will be distributed to all I&APs registered on the project database.

A statutory appeal period in terms of Section 50 of the Environmental Management Act, 2007 and Regulation 25 of the EIA Regulations 2012 will follow the issuing of the decision.

¹⁶ Note that confirmation of the receipts and administrative requests have not been included in the Comments and Responses Report but were actioned by Urban Dynamics and/or SLR.



3.4.2.5 Management of Change

As with most large, complex projects, refinement of the project design is an ongoing and sometimes lengthy process. This ESIA considered the most credible or reasonable “worst-case scenario” when assessing impacts and developing mitigation measures. However, should the project design change after submission of the Final ESIA Report, a Management of Change (MOC) Procedure will be implemented, as agreed with MEFT. The MOC Procedure applies to any changes to the project description (i.e. approved activities), impact assessment and / or mitigation and monitoring measures described in the Final ESIA Report and associated ESMP.

The level of change, as agreed with MEFT, will determine the action to be taken to ensure the changes do not affect the project’s ability to meet environmental and social performance requirements outlined in the ESIA Report, ECC and other relevant Namibian legislation (see Table 3-3). All future design changes will undergo an “Internal Screening” exercise to determine whether the change triggers a ‘Level 1’ or a ‘Level 2’ change. The MOC Procedure has also been included in the ESMP (see Appendix F).

Table 3-3 : Proposed Management of Change Procedure

Level of Change	Description of Level of Change and Action
Level 1: Minor Change	This applies where the change is largely immaterial to the ESIA findings, the listed activities that were applied for are still relevant and it does not affect the Project’s ability to meet environmental and social performance requirements outlined in the ESIA Report and ESMP. Assuming the proposed project is approved by MEFT, compliance with the ECC and ESMP would need to be externally audited in line with the frequency specified in the ECC and ESMP. As part of these external audits, the relevance of the ESMP will be reviewed and amendments proposed where necessary. These changes and their evaluation should be detailed in an application for amendment and the ESMP revised as appropriate (in terms of Section 29 of the Environmental Management Act, 2007 and Regulation 19 of the EIA Regulations 2012). In terms of Section 39 of the Environmental Management Act, 2007, an ECC may be amended if the amendment will not increase the level or nature of the impact, which impact was initially assessed and considered when application was made for an ECC.
Level 2: Significant Change	This applies where a change or upgrade would lead to a significant departure from the base-case or a key aspect of it such that the existing ESIA Report or ESMP does not adequately address potential impacts or require additional mitigation. This would imply that either a new listed activity(s) is triggered or the scope of an approved activity would change. This requires an update of the ESIA Report and ESMP through an amendment application in terms of the Environmental Management Act, 2007 and Regulations 19 and 21 of the EIA Regulations 2012, and submission thereof to MEFT for review and decision.



3.5 Public Consultation Process

This section presents the principles of public consultation and the process undertaken during the Scoping Phase and the Impact Assessment Phase.

3.5.1 Principles

The key principles of stakeholder engagement applied in this ESIA process conforms to international standards:

- Providing meaningful information in a format and language(s) that are readily understandable and tailored to the needs of the target stakeholder group(s);
- Providing information in advance of consultation activities and decision-making;
- Disseminating information in ways and locations that make it easy for stakeholders to access it;
- Respect for local traditions, languages, timeframes and decision-making processes;
- Two-way dialogue that gives both sides the opportunity to exchange views and information, to listen, and to have their issues heard and addressed;
- Inclusiveness in representation of views;
- Processes free of intimidation or coercion;
- Clear mechanisms for responding to people's concerns, suggestions, and grievances; and
- Incorporating feedback into project or programme design and reporting back to stakeholders.

3.5.2 Scoping Phase

The steps undertaken for the Scoping Phase included:

- Identification of stakeholders;
- Regulatory engagement;
- Project notification to stakeholders, including compilation of a Background Information Document (BID);
- Compilation and public disclosure of DSR (including Non-Technical Summary, NTS) for review and comment;
- Compilation of a Comments and Response Report; and
- Compilation of a FSR and disclosure for information purposes.

3.5.2.1 Stakeholder Engagement Plan

Although not a legal requirement in Namibia, a Stakeholder Engagement Plan (SEP) was prepared to meet good practice requirements. The SEP was a “live” document that was updated over the course of the ESIA, when necessary. The SEP defined a technically and culturally appropriate approach to consultation and disclosure. The SEP outlined the stakeholder engagement (or public participation) in the ESIA process and described the approach and methods to be used for stakeholder engagement. It also reflected the considerations underlying the selected approach to the public participation process for this ESIA, which were based on the nature of the proposed activities, characteristics of stakeholders, legal requirements and experience on previous comparable processes.



3.5.2.2 Stakeholder Identification

A stakeholder is defined as any external person, group of persons, or organisation on which the project (or activity) has a potential, direct or indirect, positive or negative impact. It also includes project affected people and communities.

A preliminary I&AP database was compiled based on:

- TEEPNA's existing stakeholder database for southern Namibia;
- SLR's existing databases from other offshore oil and gas ESIAs undertaken in southern Namibia;
- Urban Dynamics' existing databases for previous offshore and onshore projects in Namibia; and
- Input from the fisheries specialist in order to ensure the stakeholders and contact details from the fisheries sector was comprehensive and up to date.

The initial database focused on Namibian authorities, Non-Governmental Organisations (NGOs), Community-based Organisations, fishing industry associations / companies, adjacent licence holders, other relevant business entities and individuals (general public).

The initial database included over 600 stakeholders who may be directly or indirectly affected by the proposed activities. These stakeholders were divided into the following categories:

- Authorities:
 - o Namibian Government (national, regional and local).
 - o Traditional Authorities (//Kharas, Erongo and Hardap Regions).
 - o Maritime Authorities (MWT: Directorate of Maritime Affairs and South African Naval Hydrographic Office (SANHO)).
- Business, Associations and Professional Services:
 - o Fishing associations and companies.
 - o Offshore Oil and Gas Operators.
 - o Logistics and Infrastructure organisations.
 - o Tourism Industry and Associations.
 - o Other offshore projects in the Area of Interest (AOI).
 - o Commercial freight services.
 - o Commercial aviation.
 - o Ocean based extraction industry.
 - o Environmental Assessment Practitioners.
 - o Urban and regional planners.
 - o Consulting engineers.
 - o Other businesses.
- Academia:
 - o Universities and research centres.
- Civil Society:
 - o Namibian NGOs.
 - o International NGOs.
 - o Political and Intergovernmental Organisations.



- o Community Based Organisations (CBOs such as civil society groups, development associations, conservation associations, women's groups, fishing or other activity-based groups).
- o Disability based associations.
- o Coastal communities.
- o Artisanal fishermen.
- o Vulnerable and marginalised groups.
- o Youth groups.
- o General Public.

The I&AP database was continually updated during the ESIA process. Additional I&APs were added to the initial database based on comments received on public documents and attendance at public and focus group meetings. The current updated I&AP database is presented in Appendix E.1.

3.5.2.3 Consultation and Disclosure Methods

Pre-Application Meeting with MEFT

A meeting was held with MEFT on **29 January 2025** to provide notification of the proposed activities and TEEPNA's intent to submit an application for ECC, as well as consult on the ESIA process (including associated public participation strategy) and MEFT requirements.

Initial Notification Letter and Background Information Document

All I&APs on the initial project database were notified, via email, on **17 March 2025** by means of a notification / registration letter and a NTS (available in English, Afrikaans, Oshiwambo, Otjiherero and Damara/Nama). The purpose of the notification letter and NTS was to provide notification of the proposed project, ECC application and ESIA process, specifically the public engagements during the Scoping Phase (open sessions and meetings), and allowed people to register on the stakeholder database.

While potential I&APs, particularly from vulnerable and disadvantaged communities, may not have access to the internet and email, Namibia has a high level of cell phone usage. In order to facilitate engagement during the Scoping Phase and to register on the Project stakeholder database or provide initial comment, cell phone numbers (+264 81 124 5188 or +264 81 354 8251) were also provided in all notifications so that Urban Dynamics could be contacted via SMS and/or WhatsApp messaging.

Newspaper Advertising

Four sets of advertisements (in English) announcing the proposed development activities, the availability of the DSR (see Section 3.5.2.3), the I&AP registration / comment period and in-person engagements (see Section 3.5.2.3) were placed in the following **six newspapers (24 adverts in total)**:

- The Namibian: 17 March, 24 March, 17 April, and 24 April 2025;
- Republikein: 17 March, 24 March, 17 April, and 24 April 2025;
- The Namibian Sun: 17 March, 24 March, 17 April, and 24 April 2025;
- Allgemeine Zeitung: 17 March, 24 March, 17 April, and 24 April 2025;
- New Era: 17 March, 24 March, 17 April, and 24 April 2025; and
- Namib Times: 20 March, 28 March, 17 April, and 25 April 2025.

Text and proof of placement were provided in the FSR.



Site Notices

Site notices (in English) were placed at **26 locations in seven towns** announcing the proposed development activities, the availability of the DSR, the I&AP registration / comment period and in-person engagements were placed at the following locations:

- Bethanie: Settlement Office;
- Luderitz: Luderitz Town Council;
- Oranjemund: Oranjemund Town Council;
- Windhoek: Windhoek Central Hospital, Klein Windhoek Woerman Brock, Khomadal Woerman Brock, UN Plaza, Eros Woerman Brock and Olimpia Woerman Brock;
- Swakopmund: Swakopmund Municipality, Swakopmund Spar, Swakopmund Woerman and Brock, Veneta Woerman Brock, Mondesa Woerman Brock and Tamarisia Town Hall;
- Henties Bay: Henties Bay Municipality, Henties Bay Spar, Henties Bay Woerman Brock, Henites Bay Met Save and Henties Bay Clubhouse (front and back); and
- Walvis Bay: Walvis Bay Municipality, Walvis Spar, Narraville Woerman and Brock, Kuisebond Woerman Brock, Kuisebmond Pick 'n Pay and Kuisebmond Police Station.

A copy of the site notice and proof that the site notices were erected were provided in the FSR.

Radio Announcements

Radio announcements were broadcasted on **NBC Radio (six stations) in English, Afrikaans, Damara/Nama, Otjiherero and Oshiwambo** to announce the start of the ESIA process, availability of the DSR for registration / comment and in-person engagements. The Broadcast text and run dates were provided in the FSR. In summary, the run dates for the radio announcements were as follows with broadcast frequencies in Windhoek:

- National FM (in English) 92.9 FM: 25 and 28 March (once a day), 2 and 5 April (once a day), 16, 17, 18, 23, 24 and 25 April 2025 (twice a day);
- Kati FM (in Oshiwambo) 97.9 FM: 25 and 28 March (once a day), 2 and 5 April (once a day), 16, 17, 18, 23, 24 and 25 April 2025 (twice a day);
- Hartklop FM (in Afrikaans) 89.7 FM: 25 and 28 March (once a day), 2 and 5 April (once a day), 16, 17, 18, 23, 24 and 25 April 2025 (twice a day);
- Omurari FM (in Otjiherero) 97.4 FM: 25 and 28 March (once a day), 2 and 5 April (once a day), 16, 17, 18, 23, 24 and 25 April 2025 (twice a day);
- Kaisames FM (in Damara/Nama) 98.7 FM: 25 and 28 March (once a day), 2 and 5 April (once a day), 16, 17, 18, 23, 24 and 25 April 2025 (twice a day); and
- Radio Wave (in English) 96.7 FM: 16, 17, 18, 23, 24 and 25 April 2025 (three times a day).

Availability of the DSR

The DSR was released for a public review and comment period from **2 April to 13 May 2025**. The objective of the DSR review and comment period was to ensure that I&APs were notified about the proposed activities, given a reasonable opportunity to register on the project database and given an opportunity to provide initial comments of the proposed activities and scope of the assessment. Copies of the DSR and NTS (in English, Afrikaans, Oshiwambo and Otjiherero) were made available on the SLR website for download, as well



as hard copies at the following public locations for the duration of the review and comment period:

- Walvis Bay Municipality;
- Luderitz Town Council;
- Keetmanshoop //Kharas Regional Council;
- Bethanie Village Council;
- City of Windhoek Customer Care Centre;
- Oranjemund Town Council; and
- Swakopmund Municipal Council.

Notification Letter and Non-Technical Summary

All I&APs registered on the project database were notified, via email, on 2 April 2025 of the availability of the DSR and relating comment period and in-person engagements by means of a notification letter (in English, Afrikaans, Oshiwambo, Otjiherero and Damara/Nama). To facilitate the commenting process, a NTS was also provided in English, Afrikaans, Oshiwambo, Otjiherero and Nama/Damara. The purpose of the NTS was to summarise the findings of the DSR in more simple language to ensure the process is transparent and more easily accessible, especially for stakeholders who may not have technical backgrounds. A copy of the notification letter and NTS were provided in the FSR.

Notice of the public engagements was also shared with the local authorities/councils for dissemination across their various noticeboards and community groups (WhatsApp, Facebook, LinkedIn).

Public Meetings and Open Houses

A total of **16 public meetings and 16 open house sessions** were held during the DSR comment and review period (see Table 3-4). These meetings were held in Keetmanshoop, Bethanie, Lüderitz, Oranjemund, Windhoek, Swakopmund, Henties Bay and Walvis Bay. An online meeting was also held for those unable to attend the open days/meetings. Specific details and notice of these meetings were provided in the I&AP notification letter, NTS, advertisements and on the project website.

These engagements were structured as follows:

- **Public Meetings:** A formal presentation session followed by a question-and-answer session. At these meetings, TEEPNA and/or a JV representative, Urban Dynamics and SLR presented an overview of the proposed activities and ESIA process and provided stakeholders the opportunity to raise any issues or concerns.
- **Public Open Sessions:** An informal poster session allowing I&APs to attend and engage with the TEEPNA and/or a JV representative and ESIA team at their convenience during the designated hours.

In Lüderitz and Walvis Bay, concurrent public meetings and open days were held at different venues and times to encourage attendance and ensure accessibility. The purpose of these engagements was to provide an overview of the proposed project and ESIA process and provide stakeholders with the opportunity to raise any questions, issues or concerns. All formal meetings were conducted in English, with access to Afrikaans, Damara/Nama, Oshiwambo and Otjiherero materials, facilitators and translators. Posters were available in English and Afrikaans.



The NTS document was also made available at the meetings / open sessions in English, Afrikaans, Oshiwambo, Otjiherero and Nama/Damara. Free Wi-Fi was also made available to all attendees to enable the download of the DSR and NTS.

Minutes and attendance registers of these engagements were presented in the FSR.

Table 3-4: Scoping Phase Public Open House and Meeting Details

Town/City	Date (2025)	Venue	Open House		Meeting	
			Time	No. of Attendees	Time	No. of Attendees
Keetmanshoop	7 Apr	University of Namibia (UNAM)	13:00 - 17:30	53	17:30 - 19:30	23
Bethanie	8 Apr	Bethanie Community Hall	11:30 - 13:30	131	13:30 - 15:30	88
Lüderitz	9 Apr	New Waterfront Cornelius Frederick Conference Room	13:00 - 17:30	56	17:30 - 19:30	23
		Lüderitz Senior Secondary School Hall	09:30 - 14:00	83	14:00 - 16:00	31
	10 Apr	New Waterfront Cornelius Frederick Conference Room	09:00 - 11:00	19	11:00 - 13:00	13
		Benguela Community Hall	11:00 - 17:30	2	17:30 - 19:30	37
	11 Apr	New Waterfront Cornelius Frederick Conference Room	11:30 - 14:00	23	-	-
		St Peters Church Hall	11:30 - 14:00	2	09:30 - 11:30	21
Oranjemund	12 Apr	New Waterfront Cornelius Frederick Conference Room	09:00 - 12:00	22	-	-
		Oranjemund Recreation Club	12:30 - 14:30	27	14:30 - 16:30	16
Windhoek	22 Apr	Franco Namibian Cultural Centre (FNCC)	13:00 - 17:30	75	17:30 - 19:30	42
	23 Apr	UN Plaza	13:00 - 19:00	188	-	-
Swakopmund	28 Apr	Tamariskia Town Hall	-	-	16:00 - 18:00	46
Henties Bay	28 Apr	The Clubhouse	-	-	16:00 - 18:00	9
Walvis Bay	29 Apr	Pelican Bay Hotel	13:00 - 17:30	25	17:30 - 19:30	11
		NAMSOV Learn in Peace Centre, Kuisebmond	13:00 - 17:30	20	17:30 - 19:30	17
	30 Apr	Pelican Bay Hotel	09:00 - 11:00	65	11:00 - 13:00	10
		Walvis Bay Town Hall	16:00 - 18:00	44	14:00 - 16:00	37
Virtual Online	06 May	Microsoft Teams	-	-	14:00 - 16:00	21
Total number of attendees at open houses and public meetings				802		445

Focus Group Discussions

A total of **13 Focus Group Discussions** were held during the DSR comment and review period (see Table 3-5). Key stakeholders in each town were invited to meet with the TEEPNA and ESIA team to discuss more thoroughly the issues and concerns of these stakeholders and to ensure maximum support and collaboration on the project.



Table 3-5: Scoping Phase Focus Group Discussions Details.

<u>Stakeholder Group</u>	<u>Town/City</u>	<u>Date (2025)</u>	<u>Venue</u>	<u>No. of Attendees</u>
<u>Business & Tourism</u>	<u>Keetmanshoop</u>	<u>7 Apr</u>	<u>Unam, Noordhoek</u>	<u>5</u>
	<u>Windhoek</u>	<u>22 Apr</u>	<u>Franco Namibia Cultural Centre Board Room</u>	<u>27</u>
	<u>Lüderitz</u>	<u>10 Apr</u>	<u>Lüderitz New Waterfront</u>	<u>6</u>
<u>Authorities</u>	<u>Lüderitz</u>	<u>9 Apr</u>	<u>Lüderitz New Waterfront</u>	<u>6</u>
	<u>Walvis Bay</u>	<u>29 Apr</u>	<u>Pelican Bay Hotel</u>	<u>11</u>
<u>Youth Groups</u>	<u>Lüderitz</u>	<u>9 Apr</u>	<u>Lüderitz Senior Secondary School Hall</u>	<u>8</u>
	<u>Walvis Bay</u>	<u>29 Apr</u>	<u>NAMSOV Learn in Peace Kuisebmond Centre,</u>	<u>7</u>
<u>Small, Medium and Micro Enterprises (SMMEs)</u>	<u>Lüderitz</u>	<u>10 Apr</u>	<u>Benguela Community Hal</u>	<u>37</u>
<u>Civil Society Organisations</u>	<u>Lüderitz</u>	<u>11 Apr</u>	<u>Lüderitz New Waterfront</u>	<u>6</u>
<u>Artisanal Fishers (Hanganeni Artisanal Fishing Association)</u>	<u>Henties Bay</u>	<u>28 Apr</u>	<u>Hanganeni Artisanal Fishing Association office</u>	<u>10</u>
<u>Woman's Groups</u>	<u>Walvis Bay</u>	<u>29 Apr</u>	<u>NAMSOV Learn in Peace Centre, Kuisebmond</u>	<u>18</u>
	<u>Lüderitz</u>	<u>11 Apr</u>	<u>St. Peters Church</u>	<u>5</u>
<u>Topnaar Community Leaders</u>	<u>Walvis Bay</u>	<u>30 Apr</u>	<u>Walvis Bay Town Hall</u>	<u>2</u>
<u>Total number of attendees</u>				<u>148</u>

Minutes and attendance registers of these engagements were presented in the FSR.

The ESIA team also arranged Focus Group Discussions with the following key stakeholder groups, however, these meetings did not proceed as planned due to non-attendance despite prior confirmations and multiple reminders:

- Fishing Industry and Associations (Lüderitz);
- Civil Society Organisations (Walvis Bay);
- Small, Medium and Micro Enterprises (Walvis Bay); and
- Tourism and Business Operators (Walvis Bay).

Although these meetings did not proceed as planned, numerous other opportunities were afforded these groups to participate in the ESIA process through public open houses, public meetings and online meetings, as outlined in this section.

Dedicated Meetings

A total of **6 dedicated meetings** were held with specific institutions to discuss more thoroughly the issues and concerns of these specific institutions and to ensure maximum collaboration on the project (see Table 3-6). Minutes and attendance registers of these engagements were presented in the FSR.



Table 3-6: Scoping Phase Dedicated Meeting Details.

Stakeholder Group	Town/City	Date (2025)	Venue	No. of Attendees
//Kharas Regional Council	Keetmanshoop	7 Apr	Kharas Region Council	27
Lüderitz Town Council	Lüderitz	11 Apr	Lüderitz Town Council Chambers	10
Nama Traditional Leaders Association (NTLA)	Windhoek	23 Apr	SLR offices	6
Logistics Contractor	Lüderitz	12 Apr	Lüderitz New Waterfront	31
National Planning Council	Walvis Bay	6 May	Commissioners Boardroom, Government Office Park	12
Namibia Investment Promotion and Development Board (NIPDB)	Windhoek	7 May	NIPDB Boardroom	9
Total number of attendees				95

I&AP Comments and Responses

Comments received on the DSR were collated and responded to in a Comments and Responses Report. Comments received were considered in updating of the report into the FSR.

The key concerns raised through the public participation process during the Scoping Phase are summarised below:

- Potential impacts to the marine environment;
- Potential impacts to fisheries;
- Namibia's lack of refining capabilities;
- Potential impacts of an oil spill;
- Job opportunities limited to highly skilled individuals;
- Job opportunities for local people and contractors (both national and regional context); and
- Consideration of scope 3 GHG emissions, climate change impacts and stranded assets.

The full submissions and responses (by SLR, Urban Dynamics and TEEPNA) were included in the Comments and Responses Report appended to the FSR.

After the FSR was submitted to MIME and MEFT for consideration and acceptance, it was uploaded to the SLR website for information purposes. All I&APs registered on the project database at the end of the Scoping Phase were notified on 6 June 2025 that the FSR had been uploaded for information-purposes, and where responses to submitted comments could be viewed.



3.5.3 Impact Assessment Phase

Public consultation tasks undertaken for the Impact Assessment Phase are summarised below.

3.5.3.1 Stakeholder Notification

Newspaper Advertising

Advertisements announcing the availability of the Draft ESIA Report, the I&AP registration / comment period and in-person engagements were placed in the following **six newspapers (32 adverts in total)**:

- Namibian, New Era, Republikein, Namibian Sun and Allgemeine Zeitung (in English) on 20 October, 27 October, 3 November and 10 November 2025.
- Republikein, Namibian Sun and Allgemeine Zeitung (in Afrikaans) on 21 October, 27 October, 3 November and 10 November 2025.
- Namib Times (in English) on 31 October, 7 November and 14 November 2025.

Refer to Appendix E.2 for a copy of the advertisement text and proof of placement.

Site Notices

Site notices (in English and Afrikaans) were placed at **40 locations in 8 towns** announcing the availability of the Draft ESIA Report, the I&AP registration / comment period and in-person / online engagements were placed at the following locations:

- Bethanie: Grocer, NamPost and Bethanie Village Council.
- Keetmanshoop: Municipality of Keetmanshoop, //Kharas Regional Council and Spar.
- Lüderitz: Lüderitz Town Council, as well as additional locations (~4) across town.
- Oranjemund: Oranjemund Town Council, Spar and Zacharias Lewala Hall.
- Windhoek: Windhoek Municipality, Maerua Spar, Hochland Spar, Klein Windhoek, Otojumise shops, Stop & Shop, Ombili, Windhoek Library, Greenwell, Police Station and Olympia, FNCC and UN Plaza.
- Swakopmund: Spar, Tamariskia, Modesa View and Veneta.
- Henties Bay: Club House, Henties Bay Municipality and Woermann.
- Walvis Bay: Kuisebmond Library, Walvis Bay Municipality, Namsoy Learning in Peace Centre, Narraville Woermann, Town Centre, Duinesig, Kuisebmond USave and Singles quarters.

A copy of the site notice text and proof that the site notices were erected are provided in Appendix E.3.

In addition to site notice placement as detailed above, notices indicating town specific meeting dates and times were placed in Keetmanshoop (1 site), Lüderitz (~20 sites), Oranjemund (4 sites), Windhoek (~28 sites), Swakopmund (1 site) and Henties Bay (1 site) at TotalEnergies Marketing Namibia (TEMNA) petrol stations, as well as various locations throughout the towns. A copy of the site notice text and some photographic evidence are provided in Appendix E.3.

Radio Announcements

Radio announcements were broadcasted on **NBC Radio (eight stations) in English, Afrikaans, Damara/Nama, Otjiherero and Oshiwambo** to the availability of the Draft ESIA Report, the I&AP registration / comment period and in-person engagements. The broadcast text and proof of broadcast is provided in Appendix E.4. Two broadcasts were made per day as outlined below.



Broadcast dates for the radio announcements were on 22, 23, 27, 30 October and 4, 7, 11, 14 November 2025 on the following radio stations (with broadcast frequencies in Windhoek indicated):

- National FM (English) 92.9 FM;
- Kati FM (Oshiwambo) 97.9 FM;
- Hartklop FM (Afrikaans) 89.7 FM;
- Omurari FM (Otjiherero) 97.4 FM; and
- Kaisames FM (Damara/Nama) 98.7 FM

Broadcast dates for the radio announcements were on 20, 23, 27, 30 October and 4, 7, 11, 14 November 2025 on the following radio stations (with broadcast frequencies in Windhoek indicated):

- Radio Wave (English) 96.7 FM;
- Omulunga (Oshiwambo) 100.9 FM; and
- //Kharas FM (English) 102.3 FM.

3.5.3.2 Consultation on and Disclosure of the Draft ESIA Report

Availability of the Draft ESIA Report (including ESMP)

The Draft ESIA Report (including ESMP) was made available for public review and comment period from **3 November to 3 December 2025**. The objective of this review and comment period was to ensure that I&APs were notified about the proposed project and given a reasonable opportunity to provide comments on the impact assessment, proposed mitigation and ESMP.

Copies of the Draft ESIA Report were made available for download on the SLR website. Hardcopy reports and NTS (in English, Afrikaans, Damara/Nama, Otjiherero and Oshiwambo) were made available at public venues in Walvis Bay, Lüderitz, Windhoek, Keetmanshoop, Bethanie, Swakopmund and Oranjemund for the duration of the review and comment period (see Table 3-7).

Table 3-7: Public locations at which the Draft ESIA Report and Non-Technical Summary were made available.

Copies of Draft ESIA Report were available at:	Copies of NTS were available at:
• Walvis Bay Municipality • Lüderitz Town Council • Keetmanshoop //Kharas Regional Council and Municipality • Bethanie Village Council • City of Windhoek customer care centre • Oranjemund Town Council • Swakopmund Municipal Council	• Walvis Bay Municipality • Kuisebmond Library • Lüderitz Town Council • Lüderitz Library • Keetmanshoop //Kharas Regional Council and Municipality • Bethanie Village Council • City of Windhoek customer care centre • Oranjemund Town Council • Swakopmund Municipal Council

Notification Letter and Non-Technical Summary

Notification letters (in English) were emailed to all I&APs registered on the project database. The letter provided details of the release of the Draft ESIA Report and ESMP, and information on where the report can be reviewed. To provide information in a quick and



easily readable format, a Non-Technical Summary was also provided in English, Afrikaans, Oshiwambo, Otjiherero and Nama/Damara.

A copy of the letter and Non-Technical Summary are provided in Appendix E.5 and E.6, respectively.

Pamphlet Distribution

TEEPNA printed and distributed 1 750 pamphlets in all meeting towns / cities. The pamphlets provided notice of the ESIA public consultation process and public meeting and Open Days, as well as the details for submitting comments (see Appendix E.7).

Social Media

Notice of the public engagements was also shared with the local authorities/councils for dissemination across their various noticeboards and community groups (WhatsApp, Facebook, LinkedIn), as well as NAMCOR's LinkedIn, Instagram and Facebook profile (see Appendix E.2).

In-person Public Meetings and Open Houses

A total of 13 in-person public meetings and 12 open house sessions were held during the Draft ESIA Report comment and review period (see Table 3-8). These were held in Windhoek, Walvis Bay, Swakopmund, Henties Bay, Lüderitz, Keetmanshoop, Bethanie and Oranjemund. Online meetings were also held for those unable to attend the open days/meetings. Specific details of these meetings were provided in the I&AP notification letter, Non-Technical summary, advertisements and on the project website, as well as in the Draft ESIA Report.

These engagements were structured as follows:

- **Public Meetings:** A formal presentation session followed by a question-and-answer session. At these meetings, TEEPNA and/or JV representative, Urban Dynamics and SLR presented an overview of the proposed activities and ESIA findings and provided stakeholders the opportunity to raise any issues or concerns. The presentation is presented in Appendix E.8.
- **Public Open Sessions:** An informal poster session where I&APs can attend at any time during the hours indicated and engage with TEEPNA and the ESIA team. Posters were available in English and Afrikaans (see Appendix E.9). Furthermore, videos were shown on the proposed Venus Development Project, and other oil and gas awareness videos such as (1) Introduction to the five phases of an Oil & Gas development, (2) explanation about drilling activities, (3) FPSO description and construction, and (4) Environmental Baseline Survey conducted by TEEPNA.

The purpose of these open days and meetings was to provide an overview of the proposed project and findings of the ESIA process and provided stakeholders with the opportunity to raise any questions, issues or concerns. All formal meetings were conducted in English, with access to Afrikaans, Damara/Nama, Oshiwambo and Otjiherero facilitators and translators during the open sessions.

At these sessions, NTS documents were made available in English, Afrikaans, Oshiwambo, Otjiherero and Nama/Damara with over 1 000 being distributed. Free Wi-Fi was also made available to all attendees to enable the download of the Draft ESIA Report, NTS and various videos.

Minutes and attendance registers of these engagements are presented in Appendix E.10.



Table 3-8: Impact Assessment Phase Public Open House and Meeting Details.

<u>Town/City</u>	<u>Date (2025)</u>	<u>Venue</u>	<u>Open House</u>		<u>Meeting</u>	
			<u>Time</u>	<u>No. of Attendees</u>	<u>Time</u>	<u>No. of Attendees</u>
<u>Keetmanshoop</u>	<u>3 Nov</u>	<u>Schutzenhaus Guesthouse</u>	<u>14h00 – 17h00</u>	<u>10</u>	<u>17h30 – 19h30</u>	<u>15</u>
<u>Bethanie</u>	<u>4 Nov</u>	<u>Bethanie Community Hall</u>	<u>10h30 – 12h30</u>	<u>30</u>	<u>13h00 – 15h00</u>	<u>16</u>
<u>Lüderitz</u>	<u>5 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>13h00 – 15h00</u>	<u>28</u>	<u>17h30 – 19h30</u>	<u>21</u>
	<u>6 Nov</u>	<u>St Peter’s Church Hall</u>	<u>12h00 – 14h00</u>	<u>25</u>	<u>09h30 – 11h30</u>	<u>15</u>
	<u>7 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>15h00 – 18h00</u>	<u>14</u>	<u>12h30 – 14h30</u>	<u>18</u>
	<u>8 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>09h00 – 11h00</u>	<u>15</u>	<u>11h00 – 13h00</u>	<u>21¹⁷</u>
<u>Oranjemund</u>	<u>10 Nov</u>	<u>Zacharias Lewala Hall</u>	<u>13h00 – 16h00</u>	<u>10</u>	<u>16h30 – 18h30</u>	<u>38¹⁸</u>
<u>Windhoek</u>	<u>13 Nov</u>	<u>UN Plaza Hall</u>	<u>14h00 – 17h00</u>	<u>48</u>	<u>17h30 - 19h30</u>	<u>15</u>
	<u>14 Nov</u>	<u>Franco Namibia Cultural Centre (FNCC)</u>	<u>14h00 – 17h00</u>	<u>25</u>	<u>17h30 – 19h30</u>	<u>30</u>
<u>Henties Bay</u>	<u>17 Nov</u>	<u>The Clubhouse</u>	<u>–</u>		<u>09h00 – 11h00</u>	<u>14</u>
<u>Swakopmund</u>	<u>17 Nov</u>	<u>Tamariskia Town Hall</u>	<u>–</u>		<u>17h30 – 19h30</u>	<u>22</u>
<u>Walvis Bay</u>	<u>18 Nov</u>	<u>Namsoy Learn in Peace Centre, Kuisebmond</u>	<u>14h00 – 17h00</u>	<u>8</u>	<u>17h30 - 19h30</u>	<u>22</u>
	<u>19 Nov</u>	<u>Walvis Bay Town Hall</u>	<u>13h00 – 15h00</u>	<u>16</u>	<u>10h00 – 12h00</u>	<u>25</u>
	<u>20 Nov</u>	<u>Walvis Bay Town Hall</u>	<u>09h00 – 12h00</u>	<u>20</u>	<u>–</u>	
<u>Total number of attendees at open houses and public meetings</u>				<u>249</u>		<u>272</u>

¹⁷ Note: There were 21 registered attendees – however several attendees did not attend the full presentation, with many leaving before the presentation began or during the presentation. As such, an estimated 5 to 6 individuals attended the full presentation as well as the question and discussion session. Notably, all registered attendees have been included in the current stakeholder database, to be kept informed of the project.

¹⁸ Note: There were 38 registered attendees - however several attendees did not attend the full presentation, with many leaving before the presentation began or during the presentation. As such, an estimated 23 individuals attended the full presentation as well as question and discussion session. Notably, all registered attendees have been included in the current Stakeholder database, in order to be kept informed of the project.



Focus Group Discussions and Dedicated Meetings

A total of 18 **focus group discussions and dedicated** meetings were held during the Draft ESIA comment and review period (see Table 3-9). Key stakeholders in each town were invited to meet with TEEPNA and/or JV representatives and the ESIA team to discuss more thoroughly the issues and concerns of those stakeholders and to ensure maximum support and collaboration on the project. Specific details of these meetings were provided in the focus group/dedicated meeting notification letter and invitation email.

Minutes and attendance registers of these engagements are presented in Appendix E.10.

Table 3-9: Impact Assessment Phase Focus Group Discussion and Dedicated Meetings Details.

<u>Stakeholder Group</u>	<u>Town/City</u>	<u>Date (2025)</u>	<u>Venue</u>	<u>No. of Attendees</u>
<u>National Traditional Leaders Authority (NTLA)</u>	<u>Windhoek</u>	<u>31 Oct¹⁹</u>	<u>SLR Offices</u>	<u>5</u>
<u>Students</u>	<u>Keetmanshoop</u>	<u>3 Nov</u>	<u>UNAM Noordhoek Campus</u>	<u>16</u>
<u>//Kharas Regional Governor</u>	<u>Keetmanshoop</u>	<u>3 Nov</u>	<u>//Kharas Regional Council Office</u>	<u>2</u>
<u>//Kharas Regional Council</u>	<u>Keetmanshoop</u>	<u>4 Nov</u>	<u>//Kharas Regional Council Office</u>	<u>7</u>
<u>Lüderitz Town Council and Authorities</u>	<u>Lüderitz</u>	<u>5 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>19</u>
<u>Education, skills development, Youth</u>	<u>Lüderitz</u>	<u>5 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>3²⁰</u>
<u>Fishing Industry</u>	<u>Lüderitz</u>	<u>6 Nov</u>	<u>St Peter's Church Hall</u>	<u>4</u>
<u>Women's Groups</u>	<u>Lüderitz</u>	<u>6 Nov</u>	<u>St Peter's Church Hall</u>	<u>11</u>
<u>Business, Tourism & SMMEs</u>	<u>Lüderitz</u>	<u>7 Nov</u>	<u>Lüderitz New Waterfront Cornelius Frederick Conference Room</u>	<u>8</u>
<u>Oranjemund Town Council</u>	<u>Oranjemund</u>	<u>10 Nov</u>	<u>Oranjemund Town Council Office</u>	<u>3</u>
<u>National Planning Commission</u>	<u>Windhoek</u>	<u>13 Nov</u>	<u>National Planning Council Offices</u>	<u>11</u>
<u>Namibia Investment Promotion and Development Board (NIPDB)</u>	<u>Windhoek</u>	<u>14 Nov</u>	<u>NIPDB, Investment House</u>	<u>45</u>
<u>Government Ministries, Departments</u>	<u>Windhoek</u>	<u>14 Nov</u>	<u>FNCC</u>	<u>6</u>
<u>Artisanal Fishers (Hanganeni Artisanal Fishing Association & Namibian Women's Fisheries Network)</u>	<u>Hentes Bay</u>	<u>17 Nov</u>	<u>The Clubhouse</u>	<u>8</u>
<u>Swakopmund Artisanal Fisheries Association</u>	<u>Swakopmund</u>	<u>17 Nov</u>	<u>Tamariskia Town Hall</u>	<u>2</u>

¹⁹ A dedicated meeting was held with NTLA representatives on 31 October 2025, following an initial invitation for 3 November 2025. The date was brought forward at NTLA's request to accommodate their availability.

²⁰ Based on the number of attendees, and their indicated preference for an open-house format, the meeting was conducted as an information session. Attendees were presented with the project description and ESIA findings through open-house posters.



<u>Stakeholder Group</u>	<u>Town/City</u>	<u>Date (2025)</u>	<u>Venue</u>	<u>No. of Attendees</u>
<u>Women's Group</u>	<u>Walvis Bay</u>	<u>18 Nov</u>	<u>Kuisebmond: Namsov Learning in Peace Centre</u>	<u>12</u>
<u>Education, Skills Development, Youth</u>	<u>Walvis Bay</u>	<u>18 Nov</u>	<u>Kuisebmond: Namsov Learning in Peace Centre</u>	<u>15</u>
<u>Government Ministries, Departments</u>	<u>Walvis Bay</u>	<u>19 Nov</u>	<u>Walvis Bay Town Hall</u>	<u>9</u>
<u>Topnaar Community Leaders</u>	<u>Walvis Bay</u>	<u>20 Nov</u>	<u>Walvis Bay Town Hall</u>	<u>3</u>
<u>Business, Tourism & SMMEs</u>	<u>Walvis Bay</u>	<u>20 Nov</u>	<u>Walvis Bay Town Hall</u>	<u>13</u>
<u>NIPDB and business</u>	<u>Windhoek</u>	<u>25 Nov</u>	<u>NIPDB, Investment House</u>	<u>19</u>
<u>MEFT</u>	<u>Windhoek</u>	<u>2 Dec</u>	<u>MEFT; DEA Offices</u>	<u>7</u>
<u>MAFWLR</u>	<u>Online</u>	<u>08 Dec</u>	<u>Online</u>	<u>2</u>
<u>MWT</u>	<u>Windhoek</u>	<u>09 Dec</u>	<u>MWT Offices</u>	<u>5</u>
<u>Total number of attendees</u>				<u>235</u>

The ESIA team arranged focus group discussions with the following key stakeholder groups, however, these meetings could not proceed as planned due to non-attendance despite prior confirmations and multiple reminders:

- Benguela Ski Boat Fishing Association (Swakopmund), who were invited to attend the same meeting as Swakopmund Artisanal Fisheries Association;
- Fishing Industry and Associations (Walvis Bay)²¹;
- Government Ministries and Departments including MIME, Ministry of Home Affairs, Immigration, Safety and Security (MHAISS), Ministry of Urban and Rural Development (MURD) and Ministry of International Relations and Trade (MIRT); and
- Civil Society and Non-Government Organisations (Windhoek); however, attendance at open houses and public meetings show various participants from such organisation, including Namibia Nature Foundation (NNF), Namibian Chamber of Environment (NCE), Ocean Conservation and Youth Oil Spill Preparedness Initiative Namibia (YOSPIN).

Although these meetings did not proceed as planned, numerous other opportunities were afforded these groups to participate in the ESIA process through public open houses, public meetings and online meetings, as outlined in this section. The applicant remains open to meeting with these stakeholders throughout the remainder of the ESIA process, as well as going forward as part of the Stakeholder Engagement Plan.

Online Meetings

Four online meetings were held during the Draft ESIA Report review and comment period to accommodate I&APs who were not been able to attend the open houses and face-to-face meetings (see Table 3-10). Three of the online meetings focused on presenting an overview of the proposed project, ESIA process and summary of impacts related to a specific topic, including 1. atmospheric emissions, 2. marine ecology and fisheries impacts, and 3. societal and economic impacts. In addition, a general online meeting was held to present a summary of the findings of the entire Draft ESIA Report.

Minutes and attendance registers of these engagements are presented in Appendix E.10.

²¹ Note: The Confederation of Namibian Fishing Associations (CNFA) did confirm receipt of invitations to the Draft ESIA consultations.



Table 3-10: Impact Assessment Phase Online Meeting Details.

<u>Date (2025)</u>	<u>Topic</u>	<u>Meeting Time</u>	<u>No. of Attendees</u>
5 Nov	Understanding Atmospheric Emissions of the project	13h00 – 15h00	21
13 Nov	Focus on Marine Ecology and Fisheries impacts.	08h30 – 10h30	23
14 Nov	Focus on Societal and Economic impacts	14h30 – 16h30	22
21 Nov	General ESIA Presentation	13h00 - 15h00	26
Total number of attendees			92

3.5.3.3 I&AP Comments and Responses

All written submission received by SLR and/or Urban Dynamics on the Draft ESIA Report and ESMP during the comment period, including those received after the comment period closed²², are presented in Appendix E.11. These issues and comments have been collated, and responded to (by SLR, Urban Dynamics and TEEPNA), in a Comments and Responses Report (see Appendix E.12).

All issues raised by I&APs during public meeting have been responded to in the meeting minutes (see Appendix E.10) and Comments and Responses Report when no reply was provided during the meeting.

3.5.3.4 Stakeholder database consolidation

The database of registered I&APs has been updated based on the comments received and attendance at open sessions / meetings. At the time of compiling the Final ESIA Report, **2 865 I&APs were registered on the Project database** (see Appendix E.1 for current I&AP database).

3.5.3.5 Disclosure and I&AP Notification of Final ESIA Report

After the Final ESIA Report is submitted to MIME and MEFT for consideration and decision-making, it will be uploaded to the SLR website for information purposes. All I&APs registered on the project database will be notified via email, SMS or WhatsApp, that the Final ESIA Report has been uploaded for information-purposes, and where responses to submitted comments can be viewed.

3.5.3.6 Disclosure of Decision

The decision by the MEFT: DEA (Environmental Commissioner) on the ECC application will be uploaded onto the SLR website for information purposes. All I&APs registered on the project database will be notified, via email, SMS or WhatsApp, of the decision and the statutory appeal period in terms of Section 50 of the Environmental Management Act, 2007 and Regulation 25 of the EIA Regulations 2012. In terms of Regulation 25(2) of the EIA Regulations 2012, an appellant must submit the appeal, in the prescribed form (which corresponds substantially with Form 3 of Annexure 1 to the regulations, and obtainable from the Ministry) and pay the prescribed fee (in Annexure 2), within 14 days from the date of receipt of the notice. In terms of Regulation 25(2)(d), an appeal must be “submitted to the secretary of the appeal panel” within the Ministry.

²² Both Natural Justice and NTLA requested permission to submit comments after the closure of the Draft ESIA Report review and comment period. Although the review and comment period was in line with the EIA Regulations 2012 in relation to the duration, these requests were accommodated and their comments have been included and responded to in the Comments and Responses Report.



4.0 Description of the Proposed Activities

4.1 Project Overview

This section provides an overview of the key characteristics of and approach to the project. Key terms mentioned below are further explained in Section 4.1.4. More detail on the approach to the project, for each project phase, is provided in Sections 4.2 to 4.5.

4.1.1 Field and Resource Characteristics

The Venus development project occupies an area of ~165 km² on the seabed, with the development footprint extending ~20 km in a NW-SE direction and ~15 km in a E-W direction (see Figure 4-1). The water depth is ~3 000 m and relatively constant across the development footprint, with a variance of ~100 m across the project area up to max of 280 m. Reservoir average depth is ~6 000 m TVDSS (True Vertical Depth Subsea), comprised of ~3 000 m water depth and ~3 000 m drill depth.

The resource to be produced is crude light oil with very low CO₂ content.

4.1.2 Production Approach

The **key components** involved in the installation and operation of the proposed Venus development project and production are summarised below and conceptually illustrated in Figure 4-2:

- Up to 40 subsea wells are envisaged, to be drilled up to ~3 000 meters below the seabed, comprised of around 20 OP wells and 20 GI wells.
- Subsea infrastructure, which includes all infrastructure and equipment located on the seabed used to extract hydrocarbons from the reservoir and transport it to the FPSO, will be comprised mainly of:
 - o Up to 40 electro-hydraulic Xmas trees placed on wellheads (see Section 4.1.4.1).
 - o Approximately 25 In Line Tees (ILTs) (see Section 4.1.4.2) / Flow Line End Terminations (FLETs) for flowline tie-in and end-points (see Section 4.1.4.3).
 - o For production:
 - Two production rings (north and south), approximately 80 km in length in total, connecting the OP wells to each other and the FPSO risers via 12" Nominal Diameter piggable flowlines (see Section 4.1.4.4).
 - Four Steel Lazy Wave Risers (SLWR), around 5km long, connecting the OP wells and production flowlines to the FPSO (see Section 4.1.4.5).
 - o For gas injection:
 - Two SLWR risers, around 5km long, connecting the FPSO to the GI flowlines and wells.
 - Two 12" Nominal Diameter flowlines (north and south) approximately 35 km long and connecting risers to the GI wells.
 - o Two umbilical networks (see Section 4.1.4.6) (north and south) some 75 km long and shared between production and injection circuits.



- An all-electric FPSO vessel²³ will be moored to the seabed with up to 18 mooring lines (each in the order of 4.5 km long). The FPSO production capacity would be up to 160 000 barrels of oil per day and circa 2 million barrels of oil (Mbo) storage tank. The FPSO will process, store, and offload the oil treated onboard.
- DPSTs will be used to offload the oil from the FPSO (see Section 4.4.2). Two dedicated DPSTs are expected to be required during the first years while production is higher, reducing to one DPST thereafter once production declines (see Section 4.4.1).
- After offloading the oil from the FPSO, the DPST will sail to a nearshore transshipment area, ~5 km from the coast located ~20 km north of Walvis Bay, where it will offload the oil to a conventional tanker, which will then transport the oil to its final destination.

The overall **approach to production** is summarised below and shown in Figure 4-3. The project entails only offshore activities:

- OP wells on the seabed produce fluid (a mixture of oil, gas and water) which is transported via the flowlines and risers to the FPSO moored at the production site.
- On the FPSO, the produced fluid is separated into its components (see Section 4.4.2) and managed as follows:
 - o Gas:
 - Approximately 15 MMscfd is expected to be used in the onboard gas turbines to power the FPSO
 - Remainder is reinjected into the reservoir via the gas riser and flowlines and GIs to enhance oil production.
 - Zero routine and continuous flaring thanks to a closed flare system coupled with a venting recovery unit
 - o Water:
 - Produced water is treated on the FPSO and discharged overboard with an oil content below 15 mg/L. A low produced water rate of approximately 10 000 barrel/day is expected.
 - o Oil:
 - Processed crude oil is stored on the FPSO (capacity circa 2 million barrels of oil (Mbo) storage tank) and then offloaded from the FPSO to a DPST.
 - The DPST will then sail to a calmer nearshore area, ~20 km north of Walvis Bay (see Section 4.3.5), and transfer the oil to a conventional tanker, which then moves the oil to its final destination (see Section 4.4.2). Approximately one DPST trip per week is required during peak production. Transshipment is expected to last approximately 24 hours.

The project will be serviced from available ports and marine / aviation support bases.

²³ An all electric FPSO vessel is a vessel where all major power systems and process equipment are driven by electricity. For Venus FPSO, electricity will be generated through gas turbines, allowing better load management and optimized efficiency compared to multiple small mechanical drives.



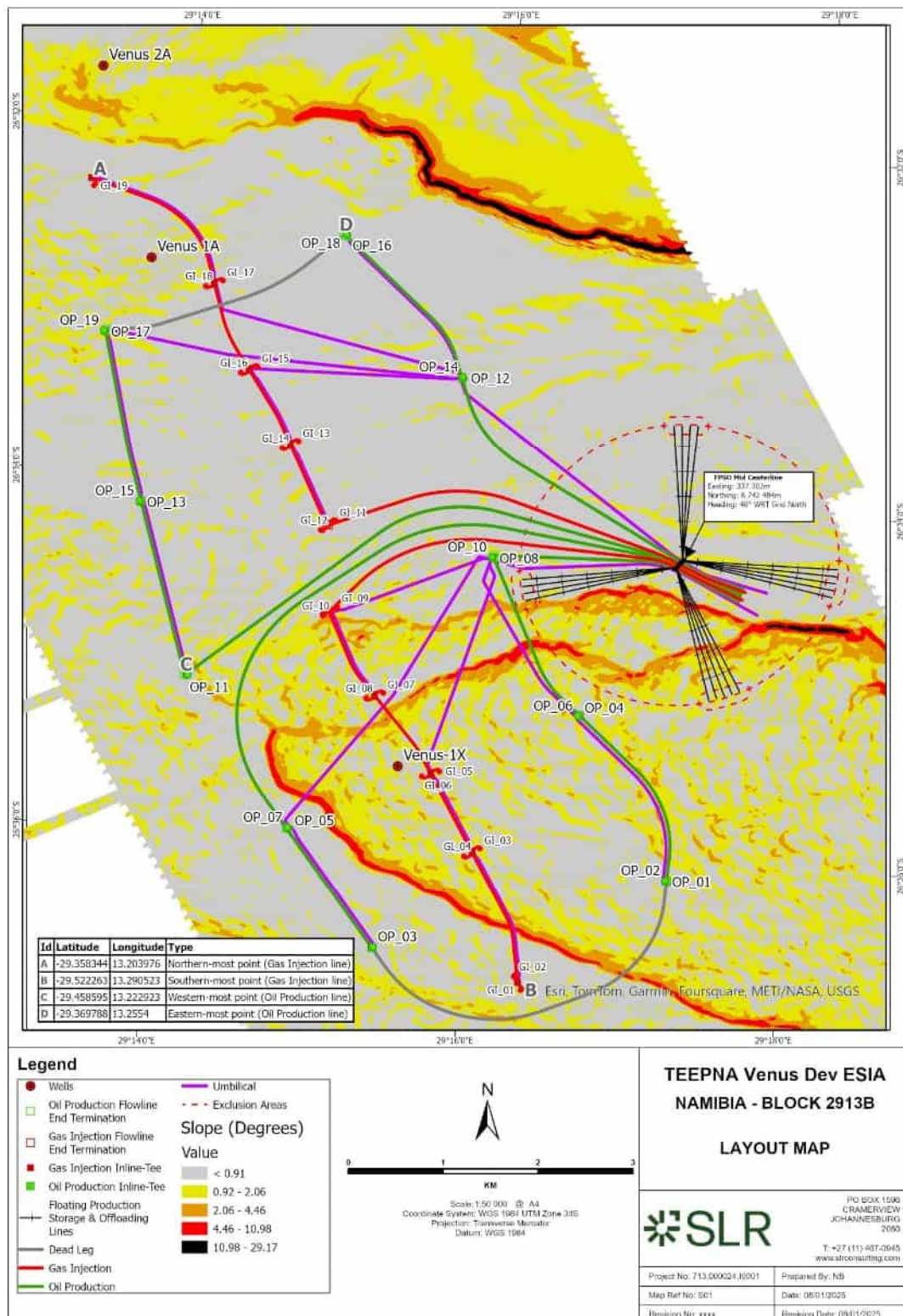


Figure 4-1: Provisional Subsea Production System layout showing the oil production, gas injection, umbilical and mooring lines layout.

Source: Layout provided by TEEPNA



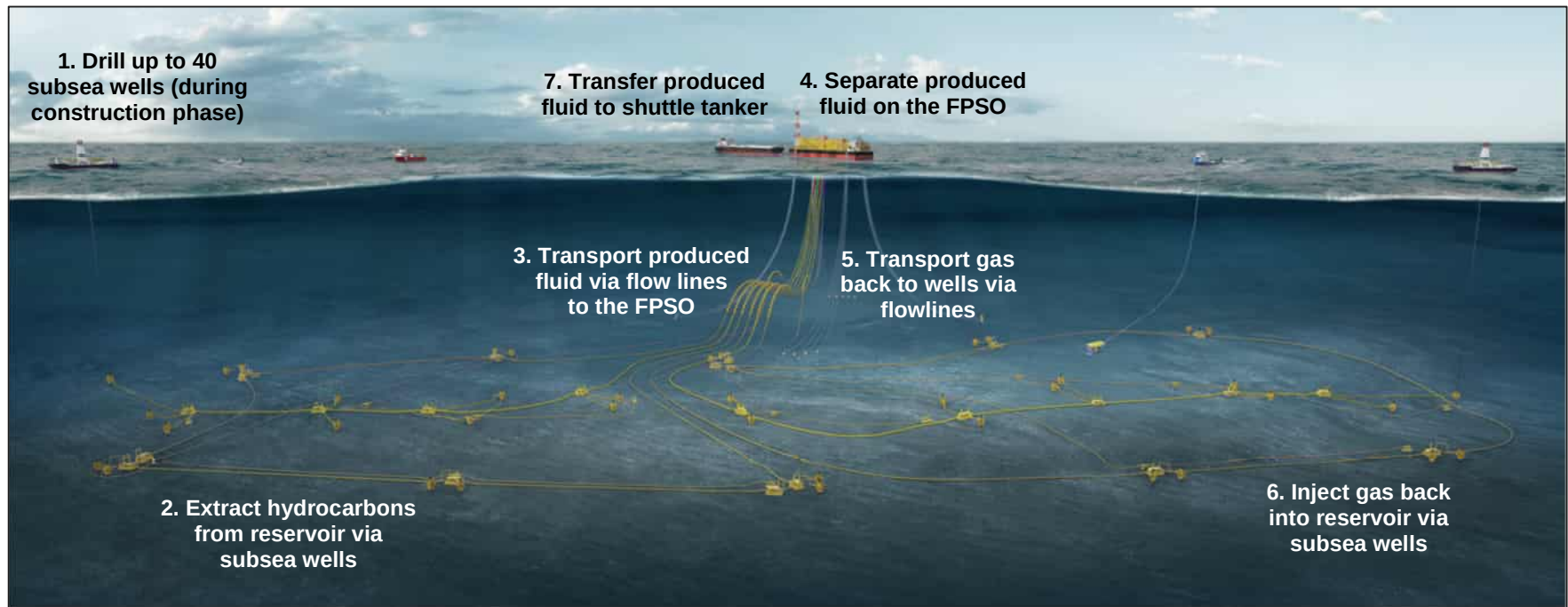


Figure 4-2: Concept of oil production at the Venus offshore project area.

This is a schematic and it does not aim at representing the number of wells and subsea equipment for this project.

Source: TEEPNA



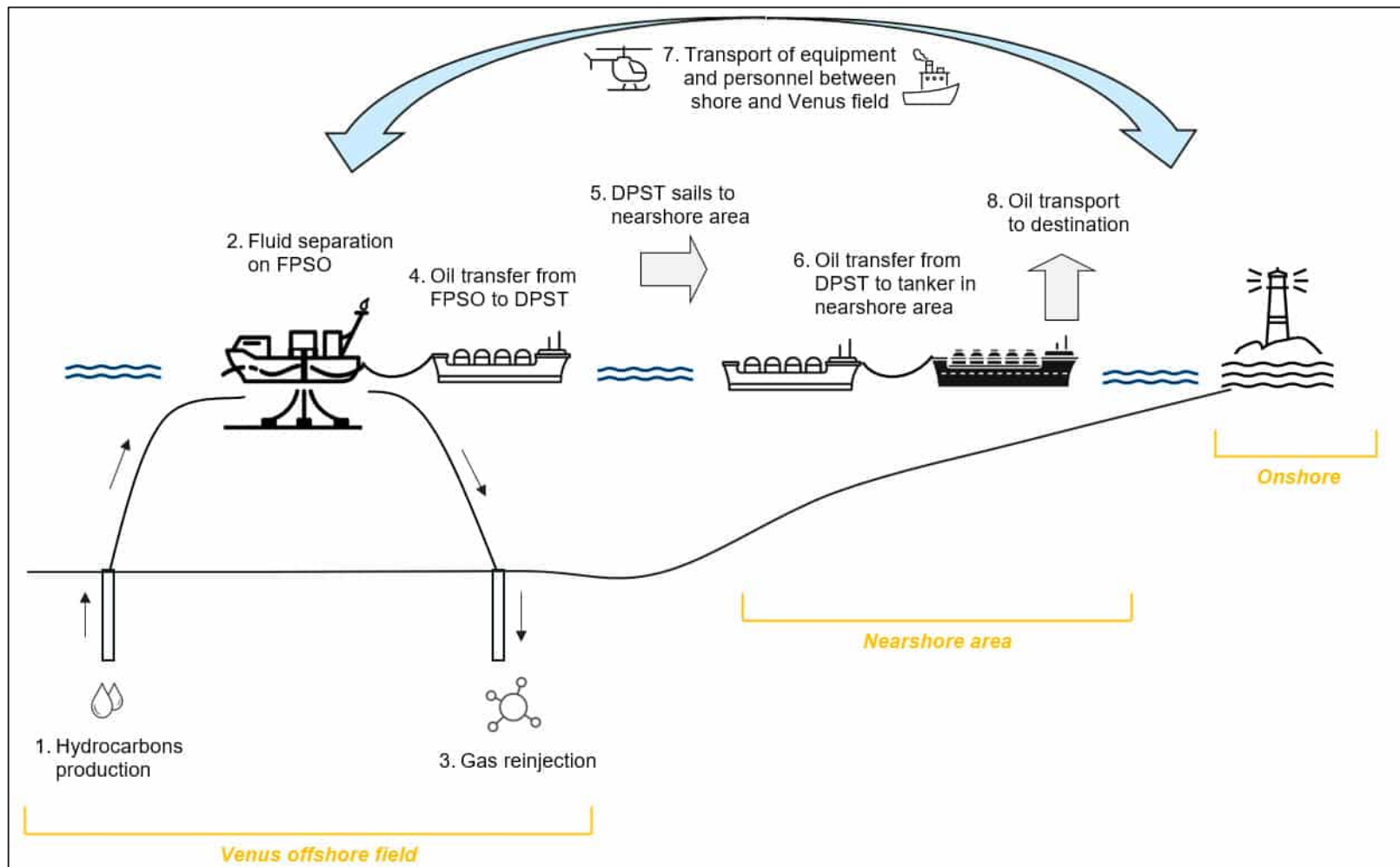


Figure 4-3: Schematic of oil production for Venus development.

Source: SLR



4.1.3 Project Timeline

Key anticipated planning and milestones of the Venus Production project are listed below:

- Project preparation and decision-making:
 - o Front-End Engineering Designs (FEED): Q2 – Q4 2025.
 - o Final Investment Decision (FID)²⁴: could be made in 2026.
- Drilling and installation:
 - o Well drilling: drilling operations are expected to commence ~18 months after FID and are planned to last for up to four years.
 - o Offshore installation (including first arrival of subsea equipment and subsequent onshore preparation): from ~ one year after FID and will take place mainly during two austral summer periods (2 x ~6 months) due to metocean condition constraints.
 - o Note: Drilling and subsea equipment installation will continue beyond first production for another ~1.5 years to 2 years.
- Production:
 - o 21 years with the option of extending production by an additional 10 years.
- Decommissioning:
 - o Decommissioning phase is expected to last approximately 1.5 years at Venus offshore project area, with a few days required to remove nearshore transshipment buoy.

4.1.4 Explanation of Key Terms

4.1.4.1 Xmas Tree

A Xmas Tree refers to a complex arrangement of equipment installed on the seafloor atop the wellhead (see Figure 4-4), where the:

- Wellhead is the structural component that supports the well and houses the Blow-Out Preventer (BOP) during drilling.
- Xmas Tree is installed after drilling is complete and focuses on production management.

The primary role of a Xmas Tree is to manage the flow of hydrocarbons from the well, ensuring safe and efficient production. A Xmas Tree includes the following components:

- Valves that control the flow of hydrocarbons.
- Gauges that monitor pressure and temperature within the well.
- Chokes that regulate the flow rate, preventing excessive pressure.

²⁴ A Final Investment Decision (FID) is a critical milestone in the development of large-scale projects, particularly in industries like energy, construction, and mining. It represents the formal approval by a project's developers to proceed with the project, committing the necessary capital resources to move from the planning stages to execution. The FID typically follows extensive feasibility studies, preliminary designs, and Front-End Engineering Designs (FEED). Once the FID is made, it signals the transition to the implementation or construction phase of the project.



- Connectors that facilitate connections to pipelines and other equipment.

A Xmas Tree has the following functions:

- Safety functions: can shut the well in case of emergency situations.
- Flow Regulation: control the flow of oil and gas, ensuring optimal production rates.
- Pressure Monitoring: constantly monitor the pressure within the well to prevent blowouts or failures.
- Injection Management: allow for the injection of fluids (like water or gas) to enhance recovery rates.
- Maintenance and Testing: enable regular testing and servicing to maintain operational integrity.

Subsea Xmas trees are specifically designed for underwater installations and engineered to withstand high-pressure conditions and are crucial for offshore drilling and production operations.

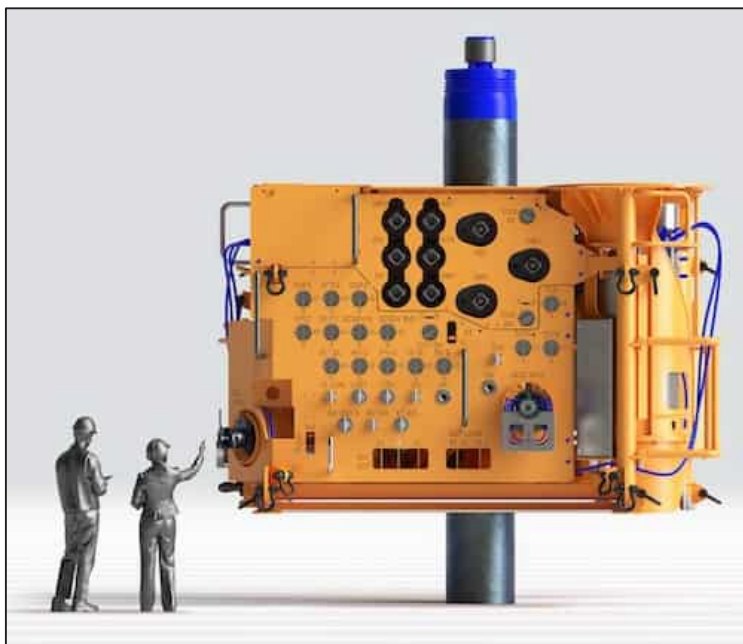


Figure 4-4: Conceptual design of a Xmas Tree and wellhead.

Source: (EPC Land, n.d.)

4.1.4.2 In-line Tee

ILT is an integrated equipment package that creates a branched line tie-in point along a pipeline. By creating a tee along the pipeline, the operator can plan for tie-in points to fit future expansion plans (Oil States, n.d.).

4.1.4.3 Flow Line End Terminations

FLETs are typically used in new construction where a flow line terminates or needs to be jumpered to another location, such as other flowlines or a riser. A FLET is the end or termination of a flow line (see Figure 4-5) (Oil States (2), n.d.).





Figure 4-5: Example of a Flow Line End Termination module.

Source: (EAB Engineering, n.d.)

4.1.4.4 Flowlines Pigging

Pigging is an essential process in the oil and gas industry used to maintain the integrity of pipelines and flowlines. Over time, lines are subject to wear and tear and can develop cracks, dents, or corrosion. Flowlines can also accumulate buildup from the products they transport, leading to reduced efficiency, slower movement, and blockages.

The deepwater production environment is characterized by low seafloor ambient temperatures, high tubing head flowing pressures, and higher external hydrostatic (water column) pressure. The high external pressure has a direct impact on the mechanical design of the flowline/pipeline, while the low ambient temperature generally has a larger impact on the hydraulics of a flowline/pipeline. Solid deposition can occur at steady and transient states and can build up into restrictions and blockages in the reservoirs, well bores, flowlines, risers and process facilities (OffshoreMag, 2001). This includes paraffin build-up in flowlines installed in cold sea bottoms, especially if paraffins and asphaltenes of high molecular weight are present in the oil that is transported (Gomes, Pereira, & Line, 1994).

Flow assurance is a common issue in design consideration for almost all producing areas, both onshore and offshore, but is most critical in deepwater and ultra-deepwater regions. Flowlines and risers are often insulated, and chemical injection umbilicals are required. Pigging facilities are incorporated for routine as well as intervention pigging (OffshoreMag, 2001).

Pipeline pigging is a technique designed to address pipeline issues, ensuring that pipelines continue to function smoothly. The process involves using a specialized cylindrical or spherical device, known as a “pig,” to clean, inspect, or perform other maintenance tasks inside a pipeline. The pig is propelled through the pipeline by the pressure of the product being transported, such as oil or gas, or through the use of a cable.

The pig is typically injected into the pipeline using a device called a pig launcher and removed using a pig receiver. As it travels through the pipeline, it serves various purposes depending on its type, from cleaning debris to inspecting the internal surface of the pipe (EPC Land (2), n.d.).



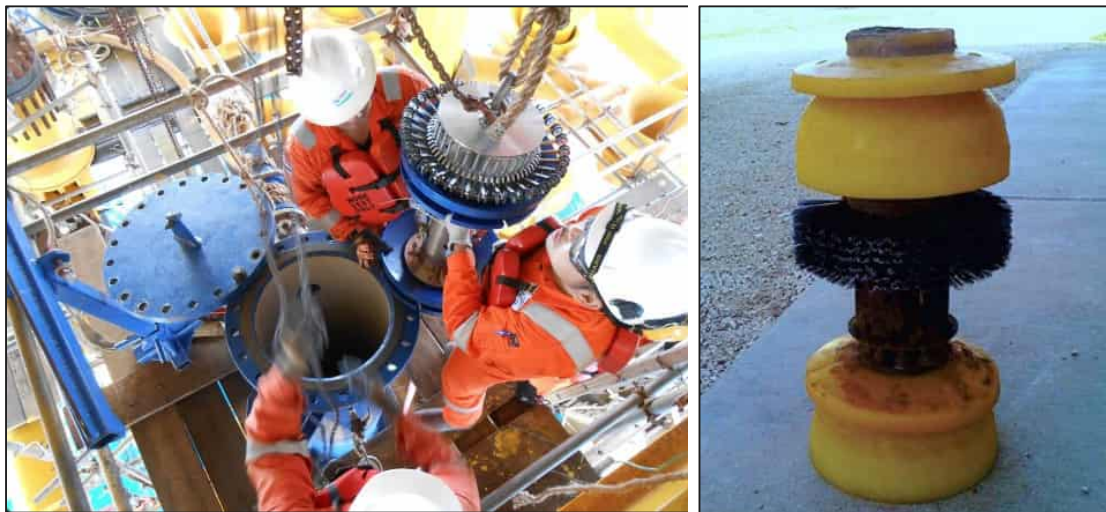


Figure 4-6: Insertion of a “pig” into a pipeline (left) and a wire brush cleaning pig (right).

Source: (EEST, n.d.) (left), TotalEnergies (right)

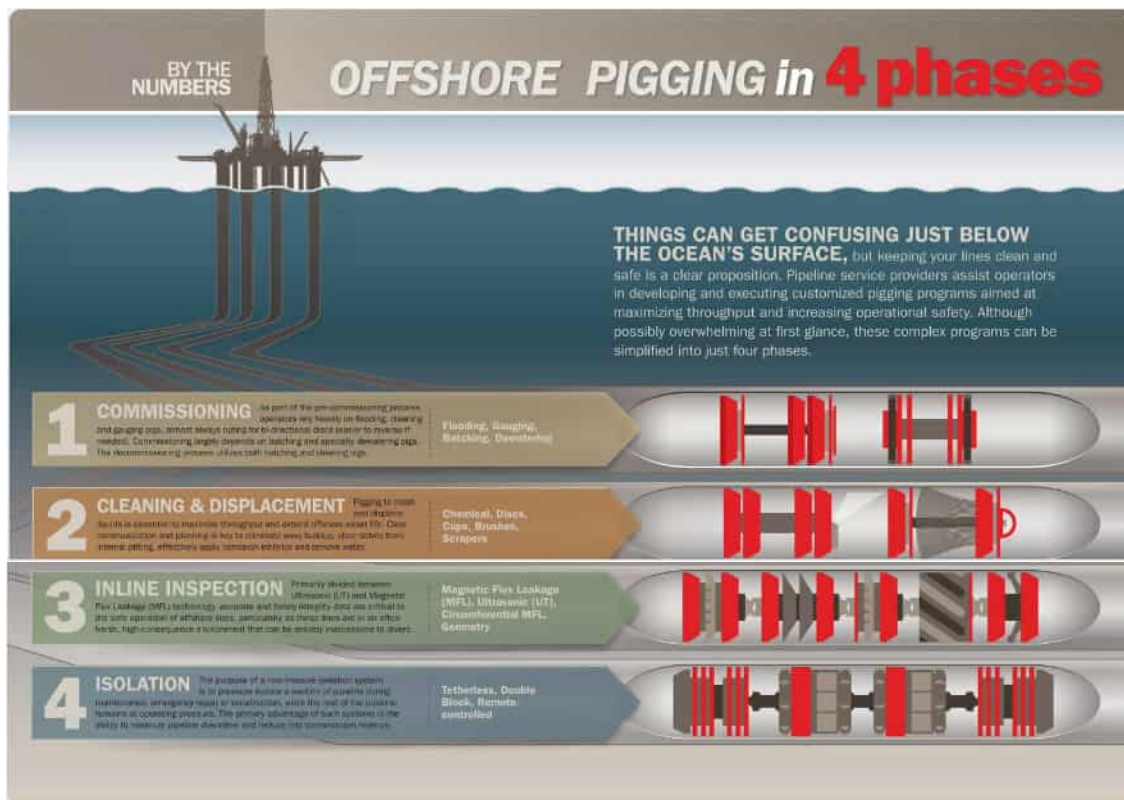


Figure 4-7: Applications for offshore pipeline pigging.

Source: (Williamson, 2014)



4.1.4.5 Steel Lazy Wave Risers

Offshore risers are vertical or near-vertical pipelines that connect subsea equipment, such as wells, to surface facilities such as platforms or FPSOs. They serve as conduits for the transportation of hydrocarbons.

Beyond fluid transport, risers are designed to handle significant mechanical stresses, temperature variations, and corrosive environments while maintaining integrity under varying load conditions.

For the Venus development, considering the harsh environment, SLWRs will be used as follows:

- Production Risers: Carry hydrocarbons from subsea wells to the FPSO.
- Gas Injection Risers: Delivering gas from the FPSO to subsea reservoirs to enhance the oil production.

The SLWR configuration is achieved by introducing buoyancy modules into a Steel Catenary Riser (SCR) - the addition of buoyancy to the riser provides the unique “lazy wave” shape (see Figure 4-8) and reduces the dynamic stresses at the touchdown zone, acting as a damper and isolating the floater motions from the critical touchdown area. This results in generally better overall performance than an SCR configuration in dealing with vessel motions and waves (ASME, 2014) (Felisita, Gudmestad, Karunakaran, & Martinsen, 2017).

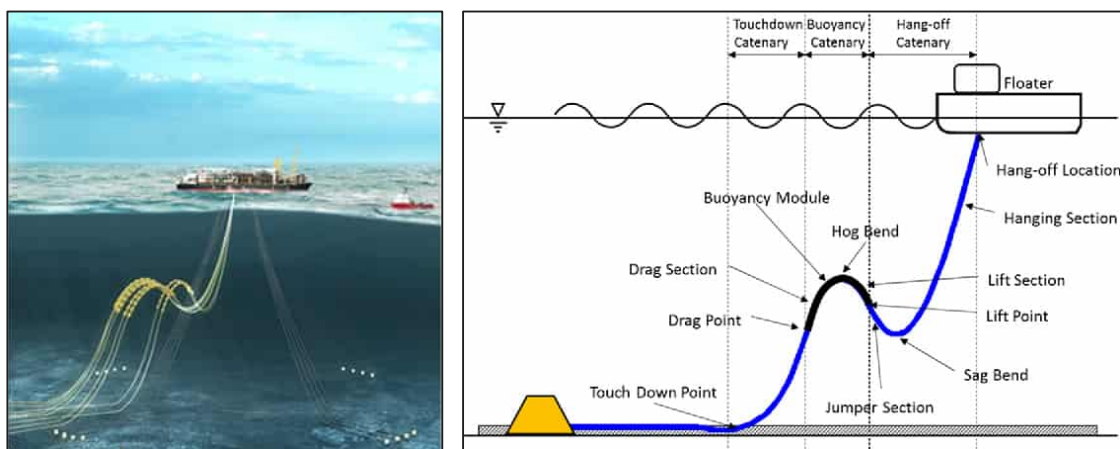


Figure 4-8: Conceptual design of a Steel Lazy Wave Risers.

Source: TotalEnergies (left), (Semantic Scholar, 2018) (right)

4.1.4.6 Umbilicals

Umbilicals in the oil and gas industry refer to specialised cables or hoses designed to transfer power, fluids, and control signals between surface facilities and various underwater equipment such as subsea production systems, sensors, and control modules.

Umbilicals are typically composed of multiple components, including electrical conductors, hydraulic lines, chemical lines and fiber optic cables, bundled together in a protective outer sheath. These umbilicals play a crucial role in enabling efficient and reliable communication, power supply, and fluid transfer for subsea operations in the oil and gas sector.



Applications of umbilicals in offshore oil and gas industry include:

- Connection between the surface facilities (like oil platforms or FPSO) and the subsea equipment located underwater.
- Power transmission from the surface to the subsea equipment, enabling them to function.
- Fluid transfer of e.g. hydraulic and chemical injection fluids to the subsea equipment.
- Control signal transmission between the surface and subsea equipment through fibre optic signals to control and monitor the equipment remotely.

Key attributes of umbilicals in the oil and gas industry include:

- Protection: They are designed with layers of protective coatings and armour wires to withstand harsh offshore conditions like high pressure, extreme temperatures, and corrosive environments.
- Flexibility: Umbilicals are flexible enough to accommodate movement and dynamic forces in the offshore environment.
- Durability: The construction of umbilicals used in the oil and gas industry ensures reliability over long distances. Their lifespan in oil and gas operations can range up to the order of 30 years.
- Customizable: They can be designed and manufactured to meet the specific requirements of a particular subsea production system.
- Remote monitoring: Offshore umbilicals in the oil and gas industry can be equipped with sensors. This enables remote monitoring of a subsea production system.
- Corrosion resistance: Oil and gas umbilicals are resistant to corrosion in offshore conditions (EZConnect, 2023).

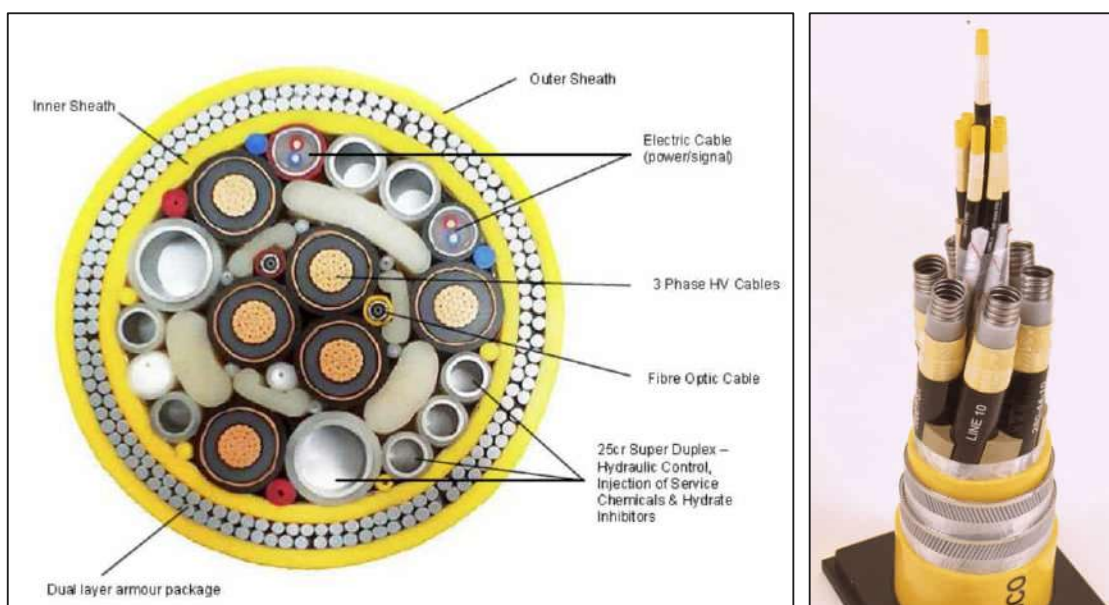


Figure 4-9: Examples of umbilicals.

Source: (Johnson & Collins, 2020)



4.1.4.7 FPSO

A FPSO (see Figure 4-10) vessel allows oil production without construction of pipeline to onshore facilities. More than 270 FPSOs are operating worldwide.

FPSOs are normally used in deep-water fields or remote locations, where conventional offshore platforms cannot be installed.

FPSOs have a mooring system that comprises of mooring lines, anchors, and connectors and holds the vessel in place against forces, waves, winds, and currents. The FPSO topside is the hydrocarbon processing unit at the top. The FPSO hull is used for oil storage. The connection to the subsea wells is made through flexible steel reinforced risers designed to absorb any motion of the vessel by waves (see Section 4.1.4.5).

An FPSO typically contains a range of equipment and system, such as:

- Gas, Water and Oil Separator;
- Gas Dehydration, Compression Treatment and Injection Units;
- Seawater, Chemical and Produced Water Treatment Units;
- Power Generation Unit;
- Cargo, Propulsion, Storage, Ballast and Boilers;
- Accommodation;
- Helicopter deck; and
- Oil storage in the hull.

Hydrocarbons (mixtures of oil, water, and gas) produced in the subsea wells are carried onboard the FPSO through flowlines and risers. These hydrocarbons get separated into oil, water, and gas at the FPSO topside production facility.

Separated treated crude oil is stored in the hull and then offloaded to tankers.



Figure 4-10: Example of an FPSO.

Source: TotalEnergies



4.1.5 Rationale for Proposed Production Approach

Considering the water depth of ~3 000 m at Venus offshore project area and the distance to shore of ~300 km, an FPSO is the only option to produce the oil.

The most appropriate recovery mechanism for Venus oil production was carefully studied and several options were considered, including for example natural depletion as well as gas and water injection. The work done on the dynamic reservoir simulations concluded that full gas reinjection is required to enhance the oil production.

When using an FPSO, the produced oil is initially stored in the FPSO hull until it is offloaded to tankers. Due to the metocean conditions at Venus offshore project area, the produced oil will be initially transferred to a DPST, which will act as a shuttle between the FPSO and the nearshore transshipment area, located ~20 km north of Walvis Bay at a distance of ~5 km from the coast. After offloading the oil from the FPSO, the DPST will sail to a nearshore area, where it will be possible to transfer the oil to a conventional tanker for onward transport to the buyer.

4.1.6 Offshore Exclusion and Restriction Areas

Both the Venus offshore project area and nearshore transshipment area will be subject to certain exclusion and restrictions. The exclusion and restrictions relevant to the Venus offshore project area, which will be implemented during all project phases, are described in Table 4-1 and presented in Figure 4-11. The nearshore transshipment buoy will be subject to a 500 m safety exclusion zone around the operational zone, resulting in a total exclusion area of 1.7 km radius around the transshipment buoy (see Figure 4-29).

Table 4-1: Maritime Exclusion, Restricted and Surveillance Areas for Venus Offshore.

Area	Distance	Access restrictions
Maritime Exclusion Area (MEA)	3 NM around subsea infrastructure and FPSO location	All vessel access and movements to authorised by Operator
Maritime Restricted Area (MRA)	10 NM around the FPSO location	“Entry permit” to be approved by Operator
Maritime Surveillance Area (MSA)	20 NM around the FPSO location	Free access, it is a surveillance area





4.2 Development Drilling

4.2.1 Overall Drilling Approach

4.2.1.1 Well Locations

The project has defined all development wells based on downhole targets, which is necessary to define the subsea associated infrastructure. It is typical that the design and layout may continue to be fine-tuned as the project progresses towards a project execution.

Two types of wells are planned to be drilled, OP wells and GI wells; both of these are drilled into the Venus oil-bearing reservoir at a depth of ~3 000 m below seabed.

To minimize the subsea footprint and overall infrastructure installed on the seabed, it is common to cluster the wells and to connect them to a common drilling centre. For Venus, whenever possible, the concept selected is to cluster the wells in pairs, using ILTs (see Section 4.1.2), i.e. two wells of similar type (either OP or GI) are drilled close to each other and tied to the same manifold:

- OP wells (shown in green in Figure 4-1) that form a pair are connected by ILT with rigid jumpers²⁵.
- GI wellheads (shown in red in Figure 4-1) will be connected by flexible jumpers, allowing each pair to be located at longer distances (1 km or more).

4.2.1.2 Well Drilling Sequence

Up to three drilling units could be active simultaneously to drill the development wells; potentially starting 18 months after FID, and drilling operations could continue for around 4 years.

When wells are clustered in pairs, each drilling unit will drill both wells in a pair, or two pairs of wells, in a single campaign as described below:

- Drill top hole²⁶ (riserless stage):
 - o Drill top hole of first well and install 36" conductor and 20" surface casing (36" and 20" riserless stage²⁷) (e.g. Well 1) (discharge of cuttings and associated muds to seabed).
 - o Move the drilling unit to the pair's other well and drill the top hole and install 36" conductor and 20" surface casing (e.g. Well 2).
 - o Move the drilling unit to the neighbouring pair and drill the top hole and install 36" conductor and 20" surface casing for each of those two wells (e.g. Well 3 and Well 4).
- Complete well drilling (risered stage):
 - o Remain with the drilling unit at the location of the well last drilled (e.g. Well 4) and:

²⁵ ILTs are connection points used in subsea oil and gas production systems to link wellheads to flowlines and risers. Jumpers are the short, rigid pipes that connect these components

²⁶ The top hole refers to the initial (riserless – see Section 4.2.4) phase of drilling a well, i.e. drilling the uppermost section of the wellbore. The top hole is usually drilled to a relatively shallow depth compared to the total depth of the well and with a larger diameter bit to accommodate the installation of surface casing.

²⁷ The uppermost well section (at the seabed) is 36 inches (90 cm) in diameter. Deeper sections of the well have an increasingly smaller diameter.



- Exchange the drilling bit (to a smaller diameter bit for deeper sections), drilling tools, mud system etc – as required for the deeper well sections of that well.
 - Install a BOP (see Section 4.2.8.1) and drilling riser (which connects the subsea wellhead to the drill ship).
 - Drill well to its full depth.
 - Complete well.
 - Clean-up (when needed), test (when needed) and suspend well. Some of the wells will need to be cleaned up to rig, while the remaining could be cleaned up directly to the FPSO once the necessary facilities are commissioned and in place. Some OP wells will also require a brief well test before connecting the well to the FPSO. This is described further in the subsequent sub-sections.
- o Disconnect and move the drilling unit back to other well of the same pair (Well 3) and drill, complete, test and/ or clean-up (when needed) and suspend the well.
 - o Disconnect and move the drilling unit back to initial well pair (Well 1 and Well 2) and drill, complete, test and/ or clean-up (when needed) and also suspend those wells.
- Initiate drilling campaign on the next pair (or two pairs) of wells.

The distance between the drilling units will vary over time, and the drilling units can work in relatively close proximity of each other at times.

The average drilling per well is expected to take around 75 days, as an order of magnitude indication. Drilling is expected to take place continuously (year-round).

4.2.1.3 Well Architecture

OP and GI wells have essentially the same architecture (see next section), requiring the same approach to drilling and generating approximately the same volume of cuttings.

The well design depends on factors such as planned depth and reservoir pore pressure. A base case architecture and order of magnitude lengths per section are indicated below in Table 4-2.

Table 4-2: Example of Well architecture.

Drill Section	Hole diameter (in)	Pipe diameter (in)	Indicative length of section (m)
Riserless stage			
1	36"	36"	80
2	26"	20"	1 115
Risered stage			
3	17.5"	14"	1200
4	13.5"	10.75"	1230
5	9.5"	Upper completion (tubing): OP 5.5" and GI 6-5/8" Lower completion (sand screens): OP and GI 6 5/8"	2 427



4.2.2 Description of Drilling Equipment and Bases

This section describes the main drilling equipment / components.

4.2.2.1 Drilling Unit (Rig)

Well drilling will most likely be undertaken using a dynamically positioning drillship; the final drilling unit will be selected depending on availability and final design specifications. A drillship is a fit for purpose-built drilling vessel designed to operate in deep water conditions. The drilling (derrick) area is normally located towards the centre of the ship with support operations from both sides of the ship using fixed cranes. A drillship has considerable storage capacity and is independently mobile.



Figure 4-12: Example of a drilling unit (drill ship).

Source: TotalEnergies

Alternatively, a dynamically-positioned semi-submersible drilling unit could be used, which is essentially a drilling rig located on a floating structure of pontoons. When at the well location, the pontoons are partially flooded (or ballasted), with seawater, to submerge the pontoons to a pre-determined depth below the sea level where wave motion is minimised. This gives stability to the drilling vessel, thereby facilitating drilling operations.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a drilling unit that is engaged in underwater operations is defined as a “*vessel restricted in its ability to manoeuvre*”, and power-driven and sailing vessels must give way to such vessels. Fishing vessels are required to keep out of the way of the well drilling operation and observe the operational safety zones. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), as amended by the Namibia Ports Authority Act No. 2 of 1994, a vessel used for the purpose of exploiting the seabed falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone.

Although a drilling unit that is engaged in drilling is protected by 500 m safety zone, TEEPNA will enforce a larger Maritime Exclusion Area (3 nm around subsea infrastructure and FPSO) and Maritime Restricted Area (10 nm around the FPSO) (see Section 4.1.6) for all phases of



the project. These exclusion and restricted areas will be described in a Notice to Mariners as a navigational warning.

4.2.2.2 Support Vessels

Each drilling unit will be supported / serviced by two to three platform support vessels (PSV) operating with regular trips, to facilitate the transportation of goods, equipment, tools and waste between the drilling unit and the onshore logistics base.

A support vessel will always be on standby near the drilling units to provide support for firefighting, oil containment / recovery, rescue in the unlikely event of an emergency and supply any additional equipment that may be required. Support vessels can also be used for medical evacuations or transfer of crew if needed.



Figure 4-13: Examples of platform supply vessels.

Source: TotalEnergies

4.2.2.3 Onshore Logistics Base

Onshore logistics is expected to be provided from Lüderitz (which is closest to the Venus offshore project area) and further support from Walvis Bay (which is closest to the nearshore transshipment area and where other facilities may be located for support to the Venus offshore project area).

The shore bases will provide for the storage of materials and equipment (including pipes, drilling fluid, cement, chemicals) that will be transported by sea to / from the drilling unit/s, and quay space for loading and offloading. The shore base will also be used for coordination of support services: accommodation, waste management services, bunkering vessels, and stevedoring / customs clearance services.

It is anticipated that the ports will have the service infrastructure required to provide the necessary onshore support in place and it will not be required to add any additional permanent onshore infrastructure for the project.



4.2.2.4 Helicopter Base

Helicopters will transfer personnel from shore to the offshore facilities (e.g. drilling units and FPSO). Such operations are planned to be conducted from Lüderitz airport. Oranjemund airport could also be used as required during operations, e.g. special weather conditions.

The helicopters can also be used for medical evacuations from the offshore facilities to shore (at day- or night-time), if required.

It is anticipated that the airports will have the service infrastructure required to provide the necessary onshore support in place.

4.2.3 Mobilisation for Drilling

The mobilisation phase will entail the required notifications, establishment of the onshore base, appointment of local service providers, procurement and transportation of equipment and materials from various ports and airports, accommodation arrangements and transit of the drilling unit and support vessels to the drilling area. This phase will also include obtaining the required permits and permissions to commence with operations.

The drilling units and supply vessels will sail to the Venus offshore project area. Ballast water discharge will adhere to any Namport protocols, where applicable, and will follow the requirements of the IMO 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments. Specifically under IMO Regulation D2 of the Convention, project vessels will use approved Ballast Water Treatment Systems to control the maximum amount of viable organisms being discharged in ballast water.

Drilling materials, such as casings, mud components, cement and other equipment and materials will be brought into the country or procured locally, if possible. Equipment will be transferred between the onshore logistics base and the drilling unit by the supply vessels.

4.2.4 Description of Well Drilling

4.2.4.1 Drilling Stages

The well will be created by drilling an initially shallow hole into the seafloor with a drill bit attached to a rotating drill string, which crushes the rock into small particles, called “cuttings”. After the initial hole is drilled, casings (sections of steel pipe) are placed in the hole and permanently cemented in place (cementing operations are described below). The next (deeper and narrower) section of the well is then drilled and casing cemented in place. This is repeated until the well has reached the desired depth. The hole diameter decreases with increasing depth (see Figure 4-14).

The casings provide structural integrity to the newly drilled wellbore, in addition to isolating different geological formations from each other and from the surface. With these zones safely isolated, and the formation protected by the casing, the well will be drilled deeper with a smaller drill bit and also cased with a smaller sized casing. For the current project, it is anticipated that there will be four sets of subsequently smaller hole sizes drilled inside one another, each cemented with casing, except the last phase that will remain an open hole without casing.



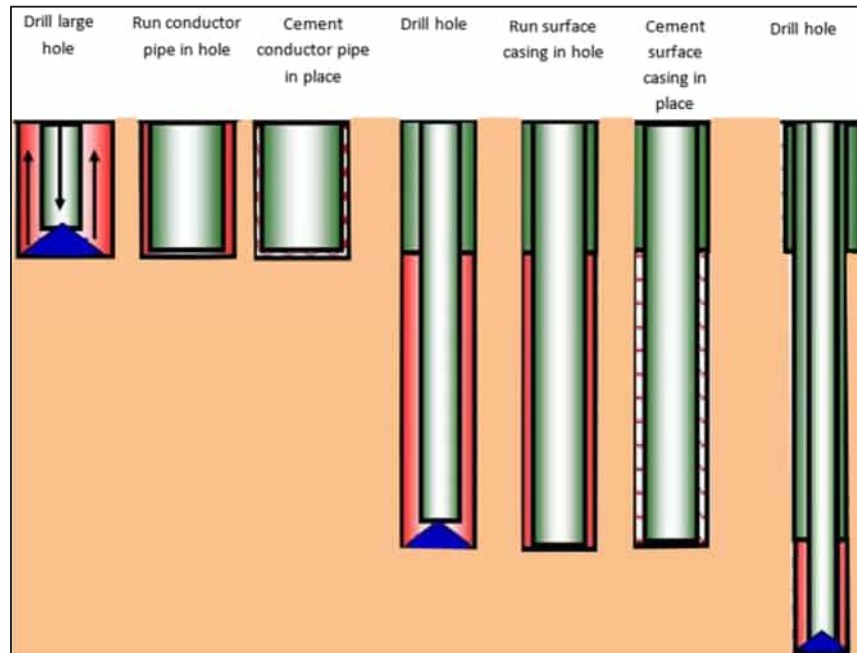


Figure 4-14: Simplified view of well drilling stages.

Adapted from Nergaard, 2005

The two key stages of drilling are the top hole / riserless (when the riser is not in place) and risered drilling stages (see Figure 4-15).

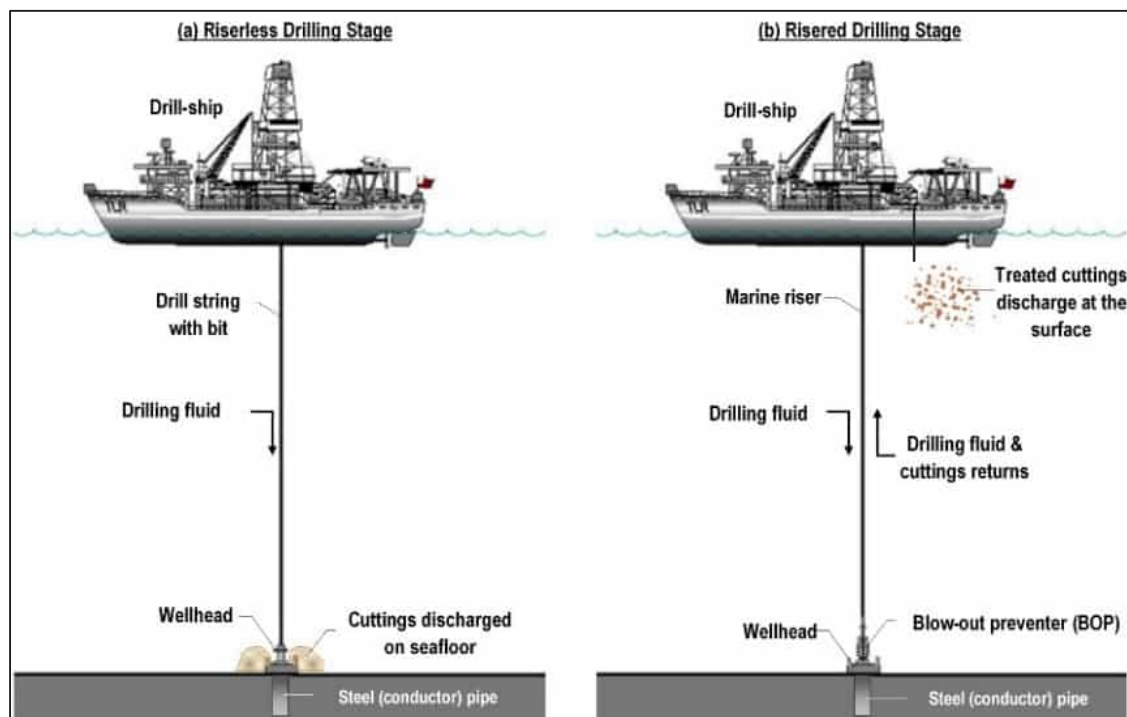


Figure 4-15: Drilling stages: (A) Riserless drilling stage; and (B) Risered drilling stage.

Source: <http://www.kochi-core.jp/cuttings/>



Initial (Riserless) Drilling Stage

The process of preparing the first section of a well is referred to as “spudding” (i.e. the process of beginning to drill a well). Sediments just below the seafloor are often very soft and loose, thus to keep the well from caving in and to carry the weight of the wellhead, a 36-inch diameter structural conductor pipe is installed. Jetting is the primary means of setting the 36 inches where no cement is required. If jetting fails then the hole is drilled to 42-inch and then the 36-inch conductor is installed and then cemented.

When the conductor pipe and low-pressure wellhead are at the correct depth (~80 m deep depending upon substrate strength), a new drilling assembly will be run inside the structural conductor pipe and the next hole section will be drilled by rotating the drill string and drill bit.

Below the conductor pipe, a hole of approximately 26 inches in diameter will be drilled with a length of ~1 100 to 1 200 m. The rotating drill string causes the drill bit to crush rock into small particles, called “cuttings”. While the wellbore is being drilled, drilling fluid is pumped from the surface down through the inside of the drill pipe, the drilling fluid passes through holes in the drill bit and travels back to the seafloor through the space between the drill string and the walls of the hole, thereby removing the cuttings from the hole. At a planned depth, the drilling is stopped and the bit and drill string is pulled out of the hole. A surface casing of 20-inch diameter is then placed into the hole and secured into place by pumping cement through the casing at the bottom of the hole and back up the annulus (the space between the casing and the borehole). The 20-inch casing will have a high-pressure wellhead on top.

These initial hole sections will be drilled using seawater (with viscous sweeps) and Water Based Mud (WBM) (see Section 4.2.4.2). All cuttings and WBM from this initial drilling stage will be discharged directly onto the seafloor adjacent to the wellbore.

Risered Drilling Stage

The risered drilling stage (refer to Figure 4-15) commences with the lowering of a BOP and installing it on the wellhead (see Section 4.2.8.1). A lower marine riser package is installed on top of the BOP and the entire unit is lowered on riser joints. The riser isolates the drilling fluid and cuttings from the environment, thereby creating a “closed loop circulation system”. A simplified illustration of a mud circulating system is shown in Figure 4-16.

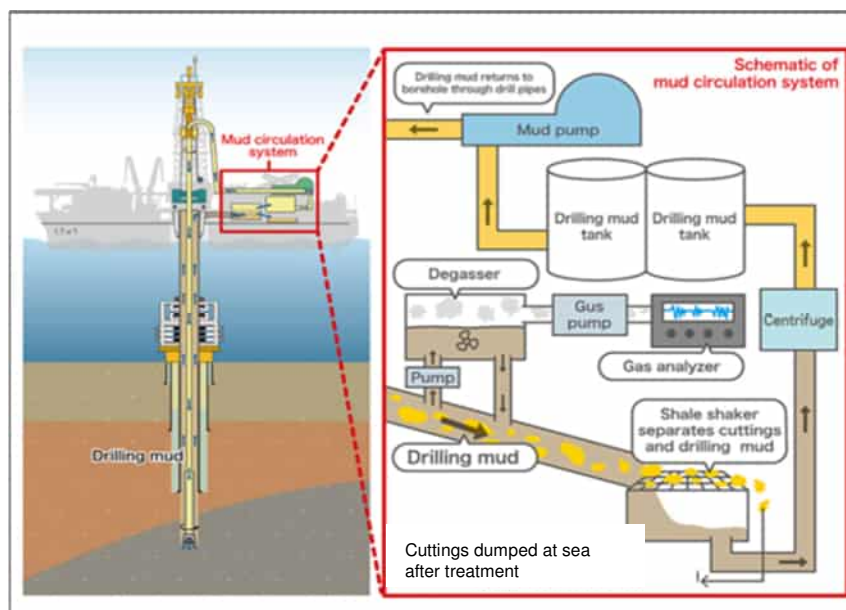


Figure 4-16: Simplified illustration of a mud circulating system.

Source: Apostolidou, 2019.



Drilling is continued by lowering the drill string through the riser, BOP and casing, and rotating the drill string. During the risered drilling stage, should the WBM be unable to provide the necessary characteristics, a low toxicity Non-Aqueous Drilling Fluid (NADF) could be used (see Section 4.2.4.4). The drilling fluid emerges through nozzles in the drill bit and then rises (carrying the rock cuttings with it) up the annular space between the drill string and the sides of the hole, casing and riser to the drilling unit.

The cuttings are removed from the returned drill mud and discharged overboard after treatment (see Section 4.2.7).

4.2.4.2 Cementing

Cementing is the process of pumping cement slurry through the drill pipe and / or cement stinger at the bottom of the hole and back up into the space between the casing and the borehole wall (annulus). Cement fills the annulus between the casing and the drilled hole to form an extremely strong, nearly impermeable seal, thereby permanently securing the casings in place. To separate the cement from the drilling fluid to minimise cement contamination a cementing plugs and/or spacer fluids are used. The plugs are pushed by the drilling fluid to ensure the cement is placed outside the casing filling the annular space between the casing and the hole wall.

Cementing has four general purposes: (i) it isolates and segregates the casing seat for subsequent drilling, (ii) it protects the casing from corrosion, (iii) it provides structural support for the casing, and (iv) it stabilises the formation.

To ensure effective cementing, an excess of cement is often used to account for uncertainties of the borehole diameter. Until the marine riser is set, excess cement from the first casings emerges out of the top of the well onto the seafloor. This cement does not set and is slowly dissolved into the seawater.

Offshore drilling operations typically use Portland cements, defined as pulverised clinkers consisting of hydrated calcium silicates and usually containing one or more forms of calcium sulphate. The raw materials used are lime, silica, alumina and ferric oxide. The cement slurry used is specially designed for the exact well conditions and temperatures encountered.

Additives can be used to adjust various properties in order to achieve the desired results. There are over 150 cementing additives available. The amount (concentrations) of these additives generally make up only a small portion (<10%) of the overall amount of cement used for a typical well. Usually, there are three main additives used: retarders, fluid loss control agents and friction reducers. These additives are polymers generally made of organic material and are considered non-toxic.

Once the cement has set, a short section of new hole is drilled, then a pressure test is performed to ensure that the cement and formation are able to withstand the higher pressures of fluids expected to be encountered from deeper formations.

4.2.4.3 Mud Logging

Evaluation of the petro-physical properties of the penetrated formations is carried out routinely during the drilling operation. Mud logging involves the examination of the drill cuttings brought to the surface by the drilling fluid. Mud logging also monitors for hydrocarbon gases that relate to changes in formation pressure and the volume or rate of returning fluid, which can aid in controlling the well, and to the intersection of reservoir rocks.



4.2.4.4 Well Logging and Profiling

Well logging involves the insertion of specialised instruments into a borehole to determine the properties of the geological formations penetrated by the well bore, using:

- Logging While Drilling (LWD) will be conducted with logging tools incorporated into the drill string that provide critical real-time well information.
- Wireline logging, performed by lowering a logging tool (or a string of one or more instruments) into the well bore after removal of the drill string, and recording petrophysical properties using a variety of sensors.

Both methods may be employed to varying degrees.

Wireline logging and LWD involve the use of sealed radioactive sources in tools kept in specially designed secured (locked) storage containers. The radioactive material is encapsulated in ceramic cylinders and sheathed in several layers of stainless steel. The size of the sealed sources is ~4" length x 1" (diameter) to 7" (length) x 1.5" (diameter) and radiation levels are very low²⁸.

Drilling units have special storage locations designated for radioactive containers and only certified logging engineers are allowed to handle the radioactive devices.

Vertical Seismic Profiling (VSP) may be undertaken as part of the conventional wireline logging programme when the well reaches target depth to generate a high-resolution seismic image of the geology in the well's immediate vicinity. The VSP images are used for correlation with surface seismic images and for forward planning of the drill bit during drilling.

A zero-offset VSP uses a small sound source (sound pressure generating), which is operated from the drilling unit. The sound source is made up of several sound sources with a total array volume of between 750 and 1 200 cubic inches (CUI). The sound source is deployed between 7 m and 10 m below sea level and has a source pressure of 2 000 pounds per square inch (psi).

During VSP operations, a string of receivers (usually four to five) is placed in a section of the borehole and the sound source is discharged approximately five times at 20 second intervals. The generated sound pulses are reflected through the seabed and are recorded by the receivers to generate a profile along a 60 to 75 m section of the well. This process is repeated as required for different stations in the well and it may take typically nine hours to complete approximately 250 pulses, depending on the well's depth and number of stations being profiled.

4.2.4.5 Well Completion, Clean-Up and Testing

Once the wells have been drilled to final depth in the reservoir, the lower completion (section across the reservoir) and thereafter the upper completion (production tubing and safety isolation valve) will be run.

- The base case for the lower completion design is to use Stand Alone Screens (SAS) which will allow the flow of the well effluent while providing a barrier to sand production (reservoir fine particles) in the form of a steel mesh.
- Once the lower completion is in place, the upper completion is run, which is comprised of the production (5-12") or injection (6-5/8") tubing, together with downhole temperature and pressure gauges as well as safety valves (such as the Tubing Isolation Valve (TIV) and the Tubing Retrievable Surface Controlled

²⁸ From 0.1-2 curies (Ci) with a 0.5 – 200 milliroentgens per hour (mR/hr) maximum radiation level at the source surface to 3-20 Ci with a 50-200 mR/hr maximum radiation level at the surface



Subsurface Safety Valve (TR-SCSSV) to allow downhole isolation of the reservoir if needed.

Figure 4-17 shows the potential lower and upper completion design for both the OP and GI wells.

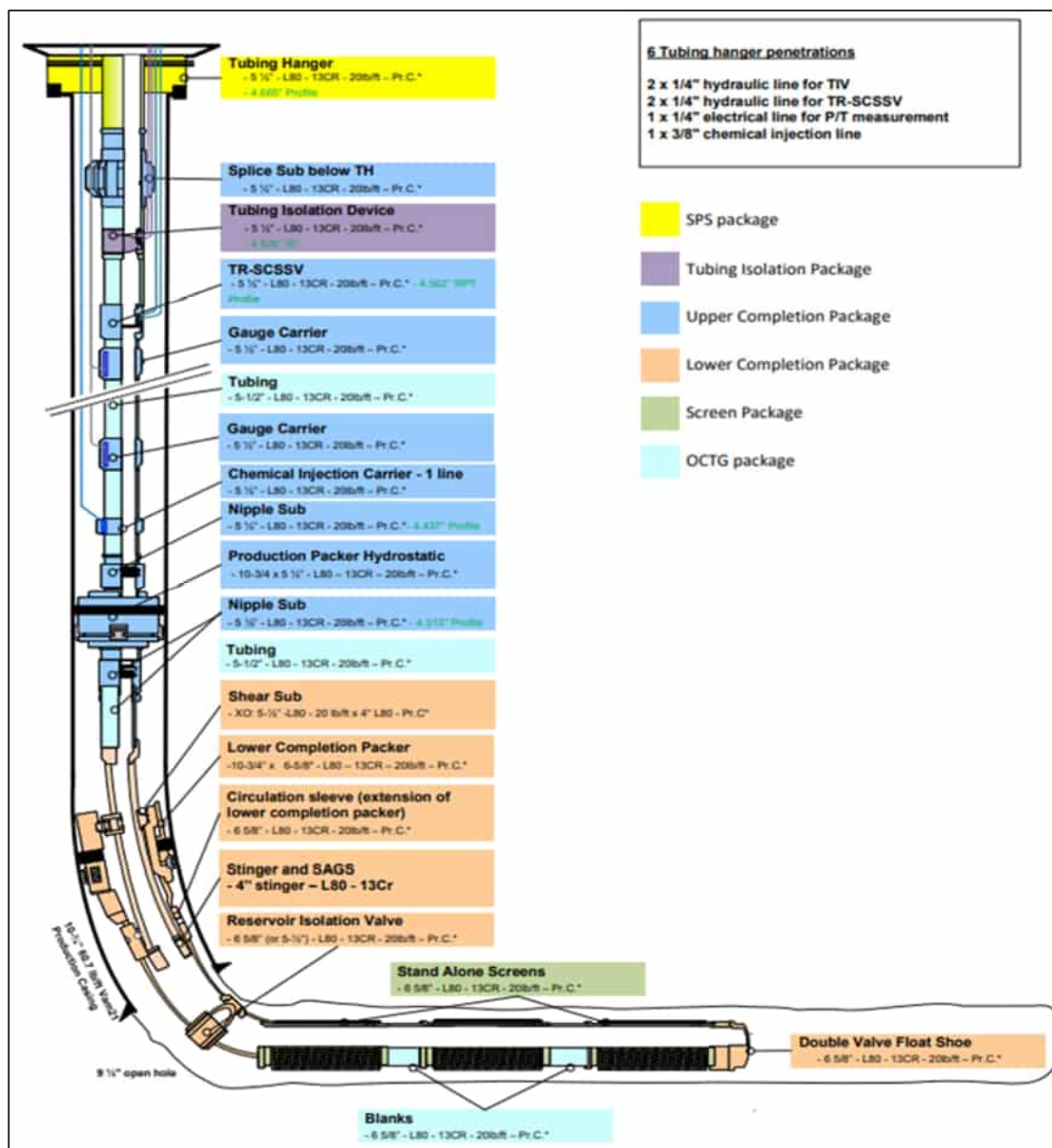


Figure 4-17: Potential lower and upper well completion design.

Source: TotalEnergies

Following the completion operations, it is anticipated that up to 12 OP wells will be cleaned-up through the drilling unit, as the FPSO will not be yet on location. However, once the FPSO is on location and producing, OP wells will be cleaned-up through the FPSO. All 20 GI wells will be cleaned-up before and after commencement of production through the drilling unit (as GI wells cannot be clean-up through the FPSO). Well clean-up refers to the process of removing drilling fluids, debris and other contaminants from the wellbore to prepare it for production, and involves the following steps:



- Flowback: The well is allowed to flow back to the surface, bringing with it the drilling fluids, cuttings and other debris.
- Separation: The flowback fluids are separated into their constituent parts, such as gas, oil, water, and solids.
- Disposal or treatment: The separated fluids and solids are either treated for reuse or disposed of according to environmental regulations.

It is anticipated that some OP wells may also need to be tested on the drilling unit to determine the well performance characterisation prior to connecting the well to the FPSO for production. This is the equivalent of performing a well test during exploration and appraisal well operations. The exact number of wells to be tested is still under review; however, it is anticipated that up to eight well tests could be undertaken. During testing, hydrocarbons are burned via a flare boom to maximise combustion of the hydrocarbons. The flare boom extends to a safe distance from drilling unit. The duration of the test will be minimised as much as possible.

4.2.4.6 Well Suspension

Once wells are completed and until they are connected to the FPSO, they will be temporarily suspended by introducing treated brine, which will protect them from any pressurised formations. The type of brine to be used will still need to be further studied and defined, however typical suspension brines could include calcium bromide, calcium chloride or sodium chloride brine. In addition, small quantities of other additives, such as monoethylene glycol (MEG) for example, could be added (still to be defined). Discharge of well suspension fluids to sea is not planned except in case of emergency.

The wells will be isolated using the isolation valves located in the upper completion and a corrosion cap will be installed on the subsea wellhead to seal the well until the Xmas Tree is installed later (using a separate installation vessel) and the FPSO is in place.

4.2.5 Drilling Fluids or Muds

Drilling fluid is a complex mixture of fluids, solids and chemicals that are carefully tailored to provide the correct physical and chemical characteristics required to safely drill the well. The main functions of drilling fluid or drilling mud (terms used interchangeably) are to:

- Provide sufficient hydrostatic pressure to control subsurface pressures and prevent kicks or blow-outs;
- Maintain a stable wellbore and prevent deterioration of the open hole, such as collapsing;
- Transport the cuttings to the surface;
- Cool and lubricate the drill bit and drill string (reduce friction);
- Power the mud motors / downhole tools during the drilling process;
- Regulate the chemical and physical characteristics of returned mud slurry on the drilling unit; and
- Displace cements during the cementing process.

Two types of drilling fluid may be used during offshore drilling, namely WBM and Non-Aqueous Based Mud (NABM) or NADF as it is hereafter referred to. For this project, it is proposed to use WBM during the riserless drilling stage (the stage where a large-diameter pipe, the riser, connecting the well to the drilling unit has not yet been put in place) and either WBM or NADF during the risered drilling stage.



All drilling chemicals proposed for the Venus development wells will be selected according to lowest toxicity, lowest bioaccumulation potential and highest biodegradation, and are selected in accordance with the pre-screening scheme based on the OSPAR²⁹ methodology. An indicative mud composition was used in the drilling discharge modelling - refer to the Drilling Discharges Modelling report for these details (Appendix H).

4.2.5.1 Water-Based Muds

Due to the variability in conditions that can be encountered, drilling fluid mixtures vary to some extent. Typically, the major ingredient making up 85 to 90% of the total volume of a WBM is freshwater and / or seawater.

The remaining 10 to 15% of the volume of WBMs typically comprise barite, potato or corn starch, cellulose-based polymers, xanthan gum, bentonite clay, soda ash, caustic soda and salts (these are usually either potassium chloride [KCl], Calcium chloride [CaCl₂] or sodium chloride [NaCl]). Other minor additives may be used in special circumstances such as citric acid for pH control; or polyethylene glycol butyl ether for clay inhibition, amongst others.

Details for some of these are provided below:

- Barite (barium sulphate) is an inert compound used as a weighting agent
- Potato or corn starch and other cellulose-based polymers are used to control the rate of filtration of water in the mud into the formation being drilled by forming a thin filter cake on the borehole wall
- Xanthan gum and minor amounts of bentonite clay are used to provide viscosity and impart rheological properties (i.e. materials responding with plastic/liquid flow or flow of matter as a “soft solid”) to the mud for cuttings transport, as well as to provide gel strength for cuttings suspension
- Caustic soda (sodium hydroxide) is used to maintain the required pH in the drilling fluid
- KCl, CaCl₂ or NaCl (table salt) are used to reduce the swelling tendencies of clays being drilled and help to maintain a stable wellbore

All chemicals to be used will have associated Material Safety Data Sheet (MSDS) or other bioassay information for ecotoxicology data, where applicable. Selection of constituents will follow best industry practices and will consider ecotoxicity, biodegradability and bioaccumulation criteria.

4.2.5.2 Non-Aqueous Drilling Fluids (Non-Aqueous Based Mud)

NADF may have to be used during the risered drilling stage (“closed loop system”) to:

- Provide optimum wellbore stability and enable a near gauge hole to be drilled;
- Reduce torque and drag in high angle to horizontal wells;

²⁹ The OSPAR Commission is an international organization that works to protect and conserve the marine environment of the North-East Atlantic. It was established through the merger of the 1972 Oslo Convention, which focused on preventing marine pollution from dumping, and the 1974 Paris Convention, which addressed land-based sources of marine pollution and the offshore industry.

The Commission consists of 15 governments (Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom) and the European Union.

The OSPAR Convention, adopted in 1992, unified and updated these earlier agreements. It also introduced new measures to protect marine biodiversity and ecosystems from non-polluting human activities.

Namibia is not a member of OSPAR and thus OSPAR rules do not apply, but they provide a good indication of the environmental acceptability of a product.



- Minimise damage to reservoirs that contain clays that react adversely to WBM; and
- Obtain irreducible water saturation log data for gas reservoirs.

The main chemicals typically used in a NADF are presented in Table 4-3.

Table 4-3: Main chemicals used in a non-aqueous drilling fluid.

Material	Description
Base fluid	Non-aqueous drilling fluids use base fluids with significantly reduced aromatics and extremely low polynuclear aromatic compounds. New systems using vegetable oil, polyglycols or esters have been and continue to be used.
Brine phase	CaCl ₂ , NaCl, KCl.
Gelling products	Modified clays reacted with organic amines.
Alkaline chemicals	Lime e.g., Ca(OH) ₂ .
Fluid loss control	Chemicals derived from lignites reacted with long chain or quaternary amines.
Emulsifiers	Fatty acids and derivatives, rosin acids and derivatives, dicarboxylic acids, polyamines.

Adapted from: Swan et al., 1994

Drill cuttings that derive from the reservoir section contain residual base fluids, which cannot be removed easily. The trend in the industry has been to move towards low toxicity NADF (Group III NADF) that are biodegradable with a lower aromatic content and will not persist in the long-term.

Three types of NADF are generally used for offshore drilling, as follows:

- **Group I NADF (high aromatic content):** These base fluids were used during initial days of oil and gas exploration and include diesel and conventional mineral oil-based fluids. They are refined from crude oil and are a non-specific collection of hydrocarbon compounds including paraffins, olefins and aromatic and polycyclic aromatic hydrocarbons (PAHs). Group 1 NADF is defined by having PAH levels greater than 0.35%.
- **Group II NADF (medium aromatic content):** These fluids are sometimes referred to as Low Toxicity Mineral Oil Based Fluids and were developed to address the rising concern over the potential toxicity of diesel-based fluids. They are also developed from refining crude oil but the distillation process is controlled such that the total aromatic hydrocarbon concentration is less than Group I NADF (0.5 – 5%) and the PAH content is less than 0.35% but greater than 0.001%.
- **Group III NADF (low to negligible aromatic content):** These fluids are characterised by PAH contents of less than 0.001% and total aromatic contents less than 0.5%. This group includes Synthetic Oil-Based Mud or synthetic-based muds, which are produced by chemical reactions of relatively pure compounds and can include synthetic hydrocarbons (olefins, paraffins and esters). Using special refining and/or separation processes, base fluids of Group III can also be derived from highly processed mineral oils (paraffins, enhanced mineral oil-based fluid).

For the current project, if NADF is confirmed, the operator is planning to use a Group III type NADF.



4.2.6 Resource Requirements

4.2.6.1 Personnel

The majority of the workforce involved in the drilling activities will comprise highly specialised skilled staff. Whenever possible, the use of local workers will be prioritized. Each drilling unit usually accommodates around 150 to 200 workers at the same time. Offshore workers on drilling units typically remain on board for 4 weeks, which is followed by 4 weeks off duty. Up to 3 drilling units are expected to be on location in the Venus offshore project area to drill the up to 40 wells.

Each drilling unit is expected to be supported by two to three support vessels, which will be used to transfer equipment between shore and the drilling unit. Each support vessel usually accommodates circa 15 workers at the same time.

Transportation of personnel to and from the drilling units will be undertaken by helicopter, with circa 5 helicopter trips per week between each drilling unit and the helicopter support base most likely in Lüderitz. When multiple drilling units will be present, helicopter trips will be optimised to minimise the number of trips.

Accommodation in Windhoek or Lüderitz during crew changes may be required for incoming or departing offshore staff.

4.2.6.2 Water

The drilling campaign will use an estimated 675 m³ of freshwater per drilling unit per week for use on board, cement and water-based mud preparation (drill water). Freshwater will be produced onboard the drilling units via seawater desalination.

4.2.6.3 Fuel

Low sulphur (0.5%) Marine Gas Oil (MGO) will be used as fuel for all vessels. Fuel will preferentially be obtained locally and transported to the drilling unit by the supply vessels. Jet-A1 fuel will be used for helicopters.

Estimates for the fuel use by a proposed drilling unit, supply vessels and aircraft during the drilling and mobilisation/demobilisation periods are presented in Table 4-4.

Table 4-4: Estimated fuel consumption for drilling campaign.

Vessel	Fuel	Fuel usage	Vessel days or helicopter trips	Total consumption
Drilling units	MGO	50 tonnes/day	2 971 drill unit days	148 550 tonnes
Support vessels	MGO	6 tonnes/day	1 294 PSV days <i>1 support vessel shared for all drill units</i>	7 764 tonnes
	MGO	6 tonnes/day	5 942 PSV days <i>2 supply vessels per drill unit</i>	35 652 tonnes
Helicopter	Jet A1	1.86 tonnes/trip	2 682 trips <i>Including helicopter trips for all project activities until end of drilling</i>	4 989 tonnes

4.2.6.4 Explosive and Radioactive Materials

The drilling unit will be equipped with a secure store for explosives, plus igniter, booster, detonator and detonating cord. The drilling unit will also ensure proper storage of radioactive materials.



4.2.7 Discharges, Emissions and Wastes

4.2.7.1 Discharges to Sea

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill related discharges would be managed by Shipboard Oil Pollution Emergency Plans (SOPEP), that all vessel contractors will be required to have in place, and an Oil Spill Contingency Plan (OSCP) that the Operator will be required to compile and share with government prior to drilling. When onshore treatment or disposal is needed, only onshore licenced waste disposal sites and waste management facilities will be used.

Anticipated sources of discharges to sea are summarised in Table 4-5. Additional detail for the anticipated volume of drill cuttings and mud to be discharged is provided in Table 4-6.

Table 4-5: Estimated sources of anticipated discharges to sea.

Discharge stream	Source	Discharge criteria
From drilling-related activities		
Drill cuttings and mud	Drill cuttings, which range in size from clay to coarse gravel and reflect the types of sedimentary rocks penetrated by the drill bit, are the primary discharge during well drilling. During the riserless drilling stage, all cuttings and associated WBM will be discharged directly onto the seafloor adjacent to the wellbore. During the risered drilling stage the operator will treat cuttings on the drillship and then discharge the treated cuttings overboard, where they are dispersed by the current and settle to the seafloor. Discharge at any one location is intermittent, as actual drilling operations are interspersed with cementing and other technical work that does not generate cuttings. Refer to Table 4-6 for the anticipated volume of drill cuttings and associated mud to be discharged.	Reduce oil content to below 6.9% Oil on Cuttings (OOC) by weight using shakers and a centrifuge
Cement and cement additives	During cementing of the surface casing, excess cement emerges out of the top of the well and onto the seafloor to ensure that the conductor pipe is cemented all the way to the seafloor.	None
BOP hydraulic fluid	The BOP control system will use hydraulic fluids to actuate the BOP valves. It is anticipated that BOP testing will take place twice for each well (for safety reasons).	BOP fluids completely biodegrade in seawater within 28 days.
From vessels		
Ballast water	Ballast water is used during routine operations to maintain safe operating conditions onboard a ship by reducing stress on the hull, providing stability, improving propulsion and manoeuvrability, and compensating for weight lost due to fuel and water consumption.	Ballast water is discharged subject to the requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments. In compliance with IMO Regulation D2 of the Convention, project vessels will use approved Ballast Water Treatment Systems



Discharge stream	Source	Discharge criteria
	While it is essential for safe operations, discharge of ballast water can pose a risk to the receiving environment when discharged due to foreign marine species (e.g., bacteria and larvae) being carried in a ships' ballast water from one location to another when mobilising the drilling unit to site.	to control the maximum amount of viable organisms being discharged in ballast water.
Slops from vessel machinery spaces	Slops include primarily bilge water (drainage water that collects in a ship's bilge space ³⁰) and possibly lab effluent, which can contain some oily and other contaminants from e.g. machinery onboard.	In accordance with MARPOL Annex I, bilge water will be retained on board until it can be discharged to an approved reception facility, unless it is treated by an approved oily water separator to <15 ppm oil content and monitored before discharge. The residue from the onboard oil/water separator will be treated / disposed of onshore at a licenced hazardous waste treatment facility. Bilge water is discharged in accordance with MARPOL 73/78 Annex I.
Deck drainage	Deck drainage consists of liquid waste resulting from rainfall, deck and equipment washing (using water and a water-based detergent). In areas of the drilling unit where oil contamination of rainwater is more likely (i.e. the drilling unit floor), drainage is routed to an oil / water separator / the bilge for treatment before discharge in accordance with MARPOL Annex I (i.e. 15 ppm oil and grease maximum). There will be no discharge of free oil that could cause either a film, sheen or discolouration of the surface water or a sludge or emulsion to be deposited below the water's surface.	Only non-oily water (i.e. <15 ppm oil and grease, maximum instantaneous oil discharge monitor reading) will be discharged overboard. If separation facilities are not available (due to overload or maintenance) the drainage water will be retained on board until it can be discharged to an approved reception facility. The oily residue from the onboard oil / water separator will be treated / disposed of onshore at an approved hazardous waste treatment facility.
Brine	Seawater is desalinated on the drill ships for freshwater and other purposes. The waste stream from the desalination plant is brine (concentrated salt), which is produced in the reverse osmosis process. The brine stream contains high concentration of salts and other concentrated impurities that may be found in seawater. Water chemical agents will not be used in the treatment of seawater and therefore the brine is a natural salt in concentrated state. Approximately 35 g of salt for each litre of water produced will be discharged to sea.	None

³⁰ The bilge is the lowest compartment on a ship, below the waterline, where the two sides meet at the keel



Discharge stream	Source	Discharge criteria
Food wastes	Food waste from the galley on vessels	The disposal into the sea of food waste is permitted, in terms of MARPOL Annex V, when it has been comminuted or ground to particle sizes smaller than 25 mm and the vessel is <i>en route</i> more than 3 nm (approximately 5.5 km) from land. Disposal overboard without macerating is permitted for moving vessels greater than 12 nm (approximately 22 km) from the coast. On the drilling units, all food waste will be macerated to particles sizes <25 mm. Food waste that cannot be macerated will be transferred to shore for further handling and disposal.
Sewage and grey water	Discharges of sewage (or black water) and grey water (i.e. wastewater from the kitchen, washing and laundry activities and non-oily water used for cleaning) will occur from vessels intermittently throughout the project and will vary according to the number of persons on board.	Grey water may be discharged to sea (without treatment) providing no floating matter or sheen is observable. Black water will be treated onboard in accordance with MARPOL 73/78 Annex IV prior to discharge. Effluent to comply with the following criteria: • Biological Oxygen Demand (BOD) of <25 mg/L (if the treatment plant was installed after 1/1/2010) or <50 mg/L (if installed before this date). • Minimal residual chlorine concentration of 0.5 mg/L. • No visible floating solids or oil and grease.

Table 4-6: Estimated drilling cuttings and mud discharges.

Drill Section	Type of drilling fluid used	Discharge location	Estimated mass of drilling fluid discharged (mT)	Estimated mass of cuttings discharged (mT)
1	Seawater	Seafloor	989	88
2	Viscous sweeps & WBM		10 341	1 281
3	NADF ¹	~10 m below sea surface	88	447
4			62	284
5			57	265
Total per well			WBM: 10 341 NADF: 207	2 365
Total for 40 wells			WBM: 413 640 NADF: 8 280	94 600
Notes:				
1. Total quantity of NADF mud discharged including Oil On Cuttings (OOC) @ 6.9% by weight of cuttings (mT) + Other constituents.				



4.2.7.2 Noise Emissions

The key sources of underwater noise during drilling are described below and are expected to result in variable sound levels, depending on the operational status at any one time:

- *Vessel propeller and positioning thrusters:* Noise from propellers and thrusters is predominately caused by cavitation around the blades whilst transiting at speed or operating thrusters under load to maintain a vessel's position. The noise produced by a drilling unit(s)', as well as support and supply vessels', dynamic positioning systems can be audible for many kilometres. Noise produced is typically broadband noise, with some low tonal peaks. The overall noise level when dynamic positioning is operating on the drilling units is approximately 197 dB re 1 μ Pa @ 1 m (or dB re 1 μ Pa²·S @ 1 m) while the generated noise levels of support and supply vessels operating simultaneously is approximately 180 dB re 1 μ Pa @ 1 m and 177 dB re 1 μ Pa @ 1 m, respectively.
- *Well logging:* Some VSP will be undertaken to generate a high-resolution image of the geology in the well's immediate vicinity. VSP is described in Section 4.2.4.4.
- *Helicopter noise:* Underwater noise due to helicopters is limited, as broadband noise generated underwater by helicopters flying at altitudes of 150 m or more is expected to be ~109 dB re 1 μ Pa (Richardson et al. 2013) at the most-affected point, which is broadly in line with ambient levels and considerably less than underwater noise generated by vessels – it can thus be considered negligible in terms of the overall noise levels. Helicopter noise can significantly affect fauna out of water (e.g. on the coast).

4.2.7.3 Air Emissions

The principal sources of emissions to air from the proposed drilling activities will be from fuel combustion (see Section 4.2.6.3), well clean-up and well flow testing (flaring), if any.

Typical combustion products from fuel combustion include sulphur oxides (SO_x), oxides of nitrogen (NO_x, N₂O), carbon dioxide (CO₂), carbon monoxide (CO), volatile organic compounds (VOC), Methane (CH₄), non-methane volatile organic compounds (NMVOC) and particulate matter (PM).

It is anticipated that up to eight well tests may be conducted lasting 7 days per test. The estimated volume of hydrocarbons to be handled during well testing cannot be estimated with much accuracy. However, it is estimated that approximately 4.73 million standard cubic metres (MSm³) gas and 59.50 thousand barrels (kbbl) of oil could be flared per well test, resulting in a total of 37.84 MSm³ gas and 476 kbbl of oil being flared for the eight tests.

The remaining 32 wells will be cleaned-up, with an estimated 0.95 MSm³ gas and 12 kbbl of oil being flared per clean-up, resulting in a total of 30.4 MSm³ gas and 384 kbbl of oil being flared for the 32 clean-ups.

4.2.7.4 Light Emissions

Operational lighting will be required on the drilling units and supply vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

4.2.7.5 Waste Management

The operator is striving to reduce waste generation, increase reuse and recycling, and move away from landfilling and incineration without energy recovery (where technically and economically feasible). A Waste Management Plan will be developed which describes how the waste streams will be managed according to the framework principles. All the external



waste management facilities will be assessed and approved prior to the start of drilling. Any export of waste streams will be organised in compliance with the Basel Convention.

Wastes (other than discharges to sea mentioned in Section 4.2.7) will be transported to shore for further treatment and disposal at authorised licensed facilities. On vessels these waste streams will be segregated, packed, labelled and transported by a support vessel under a manifest to shore. In the port, the waste will be unloaded from the support vessel, checked and transported by a licensed waste contractor to the final treatment and disposal facilities.

If needed, extra waste treatment (separation, sorting, shredding, compacting, etc.) will be carried out to optimise the reuse and recycling opportunities. Only the non-recyclable portion will be sent to a licenced waste management facility for final disposal.

Any bulk volumes of NADF remaining at the end of well drilling will either be shipped for onshore treatment and disposal through a licenced waste disposal company or re-used during any other drilling campaigns.

Waste types expected during drilling are summarised in Table 4-7. Waste treatment and disposal methods will be continuously assessed based on available techniques and facilities.

Table 4-7: Estimated total waste associated with well drilling.

Non-Hazardous Waste Type	Totals (t)
Food	28
Paper	8
Non-hazardous plastics	285
Mixed non-hazardous waste	1 627
Wood	592
Non-hazardous metals	1 516
Glass	6
Non-Hazardous Waste sub-total	4 063
Hazardous Waste Type	Total (t)
Oily Rags	6
WEEE	50
Explosives	0
Mixed Hazardous waste	514
Medical waste	1
Wastewater (oily water)	3 384
Waste Oil	1 390
Hazardous plastics	45
Hazardous metals	169
Oily drilling waste (e.g. cement cuttings, pit cleaning, etc.)	6 635
Hazardous Waste sub-total	12 195
TOTAL	16 258

Note: values are conservative estimates for 3 drilling units and 9 PSVs.



4.2.8 Emergency Prevention and Response

4.2.8.1 Prevention

Although the probability of a well blow-out³¹ is extremely low (global data maintained by Lloyds Register, cited in IOGP Report 434-02, indicates that frequency of a blow-out from deepwater drilling development wells is in the order of 3.9×10^{-5} per well drilled³²), it is a worst-case scenario that provides the greatest environmental risk during drilling operations. The operator will have a Blow-Out Contingency Plan (BOCP) in place that sets out its detailed response plan and intervention strategy, to be implemented in the unlikely event of a blow-out.

The primary safeguard against a blow-out is the column of **drilling fluid** in the well, which exerts hydrostatic pressure on the wellbore. Under normal drilling conditions, this pressure should balance or exceed the natural rock formation pressure to help prevent an influx of gas or other formation fluids. As the formation pressures increase, the density of the drilling fluid is increased to help maintain a safe margin and prevent an influx of formation fluids (“kicks” or “blow-outs”). However, if the density of the fluid becomes too heavy, the formation can break down and fracture. If drilling fluid is lost in the resultant fractures, a reduction of hydrostatic pressure occurs which can lead to an influx from a pressured formation. Therefore, maintaining the appropriate fluid density for the wellbore pressure regime is critical to safety and wellbore stability.

Abnormal formation pressures are detected by primary well control equipment, which generally consists of two sets of pit level indicators and return mud-flow indicators with one set manned by the drill crew and the other by the ‘mud logger’. The ‘mud logger’ also has a return mud gas detector, which monitors return mud temperature and changes in shale density for abnormal pressure detection. The drilling fluid is also tested frequently during drilling operations and its composition can be adjusted to account for changing downhole conditions.

The likelihood of a blow-out is further minimised by installing a specially designed safety equipment called a **BOP** (see Figure 4-18), which is a secondary control system. BOPs contain a stack of independently operated cut-off mechanisms, so there is redundancy in case of failure, and the ability to work in all normal circumstances with the drill pipe in or out of the well bore. The BOP is installed on the wellhead (on the seabed) and is designed to close in the well to prevent the uncontrolled flow of hydrocarbons from the reservoir in case the pressure of the reservoir exceeds the pressure of the drilling fluid in the reservoir resulting in hydrocarbons entering the wellbore. If this cannot be controlled, hydrocarbons could eventually exit the wellbore into the marine environment / atmosphere. Hence, the BOP system plays a key role in preventing potential risks to people, the environment and equipment. The BOP will undergo a thorough inspection prior to installation and will be subsequently pressure and function tested on a regular basis during operations aligned with industry best practices.

³¹ The uncontrolled release of crude oil and/or natural gas from a well after pressure control systems have failed and is the worst case in the loss of well control.

³² This equates to $3.9 \times 10^{-5} \times 100 = 0.0000039\%$, or one blow-out in approximately 25 641 wells drilled.



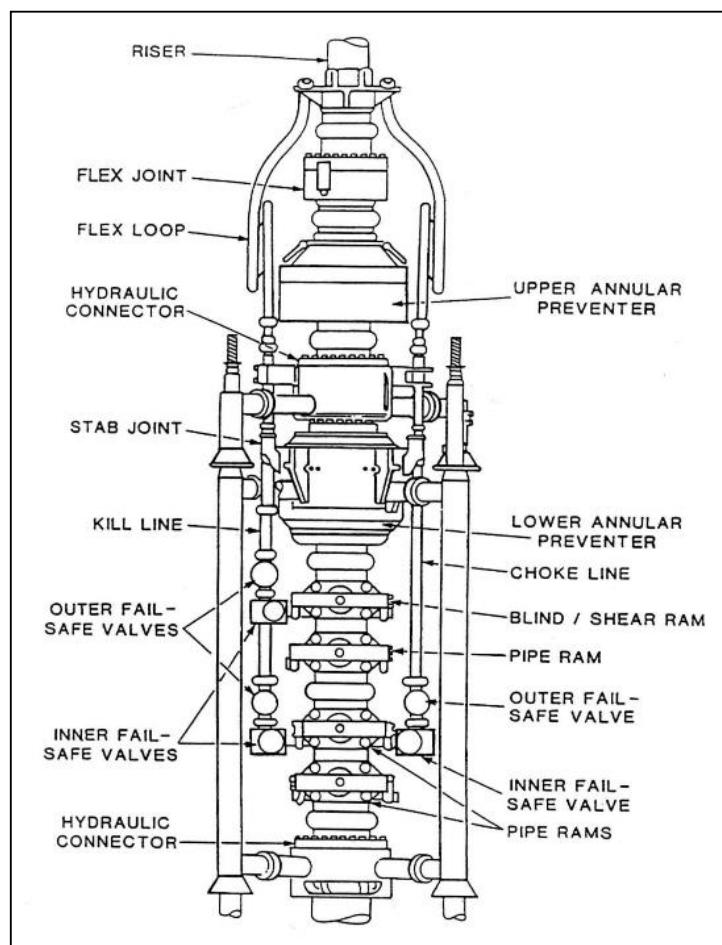


Figure 4-18: Schematic of a typical subsea BOP stack.

Source: CCA & CSM, 2001

The BOP stack typically consists of the following:

- **Annular preventer:** The annular-type blow-out preventer can close around the drill string, casing or a non-cylindrical object, such as a Kelly (i.e. a piece of equipment shaped like a pipe that is used in drilling). The drill pipe, including the larger-diameter tool joints (threaded connectors), can be "stripped" (i.e. moved vertically while pressure is contained below) through an annular preventer by careful control of the hydraulic closing pressure. Annular BOPs are typically located at the top of a BOP stack, with one or two annular preventers positioned above a series of several ram preventers.
- **Ram type preventers:** Ram type preventers are similar in operation to gate valves but use a pair of opposing steel plungers or rams. The rams extend toward the centre of the wellbore to restrict flow or retract open in order to permit flow. There are four common types of rams or ram blocks used in a BOP stack (or combination thereof):
 - o Pipe rams close around a drill pipe, restricting flow in the annulus (ring-shaped space between concentric objects) between the outside of the drill pipe and the wellbore, but do not obstruct flow within the drill pipe. Variable-bore pipe rams can accommodate tubing in a wider range of outside diameters than standard pipe rams, but typically with some loss of pressure capacity and longevity.



- o Blind rams (also known as sealing rams), which have no openings for tubing, can close off the well when the well does not contain a drill string or other tubing and seal it.
- o Shear rams cut through the drill string or casing with hardened steel shears.
- o Blind shear rams (also known as shear seal rams or sealing shear rams) are intended to seal a wellbore, even when the bore is occupied by a drill string, by cutting through the drill string as the rams close off the well.

In deeper offshore operations, there are several ways in which a BOP can be controlled, including (in order of priority):

- Electrical control signal, which is sent from the surface through a control cable (MUX cable). Functioning valves on the stack release high pressurised hydraulic fluid to function the rams or annulars. This method allows for multiple commands to be sent via a single conductor very rapidly.
- Acoustical control signal, which is sent from the surface via a modulated / encoded pulse of sound transmitted by an underwater transducer. This new technique allows for communication with the subsea BOP without the need of an umbilical.
- ROV intervention, which mechanically controls valves and provides hydraulic pressure to the stack (via “hot stab” panels).
- Emergency Disconnect System - in the event the drilling unit loses communication with the subsea BOP, then the BOP will automatically close the blind shear rams. High pressurised hydraulic fluid (released from accumulator bottles) is used to engage the shear rams.
- Emergency Disconnect Package (EDP) - Lower Riser Package (LRP) systems are used in subsea well interventions to provide well control and safety. The EDP allows for quick disconnection in case of an emergency, while the LRP provides a secure connection between the riser and the subsea wellhead.
- A Rig BOP might be used for major well workovers or interventions that require heavy equipment and extensive well control measures.

4.2.8.2 Response

The operator also has access to multiple companies providing emergency response support. It is a member of Oil Spill Response Limited (OSRL), which provides the use of globally advanced capping stacks and other response equipment (e.g., dispersants, booms, and dispersant spray equipment including aircraft) in the event of a well blow-out. Capping stacks are designed to shut-in an uncontrolled subsea well in the unlikely event of a blow-out. OSRL has one of its 10K³³ capping stacks housed at its Saldanha Bay base on the West Coast of South Africa (see Figure 4-19). The capping stack is available for global mobilisation and transportation by sea and/or air in the event of an incident.

³³ 10 k refers to a pressure rating of 10 000 pounds force per square inch (psi).





Figure 4-19: Example of an OSRL Capping Stack.

Source: <https://www.oilspillresponse.com/services/subsea-well-intervention-services/capping>

The **capping stack** would only be deployed in a situation where the BOP has failed to serve its purpose and a blow-out has occurred. It is a piece of equipment that is placed over the blown-out well as a “cap”. Its purpose is to stop or redirect the flow of hydrocarbons and to buy time for engineers to permanently seal the well. It weighs as much as 100 tonnes and requires co-ordinated logistical planning and execution in quickly transporting it to the emergency location.

Before a capping stack arrives, a Remotely Operated Vehicle (ROV) would be deployed to inspect the seabed site for engineers to confirm precisely what equipment is needed. Any debris would then be removed and the wellhead prepared. After the equipment arrives, the capping stack would be carefully maneuvered into place over the wellhead. The stack’s valves would be closed to cap the well (“cap only”) or, if necessary, the flow will be redirected to surface vessels through flexible pipes and risers (“cap and flow”).

The mobilisation of these and other incident response equipment and services will be contained in the operator’s OSCP and BOCIP.

It is relevant that subsea capping and subsea containment equipment (managed by OSRL) is located at Saldanha Bay, South Africa and, therefore, well placed for a rapid response to an unplanned event in the project area.

Dispersants can play a role in managing oil spills from a blowout. Dispersants are chemical agents designed to break up oil spills into smaller droplets. This facilitates natural processes to degrade the oil (e.g. through) microbial degradation and reduces the likelihood of oil reaching the shore. Dispersants are either applied to oil on the sea surface (via spraying from airplanes or vessels) or subsurface (injected directly at the wellhead). Dispersants can also have negative environmental consequences, and their use must be carefully considered based on the specific circumstances of the spill, including the type of oil, sea conditions, and environmental sensitivities.

Physical barriers, such as containment booms, are also used both offshore and nearshore to contain oil spills. Floating barriers are deployed around a spill to prevent the surface oil from spreading from or to an area or redirect it to an area where it can be more easily collected. Once the oil is contained, skimmers are used to remove the oil from the water surface.



4.3 Facilities Installation and Commissioning

4.3.1 Description of the Subsea Production System

The subsea production system allows three-phase fluid (oil, water, and gas) to flow from the wellbore to the FPSO for processing and the produced gas to flow from the FPSO to the Gas Injection (GI) wells. The Venus subsea production system will be made up of a north section and a south section each with a production ring, an injection line, and an umbilical line (see Section 4.1.2).

4.3.1.1 Design Philosophy

The production subsea system will be designed to a pressure rating of 10 000 psi, which will withstand the full shut-in pressure from the production wells, and the gas injection components to withstand the highest required injection pressures.

For the subsea production network, thermal wet insulation is considered for both the flowline and riser systems to allow for safe arrival temperature in steady-state conditions (with respect to hydrates and wax formation prevention) and safe preservation management in case of a full field shutdown. No insulation is needed for the gas injection subsea lines, as the gas is treated and dehydrated on the FPSO prior to re-injection.

For all subsea structures, the piping, valves and other critical equipment (e.g. sensors) will be protected against dropped objects.

The design life of the subsea system components is typically ~20 years. A design life does not indicate the pipeline and associated structure will be depleted, failure-prone, or require replacement after 20 years. For this project, the 20-year design life assumes the systems, components, and structures will perform their primary functions with acceptable safety, regulatory, and environmental performance, and will not experience large failures, require extensive replacements, or need significant repairs. In case of production lasting more than 20 years, technical assessment will be performed to ensure design life can be extended and, where necessary, mitigations will be put in place (upgrades, repairs, replacement, etc.)

Figure 4-20 shows a typical subsea system elements (not specific to Venus).

4.3.1.1 Production Network

Each of the production rings (north and south) will be made up of a flowline that connects the production wells. The 12-inch flowline will be made of carbon steel and wet insulation and configured in a loop to allow the circulation of dead oil in the event of a production shutdown and to perform pigging. The provisional layout of the production network is shown on Figure 4-1. The production rings will be approximately 80 km long.

A subsea Christmas tree (tree) positioned at the top of each well contains pressure control valves and chemical injection ports. The tree may also be equipped with instrumentation for pressure and temperature monitoring of the produced fluids. Each tree is approximately 5 m by 4 m by 4 m in size and weights approximately 50 tonnes.

ILTs and FLETs will be used along the flowlines to connect wells. These are subsea structures designed to attach the flowline end and are then lowered to the seabed in the desired orientation. A jumper (a short pipe connector) is then used to tie-in the ILT or FLET to other subsea structures (e.g., tree, manifold).



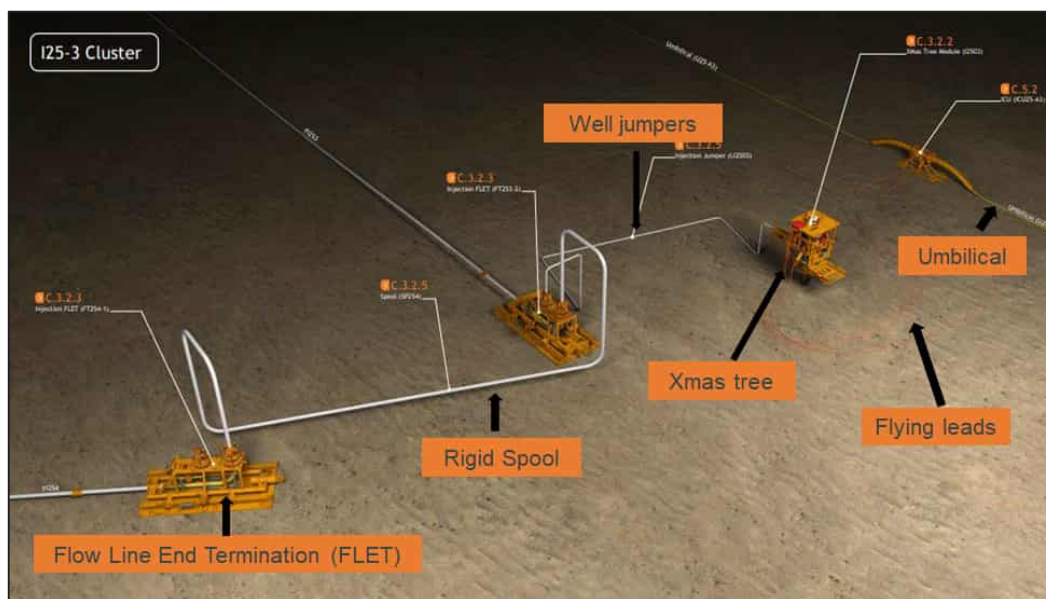


Figure 4-20: Example of a typical subsea system elements.

Source: TotalEnergies

4.3.1.2 Gas Injection Network

The north and south sections will also each have a gas injection line. These lines will be 12" carbon steel. The gas injector wells will be connected through several ILTs / FLETs along the injection lines. The layout of the injector network is shown on Figure 4-1.

The injection wells would have the same architecture as production wells, including installation of a tree at the top of each well for pressure control, pressure and temperature monitoring. Each well has jumpers connecting the subsea tree to the ILT / FLET.

4.3.1.3 Umbilical

There will be two umbilical networks, one for each section (north / south). An umbilical is a bundled arrangement of tubing and electrical conductors in an armoured sheath that is installed from the FPSO to the subsea production system equipment. The umbilicals supply electric and hydraulic power for wellhead or ILT/FLET control functions for the subsea production and safety equipment (tree, valves, etc.) as well as chemicals to suppress the formation of scale and hydrates in the production stream.

Dedicated tubes in an umbilical are used to monitor pressures and inject fluids (chemicals such as methanol) from the FPSO to critical areas within the subsea production equipment. The umbilical lines also carry bidirectional communications and control instructions between the FPSO, wellhead and downhole devices.

Each section umbilical will be made up of a dynamic umbilical plus static production and gas injection umbilicals (see Figure 4-9).

4.3.2 Installation of the Subsea Production System

4.3.2.1 General Approach

The installation of a subsea production system typically follows a specific sequence to ensure efficiency and safety. The likely order of installation is as follows:

1. Subsea mudmats are installed first to provide a foundation and structure for the rest of the equipment.



2. Flowlines are laid together with ILT and FLET, to connect the subsea wells to the production facility.
3. Umbilicals are installed to provide power, control, and communication between the subsea equipment and the surface facilities.
4. Xmas Trees are installed on the wellheads to control the future flow of oil and gas from the wells.
5. Risers are then installed to transport the produced fluids from the seabed to the surface facilities.
6. Jumpers are installed between ILT / FLET and Xmas trees.

The proposed installation phase is composed of two campaigns most likely to be planned during austral summer, when the weather and sea conditions are more favourable. The general intention in terms of planning is:

- During the 1st campaign/season, the flowlines and infrastructure will be laid, as well as umbilicals.
- During the 2nd installation campaign/season, the rest of flowlines will be laid, connected to each other and to the FPSO, which will arrive in the 2nd installation season. The remainder of the umbilicals will also be laid, connected to each other and to the FPSO.

Ensuring that subsea components are accurately placed on the seabed requires detailed surveys of the seabed, which have been conducted, and the use of various techniques and equipment, including:

- Installation vessels equipped with dynamic positioning system to maintain their position precisely over the installation site.
- ROVs equipped with cameras, sonar, and manipulator arms to assist in the precise placement and connection of subsea equipment.
- Acoustic Positioning Systems that use acoustic signals to determine the exact location of subsea equipment. Transponders are placed on the seabed and on the equipment, and the signals are used to triangulate the position with high accuracy.
- Pre-lay Guidance Systems for the installation of flowlines and umbilicals, using a combination of GPS, acoustic positioning, and ROVs to ensure the lines are laid along the predetermined path.

It is anticipated that the installation of the subsea equipment will require the following installation vessels:

- 1st campaign: J-Lay vessel, Flex-Lay vessel and Construction vessel.
- 2nd campaign: J-Lay vessel, Flex-Lay vessel and two Construction vessels.

A preliminary campaign, with only one Construction vessel, is planned prior to the two main campaigns, to pre-install transponders of the Acoustic Positioning Systems.



4.3.2.2 Flowline Laying

Flowlines will be laid by specialised installation vessels. On the flowline installation vessel, each pipe section will be welded to the preceding one. The welded joints will be visually inspected, and integrity tested using non-destructive testing techniques³⁴. The weld area will then be coated for protection with anti-corrosion material.

The flowlines will be installed using the J-lay method, which is used to install rigid pipelines in deep water. In a J-Lay system, pipe stems, consisting of up to six pipes with a total length of 72 m, are lifted and welded to the sea-going pipe in a nearly vertical slope.

The angle of the slope is set so that it is in line with the overhead of the pipe to the seabed. In this way, bending of the pipe is minimized. The J-Lay method is very suitable for deep water because the pipe leaves the laying system in a nearly vertical position and the flowline is bent only once during installation (on the seabed) (Wermac, n.d.) (see Figure 4-21). The flowlines will be laid directly on the seabed and will not be trenched; FLET and ILT are laid together with the flowline.

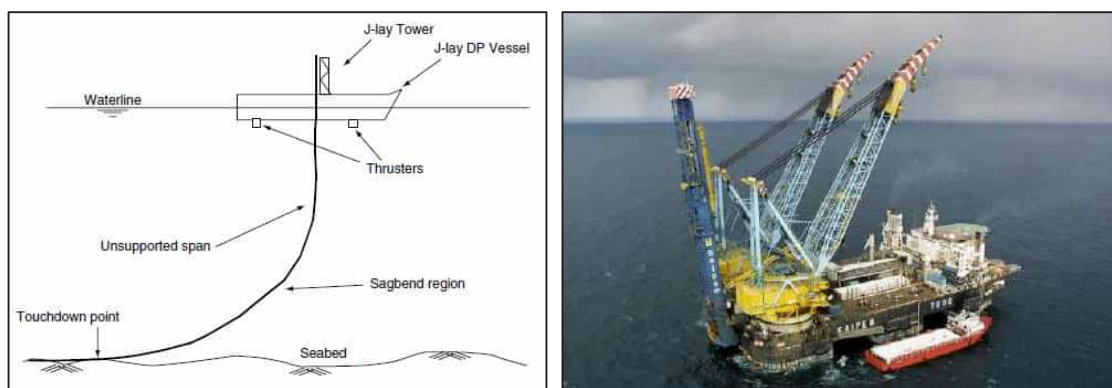


Figure 4-21: J-lay pipeline installation method and vessel example.

Source: (Wermac, n.d.)

During the offshore installation campaigns, the pipe-lay operation will be continuous, with the vessel moving progressively forward as sections of the pipe are welded, inspected, coated on board and then deployed to the seabed. The vessel will be held in position by dynamic positioning. Weather permitting, pipeline sections or structures will be delivered to the installation vessel by supply vessels. If not possible, the installation vessel will depart the Venus offshore project area to load line pipes and structures in sheltered area.

4.3.2.3 Installation of Other Subsea Equipment

Other components of the subsea production system, such as Xmas trees, jumpers, etc will be installed using crane from a construction vessel (see Figure 4-22). The subsea components will be tested to verify integrity after installation, and subsea protection will be installed where required.

Umbilicals are installed by Flex-lay vessel (see Figure 4-23) which has a dynamic positioning system to maintain precise positioning during installation, specialized lay systems such as carousels or reels to store and deploy the umbilicals, ROVs and cranes to assist in the installation and connection of umbilicals and advanced monitoring and control systems ensure the umbilicals are laid accurately and safely.

³⁴ Non-Destructive Testing (NDT) will involve the use of radiography. The Project will follow standard industry practices to manage any workforce exposure to radiation sources.





Figure 4-22: Example of a subsea construction vessel.

Source: Boskalis

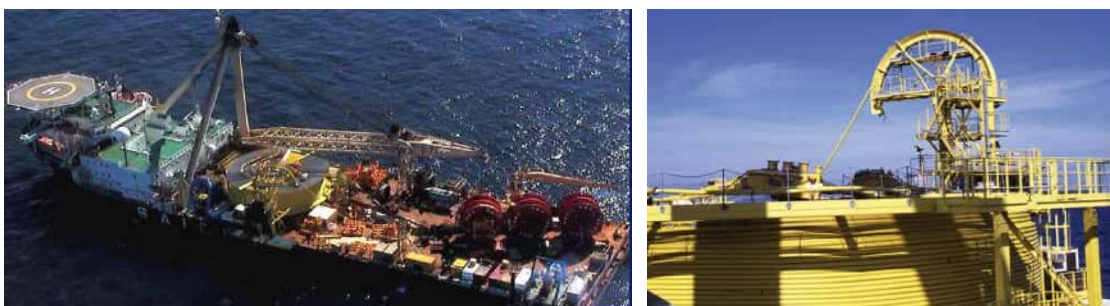


Figure 4-23: Example of a flex-lay vessel.

Source: (Johnson & Collins, 2020)

4.3.3 FPSO

4.3.3.1 Description of the FPSO

A FPSO unit will be used for production and processing of produced fluids and storage of produced oil until it can be offloaded. This will allow oil production without construction of pipeline to onshore facilities.

The FPSO facility will be designed and constructed primarily to perform the following functions:

- Maintain safety and welfare of all personal on board;
- Ensure facilities availability is kept at design target;
- Provide power and all other utilities required to perform functions of FPSO;
- Minimise release of hydrocarbons, release of GHG and impact on the environment;
- Receive produced fluids from the fields;
- Process the produced fluids to required specifications;
- Store processed crude oil;
- Offload processed crude oil;



- Process produced water and discharge overboard within the specified hydrocarbons limits; and
- Inject produced gas back to reservoir.

The FPSO facility design and construction will follow the selected Classification Society's rules for FPSOs and will comply with applicable international maritime conventions, industry codes and standards, relevant local laws and regulations, and other requirements of the selected Flag state as applicable.

The FPSO is custom-built for the Venus Development Project and key features are summarised in Table 4-8.

Separate areas would be identified for power generation and electrical room, laydown and chemical storage, oil treatment, and gas treatment and compression (see Figure 4-24).

Table 4-8: Key FPSO characteristics.

Aspect	Design characteristic
Production capacity	160 000 bbl/day of oil
Produced water treatment capacity	10 000 bbl/day
Gas treatment capacity	550 MMscfd
Storage capacity	About 2 million barrels
Power generation capacity	• Three open cycle high-efficiency gas turbines plus one spare with three x Waste Heat Recovery Units (WHRU) • Powered by approx. 15 MMscfd of the produced gas • High availability target of 95%
Crew capacity	~160 personnel
Mooring	• 18 mooring lines (polyester ropes with short chain sections at the end) each ~4.5 km long • Suction pile anchors or SEPLA (Suction Embedded PLate Anchor) • Designed for 100-year Return Period Metocean condition



Figure 4-24: Potential FPSO layout (example only).

Source: TotalEnergies



The FPSO will be spread moored (moored by mooring lines connected to anchors from the four corners of the vessel) in a four-group arrangement to maintain the vessel in a fixed wave-facing orientation.

Six rigid risers that transport products to and from the vessel will be suspended from a single riser bay on the west side of the vessel. The risers' Touch Down Point (TDP) will be ~3 km from the FPSO. Laydown area and cranes will be located on the west side at a minimum safe distance of the risers. Living quarters will be located upwind.

The FPSO topsides design uses an interconnected module concept where process equipment is packaged in modules. The design concept maximises pre-commissioning and functional testing of the modules prior to arrival offshore Namibia.

The FPSO has been designed to reduce the carbon footprint to the extent practicable (see Section 4.6).

Safety systems on the FPSO will include the following:

- Fire-fighting system.
- Fire and gas detection systems: These include fire and smoke detectors located throughout the topsides and living quarters and wired centrally with alarms sounding in the central control room, which will activate the general alarm system on the FPSO. Gas detectors are placed in areas where gas might be released or could accumulate.
- Blanket gas generation: To prevent fires, the cargo tanks will normally be blanketed with hydrocarbon gas that is supplied from the fuel gas system. The inert gas generator is only used to blanket the tanks if the fuel gas system is offline or prior to tank entry. Other spaces, including the methanol tanks, will be blanketed by nitrogen, which is produced by routing compressed air through the nitrogen membrane package.
- Lifeboats and life rafts: Freefall lifeboats will be placed at the aft of the FPSO. A fast rescue boat will also be provided, complete with a launching and retrieving system. Life rafts with escape chutes systems are provided at fore and aft.

4.3.3.2 Installation of the FPSO

The FPSO will be constructed outside of Namibia and towed to the final location (as it will have no propulsion engines). The FPSO will arrive for installation, hook-up, and commissioning fully fabricated and preassembled.

The FPSO orientation heading is anticipated as 40 / 45 degrees from the North. The heading of the FPSO (see Figure 4-25) for the spread moored solution is based on:

- The waves direction: to limit the waves effect on the FPSO hull (fatigue), the FPSO heading must be aligned (as far as possible) with the waves prevailing direction.
- The wind and current directions: that may influence approach and station keeping of the DPST during offloading operations.



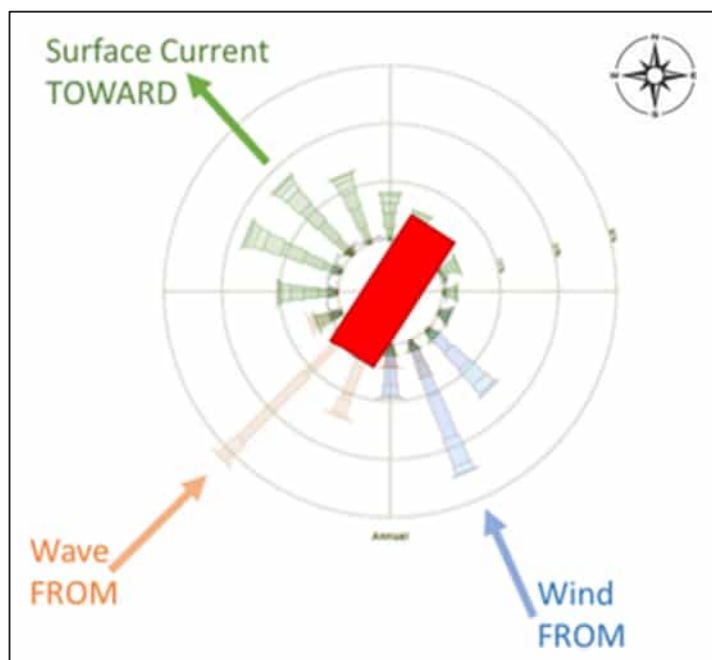


Figure 4-25: Illustration of FPSO orientation heading.

Source: TotalEnergies

The FPSO's 18 anchors (suction piles or Suction Embedded Plate Anchor, SEPLA) and mooring lines ensure the FPSO remains securely moored in place even in challenging deep water environments. Engineering is performed taking into account seabed characteristics and metocean data.

Anchors and mooring lines are installed before the FPSO arrives. Anchors are transported to site on installation vessels equipped with heavy lifting cranes and specialized equipment to handle the anchors. Example of suction piles are shown in Figure 4-26 and the installation process of suction piles is shown in Figure 4-27.

The installation process is closely monitored using ROVs and/or subsea sensors. The data is transmitted to the surface vessel, where operators can make real-time adjustments to ensure proper installation.

Mooring lines are connected to the installed anchors using subsea connectors or shackles. The mooring lines are deployed from the installation vessels and laid out along the seabed.

When the FPSO arrives at the site, the mooring lines are recovered by surface vessel using winch and ROVs. The FPSO is hooked up to the pre-installed mooring lines. Typically, four tugs are required for the hook-up operations to hold FPSO position on site, while an installation vessel is used to ensure the connection of the chains with the FPSO and the appropriate tensioning through the in-line tensioner.

After hook-up of the mooring lines to the FPSO, risers are connected.

It is anticipated that FPSO installation will require the following vessels during part of the austral summer installation campaigns:

- One installation vessel (equipped with heavy lifting crane) to install mooring lines.
- One installation vessel (equipped with heavy lifting crane) for FPSO hook-up.
- Four ocean-going tugs for 3 weeks for FPSO hook-up.





Figure 4-26: Example of a suction pile.

Source: (Wikipedia, 2024)

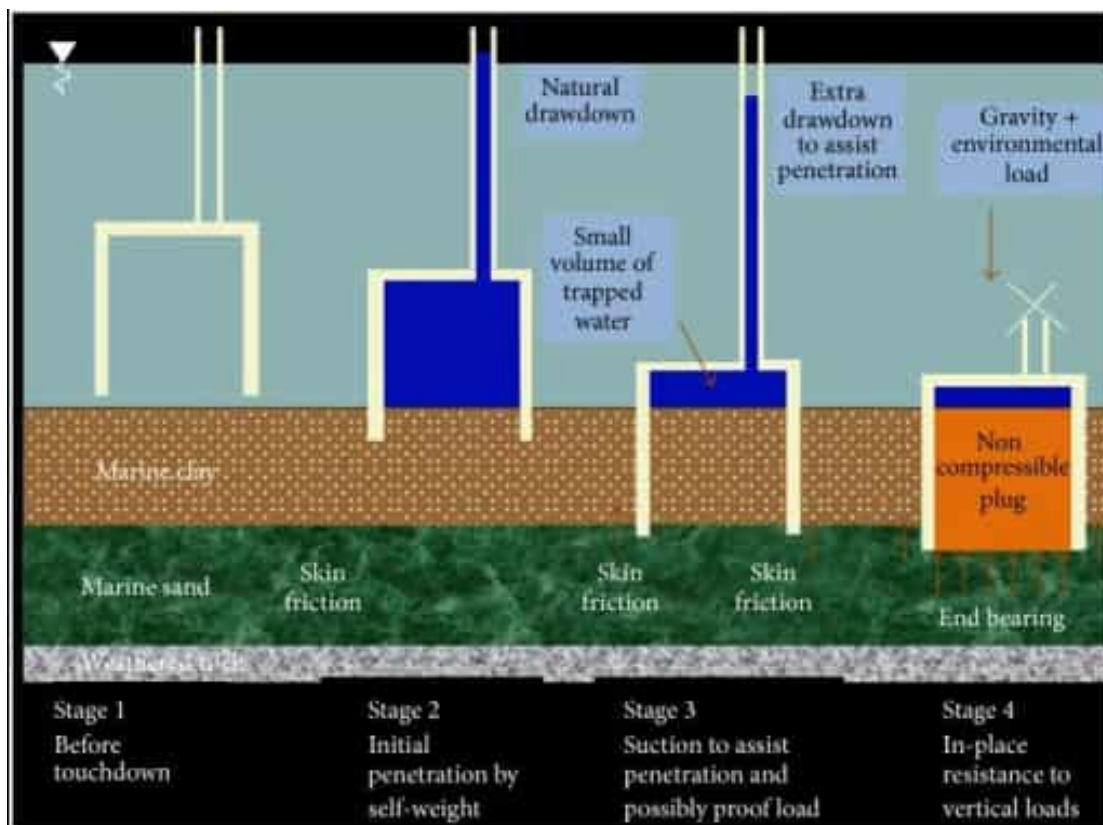


Figure 4-27: Process to install a suction pile.

Source: (Wikipedia, 2024)



4.3.3.3 Commissioning and Start-up of the FPSO

Commissioning will consist in a comprehensive series of dynamic and energized checks and tests to be carried out in order to demonstrate and ensure that the facilities are ready to operate safely and steadily in compliance with project specifications.

Commissioning phase will include four main types of activity:

- Preliminary checks to ensure that the construction and mechanical completion works are completed and documented.
- Functional tests to prove that each plant elementary function performs properly.
- Piping and vessels preparations of the pipe work to prove tightness and ability to receive live fluids safely (such as piping drying-out, process leak testing and inerting, or loading of various chemicals).
- Operational tests to prove the readiness of the equipment for continuous operation by running them during a significant period of time.

The commissioning will be validated upon successful completion of all these activities, including if required, the operational tests with hydrocarbons and hazardous material to allow start-up activities during which "Utility" and "Process" packages and equipment are gradually put into service.

Gas compression commissioning activities will require start-up flaring when performing each compression unit operational test. Limited additional start-up flaring may also occur during final complete start-up and other tests of emergency systems.

4.3.4 Commissioning of Flowlines

Once laid on the seabed, and to prevent corrosion and inhibit bacteria growth, flowlines will be chemically treated from a subsea pigging unit. At this stage, the production and gas injection flowlines and risers will be gauged, cleaned and hydrostatically tested with this chemically treated sea water. The commissioning process for the production and gas injection flowlines will occur in three distinct stages: (1) Flooding, Cleaning, Gauging and Hydrotesting (FCGH), (2) Intelligent pigging or Cleaning 1, and (3) Dewatering or Cleaning 2 – refer to Table 4-10 for a description of this process and the associated discharges.

4.3.5 Nearshore Transshipment

Due to metocean conditions in the Venus offshore project area, DPSTs will be used to offload the oil from the FPSO. After loading the oil from the FPSO, the DPST will travel to the nearshore transshipment area. There, it will connect to a dedicated mooring buoy or a conventional tanker that is moored at the dedicated mooring buoy. The DPST will then transfer the oil to the conventional tanker. The conventional tanker will then transport the oil to its final destination. It is anticipated that approximately one DPST trip per week is required during peak production. Transshipment is expected to last approximately 24 hours. As noted in Section 4.1.6, the nearshore transshipment buoy will be subject to a 500 m safety exclusion zone around the operational zone (see Figure 4-29).

The nearshore transshipment area lies ~5 km from the coast located ~ 20 km north of Walvis Bay, in waters less than 40 m deep (see Figure 4-28 and Figure 4-29). A mooring buoy will be installed at the transshipment area³⁵.

³⁵ The final location of the mooring buoy will be within the proposed transshipment area. Two initial indicative locations are shown for illustration purposes.



The nearshore area was selected based on metocean information and criteria such as:

- Availability of a sheltered area to allow safe approach and mooring;
- Protection status of the area (e.g. location of marine protected areas);
- Sea use of the area (e.g. location of existing bunkering, shipping);
- Safety of location to allow for pilot and surveyor boarding of vessels;
- Water depth of 28 m to 40 m to install a mooring buoy and allow access of the required vessels; and
- Availability of sufficient space to allow tug assistance for manoeuvring, flexible hose connections and oil transfer.

4.3.6 Resource Requirements

4.3.6.1 Personnel

During this phase, the majority of the workforce will comprise highly specialised skilled staff on the installation and support vessels. At peak, it is estimated that up to 1 000 personnel will be working offshore at the same time notably during the two austral summers periods (2 x ~6 months) over 2 years when installation activities will mainly take place. It is anticipated that a floatel³⁶ will be on site to house crew offshore for six months around the time of first oil.

Onshore logistics will be mainly provided from Lüderitz (which is closest) and Walvis Bay (where main construction facilities are located).

4.3.6.2 Water

Most vessels involved in the installation activities will assure their own freshwater supply produced directly offshore (via desalination). Specific activities, for example FPSO commissioning activities such as leak test or process safety test may require *ad hoc* quantity of freshwater which may not be able to be produced directly offshore. For these activities, freshwater could be sourced from onshore providers and transported to the Venus offshore project area by supply vessels. Smaller vessels may also need to source freshwater from shore.

³⁶ Floatel is a vessel designed to provide accommodation and services for people, functioning as a floating hotel.



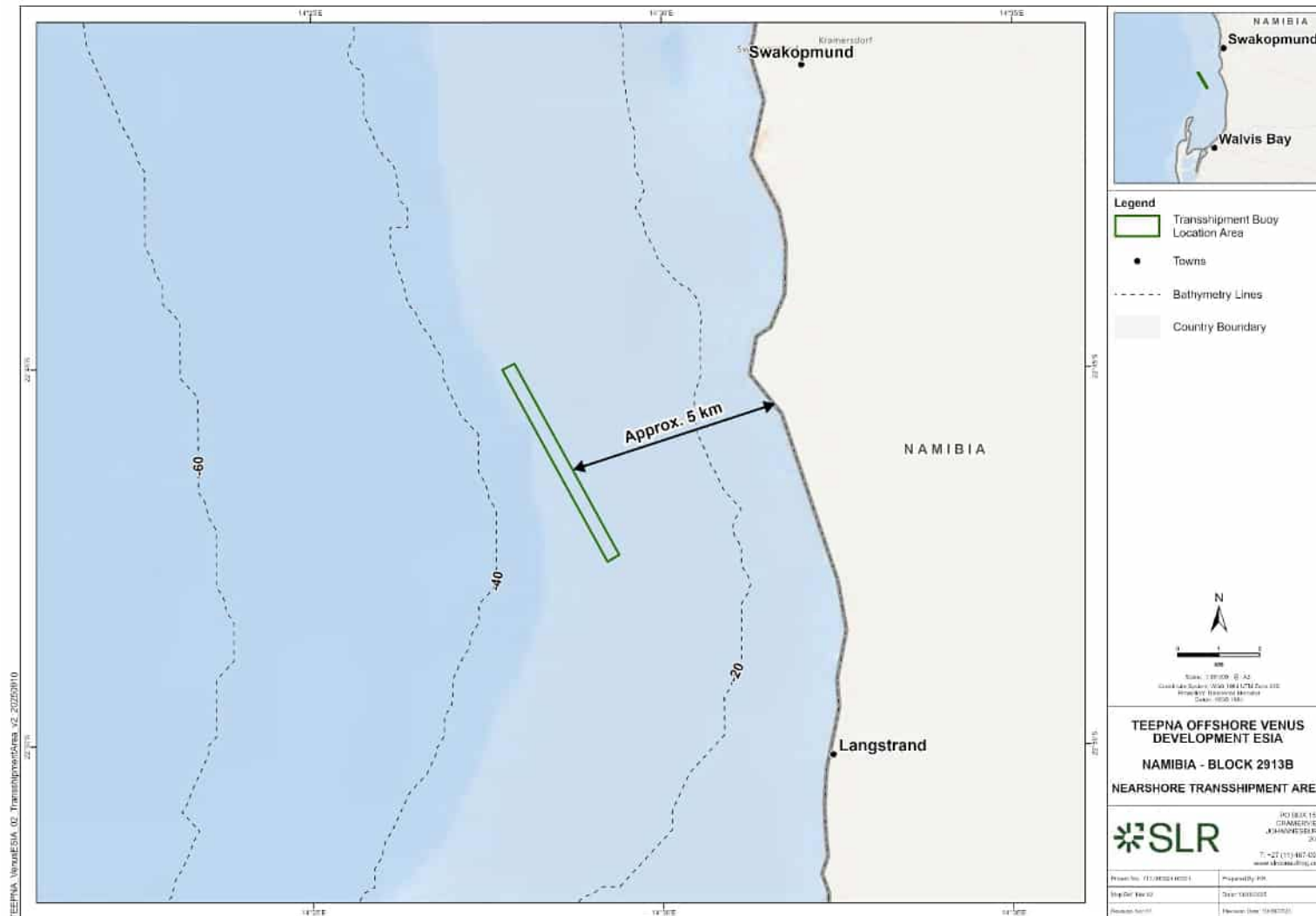


Figure 4-28: Locality map of the nearshore transshipment buoy location area.



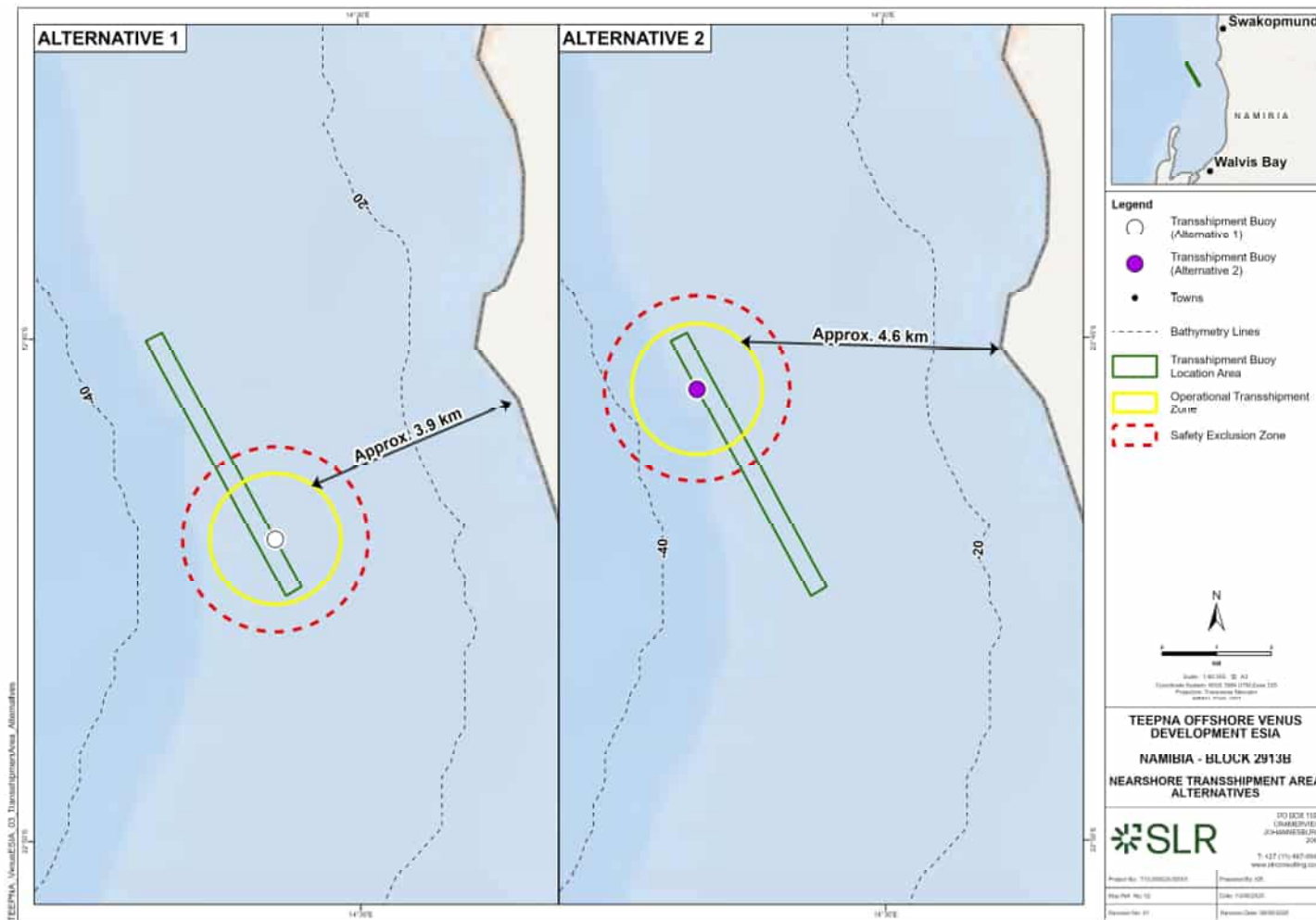


Figure 4-29: Locality map of the transshipment buoy location area showing two potential locations to illustrate the safety exclusion zone and operational zone.



4.3.6.3 Fuel

Low sulphur (0.5%) MGO will be used as fuel for all vessels. Fuel will preferentially be obtained locally and transported to the installation vessels by the supply vessels. Jet-A1 fuel will be used for helicopters. Estimates for the fuel use during installation and commissioning phase are presented in Table 4-9.

Table 4-9: Estimated fuel consumption for facilities installation and commissioning.

Vessel	Fuel	Fuel usage	Vessel days or helicopter trips	Total consumption (tonnes)
Installation vessel (J-lay)	MGO	60 tonnes/day	360 days	21 600
Installation vessel (flex-lay)	MGO	46 tonnes/day	220 days	10 120
Heavy lift vessel	MGO	35 tonnes/day	40 days	1 400
Heavy construction vessel	MGO	22.5 tonnes/day	180 days	4 050
Medium construction vessels	MGO	15 tonnes/day o	270 days	4 050
Floatel	MGO	30 tonnes/day	180 days	5 400
FSPO mooring tugs	MGO	35 tonnes/day	120 days <i>4 tugs on site for 30 days each</i>	4 200
Supply vessel	MGO	6 tonnes/day	1 080 days <i>3 supply vessels at 360 days each</i>	6 480
Helicopter	Jet A1	1.86 tonnes/trip	2 682trips <i>Including helicopter trips for all project activities until end of drilling</i>	4 989 tonnes

4.3.7 Discharges, Emissions and Wastes

4.3.7.1 Discharges to Sea

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. In the unlikely event of a spill, it would be managed by SOPEPs, that all vessel contractors will be required to have in place, and an OSCP that the Operator will be required to compile and share with government prior to activity. Onshore licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of installation operations.

Anticipated sources of discharges to sea are summarised in Table 4-10.



Table 4-10: Estimated sources of anticipated discharges to sea from project utilities installation and commissioning.

Discharge stream	Source	Discharge criteria
From installation and commissioning-related activities		
Production lines (4 branches arranged in 2 loops): Hydrostatic test and dewatering	The Production commissioning process will occur in three distinct stages (or sequences), namely (1) Flooding, Cleaning, Gauging and Hydrotesting: This stage involves filling each Production branch (half ring) with treated seawater (which includes corrosion inhibitor, oxygen scavenger, biocide and dye) up to 1.2 times of flowline volume, which equates to 20% of volume being discharged ~ 5 m above the seabed (approximately 230 m ³ per branch). (2) Intelligent pigging or Cleaning 1 (occurs ~4 – 12 months after Stage 1): This stage involves filling Production branch with 1 full volume of treated seawater (1 150 m ³ per branch), which is eventually discharged ~ 5 m above the seabed.	None
	(3) Dewatering or Cleaning 2: For this stage, production branches will be in their final closed-loop status and the hydrostatic testing fluid in the production lines will be returned to the FPSO, treated, and then discharged overboard.	Water with maximum 15 mg/L Oil content
Gas Injection lines (2 branches): Hydrostatic test and dewatering – release at the seabed	The GI commissioning process will occur in three distinct stages (or sequences), namely (1) Flooding, Cleaning, Gauging and Hydrotesting: This stage involves filling each injection line with treated seawater (which includes corrosion inhibitor, oxygen scavenger, biocide and dye) up to 1.2 times of flowline volume, which equates to 20% of volume being discharged ~ 5 m above the seabed (approximately 253 m ³ per flowline). (2) Intelligent pigging or Cleaning 1 (occurs ~4 – 12 months after Stage 1): This stage involves filling each injection line with 1 full volume of treated seawater (1 266 m ³ per flowline), which is eventually released from each flowline. (3) Dewatering and drying or Cleaning 2 (occurs ~2 – 4 weeks after Stage 2): This stage involves filling each injection line with 1 full volume of commissioning fluid, comprised of treated seawater (1 246 m ³), MEG (15 m ³) and methanol (5 m ³) in sequence (1 266 m ³ per flowline), which is eventually released from each flowline.	None
Umbilical commissioning	Umbilicals filled with 50% MEG and 50% freshwater.	None
From FPSO		
Ballast water	For transit, FPSO will comply with IMO Ballast Water Management Convention. On site, FPSO remaining always at same location, no ballast water treatment is applied.	As per Table 4-5.
Slops from vessel machinery spaces	Slops include primarily bilge water (drainage water that collects in a ship's bilge space) and possibly lab effluent, which can contain some oily and other contaminants from e.g. machinery onboard.	As per Table 4-5. Alternatively, bilge water is transfer to FPSO slops tanks for further treatment.



Discharge stream	Source	Discharge criteria
Deck drainage	Drains on deck are segregated between non-hazardous and hazardous open drains. In case of heavy rains, the design shall ensure that only water is released overboard. Greasy water is transferred to hull slop tanks for further treatment.	As per Table 4-5. After treatment, water with maximal oil content 15mg/L is rejected overboard.
Brine	Seawater is desalinated on the FPSO for fresh water and other purposes. The brine stream contains high concentration of salts and other concentrated impurities that may be found in seawater. Approximately 35 g of salt for each litre of water produced will be discharged to sea.	None
Food wastes	Food waste from the galley.	As per Table 4-5.
Sewage and grey water	Discharges of sewage (or black water) and grey water (i.e. wastewater from the kitchen, washing and laundry activities and non-oily water used for cleaning) will occur intermittently throughout the project and will vary according to the number of persons on board.	As per Table 4-5.

4.3.7.2 Noise Emissions

In addition to noise sources listed in Section 4.2.7.2, dynamic positioning of construction, installation and tug vessels, as well as associated supply vessels, are key noise sources anticipated for the installation and commissioning phase. The overall noise level when dynamic positioning is operating on the installation and construction vessels is approximately 190 dB re 1 μ Pa @ 1 m, while underwater noise generated by the FPSO positioning tugs is modelled to be 196 dB re 1 μ Pa @ 1 m.

4.3.7.3 Air Emissions

The principal sources of emissions to air during installation and commissioning will be from fuel combustion (see Section 4.3.6.3). In addition, during FPSO start-up (estimated ~6 months), power generation will use gas oil (i.e. diesel), which amounts to an estimated 7 200 tonnes of gas oil. Flaring is also required as part of the FPSO start-up (i.e. gas compression commissioning activities), which amounts to an estimated 40 MSm³ of gas being flared.

4.3.7.4 Light Emissions

Operational lighting will be required on the vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

4.3.7.5 Waste Management

Notes in Section 4.3.7.5 also refer. Waste types and management expected during installation and commissioning are summarised in Table 4-11.



Table 4-11: Waste types and management associated with installation and commissioning.

Source	Hazardous / non-hazardous	Waste type	Total waste generated (t)
Support vessels	Non-hazardous	Food	23
Support vessels	Non-hazardous	Mixed waste	1 935
Support vessels	Non-hazardous	Plastics	387
Support vessels	Non-hazardous	Wood	15
Sub-total			2 361
Support vessels	Hazardous	WEEE	15
Support vessels	Hazardous	Mixed waste	310
Support vessels	Hazardous	Metals	23
Support vessels	Hazardous	Waste oil	39
Sub-total			387
Total			2 748

4.3.8 Emergency Prevention and Response

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any vessel oil spill related discharges would be managed by SOPEPs, that all vessel contractors will be required to have in place, and an OSCP that the Operator will be required to compile and share with government prior to installation and commissioning activities.

All vessel owners will also have emergency procedures in place identifying accident scenarios and responses.

Specific coordination documents will be established between the various vessels and operators to define role and responsibilities in event of emergency.

4.4 Production

4.4.1 Production Profile

Oil production will be the highest in the first years, during the “plateau” period. The FPSO design capacity is planned at 160 kbopd, which will be the max possible rate per day (average per day will be lower considering an expected operating efficiency of circa 95%, i.e. an average daily production rate of circa 150 kbopd). Production will progressively decline thereafter for the remaining life of the field.

Similarly, the amount of gas produced will be constrained by the FPSO design capacity (planned at 550 MMscfd), but the maximum gas rate (taking into account operational efficiency) is expected to be reached after few years and then sustained at this level through the life of the field. All gas, less the amount used for powering the FPSO (circa 15 MMscfd), will be reinjected.

4.4.2 Subsea Production System Operation and Maintenance

The flowlines will be protected by a high integrity polyethylene coating together with a sacrificial anode cathodic protection system.



Corrosion inhibitor, methanol, scale inhibitor and water-based hydraulic fluid will be added to the production stream via the umbilicals before it passes through the pipelines to minimise internal corrosion.

Leak detection is monitored by several methods, including alerts for high and low pressure, temperature and/or flow. Pipeline and associated subsea equipment will be externally visually inspected with ROV typically every 3 years. In-line inspection with intelligent pigging will be performed typically every 5 years. Cathodic protection system efficiency will be monitored on a daily basis and subsea measurement shall be done by ROV typically every 9 years.

Pigging of flowlines will be as follows:

- Production loops – permanent pig traps installed topsides to allow bidirectional operational pigging for cleaning and intelligent pigging for inspection.
- Gas injection lines – no permanent pigging facilities but provision and space to install temporary pig traps (subsea receiver and/or topsides launcher).

4.4.1 Processing on the FPSO

Key processes that will take place on the FPSO during production are summarised below.

Oil / water / gas separation: An inlet manifold will be in place to receive produced fluid from the reservoir (consisting of oil, gas, and water) via the production flowlines and risers, and to route the fluid to the FPSO processing facilities. In first stage separator (high-pressure (HP) separator) and test separator, the produced fluid will be separated into liquid and gas. The liquid will then be sent to subsequent separators. Separated (“produced”) water will be sent to decanting and water polishing tanks to allow water separation and treatment so it can be rejected to sea at a maximum rate of 15 mg/L of oil in water. Final crude oil from the separation / stabilisation process will be sent to the crude oil storage tanks in the FPSO hull ready to be offloaded.

Gas processing: The purpose of the FPSO gas-processing system is to condition the associated produced gas to the appropriate specification prior to re-injection into the reservoir. The gas-processing system will consist of the following subsystems:

- Flash gas compressor – recovers and compresses flash gas from the medium-pressure (MP) separator, low-pressure (LP) separator and low-low-pressure (LLP) to be mixed with the gas from the HP separator.
- Gas dehydration – removes water vapor from gas to prevent hydrate formation in the gas injection systems where HP gas will cool to seabed temperatures.
- HP gas compression – compresses dehydrated gas from the HP separator and test separators and the flash gas compressor to an inter-stage pressure.
- Fuel gas – provides fuel gas to all electrical power generation gas turbines and all other LP gas users (pressure control of vessels, etc.).
- Injection gas (GI) compression – compresses discharge gas from the HP gas compressors to an appropriate pressure level where it can be re-injected into the reservoir. The GI re-injection gas is routed to the gas injection risers and then directed to the subsea injection wells.

Any produced gas (other than what is consumed as fuel / utility gas on the FPSO) will be re-injected back into the reservoir; no continuous operational flaring will be permitted.

During equipment maintenance and process upsets, including start-up and shutdown scenarios, part or all of the off-gas from the separation / stabilisation process may be sent to the HP or LP flare systems. Flaring could be temporary and non-routine.



Produced water treatment: The produced water treatment system will be designed to collect produced water³⁷ from process facilities and treat the water for discharge overboard via a dedicated caisson. Dispersed oil in water content will be no higher than 15 mg/L, which is more stringent target than that of the OSPAR Recommendation 2001/1 (amended by 2006/4 and 2011/8). An online oil in water monitoring system will be in place to ensure specification is met.

Key FPSO utility systems are summarised below.

Process cooling: Cooling of process streams via a closed-loop, water-based cooling medium system is required to dissipate heat generated by the oil and water treatment systems, compression systems, and miscellaneous utility systems. The seawater lift system will supply the required seawater for cooling the cooling medium closed-loop. Process hydrocarbon fluids will not come into contact with this seawater. While the lifted seawater will be discharged after heat exchange with the cooling medium closed-loop. There will be no routine discharge of cooling medium.

Process heating: A process heating system is required as part of the crude oil treatment process to achieve the required crude oil specifications. A closed-loop, water-based heating medium system will be used to add heat to the incoming production stream. Waste heat from the power generation system will be used as the source of heat.

Flaring system: A closed flare system, also known as a Flare Gas Recovery System (FGRS), will be designed and employed to ensure there is no continuous operational flaring. Re-injection of produced gas will be carried out under routine conditions.

A flare system will also be in place for the collection and safe disposition of produced hydrocarbon gases during planned maintenance or emergency process upsets (compressor trips, facility shutdown, inventory blowdown). Start-up of the FPSO is a critical period due to the unavailability of the compression chain, where the availability of the flare system will be required.

Topsides and subsea chemical injection: The FPSO will have storage and injection facilities to inject the required amounts of chemicals and methanol into the production fluids to support production operations, both for subsea chemical injection requirements and for topsides chemical injection requirements.

Air: An air compression system will be provided to supply hull and topsides equipment. Compressed air is required primarily for the operation of control valves and other process instrumentation requirements.

Nitrogen: Instrument air will feed the nitrogen generation system. Nitrogen will be provided as required for purging, inerting, and blanketing, and as required for miscellaneous utilities.

Drains: The topsides will be equipped with the following drain systems:

- Closed drain system – used to collect drain fluids from large hydrocarbon vessels and high-pressure gas vessels and route them back into the process.
- Open drain system – used to collect spillage, overflow, washdown from equipment and rain / deluge water. Consists of:

³⁷ Produced water is a byproduct to oil and gas processing on floating production installations that generally contains salt, dissolved solids, suspended oil, grease, dissolved hydrocarbons, and metals. The water is produced along with oil and gas that is brought to surface and treated through the processing equipment. Gravity separation, flotation separation, and hydrocyclone technology are the standard treatment methods to process produced water. The two forms of disposal are to discharge to sea after treatment or re-inject into the reservoir. Discharge to sea is strictly governed at a local and international level. Primarily, regulations typically allow for less than 30 ppm oil in water content. Though this number varies from location, some local regulatory agencies have more stringent requirements, and the industry is attempting to lower this requirement further (ABS, 2022)



- o Hazardous open drains – used to collect drain fluids (e.g. oil contaminated waters) from hydrocarbon areas and route them to the slop tank in FPSO hull.
- o Non-hazardous open drains – used to collect drain fluids (e.g. rainwater) from non-hydrocarbon areas and route them to the slop tank in the FPSO hull or directly overboard in case of excessive drain rates.

The oil and water in the slop tank will be gravity-separated by a minimum residence and retention time. Once separated, the oil will be skimmed off the top and sent to the cargo tanks and the water will be discharged overboard to residual oil and grease in water discharge specifications. Overboard discharge of oily water streams from the FPSO hull will be in line with MARPOL 73/78 Annex I (oil in water content < 15 mg/L).

Other utility systems: A minimum of two deck cranes will be provided for supply boat offloading and materials handling and to support general maintenance activities. Workshops, a laboratory capable of checking the properties of the produced and injection fluids as well as select discharges for compliance, a medical facility, and a storage facility for supplies and spare parts will also be provided. Heating, ventilation, and air conditioning systems will be provided for buildings and enclosures.

Integrated Control and Safety System (ICSS): Monitoring and control of the FPSO production operations will be performed by an ICSS. Located in the main control room of the FPSO, the ICSS will include process shutdown, emergency shutdown, and fire and gas systems to protect the facilities and personnel. These systems will interface with a public address and general alarm system to provide distinct audible and visual alarm notification. The ICSS includes the following subsystems:

- Process Control System (PCS) – will perform primary process control, monitoring, and data acquisition functions
- Safety Instrumented System (SIS) – will implement functions for abandoning the host facility, emergency shutdown, fire and gas detection, and process shutdown. Also included in the SIS will be a shutdown function for the subsea control / safety system. The SIS will provide detection, logic sequencing, and actuation of devices to place the facility in a safe state.
- Alarm management system
- Operator graphics / consoles
- Third-party interfaces to packaged systems (such as compressors, subsea, marine, etc.).

Communication systems: Telecommunications equipment will be installed on the FPSO to enable safe operation of the facilities in normal and emergency conditions. This equipment will allow communication with the shore base, support vessels, helicopters, DPST, as well as communication within the FPSO.

4.4.2 Transfer and Transport of Produced Fluids

Due to the challenging weather and sea conditions in the offshore Venus offshore project area, the produced oil will first be offloaded from the FPSO to a DPST, which provides a more secure connection with the FPSO, and then to a conventional tanker in the nearshore transshipment area, which will be moored at the dedicated mooring buoy. The DPST is dynamically positioned and thus has the ability to keep its position whatever the weather conditions.

The proposed method of transfer is safer as it reduces the risk of a conventional tanker collision with FPSO due to bad weather conditions, for example. This methodology is commonly used in areas with challenging weather conditions – such as North Sea and Brazil.



4.4.2.1 Offshore Transfer from FPSO to DPST

The DPST is equipped with a bow loading arrangement. This ensures a safe connection between the DPST and FPSO in case of ship's motions due to potential challenging metocean conditions on Venus offshore project area (see Figure 4-30).

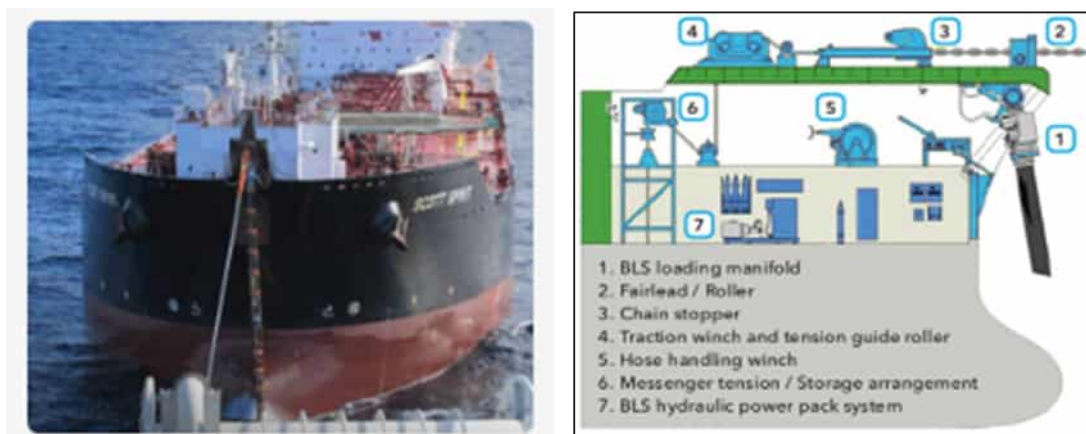


Figure 4-30: DPST bow loading arrangement.

Source: Left : <https://www.nov.com/products/bow-loading-system>; Right: Norwegian Oil and Gas recommended guidelines for Offshore Loading Shuttle Tankers - Guideline No. 140 Effective date: May 6th 2015

Connection between the FPSO and DPST is made during daytime. The offloading of an ~1 million barrel (~160 000 m³) load will take in the order of ~24 hours. The standard oil offloading procedure will include aligning the DPST in tandem to the FPSO (i.e. the DPST will position itself behind the FPSO, not side-by-side or perpendicular).

Automated systems and continuous visual watch are used to identify potential disconnection during transfer, including at night with proper lighting.

In the early production period, two dedicated DPSTs will rotate between the FPSO and the nearshore transshipment area. At peak operations, it is expected that one transfer between the FPSO, DPST and conventional tanker will take place per week. After some years, when production reduces, one dedicated DPST will be used. The DPST(s) will remain in Namibian EEZ water at all times while under contract.

4.4.2.2 Nearshore transshipment from DPST to Conventional Tanker

After offloading the oil from the FPSO, the DPST will transit to a nearshore transshipment area, near Walvis Bay, to transfer the oil to a conventional tanker (see Section 4.3.5 and Figure 4-29).

Conventional tankers will typically arrive anywhere from 1 day to several hours ahead of the scheduled loading time, as a function of weather and ocean conditions. To accommodate these vessels, a mooring buoy will be established at the selected nearshore area. When the tanker is ready to approach, a mooring master will board the conventional tanker to guide the conventional tanker to the floating terminal and to support the connection and offloading operation.

Once both vessels have arrived at the transshipment area and either the DPST or the conventional tanker is secured to the mooring buoy, the DPST will transfer oil directly to the conventional tanker. Tug support will be required during operations for mooring and hose connections (see Figure 4-31). A stand-by tug may be required to ensure safety of the terminal. The transshipment layout may, therefore, extend up to 1.2 km from the mooring buoy.



Connection between the DPST and the conventional tanker is made during daytime. The transfer of ~1 million barrel load takes ~24 hours. Automated systems and continuous visual watch are used to identify potential disconnection during transfer, including during night with proper lighting.

Conventional tankers will be owned/operated by others and will not be dedicated to the Project, but must comply with international design requirements, such as a double-hulled design. Conventional tankers calling the terminal will be approved by TotalEnergies Vetting department.

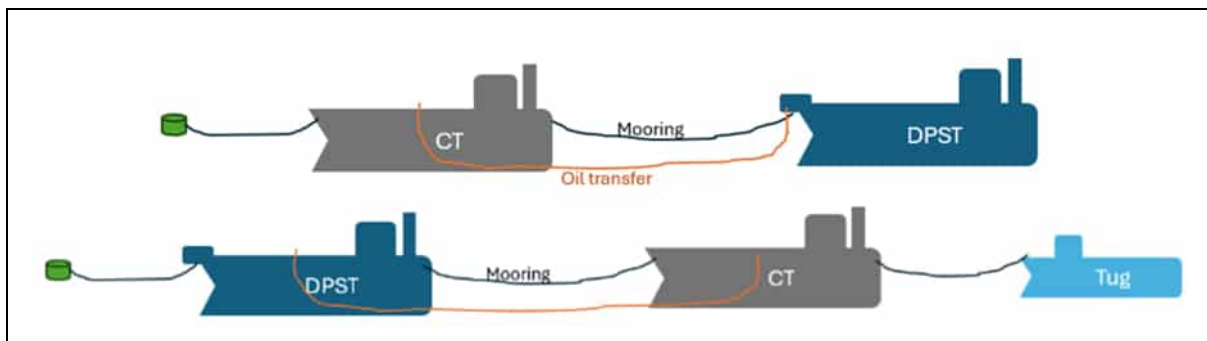


Figure 4-31: Possible configurations for transfer from DPST to CT.

Source: TotalEnergies

4.4.3 Resource Requirements

4.4.3.1 Personnel

The production phase is estimated to generate some 600 direct jobs:

- Maximum FPSO crew capacity of 160.
- Crew on support vessels, including DPST.
- Onshore support.

The majority of the workforce will comprise highly specialised skilled staff on the FPSO and support vessels.

The use of local labour will be prioritised whenever possible.

Transportation of personnel to the FPSO will be by helicopter, through an estimated 3 to 4 helicopter trips per week between the FPSO and the helicopter support base, most likely from Lüderitz.

Onshore project support staff will be either based in Windhoek and at the onshore logistics support base.

4.4.3.2 Water

During production, the FPSO will use freshwater produced onboard the FPSO via seawater desalination.

4.4.3.3 Fuel

The FPSO will be powered by a portion of the produced gas. Low sulphur (0.5%) MGO will be used for the DPST. Fuel will preferentially be obtained locally and transported to the installation vessels by the supply vessels. Estimates for the fuel use are shown in Table 4-12.



Table 4-12: Estimated fuel consumption during production.

Vessel	Fuel	Unit	Fuel usage	21 years production		31 years production	
				Vessel days or helicopter trips	Total Consumption (tonnes)	Vessel days or helicopter trips	Total Consumption (tonnes)
Supply vessels	MGO	tonnes /day	4.5 ¹	15 340 2 supply vessels shuttle	69 030	15 340 + 7 300 2 supply vessels	101 880
	MGO	tonnes /day	1	7 670 1 support vessel standby	7 670	7 670 + 3 650 1 support vessel	11 320
Maintenance Vessels	MGO	tonnes /day	50	600 1 Drilling unit	30 000	600 + 300	45 000
	MGO	tonnes /day	15	600 1 Medium construction vessel	9 000	600 + 300	13 500
DPST	Low sulphur MGO	tonnes /return trip	408 (average for 21y) 531 (average for +10y)	614 return trips	~250 512	614 + 146 return trips	328 038
Tug vessels	MGO	tonnes /day	4	1842 days 3 tugs for nearshore transshipment	7 368	1842 + 438	9 120
Helicopter	Jet A1	tonnes /return trip	1.86	4021 return trips (around 5 trips per week over the 31 year production period)	7 479	4021+2080	11348
Note: ¹ equivalent to 75% of normal consumption, as PSV at quay 25% of the time.							

4.4.4 Discharges, Emissions and Wastes

4.4.4.1 Discharges to Sea

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill related discharges would be managed by SOPEPs, that all vessel contractors will be required to have in place, and an OSCP that the Operator will be required to compile and share with government prior to activities. Onshore licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of production operations.

Anticipated sources of discharges to sea are summarised in Table 4-13.



Table 4-13: Estimated sources of anticipated discharges to sea

Discharge stream	Source	Discharge criteria
Produced water	Project generates very little produced water as the resource has a low water content. A low produced water rate of approximately 10 000 barrel/day is expected. Contains oil and grease and residual production and water treatment chemicals Discharged at increased temperature of 45°C at point of discharge.	Released 15 m below the surface. Treated to a hydrocarbon content of less than 15 mg/L (TPH, Total Petroleum Hydrocarbon) IFC guideline – temperature rise <3°C at 100 m from discharge point.
Hydraulic fluid (water soluble and low toxicity)	Control system process and subsea system.	None.
Oily water from vessel machinery spaces	As per Table 4-10.	As per Table 4-10.
Deck drainage	As per Table 4-10.	As per Table 4-10.
Cooling water	Seawater will be used for cooling. Seawater will be discharged after heat exchange with the cooling medium closed-loop. Process hydrocarbon fluids will not come into contact with this seawater.	IFC guideline – temperature rise <3°C at 100 m from discharge point.
Brine	Seawater is desalinated on the FPSO and for fresh water and other purposes. The brine stream contains high concentration of salts and other concentrated impurities that may be found in seawater.	None.
Food wastes	Food waste from the galley on the FPSO and support vessels	As per Table 4-5 Routine discharges are prohibited in the nearshore transshipment area.
Sewage and grey water	Discharges related to crew on the FPSO and other project vessels	As per Table 4-5. Routine discharges are prohibited in the nearshore transshipment area.

4.4.4.2 Noise Emissions

Dynamic positioning of production associated vessels (e.g. DPST), as well as vessel engines, are the key noise sources anticipated for the production phase. The overall noise level when dynamic positioning is operating on the DPST during offloading and transshipment operations is approximately 196 dB re 1 µPa @ 1 m. Underwater noise generated by the dynamic positioning systems of port tugs, used to position the DPST and conventional tanker during nearshore transshipment operations, is modelled to be 196 dB re 1 µPa @ 1 m.



4.4.4.3 Air Emissions

The principal sources of emissions to air from production and operations activities will be from:

- Fuel combustion (see Section 4.4.3.3).
- Power generation using natural gas from the reservoir. It is estimated that 116.3 Bcf of gas will be used for power generation on the FPSO during the 21-year production period, with an additional 49.8 Bcf during the possible 10-year extension.
- Emergency / abnormal operations flaring during process upsets and maintenance operations (routine operational flaring is not permitted). It is estimated that 17.1 Bcf of gas will be flared (no-routine) on the FPSO during the 21-year production period, with an additional 8.2 Bcf during the possible 10-year extension.
- Fugitive emissions discharges.

Emissions from visiting conventional tankers are outside the scope of direct air emissions resulting from the proposed project (i.e. Scope 1 and 2) as these vessels are not owned or controlled by the Operator.

4.4.4.4 Light Emissions

Operational lighting will be required on the FPSO and support vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

4.4.4.5 Waste Management

Notes in Section 4.2.7.5 also refer. Waste types and management expected during production are summarised in Table 4-14.

Table 4-14: Waste types and management associated with production.

Source	Hazardous / non-hazardous	Waste type	Waste generation rate (kg/year)	Total waste generated (t)	
				21 years	10-year extension
FPSO	Non-hazardous	Glass	606	13	6
FPSO	Non-hazardous	Metals	26 978	567	270
FPSO	Non-hazardous	Mixed waste	88 319	1 855	883
PSV, DPST & Tugs	Non-hazardous	Food	2 594	54	26
PSV, DPST & Tugs	Non-hazardous	Plastics	43 241	908	432
PSV, DPST & Tugs	Non-hazardous	Mixed waste	191 429	4 020	1 914
PSV, DPST & Tugs	Non-hazardous	Wood	1 731	36	17
Sub-total				7 453	3 549
FPSO	Hazardous	Batteries	513	11	5
FPSO	Hazardous	WEEE	447	9	4
FPSO	Hazardous	Fluorescent tubes	1 709	36	17
FPSO	Hazardous	Glass	1 166	24	12
FPSO	Hazardous	Liquid	28 963	608	290



Source	Hazardous / non-hazardous	Waste type	Waste generation rate (kg/year)	Total waste generated (t)	
				21 years	10-year extension
FPSO	Hazardous	Medical waste	322	7	3
FPSO	Hazardous	Metals	1 691	36	17
FPSO	Hazardous	Explosives	6	0.1	0.1
FPSO	Hazardous	Plastics	8 225	173	82
FPSO	Hazardous	Radioactive waste	40 000	840	400
FPSO	Hazardous	Mixed waste	21 834	459	218
PSV, DPST & Tugs	Hazardous	WEEE	1 531	32	15
PSV, DPST & Tugs	Hazardous	Mixed waste	30 629	643	306
PSV, DPST & Tugs	Hazardous	Metals	2 297	48	23
PSV, DPST & Tugs	Hazardous	Waste oil	3 829	80	38
Sub-total				3 006	1 432
Total				10 459	4 981

4.4.5 Emergency Prevention and Response

Flowline leaks are very rare, with an annual frequency of average pipeline failure of 0.00042 failures per km-year in 2012, a slight decrease from 0.00049 failures per km-year in 2001 (PARLOC, 2001, 2012, 2015) cited in (Kenny S. , 2018)³⁸.

Failures are most likely during and shortly after pipeline construction and installation (where the cause may be attributed to inherent defects, errors, and omissions that are generally identifiable, and for the most part, preventable) and at the end of life period (due to fatigue) (see Figure 4-32) (Kenny S. , 2018).

The major hazards for offshore pipelines include corrosion failure (e.g., internal, external - ~50% for pipelines in the Gulf of Mexico), mechanical damage (e.g., trawl gear, anchors, dropped objects - ~15%), construction and material failure (e.g., weld, fitting, clamp - ~10%), natural hazards (e.g., wave, geotechnical – 10%), and other unknown factors (Kenny S. , 2018).

The Venus offshore project area has a relatively short combined flowline and riser network of ~125 km, located at a depth of ~3 000 m. As such, the water column exerts a hydrostatic pressure of ~300 bar at the seabed.

The hydrostatic pressure at the seabed exceeds the internal operating pressure of the flowline and in the event of an **oil flowline leak** the seawater would push into the flowline rather than the oil flowing out provided the wells can be shutdown at Xmas tree. As such, the risk of sustained oil loss due to oil pipeline rupture is extremely low.

³⁸ According to the UK Health and Safety Executive (HSE UK, 2011) there were about 1 978 incidents involving offshore hydrocarbon releases between 2001 and 2011 in the UK continental shelf (Aljaroudi, 2015), which has an offshore pipeline network of ~15 000 km (Gordon & Paterson, 2020).

As per the US Pipeline & Hazardous Materials Safety Administration (PHMSA, 2014), there were about 306 offshore pipeline incidents in the U.S in the past 10 years, of which 71 involved hydrocarbon releases (Aljaroudi, 2015), for an offshore pipeline network of ~45 000 km in the Gulf of Mexico (Kenny S. , 2018).



Gas, however, is compressed (injected) at pressure that exceeds the hydrostatic pressure, and the rupture of a **gas injection flowline** would mean that the pressure of gas in the pipeline exceeds the hydrostatic pressure of the water column and that gas escapes. The associated gas loss could amount up to 267 000 m³ before the compressors on the FPSO are shut down (within 30 minutes).

As detailed in Section 4.4.1, the FPSO production operations will be monitored and controlled through an ICSS. The ICSS will include process shutdown, emergency shutdown, and fire and gas systems to protect the facilities and personnel. Amongst other functions, the SIS will implement functions for emergency shutdown, fire and gas detection, and process shutdown for FPSO and subsea systems. The SIS will provide detection, logic sequencing, and actuation of devices to place the facility in a safe state.

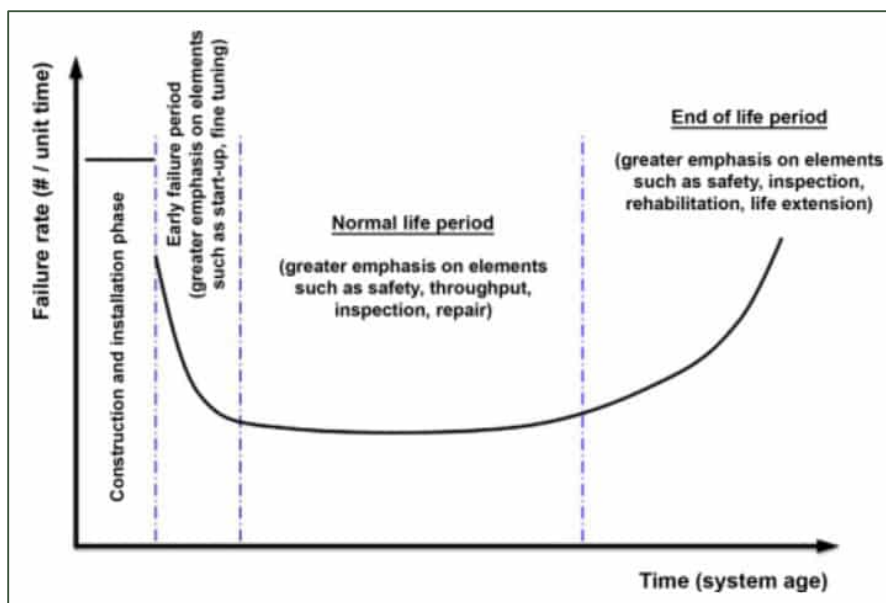


Figure 4-32: Pipeline system failure rates over time.

Source: (Kenny S. , 2018)

4.5 Decommissioning

4.5.1 Overall Decommissioning Approach

The project facilities will be decommissioned at the end of the Venus field life, which is expected to range from 21 to 31 years, depending on whether or not production is extended by an additional 10 years. Any extension will necessitate a full asset integrity review including equipment design and maintenance strategy.

The Asset Retirement Obligation (ARO) entails the legal and financial responsibility for companies to decommission and restore the site, in accordance with the legal requirements of Namibia. Companies must recognize and account for these obligations in their financial statements where applicable.

Under Part XA, Sections 68A–68E of the Petroleum (Exploration and Production) Act, 1991, the operator is legally required to prepare and submit a decommissioning plan as part of their production licence application. This plan must outline how offshore facilities will be dismantled, removed or repurposed at the end of production.

Decommissioning planning is in the early conceptual phase where preliminary estimates and plans are made to inform initial budgets and assess feasibility. In this regard, a Conceptual



Decommissioning and Closure Strategy has been compiled as part of the ESIA (see Appendix S). While this strategy is conceptual in nature, it establishes a solid foundation for future detailed planning. It will be refined and updated as new data becomes available during the operational phase, including outcomes from a Net Environmental Benefit Analysis (NEBA), which will determine final outcome with respect to the removal of certain infrastructure and equipment from the seabed, stakeholder engagement and ongoing research within the industry.

At present, it is anticipated that that decommissioning will involve the following aspects, though these will be developed further at a later stage:

- Flush and clean subsea network from FPSO.
- Isolate FPSO from subsea network and gas free the FPSO.
- Disconnect risers and umbilicals from the FPSO.
- Disconnect the FPSO from the mooring system, recover top chains and mooring lines. Bottom chain and mooring piles may remain in the seabed to limit soil disturbance and GHG linked to the pile removal operation.
- FPSO is then towed to an approved recycling facility for cleaning and recycling if it cannot be re-used, in line with the IMO Hong Kong Convention³⁹ and applicable regulations for transboundary waste transfer, ensuring that the FPSO will be recycled by facilities that are compliant with the IMO Convention standards and EU Regulations standards. This includes the requirement to use only approved recycling facilities that possess an approved Ship Recycling Facility Plan (SRFP) to ensure that ships are recycled in a safe and environmentally sound manner and all products from the dismantling are properly managed (recycled or treated).
- The decommissioning of underwater / seabed installations including risers, flowline and ILT/FLET, jumpers, Xmas-tree, umbilicals shall be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed with mitigation measures.
- Plug and abandonment of development wells following standard procedures. Typical abandonment activities include displacing the well with inhibited fluids (to prevent tubular metal corrosion) and isolating all the zones of interest (formations containing fluids) from the surface. Cement plugs will be used to isolate the wells. The plugs will be designed to withstand the conditions generated by the geological formations. All cement plugs will be pressure / weight tested. Wellheads will not be recovered as they are located in water depths of more than 500 m (in line with the Operator's internal standards) and outside of areas targeted by the demersal trawl sector. It is currently anticipated that it will require approximately 14 days of drillship time to complete the decommissioning process for each well.
- Removal of the nearshore transshipment buoy.

Nambian law also mandates the establishment of financial provisions, such as trust funds, to ensure that decommissioning costs are covered, protecting the state from future liabilities. License holders are required to establish such a decommissioning trust fund once 50% of the estimated recoverable reserves in a production area have been extracted.

³⁹ The 2009 IMO Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, commonly known as the Hong Kong Convention, is an international treaty that sets standards for the recycling of ships, including FPSO units, and requires *inter alia* removing hydrocarbons and other hazardous materials from the FPSO and ensuring that the recycling process follows the safety and environmental standards set by the convention. The convention will enter into force on 26 June 2025 following its ratification by the required number of countries.



4.5.2 Resource Requirements

4.5.2.1 Personnel

During this phase, the majority of the workforce will comprise highly specialised skilled staff on the installation and support vessels. At peak, it is estimated that up to 650 personnel will be working offshore at the same time over 1.5 years decommissioning period. Onshore logistics will be provided from Lüderitz and Walvis Bay.

4.5.2.2 Water

Most vessels involved in the installation activities will assure their own freshwater supply produced directly offshore (via desalination). Smaller vessels may need to source freshwater from shore.

4.5.2.3 Fuel

Low sulphur (0.5%) MGO will be used as fuel for all vessels. Jet-A1 fuel will be used for helicopters. Estimates for the fuel use during installation and commissioning phase are presented in Table 4-15.

Table 4-15: Estimated fuel consumption for decommissioning.

Vessel	Fuel	Fuel usage	Vessel days or helicopter trips	Total consumption (tonnes)
Drilling unit (x1)	MGO	50 tonnes/day	545 days	27 250
Tug vessels (x4)	MGO	35 tonnes/day	120 days	4 200
Heavy construction vessel (x1)	MGO	22.5 tonnes/day	360 days	8 100
Medium construction vessel (x1)	MGO	15 tonnes/day o	360 days	5 400
Supply vessels for rig support (2x <i>supply vessels</i> + 1x <i>standby vessel</i>)	MGO	6 tonnes/day	1 635 days	9 810
Supply vessels for construction vessel support (2x <i>supply vessels</i>)	MGO	6 tonnes/day	720 days	4 320
Helicopter	Jet A1	1.86 tonnes/trip	trips	1 548

4.5.3 Discharges, Emissions and Wastes

4.5.3.1 Discharges to Sea

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. In the unlikely event of a spill, it would be managed by SOPEPs, that all vessel contractors will be required to have in place, and an OSCP that the Operator will be required to compile and share with government prior to activity. Anticipated sources of discharges to sea from vessels are as summarised in Table 4-5.



4.5.3.2 Noise Emissions

The key sources of underwater noise during decommissioning include dynamic positioning of drilling unit, construction vessels, support vessels and tugs (refer to Sections 4.2.7.2 and 4.3.7.2).

4.5.3.3 Light Emissions

Operational lighting will be required on the vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

4.5.3.4 Waste Management

Final waste disposal will be determined by the NEBA and the final Decommissioning and Closure Plan. Onshore licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of decommissioning operations.

4.6 Project Financing

Each JV partner has specific economic criteria to be met to support FID. The capital expenditure (CAPEX), ahead of first oil, will be financed by the paying partners.

Carried partners will not finance any CAPEX upfront but will finance their shares from future revenues from the development once they accrue.

The applicable tax regime in Namibia will provide tax revenues to the government.

4.7 Project Alternatives

“Alternatives” to a proposed activity are generally defined as feasible and reasonable different means of meeting the general purpose and requirements of the activity (namely the Venus Development Project), which may include activity, site, design or layout or technology alternatives. The ‘No-Go’ or ‘No Project’ alternative has also been considered. Not all categories of alternatives are applicable to all projects.

The consideration of alternatives is also inherent in the development of the project design and the identification of mitigation measures. Numerous alternatives were identified and considered during the early feasibility and design screening phases of the project. Several of these alternatives were not considered viable options by the proponent for reasons summarised in Table 4-16. Alternatives that are considered viable and assessed in the ESIA are also indicated.

Table 4-16: Summary of key project alternatives considered to date

Aspect	Alternative	Consideration in ESIA	Key reason for screening out
Activity alternatives			
Resource	Production of oil	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events)	n/a
	Production of gas	Screened out during the early development feasibility studies (see Section 4.1.5)	The re-injection of the associated gas is essential to enhance the oil production. Water injection was also studied as an alternative for oil recovery, but screened out due to likelihood of not achieving adequate level of injectivity due to low permeability reservoir.



Aspect	Alternative	Consideration in ESIA	Key reason for screening out
No-Go alternative	Option of not proceeding with project, i.e. status quo as described in the baseline	Assessed in Section 10.4	n/a
Operational alternatives			
Management of associated gas	Reinjection of associated gas	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events)	n/a
	Flaring of associated gas	Screened out during project design	Not considered an environmentally acceptable option and not in line with the Global Flaring and Methane Reduction Partnership (GFMR) and TotalEnergies policies for new developments.
Oil transfer between FPSO and conventional tanker	Offshore	Screened out during project design	Discarded for metocean and safety reasons, as standard offloading in tandem or using an offloading buoy in the field will not provide sufficiently safe operation with harsh environmental conditions. <u>The DPST (i.e. transshipment vessel) is a specialized tanker fitted with Dynamic Positioning (DP) and bow loading system. The worldwide fleet of such specialized vessel is, however, very limited. Therefore, they cannot be used for international export of the crude oil. Thus, a conventional tanker (without DP nor bow loading) will be used. Conventional tankers are not fitted with DP systems and need to connect the export hose to their midship manifold. This operation requires intervention of personnel in support vessels to transfer the hose using a standard manifold crane, which is not designed for offshore operations. These vessels are thus not suitable for offshore operations in semi-harsh environments without inducing high safety concerns for the crew involved. The proposed method of transfer is safer as it reduces the risk of a conventional tanker collision with FPSO due to bad weather conditions, for example.</u>
	Offshore and nearshore - described in Section 4.4.2	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events)	n/a



Aspect	Alternative	Consideration in ESIA	Key reason for screening out
	Onshore	Screened out during project design	Deemed to have a higher environmental footprint in a more sensitive nearshore area, and anticipated project lifetime considered short for permanent onshore facility.
Nearshore oil transfer approach	With Floating Storage and Offloading (FSO) unit	Screened out during project design	Would require permanent vessel with limited operation time.
	Without FSO - described in Section 4.4.2	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events)	n/a
Site or location alternatives			
Well locations	Currently anticipated locations are shown in Figure 4-1 and will continue to be refined during technical modelling	Representative layout is assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events) Since this is preliminary layout and may be adjusted slightly during final design, the ESIA assesses generic (representative or reasonable worst-case) locations within the Venus offshore project area.	n/a
Nearshore transshipment location	Northern area (in the Walvis Bay region)	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events) The ESIA assumed the mooring buoy could be located anywhere within the nearshore transshipment location area (see Figure 4-28 and Figure 4-29)	n/a
	Southern area (in the wider Lüderitz region)	Screened out during Scoping Phase	The metocean conditions at possible southern locations were not suitable for transshipment operations. Additionally, the location overlapped with a protected area (NIMPA) and was deemed more sensitive than the northern alternative. <u>Furthermore, the proposed location is close to Walvis Bay oil terminal where it can benefit from existing safety and clean-up response in the event of an unlikely, accidental spill.</u> <u>Overall, the selected location was assessed to be the most suitable by TEEPNA, considering the metocean conditions and vessel limitations, in which these operations can take place with</u>



Aspect	Alternative	Consideration in ESIA	Key reason for screening out
			<u>several location alternatives being assessed across the Namibian coastline.</u>
Design or technology alternatives			
FPSO capacity	160 kbopd / 550 MMscfd / 2Mbo storage	Assessed in Chapter 7.0 (normal operations) and 8.0 (unplanned events)	n/a
	Higher or lower capacity	Screened out during initial project design	Base case of 160 Mbod was determined based on various liquids and gas production handling capacity configurations, reservoir studies and ongoing modelling work
Anchoring of FPSO	Suction pile anchor (see Section 4.3.3.2)	Assessed in Chapter 7.0 (normal operations)	n/a
	Suction Embedded Plate Anchor (see Section 4.3.3.2)	Assessed in Chapter 7.0 (normal operations)	n/a
	Other anchoring methods (e.g. anchor piles, vertical load anchor)	Screened out during feasibility study	Not deemed the most effective or least impact method
Treated drill cuttings disposal methods	Disposal at sea	Assessed in Chapter 7.0 (normal operations)	n/a
	Disposal onshore	Screened out during project design	For onshore disposal, the treated drill cuttings will need to be transferred to shore by PSV. Considering the distance (approx. 300 km) between the Venus offshore project area and shore, this would result in additional fuel usage and create additional emissions. This would also result in additional pressure on existing waste facilities. Moreover, once onshore, further transportation may be required to reach the waste facility. Hence, not only does this option leads to additional emissions, but it also creates additional safety risk related to the handling of the cuttings.
Well abandonment	Leave wellheads in place	Assessed in Chapter 7.0 (normal operations)	n/a
	Remove wellheads from seafloor	Screened out during project design	Standard practice for deep-water wells. Given water depth in Venus offshore project area and lack of demersal fishing in the area, no impact is expected on these sectors



Aspect	Alternative	Consideration in ESIA	Key reason for screening out
FPSO power source	Gas-powered (using a portion of the produced gas prior to re-injection)	Assessed in Chapter 7.0 (normal operations)	n/a
	Renewable sources	Screened out during project design	Power from renewable sources or via connection to the shore are not feasible due to total power requirement, need for reliable power supply, distance to shore and the lack of existing infrastructure. Gas turbine generators are the most feasible solution given their relative low footprint and weight and readily available gas from the production stream.
FPSO power generation equipment	Open Cycle Gas Turbine (OCGT) with Waste Heat Recovery Unit (WHRU)	Assessed in Chapter 7.0 (normal operations)	n/a
	Combined Cycle Gas Turbine (CCGT)	Screened out during project design	CCGT requires more equipment that needs space and adds weight to the FPSO, considerably raising operational costs. OCTG with WHRU is a much more space, weight and cost-effective solution.





5.0 Description of the Receiving Environment

This chapter provides a description of the attributes of the physical, biological, socio-economic and cultural receiving environments of the project areas (namely the Venus offshore project area and the nearshore transshipment area) and the surrounding region. The Venus offshore project area, within PEL0056/PEL0056/Block 2913B, is located off the southern coast of Namibia in water depths of ~3 000 m (see Figure 1-1), while the nearshore transshipment area is located ~20 km north of Walvis Bay, ~5 km from the coast located, in waters less than 40 m deep (see Figure 4-28).

An understanding of the environmental and social context and sensitivity within which the proposed activities would be located is important to understanding the potential impacts. The descriptions of the physical and biological environments along the southern and central Namibian coast primarily cover the offshore and coastal area from Walvis Bay (in the proximity of the nearshore transshipment area) in the north to the Orange River mouth in the south, although where appropriate reference is made to the entire Namibian coastline.

5.1 Area of Influence

The area of influence of the proposed project activities defines the spatial extent of the baseline information and can be separated into the area of influence for planned operations and for unplanned events, as summarised below:

- **The area of influence (planned operations)** includes:
 - o PEL0056/Block 2913B, specifically the area of the Venus offshore project area (see Figure 1-1), within which production activities will take place, including all production and injection wells, SPS, SURF and the FPSO mooring area;
 - o The nearshore transshipment area, ~20 km north of Walvis Bay, where oil will be offloaded from the DPST to a conventional tanker;
 - o The Port of Lüderitz and Walvis Bay where onshore support activities will be located;
 - o Marine traffic routes between Lüderitz / Walvis Bay and the Venus offshore project area;
 - o Airspace between airport (at Lüderitz / Oranjemund) and the Venus offshore project area for helicopter-based crew changes;
 - o Areas (or zones of impact) where marine resources, such as commercial fishing stocks and marine mammals, may be affected by the proposed activities, e.g. due to underwater noise, safety exclusion zones, etc.; and
 - o Coastal communities in the broader //Kharas Region and Erongo Region, potentially impacted (socio-economically) by the proposed activities.
- **The extended area of influence in the case of any unplanned events occurring** is based on the oil spill modelling results and may include areas that could be affected by such unlikely events.

5.2 Previous Offshore Environmental and Geophysical Surveys

Various offshore environmental and geophysical surveys have been undertaken by TEEPNA which have increased the understanding of the receiving environment within the Venus offshore project area. The results from these surveys have been used to inform the baseline description below.



5.2.1 Environmental Surveys

Various offshore environmental surveys (called Environmental Baseline Surveys, EBS) have been undertaken by the JV, in partnership with Benthic Solutions Limited (BSL), in PEL0056/Block 2913B since 2018 (see Figure 5-1 and Table 5-1). The objectives of these surveys were to characterize the baseline conditions for future measurement of trends, describe the benthic habitats and epifauna present, and highlight any sensitive habitats and/or species within a well site or larger the area before any operations (BSL, 2019a; 2023a; 2023b). For the Venus-1X area, the area of the first well drilling campaign within PEL0056/Block 2913B, an Environmental Post Operation Survey (EPOS) was also performed a few months after the completion of well drilling in early March 2022.

Table 5-1: Summary of the Environmental Surveys undertaken in PEL0056/Block 2913B.

Environmental Surveys	Survey Period	Sampled Well	Sampling Conducted
2018 Venus-1X EBS	23 Oct – 5 Nov 2018	Venus-1X Proposed Well Location (PWL)	Seabed (n = 8) Water (n = 2) Seabed Footage (n = 6)
2022 Venus-1A EBS	26 Jul - 9 Aug 2022	Venus-1A PWL	Seabed (n = 20) Water (n = 2) Seabed footage (n = 1)
2022 Block 2913B EBS	7 - 30 Sep 2022	-	Seabed (n = 46) Water (n = 5) Seabed Footage (n = 9)
2022 Venus-1X EPOS	20, 21, 29 Sep 2022	Venus-1X Final Well Location (FWL)	Seabed (n = 8) Water (n = 1) Seabed Footage (n = 2)

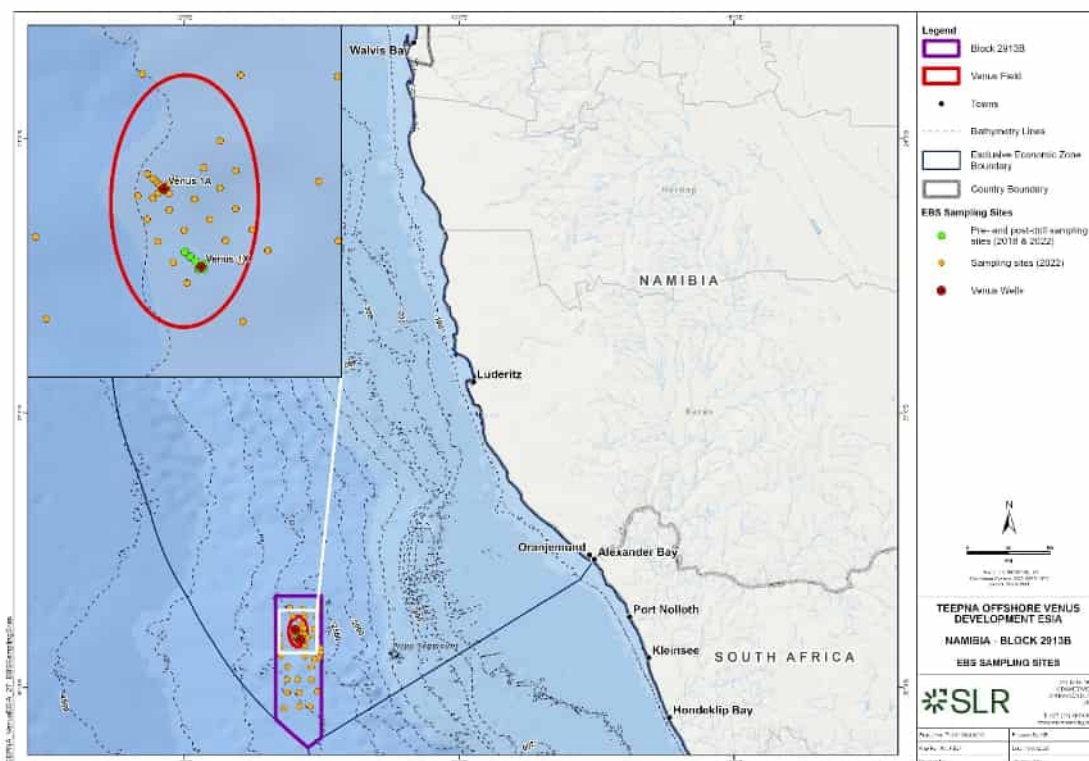


Figure 5-1: Environmental surveys sampling locations, 2018- 2022.

Source: (BSL, 2019a; 2023a; 2023b)



5.2.1.1 Environmental Baseline Surveys

Three EBS have been undertaken within PEL0056/Block 2913B:

- The first EBS was conducted at the Venus-1X well site (Proposed Well Location, PWL) between 23 October to 5 November 2018. The survey comprised seabed sampling at eight sampling stations, and water column sampling and profiling at two sampling stations. The stations followed a cruciform survey design around the Venus-1X well site out to 500 m, with additional sampling sites located 1 km, 2 km and 3 km downstream along the surface Benguela Current (BSL, 2019a).
- The EBS for Venus-1A PWL area was conducted between 26 July and 9 August 2022. Seabed sampling was undertaken at 20 sampling stations at the Venus-1A PWL area, located around 15 km north-west of the Venus-1X well location. Seabed footage was obtained at one station and seawater sampling was undertaken at two stations from three depths (near seabed, mid-water and surface) (BSL, 2023a).
- The EBS for PEL0056/Block 2913B, with denser sampling in the Venus offshore project area, was undertaken between 7 and 30 September 2022. Forty-six seabed stations were sampled across the Block with video footage obtained at nine stations and seawater sampling taking place at five stations (BSL, 2023a).

5.2.1.2 Post-drill Survey or EPOS

The EPOS for the Venus-1X well was carried during the overall PEL0056/Block 2913B EBS with eight dedicated seabed stations near to the 2018 sampled locations (see Section 5.2.1.1), one water station and two video footages around seven months after well completion. Findings showed there were negligible changes in the initial characteristics and no notable impact on the macrofaunal community post drilling (BSL, 2023b).

5.2.2 Geophysical surveys

In 2024, TEEPNA conducted geophysical surveys over the entire Venus offshore project area within PEL0056/Block 2913B. The objectives of these surveys were to (1) measure water depth variations and slope changes across the entire study area; (2) investigate seabed morphology, composition, and underlying lithology in relation to local geology; (3) identify any natural or man-made seabed or buried obstructions such as rock outcrops, escarpments, canyons, channels, reefs, depressions, debris, wrecks, industrial structures, pipelines and cables; and (4) evaluate potential shallow geohazards, such as slope failures, faults, hardgrounds and shallow gas within the top 50 m below the seabed.

This section provides a summary of this geophysical survey report.

5.2.2.1 Survey Area and Techniques

The survey area, which was divided into two areas, was 720 km² in extent (see Figure 5-2 for survey area in relation to the indicative subsea infrastructure layout). Each of these areas was targeted using a suite of geophysical techniques to ensure full spatial coverage and data quality across the zones.



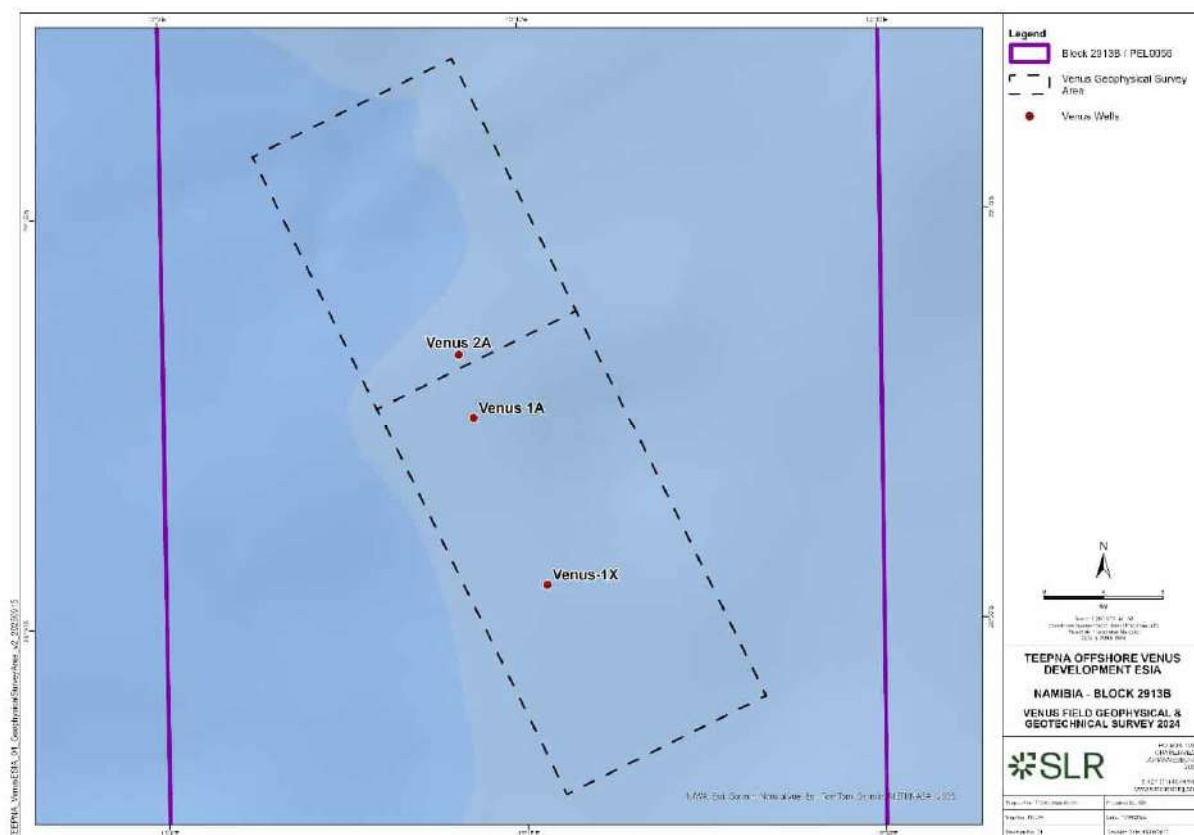


Figure 5-2: Location of the geophysical survey covering the Venus offshore project area.

5.2.2.2 Survey Results

Water depth

The study area is located on the **lower continental shelf** with water depths varying between 2 828 m in the east and 3 114 m in the west. There is thus a **286 m change in water depth** across the survey area over a distance of approximately 20 km.

Seafloor gradient

Slope gradients are typically very low, typically $<10^\circ$ except for the side slopes of the valley (and adjacent ridges) which tend to be around 20° (see Figure 5-3 and Figure 5-4).

Seafloor Features

The survey area is **typically homogenous, devoid of features** as it consists of a smooth seabed. **No colony forming corals and structural features (e.g., rocky outcrops) were identified in the Venus offshore project area during these geophysical surveys.** The seabed comprises very soft clay with small, isolated areas of darker texture, interpreted as being silt. Deposits from previously drill wells form distinctive high intensity areas radiating from the well sites. **Dominant scarps where seabed gradient exceed 5° up to 20° occur on the flanks of the ridges**, but typically slopes are less than 1° to the west (see Figure 5-5).



Small slumps occur along the valley/ridge margins. **Isolated depressions are scattered across southern survey area** with the highest concentration in the mid-western section (see Figure 5-6). These depressions are typically 40 m in diameter and 1 m deep showing an average gradient of 3°.

A magnetometer was utilised to locate the in-service **SAT-3 telecommunication cable**, which trends in an NNW-SSE direction across the western margin of the survey area (see Figure 5-7A). Examples of other objects identified on the seafloor are presented in Figure 5-7B-D.

Shallow Geology

The shallow geology is similar across the study area and is summarized as:

- Upper section - Well-layered hemipelagic⁴⁰ sediments ranging in thickness from 3 m over the scarp areas to a maximum of 40 m. This unit is interpreted to consist of alternating flat lying **very soft clay and silt layers** which overlies Unit 2 (lower section).
- Lower section – More consolidated sediments interpreted to compose a massive sequence of mixed soft to firm **clay/silt** and subordinate **sand**.

Hazards

Although there are also no significant geohazards associated with the survey areas, potential hazards include:

- **Small (<100 m) slumps** occur on the valley/ridge side margins.
- **Turbidite flows**⁴¹ travelling down the channel/valley floor.

Small faults may be associated with the ridge/valley sides, but no displacement is noted at the seabed. Small mounds and depressions may be associated with fluid escape, but no active features were noted.

⁴⁰ Hemipelagic sediments are deep-sea muds rich in both land-derived (terrigenous) clay and silt, and biogenic (organism-derived) material like microscopic shells and skeletal fragments.

⁴¹ Turbidite flows, or turbidity currents, are powerful, dense currents of sediment-laden water that move rapidly down a slope, such as the ocean floor.



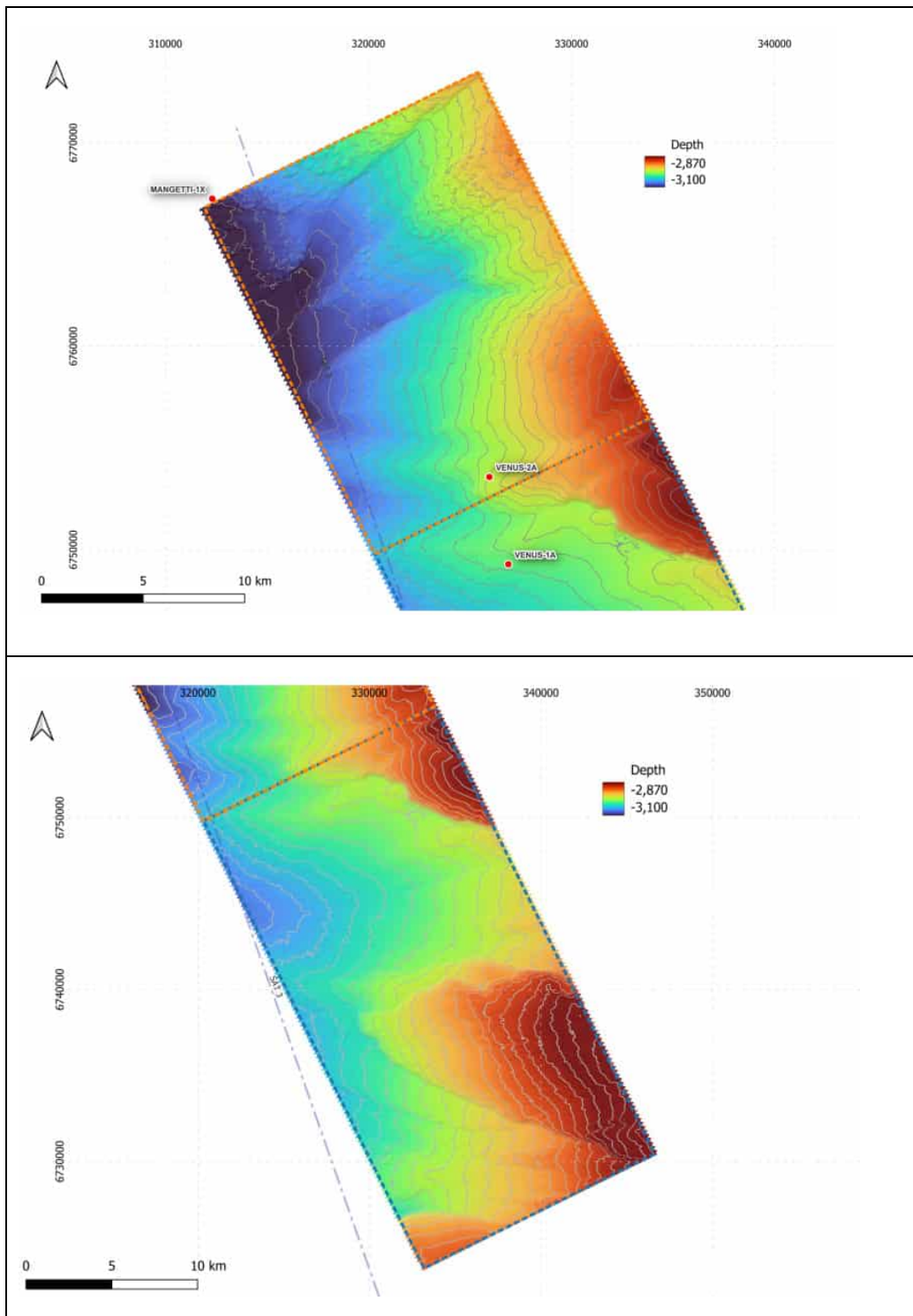


Figure 5-3: Bathymetry of the northern (top) and southern (bottom) survey areas.

Source: TEEPNA.



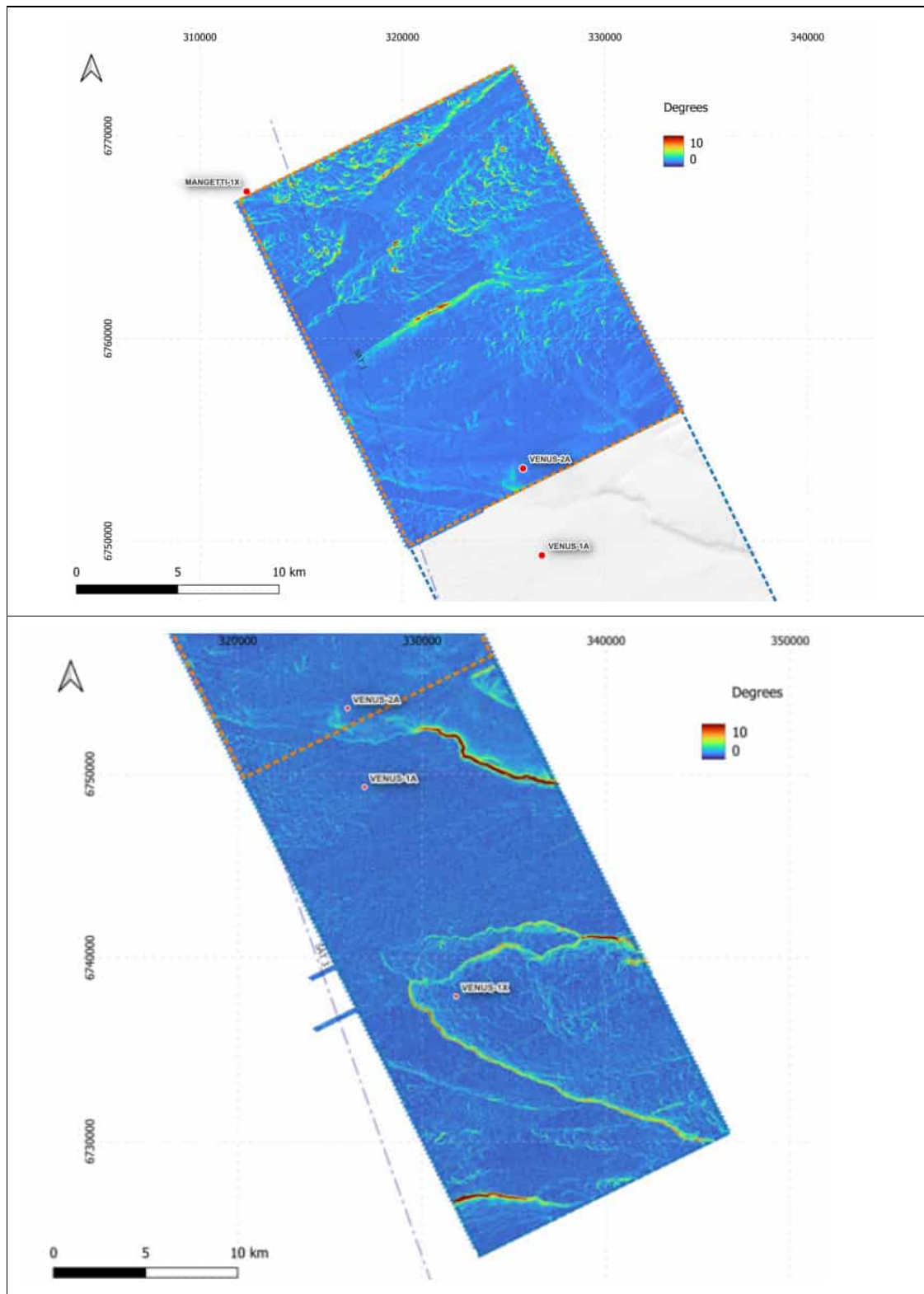


Figure 5-4: Slope gradients in the northern (top) and southern (bottom) survey areas.

Source: TEEPNA.



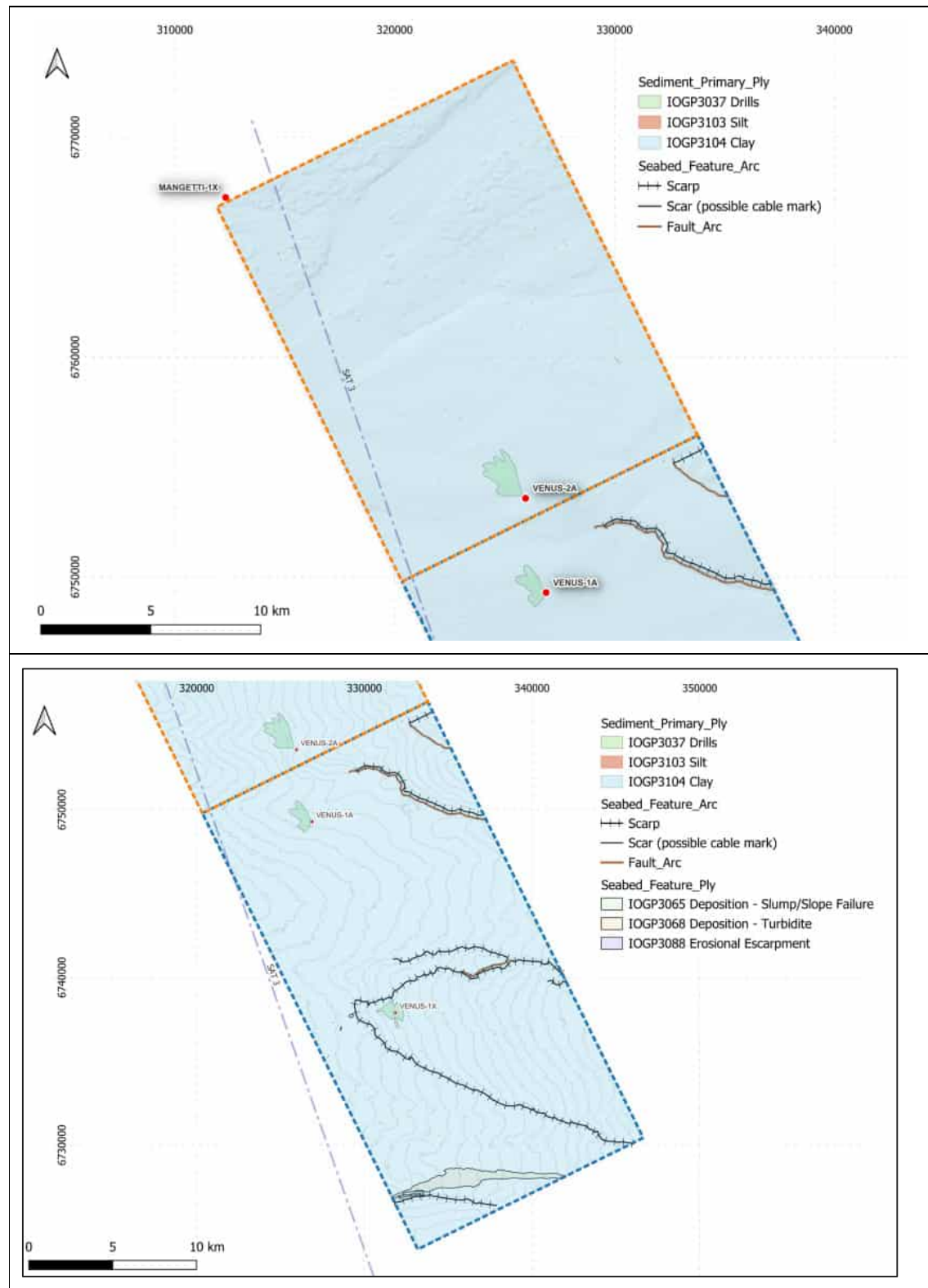


Figure 5-5: Seafloor features in the northern (top) and southern (bottom) survey areas.

Source: TEEPNA.



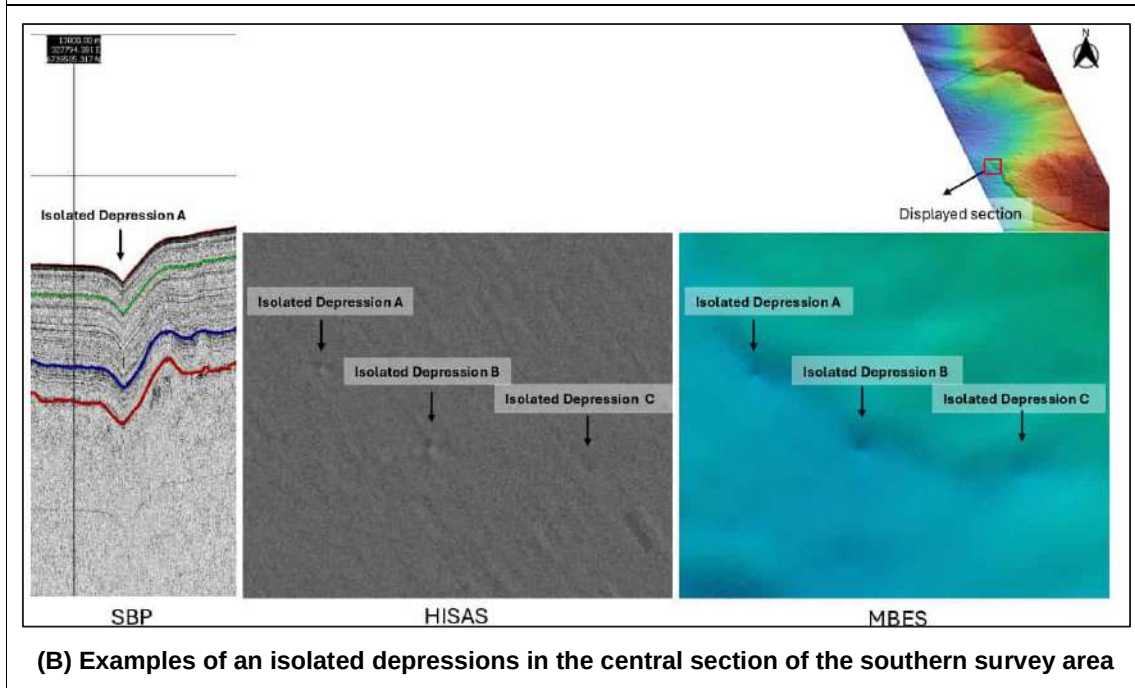
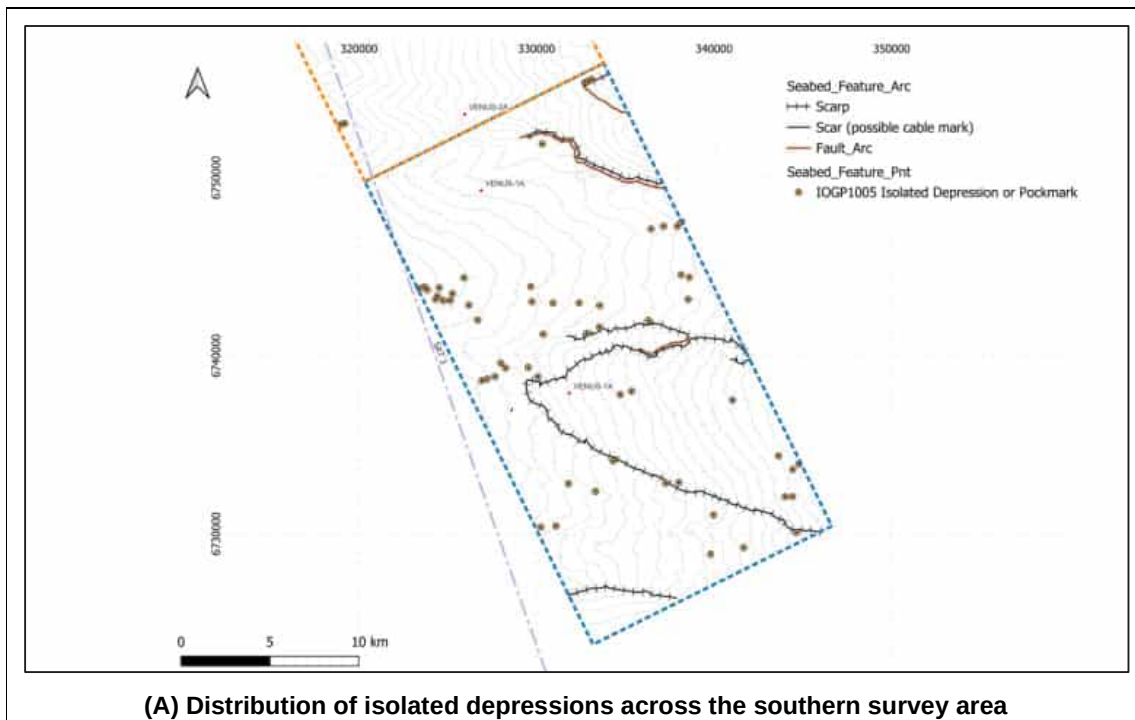


Figure 5-6: Isolated depressions across the southern survey area.

Source: TEEPNA.



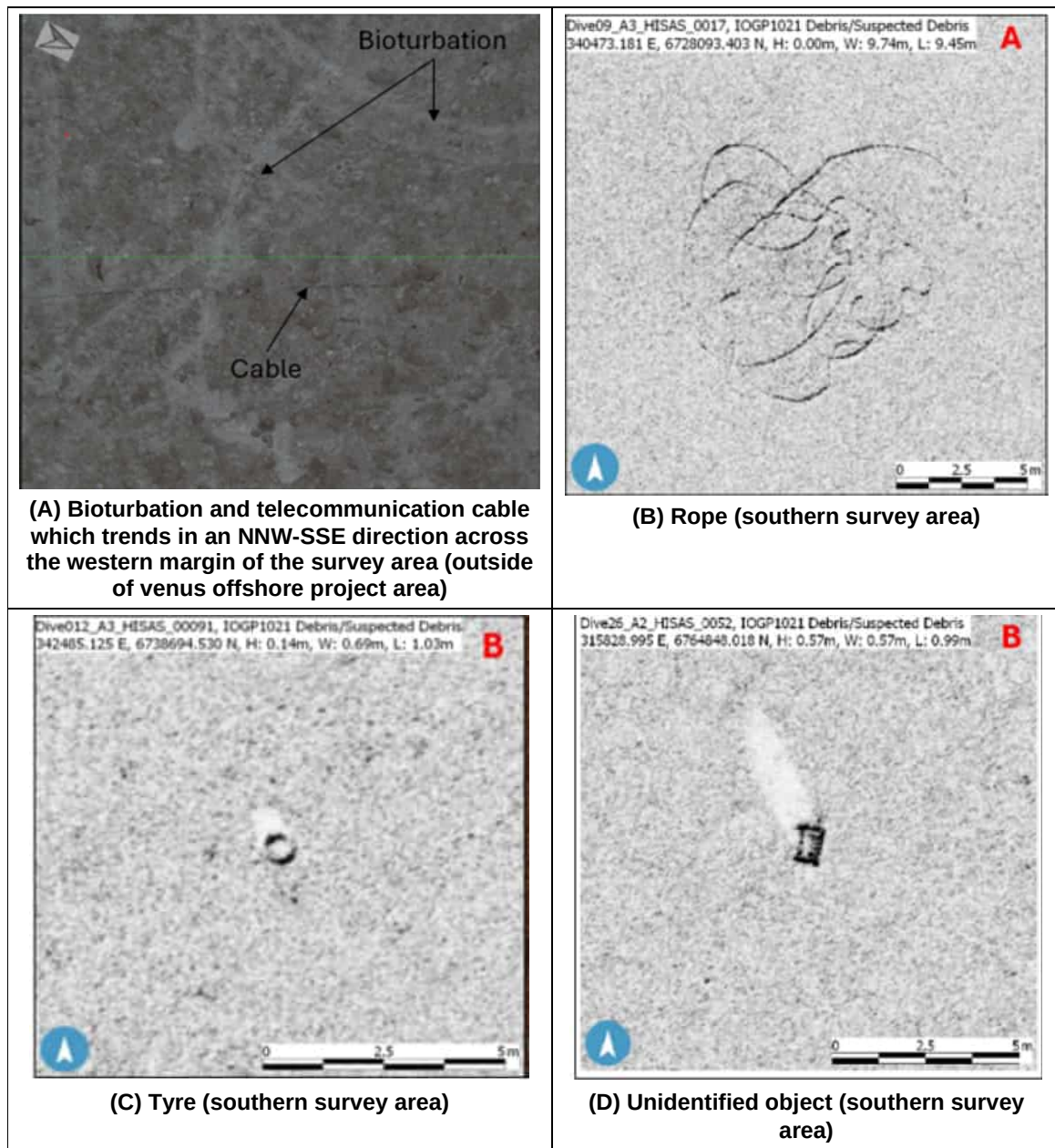


Figure 5-7: Examples of objects identified on the seafloor highlighting the clarity of the survey imagery.

Source: TEEPNA



5.3 Geophysical Characteristics

5.3.1 Bathymetry

The continental shelf along the Namibian coast varies in width and depth. Offshore of the Orange River mouth, the shelf is wide (230 km) and characterised by well-defined shelf breaks. Northwards, it reaches its narrowest point (90 km) off Chameis Bay, before widening again off Lüderitz and Walvis Bay (Rogers J. , 1977). For benthic ecosystem classifications, the continental shelf is divided into an inner shelf and an outer shelf at a depth of 150 m. The shelf edge extends to the shelf break at depths between 350 - 500 m. The inner shelf has a relatively steep gradient to approximately 100 m depth, after which the gradient decreases and undulates to depths of approximately 200 m. North of Chameis Bay, the shelf edge and break is relatively deep (400 - 450 m). The variable topography of the shelf is important for near shore circulation and for fisheries (Shannon & O'Toole, 1998). Beyond the shelf break (350 - 500 m), the slope is divided into upper and lower sections at 1 800 m, before forming the deep-sea abyss (>3 500 m) (Sink, et al., 2012; Holness, et al., 2014).

Banks along the continental shelf and within the larger offshore project area include the Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, a rounded, flat topped, sandy plateau located on the edge of the continental shelf approximately 150 km offshore in South African waters. Child's Bank rises from a depth of approximately 350 m to less than 200 m at its shallowest point and is considered a major bathymetric feature of the West Coast margin (Dingle, 1973; Birch & Rogers, 1973; De Wet, 2013).

Tripp Seamount is a geological feature situated approximately 230 km offshore of southern Namibia in water depths of 1 000 m. It is a roughly circular feature with a flat apex as shallow as 150 m deep, which drops steeply on all sides. Tripp Seamount is located approximately 85 km east of PEL0056/Block 2913B, with the Orange Bank located further inshore. Further an unnamed bathymetric feature is situated 36 km east of PEL0056/Block 2913B rising from depths of 2 000 m (see Figure 5-8).

PEL0056/Block 2913B is located along the upper slope and within the deep-sea abyss (see Figure 5-8). As noted in Section 5.2.2, the Venus offshore project area is located on the lower continental shelf with water depths varying between 2 828 m in the east and 3 114 m in the west. There is thus a depth variance of ~100 m across the project area up to max of 286 m over a distance of approximately 20 km.

The nearshore transshipment area is located in shallow waters (< 40 m deep) along the inner continental shelf, approximately 5 km from shore and 20 km north of Walvis Bay. This area lies well inshore of Tripp Seamount and other mapped seamounts, in shallower coastal waters.

5.3.2 Shelf Geology and Seabed Geomorphology

As part of the Marine Spatial Planning (MSP) process in Namibia, the marine geology of the Namibian continental shelf and geomorphic seafloor features within the EEZ were mapped (MFMR, 2021) (see Figure 5-8 and Figure 5-9). This process identified a single canyon within the block; however, this canyon was not subsequently identified by any EBS or geophysical surveys completed within the block (see Section 5.2.1). No additional geomorphic features were identified within the block.

The inner shelf is underlain by Precambrian bedrock (also referred to as Pre-Mesozoic basement), whilst outer shelf area is composed of Cretaceous and Tertiary sediments (Dingle, 1973; Birch, Rogers, Bremner, & Moir, 1976; Rogers J. , 1977; Rogers & Bremner, 1991). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water.



Within the nearshore transshipment area, situated along the inner shelf between Walvis Bay and Swakopmund, sediments are expected to consist predominantly of sand. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. A coastal zone extending up to 70 km offshore from Walvis Bay, in waters shallower than 140 m, features a band of anoxic, organic-rich sediment primarily composed of diatomaceous ooze. This deposit includes fish remains as well as both modern and older phosphorite materials (Calvert & Price, 1983). In addition, an approximately 500 km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the outer edge of the middle shelf between the Orange River and St Helena Bay in South Africa (Birch, Rogers, Bremner, & Moir, 1976; Meadows, Dingle, Rogers, & Mills, 1997; Meadows, Rogers, Lee-Thorp, Bateman, & Dingle, 2002; Herbert & Compton, 2007). These biogenic muds contribute to the formation of low-oxygen waters and sulphur eruptions off central Namibia (see Section 5.4.8). Offshore of the mud belt, the composition changes to muddy sands, sands and gravels before changing back to mud-dominated seabed beyond the 500 m contour. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Offshore environmental surveys conducted in PEL0056/Block 2913B and the Venus offshore project area (see Section 5.2.1) recorded a generally homogeneous habitat throughout the survey areas (BSL, 2019a; 2023a; 2023b). The sediments were predominantly fine-grained, with negligible gravel content both before and after drilling. Sediment samples collected during the pre-drilling EBS in the Venus offshore project area were classified into two Folk⁴² categories (namely 'sandy mud' and 'mud'):

- Overall, pre- and post-drill samples collected at the Venus-1X well site were classified as 'Sandy Mud', with seabed sediments being 'Very poorly sorted', indicating no change in the sediment properties following drilling activities.
- Pre- and post-drilling video footage recorded across the Venus-1X PWL survey area revealed evidence of bioturbation (i.e. disturbance of sedimentary deposits by living organisms) with evidence of mounds and feeding depressions and spirals, although no discernible species could be identified (see Figure 5-10).
- The Total Organic Carbon (TOC) content of the sediments was consistent between pre- and post-drill surveys. TOC levels were comparatively low, suggesting an organically deprived environment in which the carbon flux from near surface productivity is not strong. This is expected in offshore sediment habitats far removed from productive coastal upwelling.

These results were verified through geophysical surveys in 2024, which confirmed the area to be typically **homogenous, devoid of features and consisting of a smooth seabed. Furthermore, no colony forming corals and structural features (e.g., rocky outcrops) were identified in the Venus offshore project area during these geophysical surveys.**

Based on geophysical data, the **shallow geology was found to be similar across the Venus offshore project area, consisting of well-layered hemipelagic sediments in the upper sections**, with more consolidated sediments, interpreted to compose of a mixed clay/silt and subordinate sand in the lower section (see Section 5.2.2).

\

⁴² The Folk classification system categorizes marine sediments based on their grain size and composition. This system divides sediments into several categories considering a combination of the components (gravel, sands and fines), the ratio of sand : mud and percentage of gravel within the sediment. 'Sandy Muds' and 'Muds' have a <1% gravel composition and 1:1 or lower ratio of sand : mud.



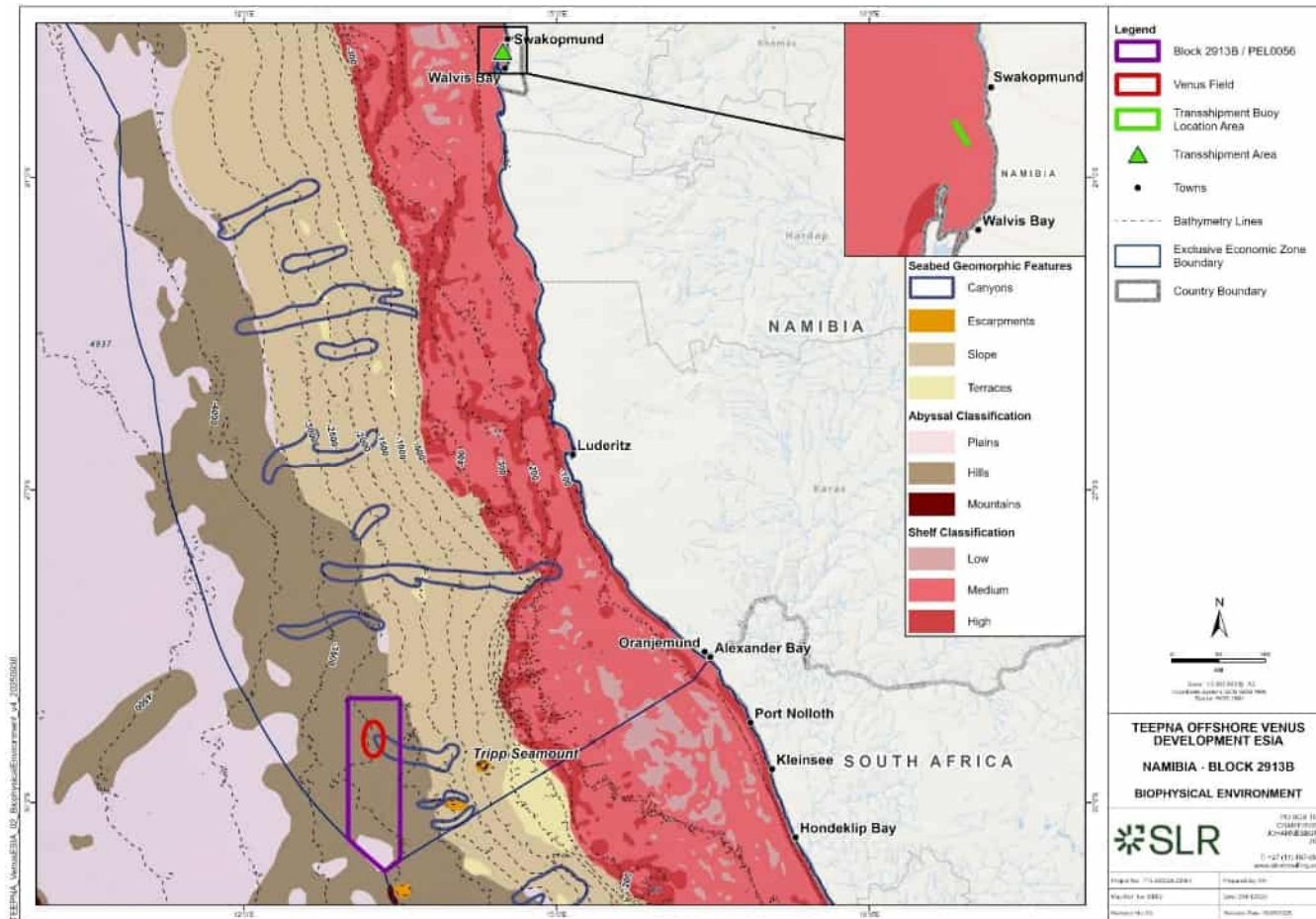


Figure 5-8: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and the nearshore transshipment area (green triangle) in relation to seabed geomorphic features off Namibia.

Source: Adapted from MFMR (2021) and MARISMA (2022).



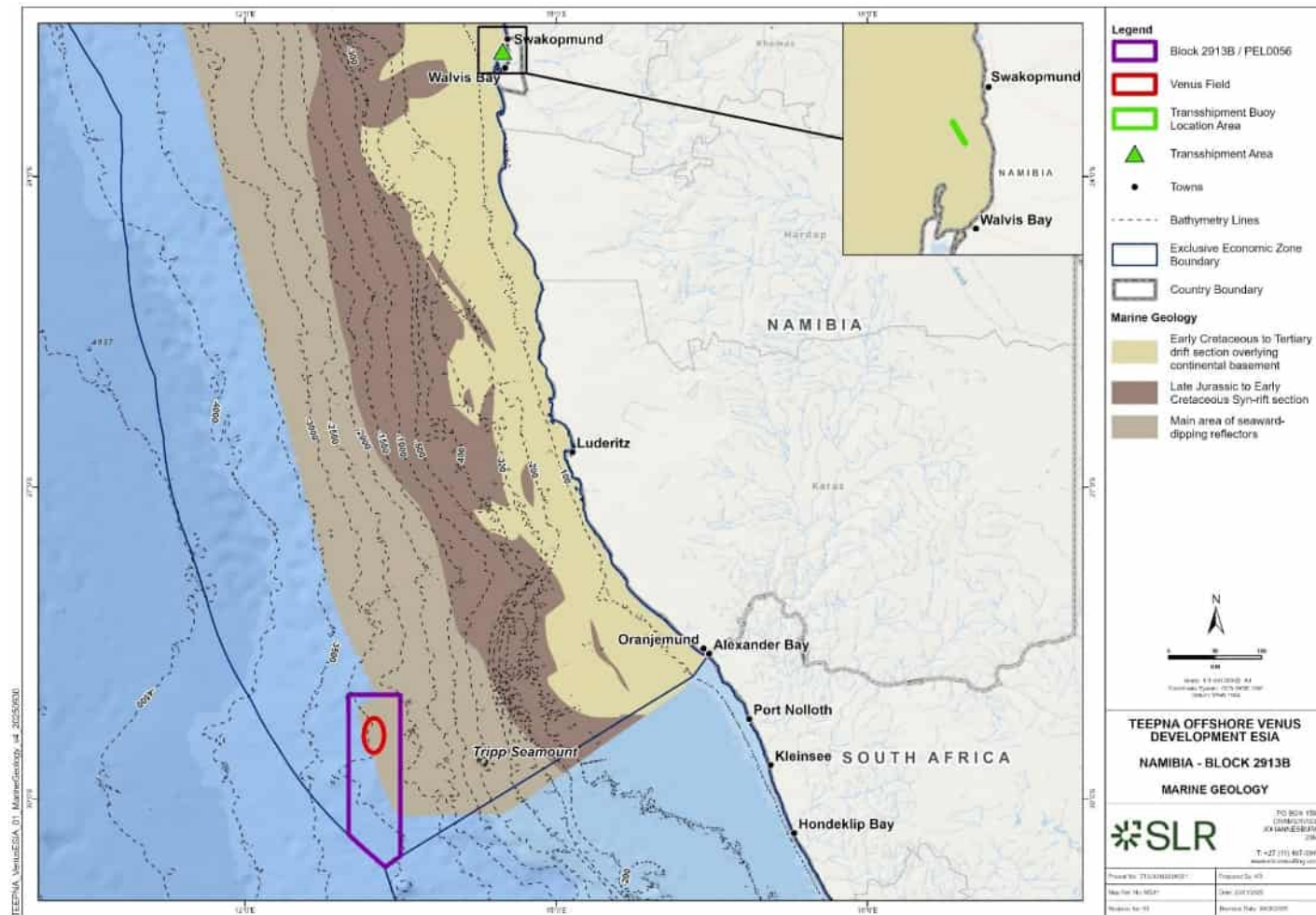


Figure 5-9: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and the nearshore transshipment area (green triangle) in relation to the marine geology of the Namibian continental shelf.

Source: Adapted from MFMR (2021).



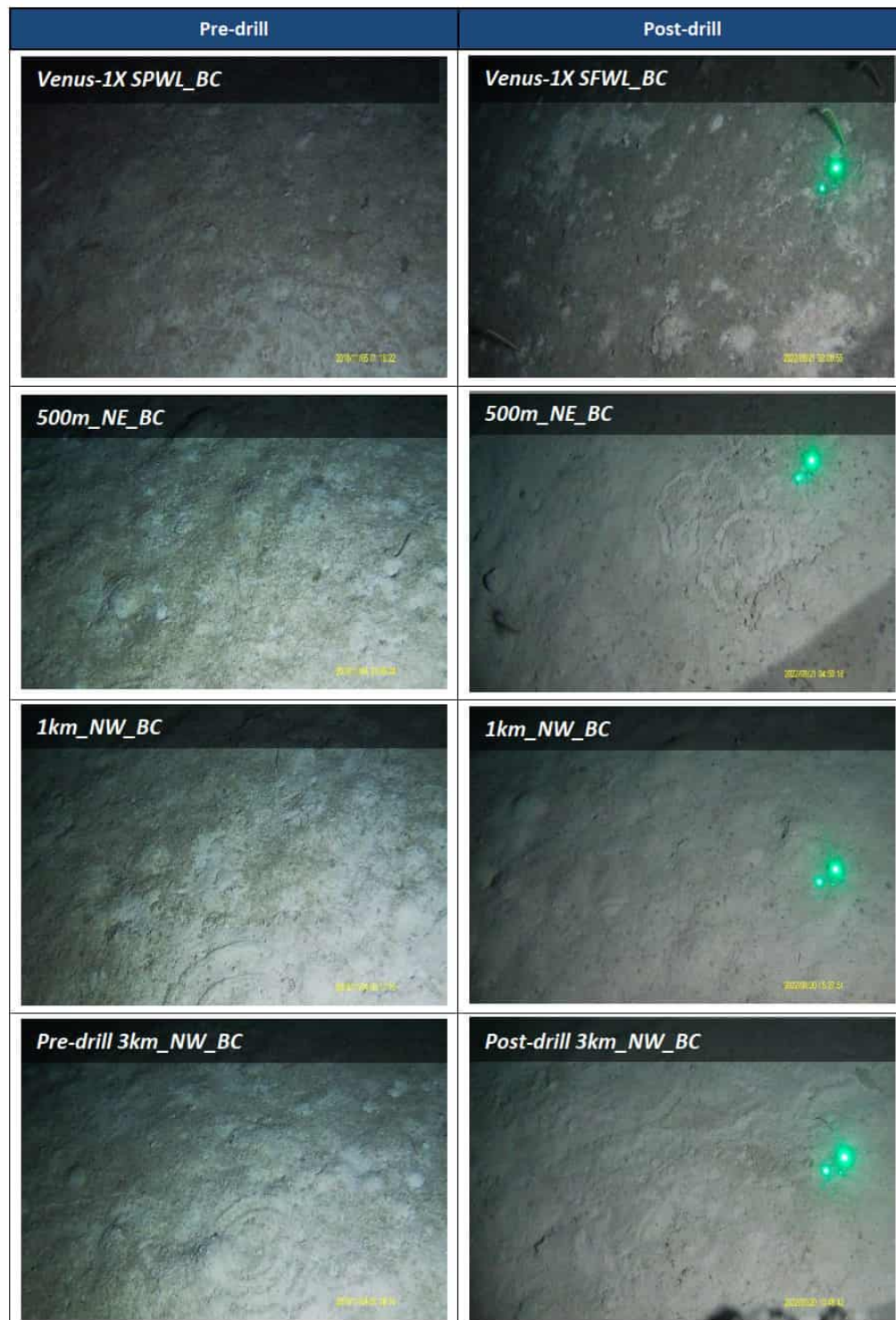


Figure 5-10: Example images from pre- and post-drilling video surveys of the Venus 1X area, with evidence of biogenic activity (bioturbation).

Source: BSL (2023b)



5.3.3 Sedimentary Phosphates

Phosphorite, sedimentary rock with 5%-20% phosphate content, is found in the marine environment as nodular hard ground or layers on continental shelves and slopes (Morant 2013). These deposits serve as a record of climate-linked palaeoceanographic changes in upwelling systems. The Benguela Upwelling System, one of the world's most productive, hosts significant phosphorite deposits over a 24 700 km² area on the Namibian shelf, generally occurring to depths of ~350 m (Compton & Bergh, 2016). It is estimated that the total resource is 7 800 million tonnes with an average grade of 19% per weight of P₂O₅ (Compton & Bergh, 2016).

The phosphorite deposits on the open shelf form when phosphate precipitates as calcium phosphate due to intense upwelling and temperature changes, which reduces phosphate solubility in oceanic waters. This precipitation occurs at the sediment-water interface, aided by the decay of siliceous phytoplankton. The resulting phosphates combine with calcium from calcareous foraminiferal and coccolithophorid debris, forming phosphatised lime-rich muds. These muds eventually solidify through secondary calcium phosphate replacement (francolite), creating a continuous layer of phosphate rock on the seafloor sediments (Birch G. , 1990; Morant P. , 2013).

Marine phosphates offshore of Namibia were first discovered and regionally mapped in the late 1960s and 1970s, with subsequent exploratory work undertaken in the 1990s, 2000s and present. Phosphorite deposits on the Namibian continental shelf are found in various locations and depths: concretionary phosphorite and pelletal phosphorite are located on the middle shelf south and north of Walvis Bay (~200 m depth), while 'rock phosphate' is predominantly found on the middle and inner shelves north of Walvis Bay (50 m to 250 m depth). Additionally, coarsening-upward pelletal phosphorite sand deposits, several meters thick, are present on the middle to outer shelf at depths of 190 m to 350 m offshore of Lüderitz and Walvis Bay.

The Venus offshore project area is in water depths of approximately 3 000 m, as such the presence of pelletal and glauconitized pelletal phosphate deposits within the project development area is deemed unlikely, with none recorded during environmental surveys.

The nearshore transshipment location, 20 km north of Walvis Bay, is located shallower (< 40 m water depth) than the known rock phosphate.

Summary of the key geophysical characteristics of the project areas

The Venus offshore project area is situated on the upper slope and within the deep-sea abyss, in water depths ranging from 2 828 to 3 114 m, with a depth variance of ~100 m across the project area up to a max of 280 m. The region's key geological features include Child's Bank in South African waters and Tripp Seamount in Namibia, which have been mapped for Marine Spatial Planning purposes. PEL0056/Block 2913B is 85 km west of Tripp Seamount and 200 km northwest of Child's Bank. Due to its offshore location (> 240 km from the coast at its closest point) the Licence Block sediments are dominated by muds and sandy muds, with photographic, geophysical and environmental surveys data showing a generally homogeneous habitat devoid of hardground habitats and/or features.

The nearshore transshipment zone is situated along the inner shelf, in water depths less than 40 m. Owing to its nearshore location (<5 km from the coast at its closest point), the transshipment area sediment is likely to consist largely of sand.

Notably, the continental shelf hosts extensive phosphorite deposits, formed by upwelling-induced phosphate precipitation. PEL0056/Block 2913B does not overlap with these phosphate-rich rocks. The nearshore transshipment location, 20 km north of Walvis Bay, is located shallower than the known rock phosphate.



5.4 Biophysical Characteristics

5.4.1 Climate

The Namibian coastline has hyper-arid conditions with low, unpredictable winter rains, and strong predominantly southerly or south-westerly winds. North of Lüderitz, summer rains prevail, and further out to sea, a south-easterly wind component is prominent. Winds reach a peak in the late afternoon and subside between midnight and sunrise.

Frequent fog occurs along the coast, about 50-75 days per year, mainly from February through May. The fog lies close to the coast extending about 20 nautical miles (~35 km) seawards (Oliver, 1992; 1995). This fog bank is dense and hugs the shoreline, reducing visibility to less than 300 m. Fog should in no way affect production activities in the Venus offshore project area. However, it may affect nearshore transshipment operations and helicopter operations between the drilling unit / FPSO and the Lüderitz airport.

Average annual rainfall in Namibia is extremely variable, ranging from 650 mm in the northeast to less than 50 mm in the southwest, with mean annual rainfall of 278 mm across the country (World Bank Group, 2021). Mild temperatures prevail year-round, averaging around 16°C along the southern coast and increasing inland up to 22°C in the north (Barnard, 1998; World Bank Group, 2021). In winter (June to August), hot easterly 'Berg' winds from the desert can cause significant daily temperature shifts, with temperatures reaching up to 30°C during such events (Shannon & O'Toole, 1998).

5.4.2 Wind Patterns

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment.

The prevailing winds in the Benguela region are influenced by the South Atlantic subtropical anticyclone, eastward-moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure patterns over the subcontinent. The South Atlantic anticyclone strengthens and extends furthest south during the austral summer but weakens and moves north-westward in winter. This results in substantial differences between summer and winter wind patterns in the region.

Southerly winds bring cool, moist air to the coast and drive the large-scale upwelling of nutrient-rich bottom waters which defines the region in summer. These strong equatorward winds are interrupted by passing coastal lows which cause periods of calm or north/northwest wind conditions.

Winter remains dominated by southerly winds, but the proximity of winter cold-front systems introduces a significant north-westerly component. This change in conditions results in a cessation of upwelling, movement of warmer mid-Atlantic water shoreward and a breakdown of the strong thermoclines which typically develop in summer. In winter, calms are more frequent and wind speeds generally don't reach the summer's maximum levels. Larger swells occur in winter than the westerly winds align with the prevailing south-westerly swell direction.

In autumn and winter, strong offshore "berg" winds can occur. These easterly winds can exceed 13 m/s and create sandstorms, which severely limit visibility at sea and on land. These winds, though intermittent for about a week, play a major role in transporting sediment into the coastal marine environment, carrying sediment up to 150 km offshore (Tlhalerwa, et al., 2005; Figure 5-11). Organic input is discussed further in Section 5.4.9.



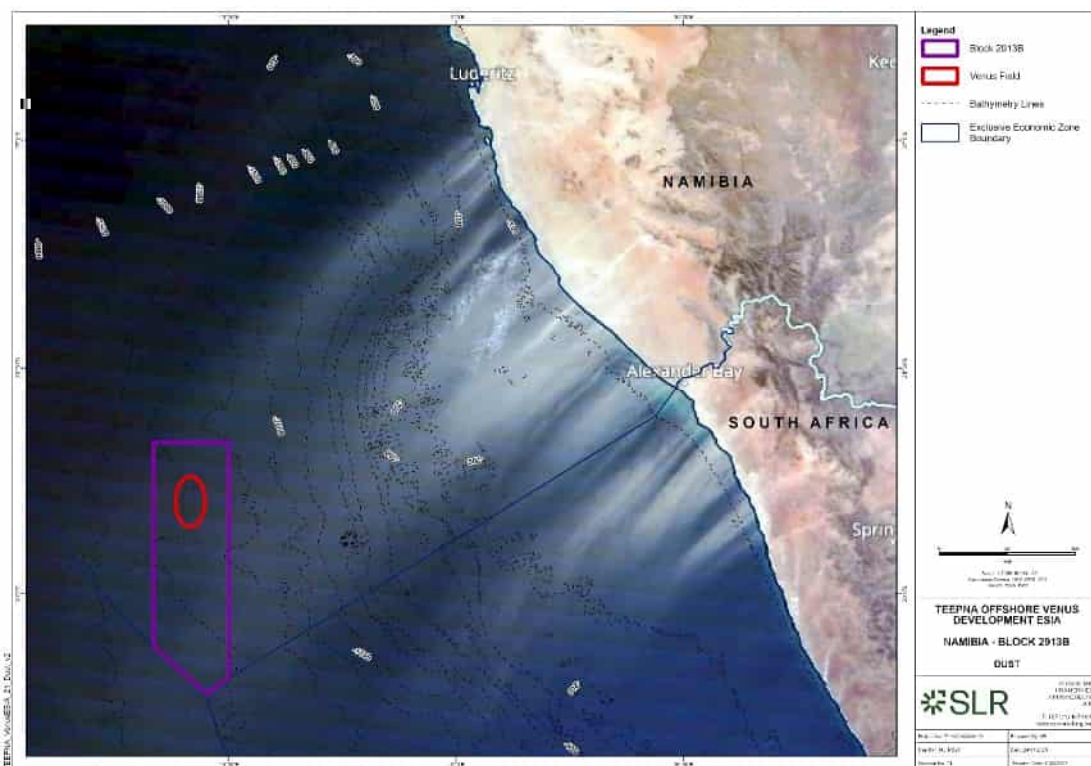


Figure 5-11: Satellite image of aerosol plumes blown offshore during a northeast 'berg' wind with the estimated position of Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon).

Source: www.earthdata.nasa.gov/worldview/worldview-image-archive/dust-blows-off-coast-namibia-south-africa.

Ambient wind statistics at the **Venus offshore project area** were modelled using a 41-year CFSR/CFSv2 database (RPS, 2025a). This study found that the annual average ambient wind speed was 7.53 m/s, with maximum speeds reaching 22.2 m/s. The predominant wind directions were from south-east and south-south-east (RPS, 2025a). During summer, wind is strongest with southerlies dominating most of the time, sometimes exceeding 20 m/s (see Figure 5-12).

Nearshore and continental winds generally lower as compared to areas further offshore, with the deflection of winds close to land resulting in the predominance of south-easterly, southerly and south-westerly winds. The coastal stretch from the Orange River mouth to Lüderitz is recognised as the windiest section along the Namibian coastline (Environmental Information Service, 2022).

Ambient wind statistics at the **nearshore transshipment location** (specifically Alternative 1) were modelled using a 32-year CFSR database as well as a 9-year CFSv2 database (RPS, 2025b). Results reported an annual ambient wind speed of 4.3 m/s, with a maximum speed of 16.5 m/s recorded in August. The predominant wind directions were from south and south-south-west, with wind strongest between July and October (mean wind speed of 4.6 m/s) (RPS, 2025b) (see Figure 5-13).



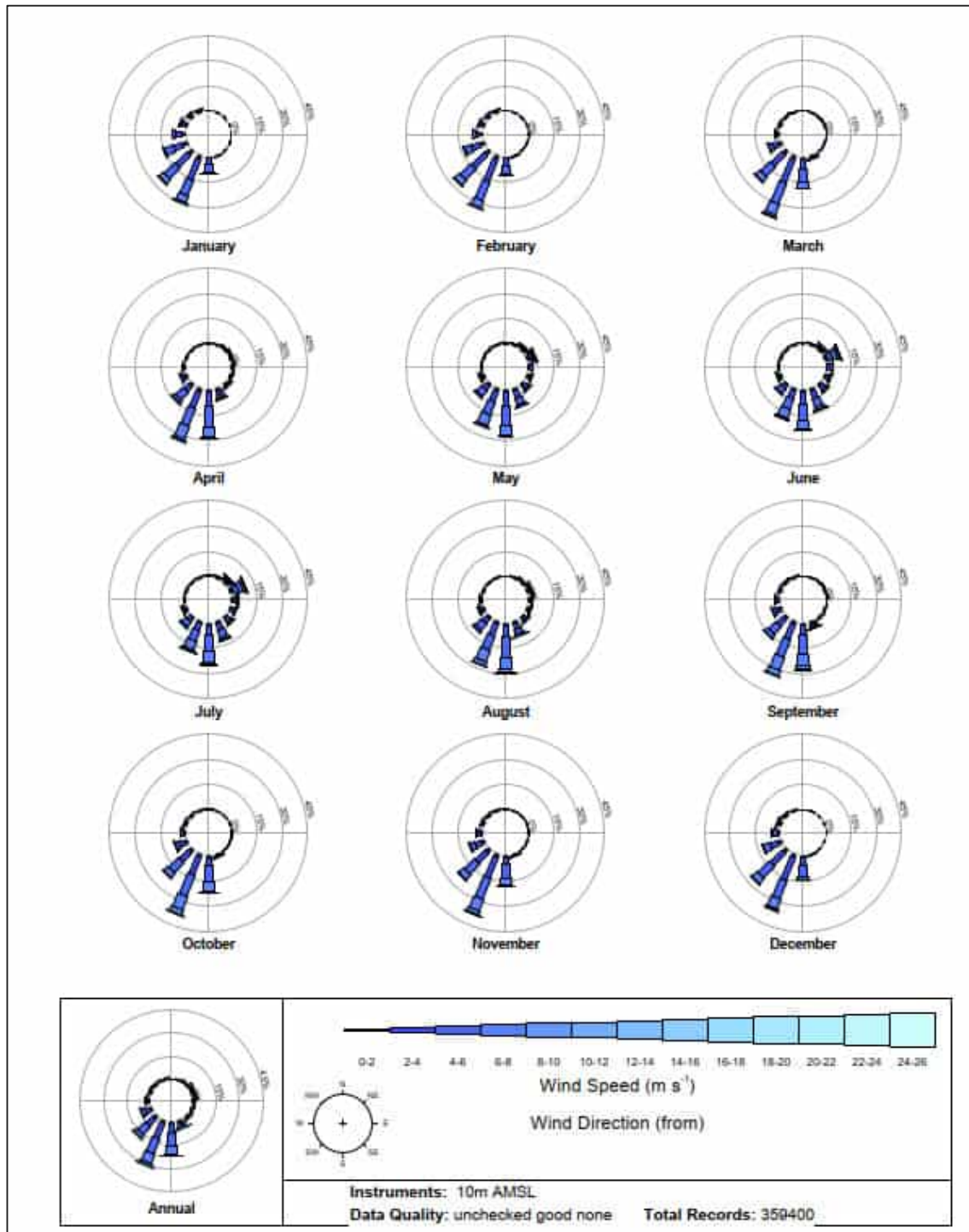


Figure 5-13: Wind data by month for nearshore transshipment area (14°29'06"E; 22°47'00"S).

Source: RPS (2025b). Data from for years 1979 to 2019.



5.4.3 Large Scale Circulation and Currents

The Namibian coastline is heavily influenced by the Benguela Current. Current velocities on the continental shelf typically range between 10-30 cm/s (Boyd & Oberholster, 1994). In the south, the Benguela Current spans 200 km in width, expanding rapidly northwards to 750 km. The barotropic current is primarily driven by wind and alternates between poleward and equatorward directions for short fluctuation periods (3-10 days) (Shillington, et al., 1990; Nelson & Hutchings, 1983; Hutchings, et al., 2009) (see Figure 5-14). However, the long-term flow average is approximately north-west alongshore. Near the bottom shelf, the flow is mainly poleward (Nelson, Poleward motion in the Benguela area. , 1989) with typically low velocities around 5 cm/s. The poleward flow becomes more consistent in the southern Benguela.

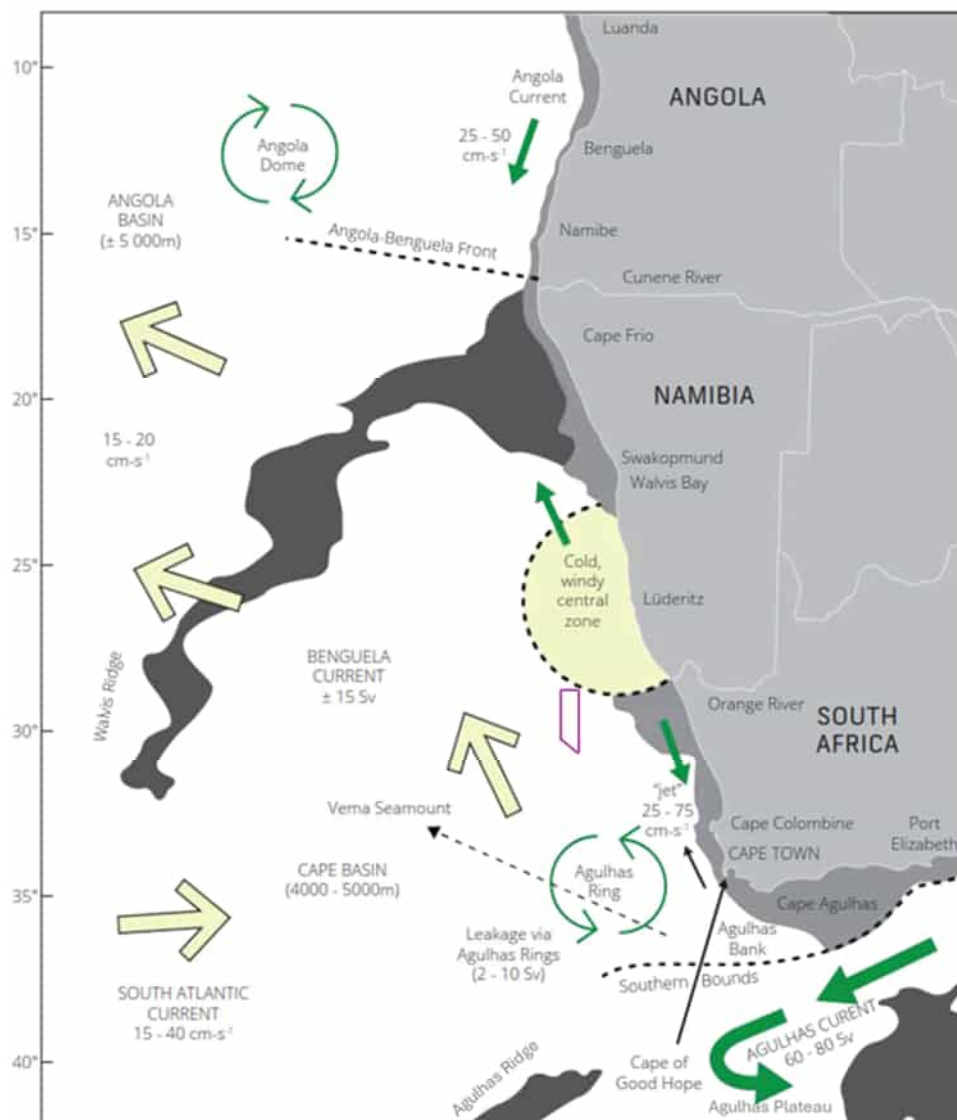


Figure 5-14: PEL0056/Block 2913B (purple polygon) in relation to major features of the predominant circulation patterns and volume flows in the Benguela System

Source: Adapted from Shannon et al. (2006) and MFMR (2018). Light grey indicates continental shelf, with dark grey representing the location of offshore ridges and plateaus (Walvis Ridge, Agulhas Ridge and Agulhas Plateau).



The Benguela Current is characterised by coastal upwelling, which supplies nutrients to surface waters, resulting in high biological productivity and abundant fish stocks. Prevailing longshore winds move nearshore surface water offshore, causing colder, deeper water to upwell closer to the coast. Although upwelling intensity varies with seasonal wind patterns, the most intense upwelling occurring where the shelf is narrow, and winds are strong.

The Lüderitz upwelling cell is the most intense, extending seaward for nearly 300 km and drawing water from depths of 300-400 m (Longhurst, 2006). Water mass analysis revealed discontinuities in central and intermediate layers along the shelf north and south of Lüderitz (Duncombe Rae, 2005). This area forms a significant environmental barrier separating the northern and southern Benguela sub-systems (Ekau & Verheye, 2005; Lett, Veitch, Van Der Lingen, & Hutchings, 2007).

Modelled operational currents based on measurements recorded at the **Venus offshore project area** indicate that surface and near surface (5 m below sea level) currents are primarily towards the west-northwest and northwest, with average speeds of 0.26 m/s. Current speeds decrease with depth to ≤ 0.05 m/s near the seabed (2 000-3 000 m deep), flowing predominantly towards the south (RPS, 2025a) (see Figure 5-15).

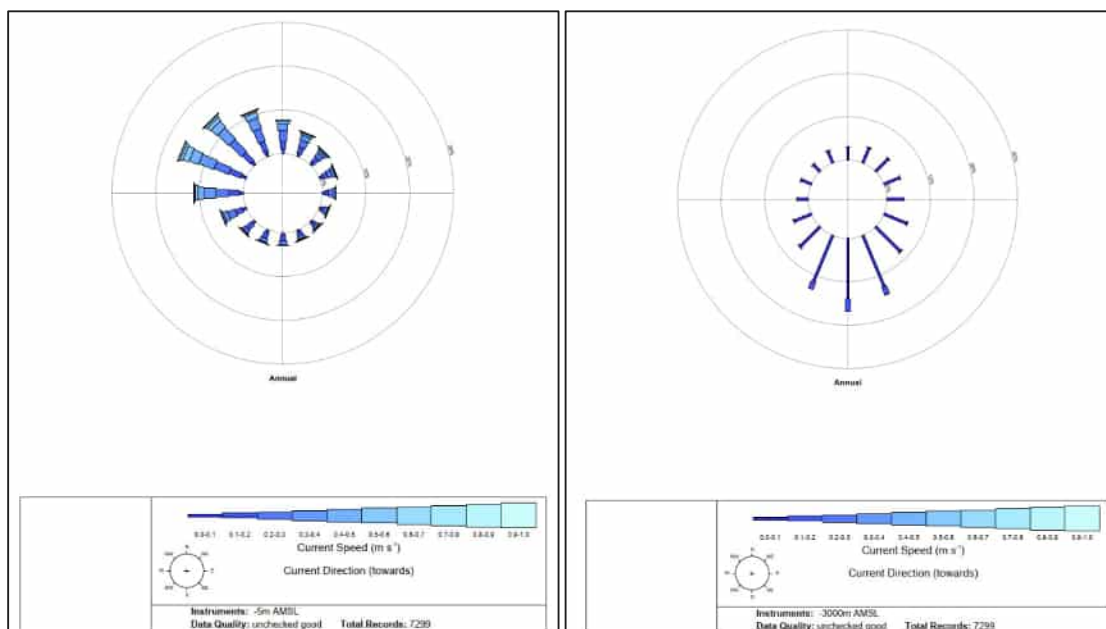


Figure 5-15: Surface (-5 m) (top) and seabed (- 3 000 m) (bottom) annual current data for years 1993 to 2012 for a grid point (29° 26' 24" S 13° 16' 48") within PEL0056/Block 2913B.

Source: RPS 2025a

Modelled operational currents based on measurements recorded at **the nearshore transshipment area** indicate that surface and near surface (5 m below sea level) currents are primarily towards the east and northwest, with average speeds of 0.125 m/s. Current speeds decrease with depth to ≤ 0.09 m/s near the seabed (31 m deep), flowing predominantly towards the east-south-east and west-north-west (RPS, 2025b) (see Figure 5-16).



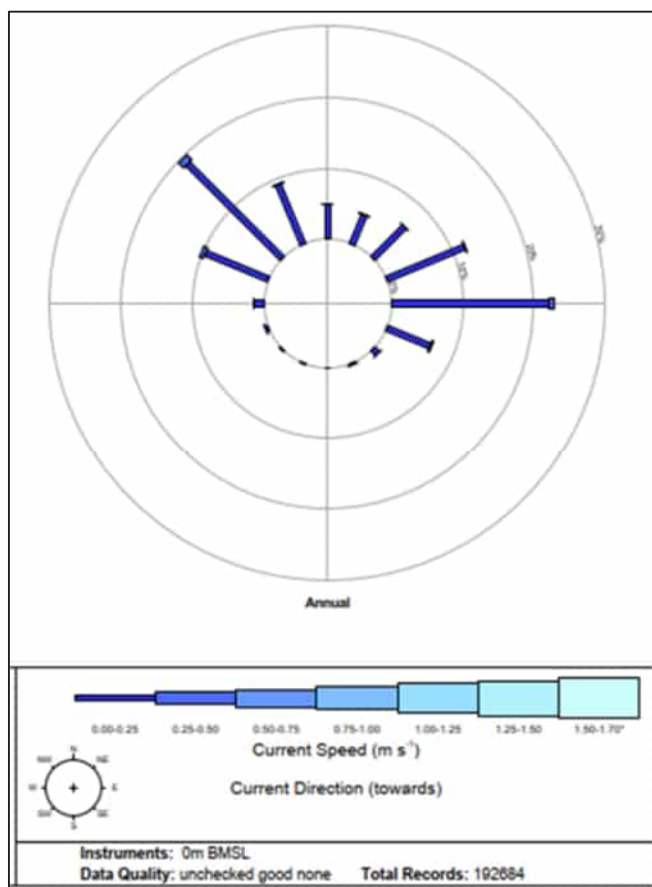


Figure 5-16: Surface annual current data for years 1994 to 2015 for nearshore transshipment area (14°29'06"E; 22°47'00"S).

Source: RPS 2025b

5.4.4 Waves and Tides

The Namibian coast is exposed to strong wave action, typically rated between 13-17 on a 20-point exposure scale (McLachlan, 1980). These major swells are primarily generated in the roaring forties and locally driven by persistent southerly winds.

Throughout the year, the wave regime along the Namibian coast remains relatively consistent, predominantly coming from the south-west-south direction, with a slight increase in winter. The median significant wave height is 2.4 m, with the main peak wave energy period around 12 seconds. Longer period swells (11 to 15 seconds) generated by mid-latitude cyclones occur about 25-30 times annually, originating from the south-south-west sectors. The largest waves recorded along the Namibian coastline reach heights of 4-7 m during these events. In winter, heavy south-westerly storms can bring waves exceeding 10 m, often accompanied by wind speeds of up to 100 km/h. Generally, wave heights decrease with depth and alongshore distance.

In contrast, spring and summer swells are smaller, typically averaging around 2 m and lacking the extreme heights of winter swells. Summer also features a more pronounced southerly swell component, characterized by shorter wave periods (~8 seconds) and steeper profiles, primarily induced by wind (CSIR, 1996). These southerly wind-induced waves, although less powerful, work in tandem with the strong southerly winds of summer to create northward-flowing nearshore surface currents. This combination of currents, wind, and waves results in significant nearshore sediment mobilization and northward transport.



In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of approximately 1.5 m at spring tide, but only 0.6 m during neap tide periods. The average annual significant wave height (sea and swell) at the **Venus offshore project area** is 1.73 m (RPS, 2025a). The waves predominantly originate from the south-south-west to south-west directions (RPS, 2025a).

The average annual significant wave height (including both sea and swell) at the **nearshore transshipment area** was modelled at approximately 0.5 m (RPS, 2025b), with wave directions predominantly originating from south-southwest to southwest (RPS, 2025b).

5.4.5 Water Characteristics

South Atlantic Central Water (SACW) comprises most of the seawater in the project area, either in its pure form in deeper regions or when mixed with upwelled water of the same origin on the continental shelf (Nelson & Hutchings, 1983). Salinity levels in these waters vary between 34.5 ppt and 35.5 ppt (Shannon V. , 1985). Full seawater profiles were sampled during environmental baseline surveys of **PEL0056/Block 2913B** (see Section 5.2.1). Levels varied in the first 100 m water depth (35.4 to 35.5 PSU), rapidly declining between 100 m and 600 m to a minimum salinity of 34.3 to 34.4 PSU, before increasing (~35 PSU) at 2 000 m and remaining constant at the seabed (BSL, 2019a; BSL, 2023a; BSL, 2023b). Modelling completed by RPS (2025b) at the **nearshore transshipment area** found consistent salinity levels across depth zones (0 to 31 m deep), with a mean salinity level of 35.1 PSU.

On the southern Benguela's continental shelf seawater temperatures typically vary between 6°C and 16°C, with similar temperatures found within the **nearshore transshipment area (range 15°C – 15.3°C)** (RPS, 2025b). Well-developed thermal fronts mark the seaward boundary of the upwelled water. These fronts generate characteristic upwelling filaments, occurring as cold surface streamers, about 50 km wide and extending beyond the normal offshore limits of the upwelling cell. Such fronts usually persist for few days to several weeks, with the filamentous mixing zone extending up to 625 km offshore. Studies have shown changes in sea surface temperatures in large areas of the Benguela region over the last 30 years (Rouault, Penven, & Pohl, 2009; Belkin, 2009), including warming of substantial areas off Namibia.

Environmental surveys conducted in **PEL0056/Block 2913B** (see Section 5.2.1) revealed that the upper 50 m of the water column were well mixed, with temperatures exceeding 17°C. A consistent mixing zone was observed in the upper layers, followed by a rapid temperature drop to approximately 5°C at the bottom of the thermocline layer (600 m). The temperature then gradually transitioned to 2.3 to 2.5°C at a depth of 3 000 m (BSL, 2019a; BSL, 2023a; BSL, 2023b).

The Benguela Upwelling System is characterised by a shallow Oxygen Minimum Zone (OMZ) (50-200 m), owing to the intense upwelling within the Benguela Upwelling System (Hamukuaya, O'Toole, & Woodhead, 1998; Hashim, Waweru, & Muthumbi, 2024). The high productivity of the Benguela Upwelling System provides a large source of carbon through photosynthesis. This carbon gradually sinks through the water column resulting in a rapid loss of oxygen, resulting in low dissolved oxygen concentrations, thereby creating an extensive, shallow minimum oxygen zone (Bohata and Koppelman, 2013; Emeis et al., 2018). As a result, the continental shelf waters of the Benguela system are characterised by low oxygen concentrations, particularly near the seafloor.

Sample collection from three transects off Lüderitz (26°S), Walvis Bay (23°S) and Terrace Bay (20°S), recorded low oxygen levels throughout. Notably, the lowest oxygen levels were recorded offshore Walvis Bay, with the two most onshore stations (at 128 m and 39 m deep) recording the lowest oxygen levels (0.02 and 0.06 MLL⁻¹, respectively) (Hashim, Waweru, & Muthumbi, 2024). Similarly low oxygen levels may be anticipated within the **nearshore**



transshipment area, with the inner shelf described to be oxygen-depleted (Levin, et al., 2009).

SACW itself exhibits depressed oxygen concentrations (oligoxic: ~80% saturation value), with even lower levels (<40% saturation) and hypoxia occurring frequently (Bailey, Beyers, De, & Lipschitz, 1985; Chapman & Shannon, 1985; Monteiro & van der Plas, 2006; Monteiro P. M., et al., 2006).

The Dissolved Oxygen (DO) profiles from environmental surveys completed within **PEL0056/Block 2913B** (see Section 5.2.1) were found to be similar. The top 100 m water depth remained relatively stable with 93% DO, which steadily decreased to 70% by 200 m and reached a minimum of 40% around 900 m. Notably the profile steadily increases from 1 400 m, reaching 48% at 2 000 m, before declining again to 38% at 3 000 m (BSL, 2019a; 2023a; 2023b).

Nutrient concentrations of upwelled water attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment (Chapman & Shannon, 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey, Beyers, De, & Lipschitz, 1985). The actual nutrient concentrations can vary widely, depending on phytoplankton uptake influenced by phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high near the coast (see Section 5.4.6), with nutrient levels expected to be similarly high at the **nearshore transshipment area**.

Considering the offshore location of PEL0056/Block 2913B, nutrient levels are expected to be low. This was confirmed by water samples collected within the Venus offshore project area during pre- (2018 Venus-1X EBS) and post-drill (2022) environmental surveys (see Section 5.2.1), which found Orthophosphate (PO₄) levels to be relatively consistent between surveys, ranging from 0.12-0.22 mg.l⁻¹ (BSL, 2019a; 2023a; 2023b). Nitrate concentrations at the **Venus offshore project area** were variable across environmental surveys with higher concentrations (0.83-6.35 mg.l⁻¹) recorded post-drill (2022 Venus-1X EPOS) as compared to pre-drill (2018 Venus-1X EBS) concentrations (<0.20 mg.l⁻¹). Nitrite levels were below the limits of detection (<0.01 mg.l⁻¹) across all surveys. Total Nitrogen was consistent across the Venus offshore project area sampling sites with low levels recorded both pre- (2018 Venus-1X EBS; mean < 0.04%) and post-drilling (2022 Venus-1X EPOS; mean 0.06%) (BSL, 2019a; 2023a; 2023b).

5.4.6 Upwelling and Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon, 1985). During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

The Venus offshore project area and PEL0056/Block 2913B area is located well offshore of coastal upwelling cells (see Figure 5-17), **with waters expected to be nutrient poor** (as discussed in Section 5.4.5). In contrast, the nearshore transshipment area is located within coastal upwelling regions (see Figure 5-10), with **nearshore waters expected to be nutrient rich** (as discussed in Section 5.4.5).



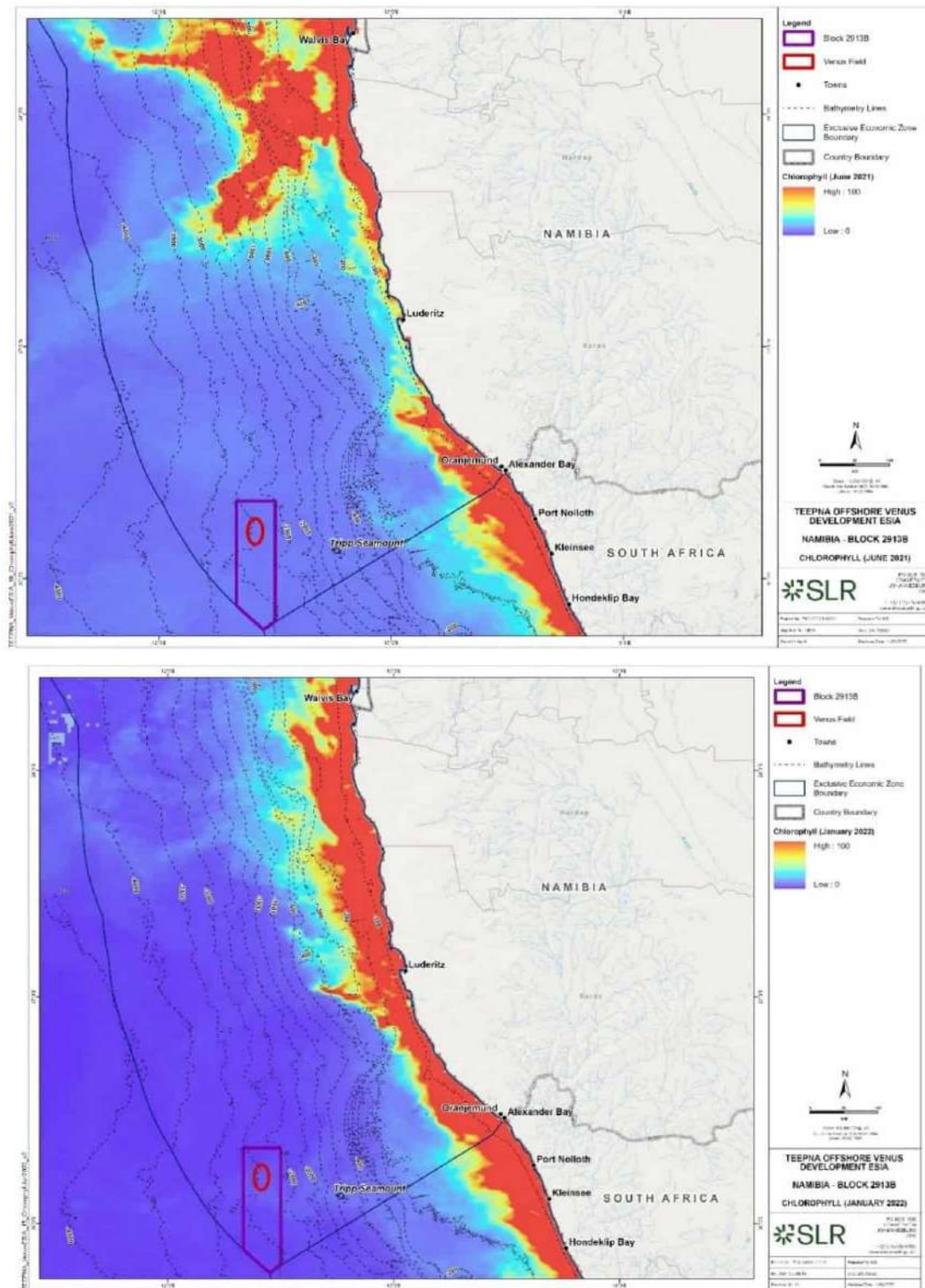


Figure 5-17: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to chlorophyll-a levels off West Coast for June 2021 (top) and January 2022 (bottom).

Source: AQUA MODIS, NASA Chlorophyll from Aqua MODIS, NASA Polar Map Preview on PolarWatch (noaa.gov)



Chlorophyll-a is a photosynthetic pigment found in phytoplankton and can be used as an indication of marine productivity and nutrient enrichment, including the effects of coastal upwelling cells. Due to differing survey methods, surveys to quantify chlorophyll-a levels between pre- and post-drill surveys are restricted, with Chlorophyll-a levels falling below the levels of detection ($<7 \mu\text{g.l}^{-1}$) for the pre-drill EBS (BSL, 2019a). **Analysis of water samples collected during the 2022 environmental survey recorded relatively low levels of chlorophyll-a throughout the water column (0.001-0.06 $\mu\text{g.l}^{-1}$)** (BSL, 2023a; BSL, 2023b). As is expected, chlorophyll-a levels were highest at the surface (0.2 to 0.4 $\mu\text{g.l}^{-1}$) (BSL, 2023a; BSL, 2023b).

5.4.7 Turbidity

Turbidity is a measure of the level of suspended particulate matter in seawater, affecting water clarity and light penetration. Total Suspended Particulate Matter (TSPM) comprises Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM):

- POM includes detritus, bacteria, phytoplankton and zooplankton, and serving as food for filter-feeders. Coastal POM levels are influenced by seasonal microphyte production during upwelling events.
- PIM, mostly of geological origin consisting of fine sands, silts and clays. Off the Namibian coast, the coastal PIM load is strongly related to natural riverine inputs. Additionally, 'berg' winds can contribute sediment levels comparable to the annual Orange River inputs (Shannon & Anderson, 1982; Zoutendyk P. , 1992; Zoutendyk P. , 1995; Shannon & O'Toole, 1998; Lane & Carter, 1999).

Suspended particulate matter concentrations in shallow coastal waters vary spatially and temporally, ranging from a few mg/L to several tens of mg/L (Bricelj & Malouf, 1984; Berg & Newell, 1986; Fegley, MacDonald, & Jacobsen, 1992). Typical Benguela current system measurements suggest coastal and continental shelf sediment concentrations are generally $<12 \text{ mg/L}$ outside major flood events, showing significant longshore variation. Similar values may be expected within the vicinity of the **nearshore transshipment area** owing to its coastal location ($\sim 5 \text{ km}$ from coastline). However, under strong wave conditions, high tides, storms, or floods, higher PIM concentrations have been reported.

In the nearshore areas off the southern Namibian coast, turbidity primarily results from redistributing inner shelf sediments by long-period Southern Ocean swells. The Benguela Current velocities (10-30 cm/s) can resuspend and transport considerable quantities of sediment equatorward. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington, et al., 1990; Rogers & Bremner, 1991). The northward littoral drift of coarser bedload sediments, parallel to the coastline, occurs due to south-westerly swells and wind-induced waves. Longshore sediment transport is notably higher in the surf-zone due to breaking waves that suspend and mobilize sediment (Smith & Mocke, 2002).

On the inner and middle continental shelf, currents are insufficient to transport coarse sediments, and resuspension and shoreward movement mainly occurs during storm conditions (see also Drake, et al., 1985; Ward, 1985).

In the offshore waters of PEL0056/Block 2913B, Total Suspended Solids (TSS) were found to be variable but low, ranging from $<5 \text{ mg.l}^{-1}$ for all water depths sampled during the 2018 Venus-1X environmental survey to 18 mg.l^{-1} within the post-drill surface waters sampled during the 2022 Venus-1X EPOS. The increased surface TSS likely reflects a higher phytoplankton abundance and wave-driven turbidity. Overall, water column profiling found that turbidity (NTU) remained low (0.02 NTU) and constant from 100 m water depth to the seabed, with a slight increase in the upper water column and surface waters (BSL, 2019a; BSL, 2023a; BSL, 2023b).



5.4.8 Low Oxygen and Hypoxic Events

The Benguela system's continental shelf waters consistently exhibit low oxygen levels, often falling below 40% saturation (e.g., Visser, 1969; Bailey, et al., 1985). Low oxygen concentrations are primarily attributed to remineralisation of nutrients in the bottom waters (Chapman & Shannon, 1985), especially in areas with carbon-rich mud deposits. As the mud patches are unevenly distributed on the shelf, specific regions tend to experience lower oxygen levels. The primary areas of low-oxygen water formation off southern Namibia are the Orange River Bight and off Walvis Bay (Chapman & Shannon, 1985; Bailey, 1991; Shannon & O'Toole, 1998; Bailey, 1999; Fossing, Ferdelman, & Berg, 2000). The spatial distribution of oxygen-poor water in these regions can vary in the short and medium term.

Periodic low-oxygen events nearshore can have devastating effects on marine communities, leading to rock lobster strandings and mass mortalities of marine life and fish (Newman & Pollock, 1971; Matthews & Pitcher, 1996; Pitcher, 1998; Cockcroft, Schoeman, Pitcher, Bailey, & Van Zyl, 2000). These events result from the development of anoxic conditions due to the decomposition of large quantities of organic matter generated by algal blooms. These blooms typically occur during summer-autumn (February to April) but can also develop in winter during 'berg' wind periods when extended calm, warm, and windless conditions prevail.

Seafloor hypoxia, especially off central Namibia, is closely linked to the production of toxic hydrogen sulphide and methane within organically rich, anoxic muds following the decay of expansive algal blooms. Under severe oxygen depletion, anaerobic bacteria in the anoxic seabed muds generate hydrogen sulphide (H₂S) gas (Brüchert, et al., 2003). Periodically, this gas is released from the muds in 'sulphur eruptions,' leading to upwelling of anoxic water and the formation of surface slicks of sulphur-discoloured water (Emeis, et al., 2004; Ohde, Siegel, Reibmann, & Gerth, 2007). **These events typically occur inshore and off the central Namibian coastline and are unlikely to occur within PEL0056/Block 2913B and the Venus offshore project area. However, low-oxygen water formation off Walvis Bay suggests such events may occur within the nearshore transshipment area** with a 70 km wide belt of anoxic, organic-rich diatom ooze located in the inner shelf offshore Walvis Bay, in waters less than 140 m deep, and likely within the vicinity of the transshipment area (Calvert & Price, 1983).

5.4.9 Organic Inputs

As detailed in Section 5.4.6, the coastal upwelling region in the Benguela current is an area of particularly high natural productivity. Balanced ecosystem models estimate that during the 1990s, the Benguela region sustained biomasses of 76.9 tonnes/km² of phytoplankton and 31.5 tonnes/km² of zooplankton alone (Shannon, Moloney, Jarre, & Field, 2003). Natural mortality affects these species, with approximately 36% of phytoplankton and 5% of zooplankton sinking to the seabed annually.

This annual influx of millions of tons of organic material onto the seabed significantly impacts the ecosystems of the Benguela Current. It supports the food requirements of benthic communities in sandy-mud habitats, contributing to the high organic content of the region's muds. As most of this organic detritus is not directly consumed, it enters the seabed decomposition cycle, leading to oxygen depletion in deeper waters.

Following transect sampling completed offshore Lüderitz, Walvis Bay and Terrace Bay (up to 1 282 m deep), Hashim et al. (2024) demonstrated an inverse relationship between depth and Total Organic Matter (%TOM), with higher organic matter values recorded in shallow stations, along the continental shelf. **Similarly high levels may be expected within the nearshore transshipment areas, with a TOM of 23.08 % recorded offshore Walvis Bay, at depths of 30 m** (Hashim, Waweru, & Muthumbi, 2024).



The Benguela system is also known for red tides (dinoflagellate and/or ciliate blooms), commonly referred to as **Harmful Algal Blooms (HABs)** (see Shannon & Pillar, 1985; Pitcher, 1998). These red tides can grow to substantial sizes. Toxic dinoflagellate species can poison fish and shellfish, while the breakdown of organic-rich material from both toxic and non-toxic blooms results in subsurface water oxygen depletion. HABs are discussed further in Sections 5.4.8 and 5.5.3.1. **HABs are mainly associated with inshore upwelling cells and are unlikely to occur in the offshore waters of PEL0056/Block 2913B and the Venus offshore project area. However, nearshore transshipment operations may take place in waters associated with these events.**

5.4.10 Natural Hydrocarbon Seeps

A study by January (2018) identified hydrocarbon seeps and gas escape structures in the Orange Basin area. Large fluid seep/pockmark fields of varying morphologies were also reported in South African waters over 500 km south of PEL0056/Block 2913B by Palan (2017).

Petroleum discharges, both from natural seeps at the seabed and discharges occurring during the production and transport of petroleum are a common source of toxic substances in marine ecosystems (NRC 2003a). An analysis by TEEPNA of 2016 and 2021 satellite imagery detected several oil spills from boats corresponding with the orientation of the main shipping lanes along the south-western African coast. No anomaly centre points were, however, identified in the vicinity of adjacent PEL0091/Block 2912 that could be considered as potential oil seeps.

Summary of the key biophysical characteristics of the study area

The Venus offshore project area within PEL0056/Block 2913B is located in a deep-water environment that lies well offshore of more coastal upwelling cells and areas of high productivity. Swells throughout the year come predominantly from a south and south-southwest direction with average significant wave height of 1.73 m.

The Venus offshore project area also lies well offshore of the areas periodically affected by low-oxygen, high nutrient and high-turbidity conditions. EBS results indicate that the offshore waters of PEL0056/Block 2913B are comparatively clear and nutrient poor.

The nearshore transshipment area falls within shallow, nutrient-rich coastal waters. Swell come predominantly from the south-southwest to southwest, with an average significant wave height of 0.5 m. Low oxygen waters are expected along the inner continental shelf.

5.5 Biological Characteristics

The Venus offshore project area lies within the cold temperate **Namaqua Bioregion**, which stretches from Sylvia Hill, north of Lüderitz in Namibia, to Cape Columbine in South Africa (Emanuel, Bustamante, Branch, Eekhout, & Odendaal, 1992; Lombard, et al., 2004), and the **marine Namib Biozone** (De Cauwer, 2007), which stretches from the shelf edge to the Namibian EEZ border (see Figure 5-18). The nearshore transshipment area, located further north, falls within the **Namib Bioregion**, extending offshore the northern and central Namibian coastline, and the **Kuiseb Biozone**, situated in the coastal waters offshore Walvis Bay. As discussed in Section 5.4.6, the dominant coastal, wind-driven upwelling along the Namibian coastline plays a pivotal role in shaping the marine ecology of the Benguela region.

Marine communities along the Namibian coast are widespread but vary based on substrate type and depth zone. These communities encompass hundreds of species and exhibit significant temporal and spatial fluctuations, even at small scales.

In the marine environment, habitats are specific physical areas where organisms live, such as sandy beaches or rocky shores, with each habitat providing the conditions necessary for



the survival of particular species. Ecosystem types are broader categories that describe the ecological characteristics and functions of these habitats. This classification helps in understanding and managing marine biodiversity.

The benthic and coastal ecosystem types of Namibia were mapped as part of the Benguela Current Commission's Spatial Biodiversity Assessment (BCC-SBA) (Holness, et al., 2014) to develop assessments of the ecosystem threat status and ecosystem protection level. Submarine canyons were also mapped as biodiversity features, although descriptions of their geographical situations were not sufficiently accurate for inclusion in the benthic habitat map⁴³ (see Figure 5-19). The benthic and coastal ecosystems were subsequently assigned an ecosystem threat status based on their level of protection and ecological condition (see Table 5-2). Further information of the delineation/classification of ecosystem types, as well as assessment of their threat status, is presented in Holness et al. (2014).

PEL0056/Block 2913B and the Venus offshore project area overlaps with the Namib Lower Slope ecosystem, which is classified as 'Least Threatened'. The nearshore transshipment location overlaps with the 'Least Threatened' Kuiseb Inshore and Central Namib Inner Shelf ecosystems.

Table 5-2: Ecosystem types, threat status and size for marine ecosystem types on the Namibian coast (adapted from Holness et al. 2014).

Ecosystem Type		Threat Status	Area (km ²)
1	Namib Abyss	Least Threatened	80 094
2	Namib Lower Slope	Least Threatened	1 380 13
3	Namib Upper Slope	Least Threatened	59 066
4	Namib Seamount	Least Threatened	26 83
5	Namaqua Shelf Edge	Endangered	44 40
6	Namaqua Outer Shelf	Least Threatened	175 29
7	Namaqua Inner Shelf	Least Threatened	69 48
8	Namaqua Inshore	Vulnerable	445
9	Lüderitz Shelf Edge	Critically Endangered	8 755
10	Lüderitz Outer Shelf	Vulnerable	18 470
11	Lüderitz Inner Shelf	Least Threatened	6 291
12	Lüderitz Islands	Least Threatened	1 332
13	Lüderitz Inshore	Least Threatened	356
14	Kuiseb Inshore	Least Threatened	29
15	Central Namib Outer Shelf	Endangered	409
16	Central Namib Inner Shelf	Least Threatened	382
17	Central Namib Shelf Edge	Vulnerable	328

Note: Habitat potentially affected by proposed drilling and production activities are in **bold**.

The typical biological communities found in the habitats represented in PEL0056/Block 2913B are and the nearshore transshipment area briefly described below, highlighting dominant, commercially valuable, and conspicuous species, as well as potentially vulnerable species that may be impacted by the proposed development project.

⁴³ Possible marine canyons identified by the international Deep Ocean project mapped them as lines. The lines were buffered by 5 km to ensure that both the canyon and its associated adjacent ecosystems were included.



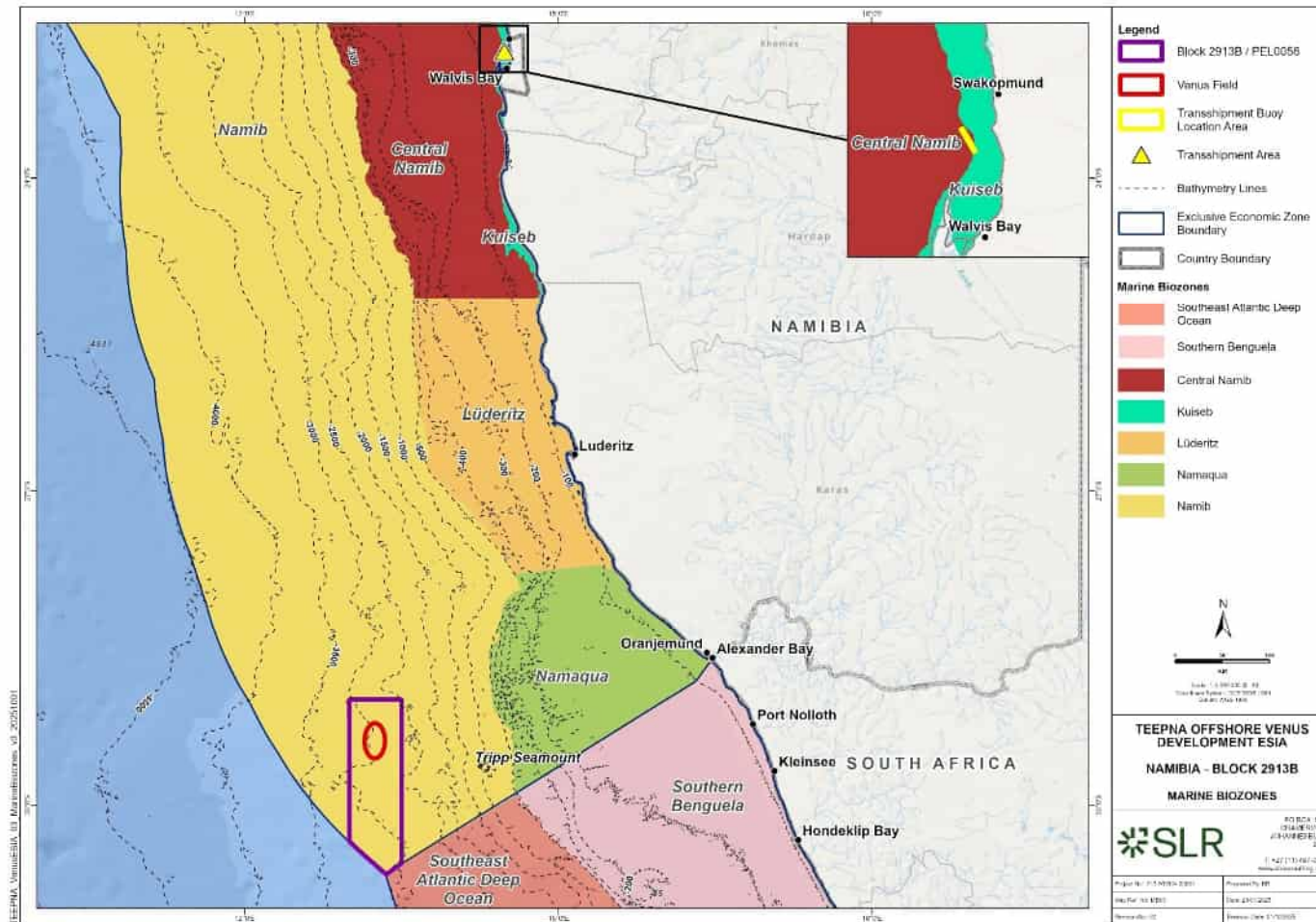


Figure 5-18: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (yellow triangle) in relation to the Namibian marine biozones and adjacent South African marine ecoregions.

Source: Adapted from De Cauwer (2007), MFMR (2021) and Sink et al. (2019)



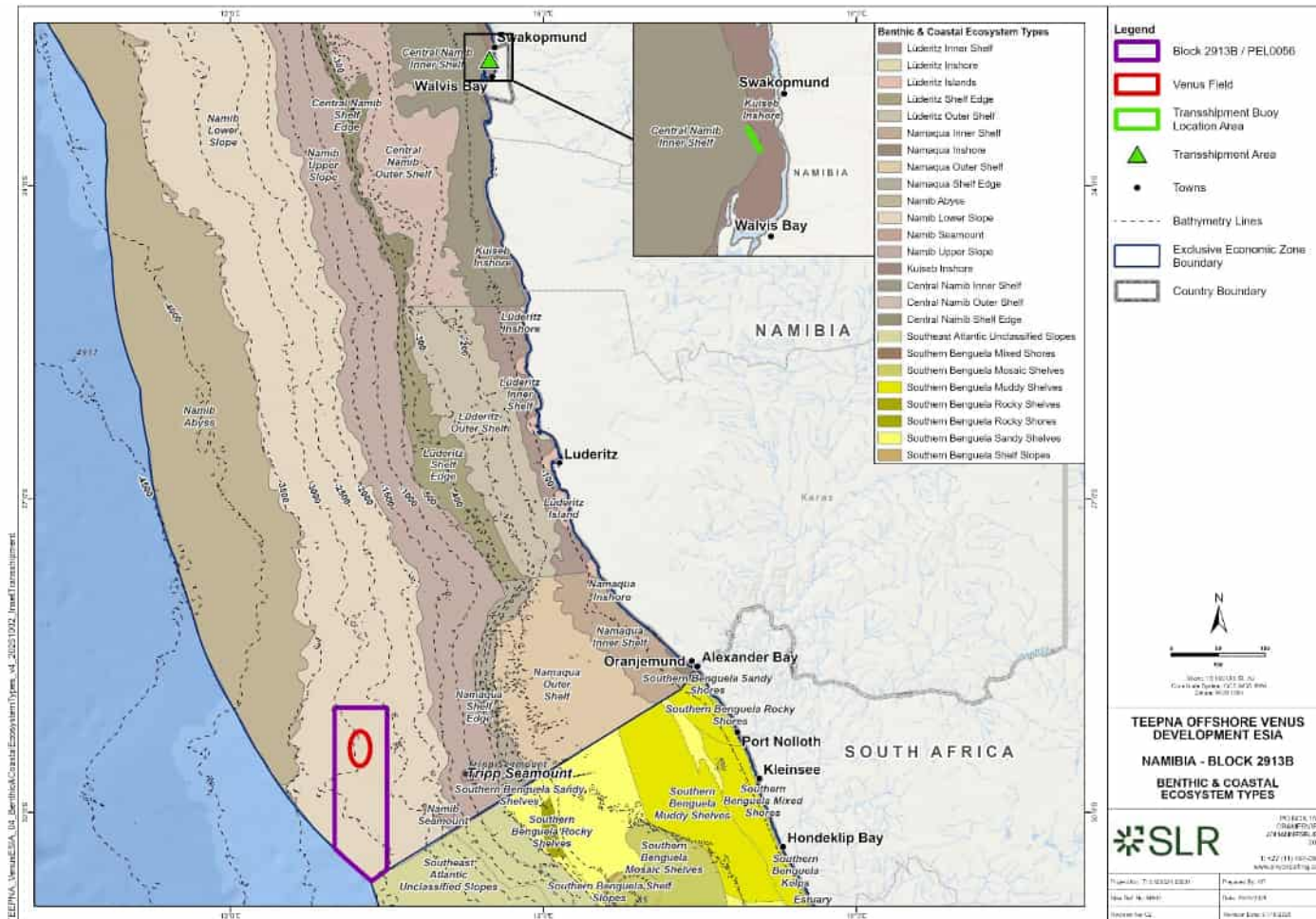


Figure 5-19: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the Namibian benthic and coastal ecosystem types and adjacent South African substratum types.

Source: Adapted from Holness et al. (2014) and Sink et al. (2019)



5.5.1 Demersal Communities

5.5.1.1 Benthic Invertebrate Macrofauna

The benthic biota of unconsolidated marine sediments comprises mainly invertebrates that either live on the sediment surface (epifauna) or within the sediment (infauna). These are further categorized by size into meiofauna (<1 mm), macrofauna (> 1 mm) and megafauna (>10 mm). Benthic macrofauna are essential for various ecological functions, including the remineralization of organic matter and maintaining sediment stability. They also serve as a food source for commercially important fish species and other higher trophic level organisms. Due to their relatively limited mobility and seasonal permanence, these organisms offer valuable insights into historically recent (months) environmental conditions and changes therein serving as indicators for assessing environmental impacts (Gray J. , 1974; Warwick, 1993; Salas, Marcos, Patricio, Perez-Ruzafa, & Marques, 2006). Temperature, depth, hydrogen sulphide and dissolved oxygen seem to be significant forces shaping macrozoobenthic communities within the Namibian shelf (Amorim & Zettler, 2023). Benthic megafauna includes large organisms such as demersal fish, crabs, shrimp, starfish, sea urchins, gastropods and are typically predators on macrobenthos and scavengers.

Numerous studies have been conducted to assess the continental shelf benthos offshore of South Africa and Namibia (Steffani & Pulfrich, 2004; Steffani & Pulfrich, 2007; Atkinson, 2009; Atkinson, Field, & Hutchings, 2011; Steffani, 2011; Steffani, 2012a; Steffani, 2012b; Steffani, 2014; Karenyi, 2014; Steffani, Sedick, Rogers, & Gibbons, 2015; Biccard & Clark, 2016; Biccard, Clark, & Brown, 2016; Duna, et al., 2016; Karenyi, Sink, & Nel, 2016; Biccard, et al., 2017; Biccard A. , et al., 2018; Gihwala, et al., 2018; Biccard A. , et al., 2019; Gihwala, et al., 2019). These have been focused on mining, pollution or demersal trawling impacts on the continental shelf and in nearshore regions. For a review of the benthic macroinvertebrates present inshore of the 1 000 m depth contour in South Africa, the reader is referred to the comprehensive field guide compiled by Atkinson & Sink (2018).

Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast of southern Africa. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments (Kendall & Widdicombe, 1999; Van Dalsen, et al., 2000; Zajac, et al., 2000; Parry, Kendall, Pilgrim, & Jones, 2003; Kenny, Rees, Greening, & Campbell, 1998), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich, 2004).

Karenyi et al. (2016) found that off the Namaqualand Coast, South Africa, species richness increases from the inner shelf across the mid-shelf and is influenced by sediment type. The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (± 50 g/m² wet weight) and decreases across the mid-shelf averaging around 30 g/m² wet weight. Similarly recent benthic sampling along the Namaqua inner shelf ecozone, offshore southern Namibia, yielded an average biomass of 31.6-38.9 g/m² (Biccard A. , et al., 2020).

This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay in South Africa, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those off the northern Namaqualand coast. Sheltered bays along the West Coast of South Africa yielded notably higher biomass (846.53-970.78 g/m²) (Clark, et al., 2020).

In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The



combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure. On the continental shelf slope and deeper regions, near-bottom conditions are oligoxic (Berg et al. 2015), with benthic communities characterised by greater stability and longer-lived species.

Amorim & Zettler (2023) provide a comprehensive study on the distribution of macrofaunal assemblages of the Oxygen Minimum Zone (OMZ) in the northern Benguela system off Namibia, using samples collected along three transects at depths between 25 m and 1 523 m. In general, the study reported high total biomass compared to OMZs worldwide. The assemblages on the shelf break (132 and 306 m) displayed intermediate diversity, abundance and biomass, and diversity was highest within the shallower and deeper assemblages. Biomass levels generally decreased offshore.

Hashim et al. (2024)) conducted a complementary study offshore central Namibia, focusing on a transect off Walvis Bay (23°S) that included three stations at increasing depths (39 m, 128 m and 318 m). Their research emphasized the role of the benthic oxygen gradient in shaping macrofaunal distribution and diversity, a pattern also noted by Zettler et al. (2013) and Teuber et al. (2013). Based on oxygen concentrations, three distinct zones were identified: microxic ($< 0.1 \text{ mL L}^{-1}$), dysoxic ($0.1\text{--}1.0 \text{ mL L}^{-1}$), and oxic ($> 1.0 \text{ mL L}^{-1}$). Across these zones, 20 macrobenthic taxa were recorded, with Nematoda, Polychaeta, Cumacea, and Oligochaeta being the most prevalent. Notably, 18 genera of macro-nematodes were identified, with *Desmolaimus* and *Paracomesoma* consistently dominating across all oxygen conditions. While Polychaeta are typically the most abundant taxon in both oxic and hypoxic environments (Eisenbarth & Zettler, 2016; Soto et al., 2017), this study found them to be dominant only in oxic zones, suggesting a more fine-scale response to oxygen availability.

In the subtidal zone off Walvis Bay, benthic communities are characterised by a diverse assemblage of polychaetes and bivalves, alongside ophiuroids, ostracods, amphipods, and cumaceans. Hooks and Duvenhage (2013) documented 21 species, noting a trend of increasing abundance along a depth gradient from approximately 20 m to 5 m. As with Hashim et al. (2024) cumaceans (*Iphinoe africana*) and polychaetes (*Prionospio sexoculata*) were the most dominant taxa, while meiofaunal diversity was largely driven by nematodes. In contrast, a later study by Laird et al. (2018) recorded only nine species, four of which were segmented polychaetes, with overall abundance and biomass markedly reduced. This decline in macrofaunal diversity and density is likely linked to dredging activities within the bay that occurred between the two sampling periods, although episodic low-oxygen conditions (as described in Section 5.4.8) may also have played a role.

Considering the low-oxygen conditions anticipated (as described in Section 5.4.5) and proximity to the aforementioned studies **similar macrobenthic community structures may be present in the nearshore transshipment area.**

Information on the benthic fauna of the lower continental slope and abyss (beyond 1 800 m depth) is largely lacking due to limited opportunities for sampling. However, deep water benthic sampling has been undertaken within PEL0056/Block 2913B (see Section 5.2), and adjacent Blocks 2913A and 2914A located east of PEL0056/Block 2913B (SLR, 2022, 2023, 2024a, 2024b).

Dominant taxa observed across Licence Block 2914A (200 m to 1800 m deep), included brittlestars (*Ophiuroidea*), sea pens (*Pennatulioidea*) and sea cucumbers (*Holothuroidea*), including *?Benthothuria* sp., *?Benthodytes* sp. and *Enypniastes eximia*, with evidence of infaunal taxa found. Two macrofaunal communities, associated with Tripp Seamount and soft-substrate habitats, respectively, were identified in Block 2913A (~400 to 2 600m deep). Dominant taxa across the survey area were associated with soft sediment habitats, with Annelid genus *Spiophanes* and *Diopatra* identified as the most abundant (SLR, 2024a). Similar communities were observed in PEL0056/Block 2913B, which is expected as



conditions in such deep-water habitats tend to be uniform (low temperatures and low oxygen concentrations characteristic of the SACW).

Benthic surveys in PEL0056/Block 2913B (2 600-3 300 m deep) revealed consistent yet impoverished (low diversity and abundance) macrofauna dominated by polychaetes, molluscs, and crustaceans (BSL, 2019a; BSL, 2023a; BSL, 2023b). The deposit-feeding polychaete, *Spiophanes* sp., was the most abundant species, highlighting the prevalence of deposit feeders in soft sediments. Additional dominant polychaetes recorded included *Aricidea* (*Acmira*) simplex, *Myriochele* sp., *Leanira quaterfagesi* and *Opheliidae* sp., with molluscs (*Microgloma mirmidina*, *Pristigloma nitens* and *Axinulus* sp.) also found to dominate. In addition, crustaceans and echinoderms were observed. Overall, a similar number of species were identified during both the pre- and post-drill surveys (2018 Venus-1X EBS and 2022 Venus-1X EPOS) of the Venus offshore project area (pre-drill mean $16 \pm 7SD$; post-drill mean $18 \pm 4SD$) (BSL, 2019a; 2023a; 2023b). Except for the carnivorous polychaete *Glycera capitata*, most species were suspension or deposit feeders typical of soft unconsolidated sediments.

All pre- and post-drill stations surveyed across the Venus-1X and PEL0056/Block 2913B area were representative of the habitat ‘Atlantic abyssal mud’ (EUNIS: MG62), based on the European Nature Information System (EUNIS)⁴⁴ classification, particle size analysis, macrofauna return and video footage/photographic evidence. Atlantic abyssal mud habitats are described by EUNIS as “*Deep-sea mud sediments have a diverse infaunal community dominated by polychaetes. Epifauna tends to be sparse, mobile species, but aggregations of erect fauna such as glass sponges, sea pens and soft corals can occur*” (BSL, 2019a; 2023b).

Examples of the macroinvertebrate infauna of the project area are illustrated in Figure 5-20.

5.5.1.2 Deep-water Coral Communities

There has been increased interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders typically occur at depths exceeding 150 m, with some species recorded as deep as 3 000 m. They vary in size, forming either reefs or smaller solitary structures. Corals enhance biodiversity by adding structural complexity to otherwise uniform seabed habitats (Breeze, Davis, Butler, & Kostylev, 1997; MacIsaac, Bourbonnais, Kenchington, Gordon, & Gass, 2001). Deep-water corals thrive beneath the thermocline, where a consistent supply of concentrated particulate organic matter is maintained by strong currents and eddies formed over topographic features. Nutrient seepage from the substratum further promotes settlement (Hovland, Vasshus, Indreeide, Austdal, & Nilsen, 2002). The productive and substantial shelf areas in the Benguela region have potential to support rich, cold water, benthic, filter-feeding communities. Evidence from video footage taken on hard-substrate habitats at depths of 100-120 m off southern Namibia suggests that sensitive gorgonians, octocorals and reef-building sponges occur on the continental shelf. Additionally, a recent EBS undertaken in adjacent Block 2913A, identifying gorgonian corals (Octocorallia), hydrocorals (Anthoathecata), stony corals (Scleractinia), zoanthids, and possible black coral (Antipatharia) at depths between approximately 160-2 600 m (SLR, 2024a). Additionally, small stony corals (Scleractinia) and raised coral rubble outcrops were identified at Tripp

⁴⁴ The EUNIS marine habitat classification system categorizes and describes various marine habitats, providing a hierarchical framework that supports biodiversity monitoring, and environmental reporting. The EUNIS classification system uses several input variables including physical characteristics, biological features, environmental parameters and geographic information.



Seamount at depths between 160-500 m (located 85 km east of the Licence Block) (SLR, 2024a). Similar communities could be expected near topographic features at these depths.

During a habitat assessment within Licence Block 2914A (located 48 km inshore of PEL0056/Block 2913B), dead fragments of what was thought to be hard coral were identified from two of the shallower stations in the north-east of the survey area, but there was no evidence of living hard coral from these or other stations (SLR, 2024b). Fossilised cold water coral reefs are known to occur on the Namibian shelf at water depths of between 160 m and 270 m; these are thought to have died in an extinction event approximately 4 500 years ago, but fragments are still widespread within shelf sediments (Tamborrino, et al., 2019). Dead coral fragments were not recorded during 2022 EBS surveys within PEL0056/Block 2913B.

No deep-water corals, colony forming corals or structural features (e.g., rocky outcrops) were observed during EBS and geophysical surveys within PEL0056/Block 2913B (see Section 5.2), with the observed homogenous, ‘Sandy Mud’/ ‘Muddy’ sediments likely restricting the establishment of these cold-coral communities.

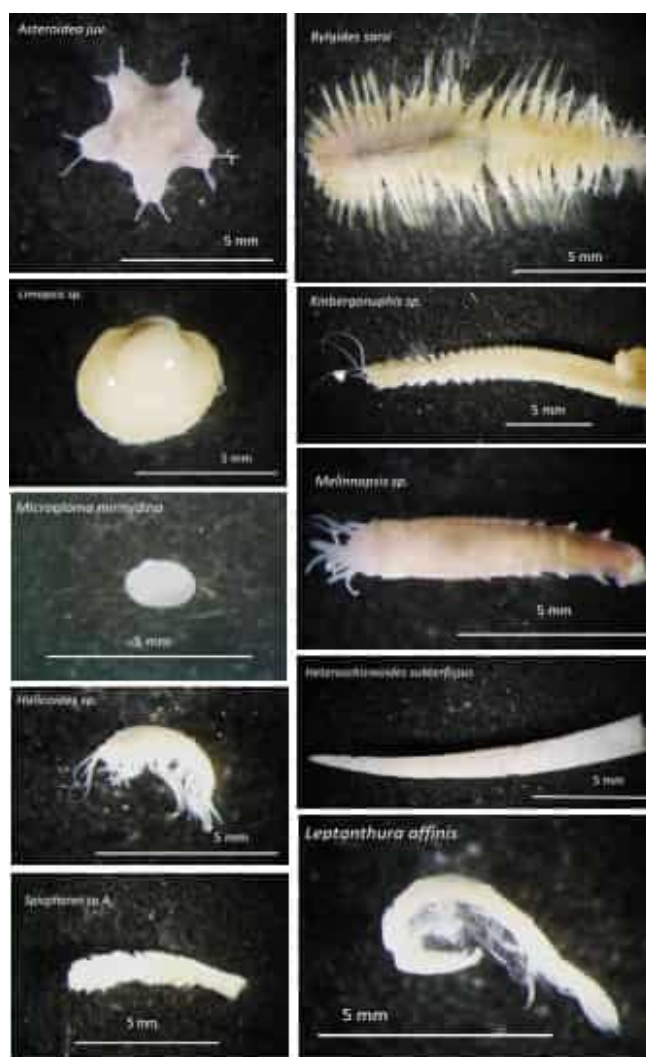


Figure 5-20: Examples of benthic macroinvertebrate specimens recorded within PEL0056/Block 2913B

Source: (BSL, 2019a)



5.5.1.3 Demersal Fish

Demersal fish are those species that live and feed on or near the seabed. As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf off southern Namibia (Roel, 1987). Changes in fish communities occur both latitudinally (Shine K. , 2006; Shine K. H., 2008; Yemane, 2015) and with increasing depth (Roel, 1987; Smale, Roel, Badenhorst, & Field, 1993; MacPherson & Gordoa, 1992; Bianchi, Hamukuaya, & Alvheim, 2001; Atkinson L. J., 2009), with the most substantial change in species composition occurring in the shelf break region between depths of 300 m and 400 m (Roel, 1987; Atkinson, 2009).

The shelf community (<350 m) is dominated by the Cape hake (*Merluccius capensis*), and includes jacobever (*Helicolenus dactylopterus*), Izak catshark (*Holohalaelurus regain*), soupfin shark (*Galeorhinus galeus*) and whitespotted houndshark (*Mustelus palumbes*). The more diverse deeper water community is dominated by the deepwater hake (*M. paradoxus*), monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*), bronze whiptail (*Lucigadus ori*) and hairy conger (*Bassanago albescens*) as well as cephalopod species (such as squid and cuttlefishes) and squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges shelf communities, with species such as the pelagic goby (*Sufflogobius bibarbatus*), and West Coast sole (*Austroglossus microlepis*) occurring in shallow water during summer only. The deep-sea community was found to be homogenous both spatially and temporally. In a more recent study, however, Atkinson (2009) identified two long-term community shifts in demersal fish communities; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables (Sea Surface Temperatures and upwelling anomalies) (Howard, Jarre, Clark, & Molo, 2007) and with the eastward shifts observed in small pelagic fish species and rock lobster populations (Coetzee, Van der lingen , & Hutchings, 2008; Cockroft, Schoeman, Pitcher, Bailey, & Van Zyl, 2000).

The diversity and distribution of demersal cartilaginous fishes on the southern African west coast was discussed by Compagno, et al. (1991). The species that may occur on the continental shelf inshore of the Venus offshore project area, and their approximate depth range, are listed in Table 5-3, **with several of these species potentially encountered during vessel transit and nearshore transshipment operations.**

Information on demersal and cartilaginous fish species beyond the shelf break is lacking. Typical upper and mid slope fishes (200 to 2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus* species), notacanthids, halosaurs, chimaeras, skates, bythitids such as *Cataetys* spp. and morids (deep-sea cods) (Smith & Heemstra, 2003) lower slope fishes include rattails, bythitids, liparidae (snail fishes) and notacanthids (*Polyacanthonotus* species and halosaurs) (Iwamoto & Anderson, 1994; Jones D. , 2014).

Fish species, such as eel-shaped fishes (Halosauridae sp.), rat-tails (Macrouridae sp.), tripod fishes (Ipnopidae sp.), cusk-eels (Ophidiidae sp.) and larvacean houses (Appendicularia sp.), were recorded by video transects during the PEL0056/Block 2913B EBS survey (BSL, 2023a).



Table 5-3: Demersal cartilaginous species found on the continental slope along the southern African west coast and their IUCN (International Union for the Conservation of Nature) conservation status.

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Friilled shark	<i>Chlamydoselachus anguineus</i>	200-1 000	LC
Six gill cowshark	<i>Hexanchus griseus</i>	150-600	NT
Gulper shark	<i>Centrophorus granulosus</i>	480	EN
Leafscale gulper shark	<i>Centrophorus squamosus</i>	370-800	EN
Bramble shark	<i>Echinorhinus brucus</i>	55-285	EN
Black dogfish	<i>Centroscyllium fabricii</i>	>700	LC
Portuguese shark	<i>Centrosymnus coelolepis</i>	>700	NT
Longnose velvet dogfish	<i>Centrosymnus crepidater</i>	400-700	NT
Birdbeak dogfish	<i>Deania calcea</i>	400-800	NT
Arrowhead dogfish	<i>Deania profundorum</i>	200-500	NT
Longsnout dogfish	<i>Deania quadrispinosa</i>	200-650	VU
Sculpted lanternshark	<i>Etmopterus scultus</i>	450-900	LC
Brown lanternshark	<i>Etmopterus compagnoi</i>	450-925	LC
Southern Lanternshark	<i>Etmopterus granulosus</i>	>700	LC
Smooth lanternshark	<i>Etmopterus pusillus</i>	400-500	LC
Spiny dogfish	<i>Squalus acanthias</i>	100-400	VU
Shortnose Spurdog	<i>Squalus megalops</i>	75-460	LC
Shortspine Spurdog	<i>Squalus mitsukurii</i>	150-600	EN
Warren's Sixgil Sawshark	<i>Pliotrema warreni</i>	60-500	LC
Goblin shark	<i>Mitsukurina owstoni</i>	270-960	LC
Smalleye catshark	<i>Apristurus microps</i>	700-1 000	LC
Saldanha catshark	<i>Apristurus saldanha</i>	450-765	LC
"grey/black wonder" catsharks	<i>Apristurus</i> spp.	670-1 005	NA
Tiger catshark	<i>Halaehurus natalensis</i>	50-100	VU
Izak catshark	<i>Holohalaehurus regani</i>	100-500	LC
Yellowspotted catshark	<i>Scyliorhinus capensis</i>	150-500	NT
Soupfin shark/Tope	<i>Galeorhinus galeus</i>	<10-300	CR
Common smoothhound/ Houndshark	<i>Mustelus mustelus</i>	<100	EN
Whitespot smoothhoundshark	<i>Mustelus palumbes</i>	>350	LC
Lesser guitarfish	<i>Acroteriobatus annulatus</i>	>100	VU
Great Torpedo Ray	<i>Torpedo nobiliana</i>	120-450	LC
African softnose skate	<i>Bathyraja smithii</i>	400-1 020	LC
Smoothnose pygmy skate	<i>Cruriraja durbanensis</i>	>1 000	DD
Roughnose/triangular legskate	<i>Cruriraja parcomaculata</i>	150-620	LC
South African dwarf skate	<i>Neoraja stehmanni</i>	290-1 025	LC



Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Thorny skate	<i>Raja radiata</i>	50-600	VU
Bigmouth skate	<i>Raja robertsi</i>	>1 000	LC
Slime skate	<i>Dipturus pullopunctatus</i>	15-460	LC
Roughbelly skate	<i>Raja springeri</i>	85-500	LC
Yellowspot skate	<i>Raja wallacei</i>	70-500	VU
Roughskin skate	<i>Dipturus trachydermus</i>	1 000-1 350	EN
Biscuit skate	<i>Raja straeleni</i>	25-500	NT
Munchkin skate	<i>Rajella caudaspinosa</i>	300-520	LC
Bigthorn skate	<i>Raja confundens</i>	100-800	LC
Ghost skate	<i>Rajella dissimilis</i>	420-1 005	LC
Leopard skate	<i>Rajella leopardus</i>	300-1 000	LC
Smoothback skate	<i>Rajella ravidula</i>	500-1 000	LC
Spearnose skate	<i>Rostroraja alba</i>	75-260	EN
St Joseph	<i>Callorhinchus capensis</i>	30-380	LC
Cape chimaera	<i>Chimaera notaficana</i>	680-1 000	LC
Brown chimaera	<i>Chimaera carophila</i>	420-850	LC
Atlantic Longnose Chimaera/ Broadnose Chimaera	<i>Rhinochimaera atlantica</i>	650-960	LC

Notes: DD = Data Deficient, LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NA = Not Assessed.

Source: Compagno et al. (1991) and IUCN

5.5.2 Seamount Communities

Seamounts, including banks, knolls, and protruding underwater features interact with the surrounding water currents. There are several seamounts located outside of the PEL0056/Block 2913B, the closest being Tripp Seamount, 85 km east. These formations can cause upwelling of cool, nutrient-rich water amidst nutrient-poor surface water, resulting in higher productivity (Clark, O'Shea, Tracey, & Glasby, 1999). This phenomenon shapes the distribution and occurrence of organisms in and around seamounts, causing diverse and abundant bottom-associated communities.

Seamounts serve as vital habitats for deep-sea commercial fish stocks such as orange roughy, oreos, alfonsino, and Patagonian toothfish, aggregating for spawning or feeding (Koslow, 1996). They also attract a variety of predators like turtles, tunas, billfish, pelagic sharks, cetaceans, and seabirds, creating mid-ocean focal points for pelagic species (Hui, 1985; Haney, Hauray, Mullineaux, & Fey, 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for many species (SPRFMA, 2007; Derville, Torres, Zerbini, Oremus, & Carrigue, 2020).

Seamounts, characterised by enhanced currents, steep slopes, and volcanic rocky substrata, support suspension feeders such as deep- and cold-water corals, barnacles, bryozoans, molluscs, and sponges, enriching benthic communities (Rogers A. , 1994; Rogers A. , 2004). There are also associated mobile benthic fauna including echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994). Corals create refugia, adding structural complexity and fostering high biological diversity as discussed in Section 5.5.1.2.



Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant, and diverse fauna, with many species likely unidentified. Consequently, associated fauna is usually highly unique and may be restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers, Clark, & Gjerde, 2008). As a result of conservative life histories (i.e., very slow growing, slow to mature, high longevity, low levels of recruitment, endemic species) and sensitivity to changes in environmental conditions, such biological communities are often identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO, 2008).

5.5.3 Pelagic (Water Column) Communities

In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the open water column. The pelagic communities are typically divided into plankton and fish, and their main predators: marine mammals (seals, dolphins, and whales), seabirds and turtles. These are discussed separately below.

5.5.3.1 Plankton

Plankton is associated with the upwelling characteristic of the region and is therefore particularly abundant in the shelf waters off Namibia, within 100 km of the coast. Plankton range from single-celled bacteria to jellyfish of 2 m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton (see Figure 5-21) (see Sections 5.4.6 & 5.4.9).

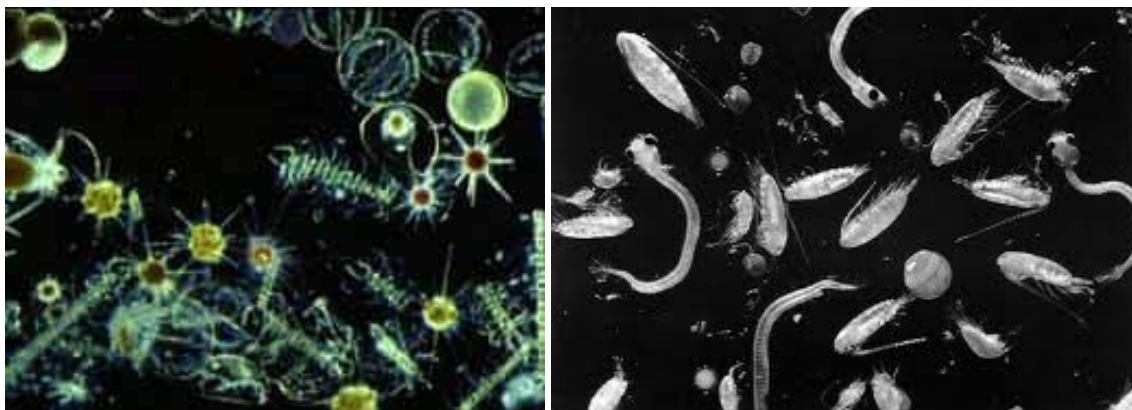


Figure 5-21: Phytoplankton (left) and zooplankton (right) associated with upwelling cells.

Source: hymagazine.com and mysciencebox.org

Off the Namibian coastline, phytoplankton are the principal primary producers with mean annual productivity at 2 g C/m²/day (Barnard, 1998). Diatoms dominate as they are adapted to the turbulent sea conditions. Diatom blooms occur after upwelling events, whereas dinoflagellate blooms more commonly occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Zooplankton abundance reaches a maximum further offshore than the phytoplankton maximum along the Namibian coastline. Samples collected over a full seasonal cycle (February to December) along a 18 to 167 km transect offshore Walvis Bay showed that the mesozooplankton (<2 mm body width) community included egg, larval, juvenile and adult stages of copepods, cladocerans, euphausiids, decapods, chaetognaths, hydromedusae



and salps, as well as protozoans and meroplankton larvae (Hansen, Cloete, & Verheye, 2005). Copepods were the dominant group making up 70–85% of the zooplankton. The hydrography, phytoplankton, and zooplankton demonstrate close coupling, with zooplankton biomass tracking upwelling intensity and phytoplankton biomass. Following upwelling peaks, there is a lag time of 3-8 weeks when copepods respond to the environmental conditions and increase in abundance (Hansen, Cloete, & Verheye, 2005). Consistently higher biomass of zooplankton occurs offshore to the west and north-west of Walvis Bay (Barnard, 1998).

Vertical trawl and water sampling conducted in PEL0056/Block 2913B recorded 8 phyla (principal taxonomic category), with Arthropoda found to be the dominant group, followed by Chaetognathes, Ophiuroid larvae and Cnidaria. Copepods were dominant amongst the Arthropoda, representing the majority of species recorded (BSL, 2019a; BSL, 2023a).

Ichthyoplankton constitutes the fish eggs and larvae. As the preferred spawning grounds of numerous commercially exploited fish species are located off central and northern Namibia (see Figure 5-22), their eggs and larvae form an important contribution to the ichthyoplankton in the region.

The Lüderitz Upwelling Cell - Orange River Cone (LUCORC) area, south of the Lüderitz upwelling cell between approximately 28°S- 31°S, is an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling (Hutchings, et al., 2002; Lett, Veitch, Van Der Lingen, & Hutchings, 2007). Areas of intense upwelling are considered unfavourable spawning habitats due to intense offshore advection and low phytoplankton levels. Despite good nutrient supply, phytoplankton levels are reduced in these regions due to high turbulence and deep mixing (Lett, Veitch, Van Der Lingen, & Hutchings, 2007). Pelagic fish species, such as anchovy, redeye round herring, horse mackerel and shallow-water hake, spawn on either side of the LUCORC area, but not within it (see Figure 5-22) (Lett, Veitch, Van Der Lingen, & Hutchings, 2007). Ichthyoplankton abundance is expected to be high in the nearshore waters offshore Walvis Bay, with the nearshore transshipment area overlapping with the spawning areas of sardine, horse mackerel, kob and monk fish (see Figure 5-22). Notably, only a single fish larvae was recorded during EBS surveys of PEL0056/Block 2913B (BSL, 2019a), with the Venus offshore project area located well offshore of spawning areas and ichthyoplankton drift (see Figure 5-22).

Orange roughy fish aggregate and spawn at several discrete locations along the continental slope (Figure 5-22). The species has a short, intense spawning period of about a month from July to August (Boyer & Hampton, 2001). Spawning is thought to occur near Tripp seamount, 85 km east of in PEL0056/Block 2913B, and in the fishery's Quota Management Area, "Johnnies", over 75 km northeast of PEL0056/Block 2913B. Eggs are fertilised in the water column, and then drift upwards to a depth of approximately 200 m and remain planktonic until they lose buoyancy and hatch close to the bottom after approximately 10 days (Branch 2001). During the spawning period orange roughy eggs could drift into the pelagic waters of PEL0056/Block 2913B, however egg distribution is extremely patchy, decreasing over 10-15 km to just 0.1% of the density in spawning centres (Branch, 2001). The orange roughy fishery has been closed since 2007 due to overexploitation.

EBS findings (see Section 5.2) indicate that the abundance of phytoplankton, zooplankton and ichthyoplankton in PEL0056/Block 2913B is low. This is expected as the block is removed from coastal upwelling processes, spawning and ichthyoplankton drift.

The abundance of phytoplankton, zooplankton and ichthyoplankton in nearshore areas is expected to be greater than the Venus offshore project area, owing to the proximity to coastal upwelling and spawning processes and ichthyoplankton drift.



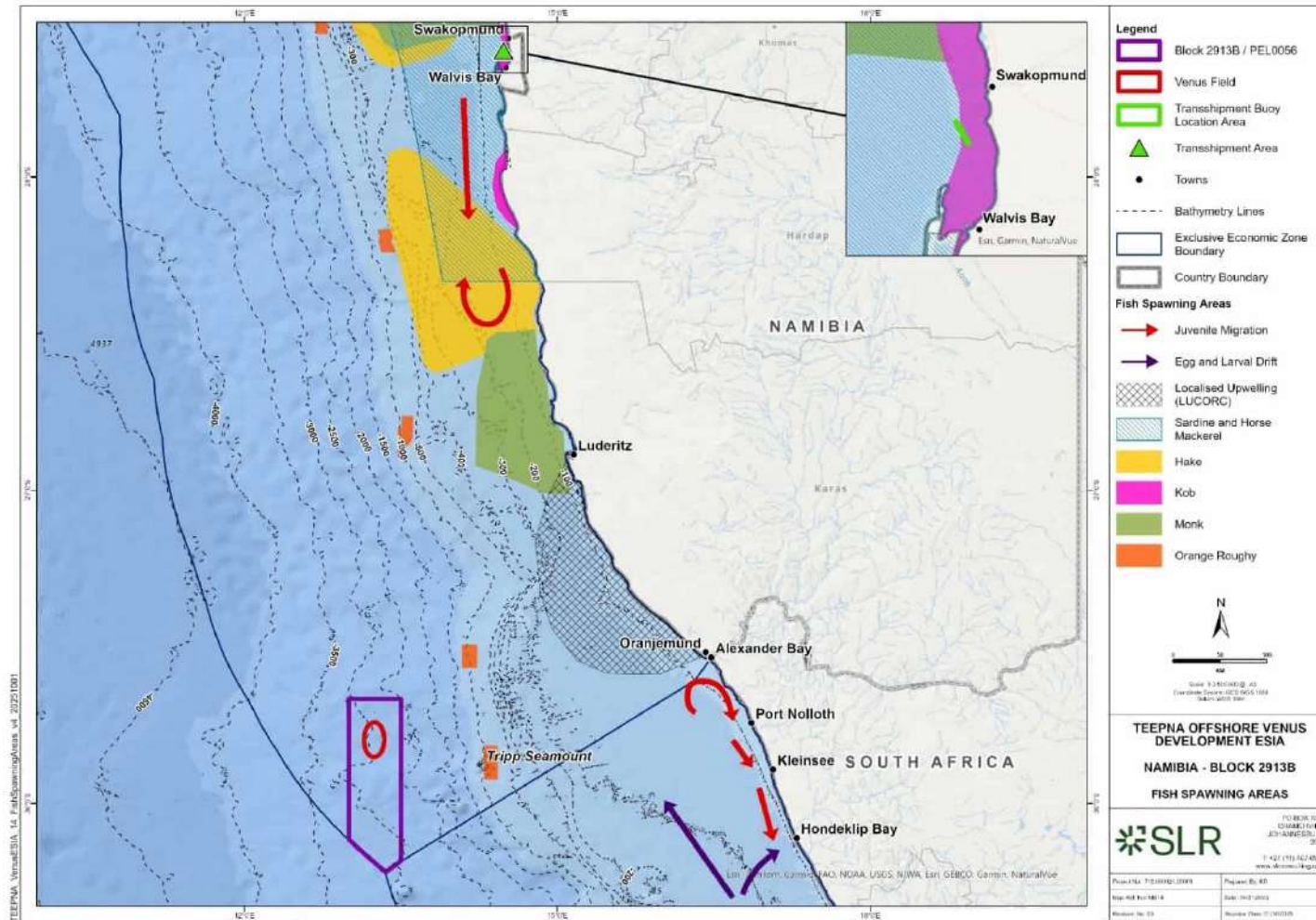


Figure 5-22: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to major spawning areas in the Benguela region.

Source: Adapted from Cruikshank (1990); Hampton (1992) and MFMR (2021).



5.5.3.2 Cephalopods

Fourteen species of cephalopods have been recorded in the southern Benguela, the majority of which are sepioids/cuttlefish (Lipinski, 1992; Augustyn, Lipinski, & Roeleveld, 1995). Most of the cephalopod resource is distributed on the mid-shelf to depths of 500 m, with a higher biomass in summer months. Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn, Lipinski, & Roeleveld, 1995). They form an important food item for demersal fish.

The colossal squid (*Mesonychoteuthis hamiltoni*) and the giant squid (*Architeuthis* sp) are rare deep-dwelling species, with the colossal squid distributed across the entire circum-Antarctic Southern Ocean, and the giant squid usually found near continental and island slopes worldwide. Growing to more than 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whales, pilot whales, elephant seals and sleeper sharks. Very little is known of their vertical distribution, but data from trawled specimens and Sperm whale diving behaviour suggest they may span a depth range of 300-1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies. Occasionally, carcasses of giant squids have washed up on South African and Namibian beaches, with 60 specimens known.

While both species could occur in the pelagic waters within PEL0056/Block 2913B, the likelihood of encounter in the project area is low. Similarly, due to their preference for deeper offshore habitats, their occurrence in the nearshore waters of the transshipment area is deemed unlikely.

5.5.3.3 Pelagic Fish

Small pelagic species include the sardine/pilchard (*Sardinops sagax ocellatus*) (see Figure 5-23, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (see Figure 5-23, right) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford, Shannon, & Pollock, 1987) and generally occur within the 200 m contour, although they may often be found very close inshore, just beyond the surf zone. They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried up the coast in northward flowing waters. Historically, two seasonal spawning peaks for pilchard occurred: the first from October to December in an inshore area between Walvis Bay and Palgrave Point and the second from February to March near the 200 m isobath between Palgrave Point and Cape Frio. However, since the collapse of the pilchard stock, spawning in the south has decreased (Crawford et al. 1987). Recruitment success relies on the interaction of oceanographic events and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small pelagic fish is highly variable both within and between species. The Namibian pelagic stock is currently considered to be in a critical condition due to a combination of over-fishing and unfavourable environmental conditions as a result of *Benguela Niños*.

Snoek (*Thyrstites atun*) and chub mackerel (*Scomber japonicas*), both rated as 'Least Concern' during the South African national assessment (Sink, et al., 2019) migrate along the southern African west coast following the shoals of sardine and anchovy. Their appearance along the Namibian coast is highly seasonal. Snoek are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. The abundance and seasonal migrations of chub mackerel are thought to be related to the availability of their shoaling prey species (Payne & Crawford, 1989). **These inshore pelagic species may be encountered within the shallower waters of the nearshore transshipment area.**





Figure 5-23: Cape fur seal preying on a shoal of sardine (left). School of horse mackerel (right).

Source: www.underwatervideo.co.za; www.delivery.superstock.com

The pelagic fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of PEL0056/Block 2913B are the large migratory species, including various tunas, billfish and sharks, many of which are considered Threatened by the IUCN, primarily due to overfishing (see Table 5-4).

Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Off the southern African west coast, fishers typically follow the movement of longfin tuna from the southern Benguela waters northwards into southern and central Namibia (see Section 5.7.5 for further details). This movement occurs from mid to late summer (January to March) at which time aggregations may occur around or near oceanic features, in particular seamounts. Other species movements (e.g., yellowfin and bigeye tuna), which occur spatially and temporally throughout the southeast Atlantic have not been clearly defined, although their availability to the fisheries is believed to increase from later summer into winter (March through to July) (Lehodeya P. , et al., 2006; Lan K. , et al., 2011). Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, which are removed, and the remainder of the body discarded.

Notably, Marine Mammal Observations (MMO) performed *en-route* from Walvis Bay to PEL0056/Block 2913B, between 11 and 16 September 2022, recorded a sunfish (*Mola mola*; IUCN Vulnerable) on two occasions, as well as an unidentified shark (BSL, 2022). Additionally, water eDNA samples collected at eight water stations across PEL0056/Block 2913B identified 40 fish taxa, all of which were ray-finned fish (Actinopterygii) taxa. Species identified included tuna (*Thunnus* sp.), ocean sunfish (*M. mola*), Blackspot seabream (*Pagellus bogaraveo*), cutthroat eel (*Synaphobranchidae* sp.), blackspot bream (*Pagellus baggravea*), flatfish (*Pleuronectidae* sp.), sardine (*Sardinops* sp.) and sea robin (*Triglidae* sp.) (BSL, 2023c), suggesting their possible presence within the offshore waters of PEL0056/Block 2913B.

Changes in the Benguela upwelling region have resulted in two contrasting pelagic ecosystems, one dominated by small pelagic fish (southern Benguela, south of the Lüderitz upwelling cell) and one dominated at the mid-trophic level by jellyfish (northern Benguela, north of the Lüderitz upwelling cell). Since the collapse of the pelagic fisheries, the structure of the Benguelan fish community has shifted, making the bearded goby (*Sufflogobius bibarbatus*) the new predominant prey species. Gobies have a high tolerance for low oxygen and high H₂S levels, which enables them to feed on benthic fauna within hypoxic waters during the day, and then move to oxygen-rich pelagic waters at night, when predation pressure is lower, to feed on live jellyfish (Utne-Palm et al. 2010; van der Bank et al. 2011). Overfishing of planktivorous filter feeding pelagic fish stocks, and their subsequent decline,



is argued to be linked to major jellyfish outbreaks (“jellyfish explosions”), resulting in a shift of the northern Benguela ecosystem to an alternative, jellyfish comminated state (Bakun & Weeks, 2006; Lynam, 2006; Richardson, Bakun, Hays, & Gibbons, 2009; Utne-Palm, et al., 2010; Jensen, Branch, & Hilborn; Roux, et al., 2013).

Table 5-4: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of Namibian waters and their Global IUCN Conservation Status.

Common Name	Species	IUCN Conservation Status
Tunas		
Southern Bluefin Tuna*	<i>Thunnus maccoyii</i>	Endangered
Bigeye Tuna	<i>Thunnus obesus</i>	Vulnerable
Longfin Tuna/Albacore	<i>Thunnus alalunga</i>	Least concern
Yellowfin Tuna	<i>Thunnus albacares</i>	Least concern
Frigate Tuna	<i>Auxis thazard</i>	Least concern
Eastern Little Tuna	<i>Euthynnus affinis</i>	Least concern
Skipjack Tuna	<i>Katsuwonus pelamis</i>	Least concern
Billfish		
Black Marlin	<i>Istiompax indica</i>	Data deficient
Blue Marlin	<i>Makaira nigricans</i>	Vulnerable
Striped Marlin	<i>Kajikia audax</i>	Least Concern
Sailfish	<i>Istiophorus platypterus</i>	Vulnerable
Swordfish	<i>Xiphias gladius</i>	Near Threatened
Pelagic Sharks		
Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	Critically Endangered
Dusky Shark	<i>Carcharhinus obscurus</i>	Endangered
Great White Shark	<i>Carcharodon carcharias</i>	Vulnerable
Shortfin Mako	<i>Isurus oxyrinchus</i>	Endangered
Longfin Mako	<i>Isurus paucus</i>	Endangered
Whale Shark	<i>Rhincodon typus</i>	Endangered
Blue Shark	<i>Prionace glauca</i>	Near Threatened

*Until recently Southern Bluefin Tuna was globally assessed as ‘Critically Endangered’ by the IUCN. Although globally the stock remains at a low state, it is not considered overfished as there have been improvements since previous stock assessments. Consequently, the list of species changing IUCN Red List Status for 2020-2021 now list Southern Bluefin Tuna is globally ‘Endangered’.

The inshore waters of the central and northern Namibian coastline are also home to a number of bony and cartilaginous fish, many of which are popular angling species. In addition to those mentioned above, these include the dusky kob (*Argyrosomus coronus*), white steenbras (*Lithognathus lithognathus*), west coast steenbras (*Lithognathus aureti*), copper shark (*Carcharhinus brachyurus*), the spotted gulley shark (*Triakis megalopterus*) and the smoothhound (*Mustelus mustelus*) (Kirchner et al. 2000; Zeybrandt and Barnes 2001).

A number of the nearshore teleost and chondrichthyan species that may occur in the transshipment area are considered ‘Endangered’, ‘Near Threatened’ or ‘Vulnerable’ (see Table 5-5).



Table 5-5: Important linefish species likely to occur off Central Namibia. The Global IUCN Conservation Status are also provided.

Common Name	Species	IUCN Conservation Status
Teleosts		
Silver kob	<i>Argyrosomus inodorus</i>	Vulnerable
Elf	<i>Pomatomus saltatrix</i>	Vulnerable
West Coast steenbras	<i>Lithognathus aureti</i>	Near threatened
West coast dusky kob	<i>Argyrosomus coronus</i>	Data deficient
Chondrichthyans		
Bronze whaler	<i>Carcharhinus brachyurus</i>	Vulnerable
Six gill shark	<i>Hexanchus griseus</i>	Near threatened
Spotted gullyshark	<i>Triakis megalopterus</i>	Least Concern
Smooth houndshark	<i>Mustelus mustelus</i>	Endangered
Broadnose seven-gill cow shark	<i>Heptranchias perlo</i>	Near threatened

5.5.3.4 Turtles

Five turtle species occur in Namibian waters, namely Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*) and Leatherback (*Dermochelys coriacea*) (Bianchi, et al., 1999). Observations of turtles in the area have been reported but are rare.

Leatherbacks (see Figure 5-24 left) are the only species that frequently inhabit deeper, offshore waters and are considered pelagic species, while the other species are primarily found in continental shelf and coastal waters. **However, the MMO reports for adjacent Block 2814B, northeast of PEL0056/Block 2913B, as well as within PEL0056/Block 2913B have reported loggerhead turtle** (see Figure 5-24 right) sightings during seismic operations. Additionally, recent telemetry data recorded by the South African Two Oceans Aquarium, shows a green turtle and loggerhead turtle recently released on the Cape Peninsula remaining in West Coast waters before heading northwards into Namibian waters, suggesting that occurrence in both offshore and coastal Namibian waters does arise⁴⁵ (see Figure 5-25).

The Benguela ecosystem is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and southeast Indian Ocean (South Africa) (Lambardi, Lutjeharm, Menacci, Hays, & Luschi, 2008; Elwen & Leeney, 2011). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays, et al., 2004). The Southwest Indian Ocean Leatherback subpopulation have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (see Figure 5-26) (Lambardi, Lutjeharm, Menacci, Hays, & Luschi, 2008; Harris, et al., 2018).

⁴⁵ <https://www.aquarium.co.za/foundation/news/tracking-our-turtles-the-first-update-of-2024>





Figure 5-24: Leatherback (left) and loggerhead turtles (right) occur in Namibian waters.

Source: Ketos Ecology 2009; BSL (2022b)

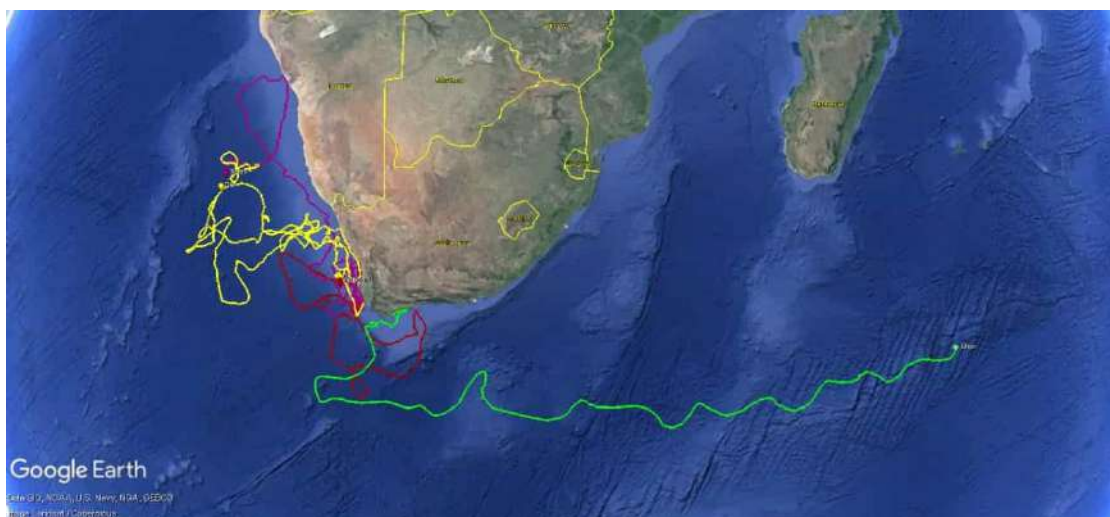


Figure 5-25: Movements of two green (orange and green lines) and loggerhead (purple and red lines) turtles recorded by telemetry (2025).

Source: aquarium.evlinc21.net/public/messages/view-online/sUxLeTchHn1pvYc9/f4ow0OckcO3B4rjT/VFS8EqhUDNyVyLW1

From mid-January to mid-March leatherback hatchlings emerge from their nests along the KwaZulu Natal coastline on the east coast of South Africa. Those which successfully escape predation, enter the sea and either actively swim to reach the Agulhas Current or are carried through coastal rip currents ~10 km offshore (Hughes, 1974). While hatchlings can swim to influence their dispersal trajectories, they are not powerful swimmers. As such hatchlings will primarily drift in a south-west direction, influenced by the Agulhas Current. The Agulhas Current migration corridor is thus expected to be very active with migrating sea turtles between January and April (Harris, et al., 2018), some of which may be distributed along the West Coast through mass transport of Agulhas Current water into the southeast Atlantic. Recent simulations estimate that Leatherback and Loggerhead turtles take between 200 and 365 days to reach the West Coast from iSimangaliso MPA, located on the east coast of South Africa (Le Gouvello, Hart-Davis, Backeberg, & Nel, 2020) (see Figure 5-27).

Overall Leatherback abundance in the offshore project area is unknown but expected to be low, with seasons of increased adult and neonate turtle's numbers anticipated.



Although they tend to avoid nearshore areas, they may be encountered off Lüderitz and south of Swakopmund and Walvis Bay between October and April when prevailing north wind conditions result in elevated seawater temperatures (see Figure 5-26). Entanglement and drowning of leatherback turtles in mariculture rafts in Lüderitz Lagoon have been reported (J. Kemper pers. obs.). Additionally, significant numbers of leatherback turtles have washed up on central Namibian shores recently, likely after mistakenly ingesting plastic pollution.

Leatherback Turtles are listed as ‘Vulnerable’ worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). Loggerhead and Olive Ridley turtles are globally listed as ‘Vulnerable’ whereas Hawksbill are globally listed as ‘Critically Endangered’, and Green turtles as ‘Endangered’. Although not a signatory of CMS, Namibia has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. Namibia is thus committed to conserve these species at an international level.

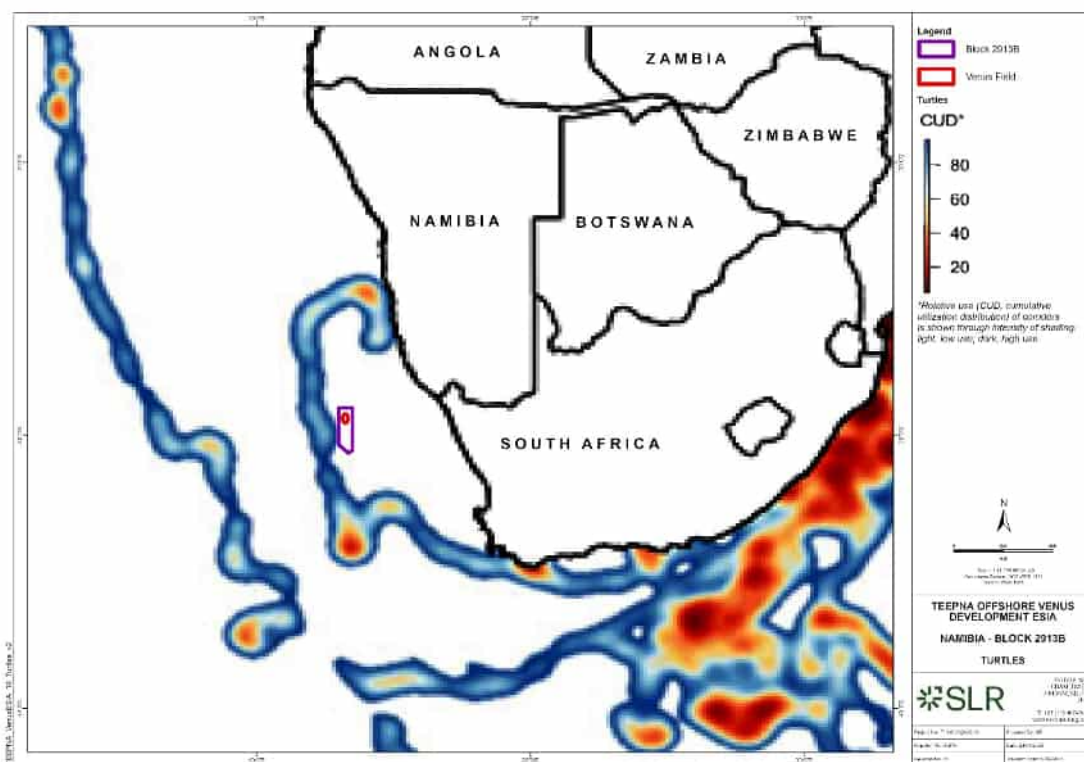


Figure 5-26: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to migration corridors of leatherback turtles in the south-western Indian Ocean.

Note: Relative use (CUD, cumulative utilization distribution) of corridors is shown through intensity of shading: light, low use; dark, high use.

Source: Harris et al. (2018)



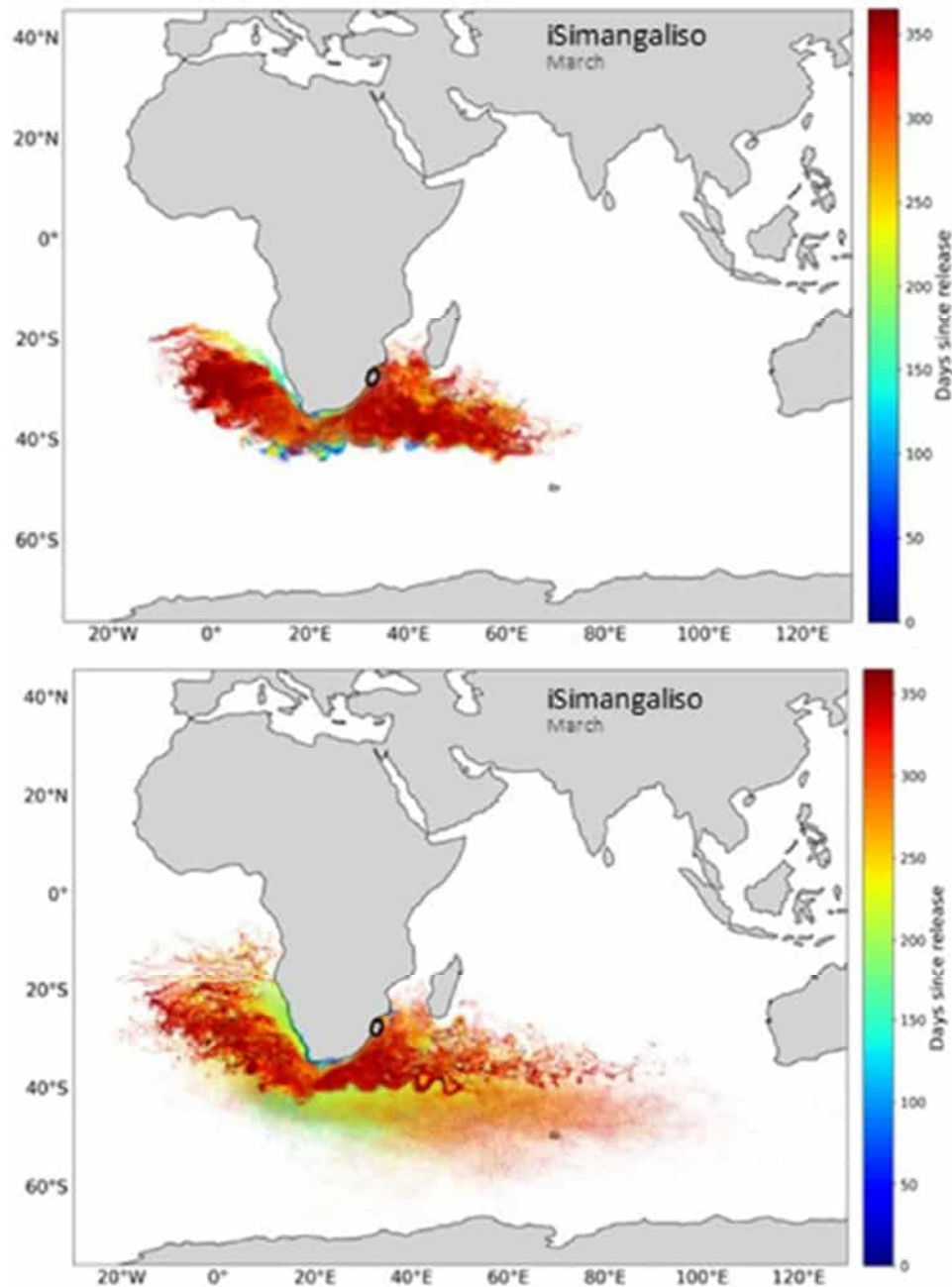


Figure 5-27: Dispersal maps showing trajectories of 5000 virtual, hatchling particles released from the respective nesting sites (iSimangaliso Wetland Park, East Coast of South Africa; white circles) in March 2018 for loggerheads (top) and leatherbacks (bottom).

Note: Colours (blue to red) indicate the number of days since release.
Adapted from Le Gouvello et al. (2020)



The most recent conservation status, which assessed the species on a scale of Regional Management Units (RMU)⁴⁶, is provided in Table 5-6. Leatherback and loggerhead turtles, the two species most likely to be encountered offshore Namibia, are rated as ‘Critically Endangered’ and ‘Near Threatened’, respectively in the Southwest Indian RMU, while Green have not been formally rated. Notably, Hawksbill and Olive Ridley RMUs do not extend past the east coast of South Africa (Wallace, et al., 2023)

Overall, although the Venus offshore project area is over 250 km offshore from the nearest coast and the relative abundance of turtles within its offshore waters is expected to be low, encounters in coastal waters *en route* between the operational area, logistics base, and transshipment locations may occur. Similarly encounters during nearshore transshipment operations may occur in the coastal waters off Walvis Bay, however the likelihood is considered to be low, with species largely encountered south of Walvis Bay, offshore Lüderitz, in deeper waters.

Table 5-6: Global and regional conservation status of the turtles occurring off the southern African coastline.

Listing	Leatherback	Loggerhead	Green	Hawksbill	Olive Ridley
IUCN Red List:					
Species (date)	VU (2013)	VU (2017)	EN (2004)	CR (2008)	VU (2008)
Population (RMU)	CR (2017)	NT (2017)	*		
Sub-Regional / South African National:					
NEMBA TOPS (2007)	CR	CR	EN	CR	EN
Hughes & Nel (2014)	EN	VU	NT	NT	DD

NT – Near Threatened, VU – Vulnerable, EN – Endangered, CR – Critically Endangered, DD – Data Deficient, * - Not yet assessed.

NEMBA TOPS: South African National Environmental Management: Biodiversity Act – List of Threatened or Protected Species (TOPS)

Note: Sub-regional and South African national assessments are included for reference. The listed turtle species have not been nationally assessed within Namibia.

5.5.3.5 Seabirds

The Namibian coastline sustains large populations of breeding and foraging seabird and shorebird species, which require suitable foraging and breeding habitats for their survival. In total, 12 species of seabirds are known to breed along the southern Namibian coast (Table 5-7). Most seabirds breeding in Namibia are restricted to areas where they are safe from land predators, although some species are able to breed on the mainland coast, either cryptically on the open ground (e.g. Damara Tern) or in inaccessible places. In general, most breed on the coastal islands off the southern Namibian coast, or to the north on the man-made guano platforms in Walvis Bay, Swakopmund and Cape Cross, well inshore of PEL0056/Block 2913B. The southern Namibian islands and guano platforms therefore provide a vital habitat to most species of seabirds that breed in Namibia. However, the number of successfully breeding birds at the particular breeding sites varies with local food abundance (see Figure 5-28).

⁴⁶ Regional Management Units (RMUs) organise marine turtles that might be on independent evolutionary trajectories within regional entities into units of protection above the level of nesting populations, but below the level of species.



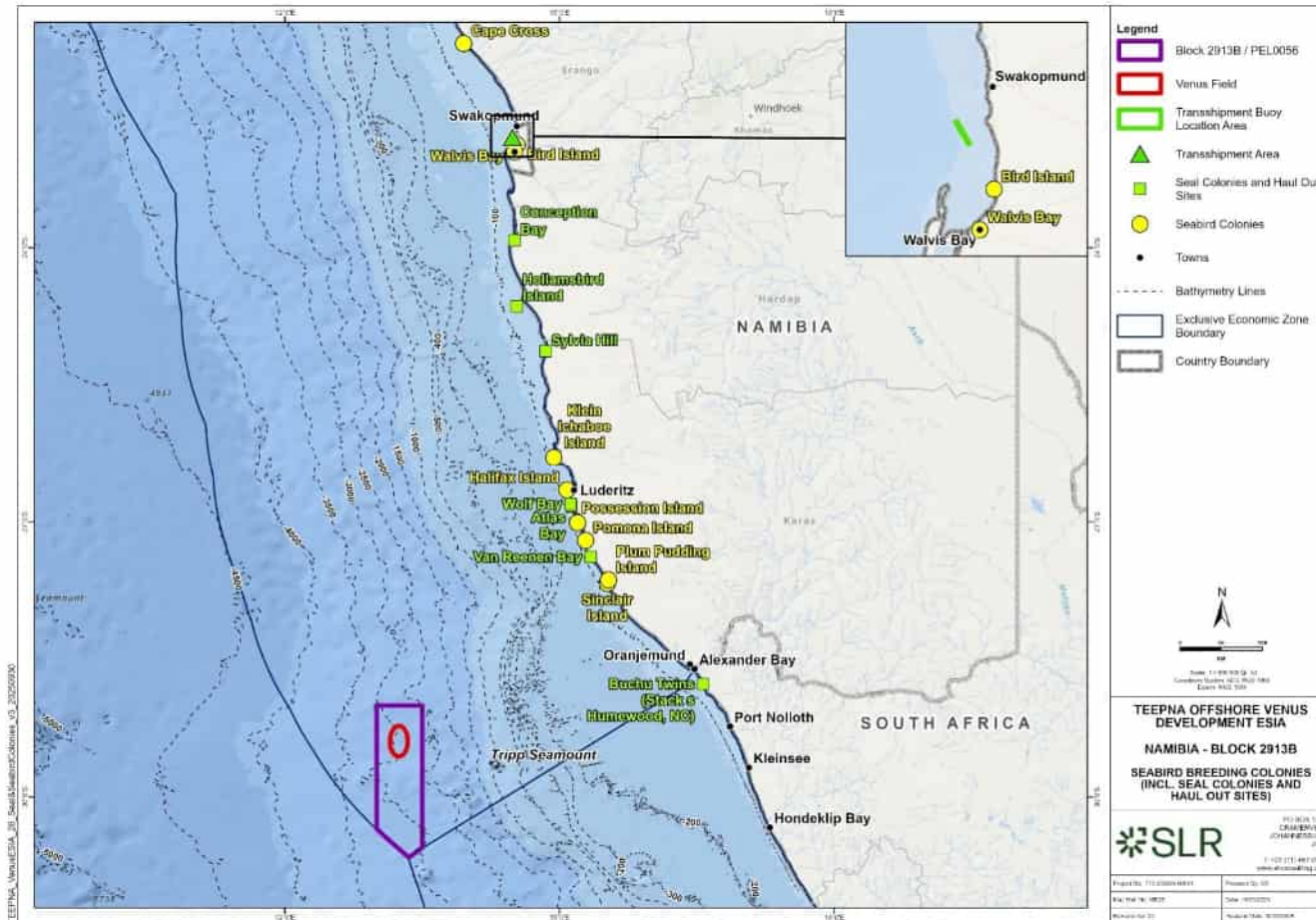


Figure 5-28: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to seabird breeding colonies and Cape Fur seal colonies and haul out sites.



Table 5-7: Namibian breeding seabird species with their Namibian and global IUCN classification.

Species	Namibian	Global IUCN
*African Penguin <i>Spheniscus demersus</i>	Endangered	Critically Endangered
*Bank Cormorant <i>Phalacrocorax neglectus</i>	Endangered	Endangered
*Cape Cormorant <i>Phalacrocorax capensis</i>	Endangered	Endangered
*Cape Gannet <i>Morus capensis</i>	Critically Endangered	Endangered
*Crowned Cormorant <i>Microcarbo coronatus</i>	Near Threatened	Least Concern
*African Black Oystercatcher <i>Haematopus moquini</i>	Near Threatened	Least Concern
White-breasted cormorant <i>Phalacrocorax lucidus</i>	Least Concern	Least Concern
Kelp Gull <i>Larus dominicanus</i>	Least Concern	Least Concern
*Hartlaub's Gull <i>Larus Hartlaubii</i>	Vulnerable	Least Concern
Caspian Tern <i>Hydroprogne caspia</i>	Vulnerable	Least Concern
*Greater Crested (Swift) Tern <i>Thalasseus bergii</i>	Least Concern	Least Concern
*Damara Tern <i>Sterna balaenarum</i>	Near Threatened	Least Concern

* denotes the species is endemic to southern Africa.

Differences between Namibia and global classifications are the result of local population size, and the extent and duration of declines locally.

Species recorded by Marine Mammal Observers (MMOs) *en route* to and within PEL0056/Block 2913B are indicated in **bold** (BSL, 2019b; BSL, 2019c).

Source: Kemper et al. 2007; Simmons et al. 2015; IUCN

The nearshore transshipment area lies within the vicinity of Walvis Bay, a region recognized as an Important Bird Area (IBA) (see Section 5.6.3) due to its exceptional avian biodiversity. The Walvis Bay wetlands, including the lagoon, intertidal mudflats, and the Pelican Point sandspit, form the most important coastal wetland in southern Africa and one of the top three on the continent (see Section 5.5.4.4). These habitats support over 100 000 birds in summer (peaking at 162 000) and around 50 000 in winter, with approximately 90% being non-breeding Palearctic and intra-African migrants.

The area is particularly important for Palearctic waders and flamingos, with 80–90% of the subregion's flamingos wintering here, especially in the saltworks and at Sandwich Harbour. At least 16 species occur in numbers exceeding 1% of their biogeographic populations. Notable species include Lesser Flamingo (*Phoeniconaias minor*), Curlew Sandpiper (*Calidris ferruginea*), Common Tern (*Sterna hirundo*), and globally significant populations of the Chestnut-banded Plover (*Charadrius pallidus*, ~60% of global population) and Black-necked Grebe (*Podiceps nigricollis*). Breeding species include Damara Tern (*Sterna balaenarum*), while other regularly observed species include Grey Plover (*Pluvialis squatarola*) and Black Tern (*Chlidonias niger*). The high species richness and abundance are driven by nutrient inputs from the Lüderitz upwelling cell, transported northward by the Benguela Current and concentrated inshore by persistent winds (BirdLife International, 2025).

Most of the seabird species breeding in Namibia feed relatively close inshore (10-30 km), although exceptions occur (Ludynia, Kemper, & Roux, 2012), particularly when birds are forced to alter their dispersal patterns in response to environmental change (Sherley, et al., 2017). Cape Gannets (see Figure 5-30, left), are known to forage up to 140 km offshore (Dundee, 2006; Ludynia K., 2007) (see Figure 5-29). **The closest Cape Gannet (IUCN; 'Endangered') colony to the Venus offshore project area is at Possession Island (~30 km south of Lüderitz) some 320 km to the north-east. Despite the distance offshore, 18 observations of Cape Gannets were recorded within PEL0056/Block 2913B during the 2022 EBS. Cape Gannet breeding colonies (namely Ichaboe,**



Mercury and Possession Island) fall far south of the nearshore transshipment area. However, encounters may also occur further inshore during transshipment operations in the vicinity and/or along support vessel passages.

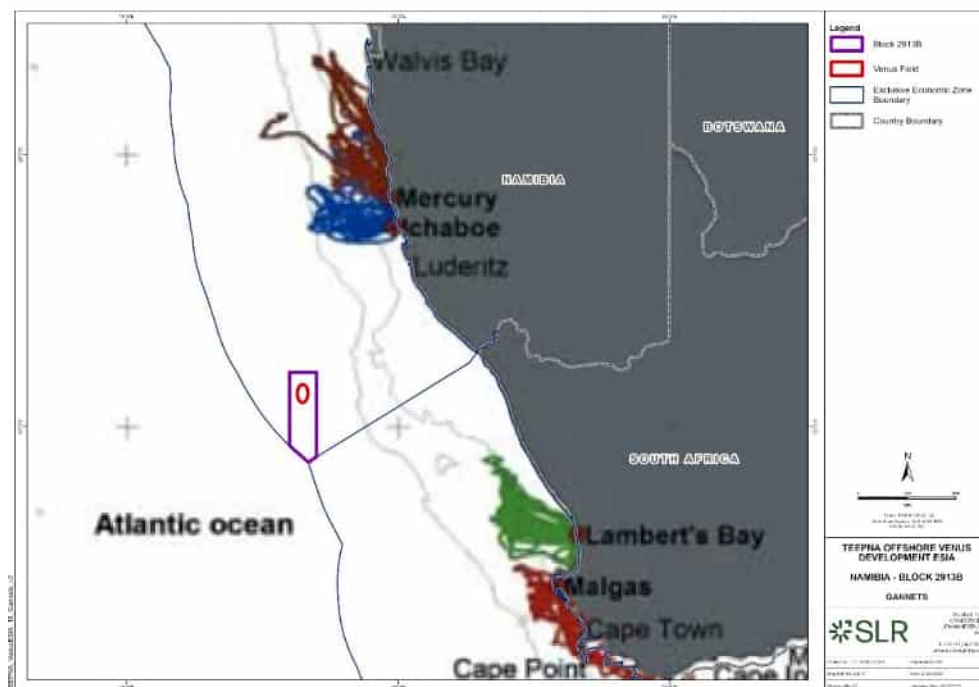


Figure 5-29: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to GPS tracks recorded for 93 Cape Gannets foraging off four breeding colonies on southern African west coast.

Source: Grémillet et al. (2008)

African Penguins (see Figure 5-30, right) have also been recorded as far as 60 km offshore (Ludynia, Kemper, & Roux, 2012). **The closest African Penguin colonies are at Plumpudding, Sinclair, and Possession Islands, which lie some 280 km, 285 km and 320 km to the north-east of the Venus offshore project area, respectively and south (>450 km) of the nearshore transshipment area. Encounters with this species within PEL0056/Block 2913B is, therefore, unlikely; however, may occur in the vicinity and/or along support vessel passages.**



Figure 5-30: Cape Gannets *Morus capensis* (left) and African Penguins *Spheniscus demersus* (right) breed primarily on the offshore islands.

Source: J. Kemper, Klaus Jost



Among the non-breeding species present off Namibia's southern coast there are at least nine species of albatrosses, petrels and giant-petrels recorded (Boyer & Boyer, 2015). Numbers foraging in Namibian waters are poorly known, although some tracking data are available for example for the Black-browed Albatross (see Figure 5-31). Forty-nine species of pelagic seabirds have been recorded in the broader project area of influence, of which 14 are resident (Table 5-8). Highest pelagic seabird densities occur offshore of the shelf-break in winter. Pelagic seabirds that have been encountered *en route* (from Walvis Bay) to or within PEL0056/ Block 2913B are recorded in Table 5-8. Notably, during the 2022 EBS surveys, there were 224 sightings of the 'Vulnerable' white-chinned petrel, as well as 42 and 17 sightings of the 'Endangered' Atlantic yellow-nosed albatross and black-browed albatross, respectively, within PEL0056/Block 2913B (BSL, 2023a).

Although the Venus offshore project area is located more than 240 km offshore from the nearest coast and is likely to host only pelagic seabirds, support, and tanker vessels (DPST and conventional tanker), as well as possible helicopter flights, may encounter more coastal seabirds when *en route* between the operational area and the ports, transshipment and airport locations.

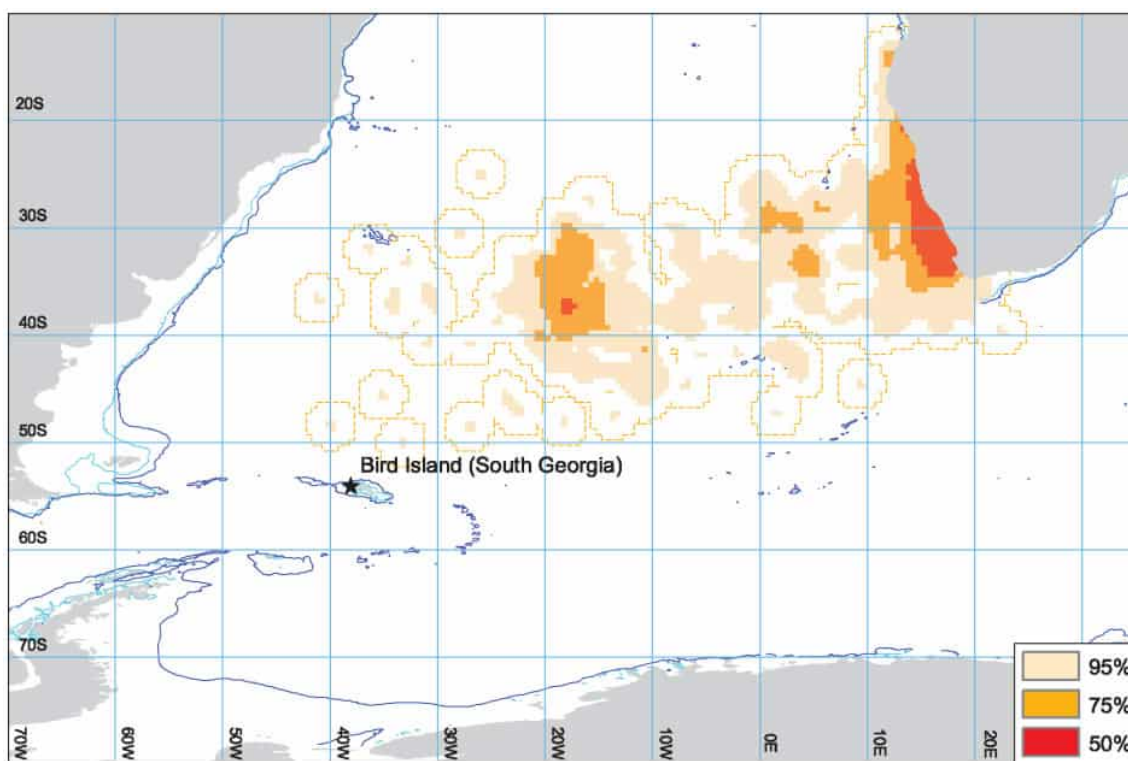


Figure 5-31: Utilisation distribution of incubating Black-browed Albatross from Bird Island, South Georgia.

Source: Birdlife International (2004)

Note: The percentage utilization, i.e., the time spent by tracked individuals within an area over the study period, is illustrated with dark red corresponding to 50%, orange to 75%, and cream to 95%.



Table 5-8: Other bird species that occur in Namibia, with their Namibian and global IUCN classification.

Species	Namibian Regional Assessment	IUCN Global Assessment
Tristan Albatross <i>Diomedea dabbenena</i>	Critically Endangered	Critically Endangered
Atlantic Yellow-nosed Albatross <i>Thalassarche chlororhynchos</i> *	Endangered	Endangered
Black-browed Albatross <i>Thalassarche melanophris</i>	Endangered	Least Concern
Wandering Albatross <i>Diomedea exulans</i> *	Vulnerable	Vulnerable
Shy Albatross <i>Thalassarche cauta</i> *	Near Threatened	Near Threatened
White-capped Albatross <i>Thalassarche sneadi</i>	Near Threatened	Near Threatened
Spectacled Petrel <i>Procellaria conspicillata</i> *	Vulnerable	Vulnerable
Northern Giant-Petrel <i>Macronectes halli</i>	Near Threatened	Least Concern
Southern Giant-Petrel <i>Macronectes giganteu</i> *s	Not listed	Least Concern
Cape (Pintado) Petrel <i>Daption capense</i> *	Not listed	Least Concern
Kerguelen Petrel <i>Aphrodroma brevirostris</i>	Not listed	Least Concern
Great-winged Petrel <i>Pterodroma macroptera</i> *	Not listed	Least Concern
Soft-plumaged Petrel <i>Pterodroma mollis</i> *	Not listed	Least Concern
White-chinned Petrel <i>Procellaria aequinoctialis</i> *	Vulnerable	Vulnerable
Leach's Storm-Petrel <i>Oceanodroma leucorhoa</i>	Not listed	Vulnerable
Wilson's Storm-Petrel <i>Oceanites oceanicus</i>	Not listed	Least Concern
European Storm-Petrel <i>Hydrobates pelagicus</i>	Not listed	Least Concern
Sabine's Gull <i>Xema sabini</i>	Not listed	Least Concern
Arctic Tern <i>Sterna paradisaea</i>	Not listed	Least Concern
Red Phalarope <i>Phalaropus fulicarius</i>	Not listed	Least Concern
Brown (Sub-Antarctic) Skua <i>Catharacta antarctica</i> *	Not listed	Least Concern
Pomarine Jaeger (Skua) <i>Stercorarius pomarinus</i>	Not listed	Least Concern
Antarctic Prion <i>Pachyptila desolata</i>	Not listed	Least Concern
Long-Tailed Jaeger (Skua) <i>Stercorarius longicaudus</i>	Not listed	Least Concern
Sooty Shearwater <i>Ardenna grisea</i>	Near Threatened	Near Threatened
Cory's Shearwater <i>Calonectris borealis</i> *	Not listed	Least Concern
Scopoli's Shearwater <i>Calonectris diomedea</i>	Not listed	Least Concern
Manx Shearwater <i>Puffinus puffinus</i>	Not listed	Least Concern
Great Shearwater <i>Ardenna gravis</i>	Not listed	Least Concern

Differences between Namibia and global classifications are the result of local population size, and the extent and duration of declines locally.

Species recorded by Marine Mammal Observers (MMOs) en route to PEL0056/Block 2913B are indicated in **bold** (BSL, 2019b; BSL, 2019c; BSL, 2022a).

Birds recorded within PEL0056/Block 2913B are shown with * (BSL, 2022a).

Species Assessment: from Kemper et al. 2007; Simmons et al. 2015; IUCN 2023.



5.5.3.6 Marine Mammals - Cetaceans

The cetacean fauna of Namibia comprises **33 species of whales and dolphins** known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (see Table 5-9). Namibian waters host resident species such as the endemic Heaviside's dolphin, bottlenose and dusky dolphins, but also species that migrate between Antarctic feeding grounds and warmer low latitude breeding grounds, as well as species with a circum-global distribution.

The Namibian shelf and deeper waters have been poorly studied with most available information in deeper waters (>200 m) arising from historic whaling records. However, recent data from MMOs and passive acoustic monitoring is improving knowledge. Current information on the distribution, population sizes and trends of most cetacean species, especially smaller cetaceans, occurring in Namibian waters is lacking.

The warmer waters offshore of the Namibian coast may host some species associated with the more tropical and temperate parts of the Atlantic such as rough toothed dolphins, striped dolphins, pan-tropical spotted dolphins and short finned pilot whales.

The distribution of cetaceans in Namibian waters can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found in the **shelf edge area (200-1 000 m) making this the most species-rich area for cetaceans**. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging. The most common species within the broader project area of influence (in terms of likely encounter rate not total population sizes) are likely to be the humpback whale (Mysticete) and pilot whale (Odontocete / Delphinid).

Cetaceans comprise two basic taxonomic groups, the mysticetes (filter feeding whales with baleen) and the odontocetes (predatory whales and dolphins with teeth)⁴⁷. Due to large differences in their size, sociality, communication abilities, ranging behaviour and principally, acoustic behaviour, these two groups are considered separately.

A review of the distribution and seasonality of the key cetacean species likely to be found within the broader project area is provided below, based on information previously provided by the Sea Search - Namibian Dolphin Project (NDP) and data sourced from: Findlay et al. (1992), Best (2007), Weir (2011), Dr J-P Roux, (MFMR pers comm) and sightings from fisheries observers and MMOs working in the area, (de Rock, et al., 2019). Table 5-9 lists the cetaceans likely to be found within the project area of influence. Table 5-10 shows the likely seasonality of key species.

The NDP holds the most up-to-date data of cetacean occurrence and distribution since whaling times, with the records including a total database of over 7 000 records with more than 1 000 sightings made by MMOs on seismic or mining vessels and fisheries observers operating in shelf or pelagic waters. From MMO sightings (see Figure 5-32) it is evident that many species do occur near and/or within PEL0056/Block 2913B and nearshore waters offshore Walvis Bay, particularly sei whales, fin whales, Bryde's whales, humpback whales and various dolphin species. It is important to highlight however that the extent of available data is dependent on the location of previous hydrocarbon exploration and appraisal activities as well as environmental surveys that utilised MMOs.

⁴⁷ The term 'whale' is used to describe cetaceans larger than approximately 4 m in length in both these groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontocetes and the family Delphinidae and are thus dolphins, not whales).



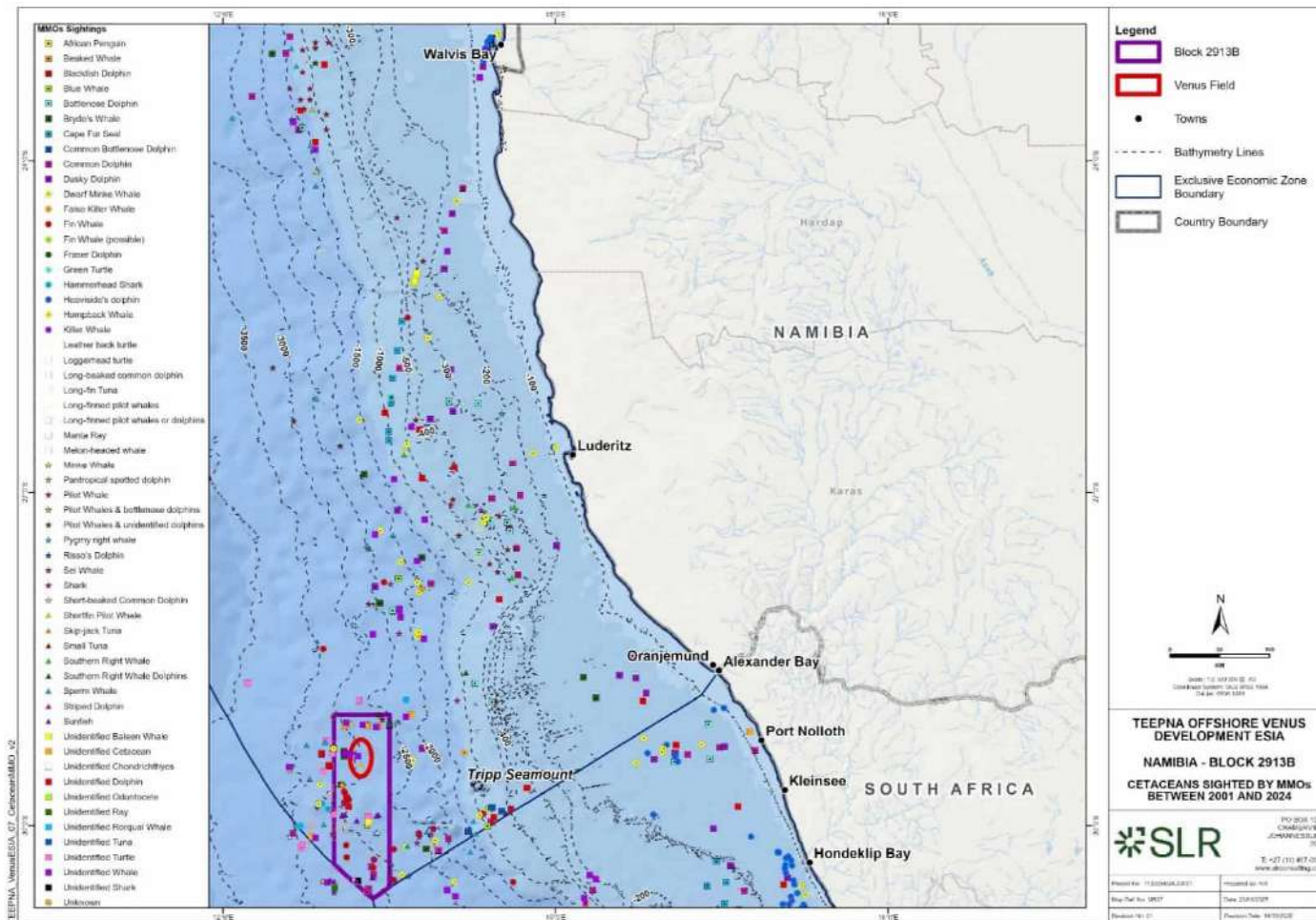


Figure 5-32: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the distribution of marine fauna sighted by MMOs within the Namibian EEZ, collated between 2001 and 2024

Source: SLR MMO database



Table 5-9: Cetaceans occurrence off the southern Namibian Coast, their seasonality, likely encounter frequency in PEL0056/Block 2913B and South Africa (Child et al. 2016) and Global IUCN conservation status.

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids (Odontocetes)							
Dusky dolphin	<i>Lagenorhynchus obscurus</i>	HF	Yes (0- 800 m)	No	Year round	Least Concern	Least Concern
Heaviside's dolphin	<i>Cephalorhynchus heavisidii</i>	VHF	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	<i>Tursiops truncatus</i>	HF	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	<i>Delphinus delphis</i>	HF	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	<i>Lissodelphis peronii</i>	HF	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	<i>Stenella coeruleoalba</i>	HF	No	Yes	Year round	Least Concern	Least Concern
Pantropical spotted dolphin	<i>Stenella attenuata</i>	HF	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	<i>Globicephala melas</i>	HF	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	HF	Edge	Yes	Year round	Least Concern	Least Concern
Rough-toothed dolphin	<i>Steno bredanensis</i>	HF	No	Yes	Year round	Not Assessed	Least Concern
Killer whale	<i>Orcinus orca</i>	HF	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	<i>Pseudorca crassidens</i>	HF	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	<i>Feresa attenuata</i>	HF	No	Yes	Year round	Least Concern	Least Concern
Risso's dolphin	<i>Grampus griseus</i>	HF	Yes (edge)	Yes	Year round	Data Deficient	Least Concern
Sperm whales (Odontocetes)							
Pygmy sperm whale	<i>Kogia breviceps</i>	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Dwarf sperm whale	<i>Kogia sima</i>	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Sperm whale *	<i>Physeter macrocephalus</i>	HF	Edge	Yes	Year round	Vulnerable	Vulnerable



Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Beaked whales (Odontocetes)							
Cuvier's	<i>Ziphius cavirostris</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	<i>Berardius arnuxii</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
Southern bottlenose	<i>Hyperoodon planifrons</i>	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	<i>Mesoplodon layardii</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
True's	<i>Mesoplodon mirus</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
Gray's	<i>Mesoplodon grayi</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
Blainville's	<i>Mesoplodon densirostris</i>	HF	No	Yes	Year round	Data Deficient	Least Concern
Baleen whales (Mysticete)							
Antarctic Minke	<i>Balaenoptera bonaerensis</i>	LF	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	<i>B. acutorostrata</i>	LF	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	<i>B. physalus</i>	LF	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	<i>B. musculus ssp. intermedia</i>	LF	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	<i>B. borealis</i>	LF	Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	<i>B. edeni (subsp)</i>	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	<i>B. edeni</i>	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	<i>Caperea marginata</i>	LF	Yes	?	Year round	Least Concern	Least Concern
Humpback	<i>Megaptera novaeangliae</i>	LF	Yes	Yes	Year round (SONDJF)	Least Concern	Least Concern
Humpback B2 subpopulation *	<i>Megaptera novaeangliae</i>	LF	Yes	Yes	Spring/Summer peak (ONDJF)	Vulnerable	Not Assessed
Southern right	<i>Eubalaena australis</i>	LF	Yes	No	Year round (ONDJFMA)	Least Concern	Least Concern

Species recorded by Marine Mammal Observers (MMOs) *en route* to PEL0056/Block 2913B and at Walvis Bay are indicated in **bold** (BSL, 2019b; BSL, 2019c; BSL, 2022a; BSL, 2022b) . Species recorded within PEL0056/Block 2913B during EBS survey indicated with * (BSL, 2022a). LF= Low Frequency; HF = High Frequency; VHF = Very High Frequency.



The South African red list of cetacean fauna was updated in 2016, with global reviews underway. These listings provide the most up to date assessments as the Namibian listings have not been updated recently. Of the 33 species listed:

- Blue whale is considered 'Critically Endangered' for both lists;
- Fin whale and Sei whale are considered 'Endangered' for both lists;
- Sperm whale, Bryde's whale (inshore) and the Humpback B2 subpopulation⁴⁸ are considered 'Vulnerable' but 'Least Concern' and Not Assessed by IUCN; and
- 11 species are listed as Data Deficient or Not Assessed underlining how little is known about cetaceans, their distributions and population trends in southern Africa.

Table 5-10: Seasonality of baleen whales in the broader project area of influence based on data from multiple sources, predominantly commercial catches and data from stranding events.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's (inshore)	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's (offshore)	H	H	H	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	H	H	L	H	H	H	L	L
Fin	M	M	M	H	H	H	M	H	H	H	M	M
Blue	L	L	L	L	L	H	H	H	L	M	L	L
Minke (Antarctic & Dwarf)	M	M	M	H	H	H	M	H	H	H	M	M
Humpback B2	M	M	L	L	L	H	H	M	M	L	M	H
Southern right	H	M	L	L	L	H	H	H	M	M	H	H
Pygmy right	H	H	H	M	L	L	L	L	L	L	M	M

Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

Source: Best 2007; NDP unpublished data and other sources

Mysticete (Baleen) whales

The majority of mysticete whales fall into the family Balaenidae. Those occurring in the study area are listed in Table 5-9 and Table 5-10. Most of these species occur in pelagic waters with only the occasional visit to shelf waters (<500 m). All these species show some degree of migration either to, or through the latitudes of PEL0056/Block 2913B when *en route* between higher latitude (Antarctic or Sub Antarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality in Namibian waters can be either unimodal, usually in winter months, or bimodal (e.g., May-July and October-November) reflecting a northward and southward migration through the area (see Table 5-10). Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations.

Due to the complexities of the migration patterns, each species is discussed in further detail below.

⁴⁸ The humpback population in the southern hemisphere is comprised of different breeding subpopulations. B2 is the subpopulation that breeds on the south-west coast of Africa (Rosenbaum *et al.* 2009).



Bryde's whales

Two genetically and morphologically distinct populations of Bryde's whales live off the west coast of southern Africa (Best P. , 2001; Penry, 2010).

The "offshore population" occurs beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the west coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the project area of influence from January to March. Several strandings of adult offshore Bryde's whales have occurred in central Namibia including in January 2012 and November 2017 near Walvis Bay.

The "inshore population" of Bryde's whales is unique amongst baleen whales in the region by being non-migratory. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the west coast with possible movements further north into the Benguela current especially in the winter months (Best P. , 2007). A live stranding of a calf of this population (population assigned genetically – G Penry pers. comm.) in Walvis Bay, Namibia confirms the current occurrence of this population in Namibian waters. An additional live sighting in the Namibian Islands Marine Protected Area (NIMPA) and a third stranding of a Bryde's whale adult in April 2013 have not been assigned to population but supports regular, year-round occurrence of both populations of the species in the central Benguela ecosystem.

Sightings of Bryde's whales have been made within PEL0056/Block 2913B (BSL, 2019b; BSL, 2019c). Encounters in the Venus offshore project area and vessel transit area of influence are thus possible. Occurring largely along the Shelf edge (200 m depth) and further offshore (> 200 m depth) encounters within the shallower waters (<40 m depth) of the nearshore area is considered unlikely.

Sei whales

There is very little information on sei whales in Namibian waters and most information on the species from the southern African sub-region originates from whaling data from 1958-1963. Sei whales spend time at high latitudes (40-50°S) during summer months and migrate north through South African waters (where they were historically hunted in relatively high numbers) to unknown breeding grounds further north (Best P. , 2007). As whaling catches were confirmed off both Congo and Angola, it is likely that they migrate through Namibian waters. Due to their migration pattern, densities in the project area of influence are likely to show a bimodal peak with numbers predicted to be highest in May to June and August to October. All whales were historically caught in waters deeper than 200 m with most catches recorded from waters deeper than 1 000 m (Best & Lockyer, 2002). There is no current information on the abundance or distribution of this species in the region, but a sighting of a mother and calf in March 2012 (NDP unpublished data) and a stranding in Walvis Bay in July 2013 (NDP unpublished data), as well as a MMO recording of an individual in September 2022 (BSL, 2022a), confirms their contemporary and probably year-round occurrence on the Namibian continental shelf and beyond. **Encounters in the Venus offshore project area of influence are thus possible.**

Fin whales

Fin whales were historically caught off the west coast of South Africa and Namibia. A bimodal peak in the catch data from South African shore-based stations suggests animals were migrating further north to breed (during May-June) before returning to Antarctic feeding grounds (during August-October). However, the location of the breeding ground (if any) and how far north it is located remains unknown (Best P. , 2007). Some juvenile animals may feed year-round in deeper waters off the shelf (Best P. , 2007). Four strandings have occurred between Walvis Bay and the Kunene River in the last decade during January, April



(2) and October (NDP unpubl. data). Groups of 5-8 animals have been seen on multiple occasions on the coast either side of Lüderitz in April, May of 2014 and January 2015 (NDP unpubl. data) confirming their contemporary occurrence in Namibian waters and potential use of the upwelling areas for feeding. To date, most sightings or strandings have occurred in late summer (April-May), supporting evidence from whaling data that this is a peak time of occurrence in southern Namibia. **Sightings of fin whales were recorded en route to and within PEL0056/Block 2913B in 2018 and 2019 (BSL, 2019b; BSL, 2019c), with eDNA sampling within PEL0056/Block 2913B identifying evidence of fin whale. Encounters in the Venus offshore project area and vessel transit area of influence are thus possible.**

Blue whales

Antarctic blue whales (*Balaenoptera musculus ssp. Intermedia*), a subspecies of Blue Whales, were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during July in Walvis Bay and Namibe, suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best P., 2007). Evidence of blue whale presence off Namibia is rapidly increasing. Acoustic detections of blue whales in the Antarctic peak between December and January (Thomisch, et al., 2016) and in northern Namibia between May and July (Thomisch K., 2017) supporting observed timing from whaling records. Several sightings of blue whales (2014-2015) have occurred during seismic surveys off the southern part of Namibia in water >1 000 m deep confirming their current existence in the area and occurrence in Autumn months.

Encounters in the Venus offshore project area of influence are thus possible, with a single individual observed within PEL0056/Block 2913B in September 2022 (BSL, 2022), while encounters during nearshore transshipment operations are considered unlikely, owing to the species offshore depth range (>200 m).

Minke whales

Two forms of minke whale occur in the Benguela, the Antarctic minke whale and the dwarf minke whale (Best 2007; NDP unpubl. data).

Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Regular sightings of semi-resident Antarctic minke whales in Lüderitz Bay, especially in summer months (December - March) and a stranding of a single animal in Walvis Bay (in February 2014) confirm the contemporary occurrence of the species in Namibia (NDP unpubl. data). Data from passive acoustic monitoring over a two-year period off the Walvis Ridge shows acoustic presence in June to August and November to December (Thomisch, et al., 2016), supporting observations from whaling records.

The dwarf minke whale has a more temperate distribution than the Antarctic minke and do not range further south than 60-65°S. Dwarf minke whales have a similar migration pattern to Antarctic minke whales with at least some animals migrating to the Southern Ocean in summer months. Around southern Africa, dwarf minke whales occur closer to shore than Antarctic minke whales and have been seen <2 km from shore on several occasions around South Africa.

Both species are generally solitary, and densities are likely to be low in the larger project area of influence (i.e. nearshore and/or offshore as well as vessel transit routes), but encounters may occur.

Humpback whales

Humpback whales are cosmopolitan species, found across all oceans. The global population is divided into four main regional subpopulations; the North Pacific, North Atlantic, Northern



Indian Ocean and Southern Hemisphere, with Humpback whales found offshore Namibia belonging to the latter.

The majority of humpback whales passing through the Benguela are migrating to breeding grounds off tropical West Africa, between Angola and the Gulf of Guinea (Rosenbaum, et al., 2009; Barendse, et al., 2010). A synthesis of available humpback whale data from Namibia (Elwen, et al., 2014) shows that in coastal waters, the northward migration stream is larger than the southward peak supporting earlier observations from whale catches (Best & Allison, 2010). This supports previous suggestions that animals migrating north strike the coast at varying places, mostly north of St Helena Bay (South Africa), resulting in increased whale density on shelf waters northwards towards Angola, but there is no clear migration 'corridor'. On the southward migration, there is evidence from satellite tagged animals and the smaller secondary peak in numbers in Walvis Bay, that many humpback whales follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs), possibly lingering in the feeding grounds off west South Africa in summer (Elwen, Gridley, Roux, Best, & Smale, 2013; Rosenbaum, Maxwell, Kershaw, & Mate, 2014). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse, et al., 2010; Best & Allison, 2010; Elwen, et al., 2014). Regular sightings of humpback whales in spring and summer months in Namibia, especially in the Lüderitz area, suggest that summer feeding is occurring in Namibian waters as well, or that the foraging range extends into southern Namibia.

Several breeding stocks have been identified within the southern hemisphere, with further evidence of substructure within these stocks (Beker et al., 1994; Valsecchi et al., 1997). Humpback whales migrating through Namibian waters belong to two Breeding Stocks (BS). BSB (South-eastern Atlantic Ocean) is found along the west coast of Africa, from breeding grounds off northwestern Africa (Gabon) to South Africa. A small component of this BS, identified as BSB2, feeds within the Benguela upwelling region (including Angola, Namibia and South Africa).

The IWC Scientific Committee's assessment of Southern Hemisphere humpback whale subpopulation, estimated the total population at 97 000 individuals, based on various survey methods (IWC, 2016). Most breeding populations have recovered significantly in recent years, except for the BSB2 subpopulation, which remains relatively depleted.

In the first half of 2017 (when numbers are expected to be at their lowest) more than 10 humpback whales were reported stranded along the Namibian and west South African coasts. A similar event was recorded in late 2021 / early 2022 when numerous strandings of young humpbacks were reported along the Western Cape Coast (South Africa) and in Namibia (Simon Elwen, Sea Search, pers. comm.). The cause of these deaths is not known, but similar events have been recorded off Brazil (2010) and the US Atlantic coast (2016 and 2022). The 2010 event was linked to possible infectious disease or malnutrition (Siciliano, et al., 2013). The West African population may be undergoing similar stresses or responding to changes in their ecosystem (see for example Kershaw, et al., (2021)). It is not yet understood what may be driving these ecosystem changes and what the long-term effects to populations could potentially be.

Humpback whales are thus likely to be the most frequently encountered baleen whale in PEL0056/Block 2913B as well as during vessel transit and nearshore transshipment operations, being the most identified cetacean both *en route* to and within PEL0056/Block 2913B during the EBS survey in 2022 (BSL, 2022). This species ranges from coastal waters to well beyond the continental shelf. They have a year-round presence with numbers peaking in June and July (northern migration) and to a lesser degree in September to October (southern migration). Regular encounters occur until February associated with subsequent feeding in the Benguela ecosystem.



Southern right whales

The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baia dos Tigres) and is considered to be a single population within this range (Roux, Brady, & Best, 2015). The most recent abundance estimate for this population is available for 2017 which estimated the population at ~6 100 individuals including all age and sex classes, which is increasing at ~6.5% per annum (Brandao, Vermeulen, Ross-Gillepsie, Findlay, & Butterworth, 2017). When the population numbers crashed in 1920, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Angola (Whitt, Warde, Blair, Deslarzes, & Chaineau, 2023), Namibia (Roux, Best, & Stander, 2001; Roux, Brady, & Best, 2015; de Rock, et al., 2019) and Mozambique (Banks, et al., 2011).

Southern right whales are one of the most abundant whales in the Benguela region, seen regularly in Namibian coastal waters (<3 km from shore), especially in the southern half of the Namibian coastline (Roux, Best, & Stander, 2001; Roux, Brady, & Best, 2011). Southern right whales have been recorded in Namibian waters in all months of the year (J-P Roux pers. Comm.) but with numbers peaking in winter (June - August). A secondary peak in summer (November - January) also occurs, probably associated with animals feeding off the west coast of South Africa performing exploratory trips into southern Namibia (NDP unpubl. data). **Notably, all available records have been very close to shore with only a few out to 100 m depth. As such encounters within PEL0056/Block 2913B are unlikely, however encounters may occur within inshore, coastal waters during transshipment operations and/or supporting vessel transfers, with a single individual recorded in 330 m deep waters en route from Walvis Bay to PEL0056/Block 2913B during the EBS survey in 2022 (BSL, 2022a).**

Pygmy right whales

The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult (Best P., 2007). The species is typically associated with cool temperate waters between 30°S and 55°S, with records from Namibia, south of Walvis Bay, providing the northern most records for the species (Leeney, Post, Hazevoet, & Elwen, 2013). **As such encounters with this species during nearshore transshipment operations, north of Walvis Bay, are deemed unlikely.**

While no MMO records of this species has been recorded within PEL0056/Block 2913B, eDNA water samples were assigned with a >80% minimum confidence to the pygmy whale, thereby suggesting the possible presence of this species within the offshore waters of the block (BSL, 2023c).

Odontocete (toothed) whales

Odontocetes are a varied group of cetaceans including the dolphins, beaked whales and sperm whales. Species occurring within the broader project area of influence display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Those in the region can range in size from 1.6 m long (Heaviside's dolphin) to 17 m (bull sperm whale).

Sperm whales

Most of the information about sperm whales in the southern African subregion stems from data collected during commercial whaling activities, i.e., pre 1985 (Best P., 2007). Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They occur in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come into waters 500-200 m deep on the shelf (Best P., 2007). They are relatively abundant globally (Whitehead, 2002) although no estimates are available for the southern African subregion. Seasonality of catches off west Southern Africa suggests that medium and large



sized males are more abundant in winter months, while female groups are more abundant in autumn (March-April), although animals occur year-round (Best P. , 2007). Sperm whales were one of the most frequently seen cetacean species from offshore seismic survey vessels operating between Angola and the Gulf of Guinea. All sightings were recorded in waters deeper than 780 m, and numbers peaked during April to June (Weir C. , 2011). Multiple sightings of sperm whales have also been recorded by MMOs from vessels operating around Tripp seamount in the last decade (NDP Unpublished data; de Rock, et al., 2019). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually. The regular echolocation clicks made by the species when diving, however, make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM). **Sperm whales in the area are likely to be encountered in deeper waters (>500 m) of the larger project area of influence, predominantly in the winter months (April - October). This has been confirmed by sightings of sperm whales en route to PEL0056/Block 2913B in April 2019 and September 2022 (BSL, 2019b; BSL, 2019c; BSL, 2022a). Encounters during nearshore transshipment operations is deemed unlikely, owing to the species offshore distribution (> 500 m).**

Dwarf and pygmy sperm whales

The genus *Kogia* contains two recognised species, the dwarf and pygmy sperm whales, both of which occur worldwide in pelagic and shelf edge waters, with few sighting records of live animals in their natural habitat (McAlpine, 2018). Both species are deep water specialists living primarily off the shelf. There is preliminary evidence of species level genetic differentiation between dwarf sperm whale populations in the Indian and Atlantic Oceans (Chivers, Leduc, Robertson, Barros, & Dizon, 2004). Due to their small body size, cryptic behaviour and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. However, their narrow-band high frequency echolocation clicks make them detectable and identifiable (at least to the genus) using passive acoustic monitoring equipment. The majority of what is known about *Kogiid* whales in the southern African subregion results from studies of stranded specimens (Ross, 1979; Findlay, Best, Ross, & Cockroft, 1992; Elwen, Gridley, Roux, Best, & Smale, 2013; Moura, et al., 2016). There are >30 records of pygmy sperm whales collected along the Namibian coastline with a peak in strandings in June and August. A single account of a dwarf sperm whale recorded in Walvis Bay in 2010, demonstrates that this species also occurs in Namibian waters (Elwen, et al., 2014). Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem (Best P. , 2007) in waters deeper than ~1 000 m. *Kogia* species **are likely to occur in the Venus offshore project area of influence at low levels; seasonality is unknown. Encounters during nearshore transshipment operations is deemed unlikely, owing to the species distribution in shelf-edge and deeper waters.**

Killer whales

Killer whales have a circum-global distribution and are found in all oceans from the equator to the ice edge (Best P. , 2007). They occur year-round in low densities off western South Africa (Best, Meýer, & Lockyer, 2010) , Namibia (Elwen & Leeney, 2011) and in the Eastern Tropical Atlantic (Weir, Collins, Carvalho, & Rosenbaum, 2010). Killer whales are found in all depths from the coast to deep open ocean environments and may **thus be encountered in the larger project area of influence (i.e. Venus offshore project area, nearshore transshipment area and vessel transit routes) at low levels.**

False killer whales

False killer whales are recognised as a single species globally, although clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed (Best P. , 2007). The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few



close to shore as well (Findlay, Best, Ross, & Cockcroft, 1992)(NDP Unpubl. data). False killer whales usually occur in groups ranging in size from 1-100 animals (mean 20.2) (Best P. , 2007) and are thus easily seen in most weather conditions. However, the strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, South Africa, all between St Helena Bay and Cape Agulhas (Kirkman, Meyer, & Thornton, 2010). There is no information on population numbers of conservation status and no evidence of seasonality in the region (Best P. , 2007). **Encounters within the project area of influence (i.e. Venus offshore project area, nearshore transshipment area and vessel transit routes) may occur.**

Long- and short-finned pilot whales

Long- and short-finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or adjacent deep waters (Mate, Best, Lagerquist, & Winsor, 2011; Findlay, Best, Ross, & Cockcroft, 1992; Weir C. , 2011; Seakamela, et al., 2022). They are regularly seen associated with the shelf edge by MMOs, fisheries observers and researchers operating in Namibian waters (NDP unpubl. data; de Rock, et al., 2019) The distinction between long finned and short finned pilot whales is difficult to make at sea. Short finned pilot whales are regarded as a more tropical species (Best P. , 2007) and most sightings within the Benguela Ecosystem are thought to be long-finned pilot whales, however, due to the low latitude and offshore nature of the project, **it is likely that both could be encountered within the project area of influence, including within the vicinity of Walvis Bay. This was confirmed by the sighting of two short-finned pilot whales enroute to PEL0056/Block 2913B in late 2018** (BSL, 2019b). There are many confirmed sightings of pilot whales along the shelf edge of South Africa and Namibia including within the Venus development area since 2010 (de Rock, et al., 2019; Sea Search unpublished data). Observed group sizes range from 8-100 individuals (Seakamela, et al., 2022).

Dusky dolphins

Dusky dolphins are frequently encountered in water less than 500 m deep. The species is very boat friendly and will often approach to bow-ride. This species is resident year-round throughout the Benguela ecosystem (Findlay, Best, Ross, & Cockcroft, 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters off South Africa and Lüderitz, although encounters nearshore are rare along the central Namibian coast (Walvis Bay area), with most records coming from beyond 5 nautical miles from the coast (Elwen, Thornton, & Reeb, 2010)NDP unpubl. data). In a recent survey of the Namibian Islands Marine Protected Area (between latitudes of 24°29' S and 27°57' S and depths of 30-200 m) dusky dolphin were the most detected cetacean species with group sizes ranging from 1 to 70 individuals (NDP unpubl. data), although group sizes up to 800 have been reported in southern African waters (Findlay, Best, Ross, & Cockcroft, 1992). Sightings of dusky dolphins have been made during trips to PEL0056/Block 2913B (BSL, 2019c), and within the vicinity of Walvis Bay, as such **encounters within the larger project area of influence and vessel passages as well as nearshore transshipment area may occur. However, due to the offshore location of PEL0056/Block 2913B, encounters within the Venus offshore project area are unlikely.**

Heaviside's dolphins

Heaviside dolphins are relatively abundant in both the southern and northern Benguela ecosystems with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (South Africa) (Elwen S. , Thornton, Reeb, & Best, 2009a) and several hundred animals living in the areas around Walvis Bay and Lüderitz. Heaviside's dolphins are resident year-round. This species occupies waters from the coast to at least 200 m depth (Elwen, et al., 2006; Best P. , Whales and Dolphins of the Southern African Subregion, 2007) and may show a diurnal onshore-offshore movement pattern feeding



offshore at night, although this varies throughout the range (Elwen, Snyman, & Leeney, 2009b).

Since this species occur primarily inshore, encounters within PEL0056/Block 2913B are unlikely. However, sightings have been recorded during various EBS trips to PEL0056/Block 2913B (BSL, 2019b; BSL, 2019c; BSL, 2022a). As such, encounters within inshore transshipment and/or vessel transfer operations are likely.

Common dolphins

Common dolphins are known to occur offshore in Namibian waters (Findlay, Best, Ross, & Cockroft, 1992). Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay, Best, Ross, & Cockroft, 1992; Best P. , 2007), although they are currently considered part of a single global species (Cunha et al. 2015). The long-beaked common dolphin lives on the continental shelf of South Africa rarely being observed north of St Helena Bay on the west coast or in waters more 500 m deep (Best P. , 2007), although more recent sightings, including those from MMOs, suggest sightings regularly out to 1 000 m or more (SLR data, Sea Search data). A stranding in Lüderitz (May 2012, NDP unpublished data) and MMO reports have confirmed their occurrence in the region. Although group sizes can be large, averaging 267 ($\pm$ SD 287) for the southern African region (Findlay, Best, Ross, & Cockroft, 1992), average sizes of 37 ($\pm$ SD 31) have been reported for the Namibian region (NDP unpublished data). They are more frequently seen in the warmer waters offshore and to the north of the country, and all sightings to date have been in water deeper than 500 m. There is no evidence of seasonality. Far less is known about the short-beaked form, which is challenging to differentiate at sea from the long-beaked form. Group sizes are also typically large. It is likely that common dolphins encountered deeper than 2 000 m are of the short-beaked form. **Encounters in the project of influence area may occur, including the waters off Walvis Bay and in the vicinity of the nearshore transshipment area.**

Common bottlenose dolphins

Common bottlenose dolphins are widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. Within Namibian waters two populations of bottlenose dolphins occur. A small population of less than 100 individuals inhabits the very near shore coastal waters (mostly <15 m deep) of the central Namibian coastline from approximately Lüderitz in the south to at least Cape Cross in the north (Elwen, Findlay, Kiszka, & Weir, 2011). This group is considered to be of conservational concern, but **its nearshore habitat (<15 m depth) makes it unlikely to be impacted by the proposed offshore project activities, nevertheless encounters with nearshore transshipment operations are likely to occur.** An offshore 'form' of common bottlenose dolphins occurs around the coast of southern Africa including Namibia and Angola (Best P. , 2007) with sightings restricted to the continental shelf edge and deeper. Offshore bottlenose dolphins frequently form mixed species groups, often with pilot whales or Risso's dolphins.

Southern right whale dolphins

The cold waters of the Benguela region provide a northwards extension of the normally sub-Antarctic habitat of southern right whale dolphins (Best, 2007). Most records in the region originate in a relatively restricted region between 26°S and 30°S roughly between Lüderitz and Tripp Seamount in water 100-2 000 m deep (Rose & Payne 1991; Best, 2007; NDP Unpublished data). There was a live stranding of two individuals in Lüderitz Bay in December 2013. They are often seen in mixed species groups with other dolphins such as dusky dolphins. It is possible that the Namibian sightings represent a regionally unique and resident population (Findlay, Best, Ross, & Cockroft, 1992). **Encounters in the project area of influence including vessel transit routes are, therefore, possible. Encounters within**



the nearshore transshipment area are less likely to occur owing to the shallower depth, with species largely recorded further south.

Beaked whales

There are almost no data available on the abundance, distribution, or seasonality of the smaller odontocetes (with dolphins) known to occur in oceanic waters (greater than 200 m) off the Namibian continental shelf (see Table 5-9). Beaked whales are all considered to be true deep-water species, usually recorded in waters in excess of 1 000-2 000 m (see various species accounts in Best 2007) and **thus may be encountered in the Venus offshore project area yet are unlikely to be encountered during nearshore transshipment operations.**

Other Delphinids

Several other species of dolphins that might occur in the deeper waters of broader project area at low levels include the pygmy killer whale, Risso's dolphin, rough toothed dolphin, pantropical spotted dolphin and striped dolphin (Findlay et al., 1992; Best, 2007). Although nothing is known about the population size or density of these species in the broader project area, **it is likely that encounters would be rare.**

5.5.3.7 Marine Mammals - Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*), considered as of Least Concern (IUCN), is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see **Figure 5-33**). Vagrant records from four other species of seal more usually associated with the sub-Antarctic environment have also been recorded: southern elephant seal (*Mirounga leonina*), sub-Antarctic fur seal (*Arctocephalus tropicalis*), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) (David, 1989).

The Namibian southern colonies (Spencer Bay to Baker's Bay) historically contributed approximately 62% to the overall seal population in Namibia. However, since the distributional shift of the seal population northwards in response to environmental changes and altered prey distributions, the southern colonies comprise just less than a third of the total Namibian seal population (J-P Roux pers comm.). Population estimates fluctuate widely between years in terms of pup production, particularly since the mid-1990s (MFMR unpubl. Data; Kirkman et al. 2007). **The colonies closest to PEL0056/Block 2913B are at van Reenen Bay and Baker's Bay approximately 280 km inshore to the north-east of PEL0056/Block 2913B, in the Tsau//Khaeb (Sperrgebiet) National Park.** These southern Namibian colonies have important conservation value since they are largely undisturbed at present, as public access to the southern Namibian coast is restricted.

Colonies and haul out sites at Atlas Bay and Wolf Bay are **located over 300 km north-east of the PEL0056/Block 2913B** (see Figure 5-29). **The closest haul out sites and colonies to the nearshore transshipment operations, are located at Conception Bay, over 120 km south, and Cape Cross, over 100 km north of Walvis Bay.**

Further colonies occur at at Buchu Twins near Alexander Bay, Kleinsee (incorporating Robeiland) and Strandfontein Point (south of Hondeklipbaai) in South Africa. The colony at Kleinsee has the highest seal population and produces the highest seal pup numbers on the South African coast (Wickens, 1994). The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status (M. Meyer, SFRI, pers. comm.). **These South African colonies are over 300 km inshore, east and south-east of PEL0056/Block 2913B and well south of the nearshore transshipment operations.**

The Cape fur seal population in the Benguela is regularly monitored by the South African and Namibian governments (e.g. Kirkman et al. 2012). Surveys of the full species range are periodically undertaken providing data on seal pup production (which can be translated to



adult population size), thereby allowing for the generation of data on the population dynamics of this species. The population is considered to be healthy and stable in size although there has been a northward shift in the distribution of the breeding population (Kirkman, et al., 2007; Skern-Mauritzen, et al., 2009; Kirkman, et al., 2012).

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles (~220 km) offshore (Shaughessy, 1979), with bulls ranging further out to sea than females. Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish. Although Cape fur seals are primarily epipelagic foragers, some degree of geographic and temporal variation in resource and habitat use have been demonstrated (Botha, et al., 2023). Benthic feeding to depths of up to 454 m has been recorded in females from the Kleinsee colony, with individual modal dive durations of 0.2 – 5.6 minutes (Kirkman, et al., 2015; Kirkman, et al., 2019). Botha et al. (2020) reported diel foraging patterns in females from the Kleinsee and False Bay colonies, with dive depth and benthic foraging increasing during daylight hours likely reflecting the vertical movements of prey species. The foraging area of tracked seals from Namibian colonies and the South African West Coast colonies was provided in Skern-Mauritzen et al. (2009) and Harris et al. (2022) respectively. **Nearshore transshipment and vessel transfer passages may fall within the foraging ranges of these species, with several Cape fur seals recorded during transit from Walvis Bay to PEL0056/Block 2913B, but also within the Block in waters ranging from 2 600 to 3 000 m deep (BSL, 2022).**

The timing of the annual breeding cycle is very regular, occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen, 1991).

There is a controlled annual quota, determined by government policy, for the harvesting of Cape fur seals on the Namibian coastline. The Total Allowable Catch (TAC) for 2020 and 2021 stands at 60 000 pups and 8 000 bulls, distributed among seven licence holders at Cape Cross and a further three in Lüderitz. The annual quotas are seldom filled with concessionaires typically only harvesting 50% of the bulls and 30% of the pups. The seals are exploited mainly for their pelts (pups), blubber and genitalia (bulls). The pups are clubbed, and the adults shot. These harvesting practices have raised concern among environmental and animal welfare organisations (Molloy & Reinikainen, 2003; Kirkman & Lavigne, 2010).

In South Africa, an unprecedented mortality event was recorded between September and December 2021 at colonies around the West Coast Peninsula and north to Lambert's Bay and Elands Bay. Primarily pups and juveniles were affected. Post-mortem investigations revealed that seals died in a poor condition with reduced blubber reserves, and protein energy malnutrition was detected for aborted fetuses, for juveniles and subadults. Although no unusual environmental conditions were identified that may have triggered the die-off, or caused it indirectly (e.g., HABs), 2021 was a year of below average recruitment of anchovy and sardine, the main food source for seals. While a lack of food, as a result of possibly climate change and/or overfishing, has been predicted to be the cause of this mass mortality, the underlying causes of the mortality event remain uncertain (Seakamela, et al., 2022). In Namibia, similar mortality events typically related to prey shortage occur periodically, the most recent being a large-scale abortion event in 2020, especially at the colonies in central Namibia (J.-P. Roux, pers. comm.).



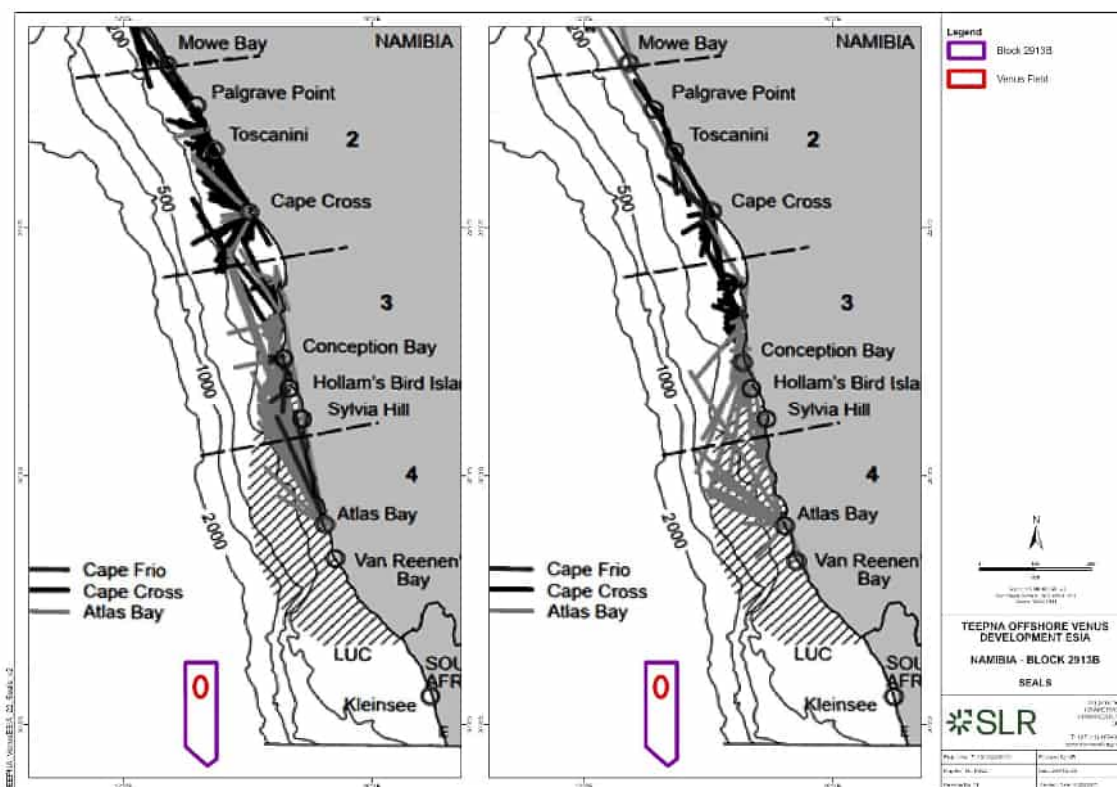


Figure 5-33: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to foraging trips of females (left) and males (right) of Cape fur seals at the Cape Frio, Cape Cross and Atlas Bay colonies.

Source: Skern-Mauritzen et al. (2009)

Trips are depicted as straight lines between the start location and the location where the seals spent most time during a trip.

5.5.4 Coastal Communities

The coastline of the broader project area is characterised by a mixture of intertidal sandy beaches, rocky shores, estuaries and rocky subtidal habitats. These ecosystems were categorized by Holness et al. (2014) and assigned a threat status based on their geographic extent and degree of ecosystem degradation (see Table 5-11 and Figure 5-34).

Approximately half of Namibia's coastline consists of intermediate sandy beaches. The remaining coastline features a mix of shore types, including mixed shores (12%), dissipative-intermediate beaches (10%), exposed rocky shores (8%), lagoon coasts (7%), and reflective beaches (7%), each occurring in relatively similar proportions (Harris et al., 2013).

A general description of coastal habitats on the central Namibian coast, potentially falling within the area of influence in the case of an unplanned hydrocarbon spill during nearshore transshipment operations, is provided below.



Table 5-11: Threat status of coastal ecosystem types in the broader project area

Ecosystem Type	Threat Status
Cunene Exposed Rocky Shore	Least Threatened
Hoanid Dissipative Sandy Beach	Least Threatened
Hoanid Dissipative-Intermediate Sandy Beach	Least Threatened
Hoanid Estuarine Shore	Least Threatened
Hoanid Exposed Rocky Shore	Least Threatened
Hoanid Intermediate Sandy Beach	Least Threatened
Hoanib Mixed Shore	Least Threatened
Hoanib Reflective Sandy Beach	Least Threatened
Hoanib Sheltered Rocky Shore	Least Threatened
Kuiseb Dissipative Sandy Beach	Least Threatened
Kuiseb Dissipative-Intermediate Sandy Beach	Least Threatened
Kuiseb Estuarine Shore	Least Threatened
Kuiseb Exposed Rocky Shore	Least Threatened
Kuiseb Intermediate Sandy Beach	Least Threatened
Kuiseb Lagoon Coast	Endangered
Kuiseb Mixed Shore	Endangered
Kuiseb Reflective Sandy Beach	Least Threatened
Kuiseb Sandy Beach	Least Threatened
Lüderitz Dissipative Sandy Beach	Least Threatened
Lüderitz Dissipative-Intermediate Sandy Beach	Least Threatened
Lüderitz Exposed Rocky Shore	Least Threatened
Lüderitz Intermediate Sandy Beach	Least Threatened
Lüderitz Island	Least Threatened
Lüderitz Lagoon Coast	Least Threatened
Lüderitz Mixed Shore	Least Threatened
Lüderitz Reflective Sandy Beach	Least Threatened
Lüderitz Sheltered Rocky Shore	Least Threatened
Lüderitz Very Exposed Rocky Shore	Least Threatened
Namaqua Dissipative-Intermediate Sandy Beach	Least Threatened
Namaqua Estuarine Shore	Least Threatened
Namaqua Exposed Rocky Shore	Vulnerable
Namaqua Intermediate Sandy Beach	Critically Endangered
Namaqua Mixed Shore	Least Threatened
Namaqua Reflective Sandy Beach	Critically Endangered

Note: Coastal ecosystems located within vicinity of nearshore transshipment area indicated in **bold**.



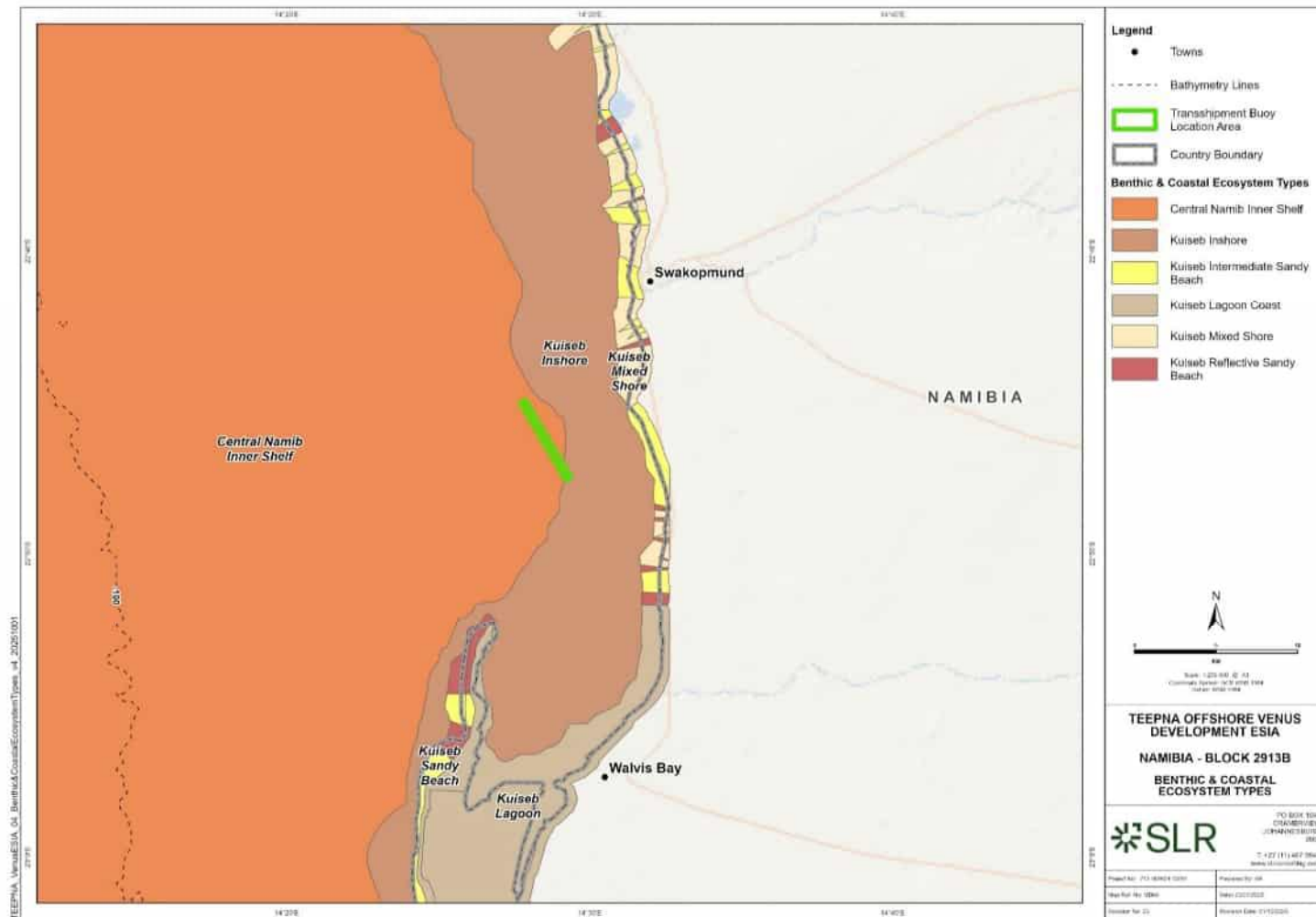


Figure 5-34: Nearshore transshipment area in relation to coastal ecosystem types.



5.5.4.1 Sandy Beaches

Sandy beaches are among the most dynamic coastal environments. Along the southern African West Coast, most beaches are highly exposed, except for a few in large bay systems such as Walvis Bay. These exposed sandy shores consist of coupled surf-zone, beach, and dune systems, forming the active littoral sand transport zone (Short & Hesp 1985). The composition of their faunal communities depends on the interaction of wave energy, beach slope, and sand particle size, a concept known as beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective, and intermediate beaches (McLachlan et al. 1993). Dissipative beaches are wide and flat with fine sands and low wave energy, harbouring the richest intertidal faunal communities. Reflective beaches have high wave energy, coarse grains, and narrow, steep intertidal faces, resulting in depauperate faunal communities. Intermediate beaches exhibit variable species composition, influenced by food availability, such as kelp wrack, which supports a rich and diverse drift-line fauna (Branch & Griffiths 1988).

The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, specific to substratum type, wave exposure, and depth zone.

The upper beach dry zone (supralittoral) is situated above the high water spring tide level, receiving water input only from large waves at spring high tides or through sea spray. This zone is characterized by a mixture of air-breathing terrestrial and semi-terrestrial fauna, while the mid-beach and surf zones are characterized by various isopods, polychaetes, and amphipods. The transition and outer turbulent zones have lower diversity due to extreme turbulence but include species like polychaetes and sea pens. Typical species in this zone include the mysid (*Gastrosaccus psammodytes*), the Ribbon worm (*Cerebratulus fuscus*), the Cumacean (*Cumopsis robusta*), and various polychaetes. These species generally extend partially into the mid-littoral zone above. In areas with a suitable swash climate, the gastropod, *Bullia digitalis*, may also be present in considerable numbers, surfing up and down the beach in search of carrion.

Interstitial meiofauna sampling across the intertidal zone and into the sublittoral region of Langstrand sandy beach, conducted by McGwynne et al. (1989), identified nematodes as the most dominant and widespread group. Crustaceans, harpacticoid copepods, and mystacocarids were present in lower numbers. Non-selective deposit feeders made up over 56% of the nematodes examined, suggesting an abundant supply of particulate food in the coastal waters offshore of Langstrand.

5.5.4.2 Intertidal Rocky Shores

Rocky intertidal zones represent ecologically diverse coastal habitats, formed by tide pools, crevices, and boulders, creating a heterogeneous habitat supporting a wide range of marine life (Stevcic et al., 2018; Smith, 2013). These environments are shaped by dynamic physical factors such as tidal fluctuations, wave exposure, temperature extremes, and substrate variability (Smith, 2013).

The intertidal zone is typically divided into three vertical bands: the upper, mid, and lower intertidal zones (Harley & Helmuth, 2003). Each zone hosts species adapted to its specific conditions, with species within the upper zone adapted to endure prolonged exposure to air and intense sunlight as compared to the lower zone which is more influenced by biological interactions (Tomanek & Helmuth, 2002).

Namibia's coastline, part of the greater Benguela upwelling system, supports a rich array of intertidal species. Limpets of the genus *Scutellastra* are particularly prominent, playing a key role in regulating algal growth and maintaining ecological balance (Mmonwa et al., 2017; Vasconcelos et al., 2021). In addition, several species of Patellid are endemic to southern Africa (Branch et al., 2010; Mmonwa et al., 2017). Mussels also feature prominently, with the



indigenous Brown mussel (*Perna perna*) being the most widespread. Other indigenous species include the Black mussel (*Choromytilus meridionalis*) and Ribbed mussel (*Aulacomya ater*), both of which contribute to ecosystem services such as water filtration and nutrient cycling (Hammond & Griffiths, 2006; Dahms, van der Bank & Greenfield, 2014).

However, the intertidal communities are increasingly affected by invasive species. *Mytilus galloprovincialis* (Mediterranean mussel) and *Semimytilus patagonicus* (bisexual mussel) have established themselves along the Namibian coast, often outcompeting native mussels due to their broad environmental tolerances and rapid growth rates (Zbawicka, Gardner & Wenne, 2019).

A field study conducted in March and June 2022 by Ochs (2023) investigated macroinvertebrate communities across six coastal sites, using transect sampling to assess species composition, size, and diversity. Four of these sites, Langstrand, Dolphin Beach, Badewane, and Mile Four beach, located inshore and to the north of the transshipment area were classified as disturbed due to their accessibility and observed human activity. The remaining two sites served as controls, representing less disturbed conditions.

Findings revealed notable differences between disturbed and control sites. Invasive mussels (*M. galloprovincialis* and *S. patagonicus*) exhibited significantly smaller sizes at disturbed locations, suggesting environmental stress or competition. *Oxystele variegata*, a native gastropod, was consistently larger at control sites, while *C. meridionalis* was absent from Dolphin Beach and Langstrand.

Species diversity was markedly higher at the control sites in both sampling periods, with statistical analysis confirming significant differences. These patterns suggest that human activities, such as harvesting and trampling, along with natural environmental variation, play a role in species assemblages and ecosystem health in the intertidal zone (Ochs, 2023).

5.5.4.3 Rocky Subtidal Habitat and Kelp Beds

Biological communities of the rocky sublittoral on the southwest coast can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m, dominated by flora, and an offshore zone below 10 meters depth, dominated by fauna. This shift in communities represents a continuum of species distributions with changing abundances. From the sublittoral fringe to a depth of between 5 m and 10 m, the benthos is largely dominated by algae, particularly two species of kelp: *Ecklonia maxima* and *Laminaria pallida*. *E. maxima* are not abundant in southern Namibia, being present to just north of Lüderitz, while *L. pallida* extends from Danger Point to Rocky Point in northern Namibia (Stegenga et al. 1997; Rand 2006).

Kelp beds absorb and dissipate much of the high wave energy reaching the shore, providing partially-sheltered habitats for a high diversity of marine flora and fauna (Branch 2008). These beds support recruitment and complex trophic food webs, including commercially important rock lobster stocks. Growing beneath the kelp canopy and epiphytically on the kelps are a diversity of understory algae, which provide food and shelter for predators, grazers, and filter-feeders. Representative understory algae include *Botryocarpa prolifera*, *Neuroglossum binderianum*, *Botryoglossum platycarpum*, *Hymenena venosa*, and *Rhodymenia obtusa*.

From an ecological perspective, the subtidal rocky shores of Namibia are poorly studied as compared to the West Coast of South Africa (Pulfrich et al., 2002). The sublittoral invertebrate fauna along the South African West Coast is dominated by suspension and filter-feeders, such as mussels *Aulacomya ater* and *Choromytilus meridionalis*, and the Cape reef worm *Gunnarea capensis*. Grazers are less common, with most herbivory restricted to grazing juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin *Parechinus angulosus*. Key predators include the commercially important West Coast rock lobster *Jasus lalandii*. The rock lobster acts as a



keystone species, influencing community structure via predation on a wide range of benthic organisms (Mayfield *et al.* 2000). Other predators include various starfish, feather and brittle stars, and gastropods. Fish species commonly found in kelp beds include Hottentot (*Pachymetopon blochii*), Two-tone finger fin (*Chirodactylus brachydactylus*), Red fingers (*Cheilodactylus fasciatus*), Galjoen (*Dichistius capensis*), Rock Suckers (*Chorisochismus dentex*), and the catshark (*Haploblepharus pictus*).

Pulfrich *et al.* (2003) investigated the ecological impacts of fine sediment discharge from diamond mining operations on subtidal rocky reef communities in Elizabeth Bay, southern Namibia. Between 1996 and 1999, the research compared two sheltered subtidal sites affected by sediment discharge with two nearby reference sites unaffected by mining. The study found significant differences in subtidal community structure between impacted and control areas. Impacted sites were reported to have higher cover of green algae and lower abundance of sessile filter-feeders, particularly sponges. Dominant algal species included *Laminaria pallida* (kelp) and various red algae such as *Epymenia obtusa* and *Neuroglossum binderianum*. As found along the West Coast of South Africa filter-feeders such as *A. ater*, *M. galloprovincialis*, and the reef worm *G. capensis* were present but notably less abundant at impacted sites. Additionally, the impacted sites had significantly higher sand content, which influenced community composition. Despite these changes, the density of mobile predators (*Nucella* spp.), scavengers, and grazers (*C. granatina*, *Scutellastra granularis* and *Siphonaria capensis*) did not differ significantly between impacted and reference sites. Overall, the study concluded that sediment discharge altered subtidal benthic community structure, particularly by reducing filter-feeder abundance and increasing opportunistic algal cover, although the effects were localized and did not extend to mobile fauna such as the West Coast rock lobster (*Jasus lalandii*).

5.5.4.4 Lagoons

Along the northern Namibian coastline, coastal lagoons are prominent geomorphological features formed by dynamic sand spits that separate shallow water bodies from the Atlantic Ocean. These sand spits, shaped by aeolian processes and longshore or cross-shore drift, are constantly evolving in response to wind and wave action (Hughes *et al.*, 1992; Schoonees *et al.*, 1998). **Two of the most ecologically significant lagoons in this region are Walvis Bay and Sandwich Harbour, are located approximately 18 km and 65 km south of the nearshore transshipment area.** These lagoons are recognized under the Ramsar Convention for their international importance as wetlands (see Section 5.6.2). The nutrient-rich Benguela Current supports high biological productivity in these systems, making them vital habitats for diverse bird species such as flamingos and pelicans, as well as fish and marine mammals (DMC and CSIR, 2010).

The Walvis Bay Lagoon is the most prominent of Namibia's lagoons, both ecologically and economically. It supports a rich benthic ecosystem and serves as a critical feeding and breeding ground for migratory birds (Heather-Clark, 2016). Designated as a Ramsar site in 1995, the lagoon is under international obligation for protection due to its ecological significance (Kapula *et al.*, 2023). However, its proximity to industrial activities such as fish processing, shipping, and ship repair, poses pollution risks, particularly from heavy metals such as mercury, lead, and cadmium (Omorieg *et al.*, 2019; Kapula *et al.*, 2023). Recent studies have detected trace levels of mercury in the southern mullet (*Chelon richardsonii*), a species that feeds on lagoon sediments, highlighting the need for ongoing monitoring.

In contrast, Sandwich Harbour remains relatively undisturbed, with minimal development since its historical use as a whaling anchorage in the 19th century (Wilkinson *et al.*, 1989). Today, it is primarily a site for eco-tourism and birdwatching. Like Walvis Bay, it is formed by a long, narrow sand spit and is influenced by the same oceanographic and climatic conditions. However, its isolation has helped preserve its ecological integrity, making it a valuable reference site for understanding natural lagoon dynamics in the region.



5.5.5 Ecological Network Conceptual Model

Figure 5-35 provides a simplified conceptual model for the nearshore and offshore receiving environment in the southern Benguela system illustrating key variables, processes, linkages, relationships, dependencies and feed-back-loops.

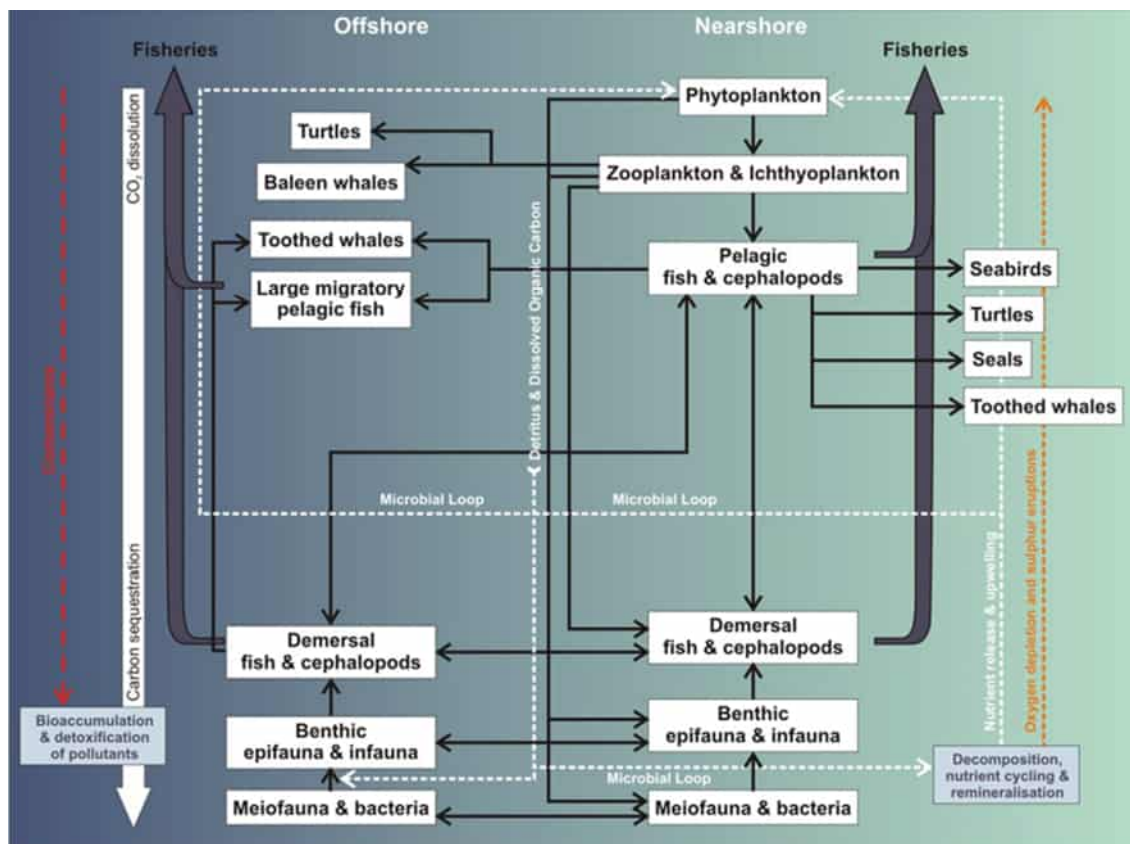


Figure 5-35: Simplified Network Diagram Indicating the Interaction Between the Key Ecosystem Components off the southern Benguela system.

Source: Pisces (2022)

The southern Benguela region's upwelling of nutrients is a critical driver of seasonal phytoplankton production, forming the foundation of a diverse food web that includes zooplankton, pelagic fish, cephalopods, marine mammals, and benthic species. This high productivity in surface waters creates a cyclical process of plankton growth, mortality, and nutrient replenishment through microbial decomposition. Millions of tonnes of organic material naturally enter the seabed each year, supporting benthic communities and contributing to the region's rich organic content. However, organic detritus that isn't consumed can lead to oxygen depletion and the formation of hydrogen sulphide due to anaerobic bacteria.

In offshore environments, particularly around seamounts, similar processes enhance local primary and secondary production, creating hotspots for higher-order consumers. Cold-water corals and other structures associated with seamounts increase habitat complexity and biodiversity, supporting detritivore-based food webs that attract scavengers and predators. These seamounts are vital habitats for commercial deep-water fish stocks, reinforcing the ecosystem's productivity and health. The functions of these marine ecosystems include



supporting fisheries, sequestering carbon, and detoxifying waste, all of which are influenced by natural variations and human activities such as hydrocarbon exploration.

Anthropogenic disturbances can disrupt marine ecosystems at both population and ecosystem-wide levels. For instance, changes in marine mammal behaviour due to human activities could alter nutrient flows in feeding areas, impacting overall ecosystem health. Similarly, significant disturbances to plankton populations can have cascading effects on the entire food web, threatening the viability of fish and marine mammal populations that rely on healthy plankton communities for sustenance. Effective management strategies must account for these potential impacts and emphasize the importance of stable predator populations in maintaining ecosystem balance.

To assess these complex interactions, researchers have developed numerical models, including the Population Consequences of Acoustic Disturbance (PCAD) framework, which evaluates how behavioural changes in individuals affect population dynamics. These frameworks are usually complex and under continual development but have been successfully used to assess the population consequences and ecosystem effects of disturbance in real-life conditions both for marine mammals (Villegas-Amtmann, Schwartz, Sumich, & Costa, 2015; Villegas-Amtmann, Schwarz, Gailey, Sychenko, & Costa, 2017; Costa, et al., 2016; Ellison, Racca, Clark, Streever, & al., 2016; McHuron, Schwarz, Costa, & Mangel, 2018; Pirotta, Booth, Costa, & al., 2018; Dunlop, Braithwaite, Mortensen, & Harris, 2021), fish (Slabbekoorn & Halfwerk, 2009; Hawkins, Roberts, & Cheesman, 2014; Slabbekoorn, et al., 2019) and invertebrates (Hubert, et al., 2018). The PCAD/ PCoD (Potential Consequence of Decision) models use and synthesise data from behavioural monitoring programmes, ecological studies on animal movement, bio-energetics, prey availability and mitigation effectiveness to assess the population-level effects of multiple disturbances over time (Bröker, 2019).

An ecosystem-based management approach is necessary to address the cumulative impacts of human activities and preserve ecosystem services. Within complex marine ecosystems, the integrated ecosystem assessment framework, which incorporates ecosystem risk assessments, provides a method for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components (Levin, Fogarty, Murawski, & Fluharty, 2009; Holsman, et al., 2017; Spooner, et al., 2021). However, quantifying reference points for effective management remains challenging, particularly in data-limited regions like southern Africa. (Slabbekoorn, et al., 2019).



Summary of key biological characteristics in the study area

The Venus offshore project area is located in a deep-water environment that exhibits much lower diversity and abundance of species than the inner shelf areas that benefit from nutrient-rich upwelled waters and the resultant higher productivity, where support vessels transit and transshipment operations will occur.

The benthic habitat at depths beyond 500 m have been assigned a threat status of 'Least Threatened' as they comprise large areas in the Namibian EEZ and experience limited impacts. However, the continental shelf is considered 'Endangered' due to habitat degradation from trawling. Nearshore transshipment area falls within the 'Least Threatened' Kuiseb Inshore and Central Namib Inner Shelf ecosystem types.

Environmental surveys undertaken within PEL0056/Block 2913B, as well as in comparable environments and depth ranges, show that benthic infauna are generally impoverished, which is typical for deep water sediments. Geophysical surveys have further confirmed a typically homogenous seafloor, devoid of features. No colony forming corals and structural features (e.g., rocky outcrops) were identified in the Venus offshore project area during these surveys. The macrofaunal communities recorded were dominated by polychaetes, with lower abundances of molluscs and crustaceans. Bioturbation, in the form of burrows, was present within all biotopes indicating the presence of infaunal taxa.

Benthic surveys along the continental shelf, and within the vicinity of the nearshore transshipment area are found to be dominated by nematoda, polychaeta cumacea, and oligochaeta, with benthic community structure influenced by oxygen availability and depth.

Fishes that typically occur on the upper and mid slopes, and into the abyss, include rattails, bythitids, liparidids (snail fishes) and notacanthids (*Polyacanthonotus* species) and halosaurs. Fish species such as eel-shaped fishes (*Halosauridae* sp.), rat-tails (*Macrouridae* sp.), tripod fishes (*Ipnopidae* sp.), cusk-eels (*Ophidiidae* sp.) and larvacean houses (*Appendicularia* sp.) were recorded within PEL0056/Block 2913B during environmental surveys. Shelf and shallow water associated fish species may be encountered within the nearshore transshipment area, including small pelagic species such as sardine/pilchard (*S. sagax ocellatus*), chub mackerel (*S. japonicus*), horse mackerel (*T. capensis*) and round herring (*E. whiteheadi*).

Key observations regarding pelagic fauna are as follows:

- Important biological processes such as primary production, fish spawning and migratory routes occur inshore (outside) of Venus offshore project area, however overlap with the nearshore transshipment area and operations
- The distribution of small pelagic fish, which include many commercially important species such as sardine and anchovy, are located inshore (outside) of the Venus offshore project area, yet may be encountered by nearshore transshipment operations.
- Large migratory pelagic fish species, such as tunas, billfish and sharks, occur seasonally throughout the southern oceans; they may thus be encountered in the larger project area of influence (i.e. Venus offshore project area and vessel transit routes).
- Turtle occurrence in the larger project area of influence (i.e. Venus offshore project area, vessel transit routes and nearshore transshipment area) is also possible but abundances are similarly expected to be low.
- Foraging and breeding areas of most resident breeding seabirds and Cape fur seals are located inshore (outside) of the Venus offshore project area, yet may overlap with nearshore transshipment area and vessel transit routes.
- Cetacean species most likely to be encountered in the larger project area of influence, including offshore Venus offshore project area, vessel transit routes as well as nearshore transshipment, are long-finned pilot, sperm, southern right and humpback whales, and common dolphins.



5.6 Conservation and Sensitive Areas

Numerous categories of conservation and sensitive areas exist along and offshore the Namibian coastline, which are discussed below.

5.6.1 National Parks

Inshore of the project area of influence, the entire coastline of Namibia is part of a continuum of protected areas that stretch along, a distance of about 1 570 km, from Southern Angola into Namaqualand in South Africa (see Figure 5-36).

From north to south these comprise the Skeleton Coast National Park, the Dorob National Park, the Namib-Naukluft National Park and the Tsau//Khaeb (Sperrgebiet) National Park.

In the south across the Orange River, it borders on the Richtersveld in South Africa, which comprises a protected area of about 1 600 km² within a multiple-use buffer zone of about 3 984 km². This whole area forms the Ai-Ais/Richtersveld Transfrontier Conservation Area under a formal co-operative agreement between the governments of Namibia and South Africa.

5.6.2 Ramsar Sites

A Ramsar site is wetland designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established by UNESCO in 1971. Namibia has a total of five Ramsar sites, three of which are located along the coast. The Ramsar sites potentially in the project's Area of Influence are listed in Table 5-12. **PEL0056/Block 2913B lies offshore of these coastal sites, however the nearshore transshipment location falls within the vicinity of the Walvis Bay Wetlands (see Figure 5-37).**

Table 5-12: List of coastal Ramsar sites inshore of PEL0056/Block 2913B and the nearshore transshipment area.

Name	Size (ha)	Description
Walvis Bay Wetlands	10 550	Ramsar site no. 742. A tidal lagoon consisting of adjacent intertidal areas, Pelican Point, mudflats exposed at low tide, and sandbars serving as roosting sites. The site supports varying numbers of wetland birds (37 000 to 79 000 individuals); some species such as flamingos occur in impressive numbers. Eleven endangered bird species are regularly observed. Human activities consist of recreation and salt production. Residential development exists along the lagoon, and natural siltation may eventually lead to its infilling.
Sandwich Harbour	13 825	Ramsar site no. 743. Two distinct wetlands and associated mudflats. One is aquifer-fed and supports typical emergent vegetation but is slowly disappearing due to natural causes. The second, under tidal influence, consists of mudflats and raised shingle bars. One of Namibia's most important coastal wetlands, supporting eight endangered species among the large numbers of wading birds. Several archaeological sites dating back 1 000 years exist within the site. The site is used for scientific research, with surrounding areas used for tourism, recreation, and angling.



Name	Size (ha)	Description
Orange River Mouth	2 000	Ramsar site no. 526. Transboundary area of extensive saltmarshes, freshwater lagoons and marshes, sand banks, and reedbeds shared by South Africa and Namibia. Important for resident birds and for staging locally migrant waterbirds. Following the collapse of the saltmarsh component of the estuary, the site was placed on the Montreux Record in 1995.

5.6.3 Important Bird and Biodiversity Areas

The confirmed Important Bird and Biodiversity Areas (IBAs) located along the Namibian coastline, as designated by BirdLife International in Namibia (see Figure 5-38), include, north to south:

- 30-kilometre Beach: Walvis-Swakopmund;
- Cape Cross Lagoon;
- Mile 4 saltworks;
- Walvis Bay
- Namib-Naukuluft Park;
- Sandwhich Harbour;
- Sperrgebiet;Mercury Island;
- Ichaboe Island;
- Lüderitz Bay Islands; and
- Possession Island;

Various marine IBAs have also been proposed in Namibian territorial waters, with a candidate trans-boundary marine IBA with South-Africa suggested off the Orange River mouth (see Figure 5-38). The proposed **Atlantic Southeast 21 marine IBA** specifically targets the protection of Atlantic Yellow-nosed Albatross, Black-browed Albatross and White-chinned Petrels, with the proposed **Sperrgebiet marine IBA** targets the protection of Yellow-nosed Albatross, Black-browed Albatross and White-chinned Petrels in addition to the Cape Gannet, Hatlaub's Gull and African Penguin. **PEL0056/Block 2913B lies west and offshore of the confirmed and proposed IBAs. However, nearshore transshipment and vessel transfer passages fall within these proposed IBAs** (see Figure 5-38).

Notably, the **nearshore transshipment zone lies within the proposed Walvis Bay–Cape Cross Lagoon–30-Kilometre Beach: Walvis–Swakopmund Marine IBA**. This IBA has been identified for the protection of several key species, including the Cape Cormorant, Kelp Gull, and breeding populations of Damara and Caspian Terns. **Additionally, the transshipment zone is located just north of the confirmed Walvis Bay IBA**, a critical habitat for a wide range of species, including waders (such as flamingos), breeding coastal and pelagic seabirds, and non-breeding Palearctic and intra-African migrants. It is also **offshore of the 30-Kilometre Beach IBA**, which is recognized as an important breeding site for the Damara Tern (see Figure 5-38).

Overall neither the Venus offshore project area and/or nearshore transshipment area fall within confirmed IBAs.



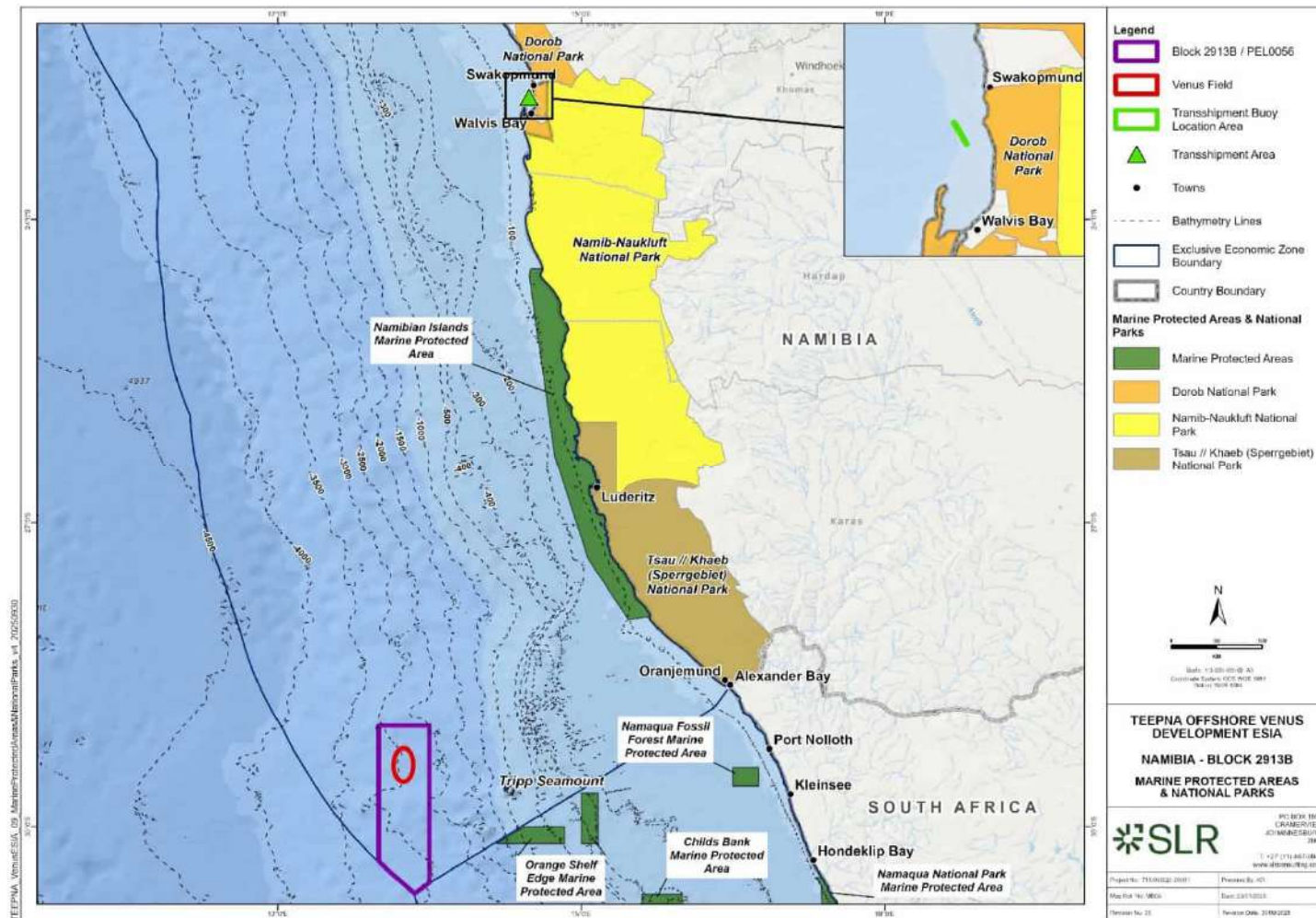


Figure 5-36: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to National Parks and Marine Protected Areas in Namibia and South Africa.



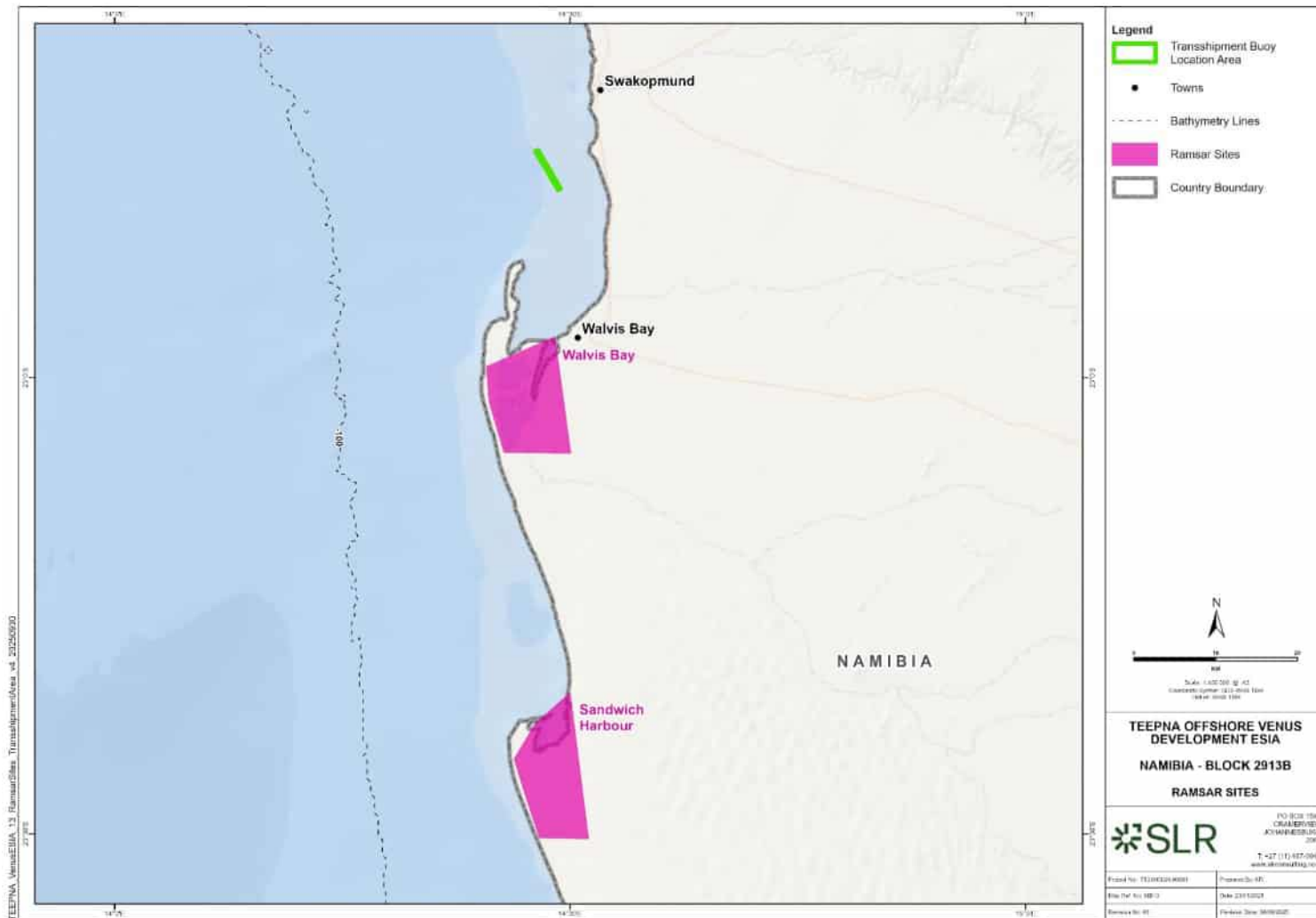


Figure 5-37: Nearshore transshipment area in relation to Ramsar sites.



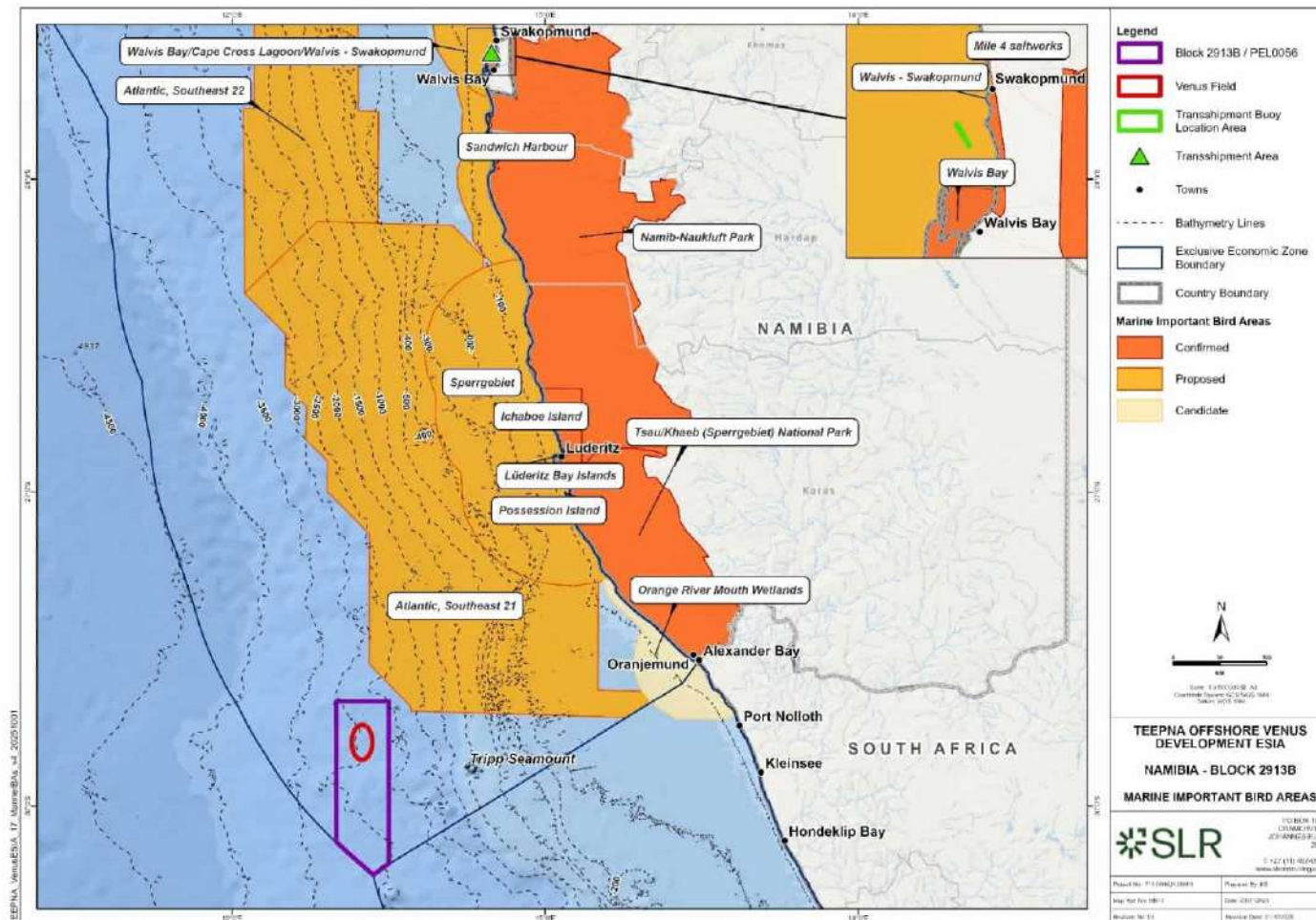


Figure 5-38: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to confirmed, proposed and candidate IBAs along the coast of Namibia.

Source: <https://maps.birdlife.org/marineIBAs/> Marine Protected Areas



The actual Namibian MPA was launched on 2 July 2009 under the Namibian Marine Resources Act (No. 29 of 1992 and No. 27 of 2000), with the purpose of protecting sensitive ecosystems and breeding and foraging areas for seabirds and marine mammals, as well as protecting important spawning and nursery grounds for fish and other marine resources (such as rock lobster). The MPA comprises a coastal strip extending from Hollamsbird Island (24°38'S) in the north, to Chameis Bay (27°57'S) in the south, spanning approximately three degrees of latitude and an average width of 30 km from the coast, including 16 specified offshore islands, islets and rocks (Currie et al. 2009). The Namibian Islands' Marine Protected Area (NIMPA) spans an area of 9 555 km², and includes the **Lüderitz Bay and Ichaboe Island Rock-Lobster** (a 478 km² coastal sanctuary stretching between Chameis Bay and Prince of Wales Bay).

The offshore islands, whose combined surface area amounts to only 2.35 km² have been given priority conservation and highest protection status (see Figure 5-36; Currie et al. 2009). The area has been zoned into four degrees of incremental protection. These are detailed in Currie et al. (2009). The closest point with **NIMPA is 225 km to the north-east of PEL0056/Block 2913B and 190 km south of the nearshore transshipment area.**

The Orange Shelf Edge MPA is 64 km east of PEL0056/Block 2913B at its closest point, in South African waters. This offshore MPA covers depths of between 250 m and 1 500 m and was proclaimed in 2019. The area has not been trawled therefore provides a good reference for a healthy benthic environment. Several other MPAs lie off the West Coast of South Africa.

PEL0056/Block 2913B and the nearshore transshipment area do not overlap with any MPAs. However, support vessels operating out of Lüderitz port will transit through NIMPA en route to and/or returning from the Venus offshore project area.

5.6.4 Sensitive Areas

5.6.4.1 Benthic and pelagic ecosystems threat and protection level

The benthic and coastal ecosystem types of Namibia were mapped as part of the Benguela Current Commission's Spatial Biodiversity Assessment (BCC-SBA) (Holness, et al., 2014) to develop assessments of the ecosystem threat status and ecosystem protection level. Submarine canyons were also mapped as biodiversity features, although descriptions of their geographical situations were not sufficiently accurate for inclusion in the benthic habitat map⁴⁹ (see Figure 5-39). The benthic and coastal ecosystems were subsequently assigned an ecosystem threat status based on their level of protection and ecological condition (see Figure 5-39).

Benthic ecosystem types along the shelf edge in southern Namibia (500 m depth contour) were classified as 'Endangered' by the BCC-SBA, largely due to the degraded habitat found in this area caused by trawling. The upper and lower shelf were considered 'Least Threatened'. **The benthic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area is classified as 'Least Threatened'** (Holness et al. 2014, Table 5-2, Figure 5-39). Similarly, **pelagic ecosystems within the vicinity and south of Walvis Bay have all been assigned a threat status of 'Least Threatened'** (see Figure 5-40), with the **pelagic ecosystems within PEL0056/Block 2913B classified at 'Least Threatened'** (Holness, et al., 2014).

⁴⁹ Possible marine canyons identified by the international Deep Ocean project mapped them as lines. The lines were buffered by 5 km to ensure that both the canyon and its associated adjacent ecosystems were included.



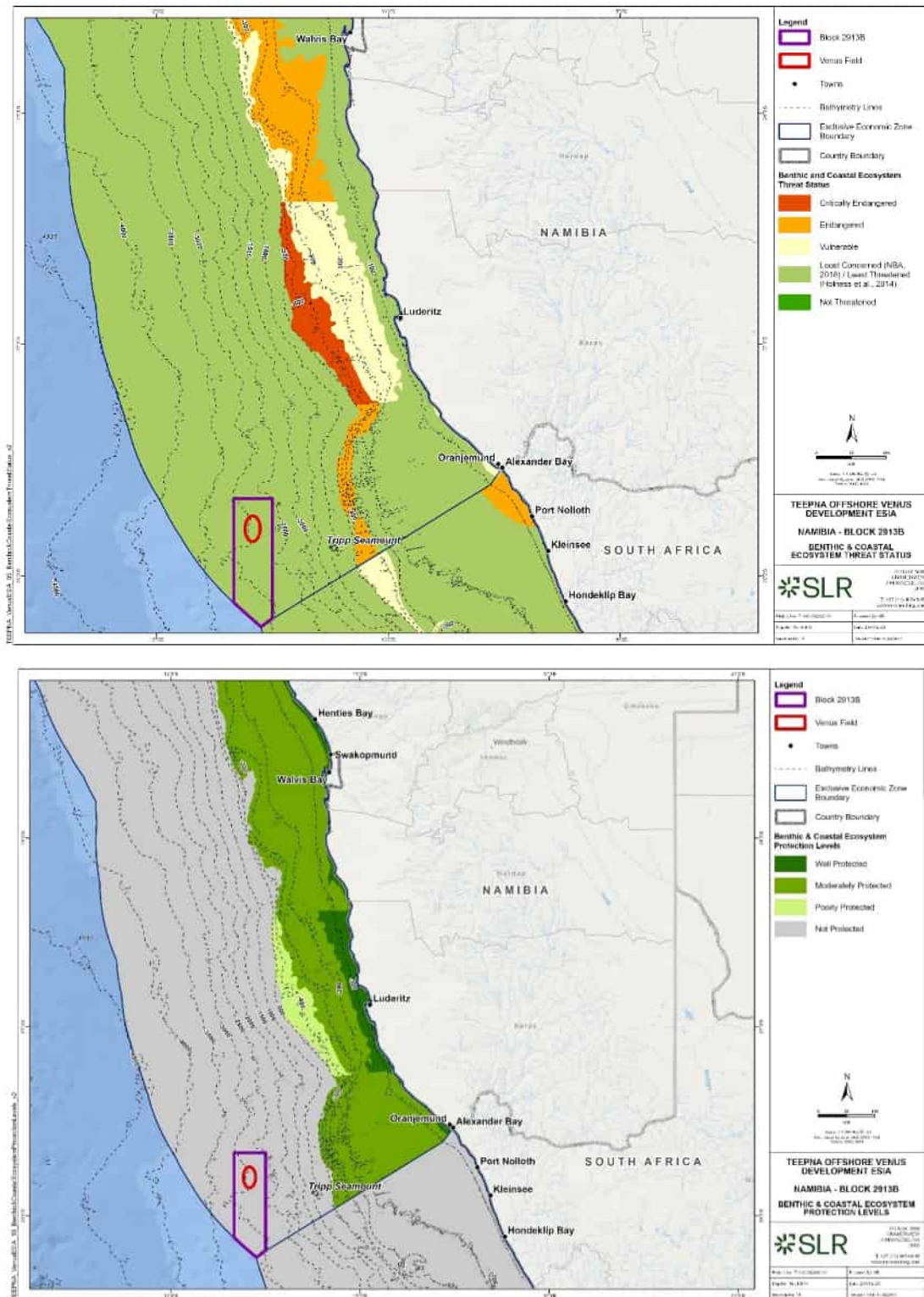


Figure 5-39: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to threat status (top) and protection levels (bottom) of benthic and coastal ecosystems.

Source: Adapted from Holness et al. (2014) and Sink et al. (2019).



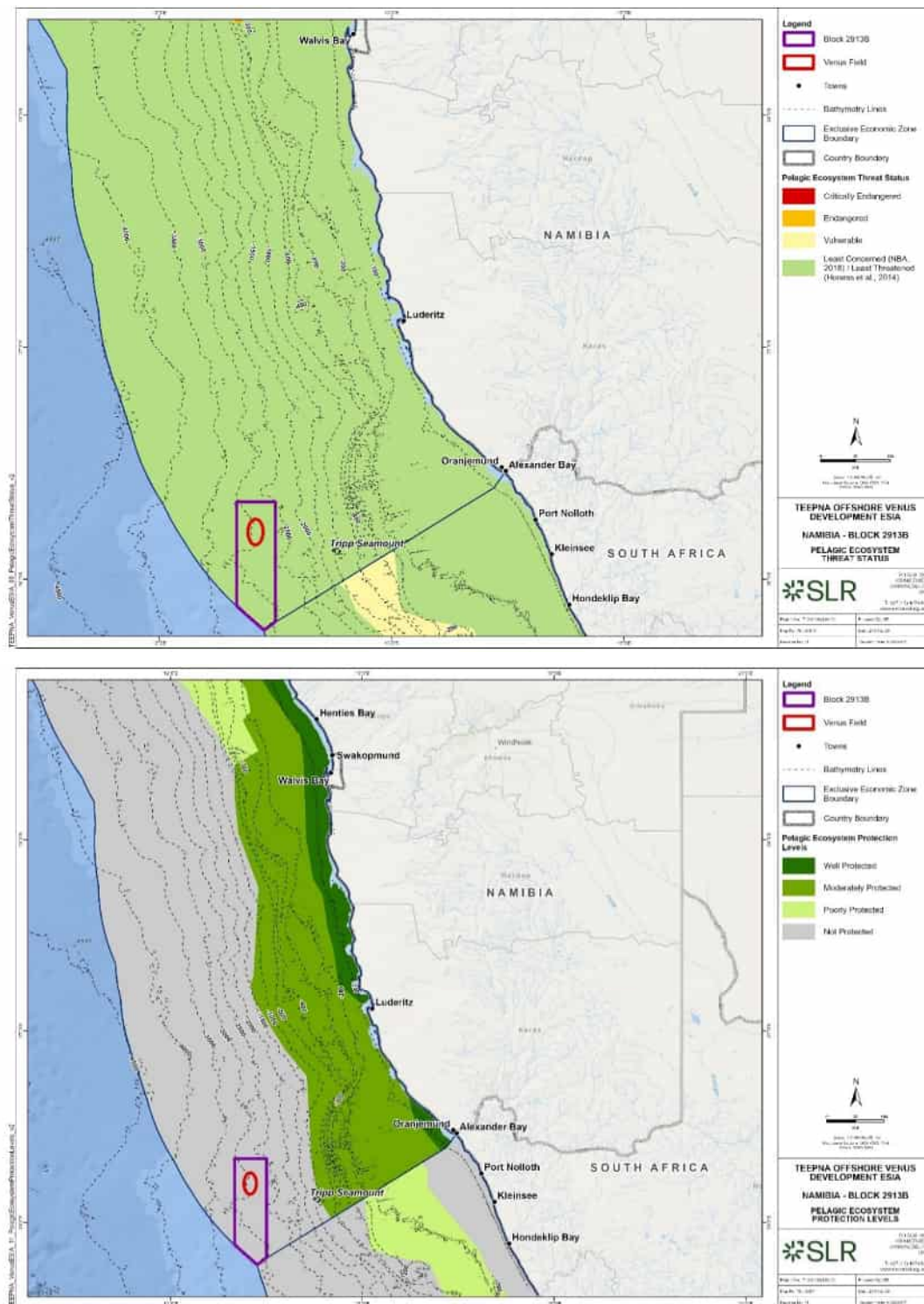


Figure 5-40: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to threat status (top) and protection levels (bottom) of pelagic ecosystems.

Source: Adapted from Holness et al. (2014)



Despite the development of the offshore EBSAs (see Section 5.6.4.2) a number of ‘Vulnerable’ ecosystem types in the broader project area are currently considered ‘not well protected’ or ‘poorly protected’ and further effort is needed to improve protection of these threatened ecosystem types (Holness, et al., 2014) (see Figure 6-32). Ideally, all highly threatened (‘Critically Endangered’ and ‘Endangered’) ecosystem types should be well protected. Currently, however, most of the upper and lower slope and abyss of the Namib biozone receives no protection at all, with the ‘Endangered’ and ‘Critically Endangered’ Namaqua Shelf Edge and Lüderitz Shelf edge being ‘poorly protected’ and ‘moderately protected’, respectively.

PEL0056/Block 2913B lies within an area receiving no ecosystem protection (see Figure 5-39 and Figure 5-40), **but support vessel will transit through vulnerable but moderately protected benthic ecosystems. Transshipment operations will take place in well protected areas / ecosystems** (see Figure 5-39 and Figure 5-40).

5.6.4.2 Ecologically or Biologically Significant Marine Areas

In the spatial marine biodiversity assessment undertaken for Namibia (Holness, et al., 2014), several offshore and coastal areas were identified as being of high priority for place-based conservation measures. To this end, EBSAs spanning the coastline between Angola and South Africa were proposed and successfully submitted for international recognition to the Convention of Biological Diversity (CBD) in March 2020. The principal objective of the EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. The EBSAs are delineated to minimise conflict and avoid negative impacts with industries. In line with Namibia’s National Development Plan 5, the EBSAs will be used to inform and enhance Marine Spatial Planning in the country’s EEZ.

No specific management actions have been formulated for the EBSAs at this stage and they carry no legal status. Any future decisions in relation to management of the areas and possible restrictions of human activities are within the mandate of the responsible authorities. However, two biodiversity zones have recently been defined within each EBSA as part of the marine spatial planning process⁵⁰ (Figure 5-41). Although the proposed zonation of the EBSAs is still under discussion, the management objective in the **zones marked for ‘Conservation’** is “*strict place-based biodiversity protection aimed at securing key biodiversity features in a natural or semi-natural state, or as near to this state as possible*”. The management objective in the **zones marked for ‘Impact Management’** is “*management of impacts on key biodiversity features in a mixed-use area to keep key biodiversity features in at least a functional state*” (Institution for Coastal and Marine Research , 2023).

In the list of sea-use activities provided for Conservation and Impact Management EBSAs, the marine spatial planning zone for petroleum activities recommends that petroleum extraction is either conditionally permissible (Consent⁵¹) or prohibited⁵² within ‘Conservation Zones’, depending on the EBSA in which the ‘Conservation Zone’ falls. **Petroleum extraction (i.e., development) activities are conditionally permissible across all ‘Impact Management’ zones, regardless of the EBSA in which it falls.** These spatial planning zones have been carried across to the draft Central MSP (see Section 0).

⁵⁰ <https://cmr.mandela.ac.za/EBSA-Portal/Namibia/Namibian-EBSA-Status-Assessment-Management>

⁵¹ Consent activities are defined as “An activity which can continue in this zone subject to specific regulation and control. Careful controls are likely to be put in place to avoid unacceptable impacts on biodiversity features, or to avoid intensification or expansion of impact footprints of uses that are already occurring and where there are no realistic prospects of excluding these activities.”.

⁵² Prohibited activities are defined as “An activity which is not allowed or should not be allowed because it is incompatible with maintaining the biodiversity objectives of the zone”.



Of the eight identified EBSAs:

- Two fall solely within Namibian national jurisdiction, Namib Flyway and Namibian Islands;
- One is shared with Angola, Namibe; and
- Two are shared with South Africa, Orange Shelf Edge and Orange Cone.

The Benguela Upwelling System transboundary EBSA extends along the entire southern African West Coast from Cape Point (South Africa) to the Kunene River (Angola) and includes a portion of the high seas beyond the Angolan EEZ. The following bullets summarise the EBSAs possibly overlapping the Venus development project activities, as adapted from the MARISMA EBSA Workstream (2020 and 2023):

- The **Namib Flyway** is a highly productive coastal area in central Namibia that attracts large numbers of seabirds, shorebirds, waterbirds, marine mammals, sea turtles, and other fauna, many of which are threatened species. The main coastal features in the EBSA provide important stopover, breeding, and/or foraging sites for resident and migratory species include two sheltered bays (Sandwich Harbour and Walvis Bay). The upwelling cell off Lüderitz raises productivity northwards due to longshore drift and predominant onshore winds. Primary production of the Benguela Current is highest in the central regions of Namibia, near the EBSA, driven by delayed blooming. **While PEL0056/Block 2913B is located well offshore of this EBSA, support vessel transit and transshipment operations overlap with this EBSA. Specifically, the nearshore transshipment area falls within the Impact Management zone of this EBSA.** Notably sea user guidelines list “port anchorage areas” as a ‘General’ activity requiring no specific detailed assessment.
- The **Namibian Islands** are located offshore of the central Namibian coastline and within the intensive Lüderitz upwelling cell. These islands and their surrounding waters are significant for life history stages of threatened seabird species as they serve as crucial seabird breeding sites within the existing NIMPA. The surrounding waters are also key foraging grounds for both seabirds and for ‘Critically Endangered’ leatherback turtles that nest along the north-eastern coast of South Africa and in Angola and Gabon. **While PEL0056/Block 2913B is located well offshore and nearshore transshipment operations to the north, support vessel transit between Venus offshore project area and Lüderitz port overlaps with this EBSA.**
- The **Orange Seamount and Canyon Complex** occur at the western continental margin of southern Africa, spanning the border between South Africa and Namibia. On the Namibian side, it includes Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and shelf-edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are ‘Threatened’, one is ‘Critically Endangered’ and one ‘Endangered’. The Orange Seamount and Canyon Complex EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures (Sea Surface Temperature (SST) mean = 18.3°C) and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf. **The eastern border of PEL0056/Block 2913B has a 0.01% surface overlap with the Conservation Zone of this EBSA. The proposed Venus offshore project area is, however, over 15 km northwest of the EBSA** (see Figure 5-41). Notably sea user guidelines within the Namibian EEZ portion of the EBSA do not prohibit petroleum extraction (development), which is



considered a 'Consent' activity requiring a detailed assessment before approval (e.g. an ESIA).

- The **Orange Cone** is a transboundary EBSA with South-Africa that spans the mouth of the Orange River. The estuary is biodiversity-rich but modified, and the coastal area includes many 'Critically Endangered', 'Endangered', and 'Vulnerable' habitat types (with the area being particularly important for the 'Critically Endangered' Namaqua Sandy Inshore, Namaqua Inshore Reef and Hard Grounds and Namaqua Intermediate and Reflective Sandy Beach habitat types). The marine environment experiences slow, but variable currents and weaker winds, making it potentially favourable for reproduction of pelagic species. An ecological dependence for of river outflow for fish recruitment on the inshore Orange Cone is also likely. The Orange River Mouth is a transboundary Ramsar site and falls within the Tsau//Khaeb (Sperrgebiet) National Park. It is also under consideration as a protected area by South Africa and is an Important Bird and Biodiversity Area. This area is thus highly relevant in terms of: 'Uniqueness or rarity', 'Importance for threatened, endangered or declining species and/or habitats' and 'Special importance for life history stages of species'. **While PEL0056/Block 2913B and the nearshore transshipment area do not overlap with this EBSA. Helicopter transfer flights operating out of Oranjemund may fly over this EBSA.**
- The **Benguela Upwelling System** is a transboundary EBSA and is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems and is characterized by very high primary production ($>1\,000\text{ mg C}\cdot\text{m}^{-2}\cdot\text{day}^{-1}$). It includes important spawning and nursery areas for fish as well as foraging areas for threatened vertebrates, such as sea- and shorebirds, turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the Northern Benguela, offshore the northern Namibian coast in waters ranging from 50 to 200 m deep, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria. **PEL0056/Block 2913B lies west of this EBSA, yet nearshore transshipment operations fall within this EBSA.**

At the same latitude, within South African waters, are the following EBSAs:

- The **Namaqua Fossil Forest** EBSA, (~285 km east of PEL0056/Block 2913B), is a small seabed outcrop composed of fossilized yellowwood trees at 136-140 m depth, approximately 30 km offshore on the west coast of South Africa. A portion of the EBSA comprised the Namaqua Fossil Forest MPA. The fossilized tree trunks form outcrops of laterally extensive slabs of rock have been colonised by fragile, habitat-forming scleractinian corals and a newly described habitat-forming sponge species. The EBSA thus encompasses a unique feature with substantial structural complexity that is highly vulnerable to benthic impacts.
- The **Childs Bank and Shelf Edge** EBSA, (~180 km southeast of PEL0056/Block 2913B) is a unique submarine bank feature rising from 400 m to 180 m on the western continental margin on South Africa. This area includes five benthic habitat types, including the bank itself, the outer shelf and the shelf edge, supporting hard and unconsolidated habitat types. Childs Bank and associated habitats are known to support structurally complex cold-water corals, hydrocorals, gorgonians and glass sponges; species that are particularly fragile, sensitive and vulnerable to disturbance, and recover slowly.

The project area of influence does not overlap with these South African EBSAs.



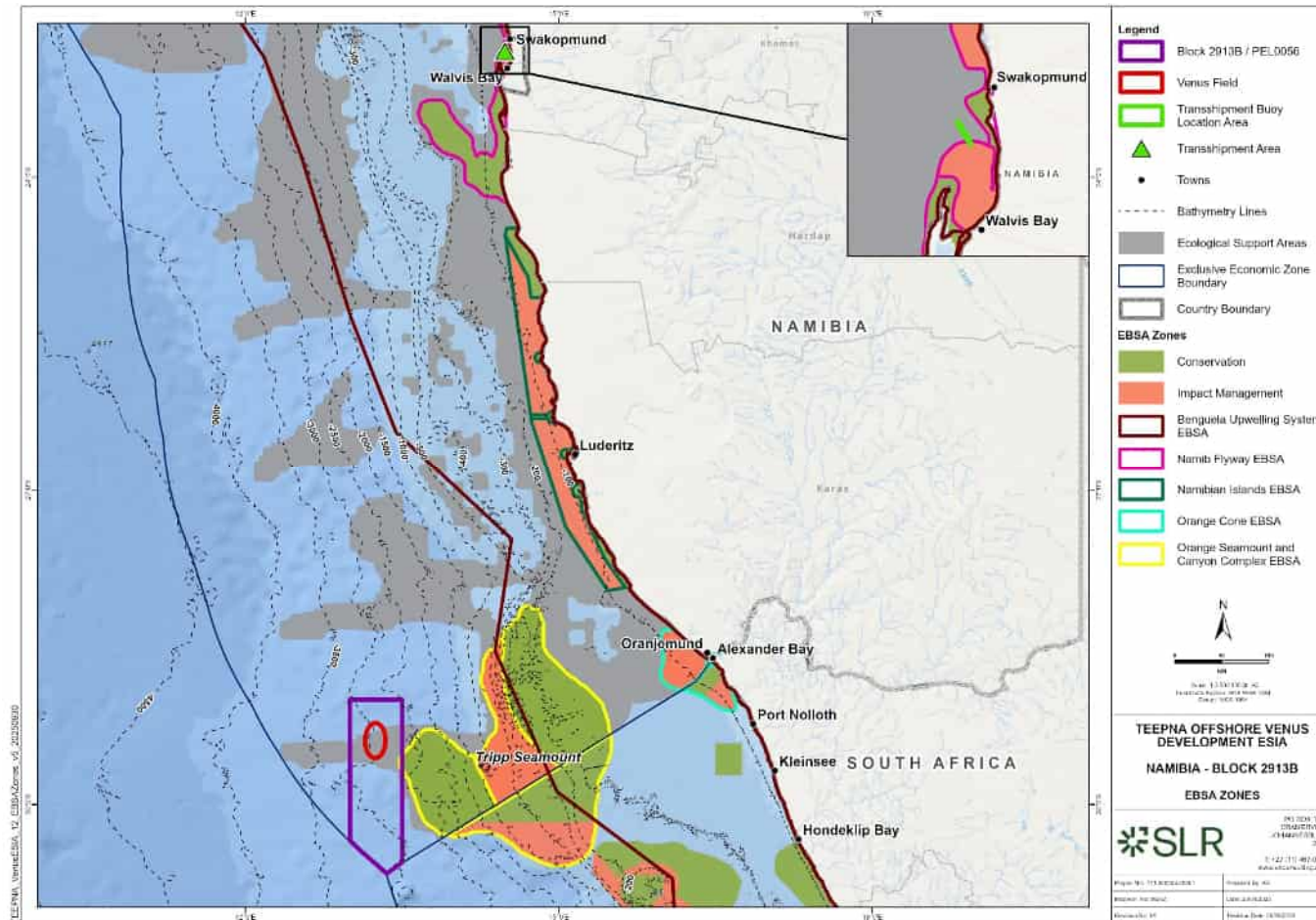


Figure 5-41: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to Ecologically and Biologically Significant Areas (EBSAs) and the Ecological Support Areas (ESAs).

Source: Adapted from MFMR (2021) and MARISMA (2020).



5.6.4.3 Ecological Support Areas and Marine Spatial Planning

In addition to EBSAs, Ecological Support Areas (ESAs) have been identified more recently. Although these areas do not meet the EBSA criteria they reflect secondary priority conservation areas in a natural, near natural or moderately degraded condition that support the ecological functioning of EBSAs and/or MPAs in the vicinity (Figure 5-41).

PEL0056/Block 2913B partially overlaps with an ESA extending from the Orange Seamount and Canyon Complex EBSA. Notably, EBS and geophysical surveys (see Section 5.2) within the ESA sections that overlap with PEL0056/Block 2913B did not record any VMEs, colony forming corals and/or structural features (e.g., rocky outcrops).

The nearshore transshipment area also partially overlaps with an ESA extending from the Namib Flyway EBSA.

Namibia also recently embarked on an MSP process implemented as a development planning approach to organize the use of the country's marine territory in such way that comprehensive, integrated, and complementary planning and management across sectors and for all ocean uses is enabled. MSP in Namibia is highly precautionary and forward-looking given the relatively low intensity of current uses of this marine territory, has a strong ecosystem-based perspective due to the pristine environment, is driven by a social equity and distributive justice agenda, and features a strong collaborative process governance (Finke F. , et al., 2020a; Finke G. , Gee, Kreiner, Amunyela, & Braby, 2020b). Although at this stage MSP lacks legislation and has only weak links to broader ocean governance, the MSP process has resulted in a clear framework for the development of the first marine plan (MFMR 2019), as it was linked to a systematic conservation planning process from the outset.

The objectives and principles for MSP, as well as the steps each planning process is expected to follow, is set out in the National MSP Framework (MFMR 2019). The Framework provides high-level direction to ensure consistent and coherent plan development, implementation and review across Namibia's marine space and its three proposed planning areas: a northern, central and southern area. It also describes the background to MSP and its overarching objectives in Namibia and identifies relevant institutional structures, roles and responsibilities (MFMR 2022).

The first MSP for Namibia is being developed for the central area, followed by the northern and the southern areas. The draft central Namibian MSP, which extends from Hottentots Bay in the south to Cape Cross in the north, outlines several 'zones', which define desired uses or combinations of use for specific marine areas, as well as the proposed regulations pertaining to each zone. Zonation is based on the eight main marine sectors, namely defence, environmental protection, fisheries, mining, mariculture, tourism, transport and infrastructure. Zones and their regulations are based on the following types of use:

- Primary use: This is an activity that is given priority in a particular zone. Other activities are only allowed in the zone if they do not impede the primary use and if an ECC (if required) is granted.
- Consent use: This is an activity that is compatible with the primary use of the zone and which can be approved in a primary use zone under specified conditions, based on and in line with the Environmental Management Act, 2007.
- Prohibited use: This is an activity that is not allowed in the zone as it would impede the primary use.

Notably, the regulations of each proposed zone do not replace existing sector regulations for specific uses (e.g. marine protected areas, fisheries and port regulations).

The MSPs in each of the three planning areas will translate the National Framework for MSP into integrated and strategic sustainable development plans that guide users, developers



and regulators in their decision-making, setting out which activities should take place where, when and under what conditions. Any future licensing decisions would need to be in line with the provisions set out in the respective plans. To date (October 2025) there is no legally binding framework in place, with the respective MSPs currently under development and/or review.

5.6.4.4 Important Marine Mammal Areas

Important Marine Mammal Areas (IMMAs) were introduced by the IUCN Marine Mammal Protected Areas Task Force in 2016 to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools including the EBSAs and IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

The majority of the west coast of Africa has not yet been assessed with respect to its relevance as an IMMA. IMMAs in southern Africa, are all restricted to the South African coast and include:

- Southern Coastal and Shelf Waters of South Africa IMMA (166 700 km²).
- Cape Coastal Waters IMMA (6 359 km²).
- South East African Coastal Migration Corridor IMMA (47 060 km²).

All identified IMMAs for southern Africa lie well to the south of PEL0056/Block 2913B and the nearshore transshipment area.

Summary of key conservation and sensitive areas in the study area.

The Venus offshore project area and nearshore transshipment area do not overlap with any MPAs, confirmed IBAs, IMMAs or Ramsar sites. However, vessel transit and nearshore transshipment operations fall within the vicinity of Walvis Bay Wetland and proposed marine IBAs. Additionally, vessel transit between the Venus offshore project area and Lüderitz port would pass through the NIMPA.

The benthic and pelagic ecosystem types along the 500 m depth contour in southern Namibia are considered 'Endangered', due to the degraded condition caused by trawling. Inshore and offshore of this, the benthic habitat is considered 'Least Threatened'. The benthic and pelagic ecosystem types within the Licence Block and nearshore transshipment area have been assigned a threat status of 'Least Concern', with the offshore project area receiving no protection.

Although PEL0056/Block 2913B partially overlaps (0.01% surface) along the eastern boundary with the Orange Seamount and Canyon Complex transboundary EBSA, the Venus offshore project area is over 15 km northwest of this EBSA. The nearshore transshipment area falls within the Namib flyway EBSA. In addition, transshipment and vessel transit activities will take place within the Benguela Upwelling System EBSA.



5.7 Socio-Economic Environment

5.7.1 Geographic and Administrative Overview

Namibia is divided into 14 Regions, with each Region being administered by a Regional Council under the management of a Chief Regional Officer. Each Region is led by a Governor who is the political head of the region, represents the President and central government and oversees the exercise of any executive function of the government in the region.

Regional Councils in Namibia play a crucial role in the governance and development of the country's regions. Their responsibilities include development planning, acting as a link between local communities and central government, implementing decentralisation policies to bring government closer to the people, overseeing local authorities in their regions and delivering essential services such as education, healthcare, and infrastructure development, tailored to the specific needs of their regions.

At local level, a hierarchy of urban areas serves each region. Municipal Councils manage the larger urban areas, which are designated as municipalities while Town Councils manage proclaimed towns and Village Councils lead proclaimed villages. Settlement areas are smaller developing urban concentrations and these are managed by the regional councils.

Figure 5-42 provides the terrestrial and offshore context of PEL0056/Block 2913B within which the Venus offshore project area is located. The most important observations are that the entire Namibian Coastline is covered by National Parks with only the Oranjemund, Lüderitz and Walvis Bay/Swakopmund enclaves linking the hinterland with the coast and constituting the main coastal towns in the country. It is where the vast majority of coastal inhabitants live and subsist and from where the fishing, logistics, mining, and exploration oil and gas sectors are served.

The Namibian southern and central coastline is sparsely populated and dominated by the uninhabited Namib-Naukluft National Park, Tsau //Khaeb (Sperrgebiet) National Park and the NIMPA.

The main settlements along the coast are Oranjemund, Lüderitz, Walvis Bay and Swakopmund.

Established in 1936, **Oranjemund** (in the Oranjemund Constituency) was run by Namdeb (formerly Consolidated Diamond Mines) until 2017, and access was restricted to employees and their relatives. However, Oranjemund was proclaimed as a town in 2011 and opened to the public in 2017. Today, Oranjemund is still dominated by the diamond mining industry, but efforts are being made to diversify its economy and create a sustainable future beyond mining. Oranjemund does not have a port and is therefore not used significantly in oil and gas exploration activities.

Located in the !Nami#Nûs Constituency in the //Kharas Region, **Lüderitz** is the southern-most port town in Namibia. Founded in 1883 the town is known for its German colonial architecture. It mainly supports the fishing and mining sectors, as well as oil and gas exploration activities, with little other industrial development. New industries, such as green hydrogen developments, have recently been proposed within the town and its surrounds. Much of the town is comprised of residential neighbourhoods, made up of both formal housing concentrated around the port and informal or low-income settlements on the outskirts of the town. The Lüderitz Port is a multi-purpose port supporting fishing, mining and oil and gas operations and industries.





230



Located in the Walvis Bay Urban Constituency in the Erongo Region, **Walvis Bay** is the third largest town in Namibia (after Windhoek and Rundu). The Walvis Bay port is Namibia's largest commercial port and handles container imports, exports and transshipments and bulk commodities. It is a base for many of Oil and Gas operations for offshore exploration activities in Namibia. Industrial development is located within and along the port boundaries and extends into the desert. The fisheries industry accounts for a significant portion of the local economy (refer to Section 5.7.2.4 and 5.7.5). Walvis Bay's residential suburbs are structured around the harbour, with formalised (middle to high income) suburbs closer to the harbour and seafront to the south while lower-income neighbourhoods are located north and east of the port, spreading across the main road into the desert.

Swakopmund is the fourth largest urban centre and one of the main tourist destinations in Namibia. Located in the Erongo Region, it is characterised by colonial German architecture with a special urban environment in the historic conservation area of the town and linked to the Mole, which is the main beach area and tourism centre. Coffee shops, restaurants and a variety of hotels serves the tourist centre of the town while ocean-based activities such as fishing and water-based sports are undertaken from and in the Mole. Bar tourism, a number of mines are located around Swakopmund and inland towards Arandis. These are mainly Uranium mines but also include dimension stone, lead and zinc while base, rare and industrial minerals. are also found. Swakopmund has a strong industrial base, mainly related to the provision of services to the mining sector inland of the town.

While Swakopmund does not have a harbour, it is the base for some artisanal fishing activity which mostly takes place close to shore as well as deeper fishing activities for species such as snoek and Mackerel.

Relative to the locality of PEL0056/Block 2913B, the most direct relationships between the offshore Venus offshore project area and the onshore environment will be within the //Kharas and Erongo Regions. Despite a portion of the Hardap Region also covering part of the coastline, the entire coastline and approximately 125 km inland is covered by the Namib Naukluft Park and the Namib Sand Sea, which is largely uninhabited. There are also no towns or settlements in the Hardap Region portion of the coastline and the impacts on the Hardap Region are likely to be predominantly indirect and related to the national impacts of the project.

5.7.1.1 The //Kharas Region

The //Kharas Region is bordered by the Hardap Region to the north and South Africa to the south, as indicated in Figure 5-43. The region is divided into seven constituencies: !Nami#Nûs, Berseba, Oranjemund, Karasburg East, Karasburg West, Keetmanshoop Urban, and Keetmanshoop Rural.

At the heart of this region lies Keetmanshoop, the largest settlement and administrative centre, which hosts the //Kharas Regional Council. Municipalities and town councils include Karasburg, Oranjemund, and Lüderitz, while proclaimed settlement areas, such as Aus, Warmbad, Grünau, Ariamsvlei, Aussenkehr and Noordoewer, complete the region's urban landscape.

According to the latest official data available reported in Namibia Household Income and Expenditure Survey (2015/16) (NHIES) the average national annual household consumption was N\$ 119 065. In comparison, the average annual household consumption for the //Kharas Region stood at N\$ 116 857, which is slightly below the national average. The highest average household consumption was in Khomas, followed by Hardap, Erongo, Oshana and //Kharas in fifth position.



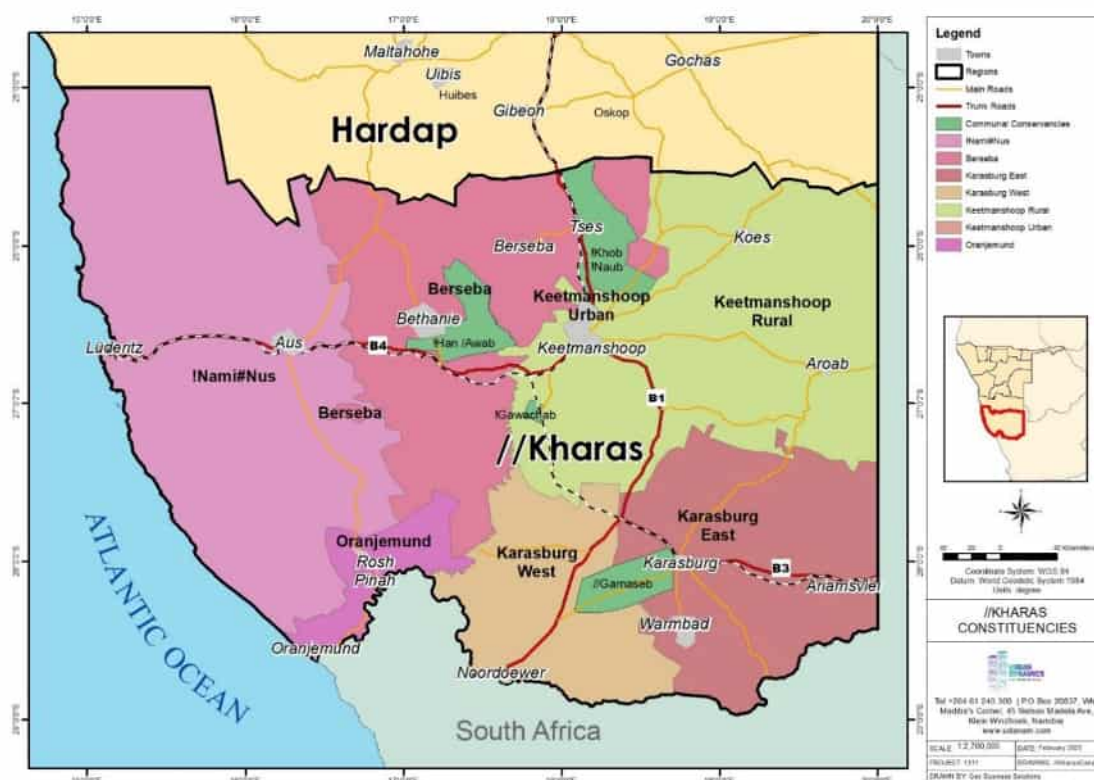


Figure 5-43: The //Kharas Region and its Constituencies and Towns.

Source: Geo Business Solutions (2025)

Key economic drivers include the Lüderitz harbour, diamond mining in and around Oranjemund, mining at Rosh Pinah, grape farming in Aussenkehr, small stock and game farming across the region, and a wide variety of tourist ventures, especially the Fish River Canyon and the lodges established around it. These sectors form the backbone of the region's economy.

Within the !Nami#Nus Constituency, the town of Lüderitz, with its strategic location and significant population concentration, serves as the focal point for the constituency's economic and social activities. The Tsau //Kheib (Sperrgebiet) National Park and the Namib Naukluft Park restrictions confine settlement and activities to Lüderitz, with the exception of the settlement of Aus, thereby concentrating the population and economic activity within Lüderitz. In 2023, 93.7% of the population of the !Nami#Nus constituency lived and worked in Lüderitz (Namibia Statistics Agency, 2024). Lüderitz therefore functions as the primary hub for transport, fisheries, trade, services, and infrastructure in the constituency, underscoring its vital role in the regional economy.

5.7.1.2 The Erongo Region

The Erongo Region comprises seven constituencies: Swakopmund, Walvis Bay Urban, Walvis Bay Rural, Arandis, Daures, Karibib, and Omaruru as indicated in Figure 5-44. The region's municipalities and town councils include Swakopmund, Walvis Bay, Arandis, Omaruru, Hentiesbaai, Karibib, and Usakos, alongside settlement areas like Uis, Okombahe, and Otjimbingwe. Swakopmund, a major administrative centre, hosts the Erongo Regional Council.



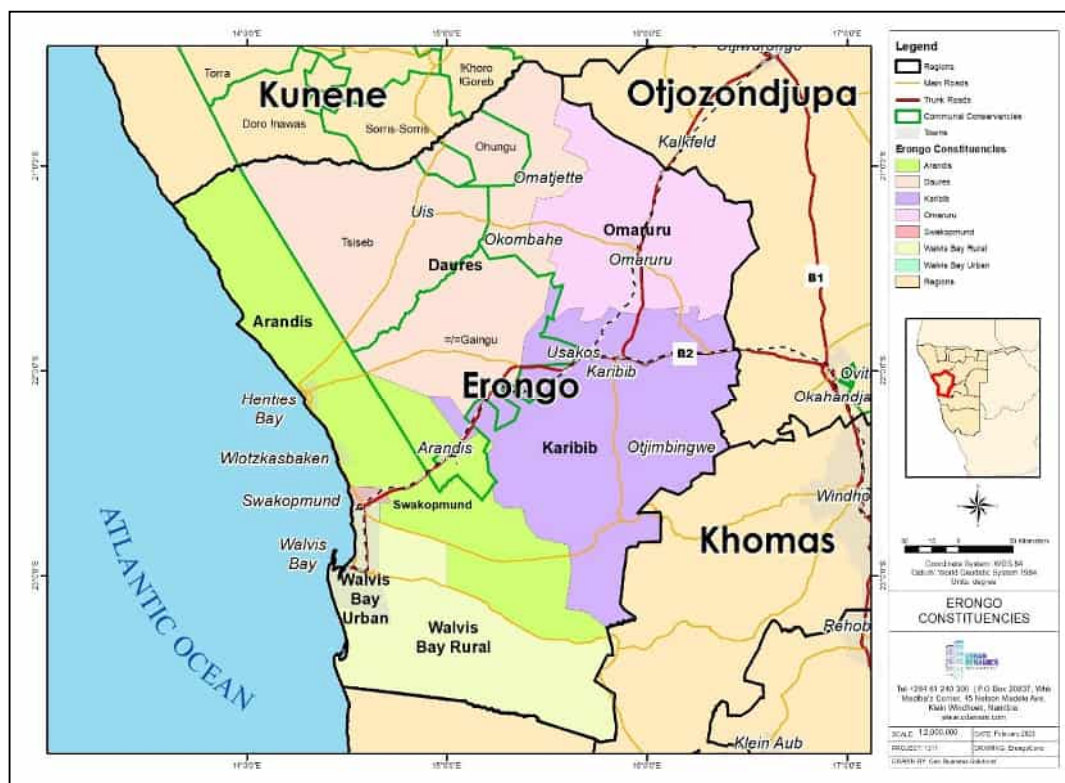


Figure 5-44: The Erongo Region and Its constituencies and Towns.

Source: Geo Business Solutions (2025)

The Port of Walvis Bay plays a strategic role in the country, facilitating both national and international import and export operations (see Section 5.7.6.1). Swakopmund boosts the region's economy with its tourism sector, attracting visitors to its beaches, cultural sites, and adventure activities. Swakopmund, Arandis, Usakos, and Karibib are important mining towns, contributing significantly through their mineral extraction and processing industries, while Omaruru stands out as a vital agricultural town.

In terms of the well-being of the population, the Erongo Region had the third highest average household consumption of all regions at N\$ 128 617 in 2015/16 according to latest public available data (Namibia Statistics Agency, 2017).

5.7.2 Socio-Economic Characteristics of the Study Area

5.7.2.1 Demographics

Population Size and Growth

According to the 2023 Population and Housing Census, Namibia's population numbered just over 3 million, increasing from 1.4 million in 1991 (an increase of 114.4% over 32 years). Between 2011 and 2023 Namibia recorded an annual population growth rate of 3% (Namibia Statistical Agency, 2024).

The population for the **!Kharas Region** was reported as 109 893 people in 2023, having grown at a rate of 2.96% between 2011 and 2023 (see Table 5-13 and Figure 5-45). The **!Nami#Nûs** Constituency accounts for 15.7% of the population within the region, while the 2023 population for the town of Lüderitz stood at 16 125. (Namibia Statistical Agency, 2024). Lüderitz is the biggest settlement in the **!Nami#Nûs** Constituency with 93.7% of the



population within the constituency residing within the town. The population of the constituency grew at a rate of 1.85% per annum between 2011 and 2023 while the population of Lüderitz grew at a rate of 2.12% per annum over the same period (NSA, 2025).

The population in the **Erongo Region** is more than double the size of the //Kharas Region at 240 206 people in 2023. Walvis Bay (rural and urban) accounted for 42.8% of the region's population with 102 704 residents. The population of the Erongo Region grew at a rate of 3.9% between 2011 and 2023, up from 3.4% during the 2001 to 2011 intercensal period. Fertility in this region is also on the decline and the rate of population growth also indicates substantial migration into the region (Namibia Statistical Agency, 2024).

The town of Walvis Bay makes up 99.6% of the population of the Walvis Bay Urban and Rural Constituencies combined with a population of 102 704 in 2023, up from 62 096 in 2011. This represents a population growth rate of 4.23% per annum over the period.

The Swakopmund Constituency comprises the town of Swakopmund with a population of 75 921 in 2023, up from 44 725 in 2011. This represents an annual growth rate of 4.5% over the period.

Table 5-13: Average Annual Rates of population Growth between 2011 and 2023.

Area	Population in 2011	Population in 2023	Average annual growth rate
//Kharas	77 421	109 893	2.96%
!Nami#Nûs	13 859	17 243	1.85%
Lüderitz	12 537	16 125	2.12%
Erongo	150 809	240 206	3.9%
Walvis Bay	62 096	102 704	4.23%
Swakopmund	44 725	75 921	4.5%

Source: NSA (2025)

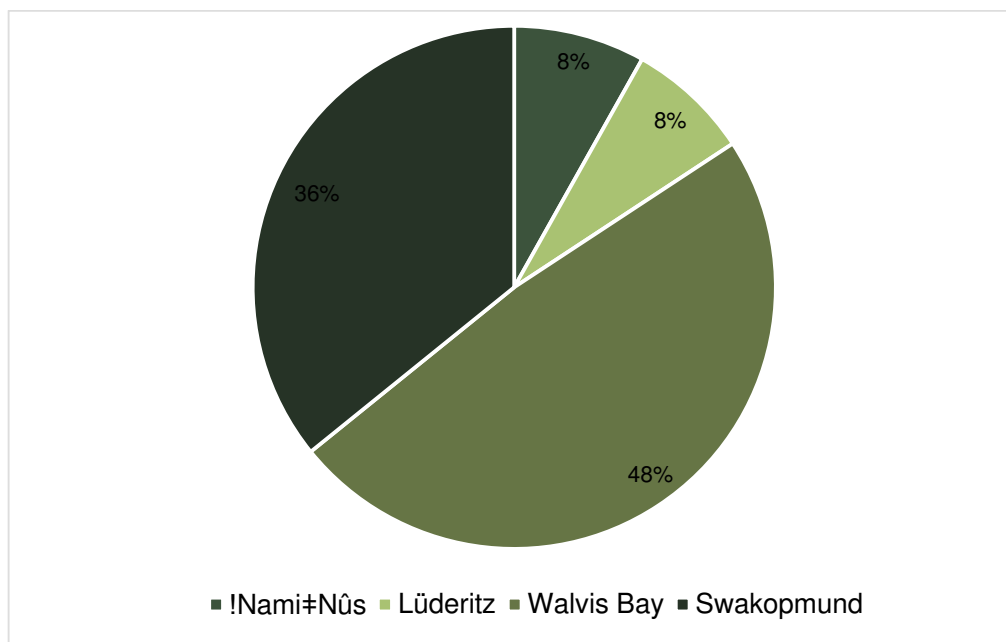


Figure 5-45: Population number per region (2023)

Source: NSA (2025)



Migration

Long term migration indicates movement of people out of their place of birth to a new place of residence. Table 5-14 shows the number of migrants received by the //Kharas and Erongo Regions, compared to the Khomas Region (Windhoek) which has historically high in-migration. In the //Kharas Region, 39% of the population were born elsewhere, while 54% of the population of the Erongo Region were born elsewhere, and 51% in the Khomas Region. This indicates comparatively high levels of in-migration into the //Kharas and Erongo Regions.

Migration is typically triggered by an actual or perceived lack or availability of opportunities and is thus not uniform. Between 2001 and 2011, the population of Lüderitz in fact decreased, and more recent movements are not yet captured in Census data. However, the specialist's observation, anecdotal evidence and house price development show that both Lüderitz and Walvis Bay have recently experienced high levels of in-migration due to actual and perceived opportunities generated by several green hydrogen, renewable energy and oil and gas projects underway in those regions (see Section 7.9.5), and the towns struggle to keep up with supplying serviced land and housing to in-migrants.

Table 5-14: Lifetime Migration for the Khomas, //Kharas and Erongo Regions.

Place of Birth	Place of Usual Residence		
	//Kharas	Erongo	Khomas
//Kharas	63 429	4 769	7 900
Erongo	1 559	101 430	11 942
Khomas	4 863	17 688	229 474
Outside Namibia	2 179	9 769	27 785
In Migrants from all regions	42 341	130 870	253 170
Total Population 2023	109 893	240 206	494 605
% of Population that migrated from elsewhere	39%	54%	51%

Population Density

Figure 5-46 provides an indication of the population density and distribution in Namibia and its regions. The mean population density in the //Kharas Region is 0.7 persons per km², while it is much higher in the Erongo Region at 3.8 persons per km². However, these region wide averages mask the distribution of the population.

The distribution of residential structures in all the coastal regions clearly demonstrates very few residential structures along the entire coastline, with residential structures almost exclusively found in the coastal towns. While this is largely due to the protected areas along the entire coast (see Figure 5-36), it also means that the direct social receptors related to the Venus development are largely limited to the urban areas of Oranjemund, Lüderitz, Walvis Bay, Swakopmund, Wlotzkasbaken and Henties Bay.

Indirect social receptors for the proposed project also include residents of the //Kharas and Erongo Regions, as well as the citizens of Namibia.



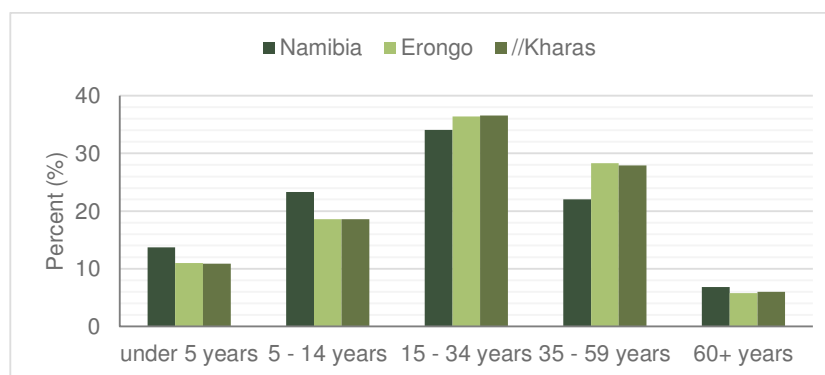


Figure 5-47: Age Composition for Namibia and the //Kharas and Erongo Regions

Source: Namibia Statistical Agency (2024)

Figure 5-48 provides age and sex pyramids for the Erongo and //Kharas Regions as well as for the !Nami# Nûs Constituency and the Walvis Bay Urban and Rural Constituencies combined.

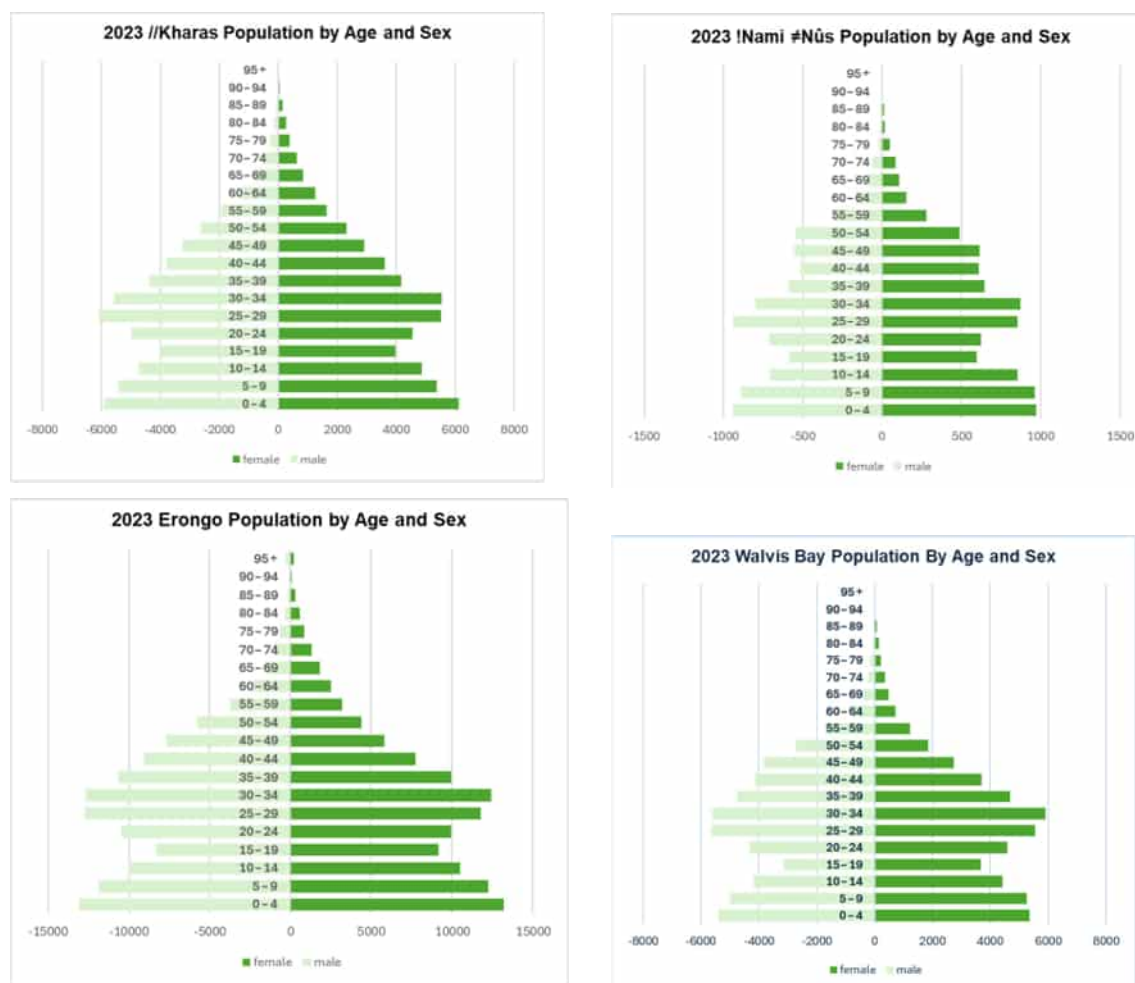


Figure 5-48: Age and Sex Pyramids for the //Kharas and Erongo regions and the associated main towns.

Source: (NSA, 2025)



Indigenous Peoples

According to the ‘Guide to Indigenous Peoples’ Rights in Namibia, Namibia has a considerable number of indigenous peoples living in its territory as citizens. The majority of these people are the San and Ovahimba, but there are also other groups such as the Ovahimba and the Ovahimba. Namibia has various obligations towards these indigenous peoples and has a duty to respect their rights (Ombudsman: Namibia, 2008).

However, national statistics are not disaggregated to a level that can isolate data and statistics on these groups and they are, in terms of statistics, incorporated into the general population census. While the Government of Namibia only regards the mentioned groups as indigenous peoples, the Nama people are increasingly re-defining themselves as indigenous and are seeking recognition, respect and inclusion into the formal economy of Namibia.

5.7.2.2 Housing and Living Conditions

According to the 2023 Population and Housing Census, 60.1% of households in the Erongo Region and 57.4% in the //Karas Region reside in formal dwellings. These include detached houses, semi-detached houses, flats, apartments, cluster houses, and Townhouses.

Figure 5-49 shows the type of dwelling occupied by households for the Erongo Region and Walvis Bay as represented by the Walvis Bay Urban and Rural Constituencies while Figure 5-50 indicates the types of dwelling in the //Karas Region and the !Nami#nūs Constituency.

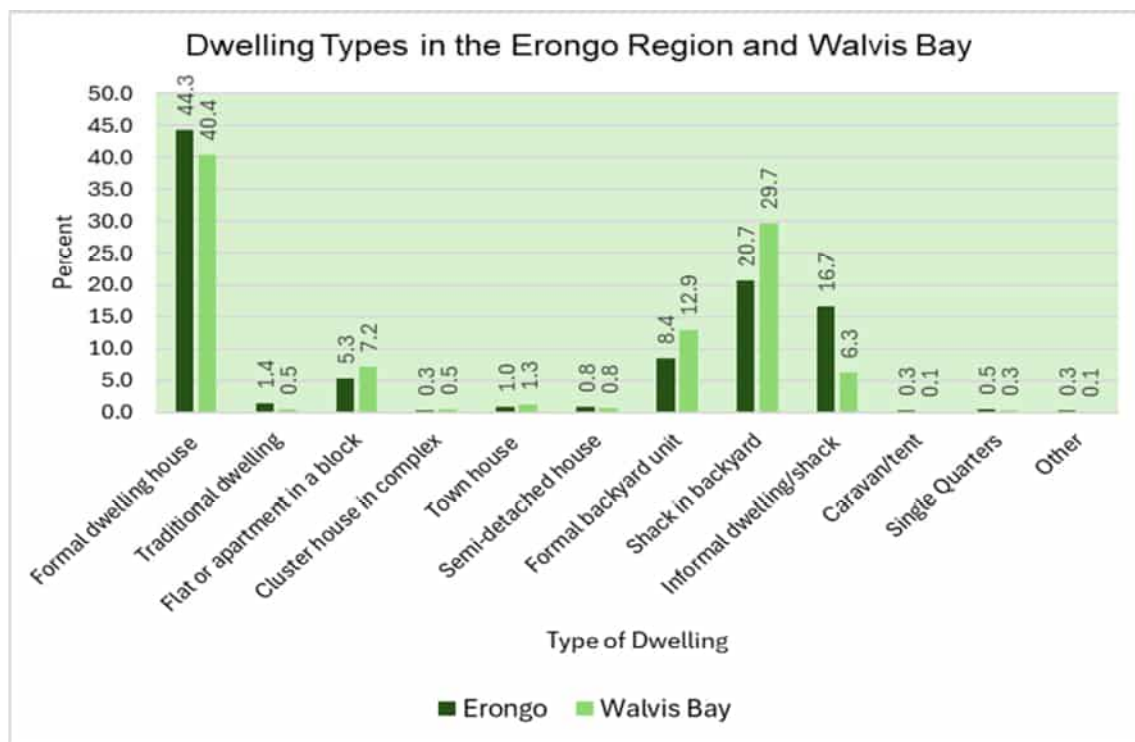


Figure 5-49: Type of Dwelling by Area in Erongo Region.



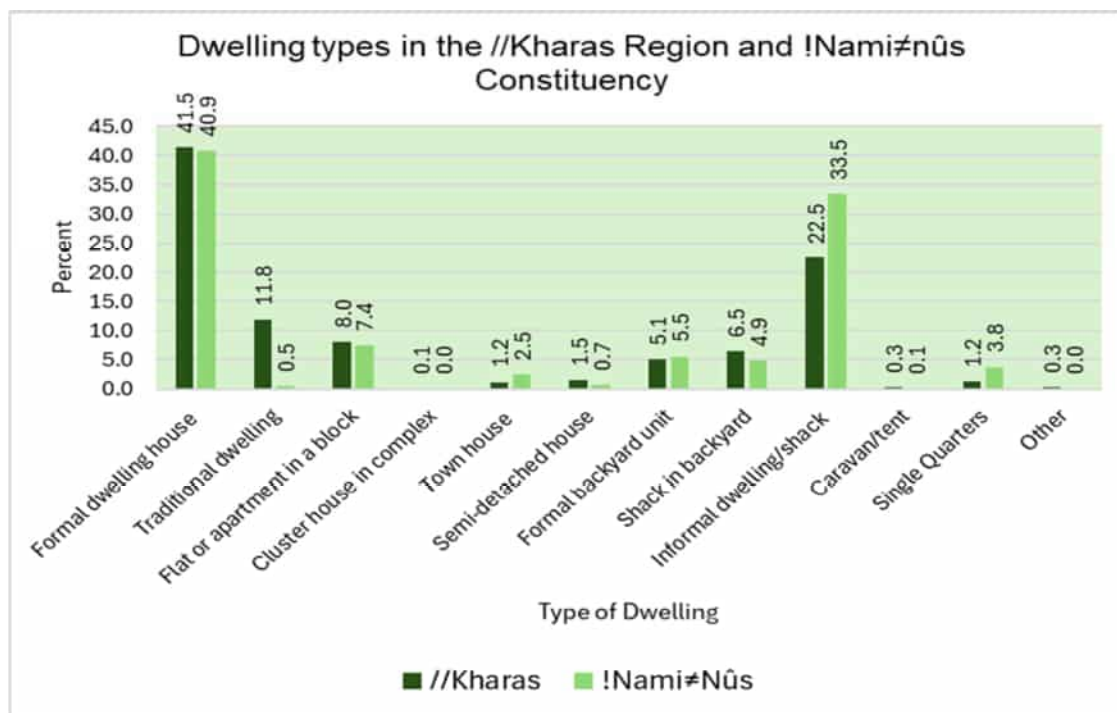


Figure 5-50: Type of Dwelling by Area in //Kharas Region.

Source: (NSA, 2025)

A much larger percentage of households in the //Kharas and Erongo Regions reside in formal housing than is the case in Namibia as a whole. However, 37.4% of households in the Erongo Region reside in informal dwellings while 29% of households in the //Kharas Region and 28.7% nationally do the same. This is an indication that adequate housing is a challenge, possibly exacerbated by a further influx of people.

This distribution is similar at the !Nami#nūs and Walvis Bay Urban Constituency levels, where 'formal dwelling house' is the most common housing type (with 50.2% in Walvis Bay and 51.5% in !Nami#nūs) and 'improvised housing' is the second most common (with 36% in Walvis Bay and 38.4% in !Nami#nūs). The high level of 'improvised housing' is likely the result of people migrating to the urban centres of Lüderitz and Walvis Bay and taking up residence on the urban fringe in informal housing. It is also important to note that there is also a relatively substantial portion of households residing in formal backyard units in both Lüderitz and Walvis Bay.

Household Size

There is a substantial difference in mean household size between the constituencies in the //Kharas Region. Keetmanshoop Urban has by far the largest mean household size with 3.9 persons per household while Karasburg West has the smallest at 2.4 persons per household. Also note the age distribution of the Karasburg West constituency, which has the highest percentage of people aged 20 – 39 years of all constituencies. This may be an indication that many younger people moved into that constituency and most likely have smaller families than in the other constituencies. The !Nami#Nūs Constituency had a mean household size of 3.

In the Erongo Region, the Walvis Bay Rural Constituency had the highest mean household size at 3.3 while Daures had the smallest, at 2.6 people per household.



Household sizes in both the regions are on the decrease. According to the previous census the average household size in the Erongo Region was 3.8 in 2001, reducing to 3.3 in 2011 and still further to the current 3.1. Household sizes in the //Kharas Region declined from 4.1 in 2001 to 3.6 by 2011 and to 3.1 in 2023 (see Figure 5-51).

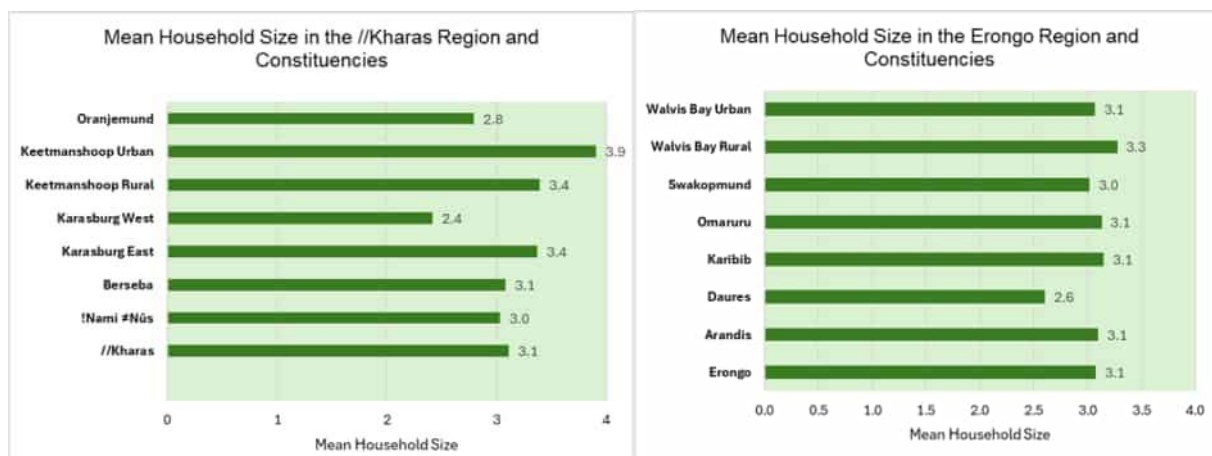


Figure 5-51: Mean Household Sizes in the two Regions and its Constituencies in 2023.

Source: (NSA, 2025)

5.7.2.3 Education

According to the Ministry of Education's Education Management Information System 2023 report, the **//Kharas Region** had eleven secondary schools, nine combined schools, and thirty-seven (37) primary schools. Seven of these schools are situated within the !Nami#Nûs Constituency (Ministry of Education, 2023).

Figure 5-52 demonstrates a steady increase in the number of learners in the region, from 22 388 in 2018 to 24 964 in 2023. The number of children per school increased from about 392 learners per school in 2018 to about 430 learners per school in 2023. This is slightly higher than the national average of 390 learners per school in 2023. The learner to teacher ratio in //Kharas increased from 22.9 in 2018 to 24.6 in 2023.

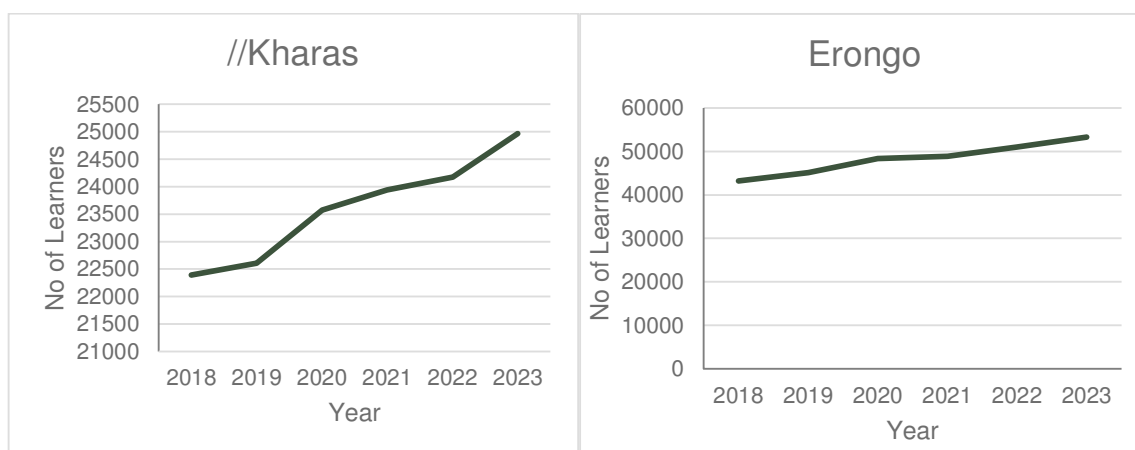


Figure 5-52: Growth in Number of Learners by Region.

Source: Ministry of Education (2023)



A similar trend is found in the **Erongo Region**. According to the Educational Management Information System (EMIS) 2023 report, the Erongo Region had 18 secondary schools, 17 combined schools and 49 primary schools in 2023. Twenty of these schools are situated within Walvis Bay.

Figure 5-52 also indicates how the number of learners in Erongo grew; from 43 213 in 2018 to 53 258 in 2023. The number of children per school in Erongo increased from about 576 learners per school in 2018 to about 619 learners per school in 2023. This is substantially higher than the national average of 390 learners per school in 2023. The learner to teacher ratio in Erongo increased from 24.8 in 2018 to 26.8 in 2023 (Ministry of Education, 2018).

Literacy

Figure 5-53 indicates the literacy rates in Namibia by region according to the 2023 Population and Housing Census. The Khomas Region has the highest literacy rate in Namibia (95.8%) followed closely by the //Kharas Region at 95.6% and the Erongo Region with 95.4%. This means that the two most impacted regions have literacy rates that are substantially above the national average of 87.3%.

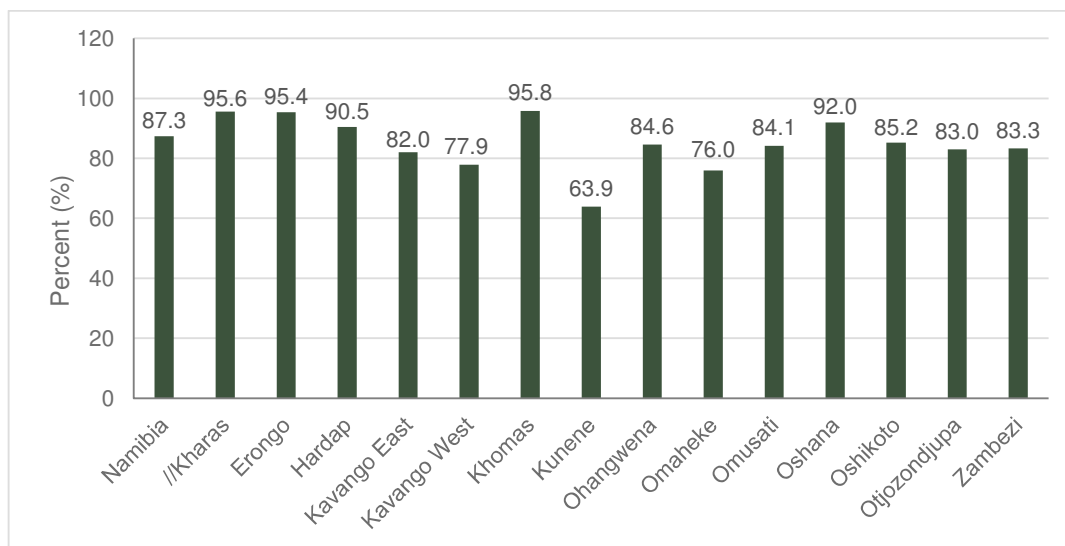


Figure 5-53: Literacy Rate by Region.

Source: 2023 Namibian Population and Housing Census

At the time of the 2011 Census, 22.9% of the //Kharas population and 29.8% of the Erongo population over the age of 6 had completed secondary school as their highest level of education, while a small portion of the population in both regions reported having tertiary education (3.8% and 6.7%, respectively).

By 2023, 56.96% of people aged older than 6 in the Erongo Region indicated that they have a secondary education while 58.05% of the //Kharas population has secondary education. The Walvis Bay and !Nami#Nûs Constituencies exhibits slightly better access to education with a higher proportion of the population over the age of 6 having completed secondary school and tertiary education. This is indicative of the more urbanised nature of the two constituencies.

Figure 5-54 below illustrates the different levels of education within the //Kharas Region and Erongo Region in 2023.



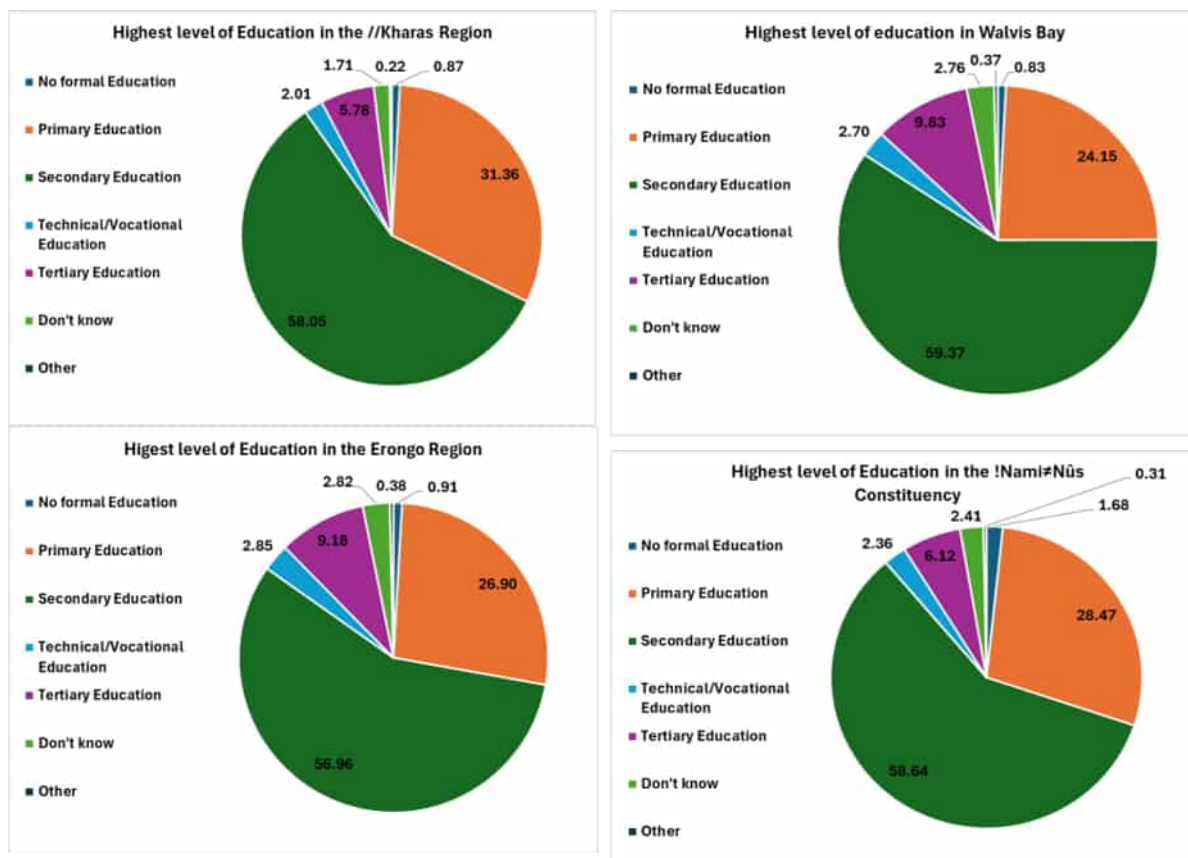


Figure 5-54: Highest level of education population over the age of 15.

Source: (NSA, 2025)

Tertiary Education

Higher Education in Namibia is available for students who successfully complete 12 years of schooling. College programs and Post Graduate Programs are offered through the University of Namibia (UNAM), the Namibia University of Science and Technology (NUST) and the International University of Management (IUM).

Established in 1992, UNAM grew into an institution of excellence with 12 campuses across the country, located in Windhoek, Ongwediva, Oshakati, Katima Mulilo, Ongongo, Rundu, Henties Bay and Keetmanshoop. UNAM offers courses in Agriculture and Natural Resources, Economics & Management Science, Education, Humanities and Social Sciences, Law, Medicine, Engineering and Information Technology, Science, Nursing, Pharmacy, Public Health and Military Science (University of Namibia, 2025).

UNAM shows awareness of the need for education and training in the emerging oil and gas industry. To this end, it offers short courses in the fundamentals of oil and gas engineering, entered into a MOU with Technip FMC (a UK Based energy technology provider) to co-develop specialized courses in subsea engineering and project management.

The Southern Campus in Keetmanshoop was inaugurated in 2023 and UNAM relocated the School of Geosciences from the main campus to the Southern Campus with the express objective to train geoscientists to work in the mining and oil and gas industry.

In 2024, UNAM inaugurated the Rhino-Halliburton Technology Centre at UNAM Southern Campus. The Technology Centre has been outfitted with next-generation computing hardware from Rhino Resources along with a comprehensive three-year software package



from Halliburton. This initiative will significantly enhance research and practical training in Petroleum Geology, Engineering Geology, Geophysics, and Data Analysis.

TotalEnergies, through its TotalEnergies Professeurs Associes (TPA), also partnered with the Southern Campus Geosciences Department where academics from the programme host specialized, weeklong courses for UNAM Geosciences Masters students.

NUST, (previously the Polytechnic of Namibia) is located in Windhoek with satellite campuses in Lüderitz and Eenhana. In addition, it also has 10 regional centres across the country which provides infrastructure for distance learning. NUST has faculties of Computing and Informatics, Engineering and the Built Environment, Commerce, Human Sciences and Education, and Health, Natural Resources and Applied Sciences. The School of Engineering offers studies in civil, mining and process engineering and in mechanical, industrial and electrical engineering (Namibia University of Science and Technology, 2025).

The Lüderitz campus was inaugurated in 2024 with an emphasis on supporting the green hydrogen and oil and gas activities planned for the south and to get support from industry.

The Namibia Training Authority (NTA) oversee the provision of vocational education in Namibia and is tasked with ensuring that acceptable training standards are maintained at these institutions. Vocational Training Centres (VTCs) are located in Windhoek, Eenhana, Outapi, Okakarara, Rundu, Ongwediva, Katima Mulilo and Khorixas. Courses such as automotive engineering, electrical engineering, boiler making, welding, pipe fitting, air conditioning and refrigeration, hospitality and tourism, commercial cookery, and civil and building services are generally offered at these VTCs. The Namibia Institute of Mining and Technology (NIMT), located in Arandis, provides similar courses with emphasis on the mining industry (www.nta.com.na, 2025).

Other institutions such as the Namibian Maritime and Fisheries Institute (Maritime Navigation, Maritime Engineering and Maritime Safety), the National Youth Service (bricklaying, plastering, welding and plumbing) and the Namibia Institute for Culinary Education (Commercial cookery skills) also contributes to the tertiary education landscape in Namibia.

5.7.2.4 Economy

According to the World Bank, Namibia had a GDP of US\$13.37 billion (~NAD245 billion) in 2024 and has recently been reclassified from an upper-middle income country to a lower-middle income country.

Namibia's economy is closely tied to that of neighbouring South Africa, which has a population of 64 million and a GDP of US\$400.26 billion – some 30 times larger than Namibia's – and which is classified as an upper middle-income country.

Namibia belongs to the Southern African Customs Union (SACU) with Botswana, Eswatini, Lesotho, and South Africa which means it shares a common external tariff on all imports. SACU import tariffs are still determined largely by South Africa as by far the largest and most powerful economy in the union. SACU provides the Namibian government with approximately a quarter to a third of its annual revenues through the SACU revenue-sharing formula, which was renegotiated in 2002 and which includes a “development component” designed to provide more revenue to the smaller members of the union than they would otherwise earn from tariffs.

Namibia belongs to the Common Monetary Area (CMA) with Eswatini, Lesotho and South Africa. The South African Rand (ZAR) is legal tender and is fixed in value at 1:1 with the Namibia Dollar (NAD). South Africa and the South African Reserve Bank (SARB) largely determine monetary policy and interest rates. The free flow of capital between Namibia and South Africa means that interest rates in Namibia cannot deviate substantially from those in South Africa. The SARB sets interest rates to achieve a target rate of inflation between 3%



and 6% in South Africa and the Bank of Namibia sets interest rates to target the 1:1 currency peg with the Rand. As a CMA member, Namibia is subject to South African exchange controls.

Namibia also belongs to the Southern African Development Community (SADC), including the SADC Free Trade Area as well as the nascent African Continental Free Trade Area (AfCFTA).

Namibia is a relatively diversified economy with important livestock, crop, fishing, mining, and manufacturing industries as well as an important tourist industry, all of which make important contributions to Namibia's exports. Within the mining sector, diamonds, uranium and gold are particularly significant. Fishing and fish processing, which mainly takes place from Walvis Bay and Lüderitz, contributed 2.7% to GDP in 2024 (NSA, 2024). The EU, South Africa, Botswana and China represent key export markets in that order according to international data from 2023.

Gross Domestic Product

Namibia's economic growth has been modest since 2016 and is expected to remain so for the next two years. The economy has recovered from the severe shock it experienced during the COVID-19 pandemic but, outside the extractive industries, private sector investment has been far too low over the course of many years to achieve sustained high rates of GDP growth and appears to be on a steady downward trend as a percentage of GDP. Without higher levels of investment, growth is destined to remain modest.

According to the 2023 Annual National Accounts, the Country's GDP grew at a rate of 1.1% in 2018 whereafter it contracted by 0.8% in 2019 and by 8.1% in 2020 (see Figure 5-55). Thereafter, the GDP grew again by 3.6% in 2021, 5.3% in 2022 and 4.2% in 2023. A breakdown of GDP by Sector in 2024 is presented in Figure 5-56.

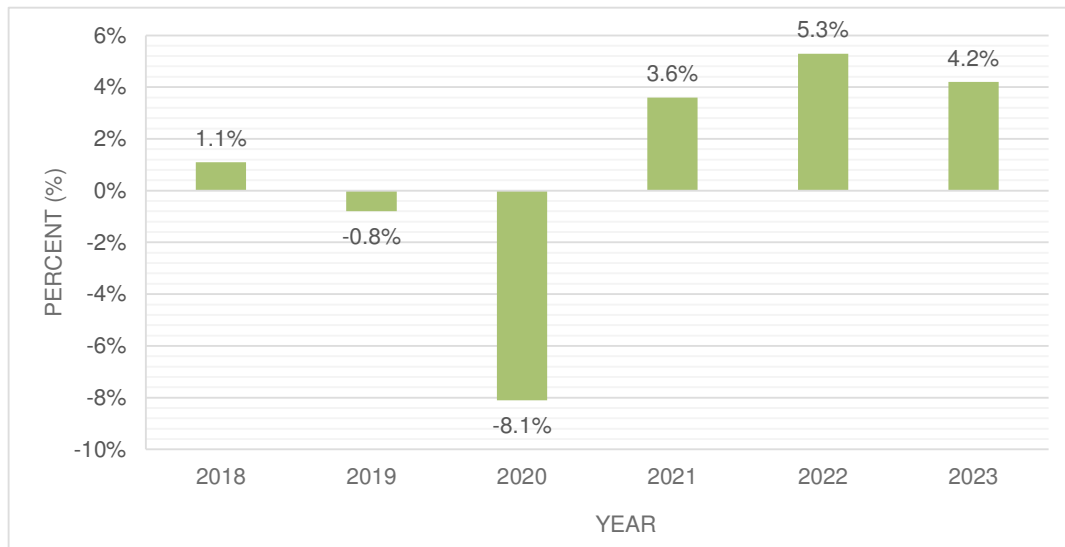


Figure 5-55: Namibian GDP Growth 2018 – 2023.

Source: Namibia Statistics Agency (2024a)



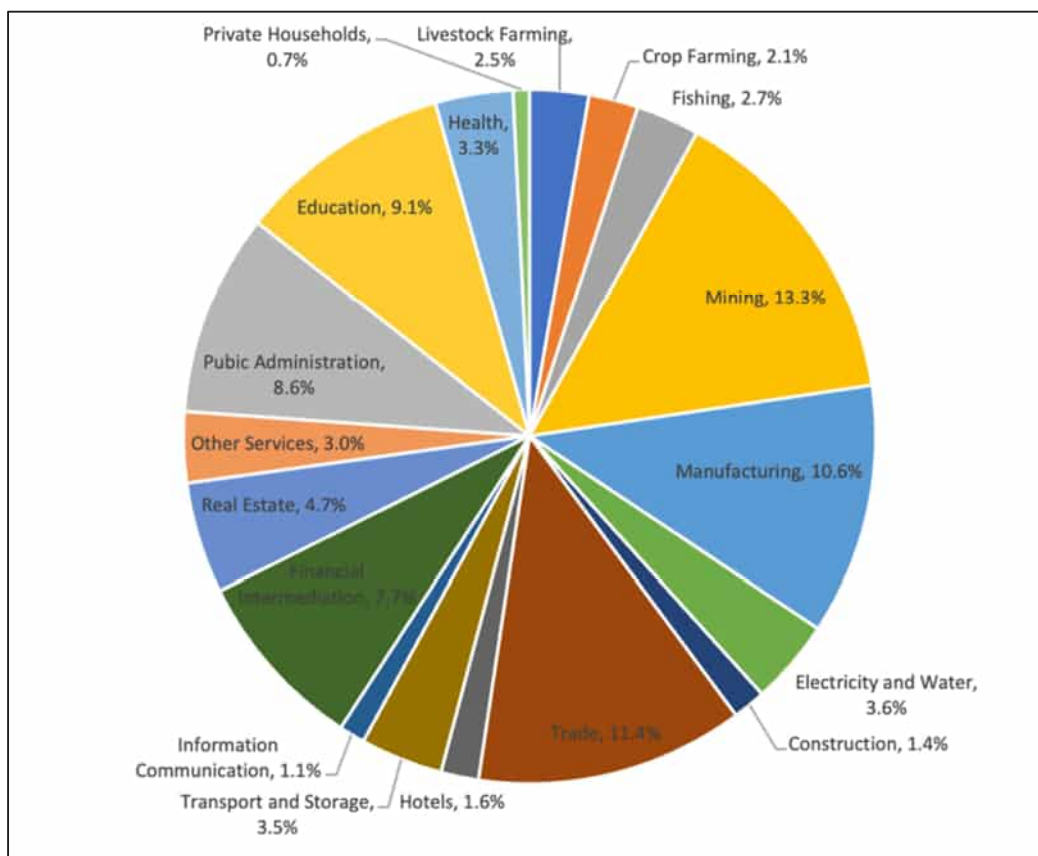


Figure 5-56: Breakdown of GDP by Sector in 2024.

Source: (NSA, 2023)

Economy and Port of Lüderitz

The Port of Lüderitz serves the local fishing industry, local diamond industry, ongoing offshore oil and gas exploration and mines in southern Namibia and in north-western South Africa with imports and exports of commodities and handling general cargo. In 2023/24, the port handled over 1.2 million tonnes of cargo with 967 vessel visits (NAMPORT, 2025)). Port operations are hampered by a limited berthing depth of 8.75 m and cannot accommodate average sized, economic bulk carriers that are used to transport bulk ore and other cargoes; it also has no direct rail connection into the harbour. Nevertheless, the Namport and other service providers contribute to the local economy with marine engineering, shipping and logistics, freight storage, vessels, boat builders and repairs, employing several hundred people. Namdeb and two other small diamond companies operate out of Lüderitz. Namport plans to upgrade the Lüderitz port to increase port capacity from 1.2 million tonnes to 3 million tonnes per annum, notably for manganese (the main export commodity) (Namport pers. comms).

The main employment sector in Lüderitz is the local commercial and subsistence fishing industry, which provides more than 80% of the employment (Luderitz Town Council, 2025), even though the industry has been in steady decline as the larger vessels relocated to Walvis Bay. The lack of economic diversity has been identified as a key risk due to variations in fish stock and much of the national fishing fleet moving to the deeper harbour at Walvis Bay. There is, therefore, an increased focus towards tourism development and the logistics industry (Luderitz Town Council, 2025). In addition, the town supports a range of secondary / service businesses including supermarkets, commercial banks, insurance, and hospitality amongst others.



Tourism to the town is recovering from the Covid-19 pandemic, as Lüderitz offers various attractions such as the Kolmanskop deserted diamond town, quaint old German architecture, a port for smaller passenger liners, the annual Crayfish Festival, the annual Lüderitz Speed Sailing Challenge and other events. It is one of the four entry points into the access restricted Tsau //Khaeb (Sperrgebiet) National Park, a protected area of high biodiversity. Tourism will always be a challenge as Lüderitz is far from Namibia's other main southern attractions, notably the Fish River Canyon and Sossusvlei.

Economy of Walvis Bay

The economy of the Erongo Region and the Walvis Bay Urban Constituency is more developed and diversified compared to Lüderitz. The region is largely dependent on the primary sector: mining (notably uranium), commercial and small-scale fishing, and agriculture (mostly livestock farming).

The economy of Walvis Bay revolves around the Port of Walvis Bay, which is Namibia's largest commercial port that received between 866 and 1148 vessels calls per annum in the 2022 – 2024 period and handled about 5.5 to 6.8 million tonnes of cargo in the same period. The Port of Walvis Bay handles container imports, exports and transshipments, as well as bulk and breakbulk volumes of various commodities. The port serves a wide range of industries such as mining, petroleum, salt, and fishing. Namport is a major employer in the region, employing most of its 841 staff in Walvis Bay (NAMPORT, 2019; NAMPORT, 2025). The container harbour at the port was expanded in response to growth in port-related activity serving the SADC region. This growth has not been sustained, partly due to the impact of Covid-19 on world trade.

Berths 7 and 8 of the Port of Walvis Bay are currently utilised by three mud plant operators who service the existing offshore O&G industry. Berth 9 is earmarked for modifications to improve and expand port capacity and capability; design work for upgrades to Berth 9 is underway and will include additional space for laydown areas and other logistics requirements. Berth 9 could be utilised exclusively for Venus-related activities, and other berths may be used by support vessels as required (Namport pers. comms).

Walvis Bay supports a diverse economy including industrial development largely centred around the Namibian Export Processing Zone and secondary / service sector businesses (finance, retail, accommodation and food). The fishing industry is however considered a critical economic sector (Walvis Bay Municipality, 2020) and provides an estimate 8 000 local jobs.

The fishing sector is also critical for the economy of Walvis Bay and warrants more consideration. About 8 000 of the 32 000 jobs in the Walvis Bay Urban and Walvis Bay Rural Constituencies are in the fishing sector (Walvis Bay Municipality, 2020). The Food and Agriculture Organisation (FAO) recognises that Namibia has one of the most productive fishing grounds in the world, with 20 fish species that are commercially exploited (Food and Agriculture Organisation, 2020). Most catches are landed at either Walvis Bay or Lüderitz (see section above); however, because of its strategic location in the middle of the fishing grounds, most of the landings and processing plants are in Walvis Bay (Food and Agriculture Organisation, 2020). Walvis Bay supports businesses in both primary commercial fishing as well secondary fish processing.

During the 2020/21 financial year, a total of 207 vessels were licenced to operate in the Namibian Exclusive Economic Zone (Ministry of Fisheries and Marine Resources, 2021) with the majority based at Walvis Bay. In 2025 the New Era reported that there were 242 vessels licensed to operate within Namibia's EEZ. (<https://neweralive.na/fishing-contributes-n15b-to-gdp>).



5.7.2.5 Employment and Occupations

The working age population in Namibia is defined as all people aged 15 years and older. Out of the population of 3 022 401, the working age population stood at 1 876 122 in 2023.

Figure 5-57 provides an indication of the proportion of the working age population that makes up the Namibian Labour Force in 2023 (Namibia Statistics Agency, 2024b)⁵³.



Figure 5-57: Namibian Labour Force.

Source: Namibia Statistics Agency (2024b)

The Erongo Region had the second most people aged between 15 and 65 years that are active in the labour force. In 2023 the labour force for Erongo stood at 106 518 persons, with a labour force participation rate of 64.4% (69.1% among males and 59.4% among females), compared to the national average of 46.2%.

The //Kharas Region's participation rate was 63.3% (68.4% for males and 58% for females) (Namibia Statistics Agency, 2024b).

In 2023, 70.4% of the labour force in the //Kharas Region and 68% in Erongo Region were employed. In the !Nami#nūs and Walvis Bay Urban Constituencies the employment rates were 75.2% and 60.2%, respectively.

There is, however, a clear gender divide in terms of employment, as unemployment rates for women are 8.1% and 5.2% higher when compared to men in the //Kharas and Erongo Regions, respectively (see Figure 5-58).

⁵³ Those outside the labour force are defined as those that do not want employment and those that are not actively seeking employment.



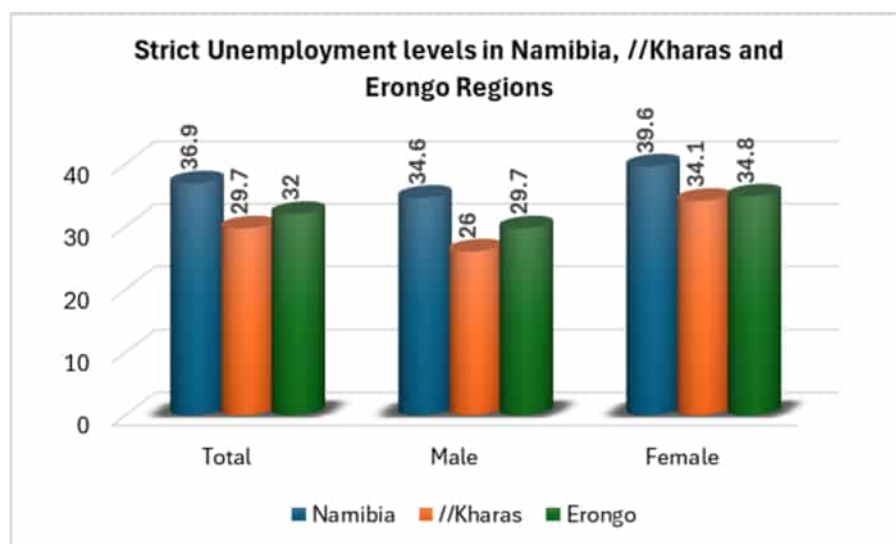


Figure 5-58: Levels of Unemployment (Strict Definition)

Source: (Namibia Statistics Agency, 2024(b))

Table 5-15 provides some labour force indicators by region and constituency. The data indicates that in terms of the broad definition of unemployment (which includes both the unemployed that actively seeks work and those that don't) unemployment in the Erongo Region is lower than in the //Kharas region as a whole and very similar to Walvis Bay. Youth unemployment levels are very high, close to 50% in most areas, except for !Nami#nūs where it is 43.1%. Walvis Bay Rural has the highest combined youth UR and PLF of 53.1%.

Table 5-15: Unemployment and Youth Unemployment

Region	Population (15 years and above)		Youth (15 – 34 years)	
	Unemployment Rate (UR)	Combined UR and PLF	Youth Unemployment Rate	Combined UR and PLF
//Kharas	29.7	40.1	37.9	48.6
!Nami#nūs	24.8	32.7	34.2	43.1
Erongo	32.0	41.9	40.7	50.6
Walvis Bay Urban	29.8	38.3	40.1	49.5
Walvis Bay Rural	34.6	42.6	44.9	53.1

Note: The potential labour force (PLF) refers to people who are available for work but are not actively looking for work.

Source: (Namibia Statistics Agency, 2024b)

5.7.2.6 Household Income

The income that a household earns provides further indication of the well-being of such a household. Household incomes in Namibia, according to the 2023 Population and Housing Census Labour Force Report, is low for the majority of households in the country.

Census data reports that 45.1% of people earned less than N\$ 3 000 per month while very few (4.3%) earn more than N\$ 30 000 per month (gross income).

The lack of employment growth is the fundamental reason why income inequality has remained high. With low levels of private sector employment growth, Government has pursued a strategy of employing as many people as possible in the public sector (in central,



regional and local government and in the public enterprise sector) without jeopardising the country's fiscal position. This has significant implications for public spending and windfalls from SACU, dividends, asset sales, and fishing and mineral rents have all been included in current revenue and spent on consumption rather than invested or used to reduce debt. Public debt has reached almost 70% of GDP as government has borrowed in local, regional and international debt markets although this ratio is set to fall to nearer 60% by the end of the 2025/26 financial year following the tabling of the national budget in March 2025

5.7.2.7 Poverty and Inequality

Namibia was defined as an upper middle-income country and had a Human Development Index (HDI) of 0.665 in 2023, which places it in the medium human development level at 136th place out of 193 monitored countries and territories. However, on 1 July 2025 it was redefined as a lower-middle income country.

When the HDI is adjusted for inequality (IHDI) the score reduces to 0.438, indicative of relatively high inequality in Namibia (UNDP, 2023).

Due to stronger GDP growth in 2022 and 2023, poverty is estimated to have decreased but remains high at 17.8% based on the \$2.15 per day international poverty line (IPL; 2017 PPP) (World Bank Group, 2024).

Between 2009/10 and 2015/16, income inequality as measured by the Gini-coefficient declined from 0.59 to 0.57, however in 2022 inequality was reported to have increased with a reported Gini coefficient of 0.61 (African Development Bank Group, 2024). A similar trend was evident with poverty levels during the same period (2009/10 to 2015/16) with the incidence of poverty decreasing from 19.5% to 17.4% and then increasing to 26.9% in 2022 (National Planning Commission, 2021) and (African Development Bank Group, 2024). This trend, i.e. increased inequality and poverty, is likely due to COVID-19 pandemic period.

Despite the economic recovery following COVID-19, the socio-economic situation has not improved materially. Vulnerable households including female-headed households, those with lower levels of educated, larger families, children and the elderly, and labourers in subsistence farming, are particularly prone to poverty (World Bank Group, 2024).

Poverty mapping undertaken in 2011 (National Planning Commission, n.d.) shows that the Erongo Region has the second lowest rates of poverty (2.4% of the total population being below a predetermined poverty limit) while //Kharas is higher at 6.7%. This compares positively against the national poverty rate of approximately 19.5% during the same period.

At the Constituency level, Walvis Bay Urban is ranked the fifth least deprived constituency in the country while !Nami#n#s is slightly more deprived but still ranked high at 10/107 constituencies (NPC, 2015 as cited in SLR 2024).

5.7.2.8 Health and Healthcare

Namibia recognises that health is a fundamental human right and is committed to achieving health for all Namibians. The latest Namibia Demographic and Health Survey compiled in 2013 identified the main health and well-being issues for Namibia as child and maternal mortality, Human Immunodeficiency Virus (HIV), malaria- and Tuberculosis (TB)-related deaths, Non-Communicable Diseases (NCDs), and road accident deaths (The Namibia Ministry of Health and Social Services (MoHSS) and ICF International, 2014).

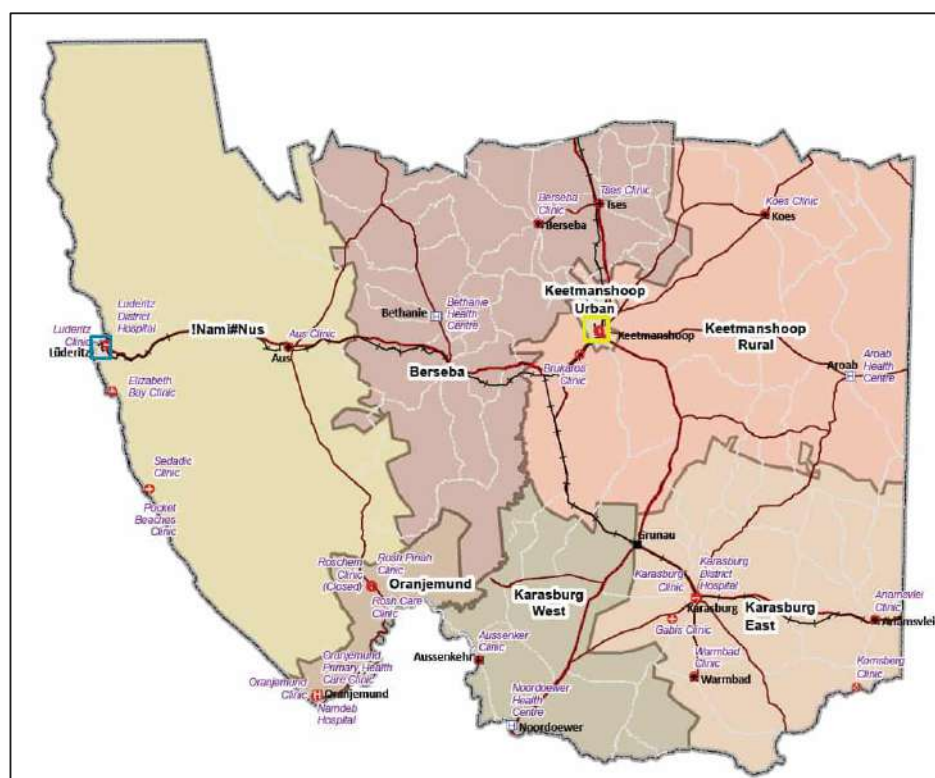
As specified in the United Nations General Assembly Special Session (UNGASS) on HIV and Acquired Immune Deficiency Syndrome (AIDS), young people in the 15-24 age range is an important group to monitor with regard to reductions in HIV incidence at the population level (UN General Assembly, 2001 (The Namibia Ministry of Health and Social Services (MoHSS) and ICF International, 2014) .



At the time, testing of women and men aged between 15 and 24 revealed an HIV positive infection rate of 4.1% in the Erongo Region and 2.8% in the //Kharas Region (The Namibia Ministry of Health and Social Services (MoHSS) and ICF International, 2014).

While new information about the regional infection rates is not available, the HIV incidence per 1 000 people (all ages) in Namibia has decreased from 3.31 in 2018 to 2.81 in 2020. The female and male incidence rates were 3.96 and 2.66 in 2018, respectively which declined to 3.70 and 2.25 in 2020 (National Planning Commission, 2021). The total number of HIV infections in the 15-49 age category was 7 190 in 2018 and reduced to 6 353 in 2020 (National Planning Commission, 2021).

TB cases declined from 524 in 2018 to 486 in 2019. Hepatitis B cases declined substantially from 191 in 2019 to 95 in 2020. Malaria incidence decreased significantly from 31.9% in 2018 to 2.8% in 2019 (National Planning Commission, 2021). Figure 5-59 provides the detail of the availability of health facilities in the //Kharas Region. The region has a total of four hospitals, (one of which is in !Nami#nūs Constituency), three health centres and 26 Clinics. Health facilities increased from 25 in 2016 to 33 in 2023.



Constituency	Health Facilities 2016	Health Facilities 2022	Clinics	Health Centres	Hospitals
!Nami#Nus	5	6	5	0	1
Berseba	3	3	2	1	0
Karasburg East	5	6	5	0	1
Karasburg West	2	2	1	1	0
Keetmanshoop Rural	5	3	2	1	0
Keetmanshoop Urban	2	7	6	0	1
Oranjemund	3	6	5	0	1
Total	25	33	26	3	4

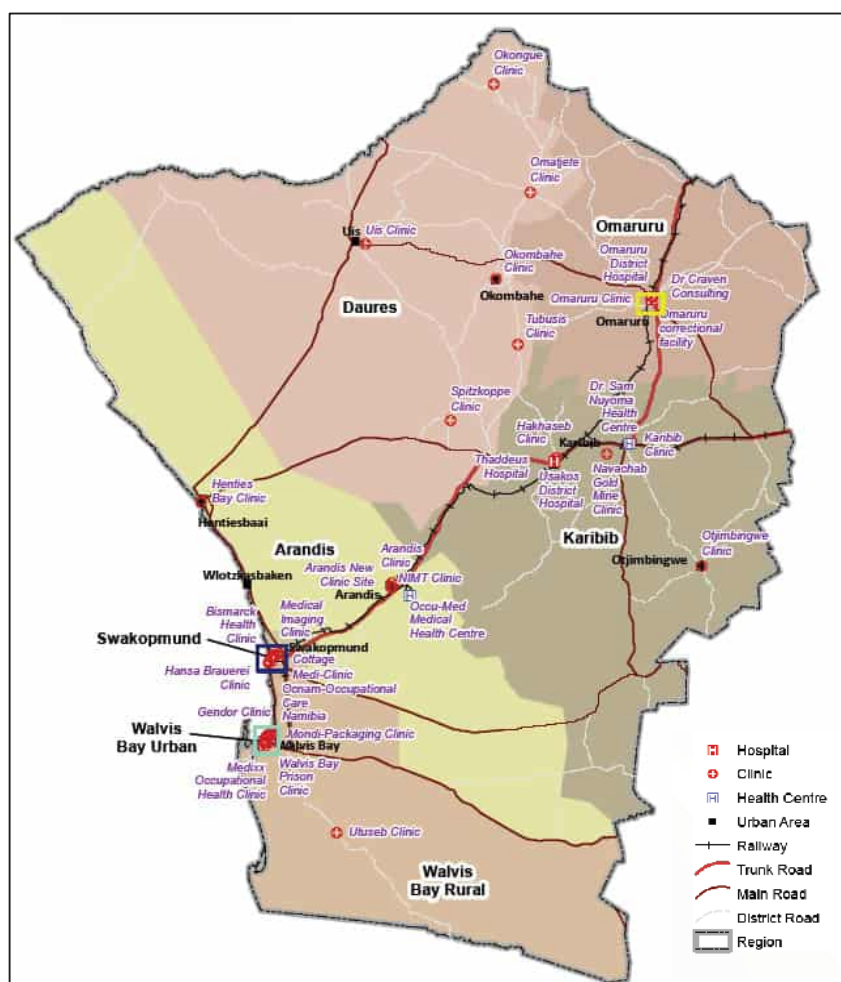
Figure 5-59: Distribution of Health Facilities in the //Kharas Region.

Source: (NSA, 2023)



Figure 5-60 shows the distribution of health services in the Erongo Region and clearly illustrates the dominance of the towns of Swakopmund and Walvis Bay with respect to access to health services. The region had seven hospitals, four health centres and 44 clinics in 2023. It had a total of 55 health facilities in 2023, up from 49 in 2016.

Overall access to healthcare in Namibia is good, with 76% of the population living within a 10 km radius of a health facility. On average, in rural areas, there are about 5 780 people per public clinic and 58 825 people per district hospital. Hospitals, however, suffer from overcrowding and long wait times, as many people bypass clinics and health centres closer to home and go directly to hospitals that are perceived to offer a higher quality of care (African Journal of Primary Health Care & Family Medicine, 2025).



Constituency	Health Facilities 2016	Health Facilities 2022	Clinics	Health Centres	Hospitals
Arandis	4	5	4	1	0
Daures	6	6	6	0	0
Karibib	7	7	4	1	2
Omaruru	3	5	3	0	2
Swakopmund	11	10	9	0	1
Walvis Bay Rural	1	2	2	0	0
Walvis Bay Urban	17	20	16	2	2
Total	49	55	44	4	7

Figure 5-60: Distribution of Health Facilities in the Erongo Region.

Source: (NSA, 2023)



5.7.2.9 Access to Services

In Namibia approximately 47.1% of households use electricity for lighting, compared to 77.9% in the Erongo Region and 66.8% in the //Kharas Region (Namibia Statistics Agency, 2024).

In the 2023 Census, safe water was defined as water from the following sources: piped water inside, outside, public pipe, well-protected, bottled water, and boreholes with tank covers. At national level, 91.4% of households have access to safe drinking water. Access to safe drinking water is similar in the Erongo and //Kharas Regions (97.6% and 90% respectively).

The majority of households in the urban areas of the Erongo Region (85.5%) use flush toilets, compared to 91.6% in the //Kharas region. However, better access to sanitation within the Erongo Region as a whole was also evident in that 9.7% of households reported no access while in the //Kharas Region 23.8% of households reported no access to sanitation (Namibia Statistics Agency, 2024).

In 2023, some 89.7% of households in the !Nami#nūs (Lüderitz) and 99.15% of households in the Walvis Bay Urban Constituencies used electricity for lighting. The proportion of households using electricity on the Walvis Bay Urban Constituency is indicative of the urban setting while a greater reliance on solar and batteries in the !Nami#nūs Constituency is likely indicative of informal settlement on the urban periphery lacking services. (NSA, 2025).

In 2023, both the !Nami#nūs and the Walvis Bay Urban Constituencies provided good access to piped and treated water; however, the level of access to piped water varied by neighbourhood. Walvis Bay provided a higher level of services with 73.72% of households having piped water inside their houses. Comparatively Lüderitz had poorer access, with 45.6% of households having access to piped water inside their houses, while poorer households in surrounding informal or low-income settlements relied on water stands inside their property (16.7%) or communal standpipes (34.9%). Overall, however access to piped water within both constituencies was higher than in the larger Erongo Region and //Kharas Region (NSA, 2025).

Access to sanitation also differed between the two constituencies with access in Walvis Bay substantively more developed, with almost 90% of households having access to private toilets and 8% to shared flush toilets connected to water-borne sewage. In contrast, only 50.47% of households in Lüderitz had access to private toilets, while 33.04% of households used shared flush toilets and 6.1% had no toilet facility (NSA, 2025).

Most households in Lüderitz (68.07% of households) and Walvis Bay (98.16% of households) had their domestic waste regularly collected by the municipality. The level of service in Lüderitz was, however, lower and some households had only irregular collections (5.7% of households).

Access to basic services at a regional and constituency level is provided in Table 5-16.

Both Lüderitz and Walvis Bay provide good access to public and private facilities and services (see Table 5-17). Walvis Bay is a much larger settlement with a proportionately larger range of services, including a wider choice of banking, retail, public and private health facilities. Accommodation, restaurants and take-aways are numerous, as well as tourism and recreational facilities, that suggest that tourism is an important sector for Walvis Bay and there is a substantial local market for recreational activities. Most of these services and facilities are found in the residential and business areas of Walvis Bay, as well as in industrial areas that surround the Port.

Lüderitz has fewer public and private facilities or services (see Table 5-17) due to its smaller population. These services are primarily used by residents of Lüderitz and the Port's visitors, although there is provision for domestic and international tourism though accommodation (notably hotels, bed and breakfasts, back-packers etc.), as well as the expanded waterfront.



Table 5-16: Basic services profile by constituency.

Type of Basic Services	Percentage of Households			
	//Kharas Region (2023)	!Nami#nūs Const. (2023)	Erongo Region (2023)	WB (Urban) Const (2023)
Source of Energy for Cooking				
Electricity from Mains	43.2%	49.1%	72.91%	97.31%
Gas	28.8%	46.2%	12.93%	2.01%
Wood/Firewood	26.5%	3.6%	13.31%	0.41%
Source of Energy for Lighting				
Electricity from Mains	66.5%	89.7%	77.7%	99.15%
Solar Energy	10.2%	1.5%	6.54%	0.07%
Battery Lamp/Torch/Cell phone	15.2%	4.2%	10.91%	0.27%
Source of Domestic Drinking Water				
Piped Water inside from water scheme	42.4%	45.6%	59.08%	73.72%
Piped Water outside from water scheme	15%	16.7%	14.66%	13.96%
Public Piped Water from water scheme	20.6%	34.9%	14.19%	4.59%
Boreholes/boreholes with tank (Covered)	8.8%	0.5%	1.10%	0.01%
Type of Sanitation				
Flush toilet connected to main sewer	49.07%	50.47%	68.83%	89.69%
Flush toilet connected to septic tank	3.51%	2.27%	2.18%	0.65%
Public flush connection to main sewer	11.38%	33.04%	5.37%	7.96%
No Toilet Facility	23.83%	6.10%	9.71%	0.13%
Waste Disposal				
Regularly Collected	57.31%	68.07%	78.4%	98.16%
Irregularly Collected	4.47%	5.75%	2.64%	0.92%
Burning	15.68%	1.11%	8.09%	0.02%
Dump in the field/bush	9.14%	1.89%	2.75%	0.03%

Source: NSA (2025)

Table 5-17: Profile of private and public services and facilities.

Type of Facility / Service	Number of Facilities / Services	
	Lüderitz Town	Walvis Bay Town
Accommodation & Food	24	32
Cemetery	2	2
Education	7	22
Finance	3	12
Government Ministries	5	11
Health	3	5
Tourism and Recreation	10	40
Retail	4	7

Source: OpenStreetMap and GRN ministerial data (2024)



5.7.3 Heritage

5.7.3.1 Marine Cultural and Heritage Resources

There are a number of shipwrecks located along the Namibian coastline. In Namibian waters, wrecks older than 50 years are declared national monuments. The majority of identified shipwrecks occur close to the coastline (Turner, 1988) and are not likely to be present in the Venus offshore project area. However, because most of the sites described on the shipwreck list have been documented only through survivor accounts, archival descriptions and eyewitness reports, many remain uncharted and undiscovered. It is not, therefore, possible to provide accurate location data. **No wrecks are known to occur in PEL0056/Block 2913B based on available information and that from environmental and geophysical surveys undertaken within the block (see Section 5.2.1). Thus, it is unlikely that any shipwrecks will be identified in the Venus offshore project area. Similarly, no wrecks are known or have been reported within the nearshore transshipment area. However, the possibility of identifying new wrecks during the installation of the nearshore buoy is of very low probability.**

No tangible cultural site has been identified in the Project Area of Influence.

5.7.3.2 Intangible Cultural Heritage

Intangible cultural heritage relates primarily to ritual and spiritual valuations and relationships with natural elements (wind, water, fire), ritual practices (ancestral veneration) and beliefs (natural-spiritual beliefs in the water sourcing / bearing deities). Intangible cultural heritages of Namibia are complex and influenced by ancient histories of the San peoples and their social-ecological relations with nature, as well as the cultural traditions and histories of the Ovahimba, Herero and Ovambo, Nama and Topnaar peoples. Some communities have intermittent cultural connection with the sea.

The small-scale fishers (SSF) of Namibia come mostly from the coastal areas and have historically enjoyed either a leisure or livelihood relationship with the sea. However, increasingly, poverty in the northern region is leading to migration of people to the coast. This has resulted in what is known as “Bicycle Fishermen” in Swakopmund: men who fish for subsistence purposes in demarcated spots along the coast. Recent research (2022-2025) revealed that SSF communities, including members of the Haganeni Artisanal Fishing Association (HAFA), maintain both livelihood and cultural relationships with the sea.

The deserts (Namib) are an important influence of concepts of time and space, human cultural engagement with the temporal and spatial aspects of cultural heritage practice and faunal/floral use for spiritual reasons.

Key cultural groups and associated practices:

- Topnaar (ǀAonin Clan of the Nama People): Historically displaced from coastal areas, the Topnaar maintain cultural ties to the sea through ritual “Returns to the Sea,” use of kelp and seawater for healing, and subsistence practices involving the !Nara plant.
- San and Nama Peoples: Known for musical traditions involving wind instruments and trance-inducing dance rituals. Wind is central to spiritual practice. There is an indication of some San cultural heritage with the ocean, but these have been largely severed by the process of forced removals from the coastal context under the colonial and apartheid regimes. San communities living inland (in places such as Tsumeb and Tsintsabis) still remember some of these rituals but are not able to revive them, due to distance from the coast.
- Ovambo, Herero, and Ovahimba: Spiritual significance is placed on inland water bodies, with beliefs in water spirits and snake deities. The floodplains and rivers are



sources of spiritual significance, since these may contain water spirits and specifically the water snake 'deity'.

- Damara and Haillom: Strong ecological and spiritual connections to water snakes and crocodiles. The beliefs suggest a deep social-ecological embedding and valuation of nature.
- European Settler Communities: No sea-related rituals identified, but leisure and tourism activities along the coast have become ritualized and culturally significant.

Key intangible cultural heritage beliefs and expressions therefore in Namibia can be summarised as follows:

- Ancestors are believed to reside in wind and water, but not in the sea.
- Inland communities retain memory of coastal rituals, though access has been historically restricted.
- Ritual journeys to the coast continue, particularly from towns like Tsumeb and Tsintsabis.
- Music, dance, and storytelling are key expressions of ICH, often linked to natural elements.
- Fishing is ritualized through generational knowledge, seasonal patterns, and communal identity.
- SSF and leisure activities along the coast are increasingly recognized as forms of ICH.

5.7.4 Human Rights Profile

This section provides a summary of the baseline of human rights protections in Namibia, recognising that the potential for adverse human rights impacts arises at the intersection of weak state protections and potential gaps in corporate responsibility. Establishing the baseline is important for understanding the broader context in which the project will operate, particularly where existing frameworks for human rights protection may be limited, inconsistently applied or inadequately enforced. The inclusion of this summary reflects the recognition that both state and corporate actors share the duty to respect, protect and fulfil human rights throughout the project lifecycle.

Since gaining independence in 1990, Namibia has made significant progress in respecting and promoting human rights, establishing a strong legal framework that protects fundamental rights. Fundamental human rights are recognised in the Namibian Constitution of 1990 guaranteeing a broad range of rights, including equality, freedom of expression, protection from discrimination, access to information, public participation, political activity, and government transparency. The Constitution is aligned with international human rights standards and Namibia is also a signatory to several international human rights conventions, such as the African Charter on Human and Peoples' Rights (adopted in 1981 and entered into force in 1986) as well as others set out in Table 5-18.

Table 5-18: Ratified Human Rights Treaties.

Treaty Description	Ratification Date
Convention against Torture and Other Cruel Inhuman or Degrading Treatment or Punishment	28 Nov 1994
Optional Protocol of the Convention against Torture	None
International Covenant on Civil and Political Rights	28 Nov 1994
Second Optional Protocol to the International Covenant on Civil and Political Rights	28 Nov 1994
Convention for the Protection of All Persons from Enforced Disappearance	None
Convention on the Elimination of All Forms of Discrimination against Women	23 Nov 1992



Treaty Description	Ratification Date
International Convention on the Elimination of All Forms of Racial Discrimination	11 Nov 1982
International Covenant on Economic, Social and Cultural Rights	28 Nov 1994
International Convention on the Protection of the Rights of All Migrant Workers and Their Families	None
Convention on the Rights of the Child	30 Sep 90
Optional Protocol to the Convention on the Rights of the Child (Armed Conflict)	16 Apr 02
Optional Protocol to the Convention on the Rights of the Child (Child Prostitution)	16 Apr 02
Convention on the Rights of Persons with Disabilities	04 Dec 07

In addition to international law and Namibia's constitution framework, Namibia, like all UN member states, has a duty to protect human rights under the UN Guiding Principles on Business and Human Rights (UNGPs). This duty encompasses protecting individuals within its territory and jurisdiction from human rights abuses, including those caused by business activities.

Overall, Human Rights in Namibia are generally respected with incidences of unlawful or extrajudicial killings, disappearances, torture and other inhumane treatment or punishment, arbitrary arrests and detention, denial of fair trial occurring very seldom or never.

The latest universal review undertaken by the United Nations in 2021 indicates that human rights are largely respected; however, the country still faces challenges with respect to addressing the root causes of poverty, hunger and uplifting the living conditions of the poor; access to education including inclusive education policy measures; and addressing violence against women and children.⁵⁴ Namibia accepted Human Rights Council Working Group recommendations on justice system reform; and it was commended for developing mechanisms for civil society and for monitoring the state of the rule of law.

Socioeconomic inequalities, the legacy of apartheid in the past, remain extremely high and were worsened by the COVID-19 pandemic. Namibian society's vast disparities have led to a dual economy: a highly developed modern sector, co-existing with an informal subsistence-oriented one. Namibia ranks as one of the world's most unequal countries, with disparities in both economic opportunities and access to services, and starkly different poverty rates across different regions and different groups, including by age and gender.⁵⁵

In this section, particular attention is given below to areas of existing human rights vulnerabilities in Namibia, of relevance to the project.

The key issues with respect to human rights in Namibia, according to the Country Reports on Human Rights Practices for 2023 (United States Department of State, 2023), are corruption, gender-based violence (mostly in the domestic context) child protection, early and forced marriage, violence and discrimination against members of the LGBTQI community and minimal advancement, through the ratification of international conventions, in addressing the worst forms of child labour.⁵⁶

⁵⁴ UN Human Rights Council Working Group on the Universal Periodic Review Thirty-eighth session Geneva, 3-14 May 2021: Draft report of the Working Group on the Universal Period Review, Namibia: <https://namibia.un.org/sites/default/files/2021-05/Namibia%20-%20Draft%20report%20circulated%20on%205%20May%202021.pdf>

Adopted by the Human Rights Council on 30 September 2021 <https://digitallibrary.un.org/record/3946892?v=pdf&ln=en>

⁵⁵ Namibia ranked 117th among 157 countries on the Human Capital Index. The World Bank in Namibia, Country Overview, 10 April 2025, <https://www.worldbank.org/en/country/namibia/overview>

⁵⁶ U.S. Department of State, 2023 Country Reports on Human Rights Practices: Namibia www.state.gov/reports/2023-country-reports-on-human-rights-practices/namibia/



Forced Labour, Modern Slavery, Human Trafficking and Child Rights & Labour

Some children in Namibia may be exposed to severe forms of child labour, including trafficking, sexual exploitation, and forced work in agriculture, domestic tasks, and street vending.⁵⁷ Migrant and refugee children, especially from Angola, face heightened risks of exploitation and forced involvement in smuggling and other illicit activities.⁵⁸ Namibia has ratified the ILO Forced Labour Convention⁵⁹ and the Protocol to the Forced Labour Convention of 2014.⁶⁰ Namibia's approach to regulating child labour is grounded in both national legislation and international commitments. Namibia has been taking steps to eliminate the worst forms of child labour, and has implemented a National Action Plan on Combating Trafficking in Persons, which aims, among other objectives, to increase public awareness as a means of protecting children from trafficking.⁶¹ Whilst these efforts have been taken, there is minimal evidence on the compliance or monitoring of these actions.

Discrimination, Harassment and Gender-Based Violence

The Constitution stipulates that all Namibians will be considered equal and will not be subject to inequality by factors such as sex, race, colour and ethnicity, religious beliefs and status in society. High rates of gender-based violence, entrenched gender inequality and harmful socio-cultural norms that disempower women and girls, are reported in Namibia.⁶² Namibia has introduced efforts to combat GBV through legislative and other government initiatives through the Ministry of Gender Equality, Poverty Eradication and Social Welfare, and the office of the Ombudsman which handles complaints about abuse and discrimination. GBV Protection Units are decentralised across 14 regions offering services from psychosocial support, legal services, investigation and medical care. The Office of the Prime Minister plays a central role in aligning GBV responses with the National Gender Policy, National Development Plans, and Vision 2030.

The legal system has the legislative and technical components to deal with rape cases, however there are key limitations in practice and implementation due to limited police investigative capacity and the withdrawal of allegations by victims, mostly because they receive compensation from the accused, family pressure, threats, shame or discouragement due to slow legal process.

Domestic violence is a widespread problem and government, civil society organisations and communities proposed various ways in which to deal with offenders, raise awareness and prevent such offences. Despite a strong legal framework, with severe penalties, effective prevention has still not been achieved to a significant extent.

⁵⁷ U.S. Department of Labor. 2023 Findings on the Worst Forms of Child Labor.

<https://www.dol.gov/agencies/ilab/resources/reports/child-labor/namibia#:~:text=Children%20in%20Namibia%20are%20subjected%20to%20the%20worst,in%20agricultural%20work%2C%20domestic%20work%2C%20and%20street%20work.>

⁵⁸ *Ibid.*

⁵⁹ ILO Forced Labour Convention, no 29 of 1930.

https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:11300:0::NO::P11300_INSTRUMENT_ID:312174

⁶⁰ Protocol of 2014 to the Forced Labour Convention, 1930, entered into force on 9 November 2016

https://normlex.ilo.org/dyn/nrmlx_en/f?p=NORMLEXPUB:11300:0::NO::P11300_INSTRUMENT_ID:312174

⁶¹ *Ibid.*

⁶² Amnesty International, Namibia 2024 <https://www.amnesty.org/en/location/africa/southern-africa/namibia/report-namibia/#:~:text=High%20rates%20of%20gender%2Dbased,vulnerable%20to%20gender%2Dbased%20violence.>

⁶³ Namibia recorded 4405 cases of gender-based violence between April 2024 and February 2025, with 1345 of those being rape cases. The Namibian 'Over 4400 GBV cases recorded in 11 months' 13 May 2025 <https://www.namibian.com.na/over-4400-gbv-cases-recorded-in-11-months/>



Security and Conflict

While human rights abuses linked to security activities in Namibia are rare, there have been isolated incidents, such as police brutality during the COVID-19 pandemic and excessive force used against GBV protestors and journalists,⁶⁴ and in curbing illegal fishing. Namibia's security forces are generally seen as professional, though incidents of police misconduct persist.⁶⁵

Freedom of Peaceful Assembly

The Constitution and law provide for the freedom of peaceful assembly and association and the government generally respects these rights. Application to demonstrate must be made to the police and it is sometimes denied due to various reasons such as police resources to monitor and potential violence as a result of the nature of the protest. For example, the police denied a permit for a protest against gay marriage, citing the risk of inciting feelings of hostility between groups. However, generally, people have the freedom to protest peacefully despite the fact that there is no general culture of protest in Namibia.

Human Rights Defenders

Civil Liberties are generally respected, citizens are free to participate in the political processes, human rights related NGOs are allowed to operate without legal restriction, and to a certain extent public protest is tolerated. There are nevertheless reported concerns of incidents of clampdowns on protests in Namibia, including protests related to environmental issues in recent years.⁶⁶

The Office of the High Commissioner for Human Rights, Southern Africa, provides technical assistance and support to human rights defenders in Namibia. The Office of the Ombudsman in Namibia is also mandated to assist individuals through receiving, investigating, and resolving complaints related to violations of human rights and protection of the environment in Namibia.¹⁵² As an independent and impartial public office bearer, it is also mandated to investigate Government corruption.

Cultural Heritage and Indigenous Peoples

Namibia has rich tangible and intangible cultural heritages which are located in the natural and desert landscapes of the country, as well as the languages, rituals and beliefs of the people. These heritages are carefully managed by the national government and the Namibian peoples.

Globally, Indigenous Peoples are recognized as culturally distinct populations who maintain historical continuity with pre-colonial societies and have retained distinct social, economic, political, and spiritual systems.

In Namibia, the situation is complex. Namibia has ratified key international instruments such as the International Covenant on Civil and Political Rights and the Convention on Biological Diversity, and in 2007, voted in favour of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). Its Constitution also prohibits discrimination based on ethnic or tribal affiliation. The Namibian government, however, while stressing the equality of all Namibians,

⁶⁴ International Commission of Jurists. 2020 Namibia: authorities must investigate police abuse of people protesting Gender Based Violence <https://www.icj.org/namibia-authorities-must-investigate-police-abuse-of-people-protesting-gender-based-violence/>

⁶⁵ Keulder, C 'Namibians see police falling short of professional conduct and respect for citizens' rights' Afrobarometer Dispatch No. 635, 28 April 2023, Accessed at: <https://www.afrobarometer.org/wp-content/uploads/2023/04/AD635-Namibians-see-police-as-falling-short-of-professional-conduct-Afrobarometer-26april23-1.pdf>

⁶⁶ Hübschle, A et al, 'Voices from the Frontlines in the Okavango River Basin: Towards a Cooperative Model of Environmental Activism in the Global South' International Journal for Crime, Justice and Social Democracy, Vol 13(1) 2024, accessed at: <https://www.crimejusticejournal.com/article/download/3317/1459#:~:text=vocal%20and%20impactful%20opponents%20of%20ReconAfrica>



does not specifically recognise the rights of Indigenous Peoples. It has not ratified ILO Convention 169, which explicitly defines and protects the rights of indigenous and tribal peoples. Moreover, Namibia's government tends to avoid using the term "indigenous peoples" in official discourse, promoting instead a discourse of national unity and ethnic equality, which can obscure the specific vulnerabilities and cultural claims of groups such as the San, Nama, and Himba.

Transparency and Corruption

Corruption and fraud cases, involving the misappropriation of state funds and resources, bribery and corruption in government tenders and contracts, and embezzlement of funds intended for social programs and development projects, are documented in Namibia.

Transparency International's Corruption Perception Index (CPI) is the most widely used corruption ranking which measures the perception on corruption of government entities by experts and business people. According to this, Namibia is ranked the 59th least corrupt country in the world and the fifth least corrupt in Africa.⁶⁷

However, significant instances of corruption occur regularly, with the NAMCOR and "Fishrot" cases the most recent examples.⁶⁸ In both cases, perpetrators are now subject to legal proceedings. Over time the general population is growing less patient with corrupt practices, with more pressure on both government and the Anti-Corruption Commission to deal with it effectively and speedily.

Namibia has established an Anti-Corruption Commission and the Financial Intelligence Centre; it has enacted the Anti-Money Laundering and Combating the Financing of Terrorism Regulations, and it has ratified international conventions against corruption and money laundering, and the implementation of measures to increase transparency and accountability in government and public institutions.

In October 2017 the *Whistleblower Protection Act, 2017* was signed into law to protect whistleblowers and combat corruption but it has yet to be put into force, effectively delaying the establishment of the Whistleblower Officer to investigate disclosures of improper conduct, and to investigate complaints of retaliation against the persons making the disclosures.

Meaningful participation and access to information

Premised on the constitutional right to freedom of expression, Namibia passed an Access to Information in 2022, which gives every Namibian the right to request information from public institutions, and some limited private ones. While the Act has not yet been brought into force, access to information requests will be handled through the Communications Regulatory Authority of Namibia which has begun preparations for its role. In the past, public information has been difficult to access by journalists and ordinary members of the public, but this seems to be shifting in the wake of the 'Fishrot' scandal and the passing of this Act.

Abuses Based on Sexual Orientation

The National Assembly of Namibia, in 2023, passed two bills criminalising same-sex marriages and excluding same-sex spouses from receiving immigration status, however the bills have not yet been passed and the legislation is not yet in effect. Civil Society Organisations reported that assaults on LGBTQI+ persons increased following this decision. However, there is no evidence that police or other government agents incite or perpetrate

⁶⁷ Transparency International Corruption Perceptions Index, 2023:
<https://www.transparency.org/en/countries/Namibia>

⁶⁸ Makwele, P 'NAMCOR corruption probe deepens' in *Confidante Namibia*, 14 July 2025, accessed at:
<https://www.confidentenamibia.com/namcor-corruption-probe-deepens> ;

'The Fishrot Scandal' PPLAAF, accessed at: <https://www.pplaaf.org/cases/fishrot.html>



violence against LLGBTQI+ individuals, though government officials confirmed reports of police responding with apathy towards victims of assault.

5.7.5 Fisheries

PEL0056/Block 2913B and the nearshore transshipment area are located off the coast of Namibia, within the Southern and Northern Benguela Current marine ecosystem, respectively. The Benguela Current is one of the most productive coastal upwelling systems in the world supporting highly productive commercial fisheries.

In Namibia, the management of fish stocks for commercial purposes is overseen by MAFWLR which receives guidance from the National Marine Information and Research Centre (NatMIRC) in Swakopmund under the Ministry. Total Allowable Catches (TACs), or in some cases effort limits (TAEs) are set annually by the Minister based on scientific resource assessments. An advisory council then advises / recommends TACs/TAEs and management measures for approval by MAFWLR.

The Confederation of Namibian Fishing Industries represents commercial fisheries at the industry level on issues of common interest, while sector-specific associations, such as the Namibian Hake Association and the Pelagic Fishing Association of Namibia, represent specific fisheries and the species they exploit.

Namibia's commercial fisheries are listed in Table 5-19. The sectors currently operating off the coast of southern Namibia (south of 26°S), and within the area of influence of the project are described in Section 5.7.5.2. Stock distributions, spawning and recruitment of important species are described in more detail in the Section 5.7.5.1.

Supported by the high productivity of the Benguela upwelling ecosystem, abundant fish stocks have historically typified Namibian waters⁶⁹. The main targeted species and gear types are demersal (bottom), small pelagic (surface), large migratory pelagic fish, linefish and crustaceans.

The country has only two major fishing ports, Walvis Bay and Lüderitz, and in 2023 had 163 Namibian-registered commercial fishing vessels (FAO, 2024), dominated by demersal trawlers that fish for hake year-round except for a one month closed season in October. This is Namibia's most valuable fishery. The midwater trawlers that target the pelagic horse mackerel is the largest fishery by volume while the much smaller large pelagic tuna longline and bait-boat vessels are also active targeting tuna and swordfish. Licensed foreign fishing vessels in Namibian waters are few – as fishing in Namibian waters is restricted to Namibians and national flagged vessels. Nevertheless, Illegal, Unreported and Unregulated (IUU) fishing remains a persistent challenge in Namibia, threatening undermining the sustainability of the fisheries sector. Despite strong regulatory frameworks and enforcement mechanisms, foreign-flagged vessels continue to overfishing of Namibia's marine resources.

Namibia's mariculture industry is developing, focusing on species such as oysters (*Crassostrea gigas* and *Ostrea edulis*), black mussels (*Choromytilus meridionalis*) and Mediterranean mussel (*Mytilus galloprovincialis*), abalone (*Haliotis midae*), and seaweed (*Gracilaria gracilis*). The industry employs various methods, including rafts, suspended long-lines, racks in ponds, and onshore flow-through tanks. Key mariculture operations are concentrated around, Lüderitz, Walvis Bay, Swakopmund, and more recently Oranjemund.

The MAFWLR conducts regular research surveys to determine the biomass of demersal, midwater, and small pelagic species, covering the entire EEZ from the Angolan to South African maritime borders in the north and south respectively. All fisheries have a suite of

⁶⁹ Noting that in the International Commission for Southeast Atlantic Fisheries (ICSEAF) period these resources were over-exploited. The northern Benguela (Namibian waters), however, remains a highly productive upwelling system resulting in proportionately (to many other countries) abundant commercial fish resources.



management measures aimed at maintaining the ecosystem and resource sustainability, including a prohibition on bottom trawling shallower than 200 m, enforced by Namibian regulations.

Table 5-19: List of fisheries that operate within Namibian waters, targeted species and gear types.

Sector	Gear Type	Water Depth (m)	Target Species
Large pelagic longline	Pelagic longline	> 500	Shark spp. Swordfish (<i>Xiphias gladius</i>) Bigeye tuna (<i>Thunnus. obesus</i>) Yellowfin tuna (<i>T. albacares</i>)
Small pelagic	Purse-seine	< 200	Sardine (<i>Sardinops sagax</i>) Cape horse mackerel (<i>Trachurus capensis</i>)
Mid-water trawl	Mid-water trawl	200 - 500	Cape horse mackerel (<i>T. capensis</i>)
Demersal trawl	Demersal trawl	< 200	Shallow water hake (<i>Merluccius capensis</i>) Deep-water hake (<i>M. paradoxus</i>) Monkfish (<i>Lophius vomerinus</i>)
Demersal longline	Demersal longline	200 - 650	Shallow water hake (<i>M. capensis</i>) Deep-water hake (<i>M. paradoxus</i>)
Pole-line	Pole and line	> 200	Albacore tuna (<i>T. alalunga</i>)
Line-fish	Hand line	< 400	Silver kob (<i>Argyrosomus inodorus</i>) Dusky kob (<i>A. coronus</i>) Snoek (<i>Thyrsites atun</i>)
Deep-water trawl	Demersal trawl	400 – 1 500	Orange roughy (<i>Hoplostethus atlanticus</i>) Alfonsino (<i>Beryx splendens</i>)
Rock Lobster	Demersal trap	10 - 80	Rock lobster (<i>Jasus lalandii</i>)
Deep-sea crab	Demersal longline trap	400 – 1 200	Red crab (<i>Chaceon maritae</i>)
Mariculture	Longlines, rafts	< 100	Pacific oysters (<i>Crassostrea gigas</i>) Black mussel (<i>Choromytilus meridionalis</i>) Seaweed (<i>Gracilaria</i> sp. and <i>Ecklonia maxima</i>)



Table 5-20: Total Allowable Catches (tonnes) from 2009/10 to 2024/25 (MFMR, 2024)⁷⁰.

Year	Sardine	Hake	Horse Mackerel	Crab	Rock Lobster	Monk
2009/10	17 000	149 000	230 000	2 700	350	8 500
2010/11	25 000	140 000	247 000	2 700	275	9 000
2011/12	25 000	180 000	310 000	2 850	350	13 000
2012/13	31 000	170 000	310 000	3 100	350	14 000
2013/14	25 000	140 000	350 000	3 100	350	10 000
2014/15	25 000	210 000	350 000	3 150	300	12 000
2015/16	15 000	140 000	335 000	3 446	250	10 000
2016/17	14 000	154 000	340 000	3 400	240	9 800
2017/18	0	154 000	340 000	3 400	230	9 600
2018/19	0	154 000	349 000	3 900	200	9 600
2020/21	0	154 000	349 000	3 900	180	9 600
2021/22	0	154 000	330 000	4 200	180	9 600
2022/23	0	154 000	290 000	4 200	180	9 000
2023/24	0	154 000	270 000	4 300	180	9 600
2024/25	0	140 000	234 000	3 900	180	9 600

Note: Deep-water trawl TAC is currently not applied for Alfonsino and Orange roughy. There is a moratorium on sardine/pilchards. ICCAT issues a TAC for albacore of which Namibia's current apportionment is 4 320 tonnes.

5.7.5.1 Stock Distribution, Spawning and Recruitment

Spawning is the process by which fish and other marine species produce and fertilize eggs to maintain populations (normally an annual seasonal process). Environmental conditions such as water temperature, light levels, and ocean currents can have a critical influence on spawning success.

Recruitment is the process by which juvenile fish develop and grow, and eventually join the adult population. This is an important stage in the life cycle of a fish, as the survival and growth of young fish can have a major impact on the overall health of the population.

Oceanographic processes in the Benguela ecosystem off the southern African west coast, including eddies, filaments and retroflexions, may contribute to the dispersion and loss of productive shelf waters offshore. These features can increase mortality of spawned products but can also have positive effects that can lead to the successful retention of planktonic eggs and larvae. This is particularly true for species that are broadcast spawners. Off the west coast of southern Africa most spawn products of commercial and many other species rely on oceanographic processes that carry these products into nearshore bays and estuaries where there is protection and food for early rapid development. This is true for both the Namibian and South African waters of the Benguela system, which can be broadly separated as the northern and southern Benguela system in South African and Namibian waters.

The location of PEL0056/Block 2913B and the Venus offshore project area is well offshore of the expected spawning areas of most fish. However, vessel transit operations may overlap with spawning grounds off central Namibia, with the

⁷⁰ Data provided by MFMR in 2024, with MFMR becoming MAFWLR in March 2025.



nearshore transshipment area off Walvis Bay falling within sardine, horse-mackerel, kob and monk fish spawning areas and ichthyoplankton drift (Figure 5-22).

The stock distribution, spawning and recruitment of key target species are discussed below.

Sardine

The Benguela sardine (*Sardinops sagax*) stock is distributed inshore of the 200 m isobath, from the Lüderitz upwelling cell into southern Angola. There was a rapid decline in the sardine stock in the late 1960s, following intense exploitation, ecosystem change and variability, and poor recruitment (Crawford, Shannon, & Pollock, 1987; Boyer D., Boyer, Fossen, & Kreiner, 2001; Erasmus V. N., 2021). The stock status remains overexploited with a low biomass estimate and a significantly contracted distribution pattern compared to historical levels. It is reported that the stock has reduced by 99.5%, from an estimated 11 million tonnes in the 1960s to 50 000 tonnes in 2015 (Erasmus, et al., 2021). The fishery is currently closed following a moratorium that was implemented in 2018.

Following the collapse of the sardine (also referred to as pilchards in Namibia) stock, two main spawning areas have been described in the northern Benguela, one off central Namibia in the Walvis Bay region (22°S and 25°S) and another further north near Palgrave Point (19°S and 21°S) (King, 1977). The spawning season is thought to be between August and April, with peaks in September/October and March. Spawning peaks 30-80 km offshore with larvae occurring slightly further offshore and recruits appearing close inshore (Hutchings, et al., 2002). Recruitment varies considerably between years, with environmental variability and conditions playing an important role (Kirchner, Bartholomae, & Kreiner, 2009). During late summer the warm Angolan Current pushes southwards, which brings eggs and larvae into nursery grounds off central Namibia (Hutchings, et al., 2002).

Cape Horse Mackerel

In Namibia, Cape horse mackerel (*Trachurus capensis*) occur predominantly north of 25°S, with juveniles present in the inshore pelagic regions up to the 200 m isobath and adult horse mackerel extending into waters up to 500 m deep. Concentrations are dense between Cape Cross and the Kunene River. Biomass estimates in this region are mostly low in summer, increasing in winter and early spring. Horse mackerel shoal in large numbers with a distinct diurnal vertical migration pattern, staying near the seabed during the day and rising in the water column to feed on zooplankton at night.

Spawning occurs between Cape Frio (18°S) and Cape Cross (22°S), with the highest spawning intensity taking place 50-100 km from the shore (O'Toole, 1977). In these areas, horse mackerel spawn continuously from September to May, peaking from January and April (Klingelhoeffer, 1994).

Large Pelagics

Albacore tuna (*Thunnus alalunga*), yellowfin tuna (*T. albacares*), bigeye tuna (*T. obesus*), pelagic sharks and swordfish (*Xiphias gladius*) are large pelagic species with an extensive offshore distribution ranging along the entire South African and Namibian coastlines and broadly throughout the Atlantic Ocean. Albacore tunas are targeted by the pole and line (also referred to as bait-boat) fishery while bigeye tuna and yellowfin tuna dominate the landings of the longline fishery. The abundance of these species has a strong seasonal signal resulting in increased availability to the fisheries targeting them at different periods.

For the tuna-pole fishery, availability increases from early summer and peaks late summer to early autumn.

- Albacore tuna is a temperate species that prefers subtropical ocean waters between 16°C and 20°C but appears to be differentially distributed depending on their life-history stage. Spawning occurs in equatorial regions where water temperatures



exceed 24 °C (Manning, 1998). In Namibian waters aggregations of albacore tuna are known to occur in the vicinity of the Tripp Seamount (approximately 75 km south-west of the licence block) and the highest catches are recorded in this area.

For the pelagic longline sector targeting bigeye tuna, yellowfin tuna, and swordfish, the availability of these target species is highest from April to September. The longline tuna fishing season peaks two to three months later than the fishery for albacore tuna.

- Bigeye tuna spawn across the east central Atlantic, North of 5°N in the warmest season when surface temperatures are above 24 °C, and in the Gulf of Guinea (Manning, 1998).
- Yellowfin tunas are distributed between 10°S and 40°S in the south Atlantic, and spawn in the central Atlantic off Brazil in the austral summer (Penney, Krohn, & Wilke, 1992). According to Crawford, et al., (1987), juvenile and immature yellowfin tuna occur throughout the year in the Benguela system. After reaching sexual maturity they migrate (in summer) from feeding grounds off the West Coast of southern Africa to the spawning grounds in the central Atlantic.
- The availability of longfin tuna increases during the summer upwelling season due to the increased biological activity and prey (sardine and anchovy) abundance.
- Swordfish spawn in warm tropical and subtropical waters and migrate to colder temperate waters during summer and autumn months.

It is important to note that weather conditions play an important role in operations within the tuna fisheries (tuna pole and longline). The high market price for tuna makes up for their relatively low catches off southern Namibia and the West Coast of South Africa (Manning, 1998).

Hake

Shallow-water hake (*Merluccius capensis*) and deep-water hake (*M. paradoxus*) are among the dominant demersal fish species in the Benguela Current ecosystem and form the most commercially important fisheries in Namibia.

These species display diurnal vertical migration, occurring in demersal waters in the daytime and moving to mid-water at night to feed. Each species shows different spawning patterns in terms of depth and timing, with food availability and environmental conditions thought to be important drivers for spawning. Hake are serial spawners, spawning throughout the year with peaks observed in October/November and March/April (Jansen, et al., 2015; Japp, et al., 2019). Compared to pelagic species, the eggs and larvae of hake are found deeper in the water column, making them less vulnerable to offshore Ekman transport (Sundby, et al., 2001; Hutchings, et al., 2002). Spawning on the edge: spawning grounds and nursery areas around the southern African coastline., 2002).

Both species occur on the West Coast of South Africa and Namibia, however deep-water hake is more abundant south of the Lüderitz upwelling cell in the southern Benguela. Shallow-water hake mainly occur between depths of 100 m and 450 m while deep-water hake occur between depths of 300 m and 1 000 m.

Shallow-water hake spawn primarily over the continental shelf in South Africa and Namibian waters at depths less than 200 m. In Namibia, areas of localized spawning appear to be focused off central Namibia (25°S to 20°S), however the exact location varies between years. Spawning peaks during July to September along the shelf break off central Namibia (Jansen, et al., 2015)

It is hypothesised that deep-water hake spawn largely between the western Agulhas Bank and Elands Bay on the West Coast with the main nursery ground between Hondeklip Bay and the northern tip of the Orange Banks. Fish then migrate northwards into Namibia as they



mature before returning south to spawn. Deep-water hake spawn at depths between 200 m and 650 m, and eggs are typically distributed between 340 m to 1 500 m (Stenevik, Verheye, Lipinski, Ostrowski, & Stromme, 2008). In contrast to shallow-water hake, several studies suggest that deep-water hake do not spawn in Namibian waters (Kainge, Kjesbu, Thorsen, & Salvanes, 2007; Stenevik, Verheye, Lipinski, Ostrowski, & Stromme, 2008; Strømme, Lipinski, & Kainge, 2015).

Monkfish

Monkfish (*Lophius vomerinus*) are found along the entire extent of the Namibian coast, with the fishery concentrated between 17°S and 29°S on the deeper continental shelf and upper slope between depths of 200 m to 500 m. Cape monkfish spawn throughout the year with a peak between July and September (Erasmus V. ..., 2021). Cape monkfish appear to spawn along almost the entire coastline, possibly overlapping with the nearshore transshipment area, with evidence of hotspot spawning aggregations between 21°S and 25°S (Erasmus V. ..., 2021).

Deep-sea Red Crab

Deep-sea red crab stocks are distributed predominantly from 23°S northwards into Angolan waters, within a depth range of approximately 300 m to 1000 m. Highest densities occur along the northern range of its distribution, the Angolan border, to 18°S. Spawning takes place throughout the year (Le Roux, 1997) in the shallower waters of the continental slope with adult females generally occurring at shallower depths to that of males.

Orange Roughy

Orange roughy has a discontinuous pattern of distribution along the continental slope. Aggregations of fish occur within four known spawning grounds (within designated Quota Management Areas) within Namibian waters. The species has a short, intense spawning period of about a month from July to August (Boyer & Hampton, 2001) during which individuals aggregate. As a result of overexploitation of the stock(s), the fishery (which only existed for four years) has been closed since 2007; however, the stock is currently being assessed and the viability of re-opening the fishery is under consideration.

Namibian Cape Rock Lobster

Namibian Cape Rock lobster (*Jasus lalandii*) is found from 25°S to 28°S at depths shallower than 100 m. The depth distribution of adults varies seasonally in response to changes in dissolved oxygen levels in the water. Adults moult during spring (males) and late autumn/early winter (females), with egg hatching peaking in October/November. Fishing activity is greatest over January and February with the number of active vessels declining towards the end of the fishing season in May.

5.7.5.2 Commercial Fishing Sectors

The large pelagic longline sector is the only Namibian commercial fishing sector which overlaps with the Venus offshore project area within PEL0056/Block 2913B.

Nearshore transshipment operations may, however, overlap with the linefish and Small-Scale Fisheries (SSF) sectors, as well as small pelagic purse-seine fisheries, should this sector reopen. The nearshore transshipment area also partially overlaps with a designated mariculture area, although this area is currently not in use.

These sectors, as well as other important fisheries are described below.



Large Pelagic Longline

The Namibian pelagic longline sector primarily targets yellowfin tuna, bigeye tuna, swordfish and various pelagic shark species (

Table 5-21).

There is provision for up to 26 fishing rights and 40 vessels. The fishery's target species are highly migratory, with populations spanning the EEZs of multiple countries and international waters. Consequently, they are managed as a "shared resource" among several nations through Regional Fisheries Management Organisations (RFMOs). Namibia is a member of, and therefore receives quotas from, the International Commission for the Conservation of Atlantic Tuna (ICCAT).

Catches of tuna species and shark species show interannual variation as shown in Figure 5-62 (ICCAT, Statistical Bulletin Vol 48., 2024). Following independence, catches increased as Namibia systematically increased their fishing capacity. There was a peak in catches in 2005 (9 594 tonnes), however, annual average catch has approximated 4 200 tonnes since. The reported catches for 2020 (8 555 tonnes) and 2021 (13 216 tonnes) were far higher than this average, with tuna spp. contributing the most to the annual catch in 2021.

Table 5-21: Key target species of the large pelagic longline fishery.

Target and bycatch species	Reference image
Bigeye tuna (<i>Thunnus obesus</i>)	
Albacore tuna (<i>Thunnus alalunga</i>)	
Yellowfin tuna (<i>Thunnus albacares</i>)	
Swordfish (<i>Xiphias gladius</i>)	
Southern bluefin tuna (<i>Thunnus maccoyii</i>)	
Shortfin mako shark (<i>Isurus oxyrinchus</i>)	
Blue shark (<i>Prionace glauca</i>)	

Source: WWF-SASSI



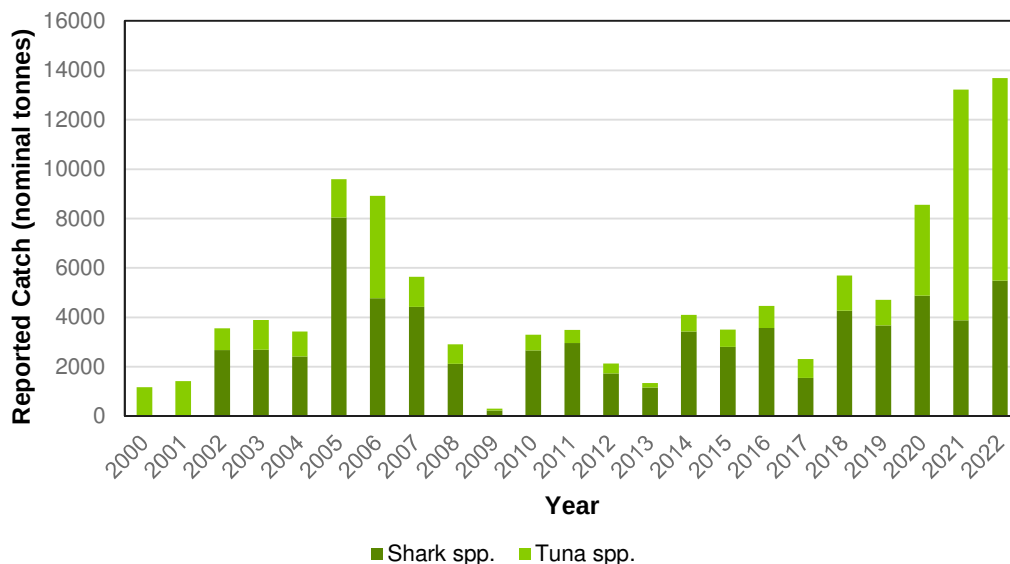


Figure 5-61: Annual longline catch (nominal tonnes) of large pelagic species between 2000 and 2022.

Source: ICCAT Statistical Bulletin (2024)

Longline vessels operate extensively around the entire coast along the shelf-break (approximately along the 500 m isobath) and into deeper waters (~2 000 m) where tuna, swordfish and sharks are targeted along thermoclines. **Effort occurs year-round with peaks from March to May and December to a lesser degree** (see Figure 5-62). This seasonality is also seen in catch data.

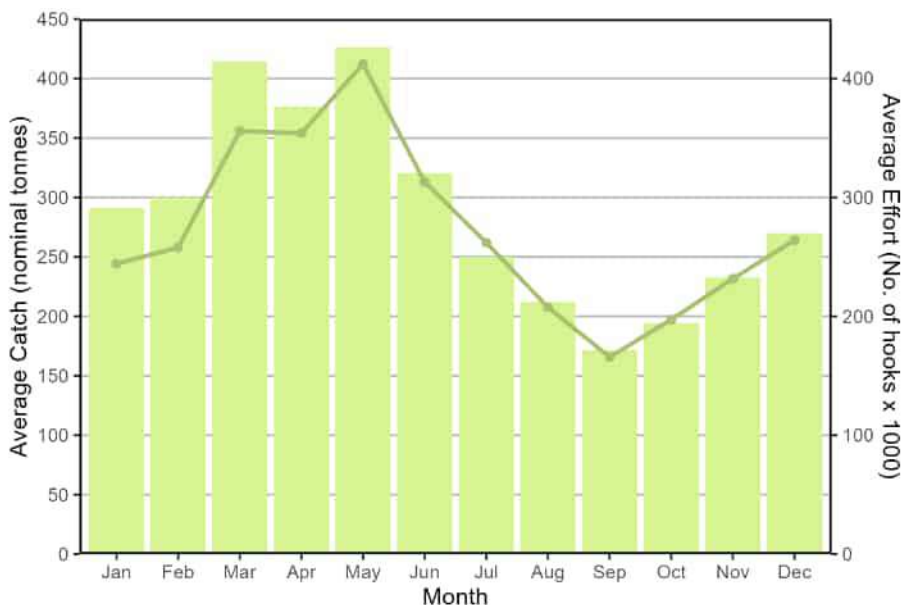


Figure 5-62: Monthly average catch (bars) and effort (line) recorded by the large pelagic longline sector within Namibian waters (2004 – 2023).

Source: Data provided by MAFWLR 2023.



Figure 5-63 shows the spatial distribution of annual average effort along the Namibian and South African West Coast over the period 2013 to 2023. **During this time large pelagic longline fishing effort was recorded within PEL0056/Block 2913B and the proposed Venus offshore project area. On average less than 5 000 hooks were set within Venus offshore project area and PEL0056/Block 2913B per year (see Table 5-22), which is low in comparison to the number of hooks set along the continental shelf break and to the north of the PEL0056/Block 2913B.**

There is no overlap with nearshore transshipment operations as the fishing sector primarily operates in waters deeper than 200 m.

Table 5-22: Annual average large pelagic longline catch (tonnes) and effort (hooks) within PEL0056/Block 2913B and the offshore Marine Restricted Area⁷¹ reported as a percentage of the national totals.

Large Pelagic Longline	Annual average catch (% of National Total)	Annual average effort (% of National Total)
Within PEL0056/Block 2913B	2 357.62 t (0.22%)	5 135.9 hooks (0.25%)
Within Maritime Restricted Area	1.17 t (0.05%)	1 481.0 hooks (0.07%)

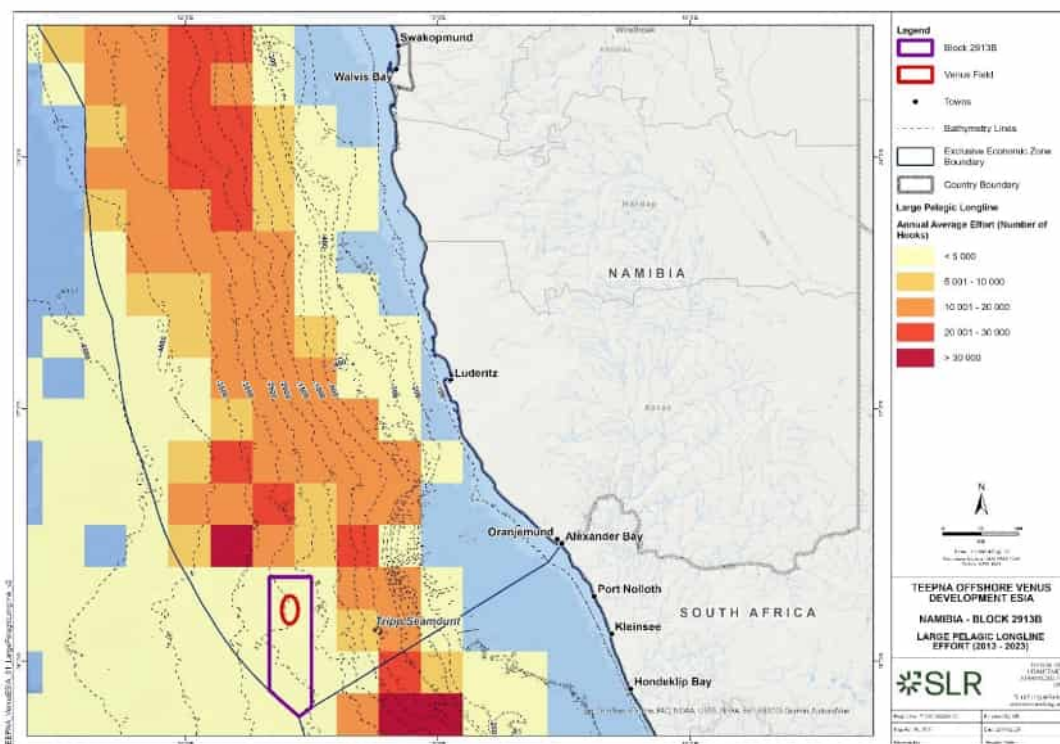


Figure 5-63: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort recorded by the large pelagic longline fisheries offshore Namibia (2013-2023).

Source: Namibian data provided by MAFWLR (2014-2023), South African data provided by DFFE (2013-2022).

⁷¹ The Maritime Restricted Area extends 10nm around the FPSO, with an “Entry permit” approved by TEEPNA Marine Operations Manager required to enter the area. See Section 4.1.6 for further detail.



Pelagic longline vessels deploy a drifting mainline that can extend up to 100 km in length. This mainline is maintained near the surface or at a specified depth (up to 20 m) using buoys connected by buoy lines, spaced approximately 500 m apart (see Figure 5-64 and Figure 5-65). Hooks are attached to the mainline via 20 m long trace lines, clipped to the mainline at intervals of about 50 m. Each line can carry up to 3 500 hooks.

Various types of buoys are used in combination to keep the mainline near the surface and to locate it if the line is cut or breaks. Each end of the line is marked by a Dahn buoy and a radar reflector, ensuring its position can be identified for later retrieval by the fishing vessel.

A line may drift for up to 18 hours before being retrieved using a powered hauler at a speed of approximately 1 knot. During hauling, the vessel's manoeuvrability is significantly restricted, and in the event of an emergency, the line may be dropped for later retrieval.

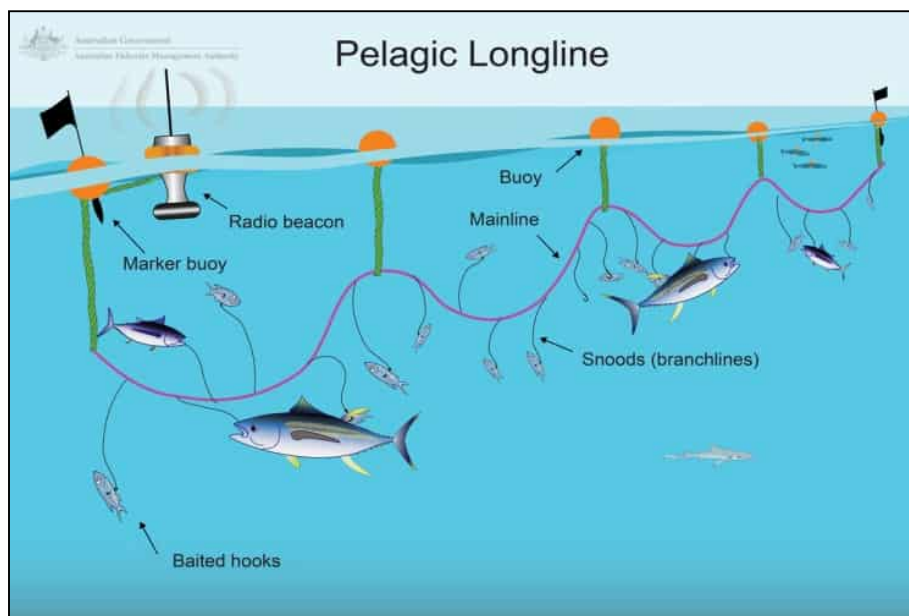


Figure 5-64: Schematic diagram of gear typically used by the pelagic longline fishery

Source: <http://www.afma.gov.au/portfolio-item/longlining>.



Figure 5-65: Photographs showing marker buoys (left), radio buoys (centre) and monofilament branch lines (right).

Source: CapMarine (2015)

Small Pelagic Purse-Seine

The pelagic purse-seine landings comprise Benguela sardine, *S. sagax* (also regionally referred to as pilchard), and small quantities of juvenile horse mackerel (see Table 5-23).



The targeted species are surface-shoaling and once a shoal has been located the vessel encircles it with a large net (see **Figure 5-66**), which has a depth of 60 m to 90 m. Netting walls surround aggregated fish both from the sides and from underneath, thus preventing them from escaping by diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed and hauled in and the fish are pumped on board into the hold of the vessel. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours.

Table 5-23: Key target species of the small pelagic purse-seine fishery.

Target and bycatch species	Reference image
Sardine (<i>Sardinops sagax</i>)	
Horse mackerel (<i>Trachurus capensis</i>)	

Source: WWF-SASSI

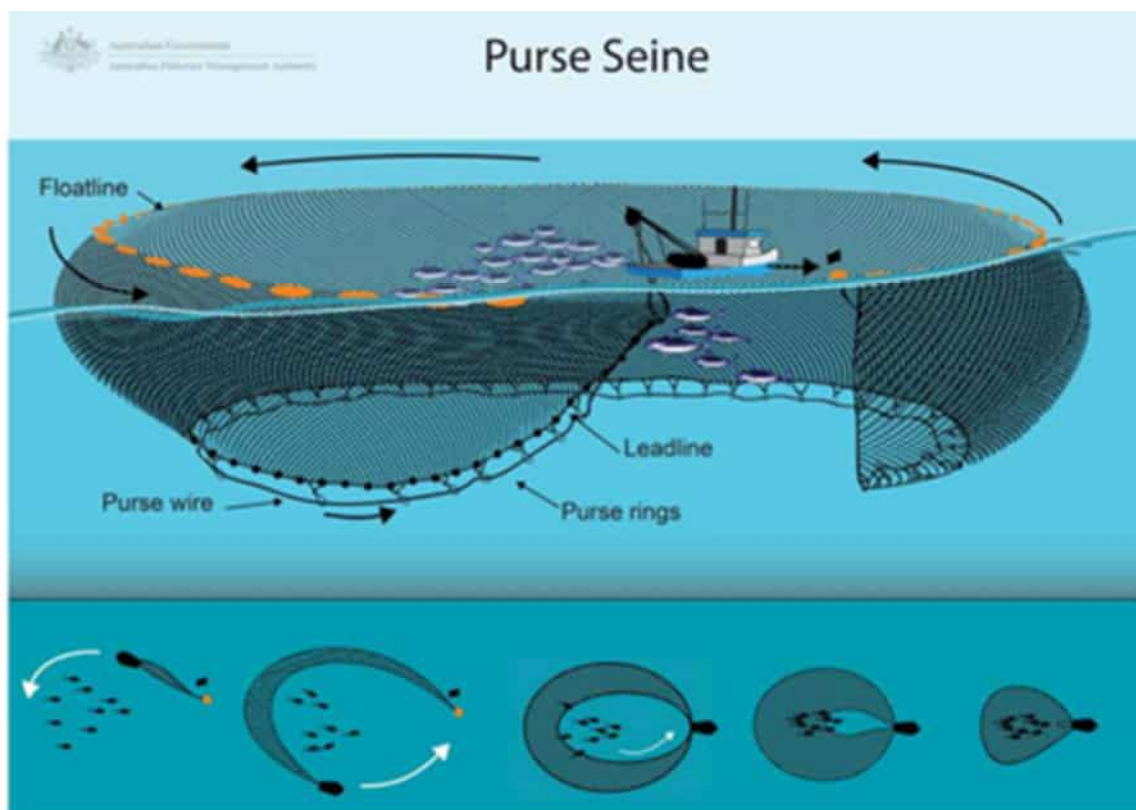


Figure 5-66: Schematic of typical purse-seine gear deployment in the "small" pelagic fishery.

Source: <http://www.afma.gov.au/portfolio-item/purse-seine>



A moratorium was implemented on pilchard fishing on 01 January 2018 due to a significant population reduction. **This fishery remains closed at present.** Prior to the stock collapse, the stock distribution extended throughout the Benguela system, however a contracted distribution is currently apparent. Recent biomass surveys have shown small aggregations of the stock mostly located inshore of the 200 m isobath. Commercial fishing activity occurred primarily inshore of 200 m, northwards of 25°S to the Angolan border with the main commercial fishing grounds situated at least 300 km northward of the licence area.

Although this fishery is currently closed and there is no overlap with historical fishing activity in the Venus offshore project area within PEL0056/Block 2913B, there could be overlap this fishery in the nearshore transshipment area should this fishery reopen (see Figure 5-67).

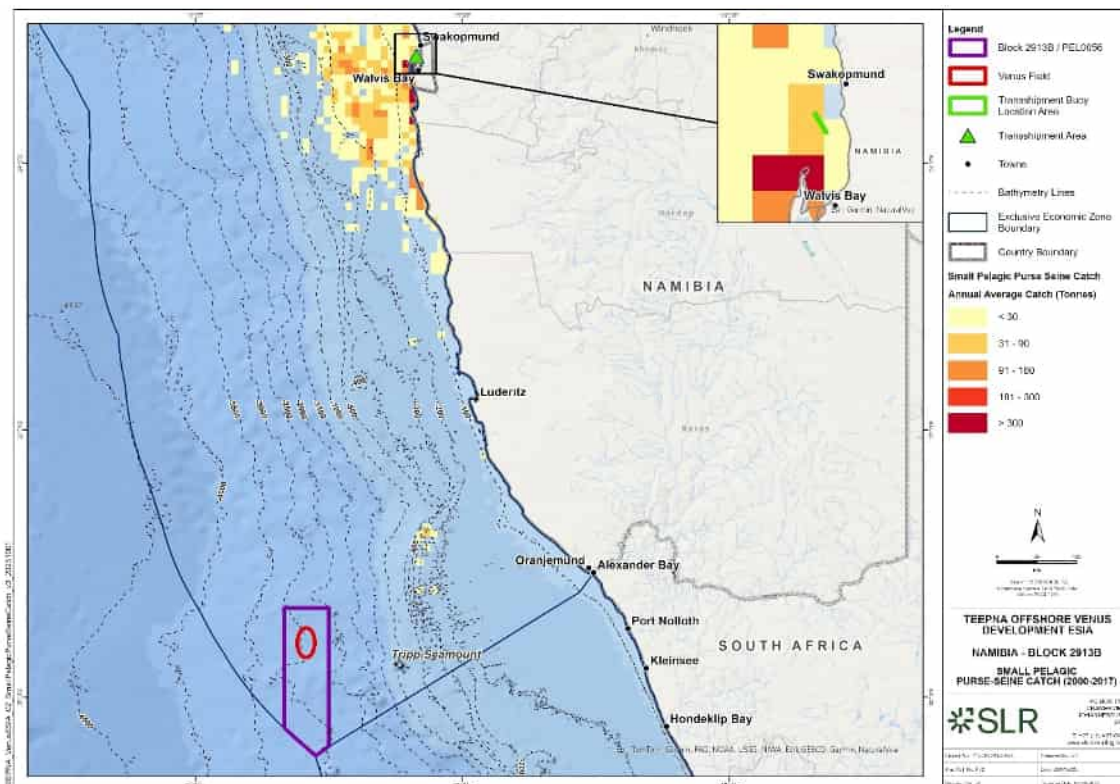


Figure 5-67: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the spatial distribution of the annual average catch recorded by the small pelagic purse-seine fishery in Namibia.

Source: Namibian data provided by MAFWLR (2000-2017).

Mid-water Trawl

The Namibian fishery for Cape horse mackerel (*Trachurus capensis*) is the largest contributor by volume and second highest contributor by value to the industry. The stock is currently caught by the mid-water trawl fishery (targeting adult horse mackerel) but was also previously caught by the small pelagic purse-seine fishery (targeting juvenile horse mackerel) (see Small Pelagic Purse-Seine above). The midwater fishery operates using large trawls within the water column to catch schools of adult horse mackerel.

The fishery operates year-round with relatively constant catch and effort values by month. The mid-water trawl fleet operates exclusively out of the port of Walvis Bay and fishing grounds extend north of 25°S to the border of Angola. Juvenile Cape horse mackerel



move into deeper water when mature and are fished mostly between the 200 m and 500 m isobaths towards the shelf break.

The main commercial fishing grounds are situated approximately 300 km northward of PEL0056/Block 2913B and the Venus offshore project area, however minor catches have been recorded 78 km to the east and 155 km north-east of the PEL0056/Block 2913B (see Figure 5-68). With fishing activities concentrated between the 200 m and 500 m isobaths, there is no overlap with the nearshore transshipment area.

Mid-water trawling gear configuration is similar to that of demersal trawlers, except the net is much larger and fishes only in midwater and above the seafloor. The towed gear may extend up to 1 km behind the vessel and comprises trawl warps, net and codend (see Figure 5-69). Once deployed, the net is towed for several hours at speeds of approximately 5 to 7 knots predominantly parallel with the shelf break.

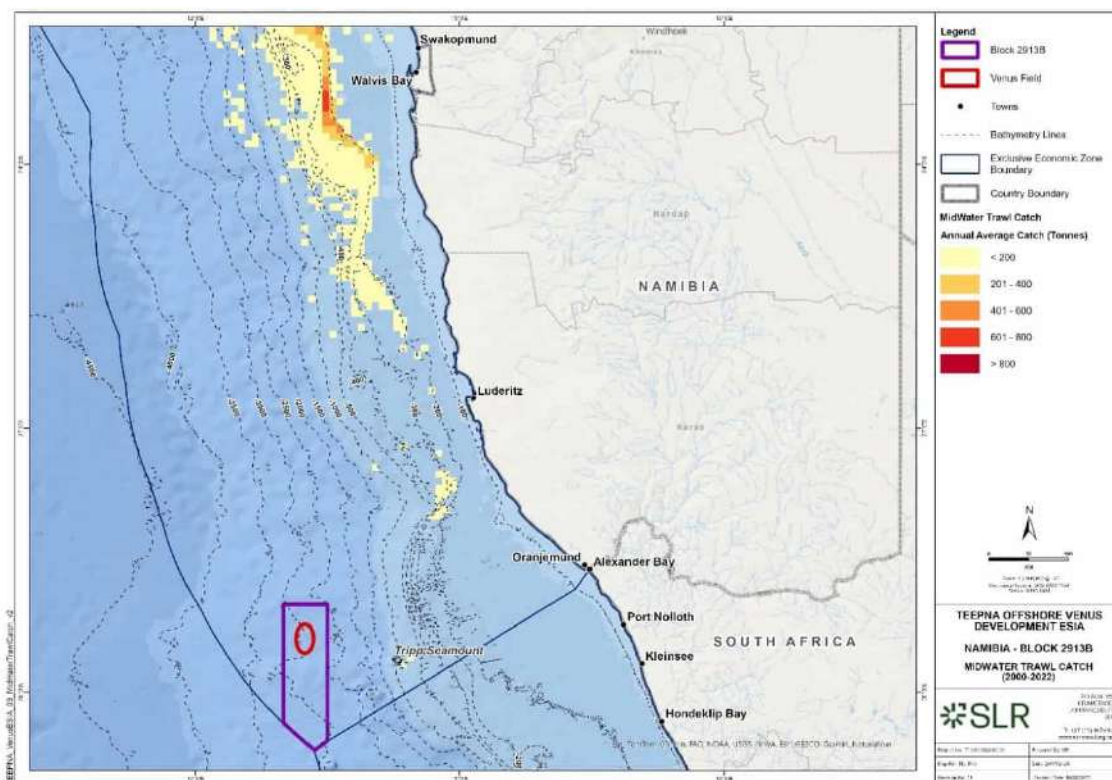


Figure 5-68: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) in relation to the spatial distribution of annual average catch recorded by the mid-water trawl fishery offshore Namibia (2000 – 2022).

Source: Namibian data provided by MAFWLR (2000-2022).



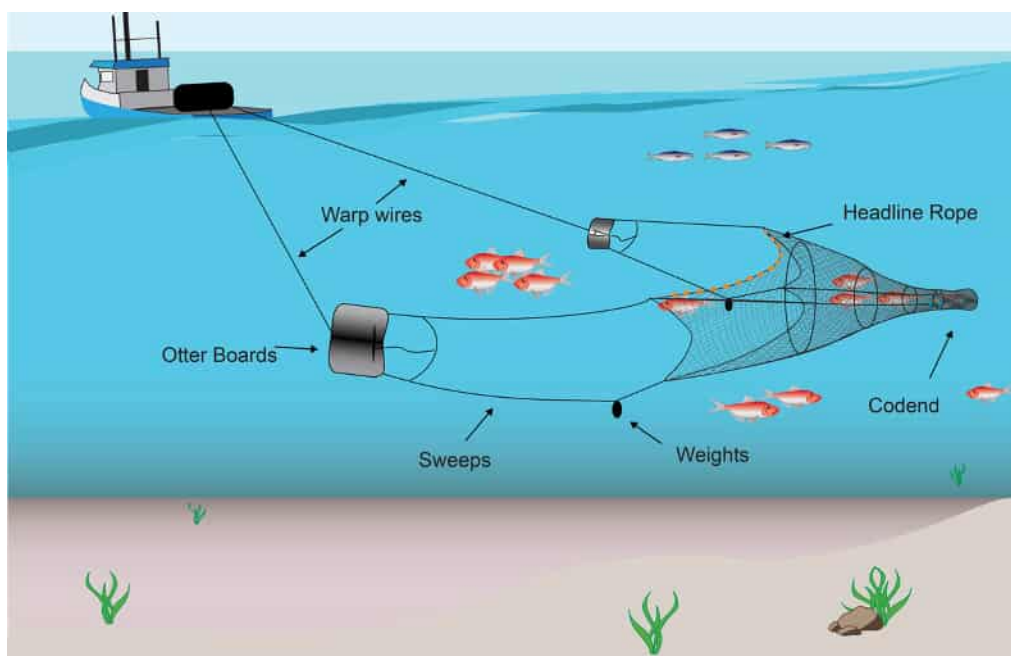


Figure 5-69: Typical configuration of mid-water trawl gear.

Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

Demersal Trawl

The demersal trawl fishery in Namibia mainly targets shallow-water and deep-water hake (Table 5-24) and is managed as a single sector. At the peak of exploitation in the mid-1970s, catches of hake in Namibian waters reached almost 1 million tonnes, although some believe that this figure was underestimated. The directed hake trawl fishery is Namibia's most valuable fishery, with a current annual TAC of 140 000 tonnes (2024/25 season). The fleet of 71 demersal trawlers licensed to operate within the fishery primarily targets hake in waters >300m and as deep as 800 m in places. A smaller group of vessels is licensed to fish for monkfish and sole. These fisheries also have a small bycatch which includes kingklip.

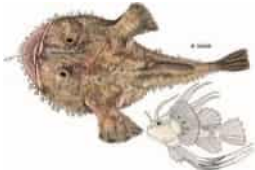
The deep-sea fleet is divided into wetfish and freezer vessels, with a prescribed 70:30 ratio. Freezer vessels process fish offshore, while wetfish vessels land fish at factories ashore for processing. Wetfish vessels are smaller, with an average length of 45 m, and can only remain in an area for about a week before returning to port, whereas freezer vessels can work in an area for up to a month at a time. Most trawlers operate from the port of Walvis Bay, with fewer vessels operating from Lüderitz.

Fishing effort is relatively constant throughout the year except for a closure for the month of October and lower levels of effort expended during November and December. Demersal trawling is prohibited in waters shallower than 200 m throughout Namibian waters with further restrictions south of 25°S⁷².

⁷² Namibia has a designated area closed to most "offshore" fishing activities under 200 m water depth to protect potential spawning areas as well as areas of high juvenile abundance for most demersal species, including hake. Demersal trawling is prohibited in waters shallower than 200 m. South of 25°S wetfish trawlers are only permitted to fish >300 m and freezer trawlers >350 m.



Table 5-24: Key target and bycatch (grey shading) species of the demersal trawl fishery.

Target and bycatch species	Reference image
Deepwater hake (<i>Merluccius paradoxus</i>)	
Shallow water hake (<i>Merluccius capensis</i>)	
West Coast sole (<i>Austroglossus microlepis</i>)	
Monkfish (<i>Lophius vomerinus</i>)	
Kingklip (<i>Genypterus capensis</i>)	

Source: WWF-SASSI

Fishing grounds extend along the entire coastline following the distribution of hake and monkfish along the continental shelf at a depth range of 200 m to approximately 850 m.

Figure 5-70 shows the spatial distribution of average effort in the vicinity of PEL0056/Block 2913B over the period 2010-2021, with **no catch and/or effort data reported by the Namibian demersal trawl fishery was recorded within the Venus offshore project area, or PEL0056/Block 2913B. There is no overlap of nearshore transshipment operations as no trawling may occur shallower than 200 m.**

Otter trawling is the primary method used in the Namibian demersal trawl fishery. This technique involves the use of trawl doors, or otter boards, which are dragged along the seafloor ahead of the net to maintain the horizontal net opening (see Figure 5-71). The trawling gear configuration is similar for both offshore and inshore vessels.



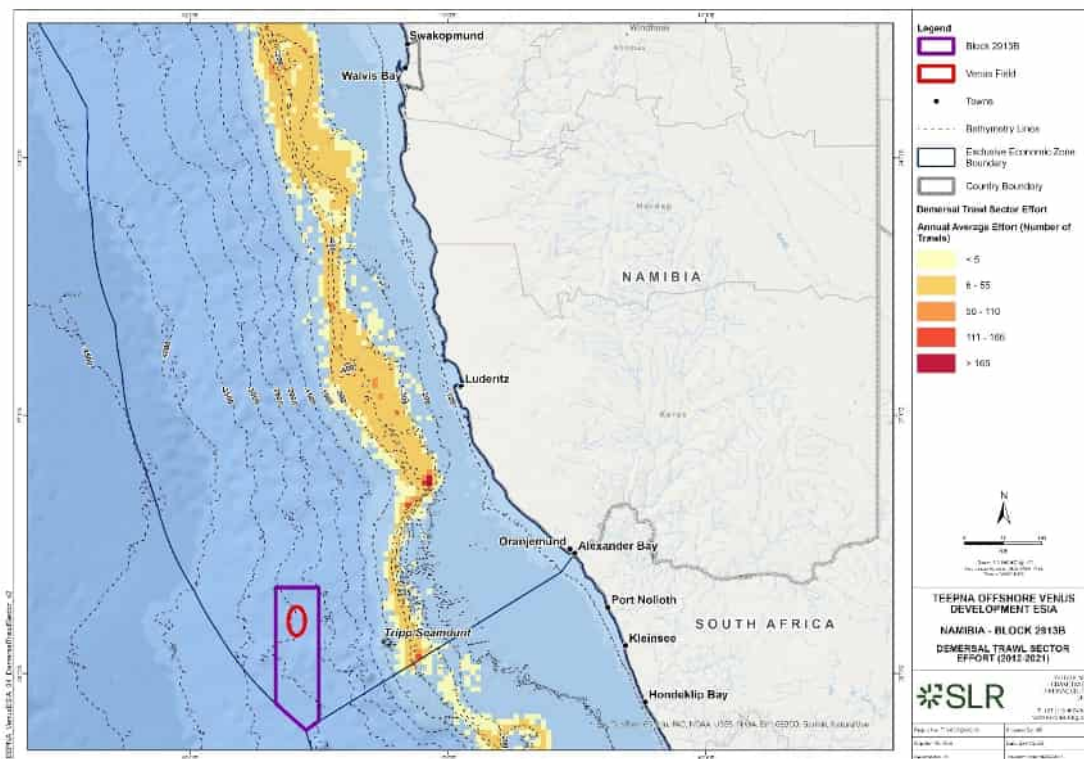


Figure 5-70: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort (no. of trawls) recorded by the demersal trawl fishery offshore Namibia (2012 -2021).

Source: Namibian data provided by MAFWLR (2012-2021), South African data provided by DFFE (2012-2021).

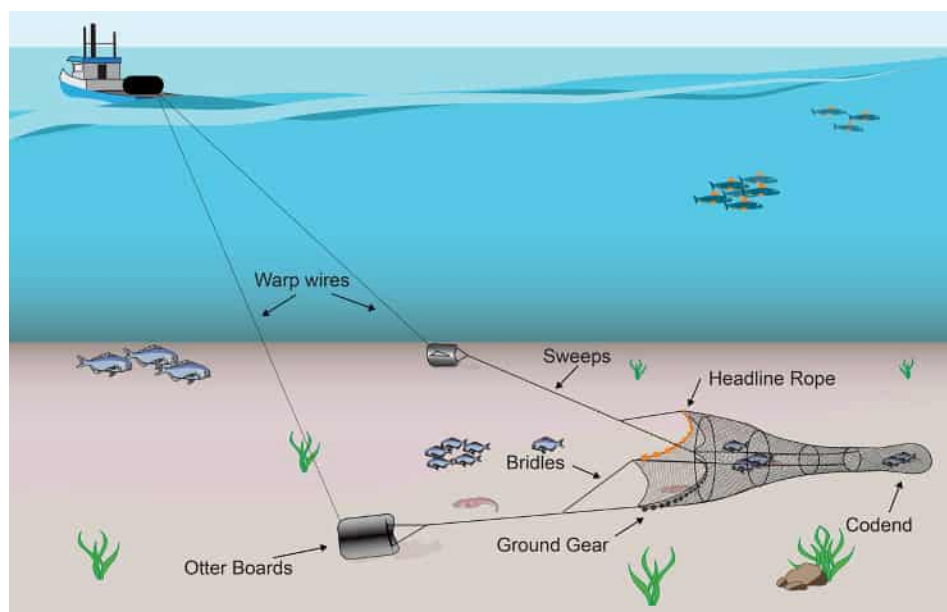


Figure 5-71: Trawl gear typically used by demersal trawlers targeting hake.

Source: <http://www.afma.gov.au/portfolio-item/trawling>



Demersal Longline

The demersal longline fishery targets bottom dwelling species, primarily Cape hakes (shallow-water and deep-water hakes), with kingklip caught as bycatch (Table 5-24). Longline vessels fish in similar areas as the hake-directed trawling fleet, in a broad area extending along the full length of the Namibian coastline at depths between 200 m to 650 m. Some 18 vessels operate within the sector. Those based in Lüderitz mostly work South of 26°S towards the South Africa border while those based in Walvis Bay operate mainly between 23°S and 26°S and north of 23°S. The fishery effort is highest offshore of Walvis Bay.

Figure 5-72 shows the spatial distribution of average effort in the vicinity of the Venus offshore project area within PEL0056/Block 2913B and nearshore transshipment area (Walvis Bay) over the period 2012-2023. **During this time (2010-2023), no catch and/or effort was recorded by the Namibian demersal longline fishery within the Venus development project area or the larger PEL0056/Block 2913B. Similar to the demersal trawl fishery, effort is concentrated along the shelf edge (200 m – 650 m) with no overlap with nearshore transshipment area.**

Lines are typically 10 to 20 km long, carrying 6 900 to 15 600 baited hooks at regular intervals (1 to 1.5 m) (see Figure 5-73). Gear is set at night at speeds of five to nine knots and left to soak for up to eight hours before retrieval. A line hauler is used to retrieve gear at approximately one knot, taking six to ten hours to complete.

Pole-line

The tuna pole fishery predominantly targets juvenile and sub-adult Albacore tuna, also known as southern Atlantic longfin tuna. Other species caught include yellowfin tuna, bigeye tuna and skipjack tuna. Historically, South African pole and line vessels were allowed to operate in Namibian waters under arrangements with Namibian right holders each year. However, recently the activity has been restricted only to Namibian-registered vessels.

The fishery is seasonal with vessel activity mostly between December and May and with peak catches in March and April. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. As such the fishery is dependent on window periods of favourable conditions relating to catch availability (see Table 5-25). Commercial landings of large pelagic species are variable and Namibian catches reported by the pole sector (also referred to as “baitboat”) are shown in Figure 5-74.

Namibia's allocation of the global TAC for longfin (albacore) tuna and swordfish is allocated by the International Commission for Conservation of Atlantic Tunas (ICCAT), of which Namibia is a member (4 320 t of albacore in 2024/25). The Tuna-Pole fishery catches albacore using long poles that have lines with hooks attached to them. Bait is thrown directly into the sea to create a feeding frenzy. The poles are manually lowered into the water and raised to retrieve the catch.



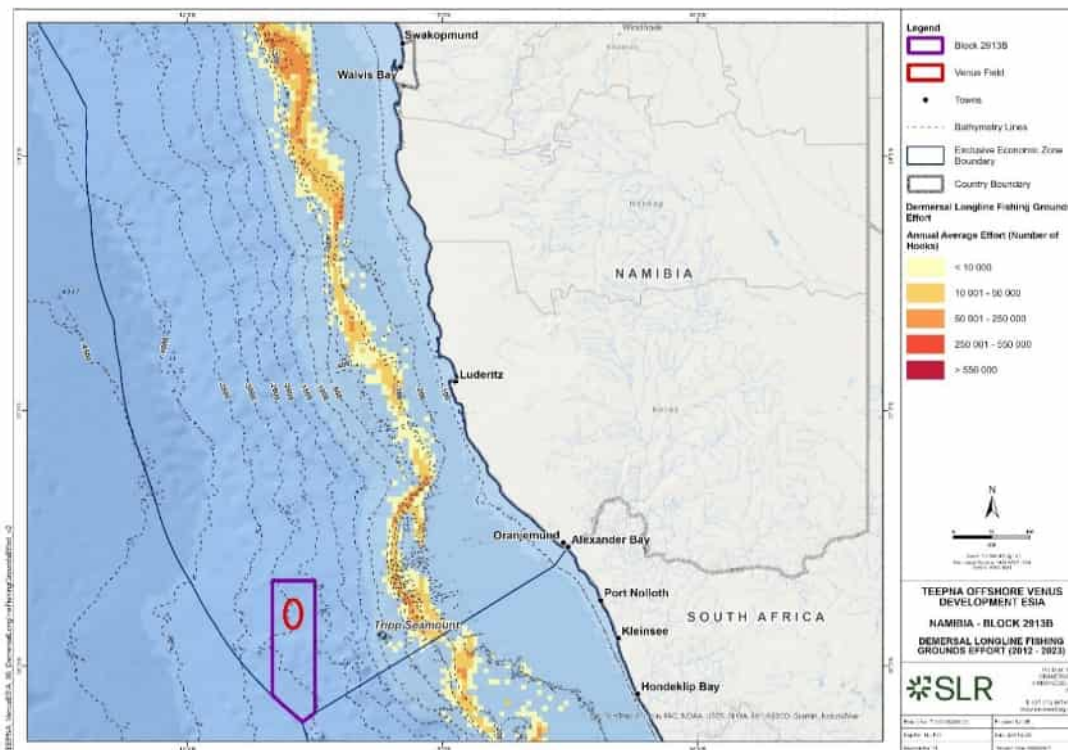


Figure 5-72: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of annual average effort recorded by the demersal longline fishery offshore Namibia (2014-2023).

Source: Namibian data provided by MAFWLR (2014-2023), South African data provided by DFFE (2018-2020).

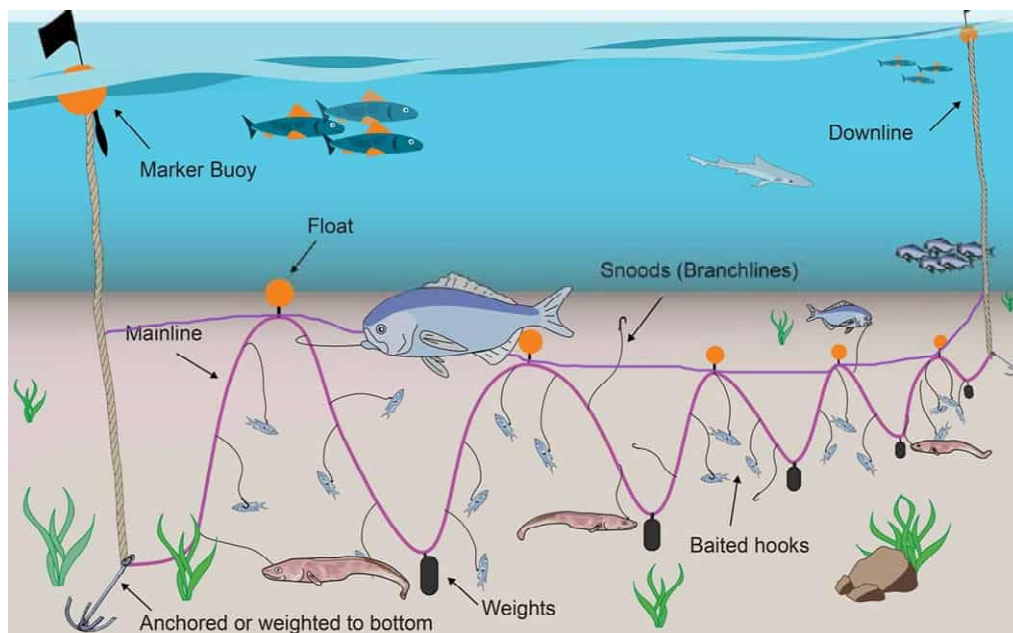


Figure 5-73: Typical configuration of demersal (bottom-set) hake longline gear.

Source: adapted from <http://www.afma.gov.au/portfolio-item/longlining>



Table 5-25: Key target and bycatch (grey shading) species of the tuna pole fishery.

Target and bycatch species	Reference image
Albacore tuna (<i>Thunnus alalunga</i>)	
Bigeye tuna (<i>Thunnus obesus</i>)	
Yellowfin tuna (<i>Thunnus albacares</i>)	
Skipjack tuna (<i>Katsuwonus pelamis</i>)	

Source: WWF-SASSI

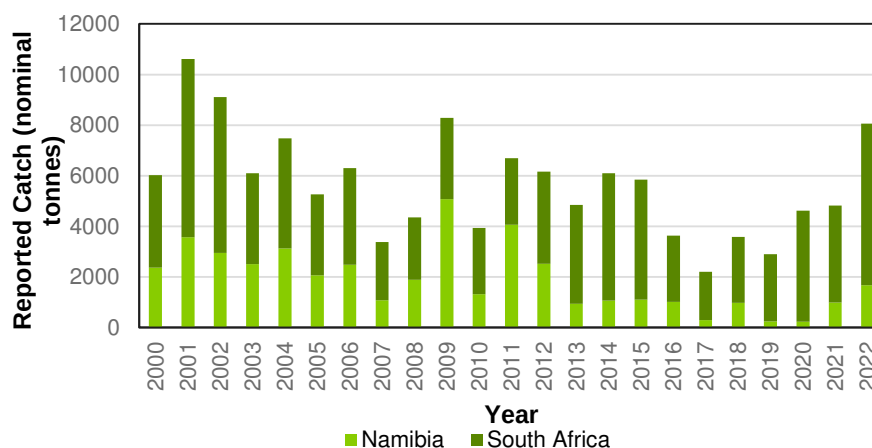


Figure 5-74: Total nominal pole-line catch (tonnes) within Namibian waters reported to ICCAT from 2000 to 2022 (Namibian (light green) and South African (dark green) flagged vessels).

Source: ICCAT Statistical Bulletin (2024).

Aggregations of albacore tuna occur in specific areas, in particular Tripp Seamount which is situated just north of the South Africa/ Namibia maritime border. Catches in this area are variable from year to year, although boats will frequent the area knowing that albacore aggregate around the seamount after migrating through South African waters. The movement of albacore between South Africa and Namibia is not clear although it is believed that the fish move northwards following bathymetric features and generally stay beyond the 200 m depth contour.

Figure 5-75 shows the spatial distribution of average catch in the vicinity of PEL0056/Block 2913B over the period 2013-2022. **There is no spatial overlap of fishing activity with the Venus offshore project area or PEL0056/Block 2913B.** The highest catch is over Tripp



seamount, 85 km east of PEL0056/Block 2913B. There is no overlap with the nearshore transshipment area in the vicinity of Walvis Bay, with fisheries effort concentrated along the shelf edge, in water depths of 200 m or deeper. The extended area of influence in the case of any unplanned events (e.g. well blow-out) may, however, overlap with this sector.

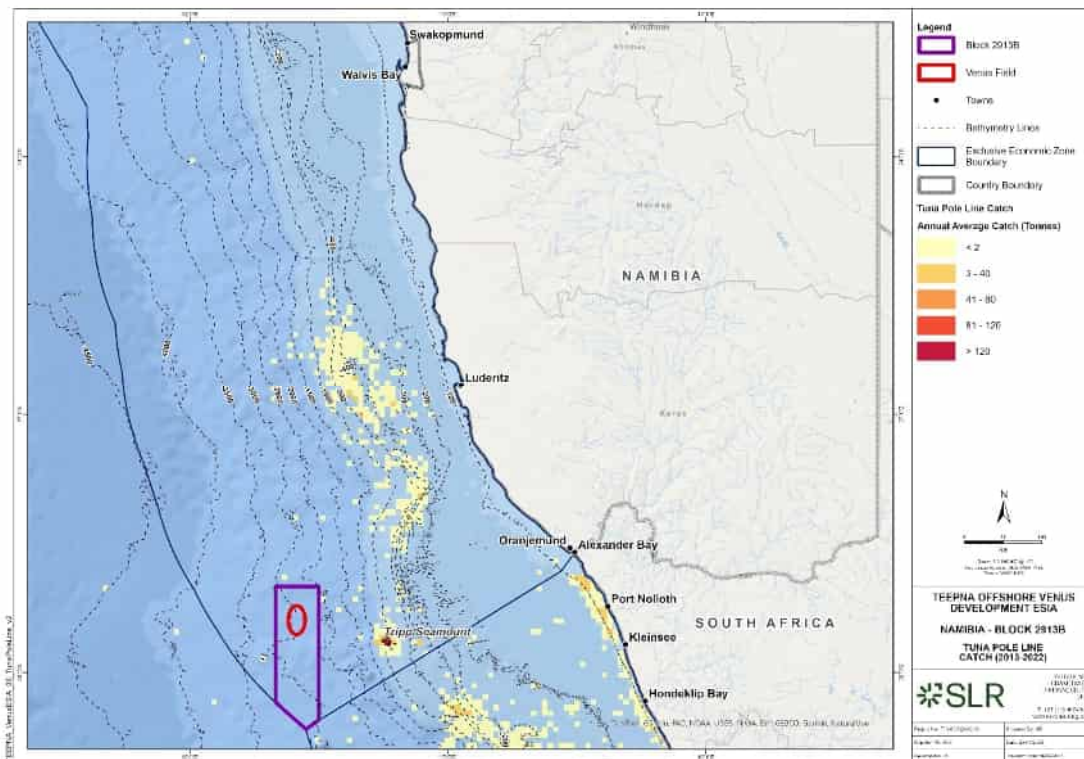


Figure 5-75: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to the spatial distribution of the annual average catch recorded by the pole-line fishery offshore Namibia (2013-2022).

Source: Namibian data provided from MAFWLR (2013-2022), South African data provided from DFFE (2013-2022).

While vessels are at sea, most of the time is spent searching for schools of tuna using sonars echo-sounders and troll lines, with actual fishing events occurring over relatively short periods. Pole fishing gear consists of a bamboo pole with nylon leader attached that ends in a hook (and sometimes artificial bait) (see Figure 5-76). Rod and reel gear is used to target yellowfin tuna.

During pole fishing, bait is thrown into the water to attract albacore tuna. In some cases, bigger boats may carry live bait. In addition, high-pressure nozzles spray water overboard around the vessel which help create a feeding frenzy and keeps the school around the vessel. The crew work in pairs to efficiently bring caught tuna on board using the poles and shorter hooked sticks, known as 'gafts'. Rod and reel methods are akin to those employed by recreational anglers; a chum line is created and up to 8 baited lines are cast.



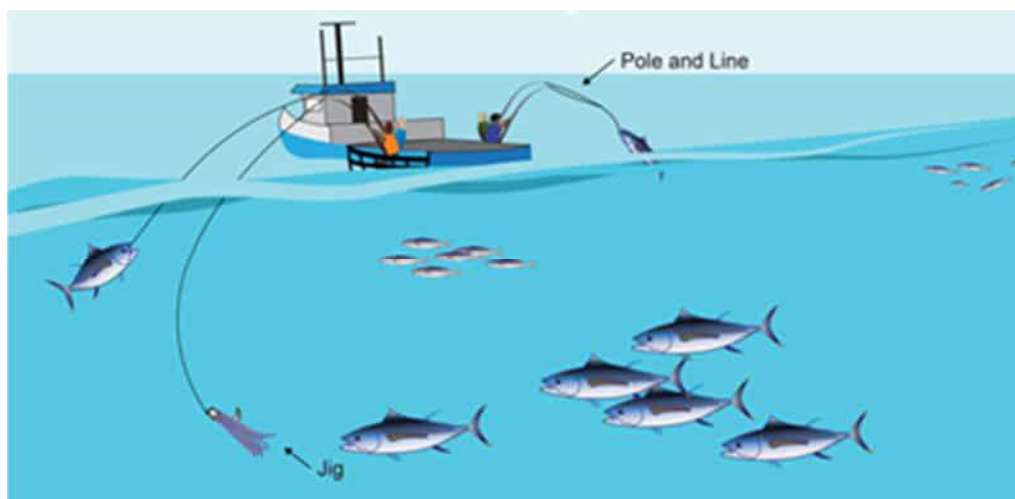


Figure 5-76: Typical tuna pole and line operations.

Source: <http://www.afma.gov.au/portfolio-item/minor-lines>

Linefish

The traditional line fishery primarily targets snoek with bycatch of yellowtail, silver kob, dusky kob, and sharks, which are sold on the local market. **Snoek availability to the fishery is seasonal. Catches peak in late summer where after the fish migrate south into South African waters. The other species caught, such as kob and shark occurs year-round, but in relatively small amounts.**

Operationally the fishery is limited in extent to Walvis Bay, Swakopmund and Henties Bay, and due to the small size of vessels, does not operate much further than 12 NM offshore (i.e., 22 km). There is also a small component of the fishery operating out of Lüderitz in the South.

The sector operates inshore of the 200 m depth contour with incidental reports of fishing in deeper waters. There is no spatial overlap of fishing activity with the Venus offshore project area within PEL0056/Block 2913B. The closest fishing activity takes place from Lüderitz, at least 300 km north-east of PEL0056/Block 2913B and off Oranjemund at least 300 km east of the block, however there are incidental catch records 20 km inshore of the Licence Block (see Figure 5-77).

The nearshore transshipment operations, as well as vessel transit overlap with the linefish fishing sectors' activities (see Figure 5-77). Although no linefish catches have been recorded within the nearshore transshipment area itself (based on historical catch data, provided as point data), **between 2007 and 2020, 0.09% of the annual average catch reported by the Namibian linefish fishery was recorded within the Walvis Bay area, encompassing inshore waters from Pelican Point to Swakopmund (see Table 5-26).** The extended area of influence in the case of any unplanned events in the nearshore transshipment area (e.g. crude oil / marine diesel spill) also overlaps with this sector.

Table 5-26: Annual average linefish catch (tonnes) and effort (hooks) reported within the nearshore transshipment area reported as a percentage of the national totals.

Pole-line	Within Walvis Bay	Proportion of National Total
Annual average catch (tonnes)	1.13	0.09%
Annual average effort (no. of lines)	29.57	0.16%



Table 5-27: Key target and bycatch species of the linefish fishery.

Target and bycatch species	Reference image
Snoek (<i>Thysites atun</i>)	
Yellowtail (<i>Seriola lalandi</i>)	
Silver kob (<i>Argyrosomus inodorus</i>)	
Dusky kob (<i>Argyrosomus coronus</i>)	

Source: WWF-SASSI

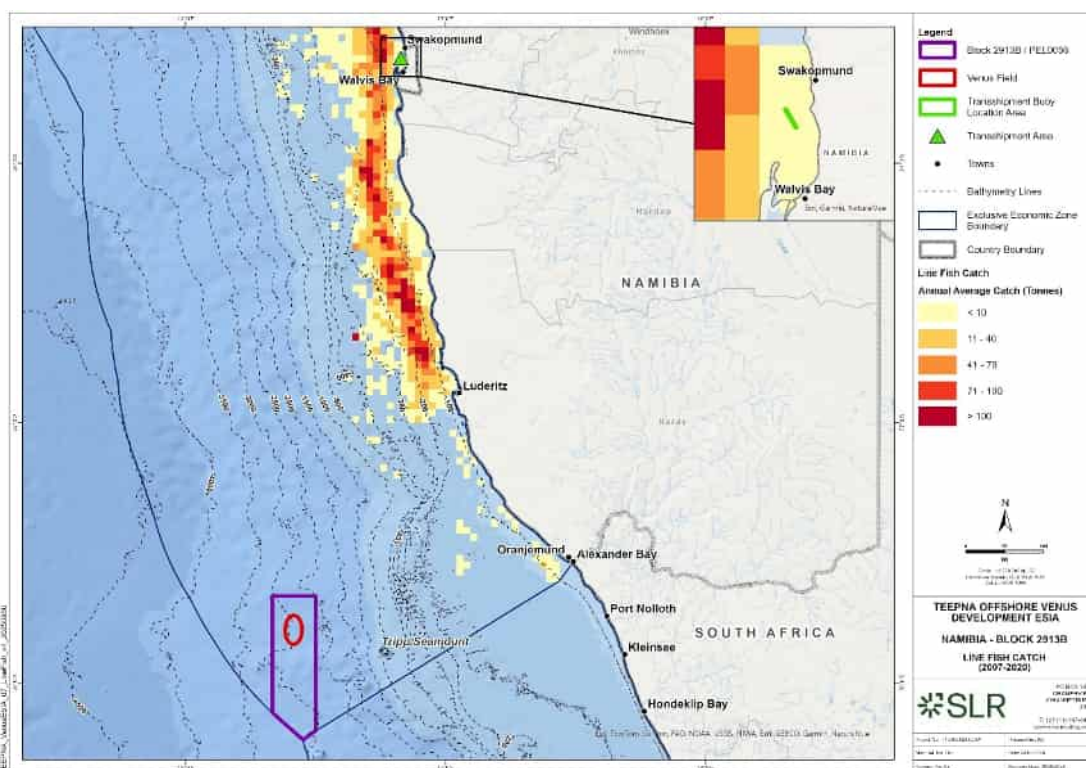


Figure 5-77: Venus offshore project area (red circle) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to the spatial distribution of the annual average catch recorded by the linefish fishery offshore Namibia (2007-2020).

Source: Namibian data provided by MAFWLR (2007-2020).

Deep-Water Trawl

The deep-water trawl fishery is a small but lucrative fishing sector directed at the outer Namibian shelf from 400 m to 1 500 m water depth targeting orange roughy (*Hoplostethus atlanticus*) and alfonso (Beryx splendens). Both species are extremely long-lived and form



dense aggregations, leading to high catch rates. General aggregations of the stock occur between June and August. Fishable aggregations are usually found on hard grounds on features such as seamounts, drop-off features or canyons (Branch, 2001). Off Namibia, orange roughy has a restricted spawning period of less than a month in late July, when spawning takes place in dense aggregations close to the bottom in small areas typically between 10 and 100 km² in extent (Boyer & Hampton, 2001).

The fishery is split into four Quota Management Areas (QMAs) referred to as “Hotspot”, “Rix”, “Frankies” and “Johnies” and TACs are set for each specific QMA (see Figure 5-78). **The Venus offshore project area within PEL0056/Block 2913B and the nearshore transshipment location in the vicinity of Walvis Bay do not overlap with any of these QMAs.**

In 2009, a three-year moratorium on orange roughy was enforced in Namibia and the deep-water fishery has not yet been re-opened.

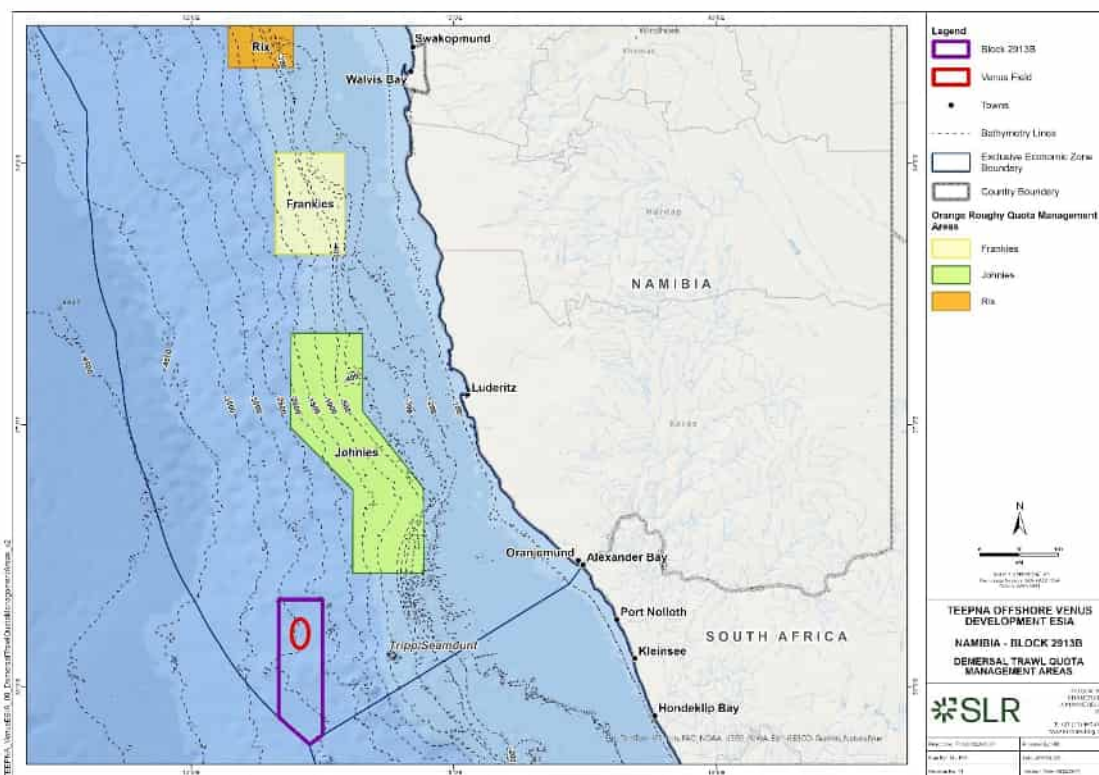


Figure 5-78: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (near Walvis Bay) in relation to deep-water trawl areas.

Source: CapMarine

Rock Lobster

The small but valuable fishery of rock lobster (*Jasus lalandii*) is based exclusively in the port of Lüderitz. The catch season is a six-month period with a closed period extending from 1 May to 31 October and highest activity levels are experienced over January and February. A total of 18 vessels participated in the 2021-22 rock lobster fishing season.

The sector operates in water depths of between 10 and 80 m. Within Namibian waters, the lobster stock is commercially exploited between the Orange River border in the south to Easter Cliffs/Sylvia Hill north of Mercury Island (approximately 25°S). The fishery is spatially



managed through the demarcation of catch grounds by management area. **The fishing grounds do not spatially overlap with the Venus offshore project area within PEL0056/Block 2913B or the nearshore transshipment area.**

Deep-Sea Crab

The Namibian deep-sea crab fishery is based on two species of crab namely spider crab (*Lithodes ferox*) and red crab (*Chaceon maritae*).

The distribution of red crab extends from ~5°S to just South of Walvis Bay and the commercial fishery operates in grounds extending northwards of 23°S and into Angolan waters. There is a minimum operational depth of 400 m set for the fishery, which sets traps at depths of up to 1 200 m. The fishery is small, with only two vessels currently operating from the port of Walvis Bay. Vessels are active year-round but with relatively low fishing effort from November to February.

Fishing grounds are located over 700 km to the north of PEL0056/Block 2913B and there is therefore no spatial overlap. Overlap with transshipment and vessel transit operations is deemed highly unlikely, with fishing activities taking place north of Walvis Bay in waters deeper than 400 m (see Figure 5-79). The extended area of influence in the case of any unplanned events (e.g. well blow-out or spill) also does not overlap with this sector.

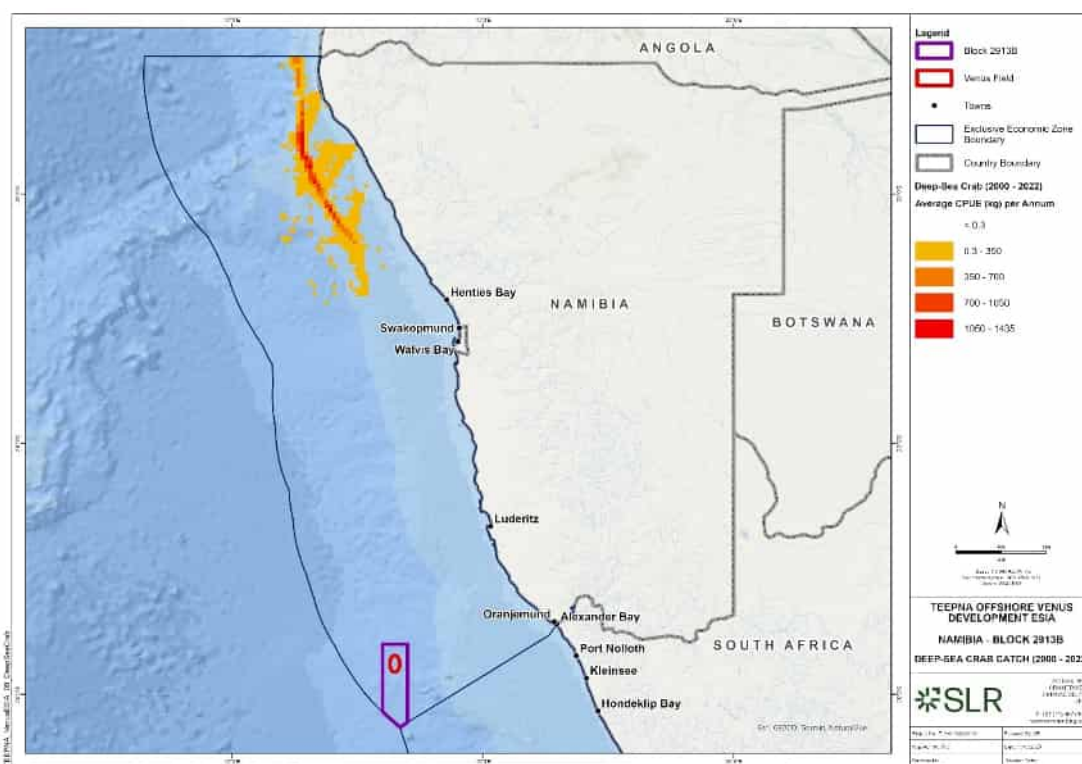


Figure 5-79: Venus offshore project area (red ellipse) within PEL0056/Block 2913B and Walvis Bay in relation to the spatial distribution of annual average catch recorded by the deep-sea crab fishery offshore Namibia (2000-2022).

Note: Average annual CPUE (kg/pot) over the period 2000 to 2022 is displayed on a 5 x 5 minute grid.



5.7.5.3 Small-Scale Fisheries

Historically, the SSF were not formally recognized by law in Namibia. The Inland Fisheries Resources Act, 2003 recognized “subsistence fisheries” as those activities where fishers regularly catch fish using traditional gear for personal and household consumption, occasionally selling or bartering excess catch locally. “Recreational fisheries” were defined as those conducted primarily for sport, with a secondary objective of catching fish for domestic consumption, but not for sale.

Recent fisheries surveys indicate that inland and coastal fishing communities dependent on fisheries display characteristics of SSF. Recognizing this, the Namibian government, in collaboration with the Food and Agriculture Organization (FAO), developed the National Plan of Action for Small-Scale Fishers (NPOA-SSF) for 2022 to 2026. This plan aims to formally recognize the SSF sector and its stakeholders while addressing the challenges faced by this sector. Namibia’s SSF sector is defined as *“small-scale fishers who are women, men, and sometimes children, using various fishing methods (e.g., small fishing vessels) on a daily or regular basis. They catch fish as a source of income, for their own consumption or livelihoods for most of the year, and sell or barter surplus within weight or number limits (note: the MAFWLR (previously the MFMR) is in the process of determining catch and limit sizes for formalization at the policy and regulatory levels)”* (MFMR; FAO, 2022).

Namibia’s SSF sector consists of two sub-sectors: inland SSF and coastal (or marine) SSF. Due to the lack of recognition and management legislation, there is no spatial-temporal data on catches by SSF communities. **Coastal SSF is largely limited to the areas offshore of Walvis Bay, Henties Bay, Swakopmund, and Lüderitz, with restricted fishing zones in the Namib-Naukluft National Park, the Sperrgebiet National Park, and the NIMPA.** Namibian SSF, often referred to as artisanal fisheries, primarily operate nearshore, within 20 nautical miles, utilizing traditional fishing methods to harvest a variety of marine species. These methods include ski-boats, nets, and hook and line, with vessel sizes being less than 25 tons. Various marine resources are harvested, including shellfish collected in Walvis Bay, Swakopmund, and Lüderitz; line fish caught through line fisheries operating out of Henties Bay and Lüderitz (including snoek, kabeljou, galjoen, and elf or shad); and mullet and rock lobster fisheries in Lüderitz (MFMR; FAO, 2022).

The sector is composed of a diverse group of actors, including men, women and occasionally children, who engage in fishing and related value chain activities such as processing, marketing, and trading. While men predominantly participate in harvesting, women play a significant role in post-harvest processing and sales, particularly in shellfish collection and seaweed harvesting along intertidal zones. **An estimated 280 000 Namibians (including both inland and coastal waters) are believed to be supported by the SSF sectors, with an estimated 9 500 livelihoods supported directly through coastal (marine) SSF activities, and an estimated value of N\$ 27.6 million** (MFMR & FAO, 2022). Estimates of the production / yield are still to be determined for coastal fisheries, owing to their recent official recognition.

Local organisations like the Hanganeni Artisanal Fishing Association (HAFA), Benguela Ski Boat Fishing Association (BSBFA), and the Namibian Women’s Fisheries Network (NAMFISHNET) represent fisher communities and advocate for their interests.

Coastal SSF off Walvis Bay focus predominantly on the collection of shellfish and harvesting of seaweed. Collection and harvesting of shellfish and seaweed typically takes place along intertidal zones and from the shore or shallow waters, respectively. Predominantly completed by women, these activities are often subsistence based but may also contribute to the local markets and household income (MFMR; FAO, 2022).

The Venus offshore project area does not overlap with these nearshore and coastal fisheries, however, overlap between nearshore transshipment operations and nearshore fishing activities off Walvis Bay and interactions may occur.



5.7.5.4 Mariculture Development

Namibia's mariculture industry is developing, focusing on species such as oysters (*Crassostrea gigas* and *Ostrea edulis*), black mussels (*Choromytilus meridionalis*) and Mediterranean mussel (*Mytilus galloprovincialis*), abalone (*Haliotis midae*), and seaweed (*Gracilaria gracilis*) as well as non-native giant kelp (*Macrocystis pyrifera*).

However, recent developments indicate a gradual shift towards diversification, with increasing interest in cultivating finfish and seaweeds. This trend is expected to enhance the sector's long-term growth potential and resilience. Due to environmental conditions along much of the Namibian coastline, marine aquaculture is largely limited to land-based systems such as ponds and tanks. These systems require significant investment, which typically restricts production to high-value species aimed at export markets. Nonetheless, a few naturally sheltered bays along the coast offer opportunities for expanding marine aquaculture operations in more cost-effective and scalable ways.

The industry employs various methods, including rafts, suspended long-lines, racks in ponds, and onshore flow-through tanks. Key mariculture operations are concentrated around, Lüderitz, Walvis Bay, Swakopmund, and more recently Oranjemund.

In Oranjemund, abandoned diamond mine pits are repurposed for culturing Pacific oysters, while Lüderitz hosts mariculture plots allocated by Namport, focusing on oysters and experimental farming of mussels and rock lobsters. In addition, Kelp Blue Trading Pty Ltd. has completed research into the cultivation of giant kelp within Lüderitz, with a commercial-scale project at two sites (Shearwater Bay and Boot Bay) proposed near Lüderitz (NAMISUN, 2023). Furthermore, three offshore sites have been proposed for the production of Atlantic Salmon, northwest of Lüderitz (Maartens, 2023).

Walvis Bay is a key hub for Namibia's mariculture industry, primarily producing Pacific oysters (*Crassostrea gigas*) and, to a lesser extent, European flat oysters (*Ostrea edulis*). Cultivation typically takes place in the sheltered waters behind Pelican Point (**13 km from the nearshore transshipment location**), where several companies operate using long-line systems with suspended baskets in deeper areas and platforms in shallower zones. In addition, **two offshore areas have been zoned for mariculture purposes**, one to the north of the nearshore transshipment area and a second further inshore (**~3.9 km**) (KPM Environmental Consulting, 2023).

A dedicated Aqua Park has been proposed for this area, covering approximately 1 200 ha under Namport's jurisdiction. Located within the boundaries of the proposed Walvis Bay Nature Reserve, the site has been zoned for aquaculture and is expected to support between 10 and 20 oyster farms (Skov et al., 2008). Additionally, marine aquaculture facilities have been proposed between Walvis Bay and Swakopmund, targeting the cultivation of shrimp, finfish, and abalone (KPM Environmental Consulting, 2023).

Beyond open-water systems, oyster farming also occurs in the feed-water ponds of the Walvis Bay salt works. In Swakopmund, onshore holding ponds are used for growing both Pacific and European flat oysters. The existing infrastructure and natural protection offered by the bays make these coastal towns central to the development and expansion of Namibia's mariculture sector (SLR, 2020; Mutra & Kibria, 2017).

As outlined in Vision 2030 and the Third National Development Plan, the Namibian government has been actively promoting the development of aquaculture and mariculture. In addition, Namibia's 6th National Development Plan (NDP6) notes that the aquaculture sector is underdeveloped and has great potential for growth and contribution to Namibia's developmental goals; thus, one of the focus areas includes the promotion and upscaling of aquaculture to increase production, enhance food security, generate employment, and support economic development through the development of aquaculture infrastructure to improve hatcheries, feed supply, and establishment of subsidies and financial support schemes. However, despite global expansion, mariculture in Namibia remains relatively



limited, with a declining trend in annual productivity observed from 2008 to 2019 (Erasmus, Hamutenya, Numwa, & Petrus, 2023).

The Venus offshore project area does not overlap with any of these inshore mariculture activities. However, nearshore transshipment area may overlap or come in close proximity to mariculture activities or designated mariculture zones (not currently in use) (see Figure 5-80).

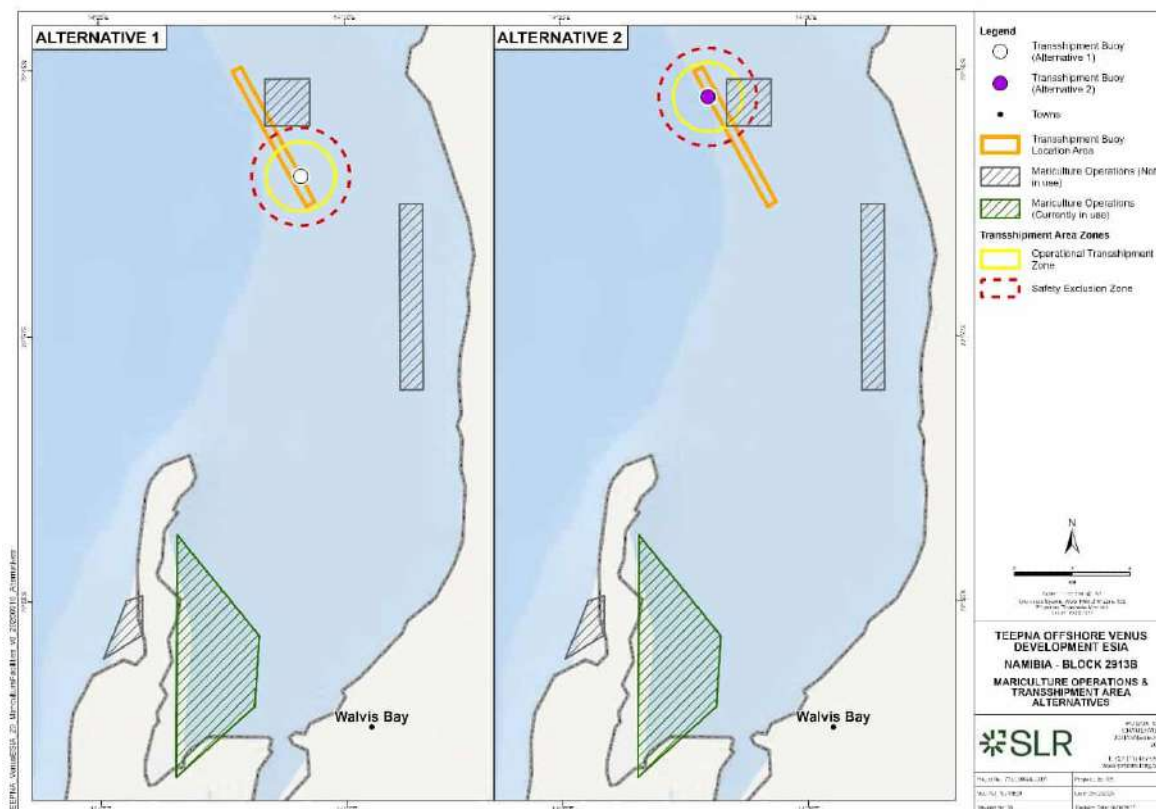


Figure 5-80: The nearshore transshipment area in relation to mariculture development areas.

5.7.5.5 Fisheries Research

MAFWLR conducts regular research (biomass) surveys for demersal, mid-water and small pelagic species. These surveys typically follow fixed transects, are spaced 20-25 NM apart, and are designed to statistically optimize the number of stations. In some years the Benguela Current Commission may conduct “transboundary” surveys.

Swept-area biomass surveys for hake are conducted annually to obtain an index of abundance, determine the geographical distribution and collect biological information of the stock. These surveys are normally carried out over the period of one month during January and February and cover the entire continental shelf from the Angolan to the South African maritime border. The method of abundance estimation from these surveys is based on depth stratification and trawls range in depth from 100 m to 600 m; **thus, overlap is not expected with the Venus offshore project area within PEL0056/Block 2913B. There is no overlap with nearshore transshipment operations which is located in waters less than 40 m deep**

Scientific acoustic surveys are carried out between February and March each year to estimate the biomass of small pelagic species (using the survey vessel F/V Welwitchia). The vessel surveys along pre-determined transects that run perpendicular to depth contours



(east-west / west-east direction). These surveys cover the Namibian shelf from the coastline to the 500 m depth contour (and up to the 2 000 m contour northwards of 18°30'S), **thus, overlap with Venus offshore project area in unlikely, yet may occur with nearshore transshipment operations.**

5.7.6 Other Human Uses

5.7.6.1 Marine Traffic and Transport

There are various international shipping routes along the Namibian coastline. The majority of the international shipping traffic is located on the outer edge of the continental shelf. Traffic inshore of the continental shelf largely comprises fishing and mining vessels, especially off the coast of Oranjemund.

The two main ports in Namibia are:

- Walvis Bay Port is Namibia's largest commercial port and is a key port for regional and international shipping trade. It offers direct access to principal shipping routes and is a natural gateway for international trade. It has a sheltered deep-water harbour which benefits from a temperate climate. The port handles fuel and vehicle imports, passenger traffic from cruise liners, and offers support and logistics services that range from ship repair and maintenance, various storage facilities, small craft harbour, to fishing operations and mariculture. The port is operated by Namport and receives approximately 3 000 vessel calls each year and handles over 5.3 million tons of cargo. Main exports commodities in 2024 included bulk salt (26%), copper/lead concentrate (17%), charcoal (8%), fish and fish products (5%) as well as bagged salt (5%). Imports included petroleum (37%), fish and fish products (5%), copper/lead concentrate (5%), vehicles (5%) and wheat (4%) (NAMPORT, 2025). Notably, petroleum imports constitute the largest share of commodities landed at the Port of Walvis Bay. Two new liquid bulk jetties, each with a maximum capacity of 90 000 Deadweight Tonnage (DWT) are located at the north port, for offloading of liquid bulk commodities, with more than 1 300 ha of backup land for tank storage of liquids and gases (and associated industries).
- Lüderitz Port is historically Namibia's second largest port, functioning mainly as a fishing port. It has expanded in recent years to ship cargo from the mining (manganese and zinc) industry and to support and service offshore petroleum exploration and diamond mining activities. In 2023/24, the port handled over 375 000 tonnes of dry bulk cargo, and 230 00 tonnes of break bulk during that year with between 1 640 and 2 115 vessel visits each year (NAMPORT, 2025). Main export commodities in 2024 included manganese ore (83%), zinc/zinc concentrate/ore (7%), ice (3%) and ship spares (4%) (NAMPORT, 2025). Imports included petroleum (39%), wet fish (20%) and ship spares (39%).

The Venus offshore project area lies within a medium to high intensity vessel route that passes around southern Africa (see Figure 5-81).

The nearshore transshipment area lies within a high intensity vessel route, being located near the entrance to the Walvis Bay Port. High levels of marine vessel traffic, related to passenger, shipping (import and/or export) and fisheries operations, is expected within the vicinity of the nearshore transshipment area.

Similarly, vessel transit to and from the Venus offshore project area and Walvis Bay and Lüderitz will take place along existing vessel routes operating into and out of the ports as well as offshore southern Africa.



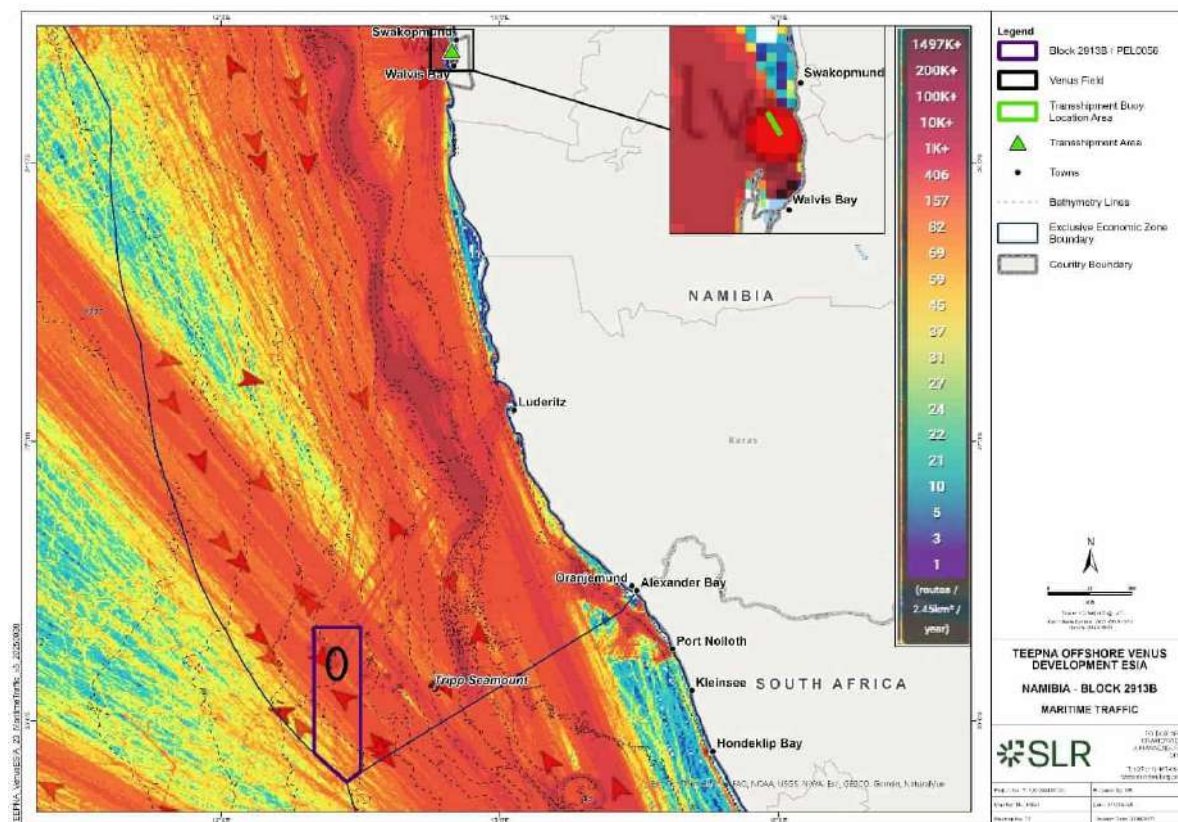


Figure 5-81: Venus offshore project area (black ellipse) within PEL0056/Block 2913B (purple polygon) and nearshore transshipment area (green triangle) in relation to shipping density around southern Africa.

Adapted from: <http://www.marinetraffic.com/> [accessed January 2025].

In addition to port operations and vessel movements, offshore bunkering activities are actively conducted off the coasts of Walvis Bay and Lüderitz, facilitated by several operators including GAC Investments, Namport, Monjasa, and Namibia Elite Supplies, among others. These entities provide Ship-to-Ship (STS) fuel transfer services, supporting both regional and international maritime traffic. NOSF (National Oil Storage Facility) has a dedicated tanker jetty capable of off-loading petroleum products and pipelines to its tank farm, indicating that a significant amount of petroleum imports is already handled via the NOSF jetty.

According to Namport's 2024 Annual Report, disruptions to maritime operations in the Red Sea and Suez Canal led to a significant rerouting of cargo vessels around southern Africa. As a result, Walvis Bay emerged as a preferred refuelling destination, with a marked increase in bunkering activity. Namport has since acknowledged the strategic importance of the port and its adjacent offshore waters as a key node for bunkering and maritime logistics in the region (NAMPORT, 2025). **Consequently, the nearshore transshipment area falls within an area in which offshore bunkering, tanker transfers (at the NOSF jetty) and anchorage take place.**

5.7.6.2 Oil and Gas Exploration and Production

Exploration aims to identify commercially viable reserves of hydrocarbons such as oil and gas. The first step in the search for hydrocarbons is to undertake geophysical surveys. These allow for the evaluation of the structure and composition of subsurface formations. Geophysical surveys include magnetometric, aerial photogrammetric, gravimetric, seismic,



radiographic and stratigraphic surveys, all of which provide a more detailed understanding of the likelihood of the existence of commercially viable hydrocarbons. The certainty which can be achieved through surveys is limited and to prove the existence of commercially viable reserves, exploration and appraisal drilling is necessary (DTI, 2001).

The first Namibian oil and gas exploration wells were drilled in the 1960s, but it wasn't until 1974 that the presence of hydrocarbons was confirmed through the discovery of the Kudu Gas Field on the northern section of the Orange Basin, directly west of Oranjemund. By 1991, fewer than 10 hydrocarbon wells had been drilled in Namibia, with no commercially viable reserves having been discovered (Light & Shimutwiken, 1991). Following unsuccessful attempts to prove commercially viable reserves, interest in Namibian oil and gas waned.

In recent years there has been a resurgence in Namibian hydrocarbon exploration, with the government allocating exploration licences to a number of companies. Improvements in deep-water drilling technology have increased the viability of what were previously considered unviable reserves.

The collection of survey, seismic and aeromagnetic data has contributed to a substantial geological and geophysical database for the country and has revealed the existence of four offshore frontier basins of interest to explorers: the Orange, Lüderitz, Walvis and Namib basins. 2D seismic surveys have been undertaken offshore much of Namibia's coastline (see Figure 5-82), supplemented by more than 20 infill 3D surveys, including various seismic acquisition in the southern Namibian offshore between 2022 and 2024.

Drilling effort has also intensified, with much of the effort focussing on the Orange Basin in which PEL0056/Block 2913B is located. Between 2010 and 2014, 13 wells were drilled in Namibia, bringing the total number of offshore hydrocarbon wells drilled in Namibian waters by 2014 to 32 (Namcor, 2017a). Since 2018, more than 20 additional wells have been drilled in the Walvis and Lüderitz (Orange) basins.

Recent, current and anticipated exploration well drilling activities nearby the Venus offshore project area includes those in Blocks:

- 2813A (Galp - Mopane wells)
- 2813B (Harmattan / Chevron- Kapana well)
- 2814A (BW Energy – Kudu wells)
- 2912 (TEEPNA - Nara and Olympe wells)
- 2913A (Shell - Cullinan, Jonkers, Lesedi and Graff wells)
- 2913B (TEEPNA – Mangetti, Venus, Tamboti and Marula wells)
- 2914B (Shell - La Rona well)
- 2914A (Rhino – Rhino well)

Table 5-28 lists key approvals for petroleum exploration in the Southern Benguela region (South African West Coast and southern Namibia) since 2007 and indicates whether those were undertaken.



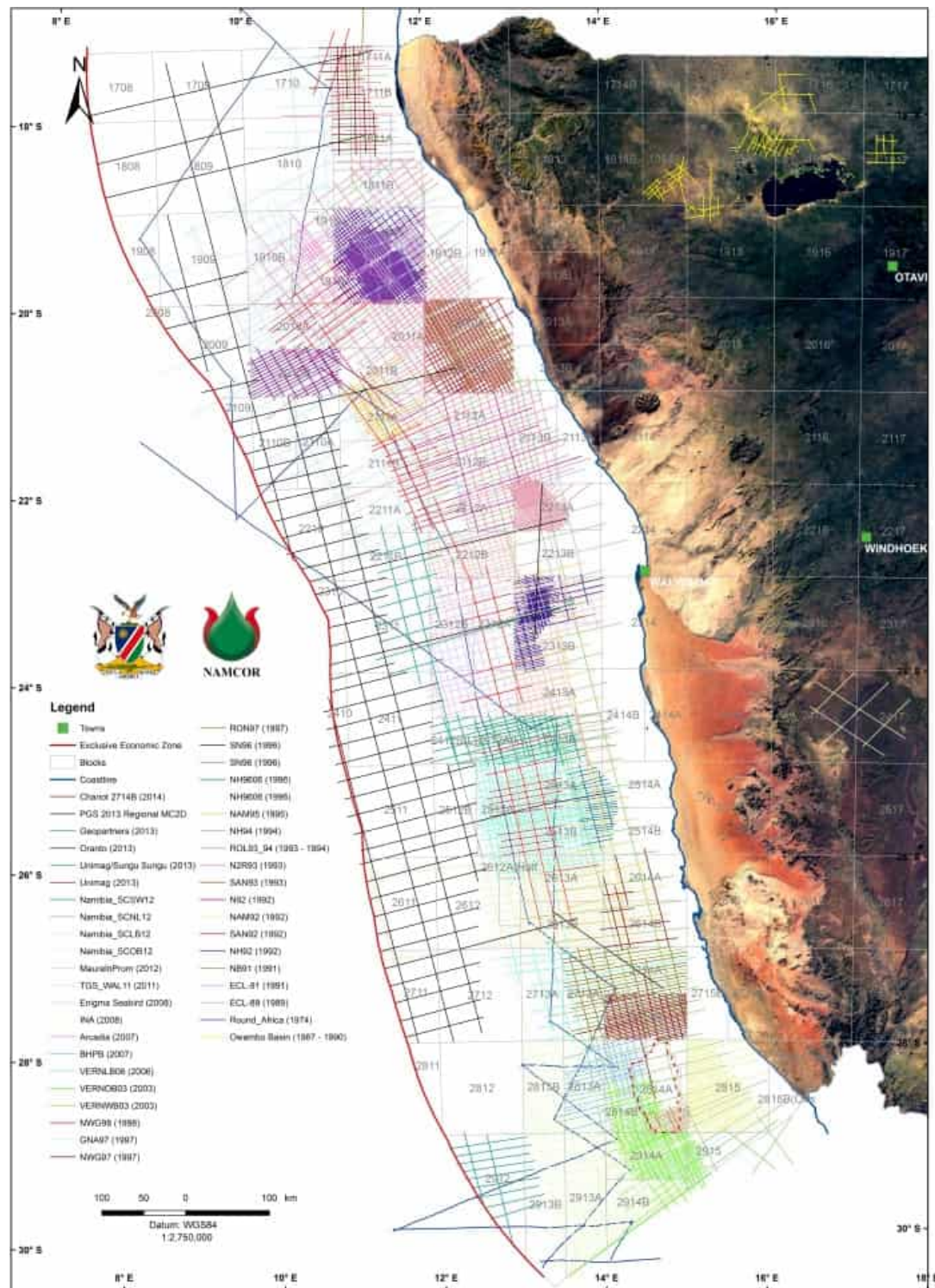


Figure 5-82: 2D seismic surveys undertaken in Namibia's offshore EEZ.

Source: MIME (2024). (Resolution of the source document is limited).



Figure 5-83: PEL0056/Block 2913B (red polygon) in relation to Petroleum Exploration and Production Licence Blocks.

Table 5-28: Overview of key Oil and Gas activities in the Southern Benguela region (southern Namibia) since 2007.

Application Year	Right holder / operator	Block	Activity	Activity completed
Southern Namibia Petroleum Exploration				
2024	BW Energy	Kudu	Exploration drilling	ECC issued: 25/07/2025 – 25/07/2028
2024	Rhino	Block 2914A	Exploration drilling	2025 ongoing
2024	Harmattan/Chevron	Block 2813B	Exploration drilling	2025 ongoing
2023	TEEPNA	Block 2913B	Exploration drilling	2025 ongoing
2023	TEEPNA	Block 2912	Exploration drilling	2023
2023	PGS	Blocks 2713, 2712A&B, 2812A&B, 2813A&B, 2814B, 2714A&B, 2614, 2613, 2612A&B	3D Seismic	2022-2023
2022	Searcher	Blocks 2614, 2613, 2612A&B, 2714A&B, 2713, 2712A&B, 2812B, 2813A, 2814A&B, 2912, 2913B, 2914A&B	2D and 3D Seismic	2023
2020	Tullow Namibia (Harmattan Energy)	Block 2813B (PEL90)	3D Seismic	2023
2020	TEEPNA	Block 2912, 2913B (PEL91; PEL56)	3D Seismic	Periodically since 2022
2020	TGS Namibia	Blocks 2711, 2712A, 2712B, 2713, 2811, 2812A, 2812B, 2913B in the Orange Basin	3D Seismic	Yes



Application Year	Right holder / operator	Block	Activity	Activity completed
2019	Galp Namibia	PEL82	Exploration drilling	No
2019	Galp Namibia	PEL83	Exploration drilling	Yes
2019	TEEPNA	Block 2913B (PEL56)	Exploration drilling	Periodically since 2022
2018	Shell Namibia	PEL39	3D Seismic	Ongoing
2017	Shell Namibia	PEL39	Exploration drilling	Yes
2016	Spectrum	Southern Namibia regional	2D Seismic	2019
2014	Shell Namibia	2913A; 2914B	3D Seismic	2015
2013	Spectrum Namibia	Orange Basin multiclient	2D Seismic	2014
2011	Signet	Block 2914B (now part of PEL39)	2D and 3D Seismic; production facility	Unknown
2011	PGS	Block 2815	3D Seismic	3D: 2011 (HRT)

5.7.6.3 Mineral Prospecting and Mining

Diamond Prospecting and Mining

Marine diamonds are mined along the Southern African West Coast from the Olifants River mouth northwards to Walvis Bay. Diamonds are mined either in:

- Shallow waters (less than 30 m depths) by shore-based divers or small vessel-based divers who employ suction pipes to deliver gravel to land for sorting;
- Midwater (30 - 70 m depth) region, where remote operated tools are used; or
- Deep waters (more than 75 m), where custom mining equipment (undersea crawlers and large rotating drills) and high-pressure airlift suction is used.

Marine diamond mining is currently limited to the southern half of the Namibian offshore. Diamond Mining Licence (ML) Areas are shown in Figure 5-84. Current diamond mining activities are minimal to non-existent, with the only active operations being in ML-47 (Atlantic 1) held by Debmarine Namibia. Deep-water diamond mining operations in the Atlantic 1 Mining Licence Area are typically conducted to depths of 150 m.

The Venus offshore project area lies far offshore and does not overlap with any diamond mining activities. Similarly, nearshore transshipment operations do not overlap with any active mining these activities and/or mining licence areas.

Phosphate Prospecting and Mining

Phosphate deposits off Namibia were delineated during regional studies in the 1970's but have remained undeveloped to date. The deposits occur as unconsolidated seafloor sediments, which can be efficiently mined by applying currently available dredging technology. Preliminary reconnaissance sampling by Bonaparte Diamond Mines NL during 2007 demonstrated potential for enrichment to commercial grades (up to 35% P₂O₅) (MRA, 2008).

In 2011, the MIME granted mining licences to two companies Namibian Marine Phosphate (NMP) and LL Namibia Phosphates for licence areas located south-west of Walvis Bay⁷³. Strong opposition to the granting of these rights resulted in the Namibian government establishing a moratorium on offshore phosphate mining. A condition of the moratorium was that an independent and comprehensive EIA must be conducted. In 2016, NMP was awarded an ECC to mine offshore phosphates. Legal action against the issuing of the

⁷³ https://cer.org.za/wp-content/uploads/2016/06/CER_Factsheet3_web.pdf



certificate was taken resulting in the High Court setting aside the ECC on concerns relating to the local fishing industry (specifically monk fish) and the environment (Perks, 2016). However, in May 2018 NMP received a further High Court judgment winning back its ECC for its marine phosphate EIA. Further legal action has since been ongoing regarding the validity of the mining licence (Russell, 2018).

The Venus offshore project area lies far offshore and does not overlap with any proposed phosphate mining activities. Nearshore transshipment operations do not overlap with proposed mining activities, while vessel transit routes may overlap with proposed offshore mining activities, dependant on the final outcomes of the ongoing legal action (see Figure 5-84 and Figure 5-85).

5.7.6.4 Recreational Use

Traditional recreational coastal pursuits are less popular in this region than in many other coastal areas because of the cold water and generally cool, foggy climate. Coastal recreation may be either consumptive or non-consumptive. Due to access restrictions along the coastline between Lüderitz and Oranjemund (part of the Namdeb mining area) no recreational activities occur within this area.

Closer inshore, the ports of Lüderitz and Walvis Bay are fully operational and already supports existing commercial vessels. Thus, certified recreational and pleasure crafts have and continue to operate around the port and alongside existing commercial vessels.

Consumptive recreational uses involve collection of material from the sea for personal use. Recreational anglers (Brouwer, Mann, Lamberth, & Sauer, 1997) and divers target line-fish from either a boat or the shore, with shore-based divers also targeting West Coast rock lobsters. Recreational angling is a well-established activity in Namibia. Shore-based angling is geographically limited to approximately 260 km of Namibia's coastline, stretching from Sandwich Harbour south of Walvis Bay to the Ugab River in the north, an area where around 90% of recreational fishing takes place (Barnes & Alberts, 2008). Target species include kob and West Coast steenbras, as well as blacktail (*Diplodus sargus*), galjoen, snoek (*Thyrstites atun*), barbel (*Galeichthys feliceps*), and several shark species such as broadnose sevengill (*Notorynchus cepedianus*), spotted gullyshark (*Triakis megalopterus*), smooth-hound (*Mustelus mustelus*), and copper shark (*Carcharhinus brachyurus*). Limited harvesting of Cape rock lobster (*Jasus lalandii*) also occurs (Mavetja Rukoro, 2005; Barnes & Alberts, 2008). Recreational fishing within the vicinity of Walvis Bay, specifically between Walvis Bay and Sandwich Harbour, is estimated at 8 800 recreational anglers, with an annual landing of 500 tons (Barnes & Alberts, 2008).

International and domestic tourism, a *non-consumptive recreational use*, is a major contributor (14.5%) to Namibia's GDP, creating approximately 18% of all employment (directly or indirectly). Offshore recreational and tourist activities which take place in the areas around Walvis Bay and Lüderitz include recreational boating, boat tours (including whale watching) and recreational angling. **The Venus offshore project area is located far offshore with overlap with nearshore recreational activities unlikely, while recreational activities may overlap with transshipment operations occurring closer to shore.**

5.7.6.5 Undersea Cables

A number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean, five of which pass through Namibian waters, namely the African Coast to Europe (ACE), the West Africa Cable System (WACS), Equiano, 2Africa and South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE) (see Figure 5-84). Both the ACE and WACS have cable landings and connections at Swakopmund. **The Venus offshore project area lies between the WACS-SAT 3 and Equiano submarine cables.** The exact positioning of WACS-SAT3 cable (closest to Venus offshore project area) in relation to proposed Venus development subsea



layout was recorded during the 2024 geophysical survey (see Section 5.2.2), which confirmed that the proposed Venus development subsea layout does not impact any subsea telecommunication cables.

The nearshore transshipment area lies to the south of the Equiano and WACS subsea cables, with the proposed location not impacting any subsea telecommunication cables Figure 5-85).

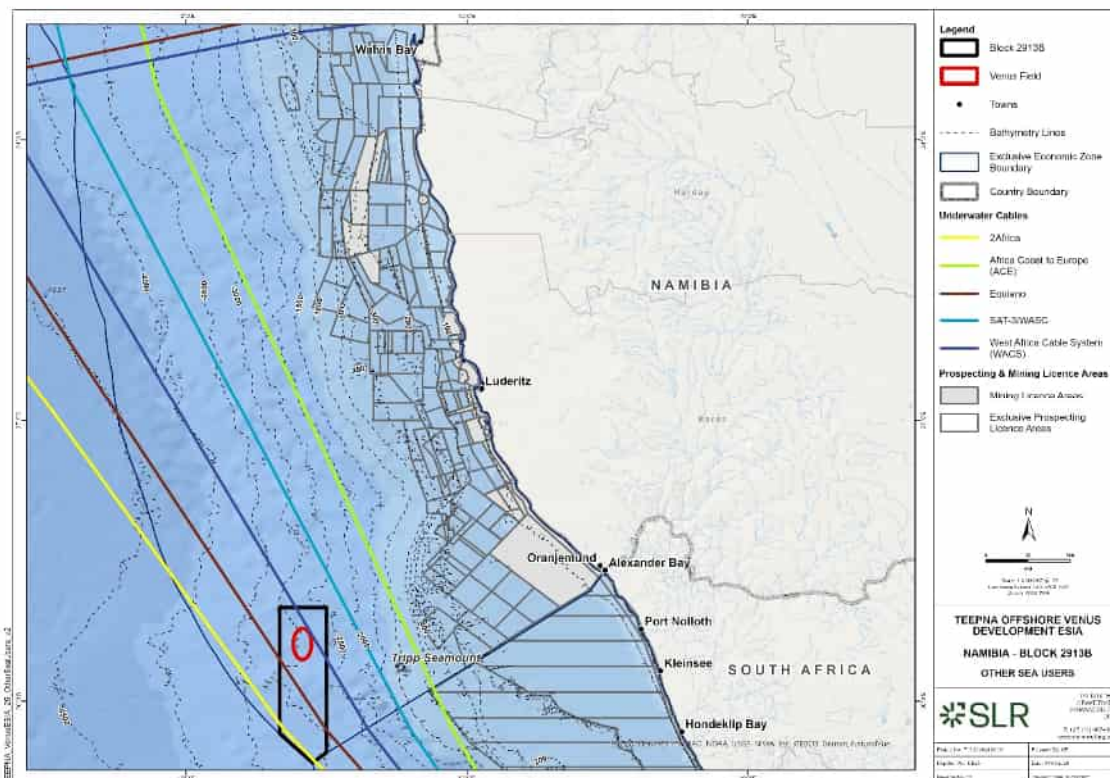


Figure 5-84: Venus offshore project area (red ellipse) within PEL0056/Block 2913B (black polygon) in relation to active marine diamond mining concessions and Exclusive Prospecting Mining Licences and telecommunications cables.

Source: Adapted from MAFWLR (2021) and Submarine Cable Map.



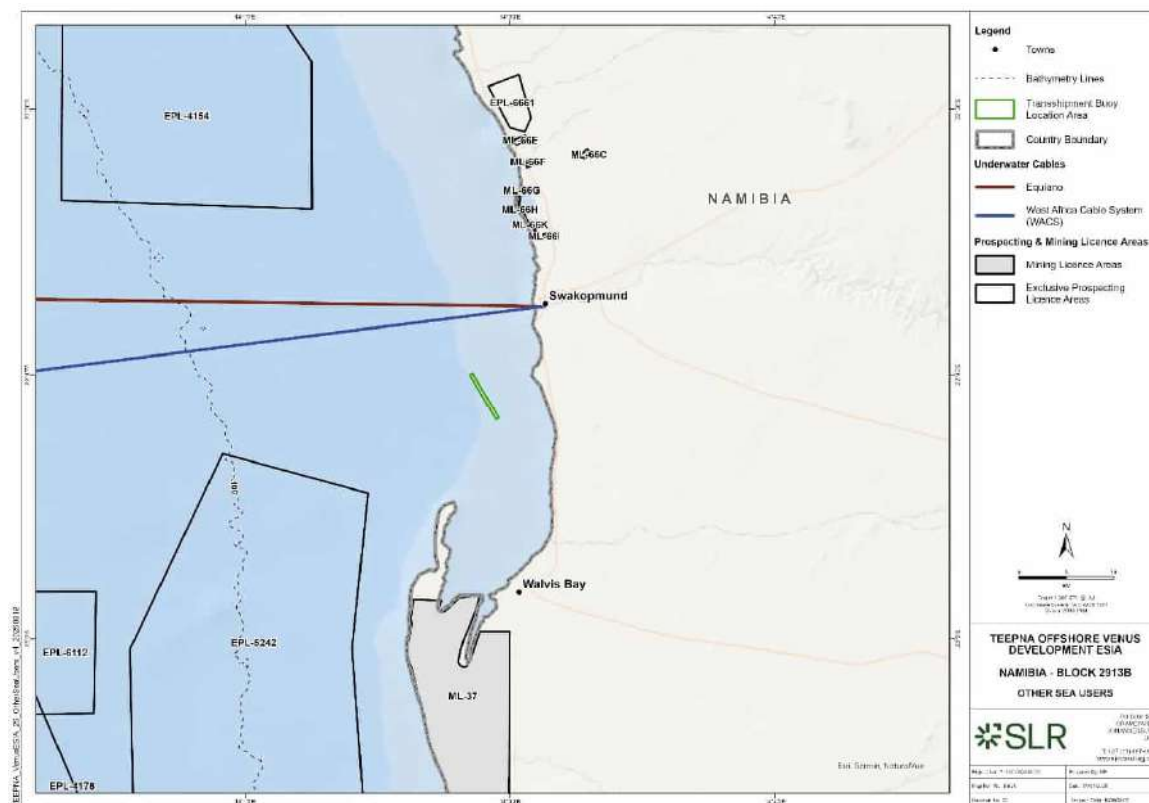


Figure 5-85: Nearshore transshipment area (green rectangle) in relation to active marine diamond mining concessions and Exclusive Prospecting Mining Licences and telecommunications cables.

Source: Adapted from MAFWLR (2021) and Submarine Cable Map.

5.7.6.6 Guano Harvesting

There is limited guano harvesting on guano platforms off the coast of Namibia. A 1.7 ha wooden platform is located approximately 200 m offshore between Swakopmund and Walvis Bay. North of Swakopmund at the Salt Pans and at Cape Cross, a further two platforms (4 ha each) have been erected (ref. <http://www.namibweb.com/guano.htm>, 6 Feb 2017).

The Venus offshore project area lies far offshore from those activities, with nearshore transshipment operations taking place in waters deeper and further offshore than the guano platforms.



Summary of key socio-economic observations

General

According to 2023 population census Namibia's population has grown on average by 3% between 2011 and 2023. The populations of the //Kharas (3% per annum between 2011 and 2023) and Erongo Regions (3.9% per annum from 2011 to 2023) are growing rapidly, particularly in urban centres like Walvis Bay and Lüderitz, driven by the hope of employment opportunities. Population distribution is concentrated in coastal towns (e.g. Oranjemund, Lüderitz, Walvis Bay, Swakopmund, Wlotzkasbaken and Henties Bay), which is largely due to the protected areas along the entire coast. Many urban residents live in informal settlements with poor infrastructure. In 2024, Namibia had a GDP of us\$13.37 billion (~NAD245 billion) and was redefined as a lower-middle income country on 1 July 2025. The Port of Lüderitz serves the local fishing industry, local diamond industry, ongoing offshore oil and gas exploration and mines in southern Namibia and in north-western South Africa with imports and exports of commodities and handling general cargo. The economy of the Erongo Region and the Walvis Bay Urban Constituency is more developed and diversified compared to Lüderitz, and largely revolves around the Port of Walvis Bay, which is Namibia's largest commercial port. The region is largely dependent on the primary sector: mining (notably uranium), commercial and small-scale fishing, and agriculture (mostly livestock farming).

In 2023, 70.4% of the labour force in the //Kharas Region and 68% in Erongo Region were employed. The urban economies of Walvis Bay and Lüderitz are, however, not robust enough to support the influx of job seekers, resulting in high unemployment rates, especially among youth with unemployment levels exceeding 50% in most areas. There is also a clear gender divide in terms of employment, as unemployment rates for women are 8.1% and 5.2% higher when compared to men in the //Kharas and Erongo regions, respectively. In Namibia, approximately 45% of individuals earn less than NAD 3 000 per month, while very few (4.3%) earn more than NAD 30 000 per month (gross income). Although poverty is estimated to have decreased, it remains high at 17.8%. Education levels are relatively high and access to health and education services is generally adequate, with 76% of the population living within a 10 km radius of a health facility.

Fishing

The large pelagic longline sector is the only Namibian commercial fishing sector which overlaps with the Venus offshore project area within PEL0056/Block 2913B. Nearshore transshipment operations may, however, overlap with the linefish and small-scale fisheries (SSF) sectors, as well as small pelagic purse-seine fisheries, should this sector reopen. Namibia promotes mariculture, particularly in Lüderitz's nutrient-rich waters and sheltered Walvis Bay waters, with allocated plots for various seafood cultivation. The nearshore transshipment area partially overlaps with a designated mariculture area, although this area is currently not in use.

Marine Traffic

PEL0056/Block 2913B overlaps the main traffic route that passes around southern Africa, with the nearshore transshipment zone falling within the main marine traffic route into and out Walvis Bay port. Similarly, vessel transit between the Venus offshore project area and coastal ports (Walvis Bay and/or Lüderitz) will fall along existing marine traffic routes. In addition to port operations and vessel movements, offshore bunkering activities are actively conducted off the coasts of Walvis Bay and Lüderitz. These entities provide Ship-to-Ship (STS) fuel transfer services, supporting both regional and international maritime traffic. NOSF has a dedicated tanker jetty capable of off-loading petroleum products and pipelines to its tank farm, indicating that a significant amount of petroleum imports is already handled via the NOSF jetty.

Other Human Uses

The coastal region south of Lüderitz is a restricted diamond mining area, which limits public access. Current diamond mining operations exist to depths of 150 m, and as such there is no overlap with the Venus offshore project area. Nearshore transshipment operations do not overlap with proposed mining activities within the vicinity of Walvis Bay, while vessel transit routes may overlap with proposed offshore mining activities, dependant on the final outcomes of the ongoing legal action. While submarine cables (WACS-SAT 3 and Equiano) pass in close vicinity to the Venus development project area and nearshore transshipment area, there is no overlap with any submarine cables and associated buffer zones.



6.0 Environmental and Socio-Economic Screening of Key Impacts

This chapter provides a high-level screening of the interaction between the proposed activities and the receiving environment, as well as an activity-specific Aspects and Impacts Register, to ensure that all environmental and social aspects⁷⁴ of the proposed development project and the associated impacts⁷⁵ are identified. Key potential impacts were identified by the ESIA project team on this basis, reviewed by I&APs during the Scoping Phase public participation process and endorsed by MEFT in their acceptance of the FSR. No additional issues were identified by I&APs during this period. Specialists were required to confirm these, as well as identify any others, and assess the significance thereof.

This chapter also presents those impacts considered to be insignificant and the rationale for which they were screened out during the Scoping Phase (and thus not formally assessed in detail) (see Section 6.3).

6.1 Environmental and Socio-Economic Interaction Matrix

During the Scoping Phase, potential impacts were identified by examining the possible interactions of all proposed activities and associated aspects (described in Chapter 4.0) with the broad physical characteristics of the area of influence (described in Chapter 5.0), through which potential impacts on biological and social receptors (or features) in the area of influence could arise. The identified possible interactions are shown in the environmental and social interaction matrix in Table 6-1. Shaded cells indicate where proposed activities may interact with a certain physical characteristic and, in turn or directly with, biological or socio-economic receptors. Interactions are broadly grouped into minor interactions and potentially significant interactions (which have been confirmed by specialist assessments). Key considerations that inform the potential interactions are the far offshore location of the Venus offshore project area (located ~300 km offshore at its closest point in water depths of ~3 000 m) and the nearshore location of the transshipment area (located ~5 km off the coast at its closest point in water depths less than 40 m), as well as the medium term duration of the proposed well drilling activities (for up to 40 wells) and long-term nature of oil production.

During normal operations, the biological receptors that may be most affected by the proposed activities include benthic communities, fish and marine mammals in the offshore and nearshore environments, although other receptors are also considered. Socio-economic receptors (or activities or resources) that may be most affected by the proposed activities include fishing, income / livelihoods, maritime shipping, cultural heritage, and public health and safety. Contribution to climate change is also considered.

Potential interactions with receptors in the case of **unplanned events**, associated with potential activity risks such as minor hydrocarbon spills, loss of equipment and an unlikely well blow-out, were also considered to ensure a comprehensive assessment. These unplanned events are unlikely to occur, and measures are in place to actively prevent them in line with Industry Best Practice and Best Available Techniques (BAT). Despite the very low probability of these unplanned events occurring, potential impacts are assessed assuming a reasonably 'worst-case' unplanned event occurs.

⁷⁴ An "aspect" is the element of an organisation's activities, products or services that can interact with the environment.

⁷⁵ An "impact" is any change to the environment, whether adverse or beneficial, wholly or partially resulting from the organisation's activities, products or services.



Table 6-1: Environmental and Social Interaction Matrix.

See legend at the end of the table.

Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment																
		Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air emissions	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Socio-economic receptors / resources						
																			Livelihoods / Income	Maritime / cultural heritage	Visual / sense of place	Services availability	Public health and safety	Climate change effects	
1. Normal Operations																									
Drilling and installation																									
Establishment of onshore logistics bases and mobilisation of staff	Procurement of facilities and services																								
	Employment of staff																								
Operation of drilling units and support / supply / installation vessels in the Venus offshore project area	Presence and implementation of safety zones																								
	Underwater noise from manoeuvring and positioning																								
	Air emissions from drilling units and support / supply / installation vessels																								
	Lighting from drilling units and support / supply / installation vessels																								
	Discharges to sea from drilling units and support / supply / installation vessels																								
	Waste generation for disposal onshore																								
Well drilling and installation of well infrastructure	Underwater noise from drilling																								
	Seabed disturbance																								
	Discharge of drill cuttings, mud and residual cement																								
Vertical seismic profiling	Underwater noise from VSP operations																								
Well flow testing	Non-routine flaring of hydrocarbons																								



Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment															
		Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air emissions	Atmospheric noise	Atmospheric light	Benthic communities	Biological receptors / resources							Socio-economic receptors / resources							
										Plankton	Fish	Seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income	Maritime / cultural heritage	Visual / sense of place	Services availability	Public health and safety	Climate change effects
Transit of helicopters	Atmospheric and underwater noise from helicopters																							
	Air emissions from helicopters																							
Transit of vessels	Underwater noise from vessels																							
	Air emissions from vessels																							
	Lighting from vessels																							
	Increased vessel traffic																							
Installation and commissioning of FPSO	Disturbance of seabed during installation of anchors																							
	Discharge at sea surface of various substances during commissioning																							
	Presence and implementation of safety zone																							
	Anti-fouling paint used on the FPSO hull																							
Installation and commissioning of subsea infrastructure in the Venus project offshore area	Seabed disturbance																							
	Discharge near seabed of various substances used for cleaning and testing																							
	Presence and implementation of safety zone																							
Installation and commissioning of transshipment buoy in nearshore area	Disturbance of seabed during installation of anchor																							
	Presence and implementation of safety zone																							
Production and Operation																								
Operation of Venus development	Procurement of goods and services																							



Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment															
		Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air emissions	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income	Maritime / cultural heritage	Visual / sense of place	Services availability	Public health and safety	Climate change effects
	Employment of staff																							
	Contribution to State income																							
Operation of support vessels, FPSO and DPST in the Venus offshore project area	Presence and implementation of safety zones																							
	Underwater noise from manoeuvring and positioning																							
	Presence of mooring chains																							
	Air emissions from DPST, FPSO and vessels																							
	Lighting from DPST, FPSO and vessels																							
	Discharges to sea from DPST, FPSO and vessels																							
	Abstraction of sea water																							
	Non-routine flaring of gas																							
	Waste generation for disposal onshore																							
	Presence of subsea infrastructure in the Venus offshore project area	Presence and implementation of safety zones																						
Infrastructure on seabed																								
Presence of radioactive materials in Xmas trees																								
Transit of helicopters	Atmospheric and underwater noise from helicopters																							
	Air emissions from helicopters																							
Transit of vessels	Underwater noise from vessels																							
	Air emissions from vessels																							
	Lighting from vessels																							



Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment														
									Biological receptors / resources								Socio-economic receptors / resources						
		Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air emissions	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income	Maritime / cultural heritage	Visual / sense of place	Services availability	Public health and safety
	Increased vessel traffic																						
Nearshore transshipment	Presence of vessels and implementation of safety zones																						
	Presence of mooring buoy																						
	Underwater noise from manoeuvring and positioning																						
	Air emissions from DPST, tugs and conventional tanker																						
	Lighting from DPST, tugs and conventional tanker																						
	Discharges to sea from DPST, tugs and conventional tanker																						
Decommissioning																							
Shutdown of onshore logistics base and demobilisation of staff	Retrenchment of staff																						
	End of procurement																						
Operation of vessels involved in decommissioning in the Venus offshore project area	Presence and implementation of safety zones																						
	Underwater noise from manoeuvring and positioning																						
	Air emissions from support / supply / decommissioning vessels																						
	Lighting from support / supply / decommissioning vessels																						
	Discharges to sea from support / supply / decommissioning vessels																						



Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment														
									Biological receptors / resources							Socio-economic receptors / resources							
		Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air emissions	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income	Maritime / cultural heritage	Visual / sense of place	Services availability	Public health and safety
	Waste generation for disposal onshore																						
Transit of helicopters	Atmospheric and underwater noise from helicopters																						
	Air emissions from helicopters																						
Transit of vessels	Underwater noise from vessels																						
	Air emissions from vessels																						
	Lighting from vessels																						
	Increased vessel traffic																						
Decommissioning of FPSO and subsea infrastructure including wells	Seabed disturbance during removal																						
	Infrastructure left on seabed																						
	Discharge of residual plugging cement to seabed																						
	Hazardous waste generation																						
2. Unplanned Events																							
Operation and transit of drilling units, support / supply vessels	Marine diesel spill																						
	Loss of equipment at sea																						
Well drilling and installation of well infrastructure	Loss of well control / Blow-out																						
Well plugging and abandonment	Hydrocarbon leak from plugged well																						
Operation of the subsea infrastructure	Gas injection line rupture																						
Transshipment of hydrocarbons	Hydrocarbon spill																						
Legend																							
	No significant interaction		Interaction of aspects with key physical characteristics in the area of influence					Potential minor interactions screened out as described in Section 6.3					Potentially significant negative interaction to be assessed in the ESIA					Potentially significant positive interaction to be assessed in the ESIA					



6.2 Aspects and Impacts Register

The activity-specific Aspects and Impacts Register in Table 6-2 identifies potential impacts for each proposed activity and associated aspect based on the interactions identified in Table 6-1. This systematic approach allowed for the planning of the scope of the specialist studies, which were agreed to as part of the FSR acceptance.

6.3 Minor Screened Out Impacts

A number of potential impacts identified during the screening described in Sections 6.1 and 6.2 are deemed to be **minor and not significant** in the larger context of the proposed activities. This includes impacts that are commonplace in the marine environment, where existing legal requirements impose adequate management requirements, and/or where impacts are of a negligible intensity in relation to receiving environment before implantation of mitigation. These impacts have thus been screened out as discussed below and are not formally assessed in the ESIA.

6.3.1 Availability of Services Supplying the Proposed Activities

The JV Operator is not proposing to construct onshore facilities as part of this project. The plan is to use existing facilities and supply services (commercially available or imported).

Namibia has existing ports and facilities (including Walvis Bay and Lüderitz) and service providers which service the oil and gas industry, including a range of offshore exploration and appraisal activities. Port Authorities (Namport) are also in the process of expanding various Port infrastructure, which is subject to separate and dedicated permitting processes.

As offshore activities and associated demand for services increase, it is expected that more service providers will enter the market (and must obtain ECCs and other permits for their activities if required). Providers of non-specialised goods or services (e.g., accommodation or land-based transportation) may be able to expand faster than providers of fixed facilities (e.g., berthing space) or specialised goods and services (e.g., drilling muds and aerial transportation). However, there is no indication of supply shortages materially affecting offshore activities to date, or that the volume of existing goods and services cannot be expanded to meet increased market demand over time. While procurement will need careful planning and preparation, and may be a limiting factor, the associated economic stimulation is reflected in the Socio-Economic Impact Assessment (see Appendix N).

It is understood that none of the required logistics / support operations or goods are of such a nature, frequency, duration or volume that they would place undue pressure on local infrastructure or resources, and that they would consequently not materially affect supply to other current users. This is, therefore, not assessed as a negative impact of the project in this ESIA.

Solid wastes generated during the installation, operations and decommissioning activities will be transported to shore for further treatment and/or disposal at a licenced waste management facility approved by the operator. A Waste Management Study has been conducted as part of this ESIA (see Appendix R).



Table 6-2: Aspects and Impacts Register.

Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section	
1. Normal Operations					
Drilling and installation					
Establishment of onshore logistics bases and mobilisation of staff	Procurement of facilities and services	Income from local procurement and spending	Socio-economic	Section 7.4.1	
		State income from taxes and levies	Socio-economic	Section 7.4.3	
		Availability of services (e.g. port services, accommodation, transportation)	Minor – Screened out	Section 6.3.1	
	Employment of staff	Income and skills training for workers	Socio-economic	Section 7.4.10	
		Shortage of skills and labour	Socio-economic	Section 7.4.10	
Operation of drilling units and support / supply / installation vessels in the Venus offshore project area	Presence and Implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.4.11 and 7.3	
		Displacement of shipping vessels and disruption of industry	Socio-economic	Section 7.4.12	
	Underwater noise from manoeuvring and positioning	Behavioural disturbance of marine fauna	Marine ecology	Section 0	
		Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4	
		Changes in catch availability due to behavioural change in fish	Fisheries	Section 6.3.2	
	Air emissions from drilling units and support / supply / installation vessels	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7.2	
	Lighting from drilling units and support / supply / installation vessels	Behavioural disturbance of marine fauna	Marine ecology	Section 7.3	
	Discharges to sea from drilling units and support / supply / installation vessels	Ecological effects from pollutants in water column from routine discharges ⁷⁶	Minor – Screened out	Section 6.3.2	
		Deterioration of cultural heritage links to the sea due to potential pollution	Cultural heritage	Section 7.5	
		Alteration of ecological composition due to introduction of invasive aliens from ballast water discharge	Minor – Screened out	Section 6.3.3	
	Waste generation for disposal onshore	Availability of services	Minor – Screened out	Section 6.3.1	
	Well drilling and installation of well infrastructure	Underwater noise from drilling	Behavioural disturbance of marine fauna	Marine ecology	Section 0
			Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
Changes in catch availability due to behavioural change in fish			Fisheries	Section 7.3	
Seabed disturbance			Smothering and disturbance of benthic fauna	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5	
		Disturbance of archaeological material	Minor – Screened out	Section 6.3.4	
		Discharge of drill cuttings, mud and residual cement	Smothering and disturbance of benthic fauna	Marine ecology	Section 7.2.1
Ecological effects from pollutants in water column			Marine ecology	Section 7.2.2	
Ecological effects from release of radioactive materials			Minor – Screened out	Section 6.3.5	
Deterioration of cultural heritage links to the sea			Cultural heritage	Section 7.5	
Changes in catch availability due to behavioural change in fish		Fisheries	Section 7.3		

⁷⁶ Routine discharges refer to those common to most vessels, including grey and black water, waste food, bilge water, deck drainage and brine generated from onboard desalination



Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section
Vertical seismic profiling	Underwater noise from VSP operations	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
		Changes in catch availability due to behavioural change in fish	Fisheries	Section 7.3
Well flow testing	Non-routine flaring of hydrocarbons	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
		Ecological effects due to hydrocarbon 'drop out'	Marine ecology	Section 7.2.2
		Behavioural disturbance of marine fauna due to flare lighting	Marine ecology	Section 0
Transit of helicopters	Atmospheric and underwater noise from helicopters	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Sense of place/disturbance of coastal towns near helicopter base	Minor - Screened out	Section 6.3.8
	Air emissions from helicopters	Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.8
Transit of vessels	Underwater noise from vessels	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
		Behavioural disturbance of marine fauna	Minor - Screened out	Section 6.3.7
		Physical and/or physiological injury to marine fauna	Minor - Screened out	Section 6.3.7
	Air emissions from vessels	Changes in catch availability due to behavioural change in fish	Minor - Screened out	Section 6.3.7
		Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.8
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from vessels	Behavioural disturbance of marine fauna	Marine ecology	Section 0
	Increased vessel traffic	Physical injury or mortality of marine fauna as a result of vessel collisions	Marine ecology	Section 7.2.4
		Disruption to shipping industry	Socio-economic	Section 7.3
		Disruption to fishing industry	Minor – Screened out	Section 6.3.7
Installation and commissioning of FPSO	Disturbance of seabed during installation of anchors	Behavioural disturbance of marine fauna	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
		Disturbance of archaeological material	Minor – Screened out	Section 6.3.4
	Discharge at sea surface of various substances during commissioning	Ecological effects from pollutants in water column	Marine ecology	Section 7.2.2
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
	Presence and implementation of safety zones	Displacement of fishing vessels	Fisheries/Socio-economic	Section 7.3
		Displacement of shipping vessels	Socio-economic	Section 7.4.12
Installation and commissioning of subsea infrastructure at Venus offshore project area	Anti-fouling paint used on the FPSO hull	Ecological effects from pollutants in water column	Marine ecology	Section 7.2.2
		Seabed disturbance	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
	Discharge near seabed of various substances used for cleaning and testing	Disturbance of archaeological material	Minor – Screened out	Section 6.3.4
		Ecological effects from pollutants in water column	Marine ecology	Section 7.2.2
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
	Presence and implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.3 and 7.4.11
Displacement of shipping vessels and disruption of industry		Socio-economic	Section 7.4.12	
Installation and commissioning of transshipment buoy in nearshore area	Disturbance of seabed during installation of anchor	Smothering and disturbance of benthic fauna	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
		Disturbance of archaeological material	Minor – Screened out	Section 6.3.4
	Presence and implementation of safety zones	Displacement of fishing vessels	Fisheries/Socio-economic	Section 7.3 and 7.4.11
		Displacement of shipping vessels	Socio-economic	Section 7.4.12
Discharges to sea from installation vessels	Ecological effects from pollutants in water column from routine discharges	Minor – Screened out	Section 6.3.2	



Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section
		Health effects from routine discharges	Minor – Screened out	Section 6.3.9
		Deterioration of cultural heritage links to the sea due to potential pollution	Cultural heritage	Section 7.5
Production and Operation				
Operation of Venus development	Procurement of goods and services	Income from local procurement and spending	Socio-economic	Section 7.4.9
		State income from taxes and levies	Socio-economic	Section 7.4.3
		Availability of services	Minor – Screened out	Section 6.3.1
	Employment of staff	Income and skills training for workers	Socio-economic	Section 7.4.10
		Shortage of skills and labour	Socio-economic	Section 7.4.10
		Crew presence in local communities during rotation	Socio-economic	Section 7.4.13 and 0
Operation of support vessels, FPSO and DPST in the Venus offshore project area	Contribution to state income	Increased Gross Domestic Product (GDP)	Socio-economic	Section 7.4.1
	Presence and implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.3 and 7.4.11
		Displacement of shipping vessels and disruption of industry	Socio-economic	Section 7.4.12
	Underwater noise from manoeuvring and positioning	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
		Changes in catch availability due to behavioural change in fish	Fisheries	Section 7.3
	Presence of mooring chains	Physical injury of marine fauna (entanglement)	Marine ecology	Section 7.2.4
	Air emissions from DPST, FPSO and vessels	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from DPST, FPSO and vessels	Behavioural disturbance of marine fauna	Marine ecology	Section 0
	Discharges to sea from DPST, FPSO and vessels	Ecological effects from pollutants in water column from routine discharges	Minor – Screened out	Section 6.3.2
		Ecological effects from discharge of produced water	Marine ecology	Section 7.2.2
		Deterioration of cultural heritage links to the sea due to potential pollution	Cultural heritage	Section 7.5
		Alteration of ecological composition due to introduction of invasive aliens from ballast water discharge	Minor – Screened out	Section 6.3.3
	Abstraction of sea water	Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
	Non-routine flaring of gas	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Waste generation for disposal onshore	Availability of services	Minor – Screened out	Section 6.3.1
		Management of hazardous waste	Waste Management	Appendix R
Presence of subsea infrastructure in the Venus offshore project area	Presence and implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.3 and 7.4.11
		Displacement of shipping vessels and disruption of industry	Socio-economic	Section 7.4.12
	Infrastructure on seabed	Modification of benthic habitat through additional hard substrate	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
	Presence of radioactive materials in Xmas trees	Ecological effects from pollutants in water column	Minor – Screened out	Section 6.3.2
Transit of helicopters	Atmospheric and underwater noise from helicopters	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Sense of place/disturbance of coastal towns near helicopter base	Minor – Screened out	Section 6.3.6
	Air emissions from helicopters	Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.8
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
Transit of vessels	Underwater noise from vessels	Behavioural disturbance of marine fauna	Minor – Screened out	Section 6.3.7
		Physical and/or physiological injury to marine fauna	Minor – Screened out	Section 6.3.7
		Changes in catch availability due to behavioural change in fish	Minor – Screened out	Section 6.3.7



Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section
	Air emissions from vessels	Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.7
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from vessels	Behavioural disturbance of marine fauna	Minor – Screened out	Section 6.3.7
	Increased vessel traffic	Physical injury or mortality of marine fauna due to vessel collisions	Marine ecology	Section 7.2.4
		Disruption to shipping industry	Socio-economic	Section 7.4.12
		Disruption to fishing industry	Minor – Screened out	Section 6.3.7
Nearshore transshipment	Presence of vessels and Implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.3 and 7.4.11
		Displacement of shipping vessels and disruption of industry	Socio-economic	Section 7.4.12
		Alteration of sense of place of coastal areas	Socio-economic and Cultural heritage	Section 7.4.15.3 and 7.5
	Presence of mooring buoy	Modification of benthic habitat through additional hard substrate	Marine ecology	Section 7.2.1
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 7.5
		Physical injury of marine fauna (entanglement)	Marine ecology	Section 7.2.4
		Alteration of sense of place of coastal areas	Socio-economic and Cultural heritage	Section 7.4.15.3 and 7.5
	Underwater noise from manoeuvring and positioning	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
		Changes in catch availability due to behavioural change in fish	Fisheries	Section 7.3
	Air emissions from DPST, tugs and conventional tanker	Health effects from atmospheric pollution	Air quality	Section 7.7
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from DPST, tugs and conventional tanker	Behavioural disturbance of marine fauna	Marine ecology	Section 0
	Discharges to sea from DPST, tugs and conventional tanker	Ecological effects from pollutants in water column from routine discharges	Minor – Screened out	Section 6.3.7
		Deterioration of cultural heritage links to the sea due to potential pollution	Cultural heritage	Section 7.5
		Human health effects from pollutants in water column due to discharges	Minor – Screened out	Section 6.3.7
		Alteration of ecological composition due to introduction of invasive aliens from ballast water discharge	Minor – Screened out	Section 6.3.3
Decommissioning				
Shutdown of onshore logistics base and demobilisation of staff	Retrenchment of staff	Job losses for workers	Socio-economic	Section 7.4.16
	End of procurement	Loss of income from local procurement and spending	Socio-economic	Section 7.4.16
		Loss of state income from taxes and levies	Socio-economic	Section 7.4.16
Operation of vessels involved in decommissioning in the Venus offshore project area	Presence and implementation of safety zones	Displacement of fishing vessels and disruption of industry	Fisheries/Socio-economic	Section 7.3 and 7.4.11
		Displacement of shipping vessels and disruption of industry	Socio-economic	Section 7.4.12
	Underwater noise from manoeuvring and positioning	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Physical and/or physiological injury to marine fauna	Marine ecology	Section 7.2.4
		Changes in catch availability due to behavioural change in fish	Fisheries	Section 7.3
	Air emissions from support / supply / decommissioning vessels	Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from support / supply / decommissioning vessels	Behavioural disturbance of marine fauna	Marine ecology	Section 0
	Ecological effects from pollutants in water column from routine discharges	Minor – Screened out	Section 6.3.9	



Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section
	Discharges to sea from support / supply / decommissioning vessels	Deterioration of cultural heritage links to the sea due to potential pollution	Cultural heritage	Section 7.5
		Alteration of ecological composition due to introduction of invasive aliens from ballast water discharge	Minor – Screened out	Section 6.3.3
	Waste generation for disposal onshore	Availability of services (port services)	Minor – Screened out	Section 6.3.1
Transit of helicopters	Atmospheric and underwater noise from helicopters	Behavioural disturbance of marine fauna	Marine ecology	Section 0
		Sense of place/disturbance of coastal towns near helicopter base	Minor - Screened out	Section 6.3.6
	Air emissions from helicopters	Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.8
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
Transit of vessels	Underwater noise from vessels	Behavioural disturbance of marine fauna	Minor – Screened out	Section 6.3.7
		Physical and/or physiological injury to marine fauna	Minor – Screened out	Section 6.3.7
		Changes in catch availability due to behavioural change in fish	Minor – Screened out	Section 6.3.7
	Air emissions from vessels	Health effects from atmospheric pollution	Minor – Screened out	Section 6.3.8
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 7.7
	Lighting from vessels	Behavioural disturbance of marine fauna	Minor – Screened out	Section 0
	Increased vessel traffic	Physical injury or mortality of marine fauna due to vessel collision	Marine ecology	Section 7.2.4
		Disruption to shipping industry	Socio-economic	Section 7.4.12
		Disruption to fishing industry	Minor – Screened out	Section 6.3.7
		Decommissioning of FPSO and subsea infrastructure including wells	Seabed disturbance during removal	Smothering and disturbance of benthic fauna
Deterioration of cultural heritage links to the sea	Cultural heritage			Section 7.5
Disturbance of archaeological material	Minor – Screened out			Section 6.3.4
Infrastructure left on seabed (including plugged wells)	Modification of benthic habitat through additional hard substrate		Marine ecology	Section 7.2.1
	Deterioration of cultural heritage links to the sea		Cultural heritage	Section 7.5
	Displacement of fishing vessels		Fisheries	Section 7.3
Hazardous waste generation	Availability of services		Waste Management	Appendix R
2. Unplanned Events				
Operation and transit of drilling units, support / supply vessels	Hydrocarbon surface spill	Ecological effects from pollutants in water column	Marine ecology	Section 8.2
		Displacement of fishing vessels and target species from polluted areas	Fisheries/Socio-economic	Section 8.2
		Deterioration of cultural heritage links to the sea	Cultural Heritage	Section 8.2
	Loss of equipment	Entanglement of fishing gear	Minor – Screened out	Section 6.3.10
		Loss of income from any disruption of fisheries	Minor – Screened out	Section 6.3.10
		Seafloor disturbance / damage to infrastructure on the seafloor	Minor – Screened out	Section 6.3.10
		Deterioration of cultural heritage links to the sea	Minor – Screened out	Section 6.3.10
Well drilling and installation of well infrastructure	Loss of well control / blow-out	Ecological effects from pollutants in water column	Marine ecology	Section 8.3
		Displacement of fishing vessels and target species from polluted areas	Fisheries/Socio-economic	Section 8.3
		Displacement of shipping vessels from polluted areas	Socio-economic	Section 8.3
		Ecological effects from pollutants on the shore	Marine ecology	Section 8.3
		Reduction of income from coastal livelihoods and recreation	Socio-economic	Section 8.3
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 8.3
		Alteration of sense of place	Socio-economic	Section 8.3
		Health impacts from atmospheric pollution	Air quality	Section 8.3



Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study	Report Section
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 8.3
Well plugging and abandonment	Hydrocarbon leak from plugged well	Ecological effects from pollutants in water column	Minor – Screened out	Section 6.3.11
		Displacement of fishing vessels and target species from polluted areas	Minor – Screened out	Section 6.3.11
		Displacement of shipping vessels from polluted areas	Minor – Screened out	Section 6.3.11
		Ecological effects from pollutants on the shore	Minor – Screened out	Section 6.3.11
		Reduction of income from coastal livelihoods and recreation	Minor – Screened out	Section 6.3.11
		Deterioration of cultural heritage links to the sea	Minor – Screened out	Section 6.3.11
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Minor – Screened out	Section 6.3.11
Operation of the subsea infrastructure	Gas injection line rupture	Ecological effects from pollutants in water column	Marine ecology	Section 8.4
		Displacement of target species from polluted areas	Fisheries/Socio-economic	Section 8.4
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 8.4
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 8.4
Transshipment of hydrocarbons	Hydrocarbon spill	Ecological effects from pollutants in water column	Marine ecology	Section 8.5
		Displacement of fishing vessels and target species from polluted areas	Fisheries/Socio-economic	Section 8.5
		Displacement of shipping vessels from polluted areas	Socio-economic	Section 8.5
		Ecological effects from pollutants on the shore	Marine ecology	Section 8.5
		Reduction of income from coastal livelihoods and recreation	Socio-economic	Section 8.5
		Deterioration of cultural heritage links to the sea	Cultural heritage	Section 8.5
		Alteration of sense of place	Socio-economic	Section 8.5
		Health impacts from atmospheric pollution	Air quality	Section 8.5
		Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change	Section 8.5



6.3.2 Ecological Effects due to Routine Discharges to Sea from Vessels

Routine discharges considered in this section include grey and black water⁷⁷, waste food, bilge water, deck drainage, brine generated from onboard desalination⁷⁸, sewage, food wastes, and detergents from deck cleaning. The discharge of such substances can in principle have several impacts, including physiological effects on marine fauna from pollutants contained in the discharge, and attracting marine fauna and associated predator species to the vessel.

Such discharges are common to all ocean-going vessels and are regulated by national law and international conventions, such as MARPOL. Discharge volumes are directly proportional to the size of the vessel and crew. While vessels (e.g. support vessels and DPST) are mobile and comparable in size to other offshore vessels, the drilling units and FPSO have larger crew complements, with the drilling units remaining largely within the Venus offshore project area for extended periods, while the FPSO will remain moored (anchored) throughout production phase.

The concentration of vessels, and associated crew, will be relatively high at the Venus offshore project area during certain construction periods extending over a number of months at a time over the four-year construction period. However, this area is located 300 km from the coast at its closest point in the open ocean, and discharges are expected to disperse rapidly to undetectable concentrations, mainly in a north-westerly direction away from the coast, and are unlikely to have a material impact on water quality at the Venus offshore project area, provided that standard discharge mitigation is implemented.

Drilling units, supply and installation vessels, FPSO and DPST are highly specialised vessels that are expected to fully implement standard international discharge management measures.

Potential discharges in the nearshore transshipment area could reach the coast; however, in terms of MARPOL standards, no routine discharges are permitted within this nearshore area; thereby, avoiding any potential impacts on the sensitive coastline.

The following management measures must be implemented and will be included in the ESMP:

- Compile and implement a Waste and Discharge Management Plan that complies with MARPOL standards. Notably;
 - o Prohibit routine discharges in the nearshore transshipment area as per MARPOL regulations.
 - o Prohibit the discharge of oily water (> 15 ppm) as outlined in MARPOL regulations.
- Use a low-toxicity biodegradable detergent for the cleaning of the deck and any spillages.
- Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system.

⁷⁷ Grey water is domestic wastewater generated from activities such as showers, sinks, washing, etc., excluding water from toilets which is classified as black water.

⁷⁸ The ecological impacts of production-related effluents from the FPSO, such as produced water, will be modelled and assessed.



- Prohibit operational discharges when transiting through NIMPA and any mapped EBSAs.
- Monitor and audit appropriate implementation of the Waste and Discharge Management Plan and MARPOL standards.

6.3.3 Introduction of Invasive Aliens due to Ballast Water Discharge

Ballast water is routinely used by offshore vessels to maintain safe operations. In this process, ballast water may be pumped into or out of the ballast water tanks of the vessel during a journey. Ballast water taken onboard will contain small marine organisms, some of which can survive the ballast water tanks. The discharge of ballast water in areas that are different from those where it was taken onboard can thus result in the release of marine organisms that are alien to the region where they are released. If these organisms are able to survive and proliferate in the new environment where they are released, they could then compete with native species and change the composition of the native ecosystem.

Such discharges are common to ocean-going vessels and are regulated by international conventions, such as the International Convention for the Control and Management of Ships' Ballast Water and Sediments (see Table 2-3). The Convention requires that all ships using ballast water exchange will do so at least 50 nm ($\pm$ 93 km) from the nearest land and wherever possible 200 nm ($\pm$ 370 km) from the nearest land in waters at least 200 m deep when arriving from a different marine region, to minimise the chances of fauna carried in the ballast water surviving.

For the proposed installation, production and decommissioning activities, ballast water from different regions will likely be discharged once off (upon arrival in the project region) by the drilling units, FPSO, DPST and supply and installation vessels. These vessels are expected to remain in the broader project region for the duration of their engagement on the project. Conventional tankers are expected to arrive from ecologically different regions every time and could thus discharge ballast water with potentially alien organisms more frequently.

The Venus offshore project area of interest is located 300 km offshore, which is offshore of the minimum discharge distance requirement of the Convention. The area is, however, closer to the coast than the preferred discharge distance, and ballast water should be exchanged, where possible *en route* to the development area.

The nearshore transshipment area, which is the destination of the conventional tanker, is located ~5 km from the coast and, hence, more sensitive and vulnerable to potential alien invasives than the offshore Venus offshore project area. However, conventional tankers will approach the nearshore transshipment area from offshore and – as other vessels calling at Namibian ports – must effect ballast water exchange offshore.

Although a number of vessels will be engaged in the commissioning and production phases, the overall number of such additional vessels and, notably, new arrivals is relatively low compared to overall shipping traffic off the Namibian coast. Ballast water discharge from project vessels is not considered to pose a materially higher risk than that from a multitude of other vessels traversing Namibian waters daily on the major commercial shipping routes and/or calling at Namibian ports. Drilling units and FPSO are highly specialised international vessels that are expected to fully implement standard international discharge management measures.

The following management measures must be implemented and will be included in the ESMP:

- Compile and implement a Ballast Water Management Plan that complies with the International Convention for the Control and Management of Ships' Ballast Water and Sediments standards (Regulation D2).



- Treat ballast water using approved Ballast Water Treatment System (BWTS) under MARPOL Regulation D2 (Ballast Water Management Convention) and adhere to any Namport protocols. As per Regulation D2, ensure discharged water contains:
 - o < 10 viable organisms per m³ with a minimum dimension ≥50 µm.
 - o <10 viable organisms per ml with dimensions between 10 µm and <50 µm.
 - o *Vibrio cholerae* (O1 and O139): <1 colony-forming units (cfu) per 100 mL or <1 cfu per gram of zooplankton.
 - o *Escherichia coli*: <250 cfu per 100 mL.
 - o *Intestinal Enterococci*: <100 cfu per 100 mL.

6.3.4 Disturbance of Archaeological Material

No wrecks are known to occur or have been identified within PEL0056/Block 2913B during previous geophysical surveys, EBS and exploration / appraisal activities. One of the objectives of the geophysical surveys was to identify any natural or man-made seabed or buried obstructions such as rock outcrops, escarpments, canyons, channels, reefs, depressions, debris, wrecks, industrial structures, pipelines and cables. No wrecks were identified within the Venus offshore project area (see Section 5.2.2). Nevertheless, the possibility of identifying new shipwrecks or maritime debris remains, although of extremely low probability given the Block's offshore location and the surveys that have been undertaken in the area.

In line with good practice, prior to spudding the wells, an ROV will be used to finalise the well position based on the presence of any seafloor obstacles that may be observed. Furthermore, an ROV will be used to confirm clear unobstructed lay corridor and landing zone. During such surveys, any visible wrecks would more than likely be detected and, if detected, would be avoided as the drilling and installation areas should be free of obstacles to ensure optimal operations.

The likelihood of finding and disturbing a shipwreck in this deep-water offshore environment is very small considering that no wrecks have been identified to date based on previous surveys and activities, and the vast size of the Namibian offshore area. Should a wreck or ship remains be discovered, this would contribute to archaeological knowledge.

The following management measures must be implemented and will be included in the ESMP:

- Adjust well and subsea equipment location to avoid any marine underwater cultural heritage (shipwrecks) identified in pre-spudding or pre-installation surveys.
- If any historic shipwreck objects are found during the pre-spudding or pre-installation surveys, or after drilling / installation commencement, which could potentially be impacted by the activity, work in the directly affected area should cease (if identified after drilling / installation commencement) until the Namibian Heritage Council has been notified and the operator has complied with any additional mitigation as specified by the Authority, including any recommended buffer.

6.3.5 Release of Radioactive Material

The target resources are not expected to be naturally radioactive. Thus, drill cuttings are not expected to be radioactive.

During drilling, wireline logging and LWD involve the use of sealed radioactive sources in tools, which are kept in specially designed secured (locked) storage containers. Only certified logging engineers are allowed to handle the radioactive devices and they will comply with necessary regulations for the transport, storage, and handling of radioactive devices. The testing itself does not generate radioactive wastes.



During production, solids may be produced from the reservoir (mainly sand) and classified as Naturally Occurring Radioactive Material. This material will be, depending on the radioactivity level, appropriately stored and disposed of onshore via the National Radiation Protection Authority (NRPA).

The following management measures must be implemented and will be included in the ESMP:

- Store and dispose of any radioactive waste generated during production, dependent on radioactivity level, via the NRPA.

6.3.6 Alteration of the Sense of Place / Disturbance of Coastal Towns due to Helicopter Operations

Sense of place impacts from the proposed project could arise at coastal towns near the helicopter base due to increased aircraft traffic. The increased use of helicopters to transport crew to and from the Venus offshore project area adds to an existing presence of such aircrafts, and economic activity, at existing bases in Lüderitz or possibly Oranjemund. These activities are not expected to materially affect the sense of place; thus sense of place impacts are expected to be limited.

Helicopters transferring personnel for the project will adhere to the Civil Aviation Act, 2016 (No. 6 of 2016) and associated regulations.

The following management measures must be implemented and will be included in the ESMP:

- Implement a public information and disclosure programme covering all TEEPNA activities to ensure that the public are informed of project-related activities.
- Pre-plan flights to avoid extensive low altitude (<762 m or 2 500 ft) flights parallel to the shore.
- Comply fully with aviation and authority guidelines and rules.

6.3.7 Ecological, Human Health and Fishing Impacts from Vessel Transit to and from Venus offshore Project Area

Vessels conducting various activities for this project (e.g. drilling, installation, transportation of supplies to and from the Venus offshore project area, and transportation of produced crude oil) will arrive in the Venus offshore project area, most likely from Walvis Bay and Lüderitz, and leave after completing their tasks. During such transit to and from the Venus offshore project area, the vessels emit noise (associated with propellers), air pollutants (associated with fuel consumption), light (associated with deck and position lights) and routine discharges (discussed in Section 6.3.2).

Such emissions are common to all ocean-going vessels, including fishing boats, cargo ships and passenger / cruise ships, and are transient in relation to any one area.

The impacts associated with project vessels during transit to and from the Venus offshore project area are not considered to pose a higher risk than those from a multitude of other vessels traversing Namibian waters daily on the major commercial shipping routes and fishing areas. Vessels implementing works for this project are generally specialised vessels from reputable contractors that are expected to fully implement international best practice to manage such effects.

The following management measures must be implemented and will be included in the ESMP:

- Routine discharges: Refer to Section 6.3.2.
- Lighting:



- o Reduce the lighting on the project vessels, drilling unit and FPSO, to a minimum compatible with safe operations whenever and wherever possible.
- o Position light sources, if possible and consistent with safe working practices, in places where emissions to the surrounding environment can be minimised.
- Emissions:
 - o Implement a maintenance plan to ensure all diesel motors and generators receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere.
 - o Plan operations efficiently. Optimise rig positioning, rig movement and the logistics (number of trips required to and from the onshore logistics base) in order to lower fuel consumption.
 - o Ensure no incineration of waste occurs within the port limits.
- Notification:
 - o Notify key stakeholders (including the fishing industry), via the Directorate of Maritime Affairs, at least three weeks prior to mobilisation of the drilling unit, installation vessels and FPSO, respectively, in the offshore Venus offshore project area and operations in nearshore transshipment area (i.e. oil transfer from the DPST to a conventional tanker).
 - o Request, in writing, the Ministry of Works and Transport and Department of Maritime Affairs, as well as SANHO, to issue a navigational warning as appropriate (e.g. via Navigational Telex (Navtext) and navigational warnings twice daily on Channel 16 VHF).

6.3.8 Human Health Effects due to Air Emissions from Helicopters during Transit to and from Venus Offshore Project Area

Helicopters will be used to transfer personnel from shore to the Venus offshore project area on a regular basis, and in medical emergencies. During such transits, including take-off and landing at a coastal location (Lüderitz or possibly Oranjemund), the helicopters will emit air pollutants (associated with burning of Jet-A1 (i.e. jet fuel)). Such emissions are common to all aircraft and transient in relation to any one area.

Air emissions associated with project helicopters are not considered to pose a higher risk than other aircraft operating in the region. Helicopters transferring personnel for the project will adhere to the Civil Aviation Act, 2016 (No. 6 of 2016) and associated regulations.

Emissions from helicopters have been included in the air emissions and greenhouse gas inventory compiled for the Air Quality Impact Assessment and Climate Change Risk Assessments (see Appendix P and Appendix Q), however, the impact to human health is considered negligible.

6.3.9 Human Health Effects due to Discharges to Sea in Nearshore Transshipment Area

Discharges considered in this section from a human health perspective include routine discharges and other effluents used during installation and maintenance of the transshipment buoy in the nearshore area. These effluents may contain pollutants and harmful substances which could pose health risks if humans would come into contact with them or ingest them. Most of these discharges are regulated by national law and international conventions, such as MARPOL (see Table 2-3), and dealt with in TotalEnergies company policies.

Although discharges are expected to be minimal and disperse rapidly to undetectable concentrations, potential discharges in the nearshore transshipment area could reach the coast. It is recommended that no routine discharges are permitted within this nearshore area; thereby, avoiding any potential health impacts on coastal receptors.



The following management measures must be implemented and will be included in the ESMP:

- Compile and implement a Waste and Discharge Management Plan that complies with MARPOL standards. Notably:
 - o Prohibit routine discharges in the nearshore transshipment area in compliance with MARPOL regulations.
 - o Prohibit the discharge of oily water (> 15 ppm) as outlined in MARPOL regulations.

6.3.10 Accidental Loss of Equipment at Sea

It is conceivable that some equipment may be lost overboard during vessel manoeuvring and/or installation and production activities. This could result in potential disturbance and damage to seabed habitats and associated fauna where the equipment settles on the seabed (although the Venus offshore project area is typically homogenous, devoid of features as it consists of a smooth seabed), and/or injury or mortality to pelagic and neritic marine fauna due to collision with or entanglement in equipment drifting on the water surface or in the water column. Equipment on the seafloor could also provide a localised area of hard substrate for colonisation by benthic organisms.

Loss of equipment during transit is in principle common to all ocean-going vessels, and it is not expected that the risk of equipment loss is considerably higher, or more consequential, for the project-related vessels that will operate as part of this project.

During installation, project vessels will purposefully lower various types of equipment overboard for placement or activities on the seabed. The risk of accidental loss of equipment is in principle higher during such activities. Given the highly specialised and costly nature of most equipment used during these activities, and the fact that specialized vessels are contracted and crews are specifically trained in their operations, it is expected that all reasonable measures will be taken to prevent equipment loss. The overall number of incidences and, therefore, effect of lost equipment is expected to be very limited, particularly when considered within the broader context of the marine environment, busy shipping traffic and other equipment that is purposefully placed on the seabed.

The following management measures must be implemented and will be included in the ESMP:

- Ensure containers are sealed / covered during transport and loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system.
- Minimise the lifting path between vessels.
- Ensure that procedures include measures to minimise risk of loss of equipment and mitigations should loss occur.
- Maintain an inventory of all equipment (moveable) and undertake frequent checks to ensure items are stored and secured safely on board each vessel.
- Attempt to retrieve lost equipment.
- Undertake a post drilling ROV survey to scan seafloor for any dropped equipment near each well.
- Notify the Directorate of Maritime Affairs of any hazards left on the seabed or floating in the water column, with the dates of abandonment/loss and locations and request that they send out a Notice to Mariners with this information.



6.3.11 Hydrocarbon Leak from Plugged Well

The risk of a leak from permanently abandoned well is very low. Well plugging and abandonment are undertaken to ensure safe closure of non-producing offshore wells. Wells are sealed, plugged, tested for integrity and abandoned according to international best industry practices, as well as TotalEnergies referential which refers to a comprehensive set of internal standards, guidelines, procedures and frameworks the company uses to ensure consistent and compliant practices across its global operations (see Section 2.5). The ultimate goal of these measures is to provide permanent containment of any remaining formation fluids and to prevent migration from the reservoir to the seabed, i.e. isolate any hydrocarbon bearing formations.

The principal technique applied to prevent cross flow between hydrocarbon bearing formations is plugging of the well with cement, thus creating an impermeable barrier between two zones. Depending on the formations encountered, a well may be plugged at multiple locations. In line with industry recommended practices, prior to leaving the location of an abandoned well, all installed barriers will be tested and verified for integrity by a number of methods. The integrity of cement plugs will be validated either by physical tests (i.e. tag or weight test) or pressure tests according to best practices standards and TotalEnergies referential.

Given that the wells will be permanently plugged and abandoned at the end the production, when oil in the reservoir has largely been depleted (with most gas being reinjected into the reservoir), pressures and quantities in the reservoir would be lower than at present and, therefore, a leak from an abandoned production well is highly unlikely. Industry has shown near-zero () occurrence of failure of production wells when abandoned in accordance with industry recommended practices (a frequency of 2.3×10^{-5} per well per year referenced in the Conceptual Decommissioning and Closure Strategy in Appendix S). Thus, no continued monitoring plan for abandoned wells is considered necessary.

For further information on plugging and abandonment, refer to the Conceptual Decommissioning and Closure Strategy in Appendix R, specifically Section 9.3 and 9.4.



7.0 Impact Assessment of Normal Operations

This chapter firstly summarises the results of the modelling studies (including underwater noise, drill cuttings, commissioning fluid, produced water and air quality) and then describes and assesses the potential impacts related to normal operations (e.g., drilling and installation operations, discharge of wastes, production, transshipment, etc.) on the receiving environment.

The methodology used to determine the significance of potential impacts is presented in Appendix D. Mitigation measures to avoid, reduce, remediate or compensate for potential negative impacts are provided, as are optimisation measures to enhance the potential benefits. The impacts that remain following mitigation are assessed and presented as residual impacts. The status of all initial and residual impacts should be considered to be negative unless otherwise indicated.

7.1 Summary of Modelling Results

This section summarises the findings of the, underwater noise (Appendix G), drilling discharge (Appendix H), commissioning effluent (Appendix I), produced water (Appendix J) and air quality (Appendix P) modelling studies that have informed the impact assessment.⁷⁹

7.1.1 Underwater Noise Modelling

Detailed modelling predictions were undertaken for noise emissions from:

- **Impulsive noise**⁸⁰ during drilling operation, namely VSP operations which are sometimes undertaken as part of the conventional wireline logging programme when the well reaches target depth; and
- **Non-impulsive noise**⁸¹, namely immediate and cumulative (continuous) vessel noise exposure during concurrent activities with the use of dynamic positioning systems (DPS)⁸².

The installation and operation of the proposed project are summarised into three phases for the purpose of the noise modelling study, namely: Drilling phase; Construction (drilling and installation) phase; and Production phase.

Noise impact criteria have been established via a review of the most relevant guidelines and literature. These criteria include physiological and behavioural impacts on marine fauna, including marine mammals, turtles, and fish.

Hearing capabilities differ between marine fauna groups, with some more sensitive to low-frequency sounds, while others hear better in the high-frequency range.

Table 7-1 provides a summary based on composite audiograms.

Noise impact zones for physiological injury and behaviour were estimated for different marine fauna groups (see Table 7-3 and) for different concurrent noise source scenarios (see Table 7-2).

⁷⁹ Summaries of oil spill and air quality modelling results relating to unplanned events are provided in Section 8.1.

⁸⁰ *Impulsive noise* is typically very short signals (seconds) and intermittent with a rapid decay back to ambient levels.

⁸¹ *Non-impulsive or continuous noise* refers to a noise event where the pressure level remains above ambient levels during an extended period (minutes to hours), but can vary in intensity with time.

⁸² The results of this modelling study represent the "worst-case" scenarios, with all possible vessels (including active thrusters) operating within the development area during the respective modelled scenarios. This approach ensures that the study accounts for the maximum potential impact on marine faunal hearing groups.



Cumulative impacts were modelled assuming that marine animals do not move away from the sound source and are constantly exposed to either multiple VSP pulses (impulsive noise) or remain within the impact zone caused by non-impulsive underwater noise. Cumulative effects would thus only be expected where the animal does not move away from the noise impacted area and represent the worst-case consideration, for as the exposure time decreases, the impact (and distance to corresponding thresholds) decreases even faster.

Table 7-1: Hearing capabilities of marine fauna groups based on composite audiograms

Marine Species Group	Hearing Capability (Hz)		Peak Hearing Sensitivity (Hz)	
	Minimum	Maximum	Minimum	Maximum
Toothed whales (odontocetes) ¹	150	160 000	20 000	120 000
Beaked whales (ziphiids) ²	5 600	160 000	40 000	50 000
Baleen whales (mysticetes) ³	7	35 000	100	200
Pinnipeds (seals; underwater)	70	>100 000	7 000	30 000
Turtles	50	3 000	100	800
Fishes	10	4 000	100	800

¹Some odontocete species can hear well below this range. ²Based on two studies in which single individuals were tested. ³Based on theoretical evidence only.
Sources: Hipsey & Booth 2012, DoN 2017, Popper and Hawkins 2019

A list of modelling scenarios with the relevant major noise-generating equipment and location was developed based on relevant vessel specifications and the indicative project description and schedule. Key details of the six modelling scenarios are provided in Table 7-2 below.

Table 7-2: Modelling scenarios assessed and relevant noise sources

Scenario	Activity	Key assumptions /considerations
Drilling Phase-1 (UD-1)	Cumulative vessel noise during initial well drilling at Venus offshore project area (non-impulsive noise) <i>Maximum concentration of vessels before the start of subsea equipment installation</i>	- Considers concurrent drilling of three wells in close proximity taking cognisance of the indicative drilling strategy and schedule (which will determine the representative “worst-case” location). - Considers a total of seven vessels, each using dynamic positioning (DPS), working at nearby well locations: - Three drilling units; - Three supply vessels; and - One support vessel (on standby within the larger Venus offshore project area).
Drilling Phase-2 (UD-2)	Noise from VSP of a well during initial drilling at Venus offshore project area (impulsive noise)	- VSP will use 6 active G-Gun, 1200 CUI (3 x 250 CUI + 3 x 150 CUI) source array deployed at an average towing depth of 8 m, and an operating pressure of 2 000 PSI. - VSP is only conducted at selected wells. Modelling VSP for one well is representative of noise impact at any well location due to similar bathymetry and depth across Venus offshore project area.



Scenario	Activity	Key assumptions /considerations
Construction Phase-1 (UC-1)	Cumulative vessel noise during concurrent well drilling and installation of subsea infrastructure at Venus offshore project area (non-impulsive noise)	- Considers installation of subsea infrastructure on the seabed (during the summer campaign) while concurrent drilling of up to three wells continues. - Scenario considers a total of 13 vessels, each using DPS and working throughout the Venus offshore project area: - Seven vessels as per Scenario UD-1 but at different locations; - Three installation vessels; and Three supply vessels for the installation vessels.
Construction Phase-2 (UC-2)	Cumulative vessel noise from well drilling, subsea infrastructure installation and FPSO arrival at Venus offshore project area (non-impulsive noise) <i>Maximum concentration of vessels during the entire project</i>	- Considers arrival of FPSO (towed by up to four tugs) after installation of mooring lines, while subsea infrastructure installation (during summer campaign) and concurrent drilling of up to two wells continue. - Scenario considers a total of 16 vessels, each using DPS and working throughout the Venus offshore project area: - Two drilling units; - Two associated supply vessels; - One drilling support vessel; - Three installation vessels; - Three installation supply vessels; - One medium construction vessel; and - Four tugs (Anchor Handling Tug; AHT). - Scenario applies to a relatively short period, as tugs will progressively disengage from FPSO and depart Venus offshore project area as FPSO is attached to mooring lines. - Tugs used for station keeping (i.e. keeping the FPSO in position while mooring takes place for 1 month). - This scenario was modelled as noise signatures resulting from the combination of different vessels may be quite different. - Note: The presence of a Flotel (DPS vessel, with no need for a tug) for a few weeks at the peak of FPSO installation was discussed. The presence of this vessel is expected to remain comparable to Scenario UC-2 with minimum one drillship + associated supply vessel having left the area.
Production Phase-1 (UP-1)	Cumulative vessel noise during the transfer of oil from FPSO to DPST at Venus offshore project area (non-impulsive noise) <i>Maximum concentration of vessels at Venus offshore project area during the production period</i>	- Considers the ~1 day/week period (at production peak) when the DPST is at the Venus offshore project area to load oil from the FPSO. - Scenario considers two vessels using Dynamic Positioning Systems and operating near the FPSO: - One DPST vessel (80 m from FPSO for oil transfer); and - One support vessel (~500 m from FPSO to supervise exclusion zone and assist). - FPSO does not generate underwater noise as it is moored and does not have thrusters/propellers. - Outside of the loading period, only a support vessel and the FPSO are at the Venus offshore project area. The support vessel will use a combination of drift, repositioning and DPS for positioning, as required at the time. 1 support vessel (permanently on site and occasionally on DPS) at 500 m for supervising the safety zone. 1 DPST (1 day/week on-site with DPS) (no tugs) at 80 m in FPSO North-West.



Scenario	Activity	Key assumptions /considerations
Production Phase-2 (UP-2)	Cumulative vessel noise during the transfer of oil from DPST to conventional tanker at nearshore transshipment area (non-impulsive noise) <i>Maximum concentration of vessels at nearshore location during production period</i>	- Considers the ~1 day/week period (at production peak) when a conventional tanker (CT) is present to load oil stored in the DPST. Both CT and DPST will be moored in tandem. Only DPST will use DPS to move into position, while CT will be assisted into position with tugs. - Scenario considers four vessels operating near each other at the nearshore transfer location: - One DPST using DPS to manoeuvre into position after which it will be moored; - Three port tugs using DPS and supporting the conventional tanker positioning. - Outside of the loading period, the tugs may remain near the location, using a combination of drift, repositioning and DPS for positioning, as required at the time, or leave for port.

A summary of the relevant zones of impact for physiological (auditory injury onset⁸³, permanent hearing threshold shift⁸⁴ and temporary hearing threshold shift⁸⁵) and behavioural responses the various faunal groups are presented in Table 7-3 for VSP operations (single pulse and cumulative 250 pulses) and Table 7-4 for multiple concurrent vessel DPS scenarios (over 24 hours and one-second exposure).

Table 7-3: Maximum exposure impact zones for a VSP source scenario (impulsive noise)

Animal Group	AUD INJ onset 250 pulses	TTS onset 250 pulses	Behavioural response 250 pulses	Behavioural response Single pulse	
	Maximum horizontal distance (m)	Maximum horizontal distance (m)	Maximum horizontal distance (m)	Animal Group	Maximum horizontal distance (m)
LF cetaceans	260	1 260	2 460	Marine Mammals	1 880
PW pinnipeds	60	200	320		
Fish with swim bladder	80	480	NA	Fish	5 480
Turtles	60 ¹	220	NA	Turtles	360
AUD INJ = auditory injury onset. Note: ¹ For turtles, the impact effect is defined as PTS = Permanent hearing threshold shift (NMFS 2024a). TTS = temporary hearing threshold shift. NA = Not applicable, as behaviour response is only assessed in response to a single exposure to impulsive noise.					

⁸³ *Auditory injury onset (AUD INJ)* refers to the point when damage occurs to the inner ear that can lead to tissue destruction as a result of exposure to a sound or pressure event.

⁸⁴ *Permanent hearing threshold shift (PTS)* is a shift in the auditory threshold, which results in permanent hearing loss.

⁸⁵ *Temporary hearing threshold shift (TTS)* is a shift in the auditory threshold, which results in temporary hearing impact.



Table 7-4: Maximum exposure impact zones for multiple concurrent vessel DPS scenarios (non-impulsive continuous noise)

Modelling Scenario	Maximum number of concurrent vessels	Animal Group	AUD INJ onset Continuous Noise 24 hours	TTS onset Continuous Noise 24 hours	Behavioural response one-second Exposure	
			Maximum horizontal distance (m)	Maximum horizontal distance (m)	Animal Group	Maximum horizontal distance (m)
UD-1	7	LF cetaceans	500	16 500	Marine mammals	74 000
		PW pinnipeds	-	5 100	Fish	638
		TU turtles ¹	-	500	Turtles	-
UC-1	13	LF cetaceans	500	21 100	Marine mammals	90 500
		PW pinnipeds	-	12 600	Fish	760
		TU turtles ¹	-	500	Turtles	-
UC-2	16	LF cetaceans	1 600	20 900	Marine mammals	~100 000
		PW pinnipeds	-	4 400	Fish	1 800
		TU turtles ¹	-	1 600	Turtles	-
UP-1	2	LF cetaceans	400	3 900	Marine mammals	38 200
		PW pinnipeds	-	1 700	Fish	400
		TU turtles ¹	-	<15	Turtles	-
UP-2	4	LF cetaceans	1 000	6 400	Marine mammals	8 900
		PW pinnipeds	700	2 800	Fish	1 200
		TU turtles ¹	-	600	Turtles	-

AUD INJ = auditory injury onset. Note: ¹ For turtles, the impact effect is defined as PTS = Permanent hearing threshold shift (NMFS 2024a).
TTS = temporary hearing threshold shift.
A dash indicates the threshold is not reached.



7.1.2 Drill Cuttings Discharge Modelling

This section summarises the results of the drilling discharge modelling study for use in assessing the impacts related to well drilling discharges.

The study used the ParTrack sub-model of the Dose-related Risk and Effects Assessment Model (DREAM), and 8 years metocean data from SAT-OCEAN hindcast dataset (2017 – 2024). The scenarios were based on the project description in Chapter 4.0 and selected to address the most conservative situations:

- **Footprint on the seabed sediment:** The discharges from a well pair (see Figure 7-1) was modelled as considered to be the representative “worst-case” location taking cognisance of the project layout, distance from the coast, proximity of protected areas (including MPAs, EBSAs and Tripp Seamount), water depth and the metocean dataset. This simulation was then transposed for all 20 well pairs to determine the cumulative sediment footprint (thickness stressor).
- **Dispersion plume in the water column:** The simultaneous discharge from three nearby well pairs was modelled (see Figure 7-1).

The model considered:

- **Four seasons:** Season 1: December to February, Season 2: March to May, Season 3: June to August, and Season 4: September to November.
- Potential **stressors** on the seabed and in the water column:
 - **Sediment:**
 - o Oxygen depletion⁸⁶: Hypoxia threshold level of 20% (PNEC -see Footnote).
 - o Burial of organisms by deposition⁸⁷: thickness threshold of 6.5 mm (PNEC – see Footnote).
 - o Change in sediment structure⁸⁸: increase in the median grain-size by more than 116 µm (equivalent to an increase of 1 064%) presents a significant risk (> 5%⁸⁹).
 - o Toxicity of chemicals⁹⁰: considers chemicals classified as insoluble or with P_{ow} , K_{ow} or K_{oc} values exceeding 1 000 ($\log \geq 3$).

⁸⁶ The risk associated with oxygen is related to biodegradation of chemicals and calculated as the difference of oxygen after discharge with that before (undisturbed sediment).

⁸⁷ The risk associated with burial of organisms is measured by the thickness added on seafloor by the discharged compounds that settle.

⁸⁸ The change of grain-size occurs when a new layer is added to the natural sediment, with a different median grain-size.

⁸⁹ Environmental risk is computed by comparing the environmental exposure to the environmental sensitivity; the Predicted Environmental Concentration (PEC) to the Predicted No Effect Concentration (PNEC). When $PEC/PNEC$ equals 1, it related to a risk level of 5%; in which 5% of the community (most sensitive species) may be affected. When $PEC/PNEC > 1$, there is an associated risk. While physical stressors have no concentration, the variable is adapted, however the same logic applies.

⁹⁰ Risk due to the chemicals in the sediment uses $PEC/PNEC$ ratio. Different thresholds are used according to the ecotoxicological data of each component. Chemicals with low partition coefficients (P_{ow} , K_{ow} or K_{oc}) are assumed to fully dissolve in the water column, whereas chemicals with higher values are assumed to form agglomerate particles that settle on the seafloor and potentially impact sediments.



- Water column:
 - o Toxicity of chemicals: thresholds depend on ecotoxicological characteristics of each component.
 - o Physical effects of suspended matter: PNEC for the cuttings of 100 000 ppb (default value in the DREAM model).

Table 7-5 summarises results for the seasons with the largest (worst case) modelled impact extent. The maps show the probability of contamination above defined threshold values.

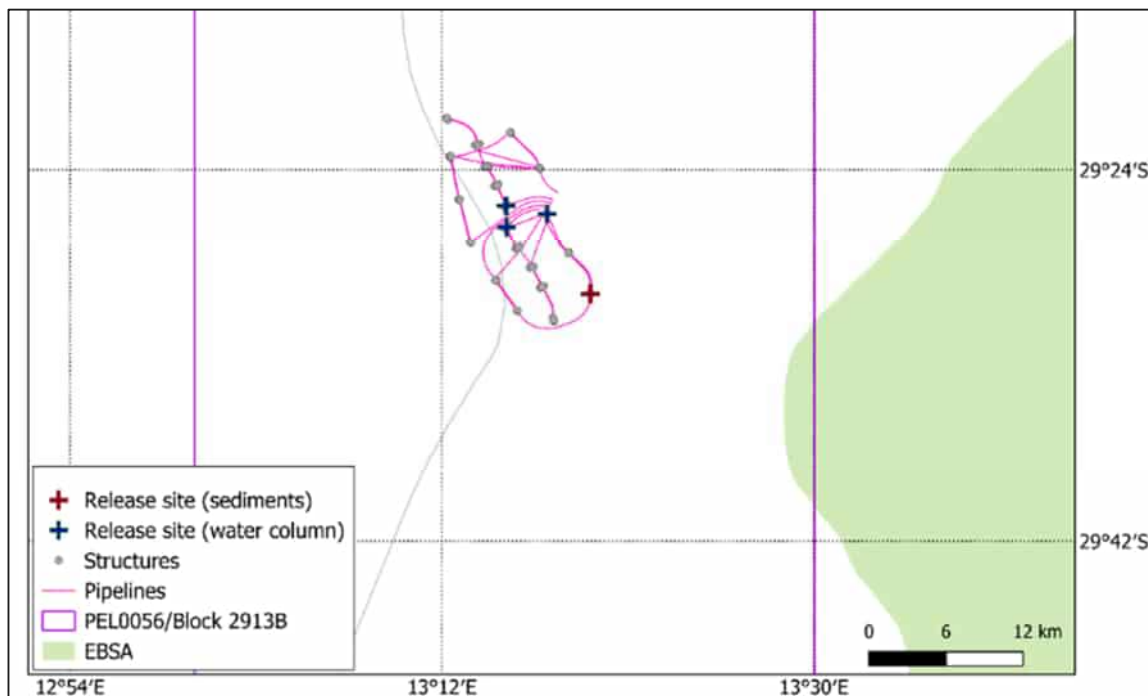


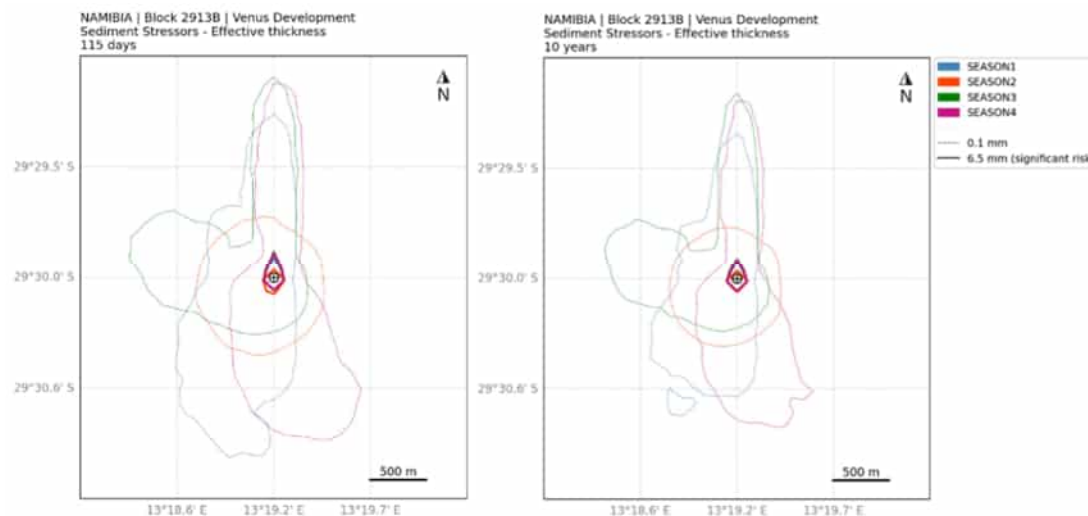
Figure 7-1: Location of the offshore drilling discharge modelling release points for seabed and water column simulations

Source: CLS Basil



Table 7-5: Summary of Drilling Discharge Modelling Results

No.	Stressor	Summary of Results
1	Sediments	
1.1	Sediments – Single well pair	
1.1.1	Burial	The maximum thickness deposit on the seafloor was up to 75 mm in Season 2. There was only a small reduction after 10 years, ranging between 66 mm and 74 mm for all seasons. Significant risk (i.e. thickness > 6.5 mm) reached 270 m to the north in Season 1, 3 and 4. After 10 years, the risk remained at 270 m in Season 3, but reduced to 75 m to 171 m for the other seasons. The furthest distance at which thickness exceeded 0.1 mm was 1.8 km to N, occurring in Season 3.



Effective thickness on the seafloor due to discharge after 115 days (left) and 10 years (right)



No.	Stressor	Summary of Results	
1.1.2	Change to sediment structure (grain size)	A maximum change of 9 887% was observed during the Season 3, occurring 7 days after the commencement of the discharge, specifically due to the discharge from the riserless sections. After 10 years, this value reduced to 7 907% for this season. Significant risk reached 296 m in Season 2. The significant risk distance did not change significantly after 10 years across seasons, except in Season 3 which reduced to 75 m after 10 years.	Grain size change on the seafloor due to discharge after 115 days (left) and 10 years (right)
1.1.3	Oxygen depletion (hypoxia)	Typically, changes in sediment oxygen are observed in the long term, correlating with the biodegradation rate of each component. The minimum oxygen change of -91% occurred after approximately 8 years from the commencement of the discharge, specifically in the Season 2. Significant risk reached 2.2 km in Season 3. The maximum distances occurred 420 days after the commencement of the discharge, since this is linked to the biodegradation of chemicals. There is no risk associated with this stressor after 115 days (end of the simulation). After 10 years, these distances reduced significantly, varying from 573 m to 1.1 km between all seasons.	Oxygen change on the seafloor due to discharge after 115 days (left) and 10 years (right)



No.	Stressor	Summary of Results
1.1.4	Chemical total concentration (toxicity)	At day 115, the maximum concentration was 2 216 420 ppm in Season 2, which then reduced to 2 176 070 ppm after 10 years. This stressor was the greatest contributor to the overall risk. Significant risk reached a maximum distance of 4.9 km in Season 1, right after the discharge. After 10 years, the risk reduced to a maximum of 1.1 km for this season. Following the predominant current directions, the significant risk tended to be distributed mainly towards the W in both Season 2 and 3. While in Season 1 and 4, it tended towards the S and SE, respectively.

NAMIBIA | Block 2913B | Venus Development
Sediment Stressors - Total concentration
115 days

NAMIBIA | Block 2913B | Venus Development
Sediment Stressors - Total concentration
10 years

SEASON1
SEASON2
SEASON3
SEASON4
--- 50 ppm
— 500 ppm

2 km

2 km

13°15.8' E 13°18.4' E 13°20.9' E

13°15.8' E 13°18.4' E 13°20.9' E

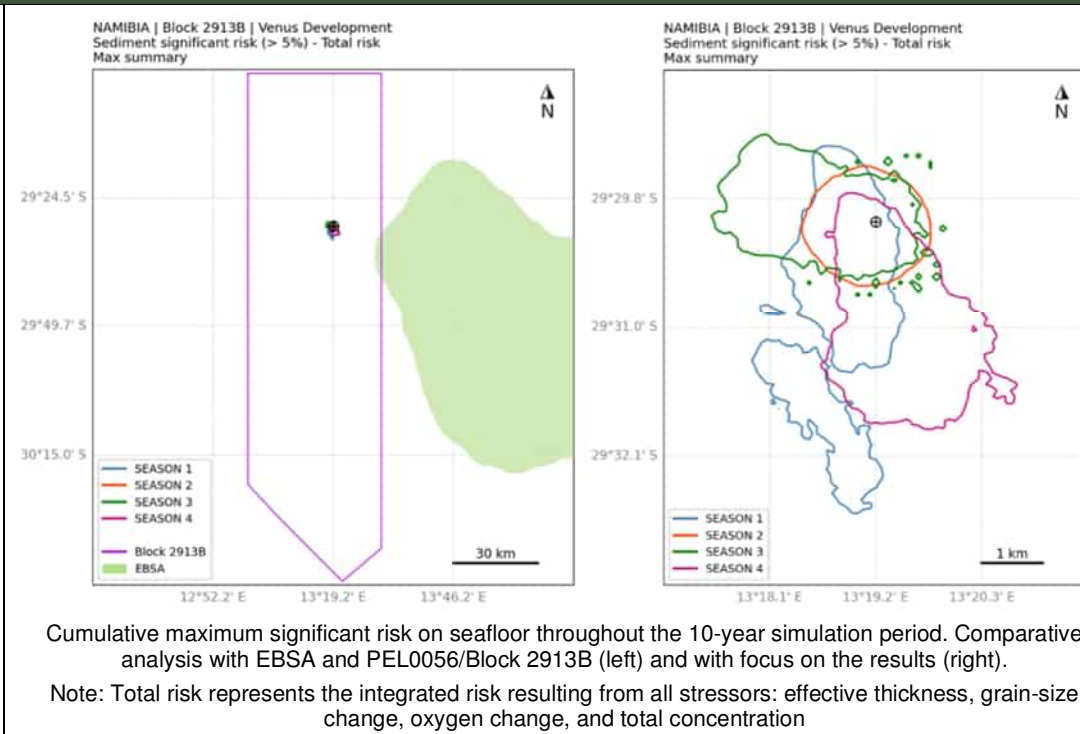
29°26.2' S 29°28.9' S 29°31.6' S

29°26.2' S 29°28.9' S 29°31.6' S

Total concentration (sum of the concentration on sediment of particulate matter, cuttings and chemicals) on the seafloor due to discharge after 115 days (left) and 10 years (right)



No.	Stressor	Summary of Results
1.1.5	Environmental Impact Factor (EIF) ⁹¹	The primary contributor to risk is the mud component EZ MUL NT A, ranging from 43% to 46.5% depending on the season. It has a very low biodegradation rate of 2.7%, the lowest among the components. Oxygen depletion is the next significant contributor, ranging from 39.4% to 44%. These contributions are likely related, with EZ MUL NT A probably causing the greater oxygen depletion in the sediments, due to its low biodegradation rate, thereby persisting for a longer period, resulting in prolonged oxygen depletion. EDC 170 SE component has a small contribution of 9% to 16%, due to its low PNEC (9.8 ppb) and a moderate biodegradation rate (58.6%). The maximum distances for total risk considering all stressors were reached for Season 1 (most frequent current), extending 4.9 km to the S. The maximum area occupied by significant risk was 714 x 10⁴ m² (714 ha) in Season 4 (see adjacent figure). Based on the modelling results for the representative well pair, no significant risk (considering all stressors) was observed reaching the EBSA or Tripp Seamount. The minimum distance of significant risk to sensitive areas was 13 km in Season 4.



⁹¹ The EIF (Environmental Impact Factor) is a quantitative metric used to express the potential environmental impact of a discharge. It quantifies this impact in terms of the area or volume occupied by significant risk, which corresponds to a risk level of $\geq 5\%$. This means the discharge affects 5% or more of the community, typically its most sensitive species. The EIF allows for the evaluation of each component's contribution to the total environmental risk. The computed maximum EIF represents the highest peak value of volume with significant risk observed at any instant throughout the simulation period. In contrast, the time-averaged EIF is the average value calculated across the entire simulation period.

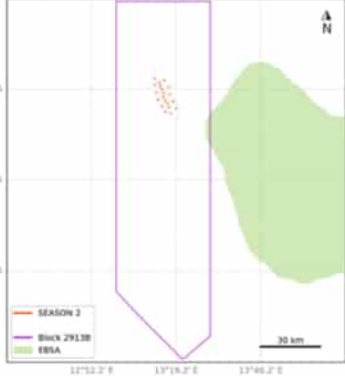
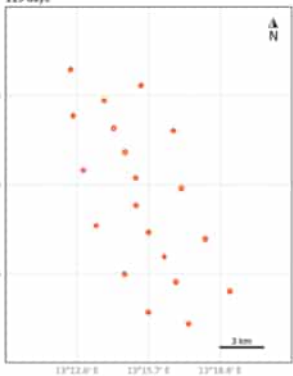
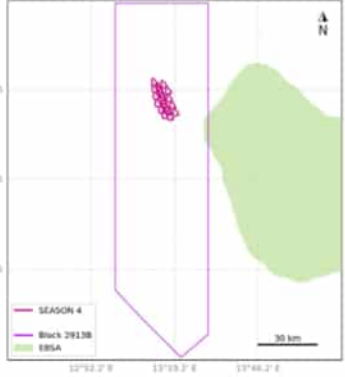
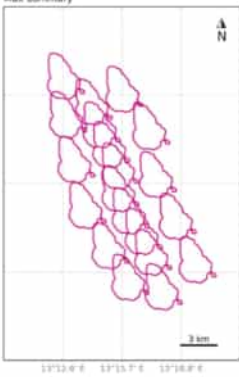


No.	Stressor	Summary of Results												
1.1.6	Sediment summary table: Maximum values associated with the significant risk of each stressor for a representative pair of wells.													
	Stressors	Significant risk ≥ 5%	Season 1 (Dec-Feb)			Season 2 (Mar-May)			Season 3 (Jun-Aug)			Season 4 (Sep-Nov)		
			Most frequent current			Lower current intensity			Higher current intensity			Critical direction to sensitive areas		
			115 d	10 yrs	max	115 d	10 yrs	max	115 d	10 yrs	max	115 d	10 yrs	max
			Max distance (m)											
	Effective thickness	≥ 6.5 mm	270	171	270	171	75	171	270	270	270	270	170	270
	Grain-size change	≥ 1,064 %	75	75	75	296	215	296	215	75	215	75	75	75
	Oxygen change	≤ -20 %	-	992	2 090 (420 days)	-	573	853 (360 days)	-	1 117	2 225 (360 days)	-	922	1 766 (420 days)
	Toxicity of chemicals	insoluble or log Kow ≥ 3	4 780	1 069	4 879	1 289	584	1 289	2 772	1 191	2 772	3 637	1 069	3 782
	Total risk (5% risk)	Direction of max distance												
		S	S	S	W	W	W	W	W	W	SE	SE	SE	
	Computed max EIF	Area (ha)												
		698 (at 111 days)			311 (from 110 to 120 days)			553 (from 110 to 118 days)			714 (from 110 to 113 days)			
	Main stressors	EZ MUL NT A (46%) Oxygen change (44%) EDC 170SE (8.9%)		EZ MUL NT A (42.9%) Oxygen change (39.4%) EDC 170SE (15.5%)		EZ MUL NT A (46%) Oxygen change (41.4%) EDC 170SE (11%)		EZ MUL NT A (46.5%) Oxygen change (40.1%) EDC 170SE (11.9%)						
	Sediment summary table: Maximum values obtained for each stressor at the end of the sediment simulations for a representative pair of well:													
	Stressors	Unit	Season 1 (Dec-Feb)		Season 2 (Mar-May)		Season 3 (Jun-Aug)		Season 4 (Sep-Nov)					
			Most frequent current		Lower current intensity		Higher current intensity		Critical direction to sensitive areas					
			115 d	10 yrs	115 d	10 yrs	115 d	10 yrs	115 d	10 yrs				
			Max distance (m)											
Effective thickness	mm	71.9	70.6	74.9	73.8	67.2	65.9	69.4	68.1					
Grain-size change	%	7 239	7 013	6 221	6 085	8 098	7 907	7 538	7 370					
Oxygen change	%	-10.6	-74.1	-11.6	-89.8	-9.6	-73	-10.8	-74.4					
Toxicity of chemicals	ppm	2 104 050	2 063 110	2 216 420	2 176 070	1 969 770	1 928 070	2 032 140	1 991 630					

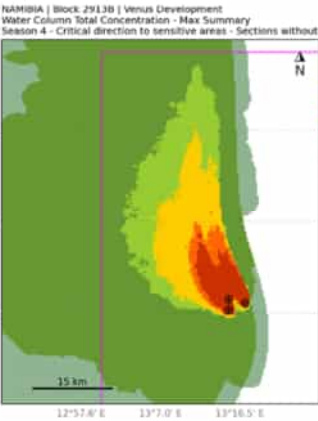
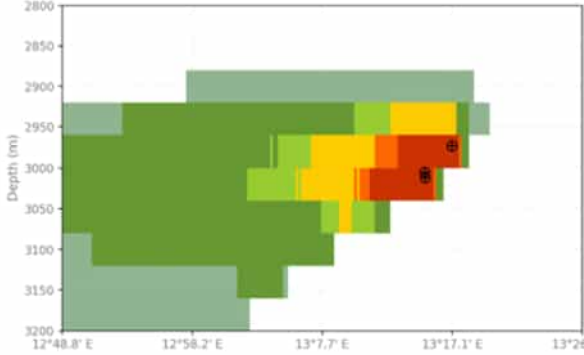
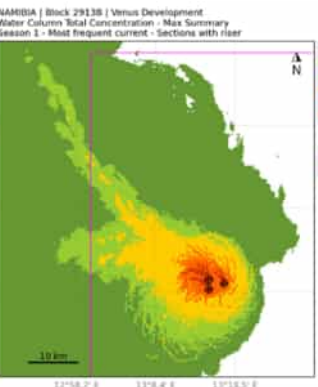
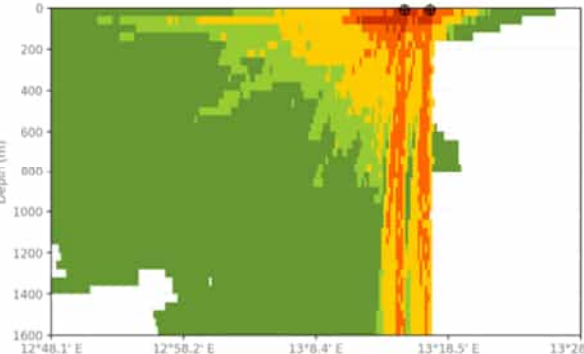


No.	Stressor	Summary of Results
1.2	Sediments – 20 well pairs	
1.2.1	Burial	The integrated thickness results show that overlap for this stressor occurs only for the smallest values, below 0.5 mm thickness. Therefore, there is no overlap of significant risk among the different well pairs. Similarly, no significant differences were observed in the maximum thicknesses found after integrating the results.
NAMIBIA Block 2913B Venus Development Sediment Stressors - Effective thickness Season 1 - Most frequent current 115 days NAMIBIA Block 2913B Venus Development Sediment Stressors - Effective thickness Season 1 - Most frequent current 10 years Effective thickness on the seafloor considering the integration for all well pairs after 115 days (left) and 10 years (right) (Season 1)		

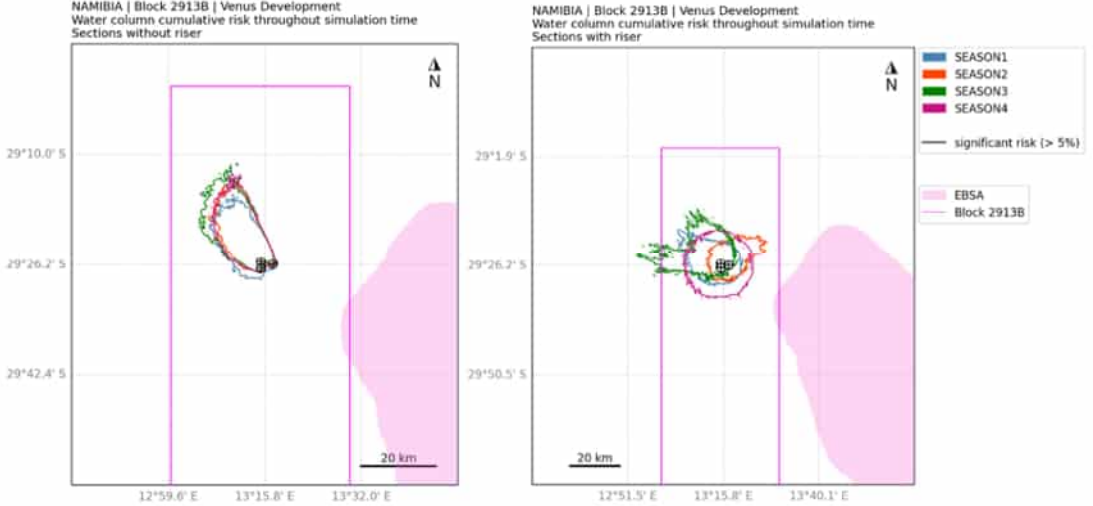


No.	Stressor	Summary of Results
		The area occupied by significant risk related to effective thickness after 115 days was up to 320 x 10⁴ m² (320 ha) in Season 2. There is unlikely to be increased total significant risk towards sensitive areas (EBSA and Tripp Seamount) due to all 20 well pairs. NAMIBIA Block 2913B Venus Development Sediment significant risk (> 5%) - Effective thickness Season 2 - Lower current intensity 115 days  NAMIBIA Block 2913B Venus Development Sediment significant risk (> 5%) - Effective thickness Season 2 - Lower current intensity 115 days  Significant risk of effective thickness on the seafloor considering the integration for all well pairs after 115 days (Season 2). Comparative analysis with EBSA and PEL0056/Block 2913B (left) and with focus on the results (right). NAMIBIA Block 2913B Venus Development Sediment significant risk (> 5%) - Total risk Season 4 - Critical direction to sensitive areas Max summary  NAMIBIA Block 2913B Venus Development Sediment significant risk (> 5%) - Total risk Season 4 - Critical direction to sensitive areas Max summary  Cumulative maximum significant total risk on seafloor throughout the 10-year simulation period (Season 4). Comparative analysis with EBSA and PEL0056/Block 2913B (left) and with focus on the results (right).



No.	Stressor	Summary of Results
2	Water Column - simultaneous discharge from three nearby well pairs	
2.1	Total concentration (particulate matter and toxicity)	The total concentration in the water column was higher during the riserless sections with maximum concentrations reached 342 392 ppb in Season 4 (see adjacent figures). In contrast, the risered sections were significantly lower reaching up to 4 077 ppb in Season 1.   Overall maximum total concentration dispersion integrated over depth (left) and maximum vertical profile (right) for the riserless sections in Season 4   Overall maximum total concentration dispersion integrated over depth (left) and maximum vertical profile (right) for the risered sections in Season 1



No.	Stressor	Summary of Results	
		Significant risk areas (defined as >5%) were primarily observed to the NW for riserless sections and remained confined near the seabed (see adjacent figure left). For risered sections, the distribution of significant risk areas varied by scenario: (see adjacent figure right): to the NW in Season 1, NE in Season 2, W in Season 3, and SW in Season 4. In these cases, the risk occupied mainly the upper water column, reaching greater depths only near the release sites. The maximum distances of significant risk were up to 28.7 km for riserless sections and 31.2 km for risered sections, both during Season 3 (higher current intensity). The risk in the water column is expected to be short-lived, typically lasting periods in the order of days. The longest period with risk > 5% for the riserless sections was 9.8 days and 11.5 days for the risered sections. The maximum distance reached by significant risk persisting for more than one day extended up to 20.6 km (Season 3) for riserless sections and up to 13.6 km (Season 3) for risered sections. There is no occurrence of significant risk reaching the EBSA and the Tripp Seamount.	 Total cumulative risk in the water column throughout the riserless sections (left) and risered sections (right)
2.2	Environmental Impact Factor (EIF)	For the riserless sections, the majority of the risk is attributed to Barite A, which accounts for approximately 75% of the total. Aldacide G (~13%) and Aquagel (~8%) also contribute, but to a lesser extent. Both Barite A and Aquagel are insoluble, non-biodegradable particulate materials discharged in relatively high quantities during the 26" sections. In contrast, Aldacide G is a biodegradable chemical, which has a significant contribution to risk even when released in small quantities. After the riserless discharge is completed, significant risk levels (>5%) typically dissipate within 8 to 10 days. For the risered sections, the chemical EDC-170 SE was the main contributor, accounting for 67% to 96% of the total depending on the season, which is discharged in the greatest mass among all riser section chemicals. In the 17 ½" and 12 ¼" x 13 ½" sections, Barite A also contributed to the EIF, representing around 17% and 27% of the total, respectively. After the risered discharge is completed, significant risk levels (>5%) typically dissipate within to 1.5 days. The maximum average volume over the full simulation occupied by significant risk was up to 16 307 x 10⁵ m³ for riserless sections and up to 689 x 10⁵ m³ for risered sections.	



No.	Stressor	Summary of Results							
2.3	Water column summary table: Maximum values associated with significant risk a representative pair of well:								
Significant risk ≥ 5%		Season 1		Season 2		Season 3		Season 4	
		Most frequent current		Lower current intensity		Higher current intensity		Critical direction to sensitive areas	
		Riserless	Riser	Riserless	Riser	Riserless	Riser	Riserless	Riser
Max distance for cumulative risk (km)		20.8	22.6	24.3	16.6	28.7	31.2	26.4	16.2
Direction of max distance		NW	NW	NW	NE	NW	W	NW	SW
Max distance for risk with duration ≥ 24 h (km)		15.7	9.5	18.2	11	20.6	13.6	18.7	8.4
Max duration (days)		9.8	10	9.2	11.5	7	8.6	7	8.5
Computed max EIF (x10 ⁵ m ³)		41 040	5 544	34 776	6 732	37 728	4 680	33 300	4 392
Time averaged EIF (x10 ⁵ m ³)		16 307	545	15 692	689	13 755	498	13 722	480
Time averaged EIF ≥ 24h (x10 ⁵ m ³)		15 392	80	14 805	177	12 387	65	12 615	36
Water column summary table: Maximum distances obtained for values of total concentration for the representative pair of wells:									
		Season 1 (Dec-Feb)		Season 2 (Mar-May)		Season 3 (Jun-Aug)		Season 4 (Sep-Nov)	
		Most frequent current		Lower current intensity		Higher current intensity		Critical direction to sensitive areas	
Concentration of riserless sections (ppb)		Max distance (km) of concentration							
1 000		11.3		14.9		14.7		15.1	
5 000		6.7		7.9		11.4		8.1	
10 000		4.9		5.7		8.7		6.3	
20 000		3.5		4.1		6.1		5.2	
50 000		2.2		3.0		3.2		3.2	
100 000		1.9		1.9		2.2		2.2	
300 000		1.5		0.0		1.5		1.5	
Concentration of risered sections (ppb)		Max distance (km) of concentration							
50		62.2		28.8		63.3		35.9	
100		47.9		23.1		62.4		21.1	
500		10.1		9.9		19.6		14.8	
1000		7.1		7.0		11.3		11.7	
3 000		2.2		-		-		-	
4 000		1.5		-		-		-	



7.1.3 Commissioning Fluid Modelling

This section summarises the results of the commissioning effluent modelling study for use in assessing the impacts related to the commissioning of the two gas injection (GI) flowlines and possibly four oil production (OP) flowlines during the installation phase.

The study modelled the discharges related to one GI, using the Dose-related Risk and Effects Assessment Model (DREAM) and SAT-OCEAN hindcast dataset (2017 – 2024) and was based on the project description in Chapter 4.0. Main parameters for the modelling are:

- **Release scenario:** The GI commissioning process will occur in three distinct stages (or sequences), namely (1) Flooding, Cleaning, Gauging and Hydrotesting FCGH), (2) Intelligent pigging, and (3) Dewatering and drying. Due to the time delays between the three stages (i.e. 4 - 12 months between stage 1 and 2, and 2 - 4 weeks between Stage 2 and 3) and dispersion of commissioning fluids, the most conservative of the discharge stages was modelled, namely Stage 3: Dewatering and drying:
 - o this involves releasing 1 266 m³ of three components per flowline (i.e. 2 532 m³ in total). The release will be at 100% of the maximum flow or 0.5 m/s (105 m³/h for a 12-inch diameter) over a 12-hour period. The sequence of this stage is as follows:
 - Seawater and components (1 246 m³);
 - Monoethylene Glycol (MEG) (15 m³); and
 - Methanol (5 m³).
- **Release location:** Commissioning effluent will be released offshore from the end of the northern and southern GI pipelines. The end of the southern GI pipeline was selected for modelling, as this is the closest to environmentally sensitive areas, namely EBSA and Tripp Seamount (see Figure 7-2) and if a commissioning process near the seabed is also done for the four OP flowlines, remains the most conservative release location. The release takes place 5 m above the seabed (2 975 m depth), oriented vertically upwards.
- **Four seasons:** Season 1: December to February, Season 2: March to May, Season 3: June to August, and Season 4: September to November.
- Potential **stressors** in the **water column**:
 - Toxicity of chemicals: thresholds depend on ecotoxicological characteristics of each component.

Table 7-6 summarises results for the season with the largest (worst case) modelled impact extent. The maps show the probability of contamination above defined threshold values.



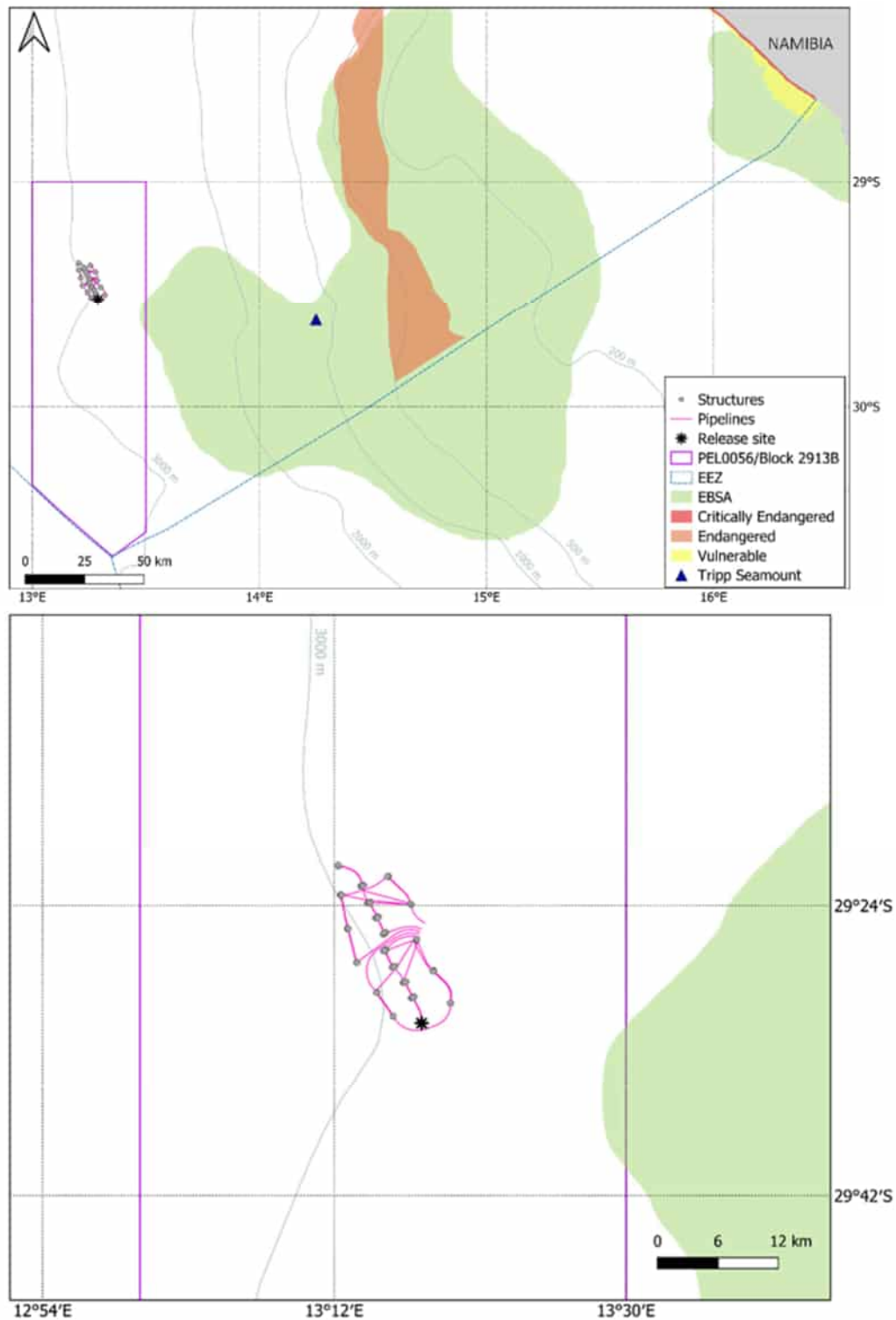


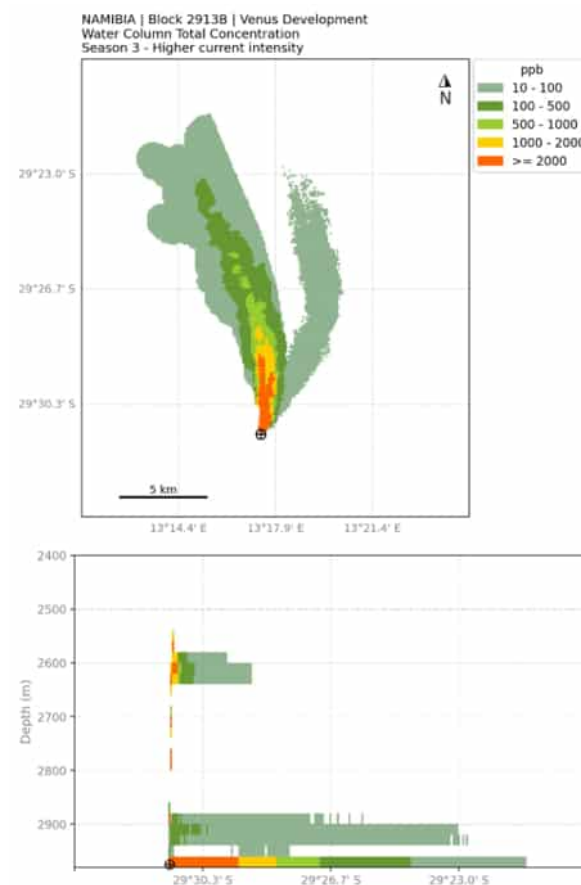
Figure 7-2: Location of the offshore commissioning effluent modelling release point

Source: CLS Basil



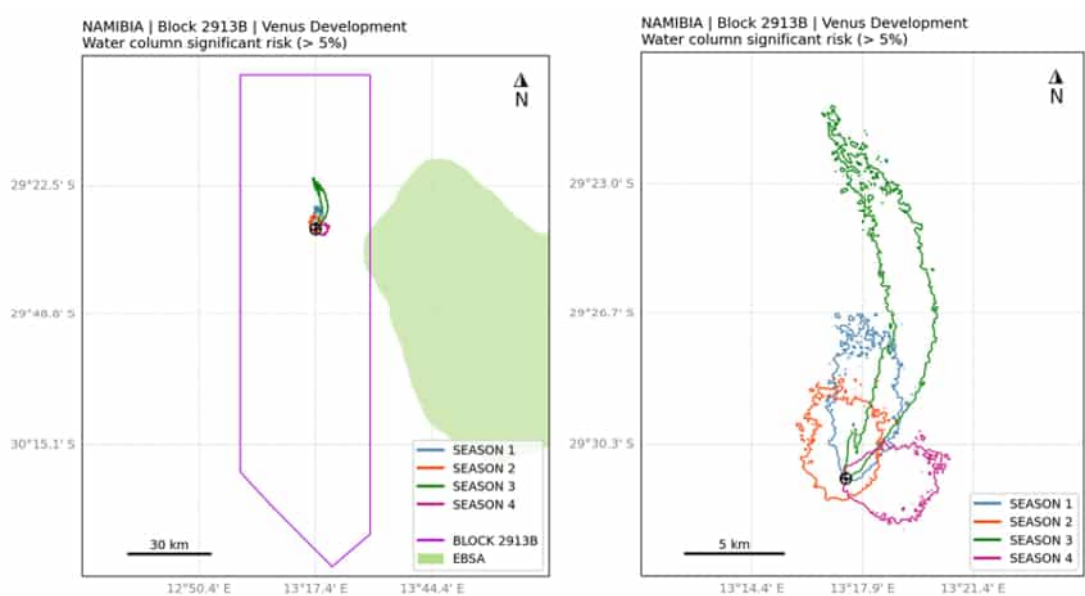
Table 7-6: Summary of Commissioning Effluent Modelling Results

No.	Stressor	Summary of Results
1.	Chemical concentration (toxicity)	Total concentration in the water column was highest during Season 2 due to lower current intensity with a maximum concentration of 1 442 721 ppb. Concentrations above 2 000 ppb, extended over greater distances (19.2 km) in the Season 3 due to higher current intensity (see adjacent figure top). Significant risk areas (defined as >5%) were mainly observed to the N, except for the Season 4 where risk occurred to the E. The plume and its associated significant risk primarily occupied the lower water column (near the seabed) in depths > 2 500 m (see adjacent figure bottom).



Overall maximum total concentration dispersion integrated over depth (top) and maximum vertical profile (bottom) in Season 3



No.	Stressor	Summary of Results
		The maximum distance for cumulative risk was reached in Season 3 with 19.2 km (N) due to higher current intensity. The maximum distance reached by significant risk lasting more than 1 day was 1 km during Season 2. No significant risk was observed reaching the EBSA or Tripp Seamount. The nearest significant risk to the EBSA is located 14 km away. The risk in the water column is short-lived, lasting only a few days. The longest period of significant risk (>5%) at a single grid point was 1.7 days, observed in the Season 2 due lower current intensity.
		 NAMIBIA Block 2913B Venus Development Water column significant risk (> 5%) NAMIBIA Block 2913B Venus Development Water column significant risk (> 5%) Cumulative significant risk in the water column across all seasons. Comparative analysis with EBSA and PEL0056/Block 2913B (left) and with focus on the results (right).
2.	Environmental Impact Factor (EIF) ⁹²	The primary contributor to risk is Tri-Alkyl Quat, which accounts for approximately 85% of the total in all evaluated scenarios. Didecyldimethylamonium chloride is the second most significant contributor, at approximately 7.5%. Both these compounds are part of the seawater treatment cocktail. In 3 days, the risk occurrence has almost entirely dissipated with Season 2 having the longest period ≤ 3.5 days. The maximum volume occupied by significant risk at any instant was up to 1 034 x 10⁶ m³ in Season 3 due to higher current intensity.

⁹² The EIF (Environmental Impact Factor) is a quantitative metric used to express the potential environmental impact of a discharge. It quantifies this impact in terms of the area or volume occupied by significant risk, which corresponds to a risk level of ≥ 5%. This means the discharge affects 5% or more of the community, typically its most sensitive species. The EIF allows for the evaluation of each component's contribution to the total environmental risk. The computed maximum EIF represents the highest peak value of volume with significant risk observed at any instant throughout the simulation period. In contrast, the time-averaged EIF is the average value calculated across the entire simulation period.



No.	Stressor	Summary of Results			
3.	Summary table:				
	Significant risk > 5%	Season 1	Season 2	Season 3	Season 4
		(most frequent current)	(lower current intensity)	(higher current intensity)	(critical direction to sensitive areas)
	Max distance for cumulative risk (km)	9.3	5.3	19.2	5.4
	Direction of max distance	N	N	N	E
	Max distance for risk > 1 day (km)	-	1.0	-	0.77
	Max duration (days)	0.9	1.7	0.6	1.0
	Computed max EIF (x10 ⁵ m³)	922	908	1 034	972
	Time averaged EIF (x10 ⁵ m³)	336	327	368	309
	Time averaged EIF > 1 day (x10 ⁵ m³)	-	53	-	13
	Main stressors	Tri-Alkyl Quat (85.2%)	Tri-Alkyl Quat (84.6%)	Tri-Alkyl Quat (85.5%)	Tri-Alkyl Quat (85.0%)
		Didecyldimethylammonium chloride (7.5%)	Didecyldimethylammonium chloride (7.7%)	Didecyldimethylammonium chloride (7.2%)	Didecyldimethylammonium chloride (7.5%)



7.1.4 Produced Water Modelling

This section summarises the results of the Produced Water modelling study for use in assessing the impacts related to the discharge of treated produced water from the FPSO along the production life. The produced water is expected to be discharged continuously into the ocean. However, since continuous simulation is not feasible, a 30-day discharge period was chosen to capture a representative range of hydrodynamic variability (a full lunar cycle).

The study used the Dose-related Risk and Effects Assessment Model (DREAM) and SAT-OCEAN hindcast dataset (2017 – 2024) and was based on the project description in Chapter 4.0. Main parameters for the modelling are:

- **Release scenario:** Discharge of produced water for a period of 30 days at a steady flow rate 1 590 m³/day (47 700 m³ in 30 days) through a 14-inch pipe located 15 m below sea surface, oriented vertically downwards.
- **Release location:** Proposed offshore location of the FPSO (see Figure 7-3).
- **Four seasons:** Season 1: December to February, Season 2: March to May, Season 3: June to August, and Season 4: September to November.
- Potential **stressors** in the **water column**:
 - Toxicity of chemicals: thresholds depend on ecotoxicological characteristics of each component (continuous addition of scale and corrosion inhibitors, with a biocide added for 5 hours every 7 days).

Table 7-7 summarises results for the season with the largest (worst case) modelled impact extent. The maps show the probability of contamination above defined threshold values.

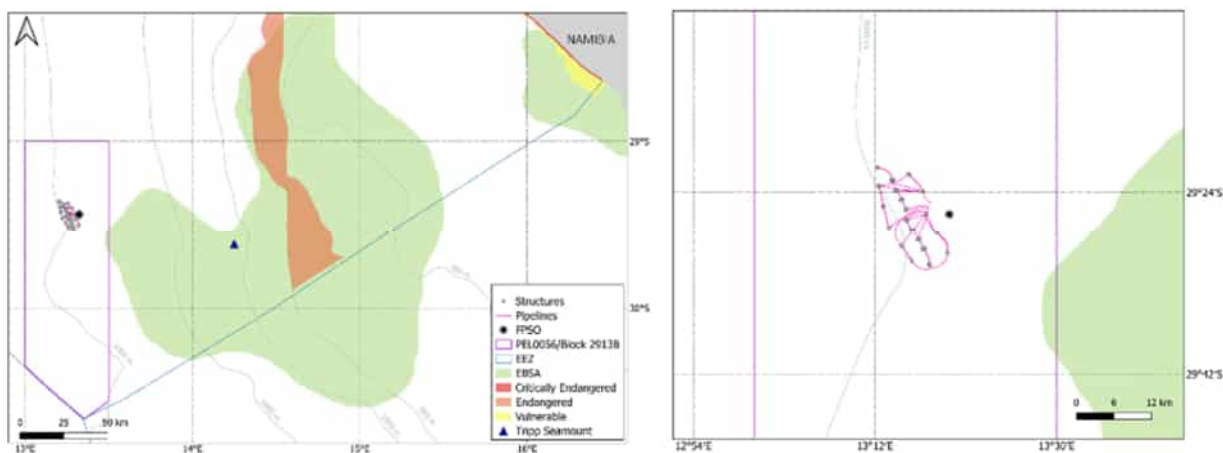


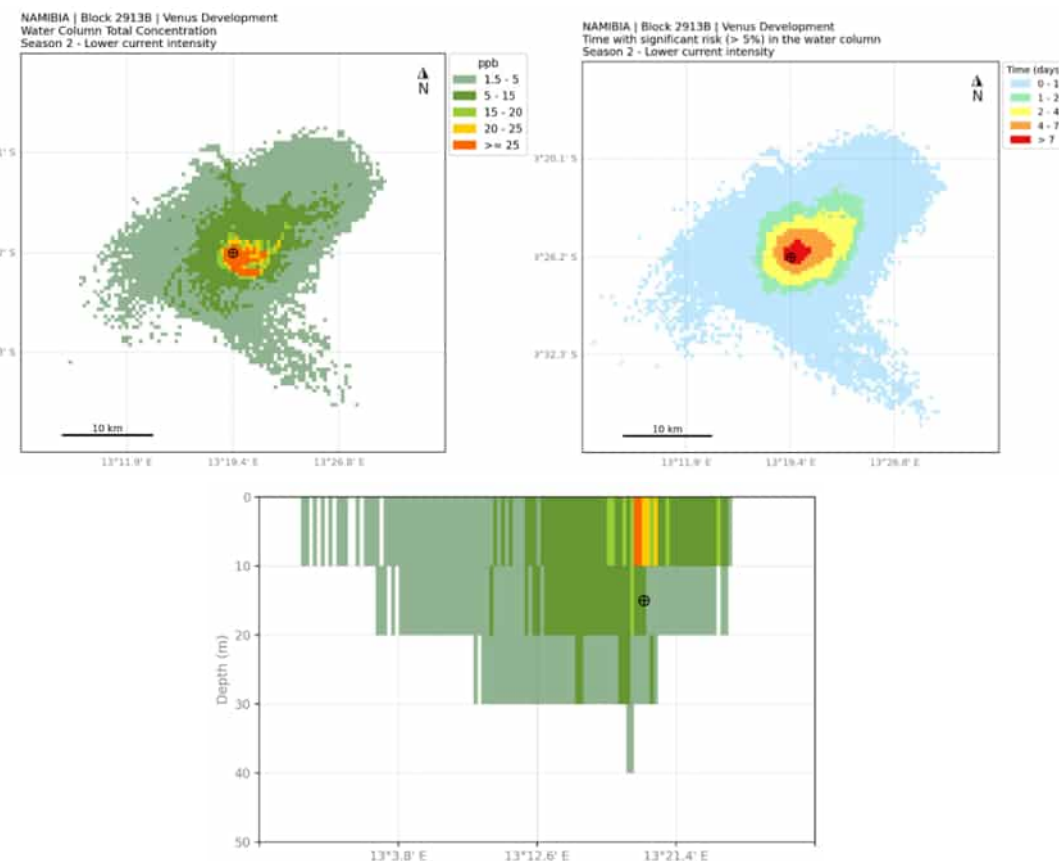
Figure 7-3: Location of the offshore produced water modelling release point from the FPSO

Source: CLS Basil



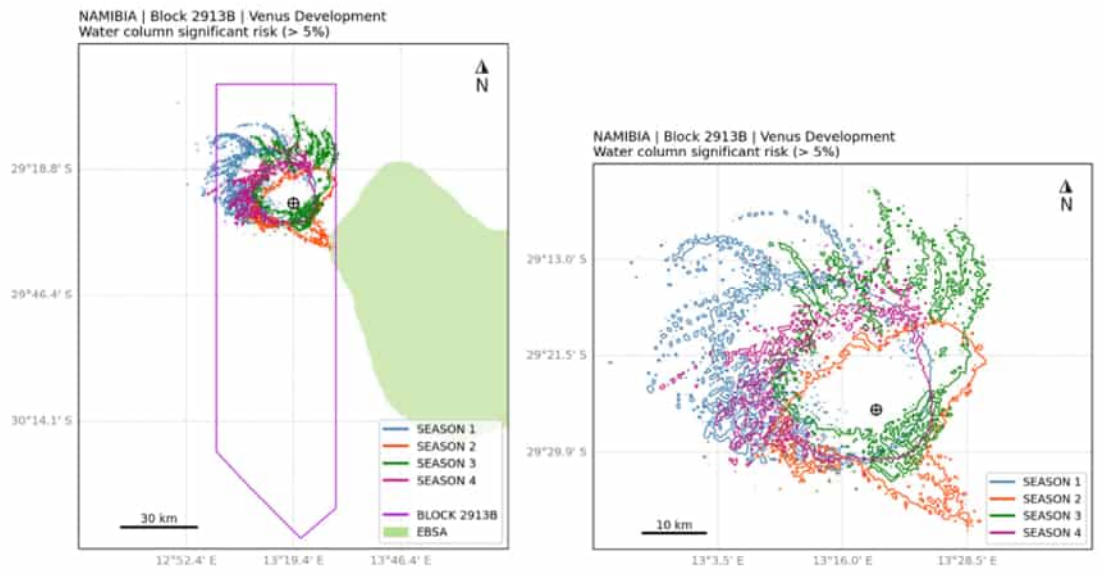
Table 7-7: Summary of Produced Water Modelling Results

No.	Stressor	Summary of Results
1.	Chemical concentration (toxicity)	Total concentration in the water column was highest during Season 2 due to lower current intensity with a maximum concentration of 68 ppb at the release point. Significant risk areas (defined as $\geq 5\%$) were observed in different directions, mainly towards NW/N/W, except for Season 2 which has driven towards SE (see adjacent figure, top left). The maximum distance reached by significant risk lasting more than 1 day was 10.5 km during Season 2 (see adjacent figure, top right). The plume and its associated significant risk primarily occupied the upper water column (near the surface), not reaching depths > 40 m (see adjacent figure, bottom).



Overall maximum total concentration dispersion integrated over depth in Season 2 (top left), time with significant risk in Season 2 (top right) and maximum vertical profile in Season 4 (bottom)



No.	Stressor	Summary of Results	 Cumulative significant risk in the water column across all seasons. Comparative analysis with EBSA and PEL0056/Block 2913B (left) and with focus on the results (right).
		The maximum distance for cumulative risk was reached in Season 1 with 62.3 km (NW) due to higher current intensity. During Season 2, which has a lower current intensity, the cumulative risk extended up to 25.1 km (SE). The risk in the water column is short-lived, lasting only a few days. The longest period of significant risk (>5%) at a single grid point was 29.4 days, observed in the Season 2 due lower current intensity which leads to higher concentrations. Season 1 (higher current intensity) showed the shortest duration with 9 days. No significant risk was observed reaching the EBSA, except marginally in Season 2, with a low probability of occurrence (< 37%), and extending for a small portion of ~2 km within the area. No significant risk reaches Tripp Seamount.	
2.	Environmental Impact Factor (EIF)	The primary contributor to risk is Pyridinium (and other components), which accounts for approximately 40% of the total in all evaluated scenarios. Fatty acids (and other components) is the second most significant contributor, at approximately 35.5%. Both are part of the corrosion inhibitor compounds. The maximum volume occupied by significant risk at any instant was up to 3 728 x 10⁵ m³ in Season 2 due to lower current intensity which leads to higher concentrations.	



No.	Stressor	Summary of Results			
3.	Summary table:				
		Season 1	Season 2	Season 3	Season 4
	Significant risk $\geq 5\%$	(higher current intensity)	(lower current intensity)	(critical direction to sensitive areas)	(most frequent current)
	Max distance for cumulative risk (km)	62.3	25.1	40.5	35.1
	Direction of max distance	NW	SE	N	W
	Max distance for risk > 1 day (km)	2.1	10.5	5.5	4.0
	Max duration (days)	9.0	29.4	24.7	19.5
	Computed max EIF ($\times 10^5 \text{ m}^3$)	1 024	3 728	1 472	2 064
	Time averaged EIF ($\times 10^5 \text{ m}^3$)	240	848	456	445
	Time averaged EIF > 1 day ($\times 10^5 \text{ m}^3$)	25	553	107	69
	Main stressors	Pyridinium, (...) (37.3%)	Pyridinium, (...) (43.6%)	Pyridinium, (...) (38.4%)	Pyridinium, (...) (40.3%)
		Fatty acids, (...) (34.8%)	Fatty acids, (...) (36.4%)	Fatty acids, (...) (35.2%)	Fatty acids, (...) (35.5%)



7.1.5 Air Quality Modelling

Atmospheric dispersion modelling simulates the transport and fate of pollutants emitted into the atmosphere. Dispersion modelling is a tool for assessing the spatial and temporal patterns of ground-level pollutant concentrations in the air originating from point, line, area, and volume emission sources.

A CALPUFF dispersion modelling assessment was conducted for one nearshore location within the transshipment area (namely Alternative 1 in Figure 4-29) to understand the dispersion of emissions (SO_2 , NO_x/NO_2 , CO, PM and NMVOC with a benzene speciation (where possible)) from **routine crude oil transfer operations** (i.e. fuel combustion and product loading) (see Appendix P for further information).

Sensitive receptors⁹³ within ~20 km of the nearshore transshipment area (Alternative 1) were selected for discrete modelling. The proximity of these receptors to source is shown in Figure 7-4. The discrete sensitive receptors selected for assessment are listed in Table 7-8. These include the nearest sensitive receptors (i.e. schools, households, medical facilities, etc.) in each cardinal direction. In air quality modelling, a discrete sensitive receptor refers to a specific, fixed location where people or the environment may be particularly vulnerable to air pollution, and where pollutant concentrations are modelled to assess potential health or environmental impacts. For low level or fugitive emissions sources, air quality impacts decrease with distance from the source.

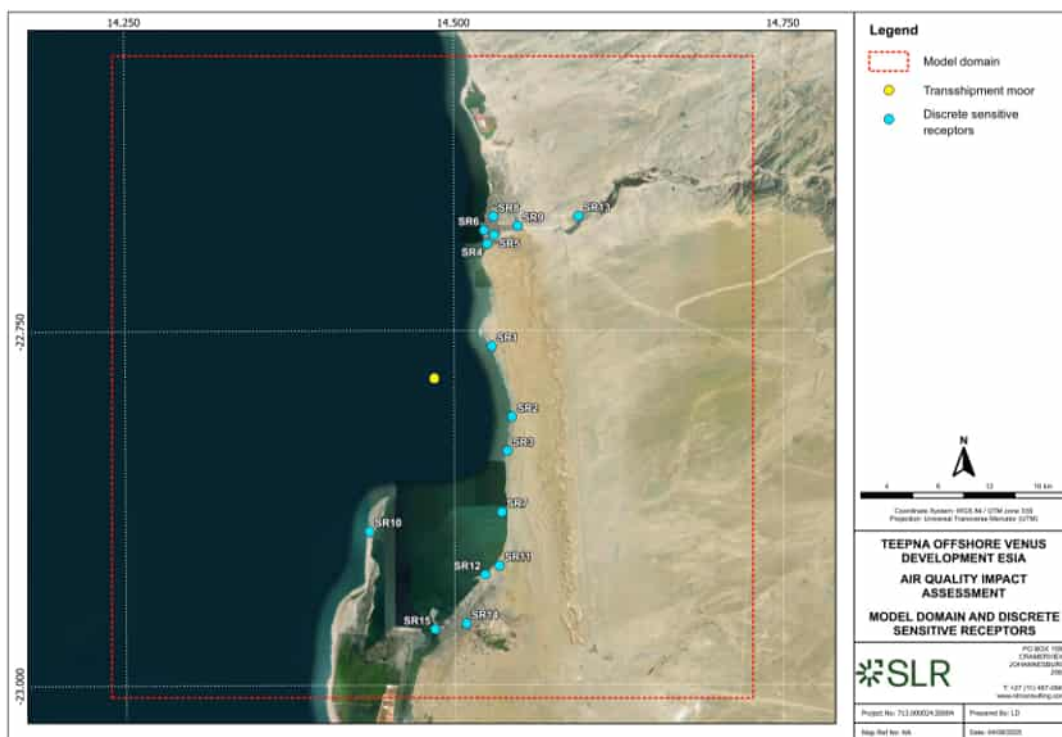


Figure 7-4: Model domain, Alternative 1 modelling location and discrete sensitive receptor locations

⁹³ In air quality modelling, a discrete sensitive receptor refers to a specific, fixed location where people or the environment may be particularly vulnerable to air pollution, and where pollutant concentrations are modelled to assess potential health or environmental impacts.



Table 7-8: Discrete sensitive receptors within 20 km of the nearshore transshipment area (Alternative 1)

ID	Receptor name	Sensitivity type	Constituency	Direction from Source	Distance from Nearshore Alternative 1	Latitude (S)	Longitude (E)
SR1	Coastline	Ecological	Walvis Bay Rural	ENE	4.3	-22.76095	14.52876
SR2	Langstrand	Residential	Walvis Bay Rural	ESE	6.2	-22.8113	14.54393
SR3	Dolphin Park Theme Park	Recreational	Walvis Bay Rural	SE	7.8	-22.83522	14.54041
SR4	Swakop River Mouth	Residential / Ecological	Swakopmund	NNE	10.7	-22.68905	14.52543
SR5	SFC Sportsclub	Recreational	Swakopmund	NNE	11.4	-22.68297	14.53064
SR6	Namib Primary School	School	Swakopmund	NNE	11.6	-22.6796	14.52295
SR7	Bird Island	Ecological	Walvis Bay Rural	SSE	11.7	-22.87833	14.53593
SR8	Swakopmund State Hospital	Medical	Swakopmund	NNE	12.8	-22.66992	14.53012
SR9	Shofar Christian Church	Religious	Swakopmund	NE	12.8	-22.67655	14.54855
SR10	Pelican Point Lighthouse	Ecological	Walvis Bay Rural	SSW	13.7	-22.89183	14.43538
SR11	Ocean View Private Academy	School	Walvis Bay Rural	SSE	15.6	-22.91598	14.5341
SR12	Independence Beach	Recreational	Walvis Bay Urban	SSE	16	-22.92237	14.52335
SR13	Rossmund Estate	Residential	Swakopmund	NE	16	-22.66983	14.59478
SR14	North Public Hospital	Medical	Walvis Bay Urban	S	19.6	-22.95679	14.50884
SR15	Walvis Bay Tennis Courts	Recreational	Walvis Bay Urban	S	20	-22.96075	14.48503



In the absence of Namibian standards, where applicable, predicted concentrations have been evaluated against their respective short-term (i.e. 1-hour, 8-hour and 24-hour) World Health Organisation air quality guidelines (WHO AQG) or Texas Commission on Environmental Quality (TCEQ) Acute Exposure Guideline Level-1 (TCEQ AEGL-1) thresholds as product transfer is completed within 24 hours.

Key findings related to ambient pollutant concentrations from routine transfer activities (i.e. fuel combustion by vessels and product loading) at the nearshore transshipment area (Alternative 1) are as follows:

- **SO₂**: 24-hour ambient concentrations (Figure 7-5) do not exceed the WHO AQG (40 µg/m³) beyond 250 m from the source; thus, the **area of exceedance does not reach the shore**. No WHO guideline exists for 1-hour averaging.
- **NO₂**: 1-hour concentrations (Figure 7-6) remain below the WHO AQG (200 µg/m³) beyond 1.5 km, and 24-hour concentrations fall below the WHO AQG (25 µg/m³) beyond 6.5 km. **Exceedance areas do not reach the shoreline** or intersect land-based sensitive receptors due to the NNE direction of the plume.
- **CO**: Ambient concentrations **remain well below** all WHO AQG levels for 1-hour (35 000 µg/m³), 8-hour (10 000 µg/m³), and 24-hour (4 000 µg/m³) averaging periods across the model domain.
- **NMVOC**: 1-hour concentrations **do not exceed** the TCEQ AEGL-1 guideline for benzene (168 000 µg/m³). This is considered conservative because NMVOC includes multiple compounds, while the TCEQ guideline applies only to benzene.
- **Benzene**: 1-hour concentrations **do not exceed** the TCEQ ^{EM}HBAL acute exposure guideline of 1 160 µg/m³ (a “safe” level for acute exposure).
- **PM**: 24-hour ambient concentrations (Figure 7-7) **do not exceed** the PM_{2.5} WHO AQG (15 µg/m³) (i.e. the most stringent guideline across particulate size fractions).

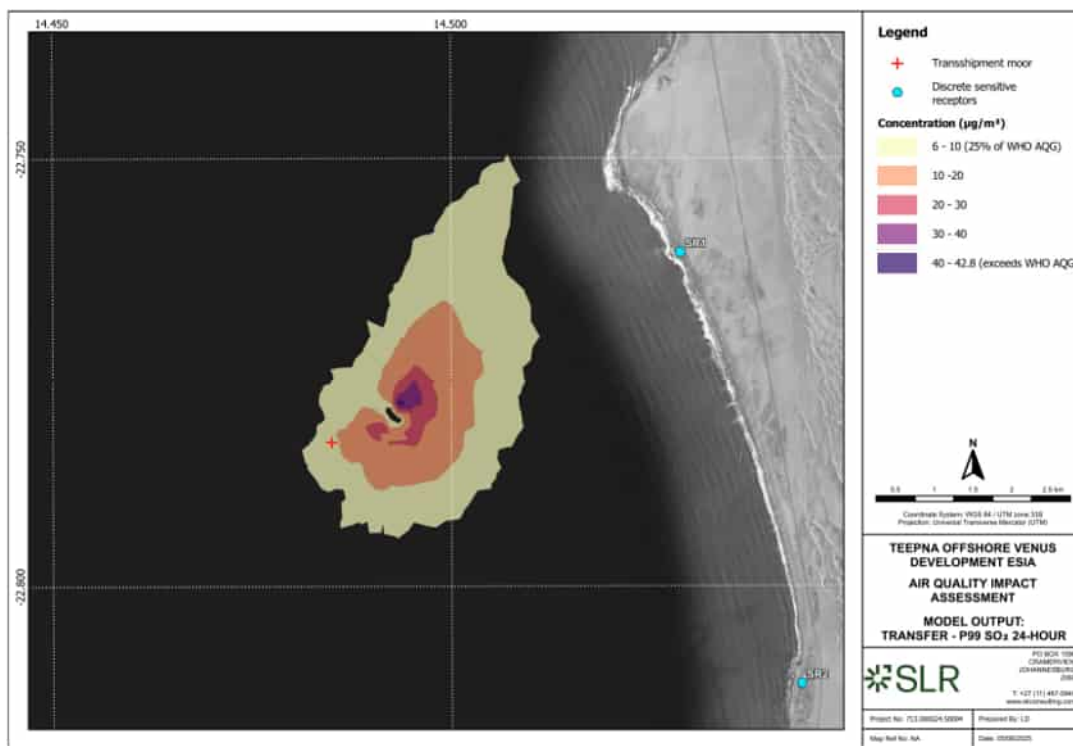


Figure 7-5: Transfer - P99 24-hour SO₂ (µg/m³)



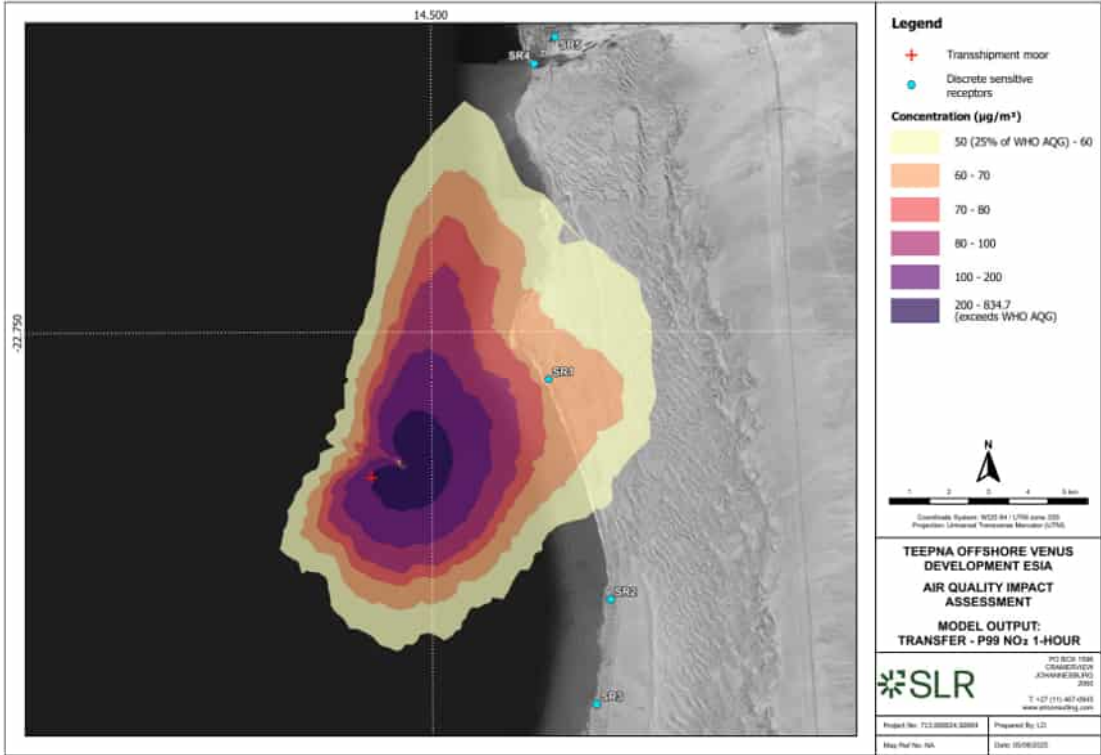


Figure 7-6: Transfer - P99 1-hour NO₂ ($\mu\text{g}/\text{m}^3$)

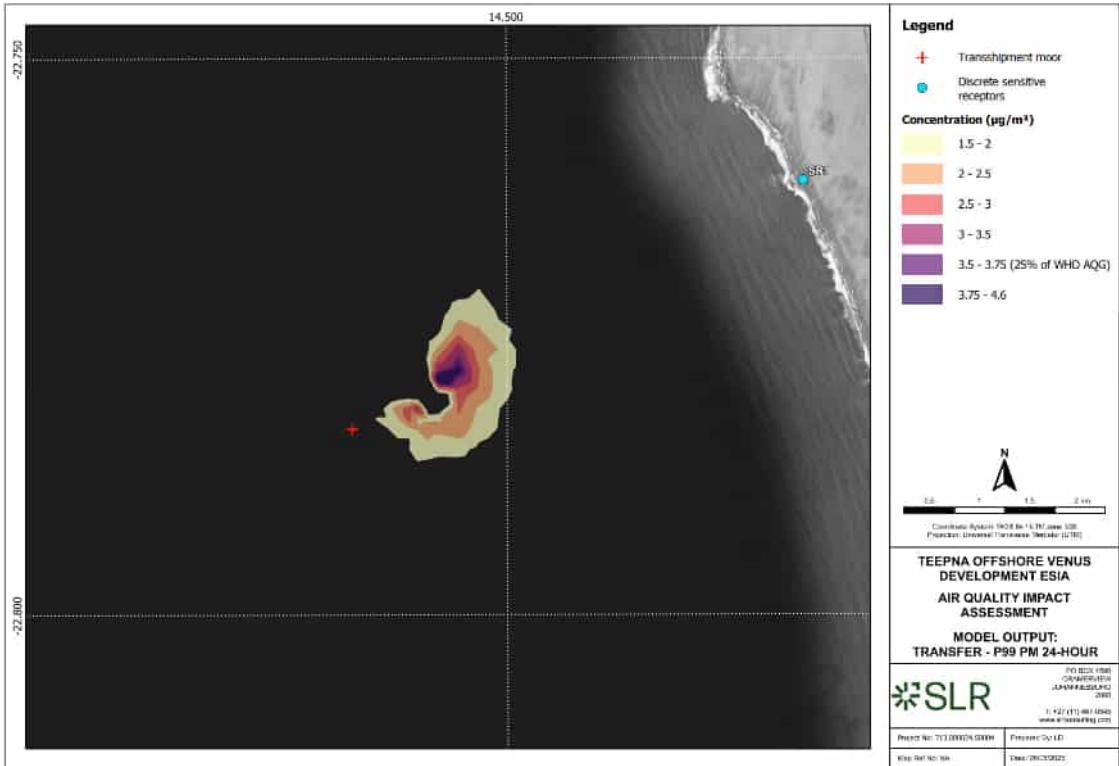


Figure 7-7: Transfer - P99 24-hour PM ($\mu\text{g}/\text{m}^3$)



7.2 Marine Ecology Impacts

This section provides a summary of the Marine Ecology Impact Assessment report provided in Appendix L.

7.2.1 Seabed and Benthic Fauna Effects

7.2.1.1 Source of Impact

The project activities that may impact the seabed and cause smothering and/or disturbance of benthic fauna are summarised in the table below:

Aspect	Drilling & Installation	Production	Decommissioning
Seabed disturbance from well drilling and installation of well infrastructure	X		
Discharge of drill cuttings, mud and residual cement	X		
Seabed disturbance from installation and commissioning of subsea infrastructure at Venus offshore project area	X		
Seabed disturbance from installation of FPSO moorings / anchors (at Venus offshore project area and nearshore)	X		
Seabed disturbance from decommissioning of well and subsea infrastructure			X
Presence of infrastructure on seabed	X	X	X

Project Controls⁹⁴

The following project controls and management measures that will reduce potential impacts on the benthic fauna are already embedded into project description (as well as captured in the ESMP). Implementation of these controls has been considered in the pre-mitigation impact rating.

Well drilling and installation of well infrastructure:

- Drilling units will be equipped with DPS to maintain their position precisely over the drill site (no anchoring).
- Contractors will ensure that drilling is undertaken in a manner consistent with good international industry practice and Best Available Techniques (BAT).
- In addition to the previous offshore environmental and geophysical surveys (see Section 5.2), which have increased the understanding of the receiving environment within the Venus offshore project area, pre-drilling seabed ROV surveys will be undertaken to confirm a clear unobstructed drill site. Wells will be sited to avoid known and/or identified (through environmental, geophysical and/or ROV surveys) sensitive or potentially vulnerable hardground habitats, as the preference will be to have a level surface area to facilitate spudding and installation of the wellhead.
- During the risered drilling stage, a low toxicity Group III NADF will be used/identified. In this instance, an “offshore treatment and disposal” process will be implemented

⁹⁴ Project Controls are the physical or procedural controls that are planned as part of the project (i.e. they are embedded into the project design).



(i.e. cuttings will be treated offshore to reduce average oil content to <6.9% Oil on Cutting (OOC) and discharged overboard).

- Cuttings will be discharged at least ~10 m below surface during riser drilling to reduce dispersion of the cuttings in the surface currents.
- Drilling fluid volumes will be continuously monitored to detect any unexpected changes (during the riserless and riser drilling stages). Any unexpected changes in volume will immediately be diagnosed, assessed and mitigated.
- NADF will be recovered to be recycled or disposed of. Rigs will be equipped with a fully watertight floor and efficient closed loop systems to optimise the fluid re-circulation and to reduce losses. It is forbidden to discharge pure NADF to the environment.
- Chemicals will be selected according to the following criteria: lowest toxicity, lowest bioaccumulation potential and highest biodegradation and must be in compliance with applicable regulations such as Regulation (EC) N°1907/2006 for Europe.
- Offshore, chemicals will be selected according to a pre-screening scheme based on the OSPAR methodology in force (refer to OSPAR Recommendation 2008/1) and provided with their Material Safety Data Sheets (MSDSs).
- Release weight of BOP onto wellhead in steps in order to ensure wellhead assembly strength by monitoring alignment (bullseye installed on BOP) and undertake Periodic Pressure and Function tests to ensure BOP integrity.
- Daily visual checks of BOP will be completed with ROV during drilling.
- Final ROV clearance survey.

Installation of subsea infrastructure and anchors:

To ensure that subsea components are accurately placed on the seabed detailed environmental and geophysical surveys of the seabed have been conducted, which has confirmed the seafloor in the Venus offshore project area is typically homogenous, devoid of features (see Section 5.2). Furthermore, the following techniques and equipment are proposed:

- Installation vessels will be equipped with DPS to maintain their position precisely over the installation site (no anchoring).
- ROVs equipped with cameras and manipulator arms will be used to assist in the precise placement and connection of subsea equipment and infrastructure.
- Acoustic Positioning Systems that use acoustic signals will be used to determine the exact location of subsea equipment. Transponders will be placed on the seabed and on the equipment, and the signals are then used to triangulate the position with high accuracy.
- Pre-lay Guidance Systems will be used for the installation of flowlines and umbilicals, using a combination of GPS, acoustic positioning and ROVs, to ensure the lines are laid along the predetermined path.

Decommissioning activities:

- A conceptual decommissioning and closure plan (Appendix S) has been compiled as part of the ESIA. This conceptual strategy will be refined and updated as new data becomes available during the operational phase, including outcomes from a Net Environmental Benefit Analysis (NEBA), which will determine what infrastructure is recovered and what is abandoned, stakeholder engagement and ongoing environmental monitoring. Namibian law requires that the Decommissioning and



Closure Plan be revised on a date one year before the estimated date on which 50% of the estimated recoverable reserves of petroleum are produced.

- At present, it is anticipated that the decommissioning will involve the following key aspects (refer to provisional Closure and Decommissioning plan (Appendix S) compiled for the ESIA for further detail):
 - o Flush and clean the subsea network from the FPSO before disconnection of the risers and umbilicals.
 - o Disconnect the FPSO from the mooring system, recover top chains and mooring lines. Bottom chain and mooring piles may remain in the seabed to limit sediment disturbance and GHG linked to the pile removal operation.
 - o FPSO to be towed to an approved recycling facility for cleaning and recycling if it cannot be re-used, in line with the IMO Hong Kong Convention⁹⁵ and applicable regulations for transboundary waste transfer, ensuring that the FPSO will be recycled by facilities that are compliant with the IMO Convention standards, EU-SRR Regulations standards and IOGP recommendations.
 - o Removal of underwater / seabed installations, including risers, flowline and ILT / FLET, jumpers, Xmas trees and umbilicals, shall be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed.
 - o Plug and abandonment of wells following standard procedures. Cement plugs will be used to isolate the wells. All cement plugs will be pressure / weight tested. Wellheads will not be recovered as they are in water depths more than 500 m (in line with the Operator's internal standards).
 - o Mooring lines from FPSO and nearshore transshipment buoy will be recovered and recycled onshore. Following the results of the comparative assessment and subject to local authorities approval, anchor pile and anchor / bottom chain attached to it (all below the mud line) will be left in place to minimise sediment disturbance.

7.2.1.2 Impact Description

Apart from Sink et al. (2010), who reported significant differences in benthic infaunal assemblages at distances up to 250 m from a wellhead in ~120 m water depth off Mossel Bay in South Africa, there are few studies that have examined the impacts of hydrocarbon infrastructure and well drilling on deepwater benthic communities in southern Africa. Although the benthic biota of the outer shelf, continental slope and beyond into the abyss are poorly known due to limited sampling, this is not the case in the Venus offshore project area. Deep water benthic sampling and surveying within PEL0056/Block 2913B, and adjacent Blocks 2913A and 2914A located east of PEL0056/Block 2913B (SLR, 2022, 2023, 2024a, 2024b), have provided insights into dominant taxa across the Venus offshore project area. Pre- and post-drill surveys completed across the Venus-1X and larger PEL0056/Block 2913B (Section 5.2) have confirmed a similar number of species between pre- and post-drill surveys (Section 5.2).

⁹⁵ The 2009 IMO Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, commonly known as the Hong Kong Convention, is an international treaty that sets standards for the recycling of ships, including FPSO units, and requires *inter alia* removing hydrocarbons and other hazardous materials from the FPSO and ensuring that the recycling process follows the safety and environmental standards set by the convention. The convention will enter into force on 26 June 2025 following its ratification by the required number of countries.



Although not directly comparable to southern Africa, several studies have been conducted in other parts of the world (e.g. USA, Mexico, North Sea) where there has been full oil and gas field production since the 1970s (Neff J. , 2005; IOGP , 2003; Trefry, et al., 2013; IOGP, 2016). These studies provide a good indication of possible impacts to benthic habitats that might be expected in future, following petroleum exploration and production activities off southern Namibia. The identified environmental aspects and the related potential impacts are discussed and assessed below using information from the international literature.

Seabed disturbance from drilling and installation of well infrastructure

Two types of wells (with the same architecture) are planned to be drilled, 20 OP and 20 GI wells; both of which will be drilled into the Venus oil-bearing reservoir at a depth of ~3 000 m below the seabed. To minimise the subsea footprint and overall infrastructure installed on the seabed, it is common to cluster the wells and to connect them to a common drilling centre. For Venus, whenever possible, the concept selected is to cluster the wells in pairs, i.e. two wells of similar type (either OP or GI) are drilled close to each other and tied to the same manifold. An indicative layout of the GI and OP wells is presented in Figure 4-1.

Various drilling activities will result in the direct localised physical disturbance and smothering of sediments, as well as potential changes in sediment characteristics and condition (direct negative impact). Any benthic biota present within the disturbance footprint, both on the seabed and/or within the sediment will be either completely eliminated or may potentially be disturbed or crushed. Resuspension of seabed sediments may also result in increased turbidity near the seabed, potentially with physiological effects on benthic biota communities (indirect negative impact).

Any benthic biota in the wellhead footprints may be physically injured, crushed and/or be eliminated.

Seabed disturbance from installation of subsea infrastructure

Laying pipelines and installing subsea infrastructure in the Venus offshore project area can impact benthic communities, primarily through direct physical disturbance and smothering. The installation process may cause physical injury, crushing or complete elimination of benthic organisms within the structural footprint of the pipeline and associated infrastructure. The extent of disturbance depends on factors such as pipeline length, diameter, burial method (trenched/buried/rock covered) and local seabed conditions. The extent of disturbance to seafloor habitats will be limited to the areas directly covered by and adjacent to the pipelines, subsea infrastructure and where anchors are deployed.

The subsea infrastructure to be installed within the Venus offshore project area are outlined in Section 4.3.

Seabed disturbance from installation of anchors and moorings

The installation of anchors and mooring systems may result, though often localised, in the direct disturbance of benthic habitats. Anchor deployment, tensioning, and dragging, especially during the installation of mooring buoys, can temporarily disrupt the seabed and associated benthic communities. The physical impact occurs not only at the anchor points but also along the path of anchor chains or cables, which may scour or crush benthic organisms as they move or settle.

Up to 18 anchors (suction piles or vertical load anchors) and associated mooring lines will be pre-installed prior to the FPSO arrival. Proposed anchor positions have been informed by the 2024 geophysical survey, which has confirmed the seafloor in the Venus offshore project area is typically homogenous, devoid of features (see Section 5.2). Once installed, mooring lines will be laid out along the seabed and connected using subsea connectors or shackles, possibly further contributing to seabed disturbance.



A mooring buoy will be installed at the transshipment area, anchored by six drag anchors and associated mooring chains.

Discharge of drill cuttings and associated mud

The discharge of cuttings and WBM onto the seabed from the top-hole section of the well during the initial riserless stage and the discharge of treated cuttings from the drilling unit during the riser drilling stage would have both direct and indirect effects on benthic communities in the vicinity of the wellhead and within the fall-out (deposition) footprint of the cuttings plume discharged from the drilling unit.

The cuttings and WBMs from the top-hole sections of the well are discharged directly onto the seafloor at the wellbore where they accumulate in a conical cuttings pile around the wellbore, thereby smothering or crushing invertebrate benthic communities living on the seabed or within the sediments.

Cuttings and associated NADF drilling muds discharged from the drilling unit would disperse and settle over a wider area (but thinner in deposition thickness) around the wellhead resulting in changes in sediment structure and community composition within the fall-out footprint of the cuttings plume. The disposal of cuttings at the wellbore and from the drilling unit would have various biochemical effects on the receiving environment. The direct effects stem from contaminants contained in the drilling muds remaining on cuttings after treatment (6.9% OOC) and the associated changes to sediment quality (e.g. particle size, oxygen levels). Although the cuttings themselves are generally considered to be relatively inert, the drilling muds are a specially formulated mixture of natural clays, polymers, weighting agents and/or other materials suspended in a fluid medium. The constituents and additives of the discharged muds may potentially have ecotoxicological effects on the sediments. The toxic effects may be of significance in terms of:

- Chronic accumulation of persistent contaminants in the marine environment (e.g. build-up of persistent pollutants (e.g., hydrocarbons or heavy metals) in the marine environment);
- Acute (short-term) or chronic (long-term) effects on biota, including effects on productivity, reproduction, growth, etc.; and
- Indirect acute (short-term) or chronic (long-term) ecosystem effects (i.e. secondary impacts on other species and overall biodiversity, resulting from disruptions to the food web or ecological balance).

Ecological impacts in response to cuttings disposal are typically characterised by reduced species diversity, enrichment of opportunistic and/or pollution-tolerant fauna and a loss of more sensitive species (Ellis, et al., 2012; Paine, et al., 2014; Jones, et al., 2012). However, significant increases in densities and richness of motile megabenthic epifauna immediately after drilling, presumably attracted to available carcasses of sessile organisms killed by drilling disturbance, have been reported (Jones, et al., 2007; Hughes, et al., 2010). Recovery of benthic communities following disturbance has been documented in various marine environments; however, the rate and extent of recovery are highly dependent on several environmental and biological factors, including sediment type, depth, hydrodynamic conditions, and the life-history traits of the affected species.

Environmental surveys in PEL0056/Block 2913B have revealed consistent yet impoverished (low diversity and abundance) macrofauna dominated by polychaetes, molluscs, and crustaceans (BSL, 2019a; BSL, 2023a; BSL, 2023b). Pre- and post-drill surveys completed across the Venus-1X and larger PEL0056/Block 2913B (Section 5.2.1) have also confirmed a similar number of species pre- and post-drill surveys (Section 5.5.1.1).



Discharge of residual cement to the seabed

The discharge of residual cement during cementing of the surface casing and plugging of the well on demobilisation would result in accumulation of cement on the seabed and on the cuttings pile, respectively. Any benthic biota present on the seabed may potentially be smothered by the residual cement or suffer indirect toxicity and bioaccumulation effects due to leaching of potentially toxic cement additives. The disturbance of and reduction in benthic biodiversity due to smothering following cementing of the surface casing would, however, result in no additional impact as the cement will be discharged in an area already affected by drill cuttings in the near vicinity of the wellbore. Similarly, impacts due to cementing for well plugging during decommissioning, would largely affect an area already impacted by the presence of the wellhead, with minimal additional impacts to benthic communities anticipated. The impact due to changes in sediment chemistry is assessed in Section 7.2.1.4.

Presence of Infrastructure on seabed

Placement of the infrastructure on the seabed over the long term (and/or subsequent permanent abandonment) provide islands of hard substrata in an otherwise uniform area of unconsolidated sediments. The availability of new hard substrata on the seabed provides opportunity for colonisation by sessile benthic organisms and provides shelter for demersal fish and mobile invertebrates thereby modifying the benthic habitat and potentially increasing biodiversity.

Although the impact is direct, it can be considered neutral and context-dependent, as it can lead to both positive and negative ecological outcomes. On the one hand, artificial hard substrates may enhance local biodiversity by providing new colonization surfaces for sessile and mobile benthic organisms. On the other hand, they may also alter natural habitat composition and structure.

7.2.1.3 Impact Assessment: Smothering and Disturbance of Benthic Fauna

Sensitivity of receptor

Venus offshore project area: Drilling and subsea infrastructure installation will be undertaken across the Venus offshore project area in the offshore marine environment (over 300 km from the coastline at its nearest points) and within the Namib Lower Slope marine ecosystem types, rated as 'Least Threatened' (i.e. good/fair condition) (see Section 5.6.4.1).

Although the benthic biota inhabiting unconsolidated sediments of the lower continental slope and abyss (> 1 800 m deep) are relatively poorly known, this is not the case in the Venus offshore project area, which has been subject to various environmental and geophysical surveys (see Section 5.2), which have increased the understanding of the receiving environment in the area. The Venus offshore project area is typically homogenous, devoid of features with an impoverished (low diversity and abundance) macrofauna, typical for deep water soft sediments. No colony forming corals and structural features (e.g., rocky outcrops) were identified. Marine invertebrate faunal communities sampled within PEL0056/Block 2913B were found to be dominated by polychaetes, molluscs, and crustaceans (BSL, 2019a; BSL, 2023a; BSL, 2023b). The deposit-feeding polychaete, *Spiophanes* sp., was the most abundant species, highlighting the prevalence of deposit feeders in soft sediments. Additional dominant polychaetes recorded included *Aricidea* (*Acmira*) *simplex*, *Myriochele* sp., *Leanira quatrefagesi* and *Opheliidae* sp., with molluscs (*Microgloma mirmidina*, *Pristigloma nitens* and *Axinulus* sp.) also found to dominate. In addition, crustaceans and echinoderms were observed.

Thus, in the Venus offshore project area and at the depths of the proposed well drilling and subsea infrastructure installation, the benthic fauna is expected to be relatively ubiquitous, varying only with sediment grain size, organic carbon content of the sediments and/or near-



bottom oxygen concentrations. These benthic infauna communities usually comprise fast-growing species able to rapidly recruit into areas that have suffered natural environmental disturbance. No rare or endangered species have been reported or are known from the continental slope and abyssal unconsolidated sediments.

Considering the availability of similar unconsolidated sediment habitat off the edge of the continental shelf off the southern and central Namibian coast in an area classified as 'Least Threatened' with benthic fauna being generally ubiquitous and comprised of fast-growing species, the sensitivity of benthic communities of offshore unconsolidated sediments, is considered **low**.

Nearshore transshipment area: The nearshore transshipment location overlaps with the 'Least Threatened' Kuiseb Inshore and Central Namib Inner Shelf ecosystem (see Sections 5.6.4.1 and 5.5.4). This area, situated along the inner shelf, is expected to be characterised by predominantly unconsolidated sandy sediments. Macrofaunal invertebrate communities within the nearshore transshipment zone are likely to be dominated by nematodes, polychaetes, and cumaceans, with community composition strongly influenced by oxygen availability (Section 5.5.1).

Considering the availability of similar unconsolidated sediment habitat on the edge of the continental shelf off the southern and central Namibian coast in an area classified as 'Least Threatened', with benthic fauna inhabiting these sediments generally ubiquitous and comprised of fast-growing species, the sensitivity of benthic communities of nearshore unconsolidated sediments, is also considered **low**.

Magnitude

Drilling and Installation Phase

Overall, the impact magnitude for smothering and disturbance of benthic fauna on offshore and nearshore unconsolidated sediment in the **drilling and installation phase** of the project is considered to be **low**. This is based on the following ratings:

- **Low intensity**, with drilling discharges and seabed disturbance from drilling and installation activities likely to have minimal effects on benthic fauna inhabiting the unconsolidated sediments within offshore and nearshore marine environments, which are classified as 'Least Threatened' ecosystem types. The benthic fauna of these unconsolidated sediments are generally ubiquitous and comprised of fast-growing species that are able to rapidly recruit into disturbed areas.
- **Long-term** duration, as the modelling predicts that these deposits will persist for over 10 years and recovery of benthic communities to functional similarity is expected to occur within the long-term.
- **Local extent**, based on cumulative area of impact due to the drilling discharges of up to 40 wells and physical disturbance due to subsea infrastructure and anchor / mooring installation. Notably for each well pair, deposition of drill cuttings >6.5 mm thickness (i.e. the threshold above which potential harm to the ecosystem might be observed) was modelled to be confined to a maximum of 270 m from each well pair, and significant risk for grain size change up to 296 m, with up to 20 well pairs proposed. The significant risk associated with effective thickness of drill cuttings across 20 well pairs occupying an area of up to 320 ha (3.2 km²). Furthermore, the subsea infrastructure, made up of 12-inch flowlines and gas injection lines, extending up to 80 km and 35 km long equalling an area of approximately 0.1 km² and representing ~0.0001% of the Namib Lower Slope ecosystem.

These ratings are discussed for each project aspect below.



Physical disturbance and removal of seabed sediments from drilling

The immediate effect of the physical disturbance and removal of seabed sediments from well spudding and wellhead placement on the benthos depends on the species degree of mobility, with sedentary and relatively immobile species likely to be physically removed, damaged or destroyed during the disturbances associated with well drilling.

Considering the availability of similar offshore unconsolidated sediment habitat on and off the edge of the continental shelf off the southern Namibian coast and the 'Least Threatened' status thereof, as well as the ubiquitous, fast-growing species likely to inhabit these sediments, disturbance of and reduction in benthic biodiversity in unconsolidated sediments within the Venus offshore project area will be of limited intensity (**low**).

The penetration of the seabed by the drill bit would physically disturb a maximum surface area of 0.9 m² per well (i.e. 36 m² cumulatively for 40 wells). Casing of the hole and installation of the wellhead and BOP would potentially also result in localised direct disturbance of an area of approximately 3 m² around the well site (i.e. 120 m² cumulatively for 40 wells within the total Venus offshore project area). This disturbance area also overlaps with conical cuttings pile at the wellbore. Impacts would, therefore, be restricted to the immediate vicinity of the individual well site (**site**), with cumulative impacts based on the drilling of up to 40 wells across the Venus offshore project area, extending to the **local** scale. Although pre- and post-drill surveys completed across the Venus-1X and larger PEL0056/Block 2913B have confirmed a similar number of species pre- and post-drill surveys (Section 5.5.1.1), the wellheads would remain on the seafloor after decommissioning and would eventually become colonised by succession communities. Thus, any reduction to biodiversity of benthic communities in unconsolidated sediments would likely only persist over the **medium-term**, with drilling operations taking place over four years. The effects from physical disturbance and removal of seabed sediments on benthic fauna from drilling would thus be of **very low** magnitude.

Discharge of drill cuttings and mud to the seabed

The primary impact of discharged cuttings, drilling fluid (or mud) and cement is smothering of relatively immobile or sedentary benthic species both directly (e.g., mortality and clogging of feeding mechanisms) and indirectly (e.g., loss of benthic prey items for bottom feeding species, disturbance of migration routes and impact on those species that spawn on the seabed or have a benthic juvenile development stage). The effects of drilling mud and cuttings discharges on the benthic environment are related to:

- the total mass of drilling solids discharged;
- whether these are discharged at the seabed or off the drilling unit; and
- the relative energy of the water column and benthic boundary layer at the discharge site.

The cuttings discharged at the seabed during the riserless drilling stage would form a highly localised spoil mound around the wellbore, thinning outwards. Corresponding results were reported by the drilling discharge study, with sediment thickness thinning outwards from the well bore (Section 0). In contrast, the cuttings discharged from the drilling unit during the riser drilling stage form two plumes as they are discharged. The larger particles and flocculated solids, which constitute ~90% of the discharge, settle to the seabed nearest the wellbore while the fine-grained non-flocculated solids and soluble components of the mud (~10% of the discharge) are rapidly diluted in the receiving waters and dispersed in the water column at increasing distances from the drill unit (Figure 7-8) (Neff, 2005). The dispersion pattern and degree of accumulation depend on water depth, current strength and the frequency of storm surges (Buchanan, Cook, & Mathieu, 2003). The solids undergo dispersion, dilution, dissolution, flocculation, and settling in the water column. If the discharge contains a high concentration of organic matter, the cuttings pile may become



anaerobic near the surface, before being altered by redox cycling, bioturbation, and bed transport.

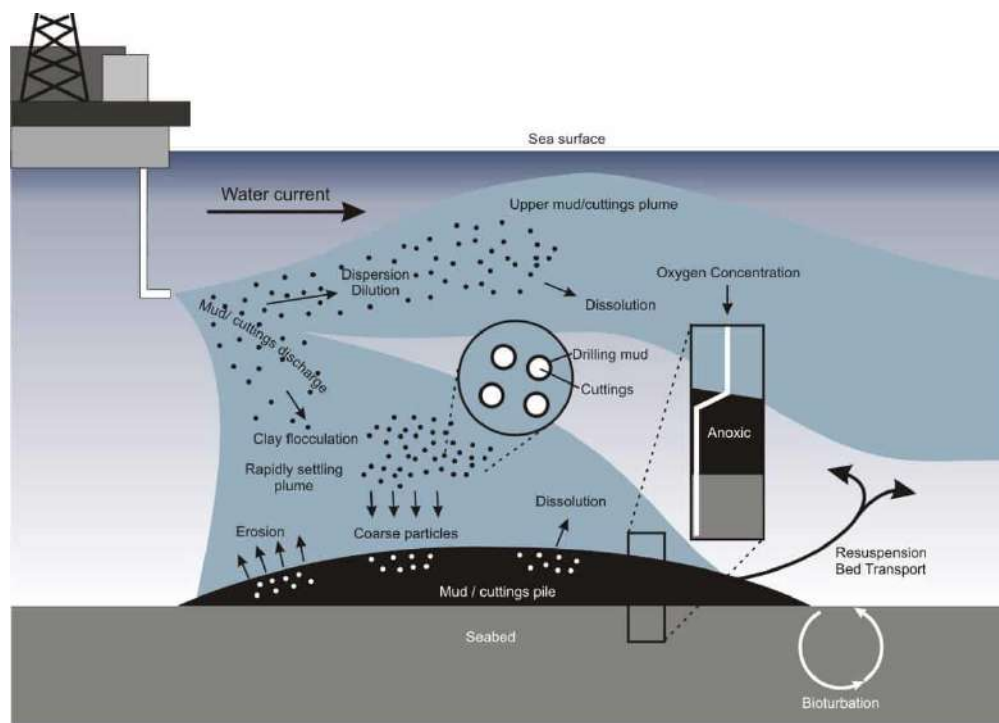


Figure 7-8: Hypothetical dispersion and fates of treated cuttings (from riser sections) following discharge to the ocean from a drilling unit (adapted from Neff 2005).

In high energy environments, accumulation of drilling discharges on the seabed is minimal as the drilling solids are rapidly dispersed and redistributed. Under such conditions adverse effects of the discharges on benthic community composition are difficult to detect above the natural variability (Lees & Houghton, 1980; Houghton, Beyer, & Thielk, 1980; Bothner, et al., 1985; Neff, Bothner, Maciolek, & Grassle, 1989; Daan & Mulder, 1993).

However, in low-energy, deep-water environments, such as those in the PEL0056/Block 2913B, the effects of drilling discharges on benthic ecosystems are more severe and long-lasting, with modelling completed for this ESIA predicting that these deposits will persist for over 10 years. The 2024 geophysical survey (see Section 5.2.2) noted that deposits from previously drill wells form distinctive high intensity areas radiating from the well sites. Based on international literature, it is found that typically, the coarse cuttings discharged during the riserless drilling stage, accumulate within 100 m of the discharge point, although depending on the strength of prevailing current, some may disperse as far as 130 m from the discharge point. The results of international modelling studies and physical sampling exercises have indicated that the majority of discharges would have a maximum accumulated height of less than 8 cm around the well bore during and immediately after drilling, with fine-sediment cover of less than 2 mm thickness likely to extend to ~500 m from the discharge point (Perry, 2005). In the discharge modelling study performed for the current project, similar patterns were observed, with the maximum seafloor deposition thickness of 75 mm being restricted to the nearby surrounds of the discharge points (well bore) with the significant risk (> 6.5 mm thickness) extending up to 270 m from the discharge point for a well pair.

The main impacts associated with drilling discharges would be smothering of sessile benthic biota, physical alteration of the benthic habitat (changes in sediment properties) and oxygen depletion due to rapid biodegradation of the base fluid in the sediment (see Section 7.2.1.4).



The effects of smothering on the receiving benthic macrofauna are determined by 1) the depth of burial; 2) the nature of the depositing sediments; 3) the tolerance of species (life habitats, escape potential, tolerance to hypoxia etc.) and 4) duration of burial (which is linked to the species tolerance) (Kranz, 1974; Maurer, Keck, Tinsman, & Leathem, 1981a; 1981b; 1982; Bijkerk, 1988).

Many benthic infaunal species are able to burrow or move through the sediment matrix, and some infaunal species are able to actively migrate vertically through overlying deposited sediment thereby significantly affecting the recolonisation and subsequent recovery of impacted areas. Studies have shown varying responses of benthic fauna to sediment deposition. Maurer et al. (1979) observed that some species can migrate upwards through up to 30 cm of sediment. However, several other studies report significant declines in benthic communities when sediment thickness exceeds 15–20 cm (Schaffner, 1993; Roberts et al., 1998; Smath and Rule, 2001; Burd, 2002). In general, mortality tends to increase with increasing depth of deposited sediments, and with speed and frequency of burial.

The survival potential of benthic infauna, however, also depends on the nature of the deposited non-native sediments (Turk & Risk, 1981; Chandrasekara & Frid, 1998; Schratzberger, Rees, & Boyd, 2000b). Although there is considerable variability in species response to specific sediment characteristics (Smit, et al., 2006), higher mortalities were typically recorded when the deposited sediments have a different grain-size composition from that of the receiving environment (Maurer, Keck, Tinsman, & Leathem, 1981a; 1981b; 1982; Maurer, Tinsman, & Leatham, 1986; Smit, et al., 2006), which would be the case in the discharge of drill cuttings. Migration ability and survival rates of organisms are generally lower in silty sediments than in coarser sediments (Hyllenberg, Nateewathana, & Chatananthawej, 1985; Ellis & Heim, 1985; Maurer, Tinsman, & Leatham, 1986; Schratzberger, Rees, & Boyd, 2000a; 2000b). The availability of food in the depositional sediment is, however, also influential.

The duration of burial would also determine the effects on the benthos. Here a distinction must be made between incidental deposition, where species are buried by deposited material within a short period of time (as would occur during drilling solids disposal), and continuous deposition, where species are exposed to an elevated sedimentation rate over a long period of time (e.g. in the vicinity of river mouths). Provided the sedimentation rate of incidental deposition is not higher than the velocity at which the organisms can move or grow upwards, such deposition need not necessarily have negative effects.

The nature of the receiving community is also of importance. In areas where sedimentation is naturally high (e.g. wave-disturbed shallow waters) the ability of taxa to migrate through layers of deposited sediment is likely to be well developed (Roberts, Murray, Gregory, & Foster, 1998). In the case of sedentary and relatively immobile species that occur in waters beyond the influence of aeolian and riverine inputs (such as the offshore waters in the area of interest), they will be more susceptible to smothering.

Deep-water fauna inhabiting unconsolidated sediments, such as in the Venus offshore project area, usually comprise fast-growing species that are able to rapidly recruit into disturbed areas. In contrast, the benthos associated with hard substrata is typically vulnerable to disturbance due to their long generation times. It should, however, be noted that during the 2024 geophysical survey, no colony forming corals and structural features (e.g., rocky outcrops) were identified in the Venus offshore project area.

The life-strategies of organisms also influences the susceptibility of benthic fauna to mortality. Studies on the burrowing habits of 30 species of bivalves showed that mucous-tube feeders and labial palp deposit-feeders were most susceptible to sediment deposition, followed by epifaunal suspension feeders, boring species and deep-burrowing siphonate suspension-feeders, none of which could cope with more than 1 cm of sediment overburden. Meiofaunal species appear to be less susceptible to burial than macrofauna (Menn, 2002). Specifically, sessile megafaunal densities and richness increased significantly with



increasing distance from drilling, with partial megabenthic recovery between 3- and 10-years post-disturbance (Gates & Jones, 2012; Jones, Gates, & Lausen, 2012). Such community changes are, however, rarely measurable beyond 500 m of the drilled area (Neff, Sauer, & Maciolek, 1992; Ranger, 1993; Montagna & Harper, 1996; Schaanning, Trannum, Øxnevad, Carroll, & Bakke, 2008), with recovery of the benthos observed to take from several months to several years after drilling operations have ceased (Husky Oil Operations Limited, 2000; 2001a; 2001b; Buchanan, Cook, & Mathieu, 2003; Neff J, 2005). Exceptions to this have, however, been reported especially for sensitive species (Ellis, Fraser, & Russel, 2012; Cordes, et al., 2016). The potential environmental effects (both smothering and toxicity) of drilling solids discharges have been discussed in several studies (Morant P. , 1999; Husky Oil Operations Limited, 2000; 2001a; CAPP , 2001; Hurley & Ellis, 2004), all of which concluded that exploratory drilling with WBMs has no enduring ecological impacts on the marine environment.

The depositional footprints with significant risk are highly localised per well pair (site) as deposition of >6.5 mm thickness (i.e. the threshold above which potential harm to the ecosystem might be observed) is confined to a maximum of 270 m from each well bore, extending to the **local** scale when considering the cumulative depositional footprints across 20 well pairs across the Venus offshore project area. Notably transposition of significant risk associated with effective thickness across all 20 well pairs was found to occupy an area of up to 320 ha (3.2 km²), which accounts for 0.0023% of the Namib Lower Slope marine ecosystem types, which is rated as 'Least Threatened' (i.e. good/fair condition), with there being no overlap of significant risk (>6.5 mm) amongst the different well pairs based on transpositional modelling results (see Section 0). Mortality of most fauna can be expected if deposit thickness of drilling discharges at the well bore is >30 mm. This would, however, be expected only within a few metres around each well bore. Notably, the maximum thickness on the seafloor was estimated to be 75 mm in Season 2, and ranging between 67 mm to 72 mm in the remaining seasons. Some biota will be smothered, but many will be capable of burrowing up through the deposited drilling solids. The impact extent is highly localised across the Venus offshore project area (**local**).

Physical changes to the sediment structure due to discharges from the drilling operations with a significant risk (>5%; grain size change of 1 064%) are expected to settle on the seabed over an area up to 296 m in all directions from the well pair, with up to 20 well pairs to be drilled across the Venus offshore project area (**local**).

Overall, such highly localised depositional impacts are unlikely to have measurable effects on recruitment success of the commercially important species. Due to variation in the near bottom currents the depositional footprint varies in direction across seasons and discharge points. Notably, the deposition footprints extend to the north, south and west across all seasons.

In their assessment of impacts associated with hydrocarbon exploration, Biccard et al. (2018) concluded that the direct and indirect risks associated with drilling discharges during exploration well drilling were mostly very low or low, with only the disturbance and/or destruction of hard-bottom communities being high (which are unlikely to occur in the Venus offshore project area). Similarly, drilling discharges in the Venus offshore project area would have a **low** intensity impact, as the depositional footprint would spread over typically homogenous unconsolidated sediments, devoid of structural features (e.g., rocky outcrops), with an impoverished (low diversity and abundance) macrofauna, comprised of fast-growing species that are able to rapidly recruit into disturbed areas. The depositional footprint of discharges of treated drill cuttings from the drilling unit during the risered phase would spread over a larger area, yet depositional thickness at the seabed would be considerably lower as compared to that resulting from depositions at the seabed during well drilling. As such, although the sediment plume may overlap with the ESA within PEL0056/Block 2913B, depending on the location of the well(s), the intensity remains **low** for impacts to affected unconsolidated sediments.



There has recently been increasing focus on the potential impacts of drilling solids disposal on vulnerable deep-water coral communities in the Northeast Atlantic (Rogers A. , 1999; Colman, Gordon, Lane, Forde, & Fitzpatrick, 2005; www.coralreef.noaa.gov/deepseacorals/threats). As deep-water corals tend to occur in areas with low sedimentation rates (Mortensen, Hovland, Fossa, & Furevik, 2001), these benthic suspension-feeders and their associated faunal communities are likely to show particular sensitivity to increased turbidity and sediment deposition associated with cuttings discharges (Dodge & Szmant-Froelich, 1985; Roberts, Wheeler, & Freiwald, 2006; Larsson & Purser, 2011; Larsson, Van Oevelen, Purser, & Thomsen, 2013; Jarnegren, Brokke, & Jensen, 2020).

International best practice recommends that pre-drilling site surveys be carefully designed to provide sufficient information on seabed habitats on and in the vicinity of the proposed drill sites, and appropriate technologies and monitoring surveys implemented to reduce the risks of, and assess the damage to, vulnerable seabed habitats and communities should they occur in the target area (Jødestøl & Furuholt, 2010; Purser & Thomsen, 2012; Purser, 2015). In this regard, a set-back distance of 610 m (2 000 ft) for sea surface discharge of drilling discharges from sensitive deep-water communities is mandated in US territorial waters.

The nearest known hardgrounds to the Venus offshore project area include Tripp Seamount located 85 km east of PEL0056/Block 2913B. Additionally, an unnamed topographic feature is situated 36 km to the east of PEL0056/Block 2913B. Ecological baseline and geophysical surveys undertaken (see Section 5.2) have confirmed that no topographical features or natural hard relief occur within the Venus offshore project area (BSL, 2019a; 2023a; 2023b). Considering modelling results (see Section 0), the largest deposition footprints with a significant risk (> 6.5 mm depositional thickness) extend up to 270 m in Season 1, 3 and 4 (i.e. remain within PEL0056/Block 2913B), furthermore based on modelling of well pairs closest to nearby sensitive areas including, Tripp Seamount and the Orange Seamount and Canyon Complex EBSA, no significant risk was found to reach the EBSA and/or Tripp Seamount. As such, the riserless drilling stage, which results in the majority of the deposit, is **highly unlikely** to affect sensitive hardgrounds in the vicinity of the well. Considering the available environmental and geophysical survey data, as well as project controls (which included pre-drilling seabed ROV surveys), impacts to benthic fauna associated with hardground are highly unlikely and not considered further, with the assessment being restricted to unconsolidated sediments.

Benthic and demersal species that spawn, lay eggs or have juvenile life stages dependent on the seafloor habitat (e.g. hake and kingklip, see Section 5.5.3.1) could also be negatively affected by smothering effects of drill cuttings. However, spawning levels within PEL0056/Block 2913B are expected to be low, with the Venus offshore project area located well offshore of spawning areas and ichthyoplankton drift (see Figure 5-22). **Although, footprints for sediment thickness <6.5 mm will be far more extensive, the overlap with key nursery and spawning regions is unlikely owing to the offshore location of the Venus offshore project area.**

Since the model predicts that deposits of significant risk will persist for over 10 years, recovery of benthic communities to functional similarity is expected to occur within the **long-term**. Similarly, physical changes to the sediment structure (grain size change) within the deposition footprint are predicted to persist over 10 years, however, are highly localised to within 215 m of the discharge point, for each well pair. Recovery of benthic communities to functional similarity is thus expected to occur within the **long-term**.

Considering the localised, low intensity and long-term nature of the potential impacts, the effects from drilling discharges on benthic fauna in unconsolidated sediments would be of **low** magnitude.



Discharge of residual cement from drilling to seabed

The disturbance of and reduction in benthic biodiversity due to smothering following cementing would result in no additional impact as the cement will be discharged in an area already affected by drill cuttings in the near vicinity of the wellbores.

Physical disturbance of seabed sediments from subsea infrastructure installation

Subsea infrastructure, comprising all equipment and systems installed on the seabed to extract hydrocarbons from the reservoir and transport them to the FPSO, will be installed during the drilling and installation phase of the project. Specifically, the offshore installation of subsea equipment at the Venus offshore project area will primarily occur over two austral summer periods (2 x 6 months) due to metocean constraints.

The installation of subsea infrastructure, as outlined above, will result in direct physical disturbance of the seabed and associated benthic communities. The extent and severity of this disturbance will depend on the type of infrastructure, the installation method, and the nature of the benthic habitat.

The placement of subsea infrastructure is expected to result in the physical removal, crushing or burial of benthic organisms within the structural footprint of the installed components. Sedentary and slow-moving species are particularly vulnerable to these impacts, with soft-bodied infauna and epifauna likely to be damaged or destroyed during installation. The installation of subsea infrastructure may also result in localised sediment resuspension and redeposition, potentially smothering nearby benthic fauna.

The area of direct impact will vary depending on the footprint of the infrastructure, including the length and diameter of pipelines, and the installation technique employed (e.g. if pipelines are trenched, buried, or rock-armoured etc.). These factors interact to influence the spatial extent of seabed disturbance.

In unconsolidated sediment environments, such as in the Venus offshore project area, the majority of impacts occur during the installation phase. However, the presence of infrastructure on the seabed may lead to longer-term changes in benthic community composition, particularly in areas of limited to no hard substrate (see Section 7.2.1.5).

Recovery times vary depending on substrate type and environmental conditions. In areas with soft, unconsolidated sediments, benthic communities may recover within one to two years following disturbance (Assessment of Impacts, 2009), except directly under the infrastructure. Recovery is also influenced by natural sedimentation rates, with faster recovery observed in areas with higher sediment input. However, this is unlikely to be a factor in the Venus offshore project area, which has low seabed currents, and more likely a factor in the nearshore transshipment area.

Impacts on hard substrate may, however, persist for longer due to the sensitivity of these long-lived, slow-growing biota to physical disturbance. Cordes et al. (2016) highlight that “the impact of anchors in the deep sea is of greatest concern in biogenic habitats, such as those formed by corals and sponges, which are fragile and have low resilience to physical forces”. Recovery of disturbed deep-sea coral communities can take up to 30 years, while the full replacement of entire coral colonies may require centuries, based on estimated growth rates and polyp recruitment (Doughty et al., 2014; Schwing et al., 2020). This is not a concern in the Venus offshore project area as the seabed is typically homogenous unconsolidated sediments, devoid of structural features (e.g., rocky outcrops), with an impoverished (low diversity and abundance) macrofauna, comprised of fast-growing species that are able to rapidly recruit into disturbed areas. Similarly, no hardground communities and/or seamount features have been mapped within the vicinity of the nearshore transshipment area, with sediments expected to be predominantly unconsolidated (sandy).

Based on this information, and considering the project’s planned controls, impacts to hardground communities are considered **highly unlikely/impossible**, as subsea



infrastructure and anchors are intended to be installed on unconsolidated substrates. As such, impacts due to subsea infrastructure will likely be restricted to benthic fauna associated with unconsolidated sediment, and not hardground communities.

Considering the availability of similar offshore unconsolidated sediment habitat which is classified as 'Least Threatened', this disturbance of and reduction in benthic biodiversity in unconsolidated sediments due to subsea infrastructure installation will be of limited intensity (**low**), with the 12-inch flowlines and gas injection lines extending up to 80 km and 35 km long equalling an area of approximately 0.01 km² and representing ~0.0001% of the Namib Lower Slope ecosystem. While impacts will be restricted to the immediate vicinity (within/near site) of the infrastructure, the subsea infrastructure and cumulative impact will extend across the Venus offshore project area (**local**). As the infrastructure and surrounding benthic habitat eventually become colonised by fast-growing species after installation or infrastructure will become buried over time, any reduction to biodiversity of benthic communities in unconsolidated sediments would likely persist over the **short-term** only.

Considering the localised, low intensity and short-term nature of the potential impacts, the potential disturbance and smothering of benthic communities on unconsolidated sediment is considered to be of **very low** magnitude.

Physical disturbance from installation of anchors

The immediate effect of the physical disturbance and removal of seabed sediments from anchor installation on the benthos depends on the species degree of mobility, with sedentary and relatively immobile species likely to be physically removed, damaged or destroyed during the disturbances associated with anchor and mooring line installation.

The setting of anchors is likely to directly disturb and damage or crush benthic epifauna and infauna located within the impact depression, most likely affecting soft-bodied species, with some molluscs and crustaceans possibly able to survive the impacts (Savage et al., 2001; Cordes et al. 2016). In addition, the potential tensioning and dragging of anchors (in the case of the installation of the nearshore transshipment buoy only) and anchor chains (both within the nearshore and/or at Venus offshore project area) may lead to the disturbance and damage of benthic macrofauna. The extent of seabed disturbance would depend on factors such as the number of anchors used, the length of anchor chain in contact with the seabed, the applied forces, and the duration of mooring. Chain lengths are generally up to 2.5 times the water depth (Vryhof Anchors BV 2010, in Cordes et al. 2016). Atkinson (2010) reports that, during drilling operations conducted in 350-450 m depth, the area disturbed per (10 tonne) anchor was estimated to be 5 m wide by 200 m long, with an additional disturbance area of 2 m wide by up to 300 m long from each section of anchor chain.

For the current project, the FPSO will be moored to up to 18 anchors (suction piles or vertical load anchor) with mooring lines. Based on provisional designs, the proposed mooring piles will measure 6 m in diameter (i.e. 28.27 m² per anchor), resulting in a total directly disturbed surface area of 508.86 m² for all 18 mooring piles. Installation of the FPSO will result in the displacement and redistribution of sediments in the immediate vicinity of the installed infrastructure. This will lead to temporary increases in turbidity due to the redistribution of sediments in the immediate vicinity of the installation activity. In the nearshore transshipment area, up to six drag anchors and associated mooring chains may be installed for connection to a mooring buoy. Nearshore transshipment buoy drag anchors are estimated to be 5 m wide, with up to 30 m drag per anchor estimated. As with offshore anchor installation, this will lead to increased turbidity within the immediate vicinity of the installation activities.

In terms of the project as a whole, the area directly impacted by the installation of anchors and mooring lines is restricted to the immediate vicinity of each individual anchor (**site**), located within a limited area within the larger Venus offshore project area and nearshore transshipment area, respectively.



Considering the seabed is typically homogenous, devoid of structural features (e.g., rocky outcrops), the availability of similar unconsolidated sediment habitat nearshore (transshipment area) and off the shelf edge (Venus offshore project area) and the 'Least Threatened' status thereof, this disturbance of and reduction in benthic biodiversity in unconsolidated sediments due to the physical disturbance of seabed sediments as a result of anchor setting will be of **low** intensity.

The persistence of impact features such as depressions, anchor scars and sediment mounds on the seabed varies depending on sediment type, the cohesiveness of surface layers, and the specific location of disturbance (Dunaway & Schroeder, 1998; Biccard et al., 2018). Studies from the northern North Sea indicate that anchor-related disturbances can remain visible for anywhere between 2 and 10 years under certain conditions (Jennings & Kaiser, 1998). However, research off the coast of Namaqualand suggests that in areas with unconsolidated sediments, such as those affected by marine mining, anchor scars tend to disappear within two years (Penney & Pulfrich, 2004; Roos, 2005). Recovery rates are also influenced by natural sedimentation, with regions experiencing high sediment input, such as those near major river outflow, showing faster benthic recovery following disturbance (Biccard et al., 2018).

Based on the above and considering the anchor would eventually become colonised by succession communities after installation, any reduction to biodiversity of benthic communities in unconsolidated sediments would likely persist over the **short-term**,

Considering the highly localised extent (site), low intensity and short-term nature of the potential impacts, impact magnitude is **very low**.

Production Phase

No additional impacts due to smothering and disturbance of benthic fauna are anticipated in the Venus offshore project area during the production phase, other than potential dragging of the mooring lines. Similarly, while physical disturbance due to anchors laying on the seafloor within the nearshore transshipment zone may occur throughout the production phase, impacts are considered to be negligible, with anchor chains likely to become buried and colonised by successive communities following their installation.

Overall, the impact magnitude for the physical disturbance of benthic fauna of unconsolidated sediment during production is considered to be.

- **Very low intensity**, with seabed disturbance from anchor / mooring line drag likely to have minimal effects on benthic fauna inhabiting unconsolidated sediments, with the offshore marine environments classified as 'Least Threatened' ecosystem types.
- **Permanent** duration, with effects unlikely to persist following the production phase and recovery of benthic communities to functional similarity is expected to occur s.
- **Site extent** as the impact is limited to the vicinity of each anchor and mooring line.

Decommissioning Phase

Overall, the impact magnitude for the physical disturbance of benthic fauna of unconsolidated sediment during **decommissioning** activities is considered to be **very low**. This is based on the following ratings:

- **Low intensity**, with seabed disturbance from decommissioning activities likely to have minimal effects on benthic fauna inhabiting unconsolidated sediments, with the offshore marine environments classified as 'Least Threatened' ecosystem types.
- **Medium-term** duration, with effects unlikely to persist following decommissioning activities and recovery of benthic communities to functional similarity is expected to occur within the medium-term.



- **Local extent** as the impact is limited to the vicinity of the subsea infrastructure located across the Venus offshore project area.

These ratings are discussed below.

Physical disturbance from decommissioning of subsea infrastructure

There are three primary decommissioning options: full removal, partial removal, and leave-in-situ. While total removal may be necessary in areas where infrastructure poses navigational or fisheries hazards (e.g. nearshore transshipment area), it can result in significant sediment disturbance and smothering of benthic habitats. Conversely, leaving structures in place, after appropriate cleaning and hydrocarbon removal, can offer additional hard substrates (assessed in Section 7.2.1.5).

Decommissioning of subsea infrastructure and wellheads at the Venus offshore project area is expected to result in similar impacts on benthic communities as those described during the construction and installation operations (as detailed above). The removal of infrastructure such as risers, flowlines, umbilicals and wellheads will directly disturb the seabed, as well as resuspend sediments, leading to localised sediment plumes that may smother benthic organisms. The extent of these impacts depends on factors such as sediment type, removal method, and water depth (Zhang et al., 2025). While these sedimentation effects are expected to be short-lived and highly localised, they may still result in the displacement or mortality of benthic communities.

Based on provisional decommissioning plans, mooring lines from the FPSO and nearshore transshipment buoy will be recovered and transported to shore. Following the results of the comparative assessment and subject to local authorities approval, anchor piles and anchor / bottom chain attached to them, all below the mud line, will be left in place to minimise seabed disturbance. As such, minimal seabed disturbance is anticipated during anchor recovery within the nearshore transshipment area and/or Venus offshore project area.

Overall, considering the availability of similar unconsolidated sediment habitat, the 'Least Threatened' status thereof, this disturbance of and reduction in benthic biodiversity in unconsolidated sediments due to the physical disturbance of seabed sediments as a result of decommissioning activities will be of limited intensity (**low**), and restricted to the vicinity of the activity, taking place across the Venus offshore project area and/or nearshore transshipment area (**local**). Any reduction to biodiversity of benthic communities in unconsolidated sediments would likely persist over the short to **medium term**, with habitats expected to recover following the completion of decommissioning activities (to take place over 1.5 years).

Considering the localised, low intensity and medium-term nature of the potential impacts, resulting in an impact of **very low** magnitude.

Significance

The highest impact magnitude and, therefore, impact significance rating across the impact sources is assessed, resulting from the maximum combination of intensity, extent and duration. For **low sensitivity** biota inhabiting offshore and nearshore unconsolidated sediments, the smothering and disturbance impacts resulting from drilling / installations, production and decommissioning activities range from **very low** to **negligible** significance. Overall, the highest impact magnitude is rated as **low** (Table 7-9).

Residual Impact

This potential impact cannot be eliminated due to the nature of the drilling approach, the need for and nature of the cuttings discharge, as well as the need for subsea infrastructure and anchoring. As no mitigation is proposed for communities in unconsolidated sediments (except for monitoring and the minimising discharge of cement, see Section 7.2.1.6), the



significance of residual impacts remains **very low** (drilling and installation phase) and **negligible** (production and decommissioning) (Table 7-9). As outlined above, no additional impacts due to smothering and disturbance of benthic fauna are anticipated during the production phase.

Table 7-9: Impact rating for smothering and disturbance of benthic fauna on unconsolidated sediment

Smothering and disturbance of benthic fauna on unconsolidated sediment						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low					
Magnitude	Low	Low	Very Low	Very Low	Very Low	Very Low
Intensity	Low	Low	Low	Low	Low	Very Low
Duration	Long-term	Long-term	Permanent	Permanent	Medium term	Medium term
Extent	Local	Local	Site	Site	Local	Local
Significance	Very Low	Very Low	Negligible	Negligible	Negligible	Negligible
Probability	Likely					
Reversibility	Fully Reversible					
Loss of resources	Low					
Degree to which impact can be avoided	Medium					
Mitigation Potential	Medium					
Cumulative impacts	Likely					

7.2.1.4 Impact Assessment: Acute or Chronic Effects on Benthic Fauna due to Turbidity, Toxicity and Hypoxic Effects

Sensitivity of receptor

Discharges from the drilling activities would be undertaken in the offshore marine environment in an ecosystem type rated as 'Least Threatened' due to the expansive areas they occupy. Overall, the sensitivity of benthic fauna in **unconsolidated sediments** within this ecosystem type is considered **low** (see Section 7.2.1.3 for details on sensitivities).

Magnitude

Overall, the impact magnitude for chronic effects on benthic fauna in unconsolidated sediments is considered to be **low**, being restricted to activities within the **drilling and installation phase only**. This is based on the following ratings:

- **Low intensity** for benthic fauna associated with unconsolidated sediment because they are generally ubiquitous and fast-growing species and able to rapidly recruit into disturbed and low oxygen areas. In addition, benthic fauna inhabits unconsolidated



sediments within a 'Least Threatened' ecosystem types, with depositional footprints not overlapping with sensitive features, such as Tripp Seamount.

- **Long-term**, as the modelling predicts that these deposits will persist for over 10 years and recovery of benthic communities to functional similarity is expected to occur within the long-term.
- **Local extent**, as the risk due to total concentration of chemicals in the sediment extended up to 4.9 km from discharge point, reducing over time to within 1.1 km, 10 years after operation. Significant risk due to reduced oxygen extending up to 2.2 km, and reducing over time to 1.1 km, 10 years after operations.

Notably should discharges spread over hard substrate, impacts to the associated benthic communities would be restricted to effects relating to increased turbidity due to the fact that toxins accumulate in soft sediments rather than hardgrounds owing to their capacity to absorb and retain pollutants. However, as previously discussed, EBSs and geophysical surveys conducted within the Block and the broader Venus offshore project area consistently indicate a seabed dominated by unconsolidated sediments, with no natural hard relief or hardground communities recorded (see Section 5.2.2). Given these findings, impacts to hardground communities due to increased turbidity resulting from drilling and installation activities are considered **highly unlikely**. Consequently, potential effects due to drilling discharges and sediment resuspension are expected to be limited to benthic fauna associated with unconsolidated sediment, as assessed in the section below.

The ratings are discussed for each project aspect below.

Increased turbidity near seabed due to discharge of drill cuttings and associated mud

WBMs would be used to drill the first riserless section of each well. This drilling fluid would be discharged at the seabed together with the drill cuttings. The cuttings themselves are generally considered to be relatively inert, but may contribute small amounts of trace metals and/or hydrocarbons to receiving waters (Neff, Bothner, Maciolek, & Grassle, 1989). However, most of the metals associated with cuttings are in immobile mineral forms from the geologic strata, and their composition will thus resemble that of natural marine sediments.

Discharge of drill cuttings and muds would lead to increased turbidity. The finer components of discharges on the seabed during the riserless drilling stage would generate a plume near the seabed, which would persist for longer due to weaker bottom currents. Increased turbidity near the seabed may have physiological effects on filter-feeding organisms and/or effects on predation success of demersal species.

Cuttings discharged from the drilling unit during the riserless stage would lead to increased water turbidity and reduced light penetration thereby negatively affecting primary productivity of phytoplankton communities, with exposure to drill cuttings potentially accelerating the sinking of aggregated phytoplankton cells (Pabortsava, Purser, Wagner, & Thomsen, 2011). This together with increased turbidity of near-bottom waters through previous disposal of WBMs and cuttings at the wellbore, may place transient stress on sessile and mobile benthic organisms, by negatively affecting filter-feeding efficiency of suspension feeders (reviewed by Clark and Wilber (2000)). However, in most cases sub-lethal or lethal responses occur only at concentrations well in excess of those anticipated at the discharge point. Consequently, owing to their low sensitivity and short generational times (short-term effects), potential impacts to benthic communities associated with unconsolidated sediments is considered limited (very low intensity), and less than effects due to smothering (as assessed in Section 7.2.1.3), resulting in **negligible** impacts.



Toxic effects due to discharge of drill cuttings and mud on seabed

Despite the widespread dispersion of the cuttings, toxicity effects may occur in the seabed sediments and in the water column from the potential solution of the constituents and additives of the discharged WBMs and NADFs. These are discussed in more detail below.

WBMs are generally assumed to be less toxic than NADFs causing only marginal effects on the benthos resulting mainly from sedimentation (Ellis, Fraser, & Russel, 2012). Typically, the major ingredients that make up over 90% of the total mass of the WBMs are fresh or sea water, barium sulphate (barite) (weighting agents), bentonite clay (viscosifier), lignite, lignosulphonate, and caustic soda (pH control). Low concentrations of other typically biodegradable organic compounds are added to gain the desired density and drilling properties.

Physical effects on the benthos from the discharge of WBM include accumulation of fine particles (disruption of filter feeding) or burial of epi- and in-faunal benthic organisms (Paine, Skinner, Kilgour, Deblois, & Tracy, 2014) as discussed in Section 7.2.1.3 above. However, some WBMs, particularly those containing glycols or organic long chain screen blinding polymers, have been found to cause temporary organic enrichment of sediments potentially leading to hypoxic conditions in the sediments, resulting in a reduction in abundance, biomass and diversity of sensitive macrofaunal species (Tranum, Nilsson, Schaanning, & Øxnead, 2010; 2011; Schaanning, Tranum, Øxnevad, Carroll, & Bakke, 2008), although enrichment effects on tolerant species have also been reported (Paine, Skinner, Kilgour, Deblois, & Tracy, 2014). Other sub-lethal effects of metals contained in barite (Edge, et al., 2016) may play an additional role (see below), with recorded lagged responses, three to five years following drilling commencement, suggesting chronic or indirect effects (Paine, Skinner, Kilgour, Deblois, & Tracy, 2014).

Based on the modelling results the overall environmental risk of drilling discharges to sediments is found to be more chemical than physical. This is primarily due to the presence of the EZ-MUL-NT-A component, an additive to the NADF mud, which has a very low biodegradation rate of 2.7%, likely leading to associated oxygen depletion. Overall, this substance contributes between 43 % to 47% of the risk to sediments. Risk due to total concentration of chemicals in the sediment extended up to 4.9 km (**locally**), reducing over time to within 1.1 km from discharge point, 10 years after operation (**long-term**). Considering the availability of similar unconsolidated sediment habitat at Venus offshore development area and the 'Least Threatened' status thereof, as well as the fast-growing species likely to inhabit these sediments, impacts to benthic communities associated with unconsolidated sediments due to chemical concentrations will be of limited intensity (**low**),

Considering the localised, low intensity and long-term nature of the potential impacts, the impact magnitude is **low**.

Development of hypoxic conditions due to discharge of drill cuttings and mud on seabed

The development of hypoxic conditions⁹⁶ in the near-surface sediment layers through bacterial decomposition of organic matter is an associated impact. Biodegradable organic matter in cuttings piles on the seabed often has a greater effect than sediment texture, deposition rate or, in some cases, chemical toxicity on the structure and function of benthic communities (Hartley, et al., 2003). Bacterial decomposition of organic matter may deplete oxygen in the near-surface sediment layers, thereby changing the chemical properties of the sediments by generating potentially toxic concentrations of sulphide and ammonia (Wang & Chapman, 1999; Gray, Wu, & Or, 2002; Wu, 2002). The rapid biodegradation of drilling solids (particularly those containing NADFs) may, therefore, lead indirectly yet rapidly to sediment toxicity, particularly in fine-grained sediments (Munro, et al., 1998; Jensen,

⁹⁶ Hypoxic conditions refer to a state where there is a deficiency of oxygen in a given environment.



Palerud, Olsgard, & Bakke, 1999; Trannum, Nilsson, Schaanning, & Øxnead, 2010). Organically enriched sediments are often hypoxic or anoxic, and consequently harbour markedly different benthic communities to oxygenated sediments (Pearson & Rosenberg, 1978; Gray, Wu, & Or, 2002). Organic matter concentration in the sediments would over time decrease in response to microbial degradation, resulting in increases in oxygen concentration in the surface-sediment layers leading to succession in the benthic community structure toward a more stable state.

WBM cuttings piles typically contain low concentrations of biodegradable organic matter and do not support large populations of bacteria (Dow, Davies, & Raffaelli, 1990). As most of the organic chemicals in WBMs are biodegradable under aerobic conditions, sediments containing WBM cuttings show only slight and short-term reductions in redox potential. However, organic chemicals in settled solids from mineral oil and diesel fuel contaminated WBMs have a high chemical and biological oxygen demand (Breteler, Requejo, & Neff, 1988). Therefore, if cuttings piles contain WBMs contaminated with hydrocarbons, the sediments may experience the ecological effects of organic enrichment, particularly if the cuttings pile is large. Notably, based on project controls detailed above and the use of WBM for riserless drilling operations, discharges near the wellbore will not contain oil.

The synthetic fluids in NADFs typically degrade rapidly and can cause localised hypoxia in underlying sediments (EPA 2000; OGP 2003). Marine organisms on seabed respond to hypoxia by first attempting to maintain oxygen delivery (e.g. increases in respiration rate, number of red blood cells, or oxygen binding capacity of haemoglobin), then by conserving energy (e.g. metabolic depression, down regulation of protein synthesis and down regulation/modification of certain regulatory enzymes), and upon exposure to prolonged hypoxia, organisms eventually resort to anaerobic respiration (Wu, 2002). Hypoxia reduces growth and feeding, which may eventually affect individual fitness. The effects of hypoxia on reproduction and development of marine animals remains almost unknown. Decreases in species diversity and species richness are well documented, and changes in trophodynamics and functional groups have also been reported. Under hypoxic conditions, there is a general tendency for suspension feeders to be replaced by deposit feeders, demersal fish by pelagic fish and macrobenthos by meiobenthos (see Wu 2002 for references). Further anaerobic degradation of organic matter by sulphate-reducing bacteria may additionally result in the production of hydrogen sulphide, which is detrimental to marine organisms (Brüchert, et al., 2003).

The bulk of the seawater in the Venus offshore project area comprises South Atlantic Central Water (SACW), which has depressed oxygen concentrations (~80 % saturation value), with lower oxygen concentrations (<40 % saturation) occurring frequently due to nutrient remineralisation in bottom waters. The Dissolved Oxygen (DO) profiles from environmental surveys completed within PEL0056/Block 2913B were found to be similar. Notably, at 3 000 m deep (i.e. seafloor), DO concentration was found to be low at only 38% (BSL, 2019a; 2023a; 2023b). The benthic communities will, therefore, be adapted to low oxygen conditions and will be characterised either by species able to survive chronic hypoxia, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. As such potential impacts to benthic communities on unconsolidated sediments due to oxygen change are considered to be of **low** intensity, with impacts not found to overlap with Tripp Seamount, inshore spawning and/or recruitment areas or nearby EBSAs as detailed below.

Notably, none of the scenarios considered in the drilling discharge modelling presented significant biological risk to benthic communities on unconsolidated sediments caused by changes in oxygen after 115 days (see Section 0 for a summary of the modelling results). However, significant risk due to reduction in oxygen (< - 20%) was observed up to 2.2 km (**local**) from the discharge point after 420 days, reducing to 1.1 km up to 10 years later (**long-term**). Oxygen levels may remain stable initially but decline years later due to the slow breakdown of buried organic matter, long-term microbial activity, and gradual changes in



sediment chemistry and benthic community structure that increase oxygen demand over time (Fukushima, Tsune, & Sugishima, 2022). Based on transposition modelling results, after 10-years there will be no overlap of significant risk areas between different wells.

Considering the localised, low intensity and long-term nature of the potential impacts, potential impacts to benthic communities on unconsolidated sediments due to chemical changes in the sediments are considered to be of **low** magnitude.

Toxic effects due to cement additives on seabed

Although various chemical additives are used in the cementing programme, the additives typically have a low toxicity to marine life (Ranger, 1993; Chevron, 1994) and the organic additives are partially biodegradable. Furthermore, the toxic effects on benthic biodiversity following cementing would, however, result in no additional impact as the cement will be discharged in an area already affected by drill cuttings in the near vicinity of the wellbore. Thus, this impact is not considered further.

Significance

Based on the overall **low** magnitude and **low** sensitivity of the receptors, the potential toxicological effects of drilling mud constituents are deemed to be of **very low** significance for sediment toxicity and reduced oxygen concentration for benthic fauna on unconsolidated sediments (Table 7-10). Impacts to benthic fauna on unconsolidated sediments due to increased turbidity are considered **negligible**, with more significant impacts due to smothering assessed in Section 7.2.1.3.

Residual Impact

This potential impact cannot be eliminated due to the nature of the drilling approach and the necessity for the use of WBM and NADFs in the drilling process. The residual impact on benthic fauna on unconsolidated sediments will have a lower intensity, considering mitigation measures, such the use of low-toxicity, low bioaccumulation potential and partially biodegradable additives as well as monitoring requirements, listed in Section 7.2.2.4, Table 7-15. The significance of residual impacts would be of **negligible** significance (Table 7-10).

Table 7-10: Impact rating for toxicity and hypoxic effects on benthic fauna on unconsolidated sediment

Acute and chronic effects on benthic fauna on unconsolidated sediment		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Drilling and Installation	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	Low	Very Low
Intensity	Low	Very Low
Duration	Long-term	Long-term
Extent	Local	Local
Significance	Very Low	Negligible



Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	Partially reversible	
Loss of resources	Low	
Degree to which impact can be avoided	Low	
Mitigation Potential	-	Low
Cumulative impacts	Likely	

7.2.1.5 Impact Assessment: Modification of Benthic Habitat due to Presence of Infrastructure on Seabed

Sensitivity of receptor

Venus offshore project area: The drilling and production activities would be undertaken in the offshore marine environment (~300 km from the coastline at its nearest point) where the ecosystem type as well as benthic habitat have been rated as of 'Least Threatened'. The Venus offshore project area is typically homogenous, devoid of features with an impoverished (low diversity and abundance) macrofauna, typical for deep water soft sediments. No colony forming corals and structural features (e.g., rocky outcrops) were identified. The sensitivity of benthic biota inhabiting unconsolidated sediments within the Venus offshore project area are, therefore, considered to be **low**.

Nearshore transshipment area: The nearshore transshipment location overlaps with the 'Least Threatened' Kuiseb Inshore and Central Namib Inner Shelf ecosystem types. This area, situated along the inner shelf, is expected to be characterised by predominantly unconsolidated sandy sediments, with associated benthic communities and habitats considered to be of **low** sensitivity.

Thus, the overall sensitivity of receptors to the presence of wellheads, subsea infrastructure and mooring anchors, considering unconsolidated sediments and the small percentage of the habitats potentially affected, is considered to be **low**.

Magnitude

Drilling, Installation, Production and Decommissioning Phase

Overall, the impact magnitude for the modification of benthic fauna of offshore and nearshore unconsolidated sediment during the drilling, installation and production phase is considered to be **low**. This is based on the following ratings:

- **Low intensity**, although the presence of infrastructure on the seabed will effectively increase the availability of hard substrate for colonisation by sessile benthic organisms, thereby locally altering and increasing biodiversity and biomass, the area of impact is small. The potential colonisation by invasive species is unlikely in the offshore Venus offshore project area, based on the water depths in the area (~3 000 m deep), while being more likely within the nearshore transshipment area (water depth of 30 m - 40 m).
- **Permanent duration**, with production activities possibly extending up to 31-years. Should infrastructure be removed following decommissioning activities this impact will cease. However, some infrastructure will remain on the seafloor, e.g. wellheads, as described in Section 7.2.1.2 with associated impacts being permanent.
- **Local** extent as the impact is limited to the immediate vicinity of the subsea infrastructure located across the Venus offshore project area and within the nearshore transshipment area. Wellheads and BOP would potentially result in



increased hard substrate of approximately 3 m² around each well site (i.e. 120 m² cumulatively for 40 wells within the total Venus offshore project area). The subsea infrastructure, made up of 12-inch flowlines and gas injection lines, extending up to 80 km and 35 km long equalling an area of approximately 0.1 km² and representing ~0.0001% of the Namib Lower Slope ecosystem.

These ratings are discussed for each project aspect below.

Infrastructure on seabed

The installation of pipelines, wellheads, subsea infrastructure and anchors on the seabed can significantly alter local benthic habitats. While these structures reduce the availability of unconsolidated sediment habitat for infaunal colonisation, they simultaneously introduce hard substrates that may be colonised by sessile benthic organisms, mobile invertebrates, and fish, including potentially non-native species. This shift in habitat type often leads to changes in benthic community composition, typically marked by a decline in soft-bodied, sedentary species and an increase in more resilient taxa such as molluscs and crustaceans (Savage et al., 2001; Sciberras et al., 2018; Biccard et al., 2018).

Many studies have reported on the rich biodiversity of marine species associated with the infrastructure provided by oil platforms (Hall, 2001; Love, Schroeder, & Lenarz, 2005; Love & York, 2006), or the increase in abundance of macroepibenthic invertebrates and demersal fish near the site of the drilling unit (Wolfson, Van Blaricom, Davis, & Lewbe, 1979; Bull & Kendall, 1994; Ellis, Wilson-Ormond, & Powell, 1996; Neff, 2005; Fechhelm, Gallaway, Hubbard, MacLean, & Martin, 2001). Jagerroos and Krause (2016) reviewed global evidence supporting the ecological value of decommissioned offshore platforms under rigs-to-reefs (R2R) programs. They highlighted that subsurface components, such as mooring systems, risers, and hulls, offer vertical relief and complex surfaces that attract a wide range of marine life. These structures can create new ecological niches in otherwise featureless seafloor environments, supporting dense communities of invertebrates, reef-associated fish, and commercially important species. In deeper waters, floating platforms may even function as “pelagic reefs,” providing habitat from the seabed to near-surface layers and enhancing connectivity for mobile species. However, the ecological benefits of such structures depend on several factors, including water depth, regional species diversity, platform design, and local fishing pressure.

While alterations to the benthic habitat and community structure due to increased hard substrate may have positive implications to certain fish species (e.g. kingklip (*Genypterus capensis*) and jacobever (*Helicolenus dactylopterus*), which show a preference for structural seabed features), and benthic invertebrates (deep-water hard substrata can support sensitive species some of which may be longer-lived VME species), it may enhance colonisation by non-indigenous species. Due to the depths (3 000 m) in the PEL0056/Block 2913B, colonisation by invasive species is unlikely to pose a significant threat to natural biodiversity in the deep-sea habitats, however such colonisation may occur within the shallower, nearshore transshipment environment.

The increase or modification of a site's biodiversity due to the presence of subsea structures would be considered a secondary impact of **low** intensity as the affected area will be localised (small area, approximately 0.00021 of Namib Lower Slope Ecosystem), with an extent that is virtually negligible in comparison to similar available habitat in the area. The impact would be highly **localised** within the Venus offshore project area and restricted to the **site** within the nearshore transshipment area, respectively. TEEPNA have indicated that production activities may take place for up to 31-years, with subsea infrastructure remaining on the seafloor throughout production activities, some of which will be abandoned on the seafloor (**permanent**).

Considering the site extent, low intensity and permanent nature of the potential impacts, the magnitude of the impact is **low**.



Significance

Due to the overall **low** magnitude and **low** sensitivity, the impact of the presence of subsea structures on seabed biodiversity is deemed to be of **very low** significance (Table 7-11).

Residual Impact

This potential impact cannot be eliminated as the subsea infrastructure, wellheads and anchors will remain on the seafloor throughout production activities and/or following decommissioning activities (as per the final decommissioning and closure plan). As such, even if some infrastructures are removed, the residual impact remains **very low** (Table 7-11).

Table 7-11: Impact rating for modification of benthic habitat due to presence of subsea infrastructures.

Modification of benthic habitat		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	All Phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Low	Low
Intensity	Low	Low
Duration	Permanent	Permanent
Extent	Local	Local
Significance	Very Low	Very Low
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	Fully Reversible	
Loss of resources	Low	
Degree to which impact can be avoided	None	
Mitigation Potential	Low	
Cumulative impacts	Unlikely	

7.2.1.6 Mitigation and Management Measures

Table 7-12 lists the recommended mitigation measures to avoid or mitigate impacts on benthic fauna from smothering and disturbance.



Table 7-13 lists the recommended mitigation measures to avoid or mitigate impacts on benthic fauna from reduced sediment quality due to drilling and installation operations.

As noted above, impacts from smothering and disturbance are related to drilling, installation and decommissioning activities, with no additional impacts on benthic fauna as a result of production phase activities. Additionally, no mitigation measures are proposed to mitigate/reduce impacts related to the modification of the benthic habitat due to the presence of subsea infrastructure.

Table 7-12: Mitigation to reduce impacts on benthic fauna from smothering and disturbance of the sediment

No.	Mitigation measure	Classification
Drilling and Installation Phase		
1	Well location: - Should a well site fall outside of the geophysical survey area⁹⁷, undertake a complimentary survey (e.g. geophysical and/or ROV) to identify (with support of a marine ecologist) any sensitive seabed features (e.g., colony forming corals) and structural features (e.g. rocky outcrops) within ≥ 250-270 m⁹⁸ of the revised/new well location(s). - If necessary, based on the results of the complementary survey, adjust the well position accordingly to avoid this 250-270 m buffer area or implement appropriate technologies, operational procedures and monitoring surveys to reduce the risks of, and assess the damage to any vulnerable seabed habitats and communities identified.	Avoid / reduce at source
2	During drilling, monitor (using ROV) cement returns through return holes on the wellhead to minimize cement excess pumped during top hole operations.	Reduce at source
3	Ensure any excess drilling fluid and cement onboard the drilling unit is shipped to shore for reuse, storage or disposal.	Reduce at source
4	Subsea infrastructure location: - Should a subsea infrastructure fall outside of the geophysical survey area, undertake a complementary survey (e.g. geophysical and/or ROV) to identify (by an internal marine ecologist) any sensitive seabed features (e.g., rocky outcrops) within ≥ 30 m of the infrastructure position. If necessary, adjust the infrastructure position accordingly to avoid any identified sensitive seabed feature, prior to finalization of infrastructure location. - Optimise subsea infrastructure routing and operations (i.e. placement/design) to minimise potential disturbance of the seabed.	Avoid / reduce at source
5	Anchor location: - Install anchors and chains prior to FPSO arrival (pre-laid on seabed) to minimise extent of impact to benthic habitats by increasing accuracy of positioning in accordance with the anchor-spread and mooring analysis. - During anchor installation, undertake ROV surveys to confirm anchor placement accuracy and a clear unobstructed anchoring area.	Abate at source

⁹⁷ Refer to Section 5.2.2 for referenced geophysical survey data. As detailed, the seabed of the Venus offshore project area was found to consist of typically homogenous, unconsolidated sediment with no hardgrounds recorded.

⁹⁸ Drilling discharge modelling predicted that areas of significant smothering (>6.5 mm thickness) will be confined to a maximum distance of 270 m, and average distance of 245 m, for all seasons. The specified survey radius (250-270 m) encompasses this predicted impact zone while remaining within the technical constraints of typical ROV operations at these depths.



Table 7-13: Mitigation to reduce impacts on benthic fauna from reduced sediment quality and/or potential toxicity, and hypoxia due to drilling operations (and associated discharges).

No.	Mitigation measure	Classification
1	Ensure only low-toxicity, low bioaccumulation potential and partially biodegradable additives (included in drilling fluids, drilling muds and cement) are used, where practicable.	Avoid / reduce at source
2	Ensure regular maintenance of the onboard solids control package to allow higher NADF recovery.	Abate on site
3	Use and discharge of all liquid wastes to the marine environment subject to Chemicals Management Plan (aimed at the selection and use (where appropriate) of low toxicity, high biodegradability and low bioaccumulation potential chemicals based on their environmental credentials to support the retention of seawater quality).	Avoid / reduce at source
4	Monitoring requirements: • Maintain a full register of MSDSs for all chemical used, as well as a precise log file of their use and discharge. • Test drilled cuttings for retained oil content to ensure specified discharge standards are maintained (average residual oil on cuttings <6.9%). • Use certified Barite with low content of heavy metals and (Br and Hg) • Test any other discharged fluids for visible oil contamination (static sheen or equivalent) • Avoid excess cement usage during the initial riserless drilling stage by monitoring for discharges during cementing using an ROV.	Reduce at source/Abate on site
5	Minimise BOP fluid discharged into the marine environment.	Reduce at source/Abate on site

7.2.2 Water Column Effects

7.2.2.1 Source of Impact

The project aspects that may cause bioaccumulation, turbidity and toxicity effects in the water column, thereby potentially impacting pelagic and/or demersal fauna, are summarised in the table below:

Aspect	Drilling & Installation	Production	Decommissioning
Discharge of drill cuttings and associated mud	X		
Non-routine flaring of hydrocarbons (hydrocarbon drop-out)	X		
Discharge at sea surface of various substances during commissioning (e.g. hydrostatic testing fluid)	X		
Discharge near seabed of various substances used for cleaning and testing (i.e. commissioning effluent)	X		
Anti-fouling paint used on the FPSO hull		X	
Discharges to sea from FPSO (i.e. produced water discharge)		X	



Project Controls

Project controls listed in Section 7.2.1.1 are also relevant for the water column impact. Additionally, the following project controls and management measure are included in the project description (also captured in the ESMP). Implementation of these controls has been considered in the pre-mitigation impact rating:

All phases:

- All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL) requirements.
- Ballast water will be discharged subject to the requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments, (specifically Regulation D-2 which requires water to be treated through an approved ballast water treatment system). Project vessels will be required to comply with this requirement.
- Bilge water will be discharged in accordance with MARPOL 73/78 Annex I, which requires bilge water to be retained on board until it can be discharged to an approved reception facility, unless it is treated by an approved oil / water separator to <15 mg/L (or ppm) oil content and monitored before discharge.
- The residue from the onboard oil / water separator will be treated / disposed of onshore at a licenced hazardous waste treatment facility.
- Only non-oily water (i.e. <15 mg/L oil and grease, maximum instantaneous oil discharge monitor reading) will be discharged overboard. If separation facilities are not available (due to overload or maintenance) the drainage water will be retained on board until it can be discharged to an approved reception facility. The oily residue from the onboard oil / water separator will be treated / disposed of onshore at an approved hazardous waste treatment facility.
- Black water will be treated onboard in accordance with MARPOL 73/78 Annex IV prior to discharge. Effluent will comply with the following criteria: Biological Oxygen Demand (BOD) of <25 mg/L (if the treatment plant was installed after 1/1/2010) or <50 mg/L (if installed before this date); minimal residual chlorine concentration of 0.5 mg/L; no visible floating solids or oil and grease.
- Contractors will be required to develop a Waste Management Plan for all wastes generated at the various sites and a Chemical Management Plan detailing the storage and handling of chemicals, as well as measures to minimise potential pollution.

Drilling and installation phase:

- Produced water from well flow testing will be separated from oily components and treated onboard (hydrocarbon content <30 mg/L) before being discharged overboard. If the hydrocarbon content is >30 mg/L it will be transferred to an onshore facility for treatment and disposal.
- Reduce oil content to below 6.9% OOC by weight using shakers and a centrifuge for drill cutting and mud.
- Hydrostatic fluid, from production line hydrostatic testing, discharged overboard, following treatment on the FPSO, will have a maximum 15 mg/L oil content

Production phase:

- The produced water treatment system will be designed to collect produced water from process facilities and treat this water for discharge overboard via a dedicated



reject caisson (potential impacts resulting from discharge of produced water assessed in Section 7.2.2.3). Dispersed oil in water content will be no higher than 15 mg/L. An online oil in water monitoring system will be in place to ensure specification is met.

- FPSO design will ensure compliance with IFC guideline of temperature rise $<3^{\circ}\text{C}$ at 100 m from discharge point with monitoring of discharge temperature from FPSO.
- Produced water will be released ~15 m below the surface, aiding in the dispersion.
- Anti-fouling paint in compliance with IMO International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention) will be applied to the FPSO.

7.2.2.2 Impact Description

Discharge of drill cuttings and associated mud

The disposal of cuttings from the drilling unit would have various biochemical effects (toxicity and bioaccumulation⁹⁹) on the receiving environment (i.e. water column). The direct effects stem from contaminants contained in the drilling muds and the associated changes to water quality. Although the cuttings themselves are generally considered to be relatively inert, the associated drilling muds are a specially formulated mixture of natural clays, polymers, weighting agents and/or other materials suspended in a fluid medium. The constituents and additives of the discharged muds may potentially have ecotoxicological effects on the water column. The toxic effects on pelagic fauna may be of significance in terms of:

- Chronic accumulation of persistent contaminants in the marine environment (e.g. build-up of persistent pollutants (e.g., hydrocarbons or heavy metals) in the marine environment);
- Acute (short-term) or chronic (long-term) effects on biota, including effects on productivity and reproduction, reduced growth, etc.; and
- Indirect Acute (short-term) or chronic (long-term) ecosystem effects (i.e. secondary impacts on other species and overall biodiversity).

Discharge of hydrocarbon during well flow testing and clean-up

If water flows during well testing, the hydrocarbon component will be separated and piped to a flare boom where it would be incinerated, while the water will be treated and discharged overboard in the Venus offshore project area. This product water contains hydrocarbons, which if released overboard without treatment would have toxic effects on marine fauna, as described above.

Inefficient combustion of hydrocarbons can result in the release of unburnt hydrocarbons, which 'drop-out' onto the sea surface and may form a visible slick of oil. Thus, similarly can have toxic effects on marine fauna.

Discharge at sea surface of various substances during commissioning

Once installed on the seabed, flowlines will be chemically treated via a subsea pigging unit to prevent corrosion and bacterial growth (Production flowlines and risers will then be gauged, cleaned, and hydrostatically tested using this treated seawater (including corrosion inhibitor, oxygen scavenger, biocide, dye). As the production system is closed-loop, commissioning fluids will be returned to the FPSO for treatment and either discharged

⁹⁹ Bioaccumulation is the gradual build-up of a substance (usually a contaminant or chemical) in the tissues of a living organism over time.



overboard in the Venus offshore project area in compliance with MARPOL regulation (oil content below 15 mg/L) or shipped to shore for further treatment.

This chemically treated water contains a mixture of additive, which if released overboard without treatment may have determinantal effects on water quality and potential toxic effects on associated marine fauna.

Discharge near seabed of various substances during commissioning

During the commissioning phases of the 2 gas injection and 4 oil producing flowlines, treated fluids will be discharged approximately 5 m above the seabed. These commissioning fluids involve a mixture of treated seawater and chemical additives, such as biocide, oxygen scavenger, corrosion inhibitor, dye, Monoethylene Glycol (MEG) and methanol. The discharge of these fluids may result in toxicity impacts to the water column and associated chronic and/or acute effects.

Discharge to sea from FPSO

During production, a mixture of oil, gas and water is extracted from the reservoir, which is then sent to the FPSO, where it undergoes a separation process. The treated oil is stored onboard for later offloading to the DPST, while the gas will be re-injected into the reservoir via the GI wells and the separated water, known as **produced water**, will be treated to reduce oil content, before being discharged overboard in the Venus offshore project area. This produced water contains hydrocarbons, biocides, scale inhibitors as well as corrosion inhibitors at varying concentrations, which if released overboard without treatment would have determinantal effects on water quality and potential toxic effects on associated marine fauna potentially leading to mortality (e.g., poisoning) and/or reduced faunal health.

Routine discharges from the drilling units, FPSO, DPST and vessels include grey and black water, waste food, treated bilge water, deck drainage and brine generated from onboard desalination. These routine discharges have been **screened out and are not considered further in this report** (see Section 6.3.2 for further information).

In addition to routine discharges, considering project controls and international regulations, the potential introduction of invasive aliens due to ballast water discharge have been **screened out and are not considered further in this report** (see Section 6.3.3 for further information).

Anti-fouling paint used on the FPSO hull

Antifouling paints are commonly used to prevent the accumulation of marine organisms on submerged surfaces, such as ship hulls. These coatings typically contain biocides and chemical agents designed to deter fouling by slowly leaching into the surrounding water and poisoning organisms that attempt to settle.

While effective at reducing biofouling, the biocidal nature of these paints means they can also pose risks to non-target marine species. The toxic compounds may affect a wide range of marine life, including those not directly involved in fouling, potentially disrupting local ecosystems.

7.2.2.3 Impact Assessment: Acute or Chronic Effects on Pelagic and Demersal Fauna due to Turbidity, Bioaccumulation, Toxicity and Hypoxic Effects

Sensitivity of receptor

The Venus offshore project area is located within PEL0056/Block 2913B, over 300 km offshore at its closest point, far removed from coastal MPAs and sensitive coastal receptors. The pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore



transshipment area is classified as ‘Least Threatened’ (see 5.6.4.1). The surface waters within PEL0056/Block 2913B are well beyond the influence of shelf-edge and coastal upwelling, resulting in low plankton abundance that varies both spatially and temporally. Similarly, PEL0056/Block 2913B is situated well offshore from the egg and larval distribution of important commercial fish species (see 5.5.3.1).

Information on demersal and cartilaginous fish species beyond the shelf break is generally lacking. Demersal fish species, such as eel-shaped fishes (Halosauridae sp.), rat-tails (Macrouridae sp.), tripod fishes (Ipnopidae sp.), cusk-eels (Ophidiidae sp.) and larvacean houses (Appendicularia sp.), were recorded by video transects during the PEL0056/Block 2913B EBS survey (BSL, 2023a), and may be encountered in the Venus offshore project area.

The taxa most vulnerable to operational discharges are pelagic turtles, large migratory pelagic fish and marine mammals. Some pelagic species that may be encountered within the Venus offshore project area (see Section 5.5.3.6) and larger water column impact zone are considered regionally or globally ‘Critically Endangered’ (Loggerhead turtle), ‘Endangered’ (e.g. fin whale and Sei whale), ‘Vulnerable’ (e.g. Sperm whale and Humpback whale) or ‘Least Concern’ (e.g. Dusky dolphin) (see 5.5.3.6). Highly mobile large pelagic migratory species that may transit through the Venus offshore project area are likely to move out of the area influenced by the plume. Furthermore, compliance with the project controls will ensure reduced discharges and reduced sensitivity of marine fauna to these discharges.

Consequently, the receptors expected in the water column are considered to be of medium sensitivity.

Magnitude

Drilling and Installation Phase

Overall, the impact magnitude for acute and chronic effects from toxicity and bioaccumulation on pelagic fauna during the **drilling and installation phase** is considered to be **very low**. This is based on the following ratings:

- **Low intensity**, due to the rapid dilution and widespread dispersion of settling particles and/or discharge plumes, and egg and larval distribution of important commercial fish species is not expected within PEL0056/Block 2913B or sediment/discharge plume. Furthermore, the pelagic habitat/ecosystem type within PEL0056/Block 2913B is classified as ‘Least Threatened’ and, as most pelagic species likely to be encountered within the Venus offshore project area are highly mobile, they would be expected to move away from the area influenced by the plume (drilling discharges, commissioning effluent, etc.).
- **Medium term**, with significant risk to the water column due to drilling operations restricted to a few days (< 12 days), yet with drilling and installation operations taking place over a period of up to 4 years.
- **Local extent**, as the maximum significant cumulative risk¹⁰⁰ throughout the water column, observed during riser discharge scenarios considered in the drilling discharge modelling, extended a maximum horizontal distance of up to approximately 31.2 km in various directions from the discharge point depending on the season. Cumulative risk due to commissioning fluid discharges were modelled to extend up to 19.2 km from the near seabed discharge point in a northerly direction.

These ratings are discussed for each project aspect below.

¹⁰⁰ Significant risk corresponds to a risk level of $\geq 5\%$, which means the discharge affects 5% or more of the community, typically its most sensitive species.



Increased turbidity and toxic effects due to discharge of drill cuttings and associated mud

One of the more apparent effects of increased concentrations of suspended particles and consequent increase in turbidity, is a reduction in light penetration through the water column with potential adverse effects on the photosynthetic capability of phytoplankton (Poopetch, 1982; Parsons, Kessler, & Guanguo, 1986a; 1986b; Monteiro P., 1998) and the foraging efficiency of visual predators (Simmons, Brown, & Kemper, 2015; Peterson, Laney, & Rice, 2001). However, due to the rapid dilution and widespread dispersion of settling particles, any adverse effects in the water column would be ephemeral, highly localised and short term. Any biological effects on nektonic and planktonic communities would be negligible (Aldredge, Elias, & Gotschalk, 1986).

Turbid water is a natural occurrence along the southern African west coast, resulting from aeolian and riverine inputs, resuspension of seabed sediments in the wave-influenced nearshore areas and seasonal phytoplankton production in the upwelling zones. Further offshore (e.g. in PEL0056/Block 2913B), surface waters tend to be clearer and less productive due to limited influence from coastal and shelf-edge upwelling. Overall, based on 2018 Venus-1X and post-drill 2022 EBS data (see Section 5.2), turbidity was found to remain low and stable (around 0.02 NTU) from 100 m depth to the seabed, with only minor increases near the surface (BSL, 2019a; BSL, 2023a; BSL, 2023b). Additionally, the Venus offshore project area and PEL0056/Block 2913B are located well offshore of coastal upwelling cells, with waters found to be nutrient poor (as discussed in Section 5.4.6).

Consequently, the major spawning areas are all located on the continental shelf, well inshore of the PEL0056/Block 2913B and the Venus offshore project area. Seasonally high abundances of ichthyoplankton (hake, sardine and anchovy eggs and larvae), particularly in late winter and early spring may occur inshore of the PEL0056/Block 2913B, but these are not expected to be influenced by **turbidity plumes** generated during drilling operations. Based on drilling discharge modelling results (see Section 0), total concentration of cuttings and chemicals was found to disperse to the NW (Season 1), NE (Season 2), W (Season 3) and SW (Season 4) in the water column, with impacts not found to reach the EBSA and/or Tripp Seamount. The rapid dilution and widespread dispersion of settling particles would ensure that any impacts are **localised** and **short-term** per well pair.

When considering the **toxic effects** of drilling discharges the maximum cumulative significant risk throughout the water column, observed during **riserless** discharge scenarios considered in the drilling discharge modelling, extended a maximum horizontal distance of 28.7 km in the NW direction (localised) when released during Season 3 (highest current intensity). Notably, cumulative risk throughout the water column was reduced (<26.4 km) for the remaining seasons. For the **risered** discharge scenarios, the significant risk to the water column extended up to a maximum horizontal distance of approximately 31.2 km (**local**). While significant risk in the water column lasted for a maximum of <10 days based on simultaneous drilling of up to three drill rigs (very short-term), up to 40 wells are to be drilled over a period of up to four years (**medium term**).

Overall, the intensity of impacts in the water column is deemed **low**, as the Venus offshore project area is well offshore from the egg and larval distribution of important commercial fish species, with pelagic and demersal species able to move outside the area of influence, and the pelagic habitat/ecosystem type within PEL0056/Block 2913B is classified as 'Least Threatened'. There is also no occurrence of significant risk reaching the EBSA and the Tripp Seamount. The duration of the impact on the populations would be **medium term** (< 10 days per well pair over a period of four years).

Considering the localised, low intensity and medium-term nature of the potential impacts, the potential for water column effects due to the discharge of drill cuttings and mud would thus be of **very low** magnitude for up to 40 wells which will be drilled over a period of up to four years.



Toxic effects due to hydrocarbon ‘drop-out’ from well flow testing and cleaning from drilling unit

Given the offshore location of the drilling area, low quantities involved and biodegradable nature of the product, in the event of **hydrocarbon ‘drop-out’**, it is expected to disperse rapidly. Although not modelled, based on the oil spill and drilling discharges modelling, it can be expected that due to the dominant winds and currents in the area, a plume would more than likely disperse to the NW, NE, W and SW. Thus, there is unlikely to be an impact on sensitive receptors nearby the Venus offshore project area (e.g. inshore spawning areas, EBSA and Tripp Seamount).

Due to the distance offshore, it is only likely to be pelagic species of fish, birds, turtles and cetaceans that may be affected by potential hydrocarbon ‘drop-out’, which are unlikely to respond to the minor changes in water quality.

The impact of hydrocarbon ‘drop-out’ during well test and clean-up would be of **low** intensity and limited to the drilling locations (**site**) over the **short-term** (although drilling will take place of a period of four years only a few ad hoc well testing and clean-up of a few days each will take place). The impact of well testing and clean-up is, therefore, considered of **very low** magnitude.

Increased turbidity and toxic effects due to discharges below sea surface of various substances during commissioning

Discharges during the installation phase includes the discharge from the FPSO after treatment of hydrostatic fluid used during the testing of production flowlines.

The hydrostatic testing fluid (treated seawater) contains several chemical additives, including a biocide, corrosion inhibitor, oxygen scavenger and dye (see Section 4.3.7). While these additives are selected for low toxicity, their discharge may still result in localised changes to water quality, with potential for toxicity, bioaccumulation and indirect ecological effects.

As with other water quality-related discharges (e.g., drilling discharges), mobile pelagic and/or demersal species are expected to avoid the area, reducing the likelihood of significant impacts. However, less mobile organisms, such as phytoplankton, ichthyoplankton or benthic species, may be more susceptible to short-term exposure within the immediate vicinity of the discharge.

Considering hydrostatic test water will be treated prior (maximum 15 mg/L oil content) to being released into the marine environment, at the offshore location of the Venus project (~300 km from the coastline at its nearest point) in an area where the pelagic habitat/ecosystem type is classified as ‘Least Threatened’, well removed from key egg and larval habitats and dispersion corridors of commercially important fish species, the likely plume direction away from coastal sensitivities and the high mobility of pelagic species likely to occur within this area, the potential impacts are assessed to be of **low** intensity.

While hydrostatic testing may take place intermittently over 2-years, occurring during the final phases of the installation programme following the installation of the flowlines and risers, the effects of each hydrostatic testing discharge event is expected to be **short-term** (< 1 year), owing to the rapid dilution and widespread dispersion within the offshore environment. The impact will be **localised**, largely confined to the vicinity of the discharge.

Overall, considering the localised, low intensity and short-term nature of the potential impacts, the impact magnitude is considered to be **very low**.

Toxic effects due to discharge near to seabed of substances used for commissioning of flowlines

Up to 2 GI and 4 OP flowlines may be tested (separately) over two austral summer periods (2 x 6 months), with commissioning fluids released 5 m above the seabed.



Based on the results of the commissioning fluid modelling study (see Section 7.1.3), the maximum significant cumulative risk (> 5% risk) distances extended at maximum 19.2 km in Season 3 (characterised by stronger currents) (**local**) reducing to 5.3 km in Season 2 (lowest current intensity). Significant risk areas were generally orientated in a N direction, except in Season 4 where risk occurred to the E, with the plume confined to the lower water column near the seabed (below 2 500 m deep). Thus, well below the depth of most pelagic marine faunal species. Tri-Alkyl Quat (≈85%) and Didecyldimethylammonium chloride (≈7.5%) were the primary contributors to toxicity due to their low PNEC values, both components being part of the seawater treatment cocktail.

Overall risk in the water column lasted up to 1.7 days in Season 2 (**short-term**), reducing to <1 day for the remaining seasons. Notably, when considering potential chronic exposure scenarios (with risks lasting > 1 day), impacts remained within the vicinity of the discharge point, extending up to 1 km (**local**). Based on EIF analysis, significant risks were found to dissipate almost entirely within three days (**short-term**), with impacts from respective GI and OP flowline tests not expected to result in cumulative impacts within the water column.

Given the offshore location of the Venus project area and the predominantly northward dispersion observed across seasons (except for Season 4), water column impacts from commissioning fluid discharge are unlikely to affect sensitive coastal receptors and/or inshore spawning and recruitment areas. In addition, all simulation scenarios, including Season 4, did not show significant risk reaching identified sensitive areas (MPAs and EBSAs). Notably, the plume and its associated significant risk primarily occupied the lower water column (near the seabed) in depths > 2 500 m, thereby mainly affecting demersal fauna associated with the seabed, and not pelagic fauna. As such the intensity of impacts in the water column is deemed **low**, with pelagic species able to move outside the area of influence.

Considering the localised, low intensity and short-term nature of the potential impacts, the magnitude is considered to be **very low**.

Production Phase

Production activities are anticipated to commence while drilling and installation activities are still taking place, with an overlap of ~1.5 years. As such, cumulative impacts due to discharges to the water column from concurrent drilling (e.g. discharge of drill cuttings and mud) and offshore production (e.g. produced water) operations within the first 1.5 years of production may occur. Notably, these cumulative impacts are expected to be limited, owing to fewer drilling days during the first year of full production and potential distance between drilling units and the FPSO. Additionally, water column impacts due to discharge of drill cuttings is expected to be limited to the short-term (<10 days per well pair) and local extent, with a potential overlap of impact zones within the water column limited.

Overall, the impact magnitude for acute and chronic effects on pelagic fauna is considered to be **low**. This is based on the following ratings:

- **Low** intensity due to the rapid dilution and widespread dispersion of settling particles, and egg and larval distribution of important commercial fish species is not expected within the PEL0056/Block 2913B or effluent plume, with pelagic species able to move outside the area of influence. Furthermore, the pelagic habitat/ecosystem type within PEL0056/Block 2913B is classified as 'Least Threatened'.
- **Permanent**, as produced water will be discharged throughout the production phase (21 - 31-years). Notably, associated impacts to the water column will not extend beyond the 31-year production period, ending/reducing to below significant levels in a few days (up to 30 days) after production activities end.
- **Local extent**, as while the maximum significant cumulative risk was modelled to extend between 25.1 km (SE) and 62.3 km (NW), depending on the season,



discharge plumes and cumulative risk was found to remain largely within PEL0056/Licence Block 2913B (see Section 7.1.4).

These ratings are discussed for each project aspect below.

Toxic effects due to discharge of produced water from the FPSO

Produced water is the largest volume waste stream generated during offshore oil and gas production and typically consists of formation water, injection water and various technological fluids. If discharged into the marine environment before treatment (although not proposed), produced water can significantly degrade water quality, with potential toxic effects on marine organisms, including respiratory damage, impaired physiological function, and in severe cases, mortality due to suffocation or poisoning.

The chemical composition of produced water is highly variable and complex, influenced by the nature of the reservoir, production methods, and treatment efficiency. While oil-water separators on offshore platforms are designed to remove particulate and dispersed oil, dissolved hydrocarbons may still be released into the sea (Neff et al., 1987). In addition to hydrocarbons, produced water may exhibit high salinity (up to 300 g/L) and contain naturally occurring materials with low radioactivity. While materials and chemicals within produced water may have low radioactivity, these can become more concentrated when co-precipitated with other elements or in combination with other chemicals. However, considering the proposed produced water treatment on the FPSO and the rapid dispersion in the offshore environment, the risk of residual radioactivity is considered low (highly unlikely).

Monitoring studies in the North Sea and Norwegian waters have demonstrated that produced water discharges can lead to elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and alkyl phenols in the water column and in marine organisms. For example, caged mussels placed 500 m from offshore platforms showed increased PAH concentrations and minor histopathological stress responses (OSPAR QSR, 2010). Similarly, demersal fish collected near installations exhibited elevated DNA adducts (i.e. segments of DNA that have a chemical compound (usually a pollutant or toxin) covalently bound to them) and histological changes, suggesting sub-lethal biological effects from chronic exposure to produced water constituents. These findings highlight the potential for bioaccumulation and long-term ecological impacts, particularly for sedentary or benthic species.

Despite these concerns, with the shallower waters of the referenced monitoring study to be kept in mind, the spatial extent of produced water impacts is generally limited due to dilution and dispersion in the open ocean and especially within the Venus offshore project area, which is in deep water far removed from the coast. Concentrations of contaminants typically decrease with increasing distance from the discharge point, and biological responses tend to follow similar gradients. Furthermore, discharge below the sea surface aids in the dispersion of produced water, owing to subsurface currents. For the current project, produced water will be released ~15 m below the surface.

Based on modelling results the maximum significant cumulative risk throughout the water column, extended a maximum horizontal distance of 62.3 km in a NW direction when released during Season 1 (highest current intensity), notably remaining largely within PEL0056/Licence Block 2913B (**local**). Despite the lower maximum distance of 25.1 km, Season 2 was the only scenario in which significant cumulative risk within the water column was found to extend towards the SE and reached the Orange Seamount and Canyon Complex EBSA, with a low probability of occurrence (< 37%), and extending for a small portion of ~2 km within the area. The longest continuous risk at a single point was 29.4 days in Season 2, reducing to less than 10 days for Season 1 (**short-term**). As such, while produced water discharge will take place throughout production operations (**permanent**), results indicate a limited potential for cumulative, long-term bioaccumulation within the area of impact.



Notably, the Predicted No Effect Concentration (PNEC) values per chemical used in the modelling study was based on chronic toxicity, which encompasses long-term biological effects (such as altered metabolism, impaired growth and reproduction, genetic mutations, and increased mortality) typically from multi-day/long-term exposures. As such, when considering risks persisting for over 1 day after the end of the discharge, the maximum risk within the water column reduced to 10.5 km (Season 2) (**local**). Overall current intensity was found to greatly influence plume dispersion, and the total area of the water column impacts by a plume with significant risk.

Overall, the intensity of impacts in the water column is deemed **low**, as the Venus offshore project is in an area where the pelagic habitat/ecosystem type is classified as 'Least Threatened', well offshore from the egg and larval distribution of important commercial fish species, with pelagic and demersal species able to move outside the area of influence. Although there is the potential (< 37% probability of occurrence) for a small overlap with the Orange Seamount and Canyon Complex EBSA (~2 km), the EBSA is largely for the protection of threatened benthic habitat types. Cumulative impacts are more likely to occur in coastal areas for the purposes of calving or important oceanic focal features such as seamounts. However, such areas and/or features fall outside of the maximum threshold distances for significant impacts to the water column. Considering, risks persisting over 1 day were modelled to extend up to a maximum of 10.5 km, cumulative impacts are considered limited.

The impacts risks extend to up to maximum distance of 62.3 km (in Season 1) from the FPSO located within the Venus offshore project area, yet remaining largely within PEL0056/Block 2913B (**local**). The duration of the impact on the populations would occur throughout the production phase (**permanent**), extending a few days following the end of the production operations and the end of the discharge.

Considering the localised, low intensity and permanent nature of the potential impact, the potential for water column effects due to the discharge of produced water would be of **low** magnitude.

Toxic effects due to anti-fouling paint used on FPSO hull

While antifouling paints are essential for operational efficiency and safety the biocides used in these coatings leach into the surrounding water, potentially harming non-target marine organisms and disrupting ecosystems. These effects are particularly pronounced in semi-enclosed or low-flushing environments, such as harbours and marinas, where contaminants can accumulate in sediments. This is not the situation in the open ocean and especially within the Venus offshore project area.

For this project, the FPSO hull will be coated with a tin-free self-polishing antifouling paint that complies with the IMO International Convention on the Control of Harmful Anti-Fouling Systems on Ships (in line with the AFS Convention which prohibits the use of harmful organotin compounds in antifouling systems and provides a framework for regulating other harmful substances). This system is designed to last the full offshore service life without the need for recoating.

Considering compliance with IMO AFS regulations and the offshore nature of the Venus project area, the accumulation of biocides, and any subsequent potential acute or chronic toxicity impacts, is expected to be negligible. Leached biocides are anticipated to disperse and dilute rapidly within the open offshore environment, with the marine mammals and pelagic fish species potentially encountered within the offshore waters being highly mobile and likely moving through the area of impact for a short period of time.

As such, any potential impacts are considered to be of **very low to negligible** intensity, largely confined to the immediate vicinity of the FPSO (**site**). The concentration of leached biocides is expected to decrease with distance from the source. Any toxic effects from antifouling paint will be limited to the operational lifespan of the FPSO while it remains on



site (i.e., up to 31 years; **permanent**). No impacts are expected following decommissioning and the departure of the FPSO from the Venus offshore project area.

Overall, considering the site extent, low-negligible intensity and permanent nature of the potential impact, the potential toxic impacts due to antifouling paint are considered to be of **very low** magnitude.

Significance

The highest impact magnitude and therefore impact significance rating across the impact sources detailed above is assessed, resulting from the maximum combination of intensity, extent and duration. Based on the **very low** (drilling and installation phase) and **low** (production phase) magnitude and **medium** sensitivity of receptors, the potential toxicological effects of various drilling, commissioning and produced discharges are deemed to be of **very low** and **low** significance, respectively, for water column bioaccumulation and toxicity (Table 7-14).

Residual Impact

This potential impact cannot be eliminated due to the nature of the drilling, installation and commissioning and production approach and the necessity to discharge these fluids. Considering the mitigation measures, including use of low bioaccumulation potential and partially biodegradable additives as well as optimization of well flow testing program, amongst others, listed in Section 7.2.2.4, the residual impact on pelagic fauna will have a lower (**very low**) intensity, and residual impact significance of **very low** for all project phases (Table 7-14).

Table 7-14: Impact rating for bioaccumulation, turbidity and toxicity effects on pelagic and demersal fauna.

Acute and chronic effects on pelagic and demersal fauna				
Type of Impact	Direct & Indirect			
Nature of Impact	Negative			
Phase	Drilling & Installation		Production	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium			
Magnitude	Very Low	Very Low	Low	Very Low
Intensity	Low	Very Low	Low	Very Low
Duration	Medium term	Medium term	Permanent	Permanent
Extent	Local	Local	Local	Local
Significance	Very Low	Very Low	Low	Very Low
Probability	Highly Likely			
Reversibility	Fully Reversible			
Loss of resources	Low			
Degree to which impact can be avoided	Low			
Mitigation Potential	Low			
Cumulative impacts	Likely			



7.2.2.4 Mitigation and Management Measures

In addition to the mitigation included in Table 7-15 lists the recommended mitigation measures to reduce water column effects on benthic, demersal and/or pelagic fauna due to various operational discharges.

Table 7-15: Mitigation to reduce impacts related to reduced water quality.

No.	Mitigation measure	Classification
Drilling and Installation Phase		
1	Optimise well test programme to reduce flaring duration as much as possible.	Reduce at source/Abate on site
2	For non-routine flaring, use burners with > 95% design efficiency to optimise combustion of the hydrocarbons in order to minimise emissions and hydrocarbon 'drop-out' during well testing.	Avoid / reduce at source
3	Commence with well testing during daylight hours, as far as possible, and operational monitoring.	Reduce at source/ Abate on site
4	Monitor flare (continuous) for any malfunctioning, etc. (including any drop-out).	Avoid/reduce at source
Production Phase		
5	Ensure only low-toxicity, low bioaccumulation potential and partially biodegradable additives (included in hydraulic fluid) are used, where practicable.	Avoid / reduce at source
6	Maintain a full register of MSDSs for all chemical used, as well as a precise log file of their use and discharge.	Avoid / reduce at source
7	Use and discharge of all liquid wastes to the marine environment subject to Chemicals Management Plan (aimed at the selection and use (where appropriate) of low toxicity, high biodegradability and low bioaccumulation potential chemicals based on their environmental credentials to support the retention of seawater quality).	Avoid / reduce at source
8	Monitor produced water discharge from the FPSO to ensure dispersed oil in water content remains below 15 mg/L.	Avoid / reduce at source
9	Ensure regular maintenance of the produced water treatment system.	Avoid / reduce at source
All phases		
10	Implement leak detection and maintenance programmes for valves, flanges, fittings, seals, hydraulic systems, hoses, etc. All hydraulic systems should be adequately maintained, and hydraulic hoses should be frequently inspected.	Avoid / abate at source
11	Use low-toxicity biodegradable detergents for cleaning of deck spillages	Avoid / abate at source
12	Prohibit routine discharges in the nearshore transshipment area and NIMPA (when transit to Lüderitz).	Avoid / abate at source



7.2.3 Marine Fauna Behavioural Disturbance Effects

7.2.3.1 Source of Impact

The project activities that may result in the behavioural disturbance of marine mammals, fish, turtles and seabirds are summarised below:

Aspect	Drilling & Installation	Production	Decommissioning
Underwater noise from drilling operations (non-impulsive)	X		
Underwater noise from vessels operations, manoeuvring and positioning (non-impulsive)	X	X	X
Underwater noise from vertical seismic profiling operations (impulsive)	X		
Non-routine flaring (light and heat) of hydrocarbons	X	X	
Vessel / drill unit / FPSO lighting	X	X	X
Helicopter atmospheric and underwater noise	X	X	X

Project Controls

- All whales and dolphins are given protection under the Namibian Law. The regulations under the Namibian Marine Resources Act, 2000 (No. 27 of 2000) states that no whales or dolphins may be harassed, killed or fished. Although not legislated in Namibia, no vessel or aircraft should approach closer than 300 m to any whale and a vessel or aircraft should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.
- The operation of helicopters and aircraft is governed by the Civil Aviation Act (No. 6 of 2016) and associated regulations.
- The Operator and contractors will ensure that the proposed activities are undertaken in a manner consistent with good international industry practice and BAT.
- All the noise abatement measures will be taken to ensure an adequate acoustical insulation of the engines, compressors, turbines (enclose engines) and gas flow lines and valves (lagging, in-line silencers, etc.).
- Lighting will be reduced to the minimum and directed in such a way so as to avoid attracting animals (such as birds, fish, plankton, turtles and marine mammals).
- The FPSO will be held moored in position throughout production activities (no DPS).

7.2.3.2 Impact Description

Underwater noise from drilling units and project vessels operations (non-impulsive)

The presence and operation of the drilling unit and project vessels (FPSO, DPST, tugs, installation vessels and support vessels) in the Venus offshore project area and nearshore transshipment areas (DPST and tugs), as well as during transit to the Venus offshore project area from either Walvis Bay or Lüderitz (mainly supply vessels and DPST), will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area.

Elevated noise levels could impact marine fauna by:

- Masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey) (indirect negative impact);



- Causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas (direct negative impact); and
- Causing direct physical injury to hearing or other organs (direct negative impact), including Auditory Injury (AUD INJ) or Temporary Thresholds Shifts (TTS) (see Section 7.1.1). Physical and/or physiological injury impacts are addressed in Section 7.2.4.

For non-impulsive and continuous noise, such as noise from vessels' DPS sources, the NMFS (2024a) acoustic threshold for all marine mammals' behavioural response is determined using the received level of 120 dB re 1 μ Pa, with a threshold of 175 dB re 1 μ Pa used for marine turtles. To determine the behaviour response (to single exposure) threshold for all fish species, except fish eggs and fish larvae, to impulsive and non-impulsive noise, NMFS (2024a) uses the common Sound Pressure Level (SPL) of 150 dB re 1 μ Pa.

Underwater noise from Vertical Seismic Profiling (VSP) operations (impulsive)

VSP is a standard method used during well logging and can generate noise that could exceed ambient noise levels. The source levels for the VSP G-Gun array show the Lpk to be 247 dB re 1 μ Pa @ 1 m and SPL to be 232 dB re 1 μ Pa @ 1 m, decreasing rapidly with distance from the source. VSP uses a small airgun array, with volumes and the energy released into the marine environment being significantly smaller than what is required or generated during conventional seismic surveys. The airgun array would be discharged approximately five times at 20 second intervals. This process is repeated, as required, for different sections of the well. A VSP is expected to take up to 9 hours and ~250 shots per well to complete, depending on the well's depth and number of stations being profiled.

The impacts from impulsive noise, based on different thresholds, are as described for non-impulsive noise (AUD INJ, TTS, masking and disturbance). This section considers behaviour impacts, while physical and/or physiological injury impacts are addressed in Section 7.2.4.

Helicopter atmospheric and underwater noise

The aircraft noise would primarily take place in the Venus offshore project area and along the route taken by the helicopters between the project area and Lüderitz / Oranjemund airport. Although the Venus offshore project area is located approximately 320 km southwest of Lüderitz and 300 km from Oranjemund, the potential flight path between the Venus offshore project area and Lüderitz may cross over NIMPA and potentially over sensitive coastal receptors near Lüderitz (e.g. key faunal breeding/feeding areas, bird or seal colonies and nursery areas for commercial fish stocks), which may be affected. Similarly, sensitive coastal receptors near Oranjemund may be affected. In addition, migratory pelagic species transiting through the flight path may also be directly affected.

The potential for underwater noise to be generated by helicopters is limited, with broadband noise levels underwater as a result of helicopters flying at altitudes of 150 m or more expected to be around 109 dB re 1 μ Pa (Richardson, et al., 2013) at the most noise-affected point. This noise level is considerably less than the underwater noise predicted to be generated by the support vessels or the drilling unit and can thus be considered negligible in terms of the overall underwater noise levels. Nevertheless, atmospheric noise generated by helicopter operations is taken into consideration.

Elevated aerial (i.e. atmospheric) noise levels from helicopters may disturb faunal species resulting in behavioural changes or displacement from important feeding or breeding areas (direct negative impact).



Non-routine flaring of hydrocarbons

Non-routine flaring during well testing and cleaning and production operations (start-up and closed flare) produces a flame of intense light and heat at the top of the flare. Increased ambient lighting may disturb and disorientate pelagic seabirds feeding in or passing through the area (direct negative impact). This increased lighting may also result in indirect physiological and behavioural effects on fish, turtles and cephalopods (direct negative impact), as these may be drawn to the lights at night where they may be more easily preyed upon by other fish and seabirds.

Operational lighting

The operational lighting of project vessels and the drilling units during transit and operations across the Venus offshore project area, in addition to lighting of the FPSO throughout production operations, can be a significant source of artificial light in the offshore environment increasing the ambient lighting in offshore areas.

Increased ambient lighting may disturb and disorientate pelagic seabirds feeding in the area (direct negative impact). Operational lights may also result in physiological and behavioural effects of fish and cephalopods (direct negative impact), as these may be drawn to the lights at night where they may be more easily preyed upon by other fish and seabirds.

7.2.3.3 Impact Assessment: Behavioural Disturbance to Marine Mammals

Sensitivity of receptor

Some marine mammals species that may be encountered within the Venus offshore project area and nearshore transshipment area (see Section 5.5.3.6) are considered regionally or globally 'Endangered' (e.g. Fin whale and Sei whale), 'Vulnerable' (e.g. Sperm whale and Humpback whale) or 'Least Concern' (e.g. Dusky dolphin) (see 5.5.3.6). Highly mobile large pelagic migratory species that may transit through the project area are likely to move out of the area influenced due to underwater noise. These marine mammals may also be attracted to areas of increased lighting, thereby potentially impacting their behaviour. Overall, species that will be potentially encountered are widely distributed outside of the project area and potential area of impact, with numbers likely being limited/restricted. The Venus offshore project area and nearshore transshipment area are in main marine traffic routes, while the nearshore transshipment area is also near a vessel anchorage area and, thus, is in an area already experiencing increased marine traffic and vessel noise and lighting. Furthermore, the pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area is classified as 'Least Threatened' (see Section 5.6.4.1).

Consequently, the marine faunal receptors using the water column are considered to be of **medium** sensitivity.

Magnitude

Drilling and Installation Phase

Overall, the impact magnitude for behavioural disturbance to marine mammals due to drilling and installation related activities is considered to be low. This is based on the following ratings:

- **Low intensity** for non-impulsive and impulsive noise and lighting, as the Venus offshore project area is located in a main marine traffic route experiencing increased vessel noise. In addition, sound sources from during drilling operations will be stationary and can thus easily be avoided by highly mobile cetaceans, which would be able to move away from the sound source before injury occurs (see Section 7.2.4). The pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area are also classified as 'Least Threatened' (see 5.6.4.1).



Very low intensity for increased underwater noise and lighting is expected from vessel transit.

- **Medium-term** duration, as drilling and installation operations will take place over a period of up to 4 years. For VSP operations, however, the duration is deemed to be short term (around nine hours per VSP operation), as VSP operations would be intermittent over the four-year drilling campaign.
- **Regional extent**, as the maximum behavioural disturbance impact zone for marine mammals extends up to around 100 km from the Venus offshore project area operations (based on the maximum number of vessels operating at the Venus offshore project area during peak drilling and installation activities). Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time (site). For VSP operations, however, the extent is deemed to be local, as behaviour disturbance for VSP operations is only expected within a maximum of 2.5 km from the drilling location and for the duration of the VSP activities.

These ratings are discussed for each project aspect below.

Underwater noise from vessels and drilling operations (non-impulsive)

The Venus offshore project area lies within a medium to high intensity vessel route that passes around southern Africa, with shipping traffic density across the northwest and southeast portions of the block area (see Figure 5-81). Given the local shipping traffic and moderate metocean conditions (as described in Section 5.7.6.1), the ambient noise levels are expected to be at least 5 dB higher than the lowest level, within the higher range of the typical ambient noise levels, i.e., 85 - 120 dB re 1 μ Pa for the frequency range 10 – 10 kHz (SLR Consulting Canada, 2025).

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön, 2012). Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping (Erbe, Dunlop, & Dolman, 2018; 2019).

The underwater noise from well drilling operations (non-impulsive) may induce localised behavioural changes or masking of biologically relevant sounds in some marine fauna, but there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry, 2005).

The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than they are one that is approaching them (Watkins, 1986; Leung-Ng & Leung, 2003) or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme, Miles, Tyack, Clark, & Bird, 1985).

For the current proposed well-drilling activities in the Venus offshore project area it was estimated that non-impulsive noise from drilling activities, as outlined for Scenario UD-1 (three drilling units and associated vessels operating concurrently in close proximity; Section 7.1.1), could result in behavioural disturbance in cetaceans to a maximum distance of up to 74 km (**regional**). Notably, the above behavioural impact zones represent the worst-case scenario during **drilling operations only** (three drilling units, one full-time support vessel and three supply vessels (operating at 50% duty cycle) simultaneously operating in close proximity to one another within the Venus offshore project area) (SLR Consulting Canada, 2025). Concurrent drilling operations by three drilling units are planned to take place within the first three years of the drilling and installation phase, with two drilling units remaining on site in the fourth year of operations (**medium term**).



The offshore installation of subsea equipment in the Venus offshore project area will primarily occur over two austral summer periods (2 x 6 months) due to metocean constraints:

- During the first construction campaign, it is anticipated that all three installation vessels and their associated supply vessels could be on site simultaneously for approximately 90 days. These will operate alongside the three drilling units and their support vessels, representing the worst-case scenario for this period, with up to 13 vessels operating concurrently across the Venus offshore project area, each using DPS. Considering this scenario (UC-1, see Section 7.1.1), behavioural impact zones are expected to extend up to 90.5 km (**regional extent**). These impacts are considered **short-term** (< 1 year), with the full fleet of 13 vessels only active for up to 90 days, after which the installation and construction vessels will periodically depart the site. Consequently, the modelled impact zones are expected to reduce to levels similar to those associated with drilling operations alone outside the 6-month installation campaign period.
- In the second construction campaign, the remaining flowlines will be installed and connected to each other and to the FPSO, which is scheduled to arrive during this phase. The FPSO will be moored with the assistance of four tugs during a one-month operation, which will coincide with ongoing installation and drilling activities. This scenario (Scenario UC-2, see Section 7.1.1) represents the peak vessel presence and the worst-case scenario for both the drilling and installation phase and the overall project. Under this scenario, up to 16 vessels may be present at the Venus offshore project area, with modelled behavioural impact zones extending approximately 100 km from the FPSO (**regional extent**) (Figure 7-9). As previously noted, this peak activity, driven by the concurrent arrival and installation of the FPSO along with other operations, will last for only one month. After this period, the four mooring tugs will disengage and depart, reducing the underwater noise and the associated impact zone, with the second installation campaign taking place over the **short-term** (< 1-year).

Considering the ability for cetaceans to move away from the sound source and the relative seasonality of species occurrence, as well as their extensive distributions, the intensity of potential behavioural disturbance due to non-impulsive noise is considered **low**. Furthermore, the Venus offshore project area is located in a main marine traffic route and, thus, is in an area already experiencing increased marine traffic and vessel noise.

A conservative assessment approach is considered in which the maximum duration of the impact on the populations would be **medium term** (extending across the four year drilling and installation phase) and to a **regional** extent (behavioural disturbances would be expected between 74 km (Scenario UD-1) to a maximum of around 100 km from FPSO during second installation campaign (Scenario UC-2; based on peak vessel activity).

Overall, considering the regional extent, low intensity and medium-term nature of the potential impact, the potential for behavioural disturbance from underwater noise would be of **low** magnitude for drilling and installation phase.



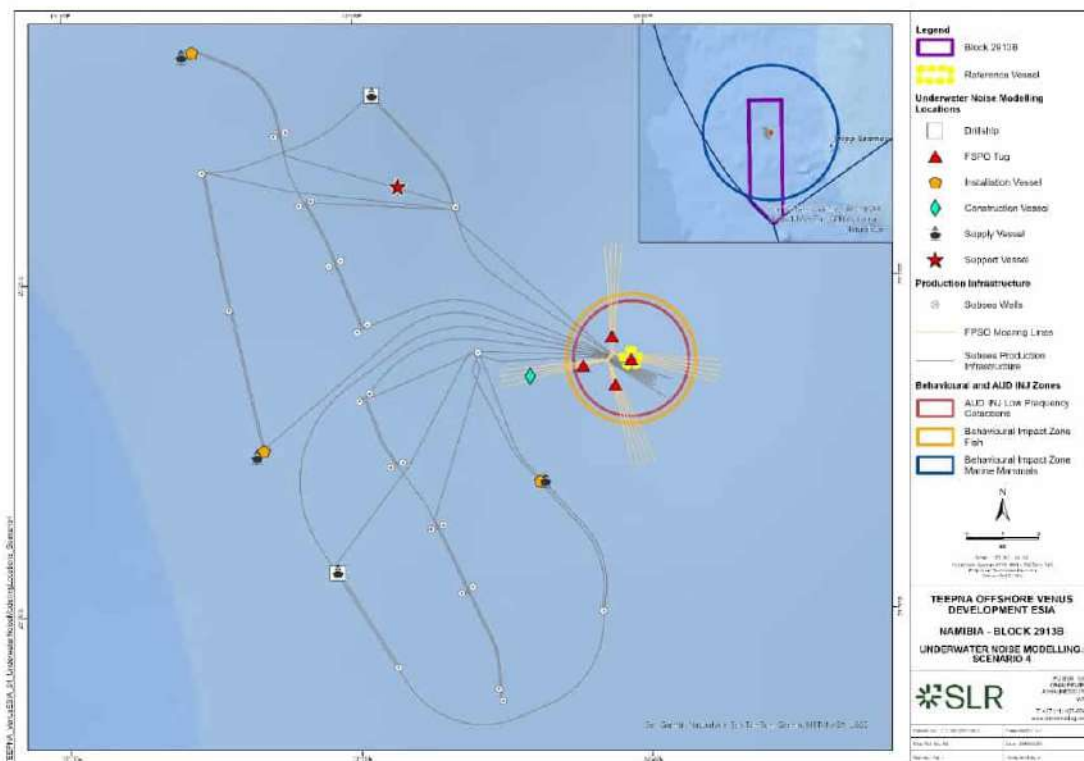


Figure 7-9: Maximum behavioural impact zone to marine mammals (in blue) during drilling and installation activities (Underwater Noise Modelling Scenario UC-2).

Source: SLR Canada (2025a)

Underwater noise from VSP pulses (impulsive noise)

Being highly mobile, marine mammals would be able to move away from the sound source before injury occurs (i.e. behavioural disturbance). Potential behavioural disturbance from the VSP pulses (impulsive noise) is predicted to occur for marine mammals of all hearing groups up to ~1.9 km from the source when exposed to a single full-operation VSP pulse and up to 2.5 km for the LF cetacean group (i.e. baleen whales such as Humpback and Southern right whales) when exposed to cumulative source pulses (250 pulses). The remaining groups (HF, VHF and OW) may respond behaviourally within the vicinity of the VSP operations (<60 m) based on cumulative exposure (250 pulses).

Only in cases where animals remain in specific coastal areas for the purposes of calving or are associated with specific oceanic focal features such as seamounts, may cumulative effects on behaviour be realised. However, key Southern right calving and nursing areas (off Lüderitz and Elizabeth Bay) and suggested Humpback summer feeding grounds (in the vicinity of Lüderitz), lie well inshore and fall outside of the maximum threshold distances for behavioural impacts. Additionally, Tripp Seamount (situated over 85 km from the project area) is far from the VSP behaviour impact zones (up to 1.9 km for a single VSP pulse to 2.5 km for multiple pulses). Therefore, the cumulative zones of impact represent the worst-case consideration and will reduce with a decreased exposure time period.

In the case of noise generated during VSP, the effects of behavioural impacts on marine mammals are considered to be of **low intensity**. Effects would extend **locally** as behavioural disturbances would be expected within a maximum of 1.9 km (all marine mammals) to 2.5 km (LF cetaceans only) from the drilling location and for the duration of the



VSP activities (9 hours per well). The impact duration is, therefore, considered **short-term** as VSP operations would be intermittent over the four-year drilling campaign. Well logging and profiling through VSP will likely only take place for the first few wells drilled to assess the reservoir.

Considering the local extent, low intensity and short-term nature of the potential impact, the impact of marine mammal behavioural avoidance and masking of sounds caused by underwater noise generated during VSP is considered of **very low** magnitude.

While VSP operations may occur concurrently with ongoing drilling activities by other drill units on site, although unlikely (very low probability), the cumulative impacts are considered limited. This is due to the short duration of VSP operations (up to 9 hours per well) and the localized area of impact, which falls within the modelled impact zone for Scenario UD-1. Any cumulative effect would therefore only occur during the brief VSP period, after which VSP-related underwater noise—and associated behavioural impacts—will cease. Additionally, VSP will be conducted for a limited number of wells and will not apply to all wells drilled.

Underwater noise from Vessel transit

Impacts from vessel movement between the Venus offshore project area and the logistics bases (Lüderitz/ Walvis Bay) and/or nearshore transshipment area (~20 km north of Walvis Bay) would be of regional extent, but limited to the immediate vicinity of the vessel at any given time. In addition, vessel movement would occur along existing marine traffic routes that pass around southern Africa, and thus in an area already experiencing increased marine traffic and vessel noise.

The effects of increased underwater noise due to vessel transit are, therefore, considered to be similar to that of other vessels transiting along the coast (**very low** intensity), restricted to the site of the vessel at any one time (**site**) and extending **regionally** throughout the drilling and installation phase (**medium-term**).

Considering the regional extent, very low intensity and medium-term nature of the potential impact, impact magnitude is considered to be **very low**.

Atmospheric and underwater noise from helicopters

Due to the physical differences between air and water (density and the speed at which sound travels), the decibel units used to describe noise underwater are different from those describing noise in air. Furthermore, hearing sensitivities vary between species and taxonomic groups.

Reactions to aircraft flyovers vary both within and between species, and range from no or minimal observable behavioural response (Belugas: Stewart, et al., 1982; Richardson, et al., 1991; Sperm: Clarke, 1956; Gambell, 1968; Green, et al., 1992), to avoidance by diving, changes in direction or increased speed of movement away from the noise source (Gray: Withrow, 1983; Belugas: Richardson et al. 1991, Patenaude et al. 2002; Sperm: Clarke 1956; Fritts et al. 1983; Mullin, et al., 1991; Würsig, et al., 1998; Minke: Leatherwood, et al., 1982; Bowhead: Patenaude, et al., 2002; Humpbacks: Smultea, et al., 1995), separation of cow-calf pairs (Gray: Withrow, 1983), increased surface intervals (Belugas: Awbrey & Stewart, 1983; Stewart et al., 1982; Patenaude, et al., 2002), changes in vocalisation (Sperm whales: Watkins & Schevill 1977; Richter et al. 2003, 2006) and dramatic behavioural changes including breaching and lobsailing (Minke: Leatherwood, et al., 1982; Sperm: Fritts, et al., 1983; Bowhead: Patenaude, et al., 2002; Beluga: Patenaude, et al., 2002), and active and tight clustering behaviour at the surface (Sperm: Smultea, et al., 2008).

Most authors established that the reactions resulted from the animals presumably receiving both acoustic and visual cues (the aircraft and/or its shadow). Smultea et al. (2008) concluded that the observed reactions of whales to brief over flights were short-term and isolated occurrences and probably of no long-term biological significance. Stewart et al. (1982) suggested that disturbance could be largely eliminated or minimised by avoiding



flying directly over whales and by maintaining a flight altitude of at least 300 m. However, repeated or prolonged exposures to aircraft over flights have the potential to result in significant disturbance of biological functions, especially in important nursery, breeding or feeding areas (Richardson W. , Greene, Malme, & Thomson, 1995).

As the frequency of aircraft engine noise overlaps with the hearing ranges of seals, these species will likely similarly receive both acoustic and visual cues from aircraft flyovers. Richardson et al. (1995), however, point out that in very few cases was it determined that seal responses were specifically to aircraft noise as opposed to visual cues. Reactions to flyovers vary between species, ranging from stampeding into the water, through to temporary abandonment of pupping beaches and alertness at passing aircraft. When in the water, seals have been observed diving when the aircraft passes overhead. Pinnipeds thus exhibit varying intensities of a startle response to airborne noise, most appearing moderately tolerant to flyovers and habituating over time (Richardson W. , Greene, Malme, & Thomson, 1995; Laws, 2009). The rates of habituation also vary with species, populations and demographics (age, sex). Any reactions to over flights would thus be short-term and, except for cases where commercial airports are located close to the coast and overflights are frequent (Erbe, Dunlop, & Dolman, 2018), occurrences around the project area would unlikely be of any long-term biological significance or have population-level effects.

Various cetacean species, such as Humpback whales, Sperm whales and Common dolphins, may be encountered within the Venus offshore project area, as well as along the flight path to and from helicopter logistics base. Southern right whales calving and nursing activities are known to occur in Hottentot Bay, approximately 60 km north of Lüderitz, and well to the north of any potential flight paths, as well as Elizabeth Bay (potentially within the flight path) (Currie, Grobler, & Kemper, 2009). The months of main calving and nursing activities include June to September.

Seals in breeding colonies and roosts along the coast could be impacted where the flight path crosses the coastal zone. A number of Cape fur seal colonies occur within the broader project area including colonies along the southern Namibian coastline (Figure 5-28). The seal colonies at Atlas Bay, Wolf Bay and Long Islands, over 300 km to the northeast of PEL0056/Block 2913B, represent the largest colonies in southern Namibia. Should Lüderitz airport be used for helicopter operations flight paths would need to be planned to avoid Cape fur seal colonies and haul out sites, particularly Atlas Bay, Wolf Bay and Long Islands, which may fall in the direct flight path from the respective airports to the area of operation.

Indiscriminate low altitude flights over whales and seals by helicopters used to support the operations thus have an impact on behaviour. The intensity of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions. The impact could range in intensity for individuals but is considered **low** intensity for the populations as a whole. As such impacts would be **site specific** and **medium-term**,

Considering the site extent, very low intensity and medium-term nature of the potential impact, the magnitude is **very low**.

Lighting from drilling/vessel operations

The operation of vessels throughout the Venus offshore project area is expected to significantly increase atmospheric light levels at night. During the drilling and installation phase, vessels engaged in drilling and installations activities will be the primary sources of artificial illumination.

This type of light pollution can affect ecosystems at multiple levels, from changes in individual organisms' physiology and behaviour to broader impacts on ecosystem processes and the services they provide (Zapata et al. 2019). A growing body of evidence shows that artificial light can significantly affect wildlife and natural ecosystems. These effects span a wide range of biological and behavioural processes, including animal orientation, circadian



rhythms (such as nocturnal and diel activity), spatial distribution, habitat selection, migration and dispersal patterns, foraging efficiency, and predator-prey interactions (Bassi et al. 2022; Brüning et al. 2018; Nelson et al. 2021; Thompson 2013).

While the taxa most vulnerable to ambient lighting are pelagic seabirds (see Section 7.2.3.6), both migratory and resident marine mammals transiting through the Venus offshore project area may also be attracted to lights from the drill units and/or vessels. Although seals are known to forage far offshore, PEL0056/Block 2913B generally falls well beyond the foraging range of seals from southern African West Coast colonies, and as such it is unlikely that these species will be attracted to the development area as a result of operational lights.

While the shipping traffic density across the northwest and southeast portions of PEL0056/Block 2913B is medium to high, the various stationary drilling units and project vessels, operating across the Venus offshore project area will notably increase the offshore ambient lighting within the region. As such impacts of increased lighting within the offshore Venus offshore project area is considered to be of **low** intensity and confined to within the Venus offshore project area and its nearby surroundings (**local**) with effects extending throughout drilling and installation operations (**medium term**). Considering the local extent, low intensity and medium-term nature of the potential impact, the magnitude is **very low**.

Impacts from increased lighting from vessels travelling between the Venus offshore project area and the logistics bases and/or nearshore transshipment area along the Namibian Coast (Lüderitz/ Walvis Bay) would be of regional extent, but limited to the immediate vicinity of the vessel at any given time. In addition, vessel movement would occur along existing marine traffic routes that pass around southern Africa, and thus in an area already experiencing increased marine traffic and ambient lighting. As such effects of increased ambient lighting due to vessel transit are therefore considered to be similar to that of other vessels transiting along the coast (**very low** intensity). As such, considering **medium term** duration, the potential for behavioural disturbance as a result of transiting project vessel lighting would thus be of **very low** magnitude.

Lighting from non-routine flaring

Non-routine flaring on the drilling units may increase artificial lighting within the Venus offshore project area. As with vessel lighting, the intense light from flaring, will increase ambient light offshore. This increased lighting may lead to behavioural impacts as outlined above. Notably, impacts are expected to be extend over the **short-term** (at any one time although occurring over a 4 year period during drilling and installation) and will be limited to the vicinity of operations (**site**). As with increased ambient lighting due to vessel operation, impacts are deemed to be of **low** intensity.

Considering the site extent, low intensity and short-term nature of the potential impact, the magnitude is **very low**.

Production Phase

Overall, the maximum impact magnitude for behavioural disturbance to marine mammals due to production related activities is considered to be **medium**. This is based on the following ratings:

- **Medium intensity** for non-impulsive noise as the nearshore transshipment area is located within the vicinity of coastal breeding and feeding areas for marine mammals, as well as migratory routes. Intensity for non-impulsive noise at the Venus offshore project area is, however, considered to be **low** and **very low** for increased underwater noise and lighting due to vessel transit.
- **Permanent duration**, for increased underwater noise at the nearshore transshipment area (despite intermittent nature of activities, namely once per week during peak production last approximately 24 hrs per transshipment) and increased



atmospheric noise and light effects as the production phase (and associated impacts) could extend up to 31-years. There would also be increased noise (intermittent; **short-term**) during crude oil transfer from the FPSO to the DPST in the Venus offshore project area over the 31-year production phase, with cumulative population-level impacts not anticipated. Notably, behavioural impacts will not extend beyond the production phase.

- **Local extent** for nearshore transshipment operations, with behavioural impacts expected within a maximum of 8.9 km from the nearshore transshipment mooring buoy. **Regional extent** for offshore operations, as the maximum behavioural disturbance impact zone for marine mammals extends to 38.2 km from the FPSO during crude transfer operations. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time (**site**).

These ratings are discussed for each project aspect below.

Underwater noise offshore crude transfer operations between the FPSO and DPST (non-impulsive)

As detailed in above underwater noise from vessel operations (non-impulsive) may induce localised behavioural changes or masking of biologically relevant sounds in some marine fauna (Perry, 2005).

During the production phase, offshore transfer operations are anticipated to take place over 24 hours/one day per week during the peak production period, which is expected to last several years after the start up. Following this peak production phase, the frequency of transfer operations will gradually decline. Underwater noise modelling (Scenario UP-1, Section 7.1.1), which simulates two vessels operating concurrently at the Venus offshore project area (one DPST vessel and one support vessel, both using DPS) indicates that non-impulsive noise generated during these operations may cause behavioural disturbance in cetaceans up to 38.2 km from the FPSO (**regional**) (Figure 7-10). The behavioural zone of impact is mitigated to some extent by the FPSO being moored, rather than using DPS, resulting in less underwater noise.

Considering the ability for cetaceans to move away from the sound source, and the relative seasonality of species occurrence, as well as their extensive distributions the intensity of potential behavioural disturbance due to non-impulsive noise is considered **low**. Furthermore, the Venus offshore project area is located in a main marine traffic route and, thus, is in an area already experiencing increased marine traffic and vessel noise, with modelled impact zones not extending to key inshore cetaceans migration routes (for mother-calf pairs), as well as marine mammals (cetacean and seal) breeding and/or feeding grounds or Tripp Seamount, thereby limiting potential cumulative behavioural impacts.

Given that transfer operations are expected to occur for up to 24 hours once per week, individual behavioural impacts on marine mammals are anticipated to be short-term and limited to the duration of each transshipment event. Underwater noise levels and associated behavioural responses are expected to return to baseline shortly after the weekly operations conclude. Furthermore, as the Venus offshore project area does not overlap with key breeding or feeding habitats (thus numbers present within the zone of impact is lower than would be expected closer to shore), cumulative or long-term population-level impacts resulting from potential displacement are considered unlikely. Consequently, impacts are expected to be **short-term** in nature (i.e. 24-hour events occurring weekly at peak operations, over the up to 31-year production phase), and spatially and temporally limited to each individual transfer operation.

Overall, considering the regional extent, low intensity and short-term nature of the potential impact, the magnitude is **very low** during crude oil offloading offshore.





Figure 7-10: Maximum behavioural impact zones during production phase (offshore transshipment operations) (underwater noise modelling scenario UP-1).

Source: SLR Canada (2025a)

Production activities are anticipated to commence while the final drilling and installation activities take place and thus overlap with the last around 1.5 years. As such, cumulative behavioural impacts due to non-impulsive underwater noise from concurrent drilling and offshore transfer operations within the first 1.5 years of production may occur. Notably, these cumulative impacts are expected to be limited, owing to a reduction in the number of drill units (from three to two), fewer drilling days during the first year of full production and potential distance between drilling units and the FPSO. Additionally, non-impulsive noise from offshore transfer operations between the DPST and FPSO is expected to be limited to 24 hours (one day) per week during this period.

Underwater noise from nearshore transshipment operations (non-impulsive)

Following offshore transshipment operations, the DPST will proceed to the nearshore transshipment buoy, where crude oil transfer will occur between the DPST and a conventional tanker. As detailed in Section 7.1.1, underwater noise modelling Scenario UP-2 simulates the presence of four vessels operating in close proximity at the nearshore site; one DPST using DPS to manoeuvre into position before being moored, and three port tugs also using DPS to assist in positioning the conventional tanker. Based on this operational scenario, it is estimated that non-impulsive noise from manoeuvring and transshipment activities could cause behavioural disturbance in marine mammals up to a maximum distance of 8.9 km from the nearshore transshipment mooring buoy (**local**).

Marine mammals likely to be encountered within the shallower, coastal waters of the nearshore transshipment zone included Humpback whales various dolphin species (e.g. Dusky dolphin, Heaviside's dolphin and Common dolphin) and seals, with a higher abundance of individuals likely to be encountered within the nearshore transshipment area



as compared to the offshore Venus offshore project area.

Therefore, whales and dolphins migrating and/or breeding along the coastline and in the vicinity of the operations may show behavioural responses to underwater noise in the nearshore transshipment area. While, suggested Humpback whale summer feeding grounds occur in the vicinity of Lüderitz, well south of the proposed nearshore transshipment zone, migrating Humpback whales, including mother-calf pairs, may pass within the vicinity of nearshore transshipment areas and the potential behavioural area of impact. Similarly breeding and/or migrating dolphins likely encountered within the nearshore area may experience behavioural impacts.

The closest seal colonies to the nearshore transshipment operations are located at Conception Bay, over 120 km south, and Cape Cross, over 100 km north, well outside the modelled behavioural impact zone. However, foraging ranges may extend to the nearshore transshipment zone. Topographic features and seamounts are located well offshore of the transshipment area, reducing the likelihood of cumulative behavioural effects on species associated with these oceanic features.

Considering the above, behavioural impacts on nearshore marine mammals are deemed to be of **medium intensity**, considering the nearshore operations and associated impact zones will take place within migratory and nearshore breeding and feeding areas, while taking into account their wide distributions, mobility and seasonality. In addition, the nearshore transshipment area is located in an area with high vessel activity due to port operations and anchoring area near the port of Walvis Bay, while this may result in species being adapted to increased vessel noise, potential cumulative behavioural impacts may similarly result due to increased underwater noise.

Although nearshore transshipment operations are scheduled to occur up to 24 hours once per week during peak operations, the long-term nature of the activity, repeated over 31 years, means that even short-term, intermittent noise exposure may result in longer-term population-level effects on sensitive marine mammals. Species such as Humpback whales, Common dolphins and seals, which migrate, breed or forage in the vicinity of the nearshore area may exhibit behavioural responses, including avoidance/displacement from the nearshore area as well as disruption in communication due to increased underwater noise. When such disturbances overlap with critical life-stages and/or habitats, they can lead to reduced fitness or reproductive success (i.e. population level impacts). Despite individual exposures being brief, the overlap with key ecological behaviours (e.g. foraging, migrating and/or breeding) or habitats (e.g. feeding and breeding areas) may result in longer-term, population-level consequences. As such following a conservative assessment approach, and considering the potential for sustained behavioural impacts, the potential population-level effects resulting from behavioural disturbances are assessed to persist across the production phase (**permanent**; up to 31 years), ceasing following the completion of the production phase.

Overall, considering the local extent, medium intensity and permanent nature of the potential impact, the potential for behavioural disturbance as a result of nearshore transshipment is of **medium** magnitude

Atmospheric and underwater noise from helicopters

As with the drilling and installation phase assessed above, the impact due to increased atmospheric and underwater noise from helicopters is considered **low** intensity for the populations as a whole, with impacts being **site** specific and extending throughout production operations (**permanent**), with overall impacts considered of **low** magnitude.

Underwater noise from vessel transit

As for impacts due to increased underwater noise from vessel transit during the drilling and installation phase, the effects are considered to be similar to that of other vessels transiting



along the coast (**very low** intensity), restricted to the site of the vessel at any one time (**site**) and extending throughout the project's timeline (**permanent**), resulting in a **very low** magnitude.

Lighting from FPSO / vessel operations

Once production begins, the permanently moored FPSO at the Venus offshore project area will become the dominant source of artificial light.

Artificial lighting from offshore platforms can penetrate up to 10 m into the surrounding water, as well as significantly alter the nighttime seascape. This illuminated zone around the offshore platforms may attract visual predators to the surface, potentially shifting local species composition and influencing both schooling behaviour and predator-prey interactions (Barker & Cowan 2018; Keenan et al. 2007). While the taxa most vulnerable to ambient lighting are pelagic seabirds (see Section 7.2.3.6), both migratory and resident marine mammals transiting through the Venus offshore project area may also be attracted to lights from the FPSO and/or vessels.

The nearshore transshipment area is located in the vicinity of main shipping routes to and from the port of Walvis Bay and anchoring area; thus, in an area already experiencing increased ambient lighting. While the shipping traffic density across the northwest and southeast portions of PEL0056/Block 2913B is medium to high, the stationary FPSO, as well as various project vessels, operating within the Venus offshore project area will notably increase the offshore ambient lighting within the region. As such, impacts are considered to be of **low intensity** and confined to the vicinity of the FPSO and vessels operating within the Venus offshore project area and nearshore transshipment area, respectively (**local**) with effects extending throughout production operations (up to 31 years; **permanent**), resulting in an impact of **low** magnitude.

As with the drilling and installation phase, potential impacts due to increased lighting resulting from vessel transit are considered to be of **very low** intensity and **regional** extent. Impacts would extend throughout the production phase (**permanent**) resulting in an impact of **very low** magnitude.

Lighting from non-routine flaring

The impact of increased lighting due to non-routine flaring would be of **low** intensity and limited to the FPSO (**site**) over the **short-term** (although production would take place up to 31 years, only ad hoc non-routine flaring is proposed). The impact of non-routine flaring is, therefore, considered of **very low** magnitude.

Decommissioning Phase

Potential behavioural impacts due to increased underwater noise (non-impulsive), ambient lighting and atmospheric noise during the decommissioning phase are similar to the drilling and installation phase assessed above. Potential impact zones due to increased underwater noise will likely be reduced given the reduced number of vessels operating across the Venus offshore project area during the decommissioning phase (up to seven in total) and their respective underwater noise profiles, with the behavioural impact zone due to non-impulsive underwater noise expected to be smaller than that modelled in Scenario UC-1 (with impact zone of up to 90 km modelled).

Overall, the impact magnitude for behavioural disturbance to marine mammals due to decommissioning activities is considered to be **low**. This is based on the following ratings:

- **Low intensity**, for non-impulsive noise and increased ambient lighting as the Venus offshore project area is located in a main marine traffic route experiencing increased vessel noise. **Very low** intensity for increased underwater noise and lighting due to vessel transit.
- **Medium term**, as impacts will be limited to the duration, approximately 1.5 years, of



decommissioning activities.

- **Regional** extent, as behavioural impacts may extend beyond the Venus offshore project area, with the zone of impact expected to be less than the 90 km modelled in Scenario UC-1 (drilling and installation).

Significance

During the drilling and installation phase, the highest impact significance of behavioural disturbance to marine mammals as a result of underwater noise from vessel, drilling and VSP operations at the Venus offshore project area based on the highest impact magnitude (**low**) and receptor sensitivity of **medium**, is assessed as **low** significance (Table 7-16).

During production operations, the highest impact significance of behavioural disturbance to marine mammals as a result of underwater noise from transshipment operations at the nearshore transshipment area, based on the highest impact magnitude (**medium**) and **medium** receptor sensitivity, is assessed as **medium** significance.

Behavioural disturbance due to operational lighting, noise from helicopters, and vessel transit, **occurring throughout all project phases**, based on the highest impact magnitude (**low**) and medium receptor sensitivity, is assessed as **low** significance.

Residual Impact

Behavioural disturbance cannot be eliminated due to the nature and requirements of operations. Considering the mitigation presented in Section 7.2.3.7, such as reducing vessel power and duty cycle to lowest safe operational level when using DPS, the impact intensity will be reduced, with the impact intensity reducing across all phases. (Table 7-16).

Table 7-16: Impact rating for behavioural disturbance to marine mammals¹⁰¹

Behavioural Disturbance to Marine Mammals						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Low	Very Low	Medium	Low	Low	Very Low
Intensity	Low	Very Low	Medium	Low	Low	Very Low
Duration	Medium term	Medium term	Permanent	Permanent	Medium term	Medium term
Extent	Regional	Regional	Local	Local	Regional	Regional
Significance	Low	Very Low	Medium	Low	Low	Very Low

¹⁰¹ The highest impact ratings across all sources for each phase are shown in the table, indicating the maximum magnitude (based on combination of intensity, extent and duration), and significance of the associated impact, per phase.



Additional Assessment Criteria	
Probability	Likely
Reversibility	Fully Reversible
Loss of resources	Low
Degree to which impact can be avoided	Medium
Mitigation Potential	Medium
Cumulative impacts	Likely

7.2.3.4 Impact Assessment: Behavioural Disturbance to Fish

Sensitivity of receptor

Venus offshore project area: Pelagic fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Venus offshore project area are large migratory species, including various tunas, billfish and sharks, some of which are considered, 'Endangered' (e.g. shortfin mako shark), 'Vulnerable' (e.g. bigeye tuna) or 'Near Threatened' (e.g. blue shark), primarily due to overfishing and bycatch (Table 5-3). Although species listed as 'Endangered' or 'Vulnerable' may potentially occur in the development area, the Venus offshore project area is located in a main marine traffic route and thus is in an area already experiencing increased presence and noise from vessels, with populations widely distributed throughout the offshore waters of the Namibian EEZ. Major spawning areas, as well as egg and larval drift pathways of commercially important species, such as hake, pilchards, horse mackerel and anchovy lie inshore of the PEL0056/Block 2913B and are unlikely to be impacted by the behavioural disturbance zone from drilling, installation and production operations. Due to the proximity of Venus offshore project area to the main traffic routes and the pelagic habitat/ecosystem type within PEL0056/Block 2913B being classified as 'Least Threatened' (see 5.6.4.1), the sensitivity of pelagic fish to an increase in underwater noise, and ambient lighting in the offshore environment is considered **medium**.

Nearshore transshipment area: Small pelagic species likely encountered within the nearshore transshipment area include the 'Endangered' smooth hound shark as well as 'Vulnerable' Elf and Silver kob, amongst others (see Section 5.5.3.3). Major spawning areas, as well as egg and larval drift pathways of commercially important species, overlap with the nearshore transshipment area and may thus be impacted by the behavioural disturbance zone from nearshore transshipment operations. Considering the above, as well as existing vessel operations into/out of and in the vicinity of the Walvis Bay port and that the pelagic habitat/ecosystem type within the nearshore transshipment area is classified as 'Least Threatened' (see 5.6.4.1), the behavioural sensitivity of pelagic fish encountered within the nearshore transshipment area to increased underwater noise and ambient lighting is considered **medium**.

Magnitude

Drilling and Installation Phase

Overall, the impact maximum magnitude for behavioural disturbance to fish is considered to be **very low**. This is based on the following ratings:

- **Low intensity**, for non-impulsive and impulsive noise, as the Venus offshore project area is located in an area where the pelagic habitat/ecosystem type is classified as 'Least Threatened', as well as in a main marine traffic route experiencing increased vessel traffic. Furthermore, the major spawning areas, as well as egg and larval drift



pathways of commercially important species lie inshore of the Venus offshore project area and are unlikely to be impacted by the behavioural disturbance zone from drilling and installation operations. **Very low** intensity for increased underwater noise and lighting is expected from vessel transit.

- **Medium-term** duration, as drilling and installation operations will take place over a period of up to 4 years. For VSP operations, however, the duration is deemed to be short term (around nine hours per well), as VSP operations would be intermittent (VSP will likely only take place for the first few wells drilled to assess the reservoir) over the 4-year drilling campaign.
- **Local extent**, as behavioural impacts from non-impulsive noise and VSP operations (impulsive) is expected within a maximum of 1.8 km and 5.5 km, respectively. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be **regional**, yet limited to the immediate vicinity of the vessel at any given time.

These ratings are discussed for each project aspect below.

Underwater noise from vessel and drilling operations (non-impulsive)

As with marine mammals, the underwater noise from well drilling and vessel operations (non-impulsive) may induce localised behavioural changes or masking of biologically relevant sounds for fish species (Perry, 2005). According to Popper et al. (2014) for non-impulsive noise sources in general, relatively high to moderate behavioural risks are expected for fish species at near to intermediate distances (tens to hundreds of metres) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of metres) from the source location.

Potential behavioural disturbance to pelagic fish from non-impulsive noise is predicted to occur up to 638 m from the source during drilling operations (Scenario UD-1, considering three drill units and associated vessels operating concurrently in close proximity, see Section 7.1.1), extending up to 760 m and a maximum of 1.8 km during installation campaigns as modelled for scenarios UC-1 and UC-2, respectively (see Section 7.1.1 for details of modelled scenarios) (SLR Consulting Canada, 2025).

Cumulative effects on fish behaviour are primarily a concern only in cases where animals remain in specific coastal areas for spawning or are associated with distinct oceanic features like seamounts. However, all the major fish spawning areas are located inshore and beyond the maximum threshold distances for fish behavioural impacts (see Figure 5-22).

Given the location of the Venus offshore project area, with marine traffic routes passing within the northeast and southwest regions of PEL0056/Block 2913B, as well as distance from inshore spawning and nursery areas, as well as egg and larval drift pathways, the intensity of the impact of non-impulsive is considered **low**. The duration of the effects on the populations would be **medium term** (up to 4 years of drilling and installation operations) and extend to a **local** scale (behavioural disturbances would be expected within a maximum of 1.8 km).

Considering the local extent, low intensity and medium-term nature of the potential impact, impact magnitude is considered to be **very low** magnitude for drilling and installation operations.

Underwater noise from VSP pulses (impulsive noise)

Potential behavioural disturbance to fish from the VSP pulses (impulsive noise) is predicted to occur up to 5.5 km from the source. Behavioural responses of fish, such as avoidance of seismic survey areas and changes in feeding behaviours in response to seismic sounds, have been documented to occur at received levels of between 130 and 180 dB re 1 µPa, with disturbance ceasing at noise levels below this (Slabbekoorn, et al., 2019). It must be



kept in mind, however, that VSP uses a small airgun array and that volumes and the energy released into the marine environment, as well as duration of operations, are significantly smaller than what is required or generated during conventional seismic surveys.

Given the location of the Venus offshore project area, with marine traffic routes passing within the northeast and southwest regions of PEL0056/Block 2913B, as well as distance from inshore spawning and nursery areas, the impact of behavioural disturbance to fish from VSP operations is considered to be of **low** intensity, extending **locally** (5.5 km) from the drilling location and persisting for the duration of VSP operations (9 hours per well). The impact duration is considered **short-term** as VSP operations would be intermittent over the four-year drilling campaign, with most well test likely to take place for the first few wells drilled.

Considering the local extent, low intensity and short-term nature of the potential impact on fish, impact magnitude related to VSP operations is considered to be **very low**.

While VSP operations may occur concurrently with ongoing drilling activities by other drill units on site, although unlikely (very low probability), the cumulative impacts are considered limited. This is due to the short duration of VSP operations (up to 9 hours per well) and the localized area of impact. As such, any cumulative effect would therefore only occur during the brief VSP period, after which VSP-related underwater noise—and associated behavioural impacts—will cease. Additionally, as noted VSP will be conducted for a limited number of wells and will not apply to all wells drilled (i.e. will not take place throughout drilling operations).

Underwater noise from vessel transit

The impact on fish from underwater noise from vessel transit during drilling and installation is as described for marine mammals (see Section 7.2.3.3). The effects of increased underwater noise due to vessel transit are considered to be similar to that of other vessels transiting along the coast (**very low** intensity), extending to a **regional** extent yet restricted to the site of the vessel at any one time (**site**) and extending throughout the drilling and installation phase (**medium term**), resulting in a **very low** magnitude.

Atmospheric and underwater noise from helicopters

To date no studies have studied the potential reactions of pelagic fish in response to helicopter noise in open, ocean waters. Overall, indiscriminate low altitude flights over the sea by helicopters used to support the operations are not expected to have a significant impact on fish behaviour, considering the depth and wide distribution of these species¹⁰² and considering that helicopters will follow dedicated flight paths and altitudes in compliance with the Civil Aviation Act (No. 6 of 2016).

Lighting from drilling/vessel operations

Operational lights during drilling and installation may result in physiological and behavioural effects on fish and cephalopods, as these may be drawn to the lights at night where they may be more easily preyed upon by other fish, marine mammals and seabirds. This would present a greater issue for a stationary drilling unit than for a constantly moving support vessel.

Many organisms rely on light or visual cues to locate and capture prey. In aquatic environments, various groups, including phytoplankton, zooplankton, fish, squid, and prawns, are known to respond to artificial light sources (Timmer and Magellan 2011, Bassi et al. 2022, Grubisic 2018, Thompson 2013). The nature and extent of these responses depend on factors such as the intensity, duration, frequency, and consistency of light exposure at night.

¹⁰² The detailed assessment of potential behavioural impacts to fish due to helicopter operations applies across all project phases.



Given the Venus offshore project area's location within an area classified as 'Least Threatened' and in a main traffic route, as well as the distance from inshore spawning and recruitment areas, the increase in ambient lighting in the offshore environment would be **low** intensity at the overall population level and confined to the larger vicinity of the Venus offshore project area (**local**). Impacts would extend throughout activities (**medium-term**). Consequently, the potential for behavioural disturbance due to increased ambient lighting is expected to be of **very low** magnitude.

Lighting from vessels traveling between the Venus offshore project site and coastal logistics hubs (such as Lüderitz and Walvis Bay) would have a **regional** reach but only affect the immediate area around each vessel at any given time. Since these routes follow established marine traffic corridors around southern Africa, already subject to elevated vessel activity and ambient lighting, the additional light from project vessels is considered to be **very low** intensity. As such, considering **medium-term** duration, the potential for behavioural disturbance as a result of transiting project vessel lighting would thus be of **very low** magnitude.

Lighting from non-routine flaring

As with vessel lighting the intense light from flaring, will increase ambient light offshore. Impacts are expected to be extend over the **short-term** as nonroutine flaring (well testing and clean up) would be intermittent over the four-year drilling campaign and will be limited to the vicinity of operations (**site**).

As with increased ambient lighting due to vessel operation, impacts are deemed to be of **low** intensity, resulting in an overall impact of **very low** magnitude.

Production Phase

Overall, the maximum impact magnitude for behavioural disturbance to fish due to production operations is considered to be **medium**. This is based on the following ratings:

- **Medium intensity**, as behavioural disturbance zones for non-impulsive noise may overlap with key spawning grounds and critical pathways for egg and larval drift, although take place within nearshore areas exposed to increased vessel traffic and underwater noise and in an area where the pelagic habitat/ecosystem type is classified as 'Least Threatened'. In contrast, impacts from non-impulsive noise at the Venus offshore project area are considered to be of **low** intensity, given that the Venus offshore project area is located offshore of key spawning areas as well as egg and larval drift pathways and in an area classified as 'Least Threatened'. **Very low** intensity for increased underwater noise and lighting is expected from vessel transit.
- **Permanent duration**, for increased underwater noise at the nearshore transshipment area (despite the intermittent nature of nearshore transshipment operations, namely once per week during peak production last approximately 24 hrs per transshipment) and for increased atmospheric light and noise, with production activities that could extend for up to 31-years. There would also be increased noise (intermittent; **short-term**) during crude oil transfer from the FPSO to the DPST in the Venus offshore project area over the 31-year production phase, with cumulative population-level impacts not anticipated. Notably behavioural impacts will not extend beyond the production phase, ending following the completion of production activities.
- **Local extent**, for nearshore transshipment operations with behavioural disturbance within a maximum of 1.2 km from the nearshore transshipment buoy. Behavioural impacts due to offshore transfer operations will extend up to 400 m (**site**). Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be **regional**, yet limited to the immediate vicinity of the vessel at any given time (**site**).



These ratings are discussed for each project aspect below.

Underwater noise offshore crude transfer operations between the FPSO and DPST (non-impulsive)

Underwater noise modelling (Scenario UP-1, Section 7.1.1), which simulates two vessels operating concurrently at the Venus offshore project area (one DPST vessel and one support vessel, both using DPS), indicates that non-impulsive noise generated during offshore transfer operations may cause behavioural disturbance in fish up to 400 m from the FPSO (**site**).

Given the Venus offshore project areas' offshore location in an area classified as 'Least Threatened', with marine traffic routes passing within the northeast and southwest regions of the larger block, as well as distance from inshore nursery areas, and egg and larval drift pathways the intensity of the impact is considered **low**. Considering the Venus offshore project area does not overlap with key breeding and/or spawning areas as noted above (thus numbers present within the zone of impact is lower than would be expected closer to shore), cumulative and longer-term population-level impacts are considered unlikely to occur. Consequently, impacts will be restricted to individual impacts over the **short-term** (24-hours per transshipment taking place up to weekly over the 31-year production phase).

Overall, the potential for behavioural disturbance as a result of vessel noise would thus be of **very low** magnitude for the production phase.

Underwater noise from nearshore transshipment operations (non-impulsive)

As detailed in Section 7.1.1, it is estimated that non-impulsive noise from manoeuvring and transshipment activities could cause behavioural disturbance in fish up to a maximum distance of 1.2 km from the nearshore transshipment buoy (**local**).

Cumulative effects on fish behaviour are primarily a concern only in cases where animals remain in specific coastal areas for spawning or are associated with distinct oceanic features such as reefs and/or seamounts. Given the overlap between the nearshore transshipment area and the behavioural impact zone with inshore spawning grounds for kob, as well as the proximity to spawning areas for monkfish and hake, there is potential for cumulative behavioural impacts on these species. However, this assessment also considers that transshipment operations occur within a major marine traffic route and near an anchoring area, which is already subject to elevated baseline levels of underwater noise, as such species may be adapted to elevated underwater noise levels. The overall impact intensity of non-impulsive underwater noise in the nearshore transshipment area is deemed to be **medium**.

As outlined above, cumulative population level impacts may occur as a result of the nearshore transshipment areas overlapping with key spawning grounds of various fish species. As such while individual-level effects would be restricted to the short-term, longer-term population-level effects due to the possible disruption of breeding and/or spawning activities, and associated reproductive success, may occur. As such following a conservative assessment approach, and considering the potential for population-level effects due to disruption in breeding and spawning, impacts are assessed to persist across the production phase (**permanent**; > 25 years) ending following the completion of the production phase.

Overall, considering the local extent, medium intensity and permanent nature, the potential for behavioural disturbance as a result of nearshore transshipment underwater noise is of **medium** magnitude.

Underwater noise from vessel transit

As with vessel transit during the drilling and installation phase, the effects of increased underwater noise are considered to be **very low** intensity, extending to a **regional** extent yet restricted to the site of the vessel at any one time (site) and extending throughout the



production phase (**permanent**), resulting in a **very low** magnitude.

Lighting from FPSO / vessel operations

Operational lighting can attract fish and cephalopods at night, increasing their vulnerability to predators such as marine mammals and seabirds. This effect is more pronounced around stationary structures like FPSOs compared to mobile support vessels.

Evidence of behavioural changes in response to increased ambient lighting near stationary offshore platforms has been documented, with contrasting observations documented. These findings highlight the complex and species-specific nature of behavioural responses to artificial light in offshore environments, with varied reactions across different marine taxa (Barker & Cowan, 2018).

Given the Venus offshore project area's proximity to main traffic routes and distance from inshore spawning and recruitment areas, the increase in ambient lighting in the offshore environment would be **low** intensity at the overall population level and confined to the vicinity of the FPSO and vessels operating within the Venus offshore project area (**local**). While increased ambient lighting due to nearshore transshipment operations occur within inshore spawning and recruitment area, impacts are similarly argued to be limited owing to the vessels location within a main marine traffic route operating into and out of Walvis Bay harbour. In addition, increased ambient lighting would be restricted to night-time transshipment / mooring operations only. Impacts would extend throughout activities (**permanent**).

Consequently, considering the local extent, low intensity and permanent nature, the potential for behavioural disturbance due to increased ambient lighting is expected to be of **low** magnitude throughout the project.

Lighting from non-routine flaring

The impact of increased lighting due to non-routine flaring would be of **low** intensity and limited to the FPSO (**site**) over the **short-term** (although production would take place up to 31 years, only ad hoc non-routine flaring is proposed; thus short-term duration). The impact of non-routine flaring is therefore considered of **very low** magnitude.

Decommissioning Phase

Potential behavioural impacts due to increased underwater noise (non-impulsive), ambient lighting and atmospheric noise during the decommissioning phase are similar to the drilling and installation phase assessed above. As outlined the vessel operations during decommissioning activities are expected to generate lower levels of underwater noise compared to those modelled for the drilling and installation phase, as a result of a reduced number of vessels and drilling units. Consequently, the associated impact zones are anticipated to be smaller than those predicted under Scenario UC-1, likely remaining within 1 km of the sound source (site).

Overall, the impact magnitude for behavioural disturbance to fish during the decommissioning phase is considered to be **very low**. This is based on the following ratings:

- **Low intensity**, for non-impulsive noise and increased ambient lighting at the Venus offshore project area. Impacts from increased underwater noise and lighting due to vessel transit are considered to be very low intensity.
- **Medium term** as impacts will be limited to the duration of decommissioning activities taking place over 1.5 years.
- **Site**, with impacts restricted to within 1 km of the sound source/operating vessels and drilling unit. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast



would be regional, yet limited to the immediate vicinity of the vessel at any given time.

Significance

During production in the nearshore transshipment area, impact significance of behavioural disturbance to fish from increased underwater noise, based on the highest impact magnitude (**medium**) and **medium** sensitivity, is considered to be if **medium** significance (Table 7-17).

However, behavioural impacts of fish at the Venus offshore project area during drilling, installation, production and decommissioning activities is considered to be of **very low** magnitude, resulting in **very low** impact significance.

Behavioural impacts due to increased atmospheric lighting, as well as underwater noise due to vessel transit, are also assessed as **very low** significance, occurring throughout the project timeline (i.e. all phases).

Residual Impact

Behavioural disturbance cannot be eliminated due to the nature and requirements of the operations. Considering the mitigations presented in Section 7.2.3.7, including reduction in vessel power and speeds, the probability as well as extent will reduce (and thus the intensity of the impact), resulting in a reduced impact intensity (Table 7-17).

Table 7-17: Impact rating for behavioural disturbance to fish¹⁰³.

Behavioural Disturbance to Fish						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Very Low	Very Low	Medium	Low	Very Low	Very Low
Intensity	Low	Very Low	Medium	Low	Low	Very Low
Duration	Medium term	Medium term	Permanent	Permanent	Medium term	Medium term
Extent	Local	Local	Local	Local	Local	Local
Significance	Very Low	Very Low	Medium	Low	Very Low	Very Low
Additional Assessment Criteria						
Probability	Likely					
Reversibility	Fully Reversible					
Loss of resources	Low					
Degree to which impact can be avoided	Medium					
Mitigation Potential	Medium					
Cumulative impacts	Likely					

¹⁰³ The highest impact ratings across all sources for each phase are shown in the table, indicating the maximum magnitude (based on combination of intensity, extent and duration), and significance of the associated impact, per phase.



7.2.3.5 Impact Assessment: Behavioural Disturbance to Turtles

Sensitivity of receptor

Observations of turtles in the area have been reported but are rare.

As outlined in Section 5.5.3.4, five turtle species occur in Namibian waters, namely Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*) and Leatherback (*Dermochelys coriacea*) (Bianchi, et al., 1999). Of these five species, the two species most likely to be found within the deeper offshore waters of the Venus offshore project area are the Leatherback and Loggerhead turtles, with records of these species within the PEL0056/Block 2913B and surrounding waters recorded. Green turtles, Leatherback and Loggerheads may also be potentially encountered within shallower, inshore regions of the nearshore transshipment area.

Global Leatherback and Loggerhead turtle populations are listed as 'Vulnerable,' and the Green turtle is classified as 'Endangered' by the IUCN, while Leatherback subpopulations (Southwest Indian and Southwest Atlantic) possibly encountered within the project area and larger area of influence are classified as 'Critically Endangered'. Therefore, taking into account the above, as well as the that pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area is classified as 'Least Threatened' (see 5.6.4.1), the proximity of the Venus offshore project and nearshore transshipment area to the main traffic routes and mobility of the species, the sensitivity of these receptors is considered to be **medium**.

Magnitude

Drilling and Installation Phase

Overall, the maximum impact magnitude for behavioural disturbance to turtles due to drilling and installation activities is considered to be **very low**. This is based on the following ratings:

- **Low intensity** for increased underwater and atmospheric noise. Being mobile, turtles would also be able to move away from the sound source before injury occurs; thus, behaviour avoidance can be expected. Nesting beaches lie well inshore and to the southeast (South African east coast) and north (Angola) of the PEL0056/Block 2913B and would not be impacted by the behavioural disturbance zone from impulsive underwater noise (VSP operations). Non-impulsive underwater noise does not reach threshold levels to induce behavioural impacts in turtles (no impact). **Very low** intensity for increased underwater noise and lighting due to vessel transit.
- **Medium-term** for impacts from increased vessel lighting, noise and helicopter operations (up to 4 years). **Short term** for increased impulsive underwater noise (intermittent VSP) and lighting from flaring only, as these activities would be intermittent over the four-year drilling campaign.
- **Local** extent, as behavioural impacts from VSP operations (impulsive) and non-routine lighting, while restricted to the immediate vicinity of each vessel / drilling unit, would extend across the Venus offshore project area, due to the multiple drilling units and installation / support vessels on site. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases (Walvis Bay and Lüderitz) would be regional, yet limited to the immediate vicinity of the vessel at any given time (**site**).



These ratings are discussed for each project aspect below.

Underwater noise from vessel and drilling operations (non-impulsive)

As with marine mammals and fish, turtles are vulnerable to disturbance by underwater noise. However, relatively low behavioural risks are expected for turtles far from the source, with behavioural effects limited to individuals near the source. Potential behavioural disturbances can cause turtles to leave their habitats, disrupt their breeding, foraging, or basking behaviours, and affect their energy use (e.g., altering foraging time, swim speed, dive depth and duration, and limiting surface access for breathing) (DeRuiter & Larbi Doukara 2012).

Notably modelling results indicate that non-impulsive underwater noise generated during well drilling, as well as concurrent installation and drilling operations, do not reach threshold levels to induce behavioural impacts in turtles (see Section 7.1.1). Thus, **no behavioural impact is anticipated**.

Underwater noise from VSP pulses (impulsive noise)

The behavioural threshold for impulsive sound events for sea turtles was established at a SPL of 175 dB re 1µPa (Finneran et al. 2017). Based on this, the maximum potential behavioural disturbance to turtles based on immediate exposure to a single VSP pulse (impulsive noise) is predicted to occur up to 360 m from the source (**site** at any one time).

The impact of behavioural disturbance to turtles from VSP operations is of **low** intensity due to anticipated low numbers of individuals in the Venus offshore project area and far removed from key turtle breeding and feeding areas. While impacts are restricted to a site-specific scale, VSP operations could take place throughout the Venus offshore project area resulting in potential impacts of a **local** extent. The impact duration is considered **short-term** as VSP operations would be intermittent over the drilling campaign (intermittent over the drilling period, up to 9 hours per well), with most well test likely to take place for the first few wells drilled.

Considering the site extent, low intensity and short-term nature of the potential impact on turtles, impact magnitude related to VSP operations is considered to be **very low**.

Atmospheric and underwater noise from helicopters

Indiscriminate low altitude flights over turtles by helicopters could have an impact on their behaviour, with turtles amongst the taxa most vulnerable to disturbance by helicopter noise. The impact could range in intensity for individuals but would be of **low** intensity for the populations as a whole, considering no nesting sites are located along the Namibian Coast and in the vicinity of the proposed flight paths, as well as low number of individuals likely to be encountered within the flight path and Venus offshore project area. As such impacts would be **site** specific and **medium-term** (occurring throughout the drilling and installation phase). The impact of behavioural disturbance to turtles as a result of noise generated by helicopters would thus be of **very low** magnitude.

Underwater noise from vessel transit

Underwater noise due to vessel transit between the Venus offshore project area and the logistics bases and nearshore transshipment area along the Namibian coast (Walvis Bay/ Lüderitz) would be of **regional** extent, but limited to the immediate vicinity of the vessel at any given time (site).

Overall, the intensity of non-impulsive noise impacts on turtle behaviour is, therefore, considered to be of **very low** intensity, restricted the immediate vicinity of the transiting vessels. Impacts would occur throughout the drilling and installation phase (**medium term**), notably ending following the completion of the project, resulting in an impact of **very low** magnitude.



Lighting from drilling/vessel operations

The drilling and installation activities would be undertaken in the offshore marine environment, approximately 300 km from the shore at its closest point and thus far removed from any potential nesting beaches, with no nesting sites are located along the Namibian Coast. Increased ambient lighting could directly affect migratory turtles, such as Leatherback turtles, transiting through the Venus offshore project area. Overall, impacts are considered to be of **low** intensity owing to the limited number of individuals likely to be encountered within the offshore waters of the Venus offshore project area. Impacts would be limited to the various vessels and drill units operating within the Venus offshore project area (**local**), occurring throughout operations (**medium term**). The impact of behavioural disturbance to turtles as a result of lighting would thus be of **very low** magnitude.

Lighting from vessels transiting between the offshore project area and coastal logistics bases or the nearshore transshipment zone (e.g. Lüderitz and Walvis Bay) would result in impacts of **regional** extent, but these would remain confined to the immediate vicinity of the vessel at any given time. Vessel movement will occur along established marine traffic routes around southern Africa, which are already subject to elevated marine activity and ambient lighting. Therefore, the contribution of project-related lighting is expected to be **very low** intensity, comparable to other vessels operating in the area. As such, considering **medium term** duration, the potential for behavioural disturbance due to lighting from transiting vessels is considered to be of **very low** magnitude.

Lighting from non-routine flaring

This increased lighting may lead to behavioural impacts as outlined above. Notably, impacts are expected to be extend over the **short-term** and will be limited to the vicinity of these punctual operations (**site**). Impacts are deemed to be of **low** intensity, resulting in an overall impact of **very low** magnitude.

Production Phase

Overall, the maximum impact magnitude for behavioural disturbance to turtles due to **production** related activities is considered to be **low**. This is based on the following ratings:

- **Low intensity** for increased atmospheric noise, considering the low population and numbers of species potentially affected. Very low intensity for increased underwater noise and lighting due to vessel transit.
- **Permanent duration**, for increased underwater noise at the nearshore transshipment area (despite intermittent nature of activities namely once per week during peak production last approximately 24 hrs per transshipment) and increased atmospheric noise and light effects as the production phase (and associated impacts) could extend up to 31-years. There would also be increased noise (intermittent; **short-term**) during crude oil transfer from the FPSO to the DPST at the Venus offshore project area extend over the 31-year production phase, with cumulative population-level impacts not anticipated. Notably, behavioural impacts will not extend beyond the production phase.
- **Local extent** for increased ambient lighting during nearshore transshipment operations and due to the offshore FPSO and vessels, the extent is expected to be limited to within the vicinity of the vessels and nearby surrounds. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time (**site**).

These ratings are discussed for each project aspect below.

Underwater noise from crude transfer operations both in the Venus offshore project area and the nearshore transshipment area (non-impulsive)



Based on non-impulsive underwater noise generated during the production phase, modelling results indicate that non-impulsive underwater noise generated during offshore and/or nearshore transfer operations will not induce behavioural impacts in turtles (see Section 7.1.1). **Thus, no behavioural impact is anticipated on turtles from non-impulsive underwater noise.**

Atmospheric and underwater noise from helicopters

As with the drilling and installation phase, behavioural impacts due to helicopter operations within the production phase would be of **low** intensity, **permanent** (occurring throughout the project), and restricted to the immediate vicinity of the impact (**site**). The impact of behavioural disturbance to turtles as a result of noise generated by helicopters would thus be of **low** magnitude.

Underwater noise from vessel transit

Overall, the intensity of non-impulsive noise impacts on turtle behaviour is considered to be of **very low** intensity, as outlined above. Impacts would occur throughout the production phase (up to 31-year timeline; permanent), notably ending following the completion of the project, resulting in an impact of **very low** magnitude.

Lighting from FPSO / vessel operations

Increased ambient lighting could directly affect migratory turtles transiting through the Venus offshore project area. The stationary FPSO will result in a notable increase in ambient lighting within the offshore area, with evidence of behavioural changes recorded for several marine species.

Overall, impacts are considered to be of **low** intensity owing to the limited number of individuals likely to be encountered within the nearshore and offshore waters of the Venus project operations (see Section 5.5.3.4) resulting in reduced population-level impacts. Impacts would be limited to the surrounds of the FPSO and vessels operating within/across the Venus offshore project and nearshore transshipment areas (**local**), occurring throughout operations (intermittent during up to 31-years; **permanent**). The impact of behavioural disturbance to turtles as a result of lighting would thus be of **low** magnitude.

As with the drilling and installation phase, impacts due to increased lighting resulting from vessel transit during production phase are considered to be of **very low** intensity and **regional** extent. Impacts would extend throughout the production phase (**permanent**) resulting in an impact of **very low** magnitude.

Lighting from non-routine flaring

The impact of increased lighting due to non-routine flaring would be of **low** intensity and limited to the FPSO (**site**) over the **short-term** (although production would take place up to 31 years, only ad hoc non-routine flaring is proposed; thus short-term duration). The impact of non-routine flaring is therefore considered of **very low** magnitude.

Decommissioning Phase

Potential behavioural impacts due to vessel transit, ambient lighting and atmospheric noise during the decommissioning phase are similar to the drilling and installation phase above. Notably modelling results indicate that underwater noise generated by project vessels and drill units operating during drilling, installation and production operations (non-impulsive) will not induce behavioural impacts in turtles (see Section 7.1.1). As such increased non-impulsive underwater noise generated by DPS of vessels/drill unit engaged in decommissioning activities is similarly argued not to result in behavioural impacts to marine turtles within the Venus offshore project area.



Overall, the impact magnitude for behavioural disturbance to turtles during the decommissioning phase is considered to be **very low**. This is based on the following ratings:

- **Low** intensity, for increased ambient lighting at the Venus offshore project area. Impacts from increased underwater noise and lighting due to vessel transit are considered to be very low intensity.
- **Medium term** as impacts will be limited to the duration of decommissioning activities taking place over approximately 1.5 years.
- **Local**, with impacts restricted to the vicinity of the various vessels and drilling unit operating across the Venus offshore project area during decommissioning activities. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time.

Significance

Based on an overall **very low** (drilling, installation and decommissioning phase) and **low** (production phase) magnitude and **medium** sensitivity, the impact significance of behavioural disturbance to turtles is assessed as **very low** and **low** significance respectively.

Residual Impact

Behavioural disturbance cannot be eliminated due to the nature and requirements of the drilling and installation operations. Considering the mitigations presented in Section 7.2.3.7, including reduction in vessel power and speeds as well as operational lighting, the impact intensity may be reduced whilst the residual impact will remain unchanged (drilling and installation) or reduced (all phases) to **very low** (Table 7-18).

Table 7-18: Impact rating for behavioural disturbance to turtles¹⁰⁴

Behavioural Disturbance to Turtles						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Very Low	Very Low	Low	Very Low	Very Low	Very Low
Intensity	Low	Very Low	Low	Very Low	Low	Very Low
Duration	Medium term	Medium term	Permanent	Permanent	Medium term	Medium term
Extent	Local	Local	Local	Local	Local	Local
Significance	Very Low	Very Low	Low	Very Low	Very Low	Very Low

¹⁰⁴ The highest impact ratings across all sources for each phase are shown in the table, indicating the maximum magnitude (based on combination of intensity, extent and duration), and significance of the associated impact, per phase.



Additional Assessment Criteria	
Probability	Likely
Reversibility	Fully Reversible
Loss of resources	Low
Degree to which impact can be avoided	Medium
Mitigation Potential	Medium
Cumulative impacts	Likely

7.2.3.6 Impact Assessment: Behavioural Disturbance to Seabirds

Sensitivity of receptor

Drilling and installation activities would be undertaken in the offshore marine environment, approximately 300 km from the shore at its closest point and thus far removed from any sensitive coastal receptors (e.g. bird colonies) and the range of most coastal seabirds (10 - 30 km from the coast). However, some of the species potentially occurring in the Venus offshore project area and along the Namibian coast, are considered regionally or globally 'Critically Endangered' (e.g. Tristan Albatross), 'Endangered' (e.g. Black-Browed and Yellow-Nosed Albatross), 'Vulnerable' (e.g. Wandering Albatross, White-chinned petrel, Damar Tern) or 'Near Threatened' (e.g. Shy Albatross).

The Venus offshore project area lies offshore of Cape Gannet foraging ranges, as well as African Penguin foraging and distribution areas, yet overlaps with the core usage areas of the Black-browed Albatross amongst others (see Section 5.5.3.5). The nearshore transshipment zone lies within the vicinity of Walvis Bay, a region recognized as an IBA (see Section 5.6.3) due to its exceptional avian biodiversity. These habitats support over 100 000 birds in summer (peaking at 162 000) and around 50 000 in winter, with approximately 90% being non-breeding Palearctic and intra-African migrants.

Increased ambient lighting is the main source resulting in behavioural impacts to seabirds and could directly affect some migratory pelagic species transiting through and/or pelagic species feeding within the Venus offshore project area, as well as coastal species during vessel transit to port and at the nearshore transshipment area.

Although species listed as 'Critically Endangered' or 'Endangered' may potentially occur the project area, the Venus offshore project area and the nearshore transshipment area are located in main marine traffic routes, while the nearshore transshipment area is also near a vessel anchorage area, already experiencing increased operational noise and lighting above ambient. Nevertheless, considering the IUCN status of the various species potentially encountered within the Venus offshore project area, as well as vicinity of the nearshore transshipment area to IBAs, the overall sensitivity of seabirds to increased ambient lighting is considered to be **medium**.

Magnitude

Drilling and Installation Phase

Overall, the maximum impact magnitude for behavioural disturbance to seabirds due to drilling and installation related activities, is considered to be **low**. This is based on the following ratings:

- **Medium intensity**, for helicopter noise considering potential disturbances seabird breeding colonies located along the provisional flight path between Lüderitz and the



Venus offshore project area, as well as within the NIMPA region which consists of several offshore islands, islets and rocks important for seabird breeding. The intensity of increased ambient lighting is considered **medium**, considering the stationary drill units and various vessels operating across the project area throughout the drilling and installation phase. **Low** intensity, for increased ambient lighting resulting from non-routine flaring, as the Venus offshore project area is located in a main marine traffic route experiencing increased lighting.

- **Medium-term**, as impacts would occur throughout drilling and installation operations. Short term for non-routine flaring operations as impacts are largely transient and limited to certain project activities.
- **Local extent**, as behavioural impacts from vessel and drilling unit lighting will be restricted to the immediate vicinity of each vessel / drilling unit, but would extend across the Venus offshore project area, due to the multiple drilling units and installation / support vessels on site. Impacts from vessel movement (increased lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time (**site**). Increased ambient lighting due to non-routine flaring will be limited to the immediate vicinity of the activity.

These ratings are discussed for each project aspect below.

Underwater noise from vessel and drilling operations (non-impulsive) as well as VSP pulses (impulsive noise)

Sensitivity of diving seabirds to increased underwater noise is poorly studied with underwater hearing having been studied in few marine bird species, such as the long-tailed duck (*Clangula hyemalis*), the great cormorant (*Phalacrocorax carbo*), and Gentoo Penguin (*Pygoscelis papua*) all of which display the ability to detect underwater sound (Hansen, Maxwell, Siebert, & al., 2017; Sørensen, Neumann, Dähne, Hansen, & Wahlberg, 2020).

Deep diving birds such as penguins are not expected within the offshore waters of the Venus offshore project area. In addition, any potential impacts to diving pelagic birds are argued to be limited and very-short term, restricted to the limited duration of the dive.

Overall, due to the limited observations and information on marine birds, and their hearing capabilities and/or response to shipping and underwater noise within the marine environment, modelling the potential underwater impact zones, due to impulsive and non-impulsive noise on seabirds, and the subsequent assessment of impacts is restricted. Nevertheless, potential impacts, should they occur, are argued to be **negligible** given the **short-term** nature of exposure (for diving seabirds) and the absence of deep-diving species, such as penguins, within the Venus offshore project area.

Atmospheric and underwater noise from helicopters

Aircraft related hazards to birds include direct strikes as well as disturbance, the degree of which varies greatly. The negative effects of disturbance of birds by aircraft were reviewed by Drewitt (1999) and include loss of usable habitat, increased energy expenditure, reduced food intake and resting time and consequently impaired body condition, decreased breeding success and physiological changes. Nesting birds may also take flight and leave eggs and chicks unattended, thus affecting hatching and recruitment success (Zonfrillo, 1992). Differences in response to different types of aircraft have also been identified, with the disturbance effect of helicopters typically being higher than for fixed-wing aeroplanes.

Sensitivity of birds to aircraft disturbance are not only species specific, but generally lessened with increasing distance, or if the flight path was off to the side and downwind. However, the vertical and lateral distances that invoke a disturbance response vary widely, with habituation to the frequent loud noises of landing and departing aircraft without ill effects being reported for species such as gulls, lapwings, ospreys and starlings, amongst others



(reviewed in Drewitt 1999). Further work is needed to examine the combined effects of visual and acoustic stimuli, as evidence suggests that in situations where background noise from natural sources (e.g. wind and surf) is continually high, the visual stimulus may have the greater effect.

The nearest seabird colonies to Lüderitz are Halifax, Possession, Pomona and Plum Pudding Island. Of these, Halifax Island potentially falls within the flight paths between Lüderitz and the Venus offshore project area. The island hosts breeding African Penguins as well as Swift Terns and Crowned Cormorant. In addition, the potential flight path may pass over the NIMPA, and associated sensitive coastal receptors. Therefore, potential behavioural effects to these breeding colonies are considered to be of **medium** intensity. Flight paths would need to be planned to avoid these colonies.

The nearest colonies to Oranjemund include Sinclair and Plumpudding Islands to the north, with these colonies likely falling outside the potential flight path between Oranjemund and the Venus offshore project area.

These impacts are expected to occur throughout the drilling and installation phase (**medium-term** duration; notably occurring intermittently), and within the immediate vicinity of the source (i.e., the **site**).

Considering the site extent, medium intensity and medium-term nature of the potential impact on seabirds, impact magnitude is considered to be **low**.

Lighting from drilling/vessel operations

The operational lighting used to illuminate the drilling units or vessels at night may disturb and disorientate pelagic seabirds feeding in the area. Potential attraction may increase during fog when greater illumination is caused by refraction of light by moisture droplets. It is expected, however, that seabirds in the area would become accustomed to the presence of the project vessels and drilling unit(s) within a few days. Since the Venus offshore project area is located within the main traffic routes that pass around southern Africa, which experience high vessel traffic, animals in the area should be accustomed to vessel traffic and associated lighting to some extent.

Although the Venus offshore project area experiences significant marine traffic, seabirds are generally more attracted to stationary light sources than to moving vessels. Considering this, along with the potential presence of large migratory seabirds in the area, including species listed as Endangered (e.g. Atlantic yellow-nosed albatross and Black-browed albatross), the increase in ambient lighting from the stationary drill unit(s) at the offshore project area is assessed as a **medium** intensity.

Impacts are considered to be confined to the vicinity of the vessels and/or drilling units operating across the Venus offshore project area (**local**) with effects extending over the drilling and installation phase (**medium term**).

Considering the local extent, medium intensity and medium-term nature of the potential impact on seabirds, impact magnitude is considered to be **low**.

For vessels travelling from port to the Venus offshore project area, the increase in ambient lighting would likewise be restricted to the immediate vicinity (site) of the vessel, yet extend regionally. Considering vessel transit will take place along existing marine transit routes, impacts are considered to be of very low intensity, resulting in an impact of **very low** magnitude.

Lighting from non-routine flaring

Due to the proximity of the Venus offshore project area to marine traffic routes, the short-term increase in ambient lighting in the offshore environment would be of **low** intensity. Impacts are considered to be confined to the immediate vicinity of the flaring (**site**) with non-routine flaring taking place intermittently across the drilling and installation phase. As such,



impacts are expected to be extend over the **short-term**. The potential for behavioural disturbance as a result of non-routine flare lighting would thus be of **very low** magnitude¹⁰⁵.

Production Phase

Overall, the impact magnitude for behavioural disturbance to seabirds across the production phase is considered to be **medium**. This is based on the following ratings:

- **Medium intensity**, for helicopter noise considering potential disturbances seabird breeding colonies located along the provisional helicopter flight path between Lüderitz and the Venus offshore project area, as well as within the NIMPA region. The intensity of increased ambient lighting is considered **medium**, considering the stationary FPSO lighting source, as well as vessels operating across the project area throughout the production timeline.
- **Permanent**, for behavioural impacts due to increased lighting at the Venus offshore project area, with production operations taking place for up to 31 years. Short-term duration for impacts due to increased lighting at the nearshore transshipment area as during crude oil transfer operations would be intermittent over the 31-year production phase. Impacts will notably cease following the end of the project.
- **Local** extent, as behavioural impacts from vessel, FPSO and DPST lighting will extend within the larger Venus project and nearshore area.

These ratings are discussed for each project aspect below.

Underwater noise offshore crude transfer operations both offshore and nearshore (non-impulsive)

As with underwater noise within the drilling and installation phase potential behavioural impacts due to increased underwater noise from offshore and nearshore transfer operations (non-impulsive), should they occur, are argued to be negligible given the very short-term nature of exposure (for diving seabirds) and the absence of deep-diving species, such as penguins, within the Venus offshore project area. While penguins may be encountered within the nearshore transshipment area, numbers are expected to be low, with breeding colonies located well south, in the vicinity of Lüderitz. **As such population-level effects are not expected.**

Lighting from FPSO / vessel operations

The operational lighting used to illuminate the FPSO or vessels at night may disturb and disorientate pelagic seabirds feeding in the area.

Although the Venus offshore project area experiences significant marine traffic, seabirds are generally more attracted to stationary light sources (e.g. FPSO) than to moving vessels. Similarly stationary light sources from conventional tanker, DPST and tugs moored and/or in position before and during nearshore transshipment operations may attract coastal and migratory seabirds within the vicinity. Most seabirds breeding in Namibia nest on predator-free coastal islands or man-made guano platforms in Walvis Bay, nearby Swakopmund and Cape Cross, with seabirds nesting on these platforms potentially feeding and/or moving through the nearshore transshipment area. In addition, the nearshore transshipment area lies offshore of IBAs and to the north of the Walvis Bay wetlands. Considering this, along with the potential presence of large migratory and/or coastal seabirds in the area, including species listed as Endangered (e.g. Atlantic yellow-nosed albatross and Black-browed albatross), the increase in ambient lighting from the stationary FPSO at the offshore project area as well as moored vessels within the nearshore area is assessed as a **medium**

¹⁰⁵Potential impacts from non-routine flaring during the production phase are expected to be similar to those assessed for the drilling and installation phases, and are considered to be of very low magnitude.



intensity.

Impacts are considered to be confined to the vicinity of the vessels operating across the Venus offshore project area and nearshore transshipment area, as well as FPSO (**local**) with effects extending up to 31-years (**permanent**), and are not expected to extend beyond the project. For vessels travelling from port and/or moored for nearshore transshipment operations the increase in ambient lighting would likewise be restricted to the immediate vicinity (site) of the vessel.

Considering the local extent, medium intensity and permanent nature of the potential impact on seabirds, impact magnitude is considered to be **medium**.

For vessels travelling from port the increase in ambient lighting would likewise be restricted to the immediate vicinity (**site**) of the vessel, yet extend regionally. Considering vessel transit will take place along existing marine transit routes, impacts are considered to be of **very low** intensity, taking place throughout the production phase (**permanent**) and resulting in an impact of **very low** magnitude.

Atmospheric and underwater noise from helicopters

As described for the drilling and installation phase, potential behavioural effects due to helicopter operations are considered to be of **medium** intensity. These impacts are expected to occur throughout the up to 31-year production phase (although occurring intermittently), with impacts ceasing following the completion of the project (**permanent**), and within the immediate vicinity of the source (i.e., the **site**). Therefore, the impact of atmospheric noise generated during helicopter operations is assessed as being of **medium** magnitude.

Decommissioning Phase

Potential behavioural impacts due to vessel transit, ambient lighting and atmospheric noise during the decommissioning phase are as assessed in the drilling and installation phase above.

Overall, the impact magnitude for behavioural disturbance during the decommissioning phase, is considered to be **low**. This is based on the following ratings:

- **Medium intensity**, for helicopter noise considering potential disturbances seabird breeding colonies located along the provisional flight path between Lüderitz and the Venus offshore project area, as well as within the NIMPA region. The intensity of increased ambient lighting is considered medium, considering the stationary drilling unit and various vessels operating across the project area throughout decommissioning activities, as the Venus offshore project area is located in a main marine traffic route experiencing increased lighting.
- **Medium-term**, as impacts will be limited to the duration of decommissioning activities taking place over approximately 1.5 years.
- **Local extent**, as behavioural impacts from vessel, and drilling unit lighting will extend within the larger Venus project. Impacts from vessel movement (increased noise and lighting) between the Venus offshore project area and the logistics bases along the Namibian coast would be regional, yet limited to the immediate vicinity of the vessel at any given time (site).

Significance

Considering behavioural impacts to seabirds are predominantly related to increased atmospheric noise and lighting, resulting from helicopter and vessel operations across all phases, based on an overall **medium** magnitude and **medium** sensitivity, the impact significance is assessed as **medium**.



Residual Impact

Behavioural disturbance cannot be eliminated due to the nature and requirements of operations. Considering the mitigations presented in Section 7.2.3.7, such as reduced lighting on the project vessels, drilling unit and FPSO, to a minimum compatible with safe operations whenever and wherever possible, as well as positioning of light sources in places where emissions to the surrounding environment can be minimised (Table 7-22 and Table 7-23), the impact intensity will reduce resulting in a residual impact of **low** significance (Table 7-19).

Table 7-19: Impact rating for behavioural disturbance to seabirds

Behavioural Disturbance to Seabirds						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Low	Very Low	Medium	Medium	Low	Very Low
Intensity	Medium	Low	Medium	Low	Medium	Low
Duration	Medium term	Medium term	Permanent	Permanent	Medium term	Medium term
Extent	Local	Local	Local	Local	Local	Local
Significance	Low	Very Low	Medium	Low	Low	Very Low
Additional Assessment Criteria						
Probability	Likely					
Reversibility	Fully Reversible					
Loss of resources	Low					
Degree to which impact can be avoided	Medium					
Mitigation Potential	Medium					
Cumulative impacts	Likely					

7.2.3.7 Mitigation and Management Measures

Table 7-20 to Table 7-23 list the recommended mitigation measures to reduce the impacts of behavioural disturbance to marine fauna. These are presented per project aspect below.

Table 7-20: Mitigation to reduce behavioural disturbance impacts related to increased underwater noise from vessel and drilling unit operations across all phases both offshore and nearshore (non-impulsive).

No.	Mitigation measure	Classification
1	Implement a maintenance plan to ensure all diesel motors and generators receive adequate maintenance to minimise noise emissions.	Avoid/reduce at source
2	During normal operations, ensure vessel transit speed between the Venus offshore project area and port remain within operational speed limits: Supply vessel: 10-13 knots.	Avoid/reduce at source



No.	Mitigation measure	Classification
	Fast supply vessel: 17-20 knots. Reduce speed to operational speed range minimums within 25 km of the coast.	
3	Reduced vessel power and duty cycle to lowest safe operational level when using dynamic positioning systems.	Avoid/reduce at source

Table 7-21: Mitigation to reduce behavioural disturbance impacts related to underwater noise from VSP operations (impulsive).

No.	Mitigation measure	Classification
1	Key personnel and equipment	
1.1	Appoint a dedicated Marine Mammal Observer (MMO), with recognised MMO certifications, on board to undertake marine fauna observations, distance estimation and reporting <u>during VSP operations</u>. Passive Acoustic Monitoring (PAM) should be undertaken during VSP operations, therefore a trained PAM Operator must be appointed to undertake PAM <u>during VSP operations</u>.	Abate on site
1.2	Ensure drilling unit vessel is fitted/compatible with PAM technology (one or more hydrophones), which detects animals through their vocalisations. A risk assessment, undertaken ahead of the VSP operations, must be conducted to confirm that the metocean conditions (specifically currents) are suitable for safe deployment of PAM equipment near the drilling unit thrusters (entanglement risk). Support vessels should be used to deploy PAM equipment should the drilling unit thrusters pose a technical risk.	Abate on site
2	Pre-start protocols for airgun testing and profiling during VSP operations	
2.1	VSP profiling should, as far as possible, only commence during daylight hours with good visibility. However, if this is not possible due to prolonged periods of poor visibility (e.g. thick fog) or an unforeseen technical issue which results in a night-time start, refer to Mitigation 5 below.	Avoid / Abate on site
2.2	Undertake a 1-hr pre-shoot visual and possible acoustic scan (prior to soft-starts / airgun tests) within the 500 m radius mitigation zone in order to confirm there is no cetaceans, turtles and shoaling large pelagic fish activity close to the source.	Abate on site
2.3	Implement a “soft-start” procedure of a minimum of 20 minutes’ duration when initiating the acoustic source (except if testing a single airgun on lowest power). This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. Delay “soft-starts” if cetaceans, turtles and shoaling large pelagic fish are observed / detected within the mitigation zone during the pre-shoot visual / acoustic scan. A “soft-start” should not begin until 20 minutes after cetaceans depart the mitigation zone or 20 minutes after they are last seen or acoustically detected by PAM in the mitigation zone. In the case of shoaling large pelagic fish and turtles, delay the “soft-start” until animals move outside the 500 m mitigation zone.	Abate on site
2.4	Maintain visual and PAM observations within the 500 m mitigation zone continuously during VSP operation to identify if there are any cetaceans present. Also see Point 5 for requirements during periods of darkness or low visibility.	Abate on site
3	Shut-Downs	
3.1	Shut down the acoustic source if cetaceans, penguins, shoaling large pelagic fish or turtles are sighted within 500 m mitigation zone until such time as the mitigation zone is clear of cetaceans for 20 minutes or in the case of shoaling large pelagic fish or turtles, the animals move outside the 500 m mitigation zone before the soft-start procedure and production may commence.	Abate on site



No.	Mitigation measure	Classification
4	Breaks in Airgun Firing	
4.1	Breaks of less than 20 minutes: - there is no requirement for a soft-start and firing can recommence at the same power level as at prior to the break (or lower), provided that continuous monitoring was ongoing during the silent period and no cetaceans, shoaling large pelagic fish or turtles were detected in the mitigation zone during the breakdown period. - If a cetacean is detected in the mitigation zone during the breakdown period, there must be a minimum of a 20-minute delay from the time of the last detection within the mitigation zone and a soft-start must then be undertaken. In the case of shoaling large pelagic fish or turtles, the animals move outside the 500 m mitigation zone within the 20 minute period.	Abate on site
4.2	Breaks of longer than 20 minutes: If it takes longer than 20 minutes to restart the airguns, a full pre-watch and soft-start process should be carried out before the survey re-commences. If an MMO/PAM operator has been monitoring during the breakdown period, this time can contribute to the 60-minute pre-watch time.	Abate on site
5	Period of low visibility	
5.1	Ensure that during periods of low visibility (where the mitigation zone cannot be clearly viewed out to 500 m), including night-time, the VSP source is only used if PAM technology is in place to detect vocalisations (subject to a risk assessment indicating that the PAM equipment can be safely deployed considering the metocean conditions) or: - there have not been three or more occasions where cetaceans, shoaling large pelagic fish or turtles have been sighted within the 500 m mitigation zone during the preceding 24-hour period; and - a two-hour period of continual observation of the mitigation zone was undertaken (during a period of good visibility) prior to the period of low visibility and no cetaceans, shoaling large pelagic fish or turtles were sighted within the 500 m mitigation zone.	Abate on site

Table 7-22: Mitigation to reduce behavioural impacts related to lighting from drilling and vessel operations (at Venus offshore project and nearshore transshipment area) and non-routine flaring.

No.	Mitigation measure	Classification
Flaring Operations (Drilling & Installation Phase)		
1	Optimise well test and clean-up programme to reduce flaring as much as possible during the operation.	Reduce at source/Abate on site
2	Commence with well testing during daylight hours, as far as possible, and ensure operational monitoring.	Reduce at source/ Abate on site
All Phases		
3	Reduce the lighting on the project vessels, drilling unit and FPSO to a minimum compatible with safe operations whenever and wherever possible.	Avoid/Reduce at Source
4	Position light sources, if possible and consistent with safe working practices, in places where emissions to the surrounding environment can be minimised.	Avoid/Reduce at Source
5	Keep disorientated, but otherwise unharmed, seabirds in dark containers (e.g. cardboard boxes) for subsequent release during daylight hours. Done in strict accordance with protocols outlined in the Wildlife Response Plan.	Repair or Restore



No.	Mitigation measure	Classification
6	Report ringed/banded birds to the appropriate ringing/banding scheme (details are provided on the ring).	Repair or restore
7	Include procedures in the Biodiversity Management Plan for how to care for downed seabirds and ensure that personnel are adequately trained in this regard.	Avoid / abate on site

Table 7-23: Mitigation to reduce behavioural impacts related to atmospheric and underwater noise from helicopters across all phases.

No.	Mitigation measure	Classification
1	Pre plan flight paths to avoid seal and bird colonies including: - Lüderitz Lagoon. - Offshore islands (including Halifax, Possession, Sinclair, Pomona, Plum pudding, Klein Ichaboe, Bird Island). - Seal colonies (including Atlas Bay, Wolf Bay, Van Reenen Bay, Sylvia Hill, Hollamsbird Island, Conception Bay and Cape Cross). If not possible, ensure a minimum altitude of 762m/2500ft is maintained, except when taking off/landing, in an emergency, and for weather reasons.	Avoid / abate on site
2	Pre-plan flights to avoid extensive low altitude (<762 m or 2 500 ft) flights parallel to the shore.	Avoid/ abate on site
3	Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.	Avoid

7.2.4 Marine Fauna Physical and/or Physiological Injury Effects

7.2.4.1 Source of Impact

The project activities that may result in the physical injury of marine mammals, fish and turtles are summarised below:

Aspect	Drilling & Installation	Production	Decommissioning
Underwater noise from drilling operations (non-impulsive)	X		
Underwater noise from vessels operations, manoeuvring and positioning (non-impulsive)	X	X	X
Underwater noise from vertical seismic profiling operations (impulsive)	X		
Presence of mooring chains		X	
Abstraction of seawater offshore		X	
Increased vessel traffic	X	X	X

Project Controls

The Operator and contractors will ensure that the proposed project activities are undertaken in a manner consistent with good international industry practice and BAT. All whales and dolphins are given protection under the Namibian Law. The regulations under the Namibian Marine Resources Act, 2000 (No. 27 of 2000) states that no whales or dolphins may be harassed, killed or fished.



7.2.4.2 Impact Description

Underwater noise from drilling units and project vessels operations (non-impulsive and impulsive noise)

Exposure to high sound levels can result in physiological injury to marine fauna through a number of avenues, including shifts of hearing thresholds as either AUD INJ, PTS or TTS, tissue damage, acoustically induced decompression sickness (particularly in beaked whales), and non-auditory physiological effects. Both AUD INJ and TTS represent actual changes in the ability of an animal to hear, usually at a particular frequency, whereby it is less sensitive at one or more frequencies as a result of exposure to sound. In assessing injury from noise, a dual criterion is adopted based on the peak SPL and SEL (a measure of injury that incorporates the sound pressure level and duration), with the one that is exceeded first used as the operative injury criterion.

AUD INJ-onset and TTS-onset thresholds differ between impulsive and non-impulsive noise, with ranges for marine mammals summarised in Table 7-1.

The risk of TTS close to continuous shipping sounds (non-impulsive) is generally low, although masking of calls and behavioural changes would be likely.

Presence of mooring chains

Mooring of the FPSO and nearshore transshipment buoy, through the use of subsea anchors and associated mooring lines, could potentially disturb and/or injure pelagic and neritic marine fauna due to collision with or entanglement in mooring lines/chains in the water column.

Abstraction of sea water

Drilling operations will take place over a four-year period, with drilling unit locations changing throughout the campaign. Seawater may be abstracted intermittently for operational purposes such as cooling and drilling mud preparation. These activities are standard in offshore operations and are typically managed in accordance with industry best practices and engineering controls designed to minimize ecological disturbance. As such seawater abstraction associated with offshore drilling operations may result in the potential entrainment of small marine organisms; however, these are considered negligible given the relatively small volumes involved, limited impact area and intermittent nature during the drilling phase.

Seawater abstraction will occur continuously on the FPSO throughout the production phase to support the cooling of process systems. Importantly, process hydrocarbons will not come into contact with the seawater at any stage.

After transferring heat via the cooling medium, the abstracted seawater will be discharged. However, there will be no routine discharge of the cooling medium itself.

During the abstraction process, small pelagic fish species, ichthyoplankton (such as fish eggs and larvae), and phytoplankton present in the intake area may be directly impacted through entrapment, potentially resulting in injury or mortality.

Increased Vessel Traffic

Collisions with marine fauna (especially turtles and cetaceans) basking or resting on the sea surface may occur during the transit of the DPST and support vessels to and from the Venus offshore project area and coastal ports.

The potential effects of vessel presence on marine fauna include physiological injury or mortality due to vessels colliding with animals.



7.2.4.3 Impact Assessment: Physical and/or Physiological Injury to Marine Mammals

Sensitivity of receptor

As detailed in Section 7.2.3.3 for behavioural effects, the sensitivity of marine mammals to physical and/or physiological injury due to increased underwater noise is also considered to be **medium**.

Of the cetacean species likely to be encountered within the Venus offshore project area and nearshore transshipment area and/or vessel transit route between the logistics bases and offshore project area, some are listed as ‘Critically endangered’, ‘Endangered’ or ‘Vulnerable’ (IUCN Red Data list Categories). However, due the offshore location of Venus project area, the extensive distributions of the various species concerned and mobility of these animals to avoid project vessels, the numbers of individuals encountered during operations are likely to be low. Furthermore, the pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area is classified as ‘Least Threatened’.

The overall sensitivity of marine mammals to physiological and/or physical impacts resulting from potential collisions, entanglement and/or increased underwater noise is therefore considered to be **medium**.

Magnitude

Drilling and Installation Phase

Overall, the maximum impact magnitude for physical and/or physiological injury to marine mammals from **underwater noise** from the drilling and installation phase is considered to be **very low**, based on the “worst-case” rating combinations provided below:

- **Low intensity** for both non-impulsive and impulsive noise, taking into account the Venus offshore project area is located in a main marine traffic route, already experiencing increased vessel traffic and related underwater noise, but also considering the proposed timing/seasonality of peak activities with installation campaigns, combined with drilling operations, taking place during two austral summer seasons. Notably, being highly mobile, it is unlikely that marine fauna in the offshore habitat of the operations would stay in the same location for the entire period and are likely to move away from the sound source before injury occurs. Additionally, modelled impact zones do not overlap with key breeding and feeding areas. The pelagic habitat/ecosystem type within PEL0056/Block 2913B and nearshore transshipment area are also classified as ‘Least Threatened’ (see 5.6.4.1).
- **Medium-term** duration with effects due to increased underwater noise considered to extend throughout the drilling and installation phase over a period of approximately 4 years.
- **Local extent** based on worst-case scenario of TTS-onset within 21.1 km for low frequency cetaceans, in the case of 24 hours continuous exposure. Notably, animals would need to be in relatively close proximity (500 m to 1.6 km) to the sound source to suffer physiological injury (AUD-INJ).

Overall, the maximum impact magnitude for physical injury and/or mortality to marine mammals due to **collision** during the drilling and installation phase is considered to be **medium**, based on the below:

- **Medium intensity** relating to the potential mortality of marine mammals due to ship strikes and/or collisions.
- **Long-term** duration as population effects from vessel strikes will extending beyond



the impact duration, yet will be reversible over time.

- Within/near to the **site**, as animals would need to be in the immediate vicinity of the vessel at any one time.

These ratings are discussed for each project aspect below.

Underwater noise from wells drilling and installation operations (non-impulsive)

There is a growing awareness that the sub-lethal physiological effects of noise disturbance (e.g. increased stress levels), which can be challenging to identify and measure, are likely to be widespread and may have more significant impacts than direct physical injuries (Forney, et al., 2017). Notably a lack of observed response by/to the various faunal groups does not imply an absence of costs such as physiological stress and reduced reproduction, survival or feeding success. Apparent tolerance to disturbance may in fact have population-level impacts that are more subtle and difficult to record with conventional methodologies.

AUD-INJ and TTS-onset zones were estimated based on the cumulative exposure (24-hours) to non-impulsive noise generated by vessel DPS, as outlined in Section 7.1.1. As most species likely to be encountered within the project area are expected to be highly mobile, they would be expected to move away from the sound source before trauma could occur. It is thus considered likely that most animals would avoid sound sources at distances well beyond those at which injury is likely to occur. However, assuming the unlikely scenario that an animal remains within the zone of impact, the maximum zones of impact shown in Table 7-4 and referenced below would apply.

In summary, AUD INJ- and TTS-onset, based on non-impulsive noise from drilling activities, as outlined for Scenario UD-1 (Section 7.1.1), were estimated to occur within maximum distance of 500 m (**site**) and 16.5 km (**local**), respectively. These modelled impact zones represent the worst-case, cumulative exposure scenario during drilling operations only, considering the concurrent operation of three drilling units as well as associated support and supply vessels operating in close proximity (SLR Consulting Canada, 2025). Notably, LF cetaceans (i.e. baleen whales such as the Humpback whale) were the only marine mammal hearing group that may experience AUD INJ. In addition, TTS-onset for the remaining hearing groups was found to be reduced, occurring within 4.6 km for VHF (i.e. toothed whales such as the Sperm whale) hearing group and within 1 km for HF (i.e. beaked whales, such as the Southern bottlenose dolphin) hearing group¹⁰⁶. Concurrent drilling operations by three drill rigs are planned to take place within the first three years of the drilling phase, with two drill rigs on site in the fourth year of operations (**medium term**).

The offshore installation of subsea equipment at the Venus offshore project area will primarily occur over two austral summer periods (2 x 6 months) due to metocean constraints.

- During the first construction campaign, it is anticipated that all three installation vessels and their associated supply vessels will operate alongside the three drilling units and their support vessels, representing the worst-case scenario for this installation campaign, with up to 13 vessels operating concurrently across the Venus offshore project area, each using dynamic positioning systems (DPS). Considering this scenario (UC-1, see Section 7.1.1), AUD-INJ and TTS-onset may occur within 500 m (**site**) and 21.1 km (**local**), respectively. As with underwater noise due to drilling operations, LF cetaceans were found to be the most sensitive, with no AUD-INJ modelled for the remaining hearing groups. These impact zones will occur over the **short-term** (< 1 year), with the full fleet of 13 vessels only active for up to

¹⁰⁶ Phocid pinniped (PW) such as seals and Otariid pinniped (OW) such as sea lions, are not anticipated within the deep, offshore waters of the Venus offshore project area.



90 days, after which the installation and construction vessels will periodically depart the site.

- In the second construction campaign, up to 16 vessels are expected to be operating across the Venus offshore project area (Scenario UC-2, see Section 7.1.1) representing the peak vessel presence and the worst-case scenario for both the drilling and installation phase as well as the overall project. Under this scenario, AUD-INJ and TTS-onset may extend up to a maximum of 1.6 km (**local**) and 20.9 km from the FPSO (**local**) for LF group. TTS-onset zones were found to be reduced for VHF (3.7 km; local) and HF (1.9 km; site) hearing groups. As previously noted, this peak activity, driven by the concurrent arrival and installation of the FPSO along with other operations, will last for only one month. After this period, the four mooring tugs will disengage and depart, reducing the underwater noise and the associated impact zones, with the second installation campaign taking place over the **short-term** (< 1-year).

Overall, underwater non-impulsive noise levels and resulting impact zones outside of the peak installation campaigns are argued to return to levels modelled for drilling operations only, with potential impact zones extending **locally** (TTS-onset occurring within a maximum of 20.9 km from the reference vessel).

LF cetaceans were found to be most sensitive to increased non-impulsive underwater noise levels, with AUD-INJ onset restricted to this hearing group alone. Baleen whales (i.e. LF) possibly encountered within the offshore waters of the Venus offshore project area include the Humpback ('Vulnerable'), Sei ('Endangered') and Fin ('Endangered') whale all of which display bimodal seasonality. Humpback whales in Namibia show a bimodal seasonality in occurrence, with a primary peak in austral winter (July) and a secondary peak in spring (September), although animals occur year-round (Best P., 2007). Similarly, Sei and Fin whales are more likely to occur in winter (April – May) and spring (August – October) months. As such encounters and potential physical and/or physiological impacts on these LF cetaceans during peak periods of underwater noise (i.e. installation campaigns) is likely less owing to their seasonality. Similarly encounters with Sperm whales (VHF hearing group) is likely reduced during the summer installation campaigns, with encounters argued to occur mostly in winter months (April – October).

As most species likely to be encountered within the Venus offshore project area are highly mobile, they would be expected to move away from the sound source before trauma could occur, with potential cumulative impact zones possibly occurring should animals remain in specific coastal areas for the purposes of calving or are associated with specific oceanic focal features such as seamounts. Notably, key southern right calving and nursing areas, off Lüderitz and Elizabeth Bay, as well as suggested Humpback summer feeding grounds in the vicinity of Lüderitz, lie well inshore and fall outside of the maximum threshold distances for this species. Therefore, the cumulative zones of impact represent the worst-case consideration and will reduce with a decreased exposure time period.

Overall, the impact of physical and/or physiological injury to marine mammals due to non-impulsive underwater noise is **low** intensity, considering the mobility and seasonality of species encountered in the Venus offshore project area, high vessel traffic within the vicinity of the Venus offshore project area, stationary sound sources as well as no overlap of modelled impact zones with key feeding (e.g. Tripp Seamount) and breeding grounds. Impacts would extend to a **local** scale (maximum TTS-onset within ~21 km). Individual AUD INJ effects may be permanent, however AUD INJ impacts at the population level are considered limited. TTS effects are temporary, with individuals and population-level recovery likely occurring over the **medium-term**.

Considering the local extent, low intensity and medium-term nature of the potential physical/physiological impacts (at the population-level), the magnitude is considered to be **very low**.



Underwater noise from VSP pulses (impulsive noise)

Due to the highly localised and extremely short-term noise generated by VSP, sub-lethal effects (should they occur) would likely be acute (short-term) rather than chronic (longer-term and associated with many overlapping activities).

As most pelagic species likely to be encountered within the Venus offshore project area are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur. Furthermore, the operations will take place far offshore and removed from key feeding grounds as well as breeding areas for marine mammals, in area classified a 'Least Threatened'. However, assuming the animal does not move away from the noise source, the cumulative maximum threshold distances would apply (Table 7-3, see SLR Consulting Canada 2025 for further information).

Considering the cumulative impact (250 VSP discharges over approximately 9 hours) on marine mammals, the maximum threshold distances will be in the range of 40 m to 1 260 m for TTS onset, and up to 260 m for AUD-INJ onset in the case of the most sensitive LF cetaceans, with the threshold distances for the remaining hearing groups being considerably lower (< 60 m).

It is evident from Table 7-3 that animals would need to be in relatively close proximity (<300 m) to the operating VSP sound source to suffer physiological injury, and in reality, marine fauna in the offshore habitat of the Venus offshore project area would not stay in the same location for the entire period. As such, cumulative effects would not be expected, with the worst-case, cumulative scenario modelled argued to be conservative. In addition, if VSP soft start procedures are implemented (as recommended, see Section 0), the zones of impact would be reduced to less than that predicted based on exposure to a single full-operation VSP pulse, as well as cumulative exposure (SLR Canada, 2025b). It is thus considered likely that most animals would avoid sound sources at distances well beyond those at which injury is likely to occur.

In the case of noise generated during VSP, the effects on marine mammals are considered to be of **low** intensity, with the worst case being possible cumulative TTS onset in LF cetaceans within 1.3 km of the sound source. Effects would, however, extend to a **local** scale over the **short-term** duration (with VSP activities taking place intermittently, up to 9 hours per well, throughout drilling operations).

Considering the local extent, low intensity and short-term nature of the potential, the impact of underwater noise generated during VSP is of **very low** magnitude.

Collision during vessel transit

Peak vessel traffic is anticipated in the concurrent drilling and installation phase, with multiple vessels operating across the Venus offshore project area and transiting between port and the Venus offshore project area, notably reducing during the production and subsequent decommissioning phases.

Ship strikes are globally the biggest threat to large whales, having direct, long-term and population-level consequences (Schoeman, Patterson-Abrolat, & Plon, 2020).

Sub-lethal ship strikes have been reported to result in medium-term effects such as evasive behaviour by animals experiencing stress, or longer-term effects such as decreased fitness or habitual avoidance of areas where disturbance is common, and in the worst case death (Constantine, 2001; Hastie, Wilson, Tufft, & Thompson, 2003; Lusseau, 2004; 2005; Bejder, Samuels, Whitehead, & Gales, 2006; Lusseau, Bain, Williams, & Smith, 2009). The potential for ship strikes of cetaceans is dependent on the spatial and temporal abundance and behaviour of cetaceans in the area and vessel speed. Due to their extensive distributions and feeding ranges, the number of cetaceans encountered by project vessels in the offshore environment is expected to be low for much of the year. Bimodal peaks in abundance of species migrating northwards to their breeding grounds and on their return migrations to low-



latitude feeding grounds (e.g. Humpback (Vulnerable), Southern Right (Least Concern), Fin (Endangered) and Sei (Endangered) whales) and winter distributions of Sperm whales off the shelf edge may, however, occur. Any increase in vessel traffic through areas used as calving grounds or through which these species migrate will increase the risk of collision with a vessel (Piscès, 2020). Although the project area (both offshore and nearshore) does not fall within a recognised IMMA, the chances of collisions would increase during migratory periods and/or seasons of increased abundance.

As the Venus offshore project area is located in a region of very high vessel traffic, potential collisions between marine fauna and vessels would not be limited to project-specific support vessels and drilling units. For the duration of the operations, a maritime restricted area would be established around the Venus offshore project area, potentially requiring adjustment of vessel traffic routes. Such re-routing and associated changes in the concentrations of vessels needs to take into consideration whale migration routes or feeding aggregation sites to endeavour that these are not compromised as a result of the re-routing, and therewithin potentially leading to increased risk of ship strikes (Schoeman, Patterson-Abrolat, & Plon, 2020). Although ship strikes from project vessels are unlikely, they may occur during the transit of the support vessels between the logistics bases and the Venus offshore project area.

Overall, while the potential impacts of ship strikes would be of high intensity for individuals they are argued to be of **medium** intensity for the population(s) as a whole, based on a precautionary approach and considering the Endangered and/or Vulnerable IUCN status of the potential species possibly impacted. While vessel collisions potentially resulting in individual mortality would have irreversible effects on the affected animals, these effects will be reversible at the population level over time due to natural recovery processes. As such, effects would extend beyond the impact duration/exposure (i.e. project lifespan), yet will be reversible over time (i.e. not permanent), with natural recovery taking place over the **long-term** (considering the long generation times and low reproductive rates of potentially impacted species (e.g. Humpback and Sperm whales)). Effects would be limited to the immediate vicinity of the vessel at any one time (**site**). Should ship strikes occur, the impact is, therefore, considered to be of **medium** magnitude.

Production Phase

Overall, the maximum impact magnitude for physical and/or physiological injury to marine mammals due to **increased underwater noise** related to production activities/operations is considered to be **low**, based on the below:

- **High intensity** for non-impulsive noise in the nearshore area, due to the zone of impact in proximity to coastal migratory routes and breeding and feeding grounds, and increased number of individuals passing through the area. **Low** intensity for non-impulsive and impulsive noise at the Venus offshore project area. Notably, being highly mobile, it is unlikely that marine fauna would stay in the same location for the entire period and are likely to move away from the sound source before injury occurs.
- **Short-term duration** as physical (and physiological) impacts due to TTS-onset would be temporary, with individual and population-level effects and associated recovery expected over the short-term, following intermittent transshipment/transfer operations.
- **Local extent**, based on worst-case scenario of TTS-onset within 6.4 km for low frequency cetaceans. Notably, animals would need to be in relatively close proximity to the sound source to suffer physiological injury.

Overall, the impact magnitude for physical and/or physiological injury to marine mammals due to **collision and entanglement** during the production phase is considered to be **medium**, based on the below:



- **Medium intensity** for collisions/entrapment with mooring chains/lines, considering the relatively low population numbers of potential species encountered within the Venus offshore project area and reduced probability of collisions and/or entanglement with nearshore mooring chains/lines (owing to fewer and shorter chains/lines).
- **Permanent duration**, as production operations will take place up to 31-years. Population effects in the case of vessel strikes resulting in individual mortality and/or injury, will extend beyond the impact duration, yet will be reversible over time.
- Within/near to the **site**, as animals would need to be in close proximity to production infrastructure or vessel to suffer injury through entanglement/collision, respectively.

These ratings are discussed for each project aspect below.

Underwater noise from offshore crude transfer/vessel operations (non-impulsive)

During the production phase, offshore transfer operations are anticipated to take place over 24 hours/one day per week, particularly during the peak production period, which is expected to last the first several years. Following this peak phase, the frequency of transfer operations will gradually decline.

Underwater noise modelling (Scenario UP-1, Section 7.1.1), which simulates two vessels operating concurrently at the Venus offshore project area (one DPST vessel and one support vessel, both using DPS) indicates that non-impulsive noise generated during these operations may cause AUD-INJ and TTS-onset in cetaceans up to 400 m and 3.9 km from the FPSO (local), respectively for LF hearing group.

AUD-INJ impacts were found to be limited to the LF hearing group (i.e. Humpback whales) only, with underwater sound levels not reaching thresholds to induce AUD-INJ impacts in the remaining hearing groups. TTS impact zones were found to be notably reduced in the remaining hearing groups, occurring within 1.3 km and 600 m for VHF and HF cetaceans, respectively.

Considering pelagic species likely to be encountered within the Venus offshore project area are highly mobile, if marine mammals only pass through the site near the non-impulsive stationary noise sources over a very short period of time, the potential impact zones are argued to be reduced, with the cumulative impact zones modelled being conservative.

Overall, the impact of physical and/or physiological injury to marine mammals due to non-impulsive underwater noise is of **low** intensity as previously outlined. Impacts would extend to a **local** scale (maximum TTS-onset within ~4 km). Individual AUD INJ exposure may be long term, however AUD INJ impacts at the population level are considered limited. TTS effects are temporary, with individual recovery likely occurring over the short-term (hours to a few days following injury). As with AUD- INJ, population-level impacts due to TTS-onset are considered limited, with species likely to move out of the impact zone before injury occurs.

Considering the Venus offshore project area does not overlap with key breeding and/or feeding areas, cumulative and longer-term population-level effects are considered limited. Consequently, impact effects are expected to be limited to individual transfer events, thereby extending over the **short-term** (limited to up to 24-hours per transshipment, taking place weekly at peak operations, over the 31-year production phase) with individual and associated population-level effects not expected to persist for more than a few days beyond each offloading event.

Considering the local extent, low intensity and short-term nature of the potential, effects of physical/physiological injury (at the population-level) due to increased non-impulsive underwater noise resulting from intermittent offshore transfer operations is considered to be of **very low** magnitude.



Production activities are anticipated to begin following the second summer installation campaign and the connection and installation of the FPSO. As such, cumulative physical and/or physiological impacts due to non-impulsive underwater noise from concurrent drilling and offshore transfer operations within the first 1.5 years of production may occur. Notably, these cumulative impacts are expected to be limited, owing to a reduction in the number of drilling units (from three to two) and fewer drilling days during the first year of full production. Additionally, non-impulsive noise from offshore transfer operations between the DPST and FPSO is expected to be limited to 24 hours (one day) per week during this period.

Underwater noise from nearshore transshipment operations (non-impulsive)

Similar to the Venus offshore project area, nearshore transshipment activities will generate non-impulsive underwater noise, which may lead to physiological and/or physical impacts in marine mammals within the area of influence.

These nearshore operations are planned to occur over a 24-hour period/one day per week, during the peak production years. As detailed in Section 7.1.1, underwater noise modelling Scenario UP-2 simulates the presence of four vessels operating in close proximity at the nearshore site; one DPST using dynamic positioning (DPS) to manoeuvre into position before being moored, and three port tugs also using DPS to assist in positioning the conventional tanker. Based on this operational scenario, it is estimated that non-impulsive noise from manoeuvring and transshipment activities could cause AUD-INJ and TTS-onset in marine mammals up to a maximum distance of 1 km and 6.4 km from the nearshore transshipment buoy (**local**), respectively. This represents a local-extent impact, recurring weekly at peak production, and throughout the production phase (potentially taking place up to 31-years). As with offshore transfer operations LF cetaceans were found to be most sensitive to increased non-impulsive noise. No AUD-INJ impact zones were modelled to occur for HF and/or VHF hearing groups, however AUD-INJ was modelled to occur within 700 m of the transshipment buoy for PW hearing group species (e.g. seals). TTS-onset was however reduced for PW (2.8 km), as well as for HF (1 km) and VHF (1.1 km) cetaceans as compared to maximum impact zones modelled for LF cetaceans (6.4 km).

Modelled cumulative impact zones based on 24-hour exposure are considered conservative, with marine mammals encountered within the area of influence argued to move out of the impact zone before physical injury may occur. Marine mammals likely to be encountered within the shallower, coastal waters of the nearshore transshipment zone included Humpback whales and various dolphin species (e.g. Dusky dolphin, Heaviside's dolphin and Common dolphin) as well as seals, with a greater abundance of individuals likely encountered within the nearshore area as compared to the Venus offshore project area.

Therefore, whales and dolphins (such as Humpback as well as Common dolphins) migrating and/or breeding along the coastline and in the vicinity of the operations may be impacted by increased underwater noise. While, suggested Humpback summer feeding grounds occur in the vicinity of Lüderitz, well south of the proposed nearshore transshipment zone, migrating mother-calf pairs may pass through/nearby the nearshore transshipment operations.

The closest northern Namibian seal colony and haul out sites to the nearshore transshipment operations, are located at Conception Bay, over 120 km south, and Cape Cross, over 100 km north, well outside the modelled impact zone, however the modelled impact zones may overlap with foraging ranges.

Considering the modelled impact zones, vicinity of nearshore operations to coastal breeding and/or migratory routes, conservation status of species potentially encountered as well as higher abundance of marine mammals and seals likely to be encountered within the nearshore area, physiological and/or physical impacts on nearshore marine mammals are deemed to be of **high** intensity. Individual AUD INJ effects may be long-term potentially occurring throughout the up to 31-year production phase. However, AUD INJ impacts at the population level are considered limited, with impacts limited to LF and PW hearing groups



only, and impact zones conservatively based on 24-hour exposure. Similarly, while TTS-onset may occur throughout nearshore transshipment operations, effects are considered temporary with individual (and associated population) recovery taking place over a few hours to days following injury.

Consequently, although nearshore transshipment operations take place intermittently over 31-years, each transshipment event results in **short-term** and localised impacts. Overall, considering the local extent, high intensity and short-term nature of the effects, the potential for physical and/or physiological impacts as a result of vessel noise would thus be of **low** magnitude for the production phase.

Collision and entanglement with mooring lines (offshore and nearshore)

The proposed anchoring of the FPSO and installation of nearshore transshipment buoy could potentially disturb and/or injure large marine fauna, specifically cetaceans, through entanglement with the mooring lines/chains. Mooring and buoy lines, along with large-mesh shark nets and static fishing gear, are the primary causes of large whale entanglements (mainly Southern right and Humpback whales) in South Africa (Meÿer et al., 2011), with anchor lines accounting for 8% of entanglements of large whales since 1975 (Meÿer et al., 2011).

The potential collisions/entanglements with the mooring chains/lines of cetaceans and large marine mammals are dependent on the spatial and temporal abundance and behaviour of cetaceans in the area. Due to their extensive distributions and feeding ranges, the number of cetaceans encountered within the Venus offshore project area is expected to be low for much of the year. Bimodal peaks in abundance of species migrating northwards to their breeding grounds and on their return migrations to low-latitude feeding grounds (e.g. Humpback, Southern right, Fin and Sei whales) and winter distributions of Sperm whales off the shelf edge may, however, occur. While abundance levels and potential encounter rates may be higher within the nearshore transshipment area, the potential for collision will be reduced with fewer mooring lines installed for the nearshore mooring buoy, as compared to the offshore FPSO.

Should collisions or entanglements occur, the impacts would be of high intensity for individuals but of **medium** intensity for the population(s) as a whole, with the impacts and associated population effects potentially occurring throughout the up to 31-year production phase, and with effects reversible at the population level following the end of the production phase (**permanent**; > 25 years), and limited to the **site**.

Considering the site extent, medium intensity and permanent nature of the potential, the impact magnitude is **medium**.

Vessel collision during transit

Overall, while the potential impacts of ship strikes would be of high intensity for individuals they are argued to be of **medium** intensity for the population(s) as a whole. While vessel collisions potentially resulting in individual mortality would have irreversible effects on the affected animals, these effects will be reversible at the population level over time due to natural recovery processes. As such effects would, extend beyond the impact duration (i.e. Project lifespan), yet will be reversible over time (i.e. not permanent). Effects would be limited to the immediate vicinity of the vessel at any one time (**site**). Duration is **permanent** (>25 years), with potential population effects as a result of individual mortality extending beyond the individual impact duration. Should ship strikes occur, the impact is, therefore, considered to be of **medium** magnitude.

Decommissioning Phase

Potential physical and/or physiological impacts due to increased underwater noise (non-impulsive), as well as physical injury and/or mortality due to vessel collisions during the decommissioning phase are similar to the drilling and installation phase assessed above.



Notably, potential impact zones due to increased underwater noise will likely be reduced given the reduced number of vessels operating across the Venus offshore project area during the decommissioning phase (up to seven in total) and their respective underwater noise profiles, the AUD-INJ and TTS-onset impact zones due to non-impulsive underwater noise is thus expected to be smaller than that modelled in Scenario UC-1.

Overall, the impact magnitude for physical and/or physiological injury to marine mammals from **underwater noise** within the decommissioning phase is considered to be **very low**, based on the “worst-case” rating combinations provided below:

- **Low intensity** for non-impulsive and impulsive noise, taking into account the Venus offshore project area is located in a main marine traffic route, already experiencing increased vessel traffic and related underwater noise.
- **Medium-term duration** as impacts will be limited to the duration of decommissioning activities taking place over approximately 1.5 years.
- **Local extent** based on worse-case scenario of TTS-onset up to 21.1 km for low frequency cetaceans.

Overall, the impact magnitude for physical injury and/or mortality to marine mammals due to **collision** during the decommissioning phase is considered to be **medium**, based on the below:

- **Medium** intensity relating to the potential mortality of marine mammals due to ship strikes and/or collisions.
- **Long-term** duration, as population effects in the case of vessel strikes resulting in individual mortality and/or injury, will extending beyond the impact duration, yet will be reversible over time.
- Within/near the **site**, as animals would need to be in the immediate vicinity of the vessel at any one time.

Significance

Considering the highest (**low**) magnitude rating related to increased underwater noise in the nearshore transshipment area and the **medium** sensitivity of marine mammals, physical and/or physiological injury to marine fauna due to increased underwater noise is considered to be of **low** significance. Notably, due to reduced impact zones, fewer individuals likely encountered as well as distance from coastal feeding and breeding area, potential physiological impacts due to increased underwater noise at the Venus offshore project area, during the production phase, is assessed as **very low** magnitude and significance.

Considering the **medium** magnitude rating and the **medium** sensitivity of marine mammals due to physical and/or physiological injury from collisions and entanglement is considered to be of **medium** significance (Table 7-24).

Residual Impact

The generation of underwater noise from the drilling units, VSP as well as vessel operations cannot be eliminated due to the operating requirements of the project. Considering the mitigation measures recommended in Section 7.2.3.7, the extent of the impacted area and probability of the impact may reduce (thereby reducing the number of individuals potentially impacted). Overall, the intensity and the residual impact is therefore reduced (Table 7-24).

Considering the mitigation measures recommended in Section 0 (Table 7-27), the intensity of the impact due to collisions and entanglement is reduced to **low**, along with the magnitude and residual impact (Table 7-24).



Table 7-24: Impact rating for physical and/or physiological injury and/or mortality to marine mammals¹⁰⁷

Physical and/or Physiological Injury to Marine Mammals						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Medium	Low	Medium	Low	Medium	Low
Intensity	Medium	Low	Medium	Low	Medium	Low
Duration	Long term	Long term	Permanent	Permanent	Long term	Long term
Extent	Local	Local	Site	Site	Local	Local
Significance	Medium	Low	Medium	Low	Medium	Low
Additional Assessment Criteria						
Probability	Probable – increased underwater noise Possible – collisions and/or entanglement					
Reversibility	Fully Reversible					
Loss of resources	Low					
Degree to which impact can be avoided	Low					
Mitigation Potential	Medium					
Cumulative impacts	Likely					

7.2.4.4 Impact Assessment: Physical and/or Physiological Injury to Fish and Ichthyoplankton

Peak sound pressure levels (SPL) for impulsive noise resulting in mortality or potential mortal injury for fish eggs and larvae, and fish range from 207 - 213 dB re 1 μ Pa, with TSS in fish occurring at cumulative sound exposure levels of above 186 dB re 1 μ Pa²·s (see Table 5 in SLR Canada 2025a for details).

Sensitivity of receptor

Unlike marine mammals and fish, ichthyoplankton cannot move away from the approaching sound source and is, therefore, likely to suffer mortality and/or physiological injury within the predicted zone of impact. Potential impacts on ichthyoplankton would thus be of high intensity at close range. Major spawning areas, as well as egg and larval drift pathways of commercially important species lie inshore of the Venus offshore project area with the abundance of ichthyoplankton expected to be low as the area is removed from coastal upwelling processes, spawning and ichthyoplankton drift. However, the nearshore transshipment area, and potential impact zones, fall within the inshore spawning grounds of kob, as well as in the proximity of monkfish and hake spawning grounds, with ichthyoplankton within the nearshore area expected to be high. However, this assessment

¹⁰⁷ The highest impact ratings across all sources for each phase are shown in the table, indicating the maximum combination of intensity, extent, duration, magnitude, and significance of the associated impact, per phase.



also considers that transshipment operations occur within a major marine traffic route and near an anchoring area.

Overall, considering the above as well as sensitivity of fish as detailed in Section 7.2.3.4, the sensitivity of receptors to non-impulsive underwater noise, is considered **medium**.

Magnitude

Drilling and Installation Phase

Overall, the maximum impacts on fish and ichthyoplankton due to mortality/non-recoverable injury resulting from drilling and installation activities are considered to be of **very low** magnitude. This is based on the following ratings:

- **Medium intensity** for VSP noise (impulsive noise), as the major spawning areas, as well as egg and larval drift pathways, of commercially important species lie inshore of the Venus offshore project area and are unlikely to be impacted by the zones of impact from VSP operations. Non-impulsive noise sources (from the DPS systems used by drill units and vessels) are predicted to have no physiological impacts on fish species.
- **Short-term** duration, as VSP operations will take up to nine hours to complete approximately 250 shots. Physical impacts due to non-impulsive noise are not expected to occur based on underwater modelling results.
- Within/near **site** extent, as individuals would need to be in relatively close proximity to the operating VSP sound source to suffer physiological injury. For fish maximum distances were predicted to be in the order of 60 m and 480 m for mortality/non-recoverable injury and TTS-onset, respectively. While recoverable injury is modelled to occur within 660 m of the sound source for fish > 2 g and < 2 g. Considering exposure to a single VSP pulse, impact zones are reduced, with non-recoverable and recoverable injury both occurring within 60 m of the VSP sound source.

Underwater noise from well drilling and installation operations (non-impulsive)

Unlike marine mammals, non-impulsive noise sources (from the DPS systems used by drill units and vessels) are predicted to have no physiological impacts (both mortality and recovery injury) on fish species (SLR Consulting Canada, 2025), with no current direct evidence of mortality and/or mortal injury to fish due to non-impulsive noise sources (Popper, et al., 2014). Since non-impulsive underwater noise does not reach threshold levels to induce physiological injury, no impact is anticipated.

Underwater noise from VSP pulses (impulsive noise)

The peak pressure levels from impulsive VSP seismic pulses, may cause potential mortal injury in fish and plankton (including ichthyoplankton). The animals would, however, need to be directly adjacent to or below the VSP source to be affected. For fish maximum distances were predicted to be in the order of 60 m and 80 m for mortality/non-recoverable injury and recoverable injury, respectively, extending to 480 m for TTS-onset when considering cumulative impact zones (250 VSP discharges) (SLR Consulting Canada, 2025).

The zone of impact for ichthyoplankton to suffer mortality and non-recoverable injury is in relatively close proximity to the operating sound source (60 m). Unlike marine mammals and fish this faunal group, however, cannot move away from the approaching sound source, and is therefore likely to suffer mortality and/or physiological injury within the zone of impact. Potential impacts on ichthyoplankton would thus occur at close range (< 60 m), yet would be transient due to the highly localised (**site**) and **short-term** nature of VSP operations (intermittent over the 4-year drilling phase). The major commercial species spawning areas, as well as egg and larval drift pathways of commercially important species, all lie inshore of the Venus offshore project area, and should in no way be affected by the highly localised



VSP operations. Declines in zooplankton abundance as a result of VSP operations are therefore likely to be negligible and unlikely to affect recruitment success of commercial species or have population effects on higher order consumers. As such overall impacts are considered to be of **medium** intensity.

Considering the site extent, medium intensity and short-term nature, impacts to fish and ichthyoplankton are considered to be of **very low** magnitude.

Production Phase

Overall, the impacts on fish and ichthyoplankton due to mortality/non-recoverable injury are considered to be of **very low** magnitude. This is based on the following ratings:

- **Very low intensity** for seawater abstraction. With no impacts expected as a result of non-impulsive underwater noise, as the threshold is not reached to induce physiological injury.
- **Permanent duration**, as seawater abstraction operations will take place for up to 31-years, with impacts not extending beyond the production phase/operations, and population level effects reversible over time.
- Within/near **site extent**, as animals would need to be in relatively close proximity to the abstraction source to suffer physiological injury.

Underwater noise from offshore crude transfer/vessel operations and nearshore transshipment operations (non-impulsive)

As stated above, **non-impulsive noise from vessel DPS sources is not expected to cause mortality or potential mortal injury to fish species**. Thus, impact would be expected from the non-impulsive vessel DPS noise sources on fish species, with no cumulative impacts expected.

Seawater Abstraction offshore

Abstraction of seawater will take place throughout production activities to assist in the cooling of the process streams via a closed-loop, water-based cooling medium system. The seawater pump will supply the required seawater for cooling the medium closed-loop. Process hydrocarbon fluids will not come into contact with this seawater. While the abstracted seawater will be discharged after heat exchange with the cooling medium closed-loop (and after ensuring oil in water content is no higher than 15 mg/L and compliance IFC guideline of temperature rise <3°C at 100 m from discharge point), there will be no routine discharge of cooling medium.

During seawater abstraction, small pelagic fish species, ichthyoplankton (fish eggs and larvae), and phytoplankton may be directly affected through entrapment in the intake system, potentially resulting in injury or mortality. While the impact on individual organisms may be severe (high intensity) the overall effect at the population level is expected to be **very low** intensity, considering the major spawning grounds and larval drift pathways of commercially important species are located inshore of the Venus offshore project area and are, therefore, unlikely to be influenced by the highly localised abstraction activities (within/near **site**).

Consequently, any reduction in zooplankton abundance due to abstraction is expected to be negligible and unlikely to affect the recruitment success of commercial fish species or have cascading effects on higher trophic levels. Furthermore, large migratory pelagic fish species, which may occasionally pass through the offshore project area, are unlikely to be impacted by the abstraction process. In contrast, smaller pelagic species may be more susceptible.

Overall, the impact of seawater abstraction is assessed to be of **very low** magnitude, with impacts (and potential effects) extending throughout production activities (taking place for up to 31-years (i.e. **permanent** duration), yet not extending beyond these activities with population effects reversible over the short-term following the end of operations.



Collision and entanglement with mooring lines

Entanglement of fish with mooring lines and chains is considered highly unlikely, with negligible / no population-level impact expected.

Decommissioning Phase

As with underwater noise from well drilling and installation operations (non-impulsive) physical and/or physiological injury to fish and ichthyoplankton from underwater noise (non-impulsive) within the decommissioning phase are predicted to have no physiological impacts (both mortality and recovery injury) on fish species (SLR Consulting Canada, 2025), with no current direct evidence of mortality and/or mortal injury to fish due to non-impulsive noise sources (Popper, et al., 2014).

Significance

Considering the overall **very low** magnitude rating for the drilling and installation, as well as production phase, and **medium** sensitivity of receptors, physical and/or physiological injury to marine fish and ichthyoplankton is considered to be of **very low** significance (Table 7-25).

Residual Impact

The generation of noise from VSP, abstraction of seawater and underwater noise cannot be eliminated due to the operating requirements of the project. Considering the mitigation measures recommended in Table 7-21, the impact intensity related to increase underwater noise from VSP operations (impulsive noise) will be reduced. Notably, while mitigation measures recommended in Section 0, such as fitting of seawater intakes with grids, will assist to reduce the impacts related to seawater abstraction, the impact intensity remains very low. The overall residual impact significance remains **very low** (Table 7-25).

Table 7-25: Impact rating for physical and/or physiological injury and/or mortality to fish and ichthyoplankton¹⁰⁸

Physical and/or Physiological Injury to Fish and Ichthyoplankton				
Type of Impact	Direct & Indirect			
Nature of Impact	Negative			
Phase	Drilling & Installation		Production	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium			
Magnitude	Very Low	Very Low	Very Low	Very Low
Intensity	Medium	Low	Very Low	Very Low
Duration	Short-term	Short-term	Permanent	Permanent
Extent	Site	Site	Site	Site
Significance	Very Low	Very Low	Very Low	Very Low
Probability	Possible			
Reversibility	Fully Reversible			
Loss of resources	Low			
Degree to which impact can be avoided	Medium			

¹⁰⁸ The highest impact ratings across all impact sources per phase are shown in the table, indicating the maximum intensity, scale, duration, consequences, and significance of the associated impact, per phase.



Physical and/or Physiological Injury to Fish and Ichthyoplankton	
Mitigation Potential	Medium
Cumulative impacts	Likely

7.2.4.5 Impact Assessment: Physical and/or Physiological Injury to Turtles

Sensitivity of receptor

Unlike adult individuals, turtle hatchlings cannot move away from the sound source and are, therefore, likely to suffer physiological injury within the predicted impact zone. Potential impacts on hatchlings would thus be of high intensity at close range. However, nesting beaches offshore the KwaZulu Natal coastline on the east coast of South Africa, and to the north in Angola, are located far from the Venus offshore project area and nearshore transshipment area. While hatchlings can swim to influence their dispersal trajectories, they are not powerful swimmers. Consequently, hatchlings off the East Coast of South Africa will primarily drift in a south-west direction, influenced by the Agulhas Current, some of which may be distributed up the West Coast into southern Namibia through mass transport of Agulhas Current water into the southeast Atlantic. Overall, Leatherback abundance in the offshore project area is unknown, but expected to be low, with seasons of increased adult and neonate turtle's numbers anticipated.

Overall, considering the above as well as sensitivity detailed in Section 7.2.3.5, the sensitivity of turtles, likely to be encountered within the Venus offshore project area and nearshore transshipment area, to increased underwater noise and due to physiological and physical injury due to vessel/mooring chain and lines strikes/collisions is considered to be **medium**.

Magnitude

Drilling and Installation Phase

Overall, the maximum impact magnitude of physical and/or physiological injury to turtles due to **underwater noise** from drilling/vessel (non-impulsive) and VSP operations (impulsive) is considered to be of **very low** magnitude. This is based on the below ratings:

- **Low intensity** for impacts due to non-impulsive and impulsive noise (VSP) as turtle numbers are expected to be low and the PEL0056/Block 2913B is located in a main marine traffic route experiencing increased vessel noise. Furthermore, being mobile, it is unlikely that marine fauna in the offshore habitat of would stay in the same location for the entire period and are likely to move away from the sound source before injury occurs.
- **Medium-term** duration with regards to increased underwater noise, as installation and drilling will take place over a period of up to 4 years.
- **Local extent**, for non-impulsive noise as TTS-onset zones can be expected within to 1.6 km (local) during peak vessel activity (i.e. installation campaigns), reducing to 500 m during drilling operations only.

Overall, the impact magnitude of physical injury and/or mortality to turtles due to potential **vessel strikes/collisions** is considered to be of **medium** magnitude. This is based on the following “worst-case” ratings combination provided below ratings:

- **Medium intensity** for vessel strikes/collisions on the population(s) as a whole.
- **Long term duration** as population effects in the case of vessel strikes resulting in individual mortality, will extend beyond the impact duration, yet will be reversible over time.



- Within/near **site extent**, as impacts would be restricted to the immediate vicinity of the vessel in the case of vessel collisions and/or strikes.

These ratings are discussed for each project aspect below.

Underwater noise from well drilling and installation operations (non-impulsive)

Considering the various underwater noise modelling scenarios, related to drilling operations (Scenario UD-1; three drilling rigs and associated support and supply vessels operating concurrently in close proximity) and installation campaigns (UC-1 and UC-2), as previously described and outlined in Section 7.1.1 TTS may occur within a maximum of 1.6 km for sea turtles if exposed to 24-hours of non-impulsive noise under Scenario UC-2 (i.e. maximum vessel concentration at the offshore development area)(SLR Consulting Canada, 2025). Notably, TTS-onset zones were reduced to 500 m under Scenarios UD-1 and UC-1 (Section 7.1.1). Being highly mobile, mature individuals would be expected to move away from the sound source before trauma could occur. AUD-INJ was not modelled to occur under any of the above scenarios.

However, as discussed above, hatchlings have limited mobility and are unable to actively avoid the sound source. As a result, they may remain within the modelled impact zones for longer durations, increasing the likelihood of experiencing TTS under continuous exposure conditions. Despite this, the zone within which hatchlings may suffer physiological injury remains relatively close to the operating sound source (within 1.6 km at peak operations, reducing to 500 m throughout the majority of the drilling and installation phase). Seasons of increased numbers of neonate turtle's may be anticipated, based on recent simulations (see Section 5.5.3.4). As such should hatchlings and/or neonates be within the modelled impact zones potential impacts would thus be of **high** intensity at close range.

The number of turtles encountered in the Venus offshore project area is expected to be low (as detailed in Section 5.5.3.4). Additionally, the block is located far offshore of key turtle breeding areas along the KZN (> 1 000 km southeast) and Angolan (> 1 000 km north) coastlines. Considering their ability to move away from the source before trauma could occur and the low abundance in the Venus offshore project area, as well as seasonality of potential increased neonate numbers, the intensity of potential physiological injury on the population due to non-impulsive underwater noise is **low**. Effects would remain over the **medium-term** and **local** extent (maximum 1.6 km from the source). The impact of non-impulsive underwater noise generated during drilling is thus considered of **very low** magnitude.

Underwater noise from VSP pulses (impulsive noise)

For turtles, the cumulative impact from impulsive underwater noise (250 VSP discharges) will result in AUD INJ and TTS onset at maximum distances of 60 m and 220 m, respectively. As with marine mammals, turtles in the offshore habitat of the development area are unlikely to stay in the same location for the entire 9-hour period. As such, cumulative effects would not be expected, with the worst-case, cumulative scenario modelled being highly conservative.

Notably, AUD INJ and TTS onset were modelled to occur within 20 m and 40 m, respectively when exposed to a single VSP pulse.

Overall, the effects on turtles resulting from noise generated during VSP, are considered to be of **low** intensity for the population. Effects would, be restricted to within/near the **site** for the **short-term** duration of the VSP activities (9 hours per well). The impact of underwater noise generated during VSP is thus considered of **very low** magnitude.

Collision (during transit)

Overall, while the potential impacts of ship strikes would be of high intensity for individuals they are argued to be of **medium** intensity for the population(s) as a whole considering the low population numbers and 'Critically Endangered' and 'Near Threatened' status of species



potentially impacted (e.g. Leatherback and Loggerhead), while keeping in mind the low abundance expected within the Venus offshore project area and distance from key breeding beaches. Although the expected abundance of these species is expected to be low, the loss of individual(s), taking into account the globally and regionally low population numbers, would result in population-level impacts. As such, effects would extend beyond the impact duration/exposure. While vessel collisions potentially resulting in individual mortality would have irreversible effects on the affected animals, these effects will be reversible at the population level over time due to natural recovery processes (i.e. **long term**). Effects would be limited to the immediate vicinity of the vessel at any one time (**site**).

Should ship strikes occur, the impact is, therefore, considered to be of **medium** magnitude.

Production Phase

Overall, the maximum impact magnitude for physical and/or physiological injury to turtles due to underwater noise and seawater abstraction is considered to be **low**, based on the below:

- **Low intensity** for non-impulsive noise taking into account the low number of individuals likely to be encountered during project activities. Notably, being highly mobile, it is unlikely that marine fauna would stay in the same location for the entire period and are likely to move away from the sound source before injury occurs. Impacts due to offshore seawater abstraction, largely limited to neonate turtles and hatchlings, is considered to be of **very low** intensity.
- **Short-term duration** for impacts related to increased underwater noise, as physical (and physiological) impacts due to TTS-onset would be temporary, with individual and population-level effects and associated recovery expected over the short-term. **Permanent duration** for impacts related to seawater abstraction, as production operations will take place for up to 31-years. Impacts will not extend far beyond the production phase with population level effects reversible over time.
- Within/near **site**, based on worst-case scenario of TTS-onset within 600 m for 24 hours exposure. Animals would need to be in relatively close proximity to production infrastructure to suffer injury through seawater abstraction.

Overall, the impact magnitude for physical injury and/or mortality to turtles due to **collisions and entanglement** is considered to be **medium**, based on the below:

- **Medium intensity** for mooring line collision/entrapment (at both Venus offshore and nearshore transshipment areas) and vessel strikes / collisions taking into account the low number of individuals likely to be encountered as well as low global population numbers of the species potentially impacted.
- **Permanent duration**, as production operations will take place for up to 31-years. Impacts will not extend far beyond the production phase with population level effects reversible over time.
- Within/near **site**, as animals would need to be in relatively close proximity to FPSO and nearshore mooring sites to suffer injury/mortality through entanglement/collision with mooring chains/lines or in the immediate vicinity of the transiting vessel in the case of vessel collisions and/or strikes.

These ratings are discussed for each project aspect below.

Underwater noise from offshore crude transfer/vessel operations (non-impulsive)

Considering the underwater noise modelling Scenario UP-1, as previously described and outlined in Section 7.1.1 TTS may occur within a maximum of 15 m for sea turtles if exposed to 24-hours of non-impulsive noise (SLR Consulting Canada, 2025). Notably, non-impulsive noise levels were not found to result in AUD-INJ impacts. Being highly mobile, mature



individuals would be expected to move away from the sound source before trauma could occur.

However, as discussed above, hatchlings have limited mobility and are unable to actively avoid the sound source. Despite this, the zone within which hatchlings may suffer physiological injury remains relatively close to the operating sound source (within 15 m; site). Potential individual-level impacts on hatchlings would thus be of high intensity at close range, yet the number of hatchlings likely to be encountered within the impact zone if considered to be low, thus resulting in a low intensity impact (as outlined below).

As for increased underwater noise during drilling and installation operations, the intensity of potential physiological injury due to non-impulsive underwater noise as a result of offshore transfer operations is **low**. Exposure would be limited to offshore transfer operations only and occur within the immediate vicinity of the FPSO and transfer operations (maximum 15 m from the source; **site**). Overall, TTS effects are temporary, with individual and associated population-level effects / recovery likely occurring over the **short-term**, following each individual transfer operation, and with long-term cumulative impacts not anticipated, taking into account the intermittent nature of transfer operations.

Considering the site extent, low intensity and short-term nature, impact magnitude is **very low**.

Underwater noise from nearshore transshipment operations (non-impulsive)

Modelling results indicate that non-impulsive underwater noise generated during nearshore transfer operations may result in TTS-onset within 600 m of the source (**site**), with no AUD-INJ expected.

Overall, the intensity of non-impulsive noise impacts on turtle is, therefore, considered to be of **low** intensity, considering both the main marine traffic routes within the vicinity of the nearshore area and the species mobility. Impacts would be restricted to the immediate vicinity of the nearshore transshipment operation (**site**). The duration of potential effects would be **short-term**, limited to each intermittent transshipment operation, with individuals and population-level recovery anticipated following the end of transshipment operations,

Considering the site extent, low intensity and short-term nature, impact magnitude is **very low**.

Seawater Abstraction offshore

As described in Section 7.2.4.4, seawater abstraction may result in physical injury and, in the worst-case scenario, mortality of small pelagic fish species, ichthyoplankton, and phytoplankton present within the area of impact. Similarly, small hatchlings that may occur in the offshore project area could become entrapped and injured during abstraction activities.

Considering the low likelihood of encountering hatchlings offshore, potential impacts are considered to be of **very low** intensity. These impacts are expected to be highly localized, restricted to the immediate vicinity of the abstraction **site** and limited to the production phase of the project (**permanent**). Overall impacts due to seawater abstraction are considered to be of **very low** magnitude.

Vessel collision during transit

Overall, while the potential impacts of vessel collision during transit would be of high intensity for individuals they are argued to be of **medium** intensity for the population(s) as a whole considering the low population numbers and 'Critically Endangered' and 'Near Threatened' status of species potentially impacted (e.g. Leatherback and Loggerhead), while keeping in mind the low abundance expected within the offshore development field and distance from key breeding beaches. Effects would, however, extend beyond the impact duration/exposure, with impacts potentially occurring throughout the project timeline (**permanent**) and with the loss of individuals resulting in population-level impacts. While



vessel collisions potentially resulting in individual mortality would have irreversible effects on the affected animals, these effects will be reversible at the population-level over time due to natural recovery processes. Effects would be limited to the immediate vicinity of the vessel at any one time (**site**).

Should ship strikes occur, the impact is therefore considered to be of **medium** magnitude.

Collision and entanglement with mooring lines

The potential collisions/entanglements with the mooring chains/lines of turtles are dependent on the spatial and temporal abundance and behaviour of the species in the area. As previously outlined, while the abundance of Leatherback and Loggerhead turtles in the offshore project area is unknown, it is expected to be low, with seasonal increases in neonate and hatchling presence. Similarly encounters within the nearshore transshipment area may occur however the abundance/likelihood is considered to be low, with adult species largely encountered south of Walvis Bay, offshore Lüderitz, in deeper waters.

As such, should collisions or entanglements occur, the impacts would be of high intensity for individuals but of **medium** intensity for the population(s) as a whole. Impacts and associated population-level effects may occur throughout the production phase (**permanent**, >25 years). Notably, while impacts to individuals are irreversible, population-level impacts will not extend far beyond these activities with population effects reversible over the long-term, and limited near to the **site**, resulting in a **low** magnitude impact.

Decommissioning Phase

Potential physical and/or physiological impacts due to increased underwater noise (non-impulsive), as well as physical injury and/or mortality due to vessel collisions during the decommissioning phase are similar to the drilling and installation phase assessed above.

Overall, the impact magnitude of physical and/or physiological injury to turtles due to underwater noise from drilling/vessel operations is considered to be of **very low** magnitude. This is based on the below ratings:

- **Low** intensity for impacts due to non-impulsive underwater noise.
- **Medium-term** duration with regards to increased underwater noise, as decommissioning activities will take place over approximately 1.5 years.
- **Local** extent, for non-impulsive noise as TTS-onset zones can be expected to be within less than 1.6 km (local).

Overall, the impact magnitude of physical injury and/or mortality to turtles due to potential vessel strikes/collisions is considered to be of **medium** magnitude. This is based on the following “worst-case” ratings combination provided below ratings:

- **Medium** intensity for vessel strikes/collisions.
- **Long term** duration as population effects in the case of vessel strikes resulting in individual mortality and/or injury, will extending beyond the impact duration, yet will be reversible over time.
- Within/near **site extent**, as impacts would be restricted to the immediate vicinity of the vessel in the case of vessel collisions and/or strikes.

Significance

Considering the highest impact magnitude rating related to increased underwater noise (production phase; **low**) and **medium** sensitivity of receptors, physical and/or physiological injury to turtles is considered to be of **low** significance (Table 7-26).



Considering the greatest impact magnitude rating (**medium**) and **medium** sensitivity of receptors, physical injury and/or mortality to turtles due to collisions, entanglement and seawater abstraction is considered to be of **medium** significance (Table 7-26).

Residual Impact

The generation of noise from the drilling units, project and support vessels and VSP cannot be eliminated due to the operating requirements of the project. Considering the mitigation measures recommended in Section 0, including reduction in vessel speeds and surveillance by vessel captains, the intensity the impact will likely reduced.

Considering the mitigation measures recommended in Section 0, the probability of collisions and/or seawater abstraction may reduce. The intensity will be reduced to **low**, with the residual impact reducing to **low**.

Table 7-26: Impact rating for physical and/or physiological injury and/or mortality to turtles¹⁰⁹

Physical and/or Physiological Injury to Turtles						
Type of Impact	Direct					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Medium	Low	Medium	Low	Medium	Low
Intensity	Medium	Low	Medium	Low	Medium	Low
Duration	Long term	Long term	Permanent	Permanent	Long term	Long term
Extent	Local	Local	Local	Local	Local	Local
Significance	Medium	Low	Medium	Low	Medium	Low
Additional Assessment Criteria						
Probability	Probable – increased underwater noise Possible – collisions and/or entanglement					
Reversibility	Fully Reversible					
Loss of resources	Low					
Degree to which impact can be avoided	Low					
Mitigation Potential	Medium					
Cumulative impacts	Likely					

¹⁰⁹ The highest impact ratings across all impact sources, per phase, are shown in the table, indicating the maximum intensity, scale, duration, consequences, and significance of the associated impact, per phase.



7.2.4.6 Mitigation and Management Measures

The same project controls and mitigation measures related to underwater noise listed in Section 7.2.3.7 are applicable for the impact of physical and/or physiological injury to marine fauna.

Table 7-27 lists the additional mitigation measures to reduce and or mitigate potential impacts to marine fauna due to vessel collisions. Table 7-28 lists the recommended mitigation measures to reduce and or mitigate potential impacts to pelagic fauna due to seawater abstraction. No mitigation measures are recommended to reduced or mitigate impacts due to potential collisions and/or entanglement with mooring lines.

Table 7-27: Mitigation to reduce impacts of vessel collisions with marine fauna.

No.	Mitigation measure	Classification
1	Keep a constant watch from all vessels (Vessel Captain and crew) for cetaceans and turtles in the path of the vessel. Alter course of vessels in transit and avoid animals when necessary.	Abate on site
2	During normal operations ensure vessel transit speed between the drill area and port remain within operational speed limits: - Supply vessel: 10-13 knots - Fast supply vessel: 17-20 knots Reduce speed to operational speed range minimums within 25 km of the coast.	Avoid/reduce at source
3	Report any collisions with large whales to the International Whaling Commission (IWC) database, which has been shown to be a valuable tool for identifying the species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk (Jensen & Silber 2003).	Repair or restore
4	Ensure that vessel paths avoid breeding areas or migration routes during peak migration or breeding times of year, if possible.	Avoid/abate on site
5	No hovering or circling of aircraft over whales, or other marine megafauna.	Avoid/abate on site
6	Educate and create awareness with mariners about collision risks	Avoid/abate on site
7	Application of the measures noted within BOEM (2020) with regard to vessel strike, including: - Maintain a vigilant watch for marine mammals and turtles, if sighted, vessel speed is reduced - If whale species are sighted a distance of 91 m (or greater) is maintained - If marine turtles or cetaceans are sighted, a distance of 45 m (or greater) is maintained - Attempt to remain parallel with animals course, avoiding excessive speed or directional changes - Reduce vessel speeds to 10 knots should mother and calf pairs be encountered.	Avoid/abate on site

Table 7-28: Mitigation to reduce impacts of seawater abstraction offshore.

No.	Mitigation measure	Classification
1	Fit seawater intakes (e.g. for cooling or ballast) with grid system, featuring bars spaced approximately 50 mm or equivalent, to prevent entrainment of small fish and turtle hatchlings.	Avoid/reduce at source
2	Regularly inspect and maintain grid systems to ensure effectiveness	Avoid/reduce at source



7.3 Fisheries Impacts

7.3.1 Impacts to Fisheries and /or Mariculture Operations

7.3.1.1 Source of Impact

The following project aspect may cause the displacement of fishing vessels and changes in resource availability that may affect potential catch:

Aspect	Drilling & Installation	Production	Decommissioning
Implementation of safety zones (i.e. Maritime Restricted Area)	X	X	X
			X
Underwater noise from vessel and drilling operations (non-impulsive)	X	X	X
Underwater noise from vertical seismic profiling operations (impulsive)	X		
Discharge of treated drill cuttings from the drilling unit	X		
Discharges to sea from FPSO, DPST and vessels		X	

Project Controls

As per the project description, the following project controls that will reduce impacts on fisheries are already proposed as part of the project description (but are also captured in the ESMP). Implementation thereof has thus been considered in the pre-mitigation impact rating:

All Phases:

- Compliance with COLREGS (Convention on the International Regulations for Preventing Collisions at Sea) and SOLAS (the Convention for Safety of Life at Sea). Specifically, in terms of Part A, Rule 18 of COLREGS (1972), a power-driven vessel underway shall keep out of the way of a vessel restricted in her ability to manoeuvre.
- Compliance with the Marine Traffic Act, 1981 (No. 2 of 1981) (and as amended by the Marine Traffic Amendment Act 5 of 1983, the Marine Traffic Amendment Act 5 of 1991, and the Namibian Port Authority Act 2 of 1994), in which a vessel used for the purpose of exploiting the seabed and any installation which is used for the transfer of oil to or from a ship, and includes any exploration or production platform, falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone.
- Enforcement of a Maritime Exclusion Area (3 NM around subsea infrastructure and FPSO) and Maritime Restricted Area (10 NM around the FPSO) throughout the Project timeline, which will be described in a Notice to Mariners as a navigational warning.
- See Section 7.2.2.1 for project controls that will be implemented with regards to discharges to sea across all phases, during well drilling and installation of well infrastructure as well as throughout production operations.

Decommissioning activities:

See Section 7.2.1.1 for details of the project controls related to Decommissioning



7.3.1.2 Impact Description

Displacement of Fishing Vessels

The following project aspect may cause the displacement of fishing vessels:

- Implementation of safety zones (i.e. Maritime Restricted Area); and
- Infrastructure on seabed.

Maritime Exclusion Area and Maritime Restricted Area

The drilling units, FPSO and moored DPST and conventional tanker are considered to be 'offshore installations' and during drilling / operation there would be a minimum safety zone of 500 m around these vessels (0.79 km²). Similarly, a vessel engaged in the laying, servicing, or picking up of pipeline and/or engaged in underwater operations is considered a 'vessel restricted in her ability to manoeuvre'. As such, a minimum 500 m safety zone is also applicable around all installation and construction vessels engaged in installation and construction activities and working throughout the Venus offshore project area as per COLREGS, SOLAS and the Marine Traffic Act, 1981.

Throughout the Venus development project, multiple drilling units, installation construction vessels, and operational vessels (DPST and conventional tanker) along with the FPSO, each with their own safety exclusion zones, will operate across the project area, as summarized in Table 7-29.

Table 7-29: Overview of vessel types and operations associated with each phase of the Project.

Phase	Vessels
Drilling and Installation Phase	
Well drilling operations only	• Three drilling units • Three supply vessels (one per drilling unit) • One support vessel (on standby within the larger Venus offshore project area)
First Installation campaign (<i>concurrent well drilling and installation of subsea equipment at the Venus offshore project area</i>)	• Seven vessels, as per well drilling operations • Three installation vessels • Three supply vessels for the installation vessels
Second Installation campaign (<i>well drilling, subsea equipment installation and FPSO arrival at the Venus offshore project area</i>)	• Two drilling units • Two associated supply vessels (one per drilling unit) • One drilling support vessel • Three installation vessels • Three installation supply vessels (one per installation vessel) • One medium construction vessel • Four Anchor Handling Tugs (AHT)
Production Phase	
Offshore transfer operations (<i>transfer of oil from FPSO to DPST at the Venus offshore project area</i>)	• One DPST vessel • One support vessel • One moored FPSO
Nearshore transshipment operations (<i>transfer of oil from DPST to conventional tanker at nearshore location</i>)	• One DPST (moored) • One conventional tanker (moored in tandem) • Three port tugs using DPS and supporting the conventional tanker positioning.



Phase	Vessels
Decommissioning	
Offshore decommissioning activities (at the Venus offshore project area)	• One drill unit • One tug • One heavy construction vessel • One medium construction vessel • Two associated supply vessels • One support vessel

For consistency, throughout all phases and to account for the combined vessel presence and movement, TEEPNA will request a larger **Maritime Exclusion Area and Maritime Restricted Area**¹¹⁰ around the Venus offshore project area for the duration of the Project (i.e. all phases) (see Table 4-1 and Figure 4-11). The proposed Maritime Exclusion Area is 3 NM around subsea infrastructure and FPSO (542 km²), while the proposed Maritime Restricted Area is 10 NM around the FPSO (1 078 km²).

These larger exclusion / restricted areas are proposed to prevent possible damage to and entanglement with subsea infrastructure, project vessels and/or drilling units, as well as disruptions to operations and potential damage to third party vessels and/or equipment. The larger **Maritime Restricted Area of 1 078 km²** is considered for this assessment for the duration of the project (maximum 35 years) (Figure 4-11).

Vessels operating in the large pelagic longline sector set mainlines that may be up to 100 km in length. Once deployed, the line is left to drift in surface water currents for several hours before retrieval. The fishing gear, therefore, covers a large area during this time and risks entanglement around stationary and slow-moving project vessels, particularly the FPSO and drilling units, if gear is set nearby. The potential area of avoidance/exclusion for the pelagic longline fishery would, therefore, need to extend beyond the proposed Maritime Restricted Area around the Venus offshore project area and FPSO to avoid gear entanglement with the stationary and/or slow-moving vessels. Based on an assumed average line length of 60 km, operators could reasonably be expected to avoid setting lines within a distance of 30 km/16 NM of the operations. Consequently, an extended effective exclusion zone of 4 562.86 km² (encompassing the Venus offshore project area, FPSO and an additional 30 km/16 NM buffer) is considered for this fishery for the lifetime of the Project.

All unauthorised vessels would be excluded from entering the relevant maritime exclusion and restricted areas whilst the drilling units, installation, construction and production vessels, are on site (i.e. throughout the project). The exclusion of fisheries from these zone(s) will result in the displacement of fishing effort into alternative areas or, if no alternative areas are available, the loss of catch (direct negative impact).

With the transshipment buoy located ~5km from the coast, nearshore transshipment operations could take place at ~4 km of the coast considering the weathervaning of the tankers, with other vessels expected to remain outside of a 1.7 km safety exclusion zone around the mooring buoy (1.2 km transshipment zone and 500 m safety exclusion zone), resulting in an effective exclusion area of **9.1 km²**, during nearshore transshipment

¹¹⁰ The final restrictions of the maritime restricted area will be designated at a later stage, in collaboration with maritime authorities and other relevant stakeholders. A triage approach will be adopted, applying varying levels of exclusion and restrictions on vessel activity within different zones of the proposed area. However, for the purposes of this assessment, a conservative approach has been taken—assuming that all fishing activities will be excluded from the entire maritime restricted area for the full duration of the project.



operations. Figure 4-29 shows the safety exclusion zone, applicable to all vessels, during nearshore transshipment operations¹¹¹.

Permanent abandonment of infrastructure on seabed

Although wellheads will be abandoned on the seafloor, the removal of seabed installations, including risers, flowline and ILT/FLET, jumpers, Xmas-tree, umbilicals, and mooring piles, will be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed.

The abandonment of wellheads, and possibly subsea infrastructure, on the seafloor could pose an obstruction to fishing activity directed towards the seabed (specifically the demersal trawl sector). The demersal trawl sector would be required to trawl around or lift nets off the seabed to avoid the abandoned wellheads or infrastructure (to avoid damage to their trawl gear). Reducing fishing grounds for this sector, assuming overlap, could result in a potential reduction in catch and damage to fishing gear (economic cost) (direct negative impact).

Considering historical fishing data, there is no demersal trawl fishing effort within the Licence Block or Venus offshore project area, thus impacts on this sector are unlikely. Similarly demersal trawl fishing activities do not overlap with the nearshore transshipment area, taking place in waters deeper than 100 m. Although the demersal long-line and deep-sea crab sectors, which also sets its gear on the seafloor, would be permitted to set lines over abandoned wellheads and infrastructure, there is also no evidence of fishing effort in the Venus offshore project area and/or nearshore transshipment area. Therefore, the permanent abandonment of infrastructure on the seabed following decommissioning activities will have **NO IMPACT** on commercial fisheries. Furthermore, there will be **NO IMPACT** in the nearshore transshipment area for any infrastructure abandoned on the seafloor. As such, the potential impacts related to the abandonment of infrastructure on the seabed are not assessed further.

Changes in Resource Availability that may affect Potential Catch

The project aspects that may result in changes in target species availability to each specific fishery affected due to induced behavioural responses from fish include:

- Underwater noise from vessel and drilling operations (non-impulsive);
- Underwater noise from vertical seismic profiling operations (impulsive);
- Discharge of treated drill cuttings from the drilling unit; and
- Discharges to sea from FPSO, DPST and vessels.

In order to assess the impacts related to increased underwater noise and drilling discharges, modelling studies were undertaken to determine the zones of impact. The results from these studies, which are summarised in Section 7.1, were used to inform the descriptions and assessment below.

For this assessment, underwater noise is separated into non-impulsive and impulsive noise. Non-impulsive noises (e.g. drilling and vessel engines) are typically continuous and produce sounds that can be narrowband, or tonal, and brief or prolonged. It does not have the high peak sound pressure with rapid rise time typical of impulsive sounds. Impulsive noises (e.g.

¹¹¹ As with the offshore marine restricted area, the final safety exclusion zone and relevant vessel restrictions will be determined in collaboration with maritime authorities as well as relevant stakeholder consultation. As such as conservative approach has been applied within this study, assuming all fishing operations are excluded from the nearshore transshipment area and associated 500 m safety exclusion zone for the full duration of production activities.



noise from vertical seismic profiling) are typically very short (in seconds), broadband and have high peak pressure with rapid time and decay back to ambient levels.

As most targeted fish species likely to be encountered within the licence area are highly mobile, they would be expected to respond by avoiding the sound source before trauma could occur. However, this assessment is based on the assumption of the worst-case scenario that the animal does not move away from the noise source.

Underwater noise from vessel (drilling, installation and production) and drilling operations (non-impulsive)

Depending on the received sound level, noise could impact fish by:

- Causing direct physical injury to hearing or other organs, including Audible Injury (AUD INJ¹¹²) or temporary threshold shifts (TTS¹¹³) in hearing;
- Masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey); and
- Causing disturbance to the receptor resulting in behavioural changes including displacement from fishing grounds, important feeding or breeding areas.

The presence and operation of the project vessels, including drilling units, FPSO, DPST, conventional tanker and support vessels operating in the Venus offshore project area and nearshore transshipment area will introduce a range of underwater noises into the surrounding water column during the drilling, installation, production and decommissioning phases that may potentially contribute to and/or exceed ambient noise levels in the area.

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön, 2012). The main frequencies of noise generated by DPS would be less than 0.2 kHz. The noise generated by vessels and well drilling operations in general, therefore, falls within the hearing range of most fish, including target species of the large pelagic longline sector operating within the Venus offshore project area, as well as linefish and SSF sectors operating within the vicinity of the nearshore transshipment area, and would be audible for considerable ranges before attenuating to below threshold levels.

The potential for underwater noise to be generated by helicopters is limited as broadband noise levels underwater due to helicopters flying at altitudes of 150 m or more are expected to be around 109 dB re 1 μ Pa (Richardson W. J., et al., 2013) at the most noise-affected point. This noise level is considerably less than the underwater noise generated by support and operational vessels or the drilling platform and can be considered negligible in terms of the overall noise levels.

Underwater noise from VSP operations (impulsive)

VSP is a standard method used during well logging and can generate noise that could exceed ambient noise levels. A VSP is expected to take up to 9 hours and ~250 shots per well to complete, depending on the well's depth and number of stations being profiled. The source levels for the VSP G-Gun II array show a zero-to-peak sound pressure level (PK) of $L_{p,pk}$ 247 dB re 1 μ Pa @ 1 m, a root-mean-square sound pressure level (SPL) of $L_{p,rms}$ 236 dB re 1 μ Pa @ 1 m and a sound exposure level (SEL) of L_E 222 dB re 1 μ Pa²·s.

¹¹² If damage occurs to the inner ear that can lead to tissue destruction, the effect is called auditory injury (AUD INJ) and may or may not result in permanent hearing loss or permanent threshold shift (PTS).

¹¹³ A temporary threshold shift (TTS) is a shift in the auditory threshold, which results in temporary hearing impact.



The potential impacts from impulsive noise are as described for non-impulsive noise above (physiological injury, masking and behavioural disturbance).

Discharge of treated drill cuttings to the water column

The discharge of treated cuttings from the drilling unit during the risered drilling stage would have both direct and indirect effects on marine fauna within the fallout footprint of the cuttings plume discharged from the drilling unit. These impacts on marine fauna have been assessed in the marine ecology assessment (see Section 7.2.2).

The effects of discharges into the water column could lead to avoidance of the plume, toxic effects on pelagic communities and associated trophic level cascade effects which could affect normal feeding patterns of certain fish species. This could have an impact on the large pelagic longline sector operating in the Venus offshore project area and associated impact area (i.e. area impacted by produced water discharge) through the reduction in catch rates and/or displace fishing effort.

Discharge of produced water to sea from FPSO

The effects of produced water discharges into the water column could lead to avoidance of the plume, toxic effects on pelagic communities and associated trophic level cascade effects which could affect normal feeding patterns of certain fish species. This could have an impact on large pelagic longline sector that operate in the area through the reduction in catch rates and/or an displace fishing effort.

Notably, this product water contains hydrocarbons at varying concentrations, which if released overboard without treatment would have determinantal effects on water quality and potential toxic direct and indirect effects on marine fauna. These potential impacts on marine fauna have been assessed in Section 7.2.2 above.

7.3.1.3 Impact Assessment: Impact on Large Pelagic Longline Sector

Section 5.7.5.2 provides an overview of the Namibian fishing industry and describes each commercial sector. The affected fisheries have been identified based on the overlap of fishing grounds with estimated impact zones related to vessel displacement and behavioural disturbance of fish due to drilling, installation, production and decommissioning operations.

The **large pelagic longline sector** is the only fishery operating within the Venus offshore project area and the estimated zones of impact for exclusion, noise and discharges, because of drilling, installation, production and decommissioning operations, and is thus assessed in detail below. There is expected to be **NO IMPACT** because of the proposed Project activities (normal operations) at the **Venus offshore project area** on the other fisheries sectors (including small-scale fishers), and mariculture operations.

Sensitivity of receptor

Sensitivity and intensity herein consider the extent of the fishing ground, the ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations (linked in part to fishing gear type and vessel manageability), as well as the vulnerability of the targeted fish species.

Vessels in the large pelagic longline sector set a mainline up to 100 km in length, which drifts in surface water currents for several hours before retrieval. During this time, the gear may cover a large area and potentially entangle around the drilling units and/or FPSO as well as potentially interfere with the operations of construction and installation vessels operating across the Venus project area.

Fish without swim bladders and crustaceans are less susceptible to noise-induced reaction on behaviour than fish with swim bladders. However, the target species of the large pelagic



longline fishery (*Thunnus spp.*) do have swim bladders (Collette & Nauen, 1983) and so may be more vulnerable to behavioural disturbance.

Due to these factors, the sensitivity of the large pelagic longline sector is considered to be **medium**.

Magnitude

Drilling and Installation Phase

Overall, the impact magnitude to the large pelagic longline fishery, due to drilling and installation activities, as well as the maritime restricted area, is considered to be **low**. This is based on the following overall ratings:

- **Low** intensity resulting from the enforcement of the maritime restricted area and effective exclusion zone as the potential disruption to fishery operations is considered a minor disturbance given that the project area is not a key fishing ground and the fishery could focus efforts elsewhere for the duration of the drilling and installation activities. Very Low intensity for behavioural disturbance as the potential disruption to target species is considered a minor disturbance as the behavioural/ displacement impact zones due to increased underwater noise and/or drilling discharges fall within the effective exclusion zone and outside of key spawning and recruitment areas.
- **Regional** extent: as the impact zones related to exclusion (maximum 30 km buffer around the Venus offshore project area equalling 4 562.86 km²) extend beyond PEL0056/Block 2913B. Behavioural disturbance (maximum 5.5 km) and drilling discharges (maximum 27 km) are confined within PEL0056/Block 2913B and nearby surrounds (local).
- **Medium-term** duration: as the impacts are unlikely to continue after the drilling and installation operations/phase, which are expected to take place over a four-year period.

These ratings are discussed for each project aspect below and summarized in Table 7-31.

Implementation of maritime restricted area (offshore)

The maritime restricted area (1 078 km²) and extended pelagic longline exclusion zone (4 562.86 km²) detailed in Table 4-1 and Section 7.3.1.2, were considered for the catch and effort calculations across all phases of the project. For this fishery, an effective exclusion area of 30 km/16 NM around the Venus offshore project area (including the FPSO) is considered, as operators would be obliged to avoid setting lines that could interfere and/or become entangled with construction (drilling and installation), production (offshore transfer) and decommissioning operations, as well as stationary vessels (e.g. drilling units and FPSO) and mooring lines. Therefore, the extent of the impact is considered to be **regional**, extending beyond the boundaries of the Licence Block and Venus offshore project area (Figure 7-11).

Table 7-30 lists the average annual catch and/or effort amounts of the longline sector as a percentage of the average annual catch and/or effort reported on a national scale, considering the exclusion from the proposed maritime restricted area (see see Table 4-1 and Figure 4-11), as well as the extended effective longline exclusion zone (16 NM buffer). The highest catch and effort were recorded within the Venus offshore project area the maritime restricted area and effective longline exclusion zone in Season 4 (September – November) for the large pelagic longline fishery.



Table 7-30: Average annual catch and effort for large pelagic longline fisheries (2014-2023) recorded within the maritime restricted area and effective exclusion zone reported as a total and a percentage of the national totals.

Annual catch and effort	Within Maritime Restricted Area (1 078 km ²)		Within Effective Exclusion Zone (4 563 km ²) *	
	Total	Proportion of National Total (%)	Total	Proportion of National Total (%)
Annual average catch (tonnes)	1.17	0.05	3.7	0.16
Annual average effort (no. of hooks)	148.0	0.07	3 392.5	0.16
Notes: An effective exclusion area of 16 NM radius around the Venus project area and FPSO is considered for large pelagic longline fishery.				

Considering the historical catch and effort recorded in the larger PEL0056/Block 2913B (Table 5-22) and the impact zone as a result of displacement (Table 7-30), the impact to the large pelagic fishery as a result of displacement of fishing activities is considered to be of **low** intensity, with the overlap low (< 0.2% of fisheries taking place within the larger effective exclusion zone).

Following a conservative approach, it is assumed that the maritime restricted area, and associated larger effective exclusion zone, will be enforced throughout the Project timeline, including the drilling and installation phase, taking into account the various vessels that may operate across the Venus offshore project area throughout the phase. During this time, fishing could continue in adjacent areas. While fishing may continue in adjacent areas, it is acknowledged that fishers typically prefer zones with higher catch rates. However, given the historically lower catch rates within the proposed maritime restricted area and the minimal overlap with active fishing grounds, the overall impact is considered limited. Thus, the impact magnitude based on intensity (**low**), duration (**medium term**, in the case of the drilling and installation phase only)¹¹⁴ and extent (**regional**) is considered to be **low**.

Underwater noise from vessel and drilling operations (non-impulsive)

As mentioned in Section 7.1.1, local shipping traffic and moderate metocean conditions are expected to elevate ambient noise levels with shipping noise being a component of the ambient noise environment (greater than 85 dB re 1 µPa) over the Block area (SLR Consulting Canada, 2025).

Underwater noise during drilling and installation and associated vessel operations (non-impulsive) may induce localised behavioural changes or masking of biologically relevant sounds for fish species (Perry, 2005). Behavioural responses can vary but may include leaving the area of the noise source, changes in vertical and horizontal distribution, activity level, schooling behaviour, and feeding behaviour.

As described in Section 7.1.1, potential behavioural disturbance to fish from non-impulsive noise due to **drilling operations only** (Scenario UD-1; three drilling units, one full-time support vessel and three support vessel (operating at 50% duty cycle) simultaneously) is predicted to occur up to **638 m** from the source, representing the worst-case scenario during

¹¹⁴ Notably this report conservatively assumes that the maritime restricted area and effective exclusion zone will be enforced throughout the project timeline (i.e. across all phases) with impacts due to displacement as a result of the maritime restricted area/effective exclusion zone extending into the production and subsequent decommissioning phase (as assessed per phase below).



drilling operations (SLR Consulting Canada, 2025). Considering concurrent drilling and installation operations taking place intermittently across three-years, modelled behavioural impact zones increase to **760 m** as estimated by underwater noise modelling Scenario UC-1 (Section 7.1.1). As such, behavioural disturbance to fish is estimated to occur within **<1 km** of the source (**site**), throughout the majority of the four-year drilling and installation phase.

Considering the **maximum concentration of vessels at the Venus offshore project area during the drilling and installation phase (and entire project)** as modelled in Scenario UC-2 (Section 7.1.1), the largest zone of behavioural disturbance to fish with and without a swim bladder caused by non-impulsive underwater noise, is estimated to be up to **1.8 km** from the source location (**local**) (Figure 7-11). This represents the worse-case scenario, with concurrent FPSO arrival and mooring, installation, construction and drilling operations taking place. Modelled impact zones are expected to reduce following one-month mooring operations, after which the four mooring tugs will sequentially disengage and move off from the site. Since this behavioural zone of impact occurs within the overall maritime restricted area, potential behavioural disturbance would not result in any additional impact on this sector. It may mean that fish move out into areas accessible for fishing.

According to Popper et al. (2014), for non-impulsive noise sources in general, relatively high to moderate behavioural risks are expected for fish species at near to intermediate distances (tens to hundreds of metres) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of metres) from the source location. Notably, non-impulsive noise sources (from the DPS systems used by drill units and vessels) are predicted to have no physiological impacts (both mortality and recovery injury) on fish species (SLR Consulting Canada, 2025), with no current direct evidence of mortality and/or mortal injury to fish due to non-impulsive noise sources (Popper, et al., 2014).

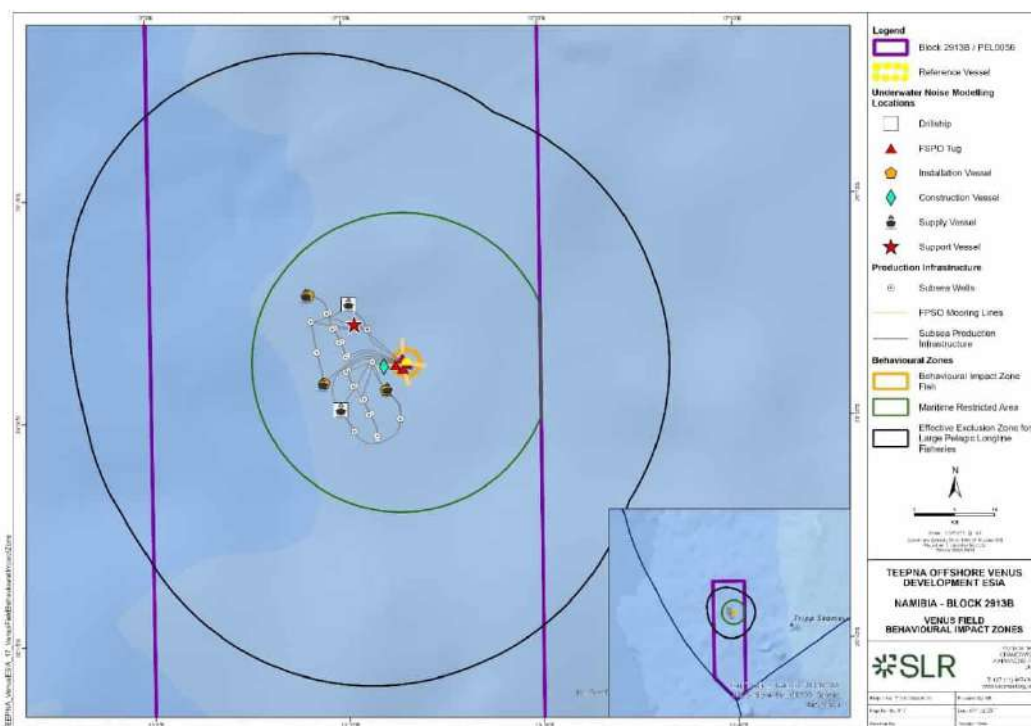


Figure 7-11: Maximum behavioural impact zone to fish during drilling and installation activities (underwater noise modelling Scenario UC-2).

Source: SLR Canada (2025)



Not all species are expected to be similarly affected as some species may be more tolerant of the disturbances and may also be drawn to the vessels and project infrastructure. Nevertheless, availability of target fish species to the large pelagic longline sector in the proximity of the operation and within the estimated impact zones, is expected to be lower than in adjacent areas.

Given the offshore location of PEL0056/Block 2913B in main marine traffic routes, as well as considering that the behavioural impact zones fall within the effective safety exclusion zone for large pelagic fisheries, the intensity of the impact is considered **very low**. The duration of the effects on the populations would be **medium-term** (i.e. throughout the drilling and installation phase) and extend to a **local** scale (behavioural disturbances would be expected within a maximum of 1.8 km). Thus, the impact magnitude based on intensity, duration and extent is considered to be **very low**.

Underwater noise from VSP operations (impulsive)

As described in Section 7.1.1, potential behavioural disturbance to fish from the VSP pulses (impulsive noise) is predicted to occur up to **5.5 km** from the source (Underwater modelling scenario UD-2). Moderate behavioural risks are expected for fish species at near to intermediate distances (tens to hundreds of meters) from the impulsive noise source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. Behavioural responses of fish, such as avoidance of seismic survey areas and changes in feeding behaviours in response to seismic sounds, have been documented to occur at received levels of between 130 and 180 dB re 1 μ Pa, with disturbance ceasing at noise levels below this (Slabbekoorn, et al., 2019). However, VSP uses a small airgun array, thus the volumes and energy released into the marine environment are significantly smaller than what is required or generated during conventional seismic surveys. Since this behavioural zone of impact occurs within the overall maritime restricted area, potential behavioural disturbance would not result in any additional impact on this sector.

The largest zone of impact for mortality and non-recoverable injury; recoverable injury, TTS-onset and behavioural disturbance for fish with and without a swim bladder were **60 m, 80 m, 480 m and 5.5 km**, respectively, as estimated by underwater noise modelling (see Section 7.1.1 and Appendix G for further information). Fish grouped by size, smaller (< 2g) and larger (> 2g) fish, are susceptible to being impacted by recoverable injury up to **660 m**.

Cumulative effects on fish behaviour are primarily a concern only in cases where animals remain in specific coastal areas for spawning or are associated with distinct oceanic features like seamounts. Major fish spawning areas are located inshore and beyond the maximum threshold distances for TTS, AUD INJ, and behavioural impacts. Similarly, Tripp Seamount which is situated 85 km east of PEL0056/Block 2913B falls outside these threshold distances. Consequently, the impact zones represent a worst-case scenario and are expected to decrease logarithmically with shorter exposure times.

Concurrent drilling and VSP operations across the Venus project area may result in cumulative behavioural impacts. However, considering the local extent of behavioural impacts modelled for offshore installation and drilling operations (non-impulsive noise), these impacts are argued to be limited, with VSP operations and associated behavioural impacts being short-term and taking up to 9-hours to complete per well.

The impact of behavioural disturbance to fish from VSP operations is considered to be of **very low** to negligible intensity considering that the behavioural impact zone falls within the effective safety exclusion zone for large pelagic fisheries, extending **locally** (5.5 km) from the drilling location and persisting for the duration of VSP operations (9 hours per well). The impact duration is considered **short-term** as VSP operations would be intermittent over the drilling campaign and limited to selected wells. Since the species targeted by the large pelagic longline fishery do not spawn in the region, longer lasting population level impacts



are not anticipated. The impact of fish behavioural avoidance and masking of sounds caused by underwater noise generated during VSP is thus considered of **very low** magnitude.

Discharge of treated drill cuttings from the drilling unit

One of the more apparent effects of increased concentrations of suspended sediments and consequent increase in turbidity, is a reduction in light penetration through the water column with potential adverse effects on the photosynthetic capability of phytoplankton (Poopetch, 1982; Parsons, Kessler, & Guanguo, 1986a; 1986b; Monteiro P. , 1998) and the foraging efficiency of visual predators (Simmons, Brown, & Kemper, 2015; Peterson, Laney, & Rice, 2001). However, due to the rapid dilution and widespread dispersion of settling particles, any adverse effects in the water column would be ephemeral, highly localised and short term. Any biological effects on nektonic and planktonic communities would be negligible (Aldredge, Elias, & Gotschalk, 1986). As noted in Section 5.4.7, turbid water naturally occurs along the Namibian coast, however, the further offshore waters of the Venus offshore project area within PEL0056/Block 2913B tend to be clearer and less productive as they are beyond the influence of coastal and shelf-edge upwelling.

Consequently, the major Namibian recruitment areas are all located on the continental shelf, well inshore of the PEL0056/Block 2913B (Figure 5-22). Seasonally high abundances of ichthyoplankton (e.g. hake, monk and kingklip and anchovy eggs and larvae), particularly in late winter and early spring may occur inshore of the PEL0056/Block 2913B, but these are not expected to be influenced by turbidity plumes generated during drilling operations. Species targeted by the large pelagic longline fishery do not spawn in the region (see Section 5.5.3).

For the **riserless** discharge scenarios considered in the drilling discharge modelling, the maximum cumulative risk throughout the water column extended a maximum horizontal distance of **28.7 km** in a northwest direction when released simultaneously from nearby well pairs (3 discharge locations) in Season 3. Notably, cumulative risk throughout the water column was reduced **<21 km** when considering a duration greater than 1 day. For the **risered** scenarios considered in the drilling discharge modelling significant risk to the water column, extended up to a maximum horizontal distance of approximately **31.2 km**, reducing to **<5 km** when considering a duration greater than 1 day. Overall significant risk in the water column lasted for a maximum of **9.8 days** for the riserless sections (Season 1) and **3.7 days** for the riser section (Season 2).

The intensity of impacts in the water column is deemed **very low**, as pelagic species are able to move outside the area of influence thereby reducing potential toxic effects on pelagic communities, with key spawning and recruitment areas located well inshore and outside the potential area of impact. In addition, potential movement outside of the area of influence (up to 29 km from discharge point) falls within the extended effective exclusion zone (30 km from Venus project area and FPSO) with no additional impacts as a result of fisheries displacement anticipated. The rapid dilution and widespread dispersion of settling particles would ensure that any impacts are **localised** and **medium-term** (drilling operations taking place over a four-year period).

The impact of increased turbidity and toxic effects is therefore considered of **very low** magnitude for all 40 wells.

Production Phase

Overall, the impact magnitude to the large pelagic longline fishery, due to production activities, considering the highest intensity, extent and duration, is considered to be **medium**. This is based on the following overall ratings:



- **Low** intensity as a result of displacement with the potential disruption to fishery operations considered a minor disturbance as the operational overlap is low, the project area is not a key fishing ground and the fishery could focus efforts elsewhere for the duration of the production activities. Very Low intensity for changes in resource availability due to increased underwater noise and/or discharge of produced water as the potential disruption to fishery operations is considered a minor disturbance as the potential area of impact is not a key fishing, spawning and recruitment ground.
- **Regional** extent: as the impact zones related to exclusion (maximum 30 km buffer around the Venus offshore project area which equates to an extent of 4 562.86 km²) and produced water discharge (up to 62.3 km) extend beyond PEL0056/Block 2913B. Behavioural disturbance due to increased underwater noise is restricted to within the site (maximum 400 m).
- **Permanent** duration: although the impacts are unlikely to continue after project operations, they are expected to take place over a maximum 31-year production period.

These ratings are discussed for each project aspect below and summarized in Table 7-31.

Underwater noise from vessel operations (non-impulsive)

Underwater noise from offshore transfer operations between the DPST and FPSO (non-impulsive) as modelled in Scenario UP-1 (Section 7.1.1) may induce localised behavioural changes or masking of biologically relevant sounds for fish species, as outlined above (Perry, 2005).

As described in Section 7.1.1, potential behavioural disturbance to fish from non-impulsive noise is predicted to occur up to **400 m** from the source, representing the underwater noise generated during offshore offloading operations (one DPST and one support vessel operating simultaneously, during offshore oil transfer operations) (SLR Consulting Canada, 2025). Availability of target fish species to the large pelagic longline sector in the proximity of the operation and within the estimated impact zones, is thus expected to be lower than in adjacent areas. The impacts to fish from non-impulsive noise were limited to behavioural responses (no TTS and PTS impacts). Overall, the area of impact, and possible avoidance by large, migratory pelagic species, falls within the proposed maritime restricted area. Thus, potential avoidance of this area by the targeted species would not result in any additional impact on this sector.

Considering the offshore location of PEL0056/Block 2913B in the vicinity of marine traffic routes, as well as the fact that the behavioural impact zone falls within the larger 30 km/16NM exclusion zone for longline fisheries, the intensity of the impact is considered **very low**. Impacts are restricted to the nearby vicinity of the source (**site**), with behavioural disturbances expected within a maximum of 400 m from the DPST and FPSO. It is anticipated that offloading operations will take place one day (i.e. 24-hours) per week over the 31-year production timeline. Considering transfer operations take place up to 24-hours/one day per week, individual behavioural impacts would be **short-term** and limited to the duration of transfer operations. Thus, the impact magnitude based on intensity, duration and extent is considered to be **very low**.

Discharge of produced water

Produced water is the largest volume waste stream generated during offshore oil and gas production and typically consists of formation water, injection water, and various technological fluids. These waters are often contaminated with hydrocarbons, dissolved salts, trace metals, and chemical additives such as corrosion inhibitors, biocides, and scale preventers (Somerville et al., 1987; GESAMP, 1993).



The effects of discharges into the water column could lead to avoidance of the plume, toxic effects on pelagic communities and associated trophic level cascade effects which could affect normal feeding patterns of certain fish species. This could have an impact on large pelagic longline fisheries that operate in the area through the reduction in catch rates and/or a displacement of fishing effort.

Despite these concerns, the spatial extent of produced water impacts is generally limited due to dilution and dispersion in the open ocean. Concentrations of contaminants typically decrease with distance from the discharge point, and biological responses tend to follow similar gradients.

Based on produced water modelling results the maximum significant cumulative risk throughout the water column, may extend a maximum horizontal distance of 62.3 km in a northwest direction when released from the FPSO in Season 1. Notably, significant cumulative risk throughout the water column was reduced 10.5 km when considering a duration greater than 1 day. Overall significant risk in the water column lasted for a maximum of 29.4 days. Significant impact zones were not found to extend beyond PEL0056/Block 2913B, with no significant risk reaching Tripp Seamount.

The major Namibian recruitment areas are all located on the continental shelf, well inshore of the PEL0056/Block 2913B and outside of the modelled area of impact. As such, potential population level effects, due to impacts to these key spawning and recruitment grounds are deemed unlikely, with species targeted by the large pelagic longline fishery not spawning within the area of impact. In addition, while the area of impact, and possible avoidance by large, migratory pelagic species, falls outside proposed maritime restricted area (up to 62 km from FPSO), impacts remain within the larger PEL0056/Block 2913B. Thus, potential avoidance of this area by the targeted species is considered a minor disturbance, as the fisheries overlap within PEL0056/Block 2913B is low (1.68% of the Namibian large pelagic longline fishing grounds within the Namibian EEZ falls within the larger Licence Block), as the pelagic longline could move to alternative areas if there was resource availability in an area other than the affected area.

Considering the above the intensity of impacts in the water column is deemed **very low**, as pelagic species are able to move outside the area of influence thereby limiting potential cumulative population-level impacts. The rapid dilution and widespread dispersion of produced water extends regionally (up to 62.3 km from FPSO discharge point). While the modelled impacts were found to be relatively short-lived, typically lasting only a few days (less than 30 days), the modelling was based on a 30-day discharge period for produced water. In practice, produced water is expected to be released continuously throughout production operations. Therefore, the impacts are assessed as having a **permanent** duration (greater than 25 years), although they are not anticipated to persist beyond the end of production activities, with effects expected to dissipate within a few days following the end of discharge.

The impact of produced water discharge is, therefore, considered of **very low** magnitude for the large pelagic longline sector.

Decommissioning Phase

The removal of subsea infrastructure will be considered on a case-by-case basis following a comparative assessment between removal or abandonment at seabed. Wellheads will not be recovered as they are in water depths more than 500 m (in line with the Operator's internal standards) and with no demersal trawl activity taking place within the Venus project area.



The abandonment of subsea infrastructure and wellheads could pose an obstruction to fishing activity directed towards the seabed. The Namibian fisheries sectors that deploy gear at or near the seabed are the demersal trawl, demersal longline and deep-sea crab sectors. Based on historical fishing data, no demersal fishing effort (including deepwater for orange roughy) occurs within PEL0056/Block 2913B or the Venus project area; thus, no impacts are likely.

As such, there is expected to be **NO IMPACT** as a result of the proposed decommissioning activities (normal operations) at the Venus offshore project area on the other fisheries sectors and mariculture operations, with impacts relating to the abandonment of subsea infrastructure screened out as detailed in the Fisheries specialist impact assessment (Appendix M).

Overall, potential impacts due to increased underwater noise (non-impulsive) and displacement (effective exclusion zone) during the decommissioning phase are as assessed in the drilling and installation phase above. Notably, potential impact zones from increased underwater noise are expected to be reduced during the decommissioning phase, given the lower number of vessels (up to seven) operating across the Venus project area. As a result, the behavioural impact zone from non-impulsive underwater noise is anticipated to be smaller than that modelled in Scenario UC-1.

The impact magnitude to the large pelagic longline fishery, due to **decommissioning activities** as well as the maritime restricted area, is considered to be **low**. This is based on the following overall ratings:

- **Low** intensity due to maritime restricted area and effective exclusion zone. Very Low intensity for behavioural disturbance.
- **Regional** extent: as the impact zones related to related to exclusion (maximum 30 km buffer around the Venus offshore project area equalling 4 562.86 km²) extend beyond the Licence Block. Behavioural disturbance will be confined to the site (maximum 760 m based on the impact zone modelled in Scenario UC-1).
- **Medium-term** duration: as impacts will be limited to the duration of decommissioning activities.

See Table 7-31 for a summary of the impact rating and significance.

Significance

The highest impact magnitude and therefore impact significance rating across the impact sources detailed above (per phase) is assessed, resulting from the maximum intensity, scale and duration. Based on the sensitivity of the receptor (medium) and the highest impact magnitude, medium, related to vessel displacement (due to exclusion) within the production phase, the overall potential impact to the large pelagic longline sector is assessed to be of **medium** significance (Table 7-31).

Notably, impacts related to increased underwater noise as well as drilling and produced water discharge are assessed to be of **very low** magnitude and significance.

Residual Impact

The potential impacts cannot be eliminated due to the nature of the activities and the associated effective exclusion zone. Considering the management and mitigation measures listed in Section 7.3.1.6 the intensity is reduced to **very low**. The residual impact significance reduces to **very low** (Table 7-31).



Table 7-31: Summary assessment for the overall impact to the large pelagic longline fishery¹¹⁵

Impact to the Large Pelagic Longline Fishery						
Type of Impact	Direct and Indirect					
Nature of Impact	Negative					
Phase	Drilling & Installation		Production		Decommissioning	
Criteria	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium					
Magnitude	Low	Very Low	Medium	Very Low	Low	Very Low
Intensity	Low	Very Low	Low	Very Low		
Duration	Medium term	Medium term	Permanent	Permanent	Medium term	Medium term
Extent	Regional	Regional	Regional	Regional	Regional	Regional
Significance	Low	Very Low	Medium	Very Low	Low	Very Low
Additional Assessment Criteria						
Probability	Likely	The impacts cannot be completely eliminated due to the nature of the activities.				
Confidence	High	Assessment used quantitative catch and effort logbook data from the MFMR (now called MAWLR) and it was also informed by the modelling results.				
Reversibility	Fully reversible	The sector can operate within the safety exclusion zone as soon as Project activities are complete. Additionally, the behavioural impacts related to increased underwater noise will cease following completion of Project activities and reduction of underwater noise.				
Loss of resources	None	The fisheries resource is not being removed.				
Avoidance Potential	Low	Some impacts can be avoided by communication to the fisheries allowing for operational planning.				
Mitigation Potential	Low	Mitigation measures can reduce the intensity of the impact.				
Cumulative impacts	Possible	Should multiple operators be drilling and/or undertaking development/production activities at the same time, then these impacts could be exacerbated.				

7.3.1.4 Impact Assessment: Impact on Linefish Sector

The **linefish sector and SSF activities** (assessed in Section 7.3.1.5) may overlap with nearshore transshipment operations (production phase) and are thus assessed in detail below. No impacts are expected during the installation and decommissioning phases.

There is expected to be **NO IMPACT** as a result of the proposed Project activities (normal operations) at the **nearshore transshipment area** on other operational fisheries sectors and mariculture operations.

The proposed nearshore transshipment area (including safety exclusion zone) may overlap with an area currently zoned for mariculture activities (but not currently in use), should this area become operational in future (Figure 5-80). Importantly, the final nearshore transshipment area will be determined through consultation with relevant maritime authorities. As the proposed mariculture area is not currently operational, this zoned area

¹¹⁵ The highest impact ratings across all impact sources per phase are shown in the table, indicating the maximum intensity, scale, duration, consequences, and significance of the associated impact, per phase.



may be revised based on the finalized nearshore transshipment area and associated safety exclusion zone.

There is expected to be no significant impact as a result of the proposed installation (installation of nearshore transshipment buoy) and decommissioning activities (removal of nearshore transshipment buoy) at the **nearshore transshipment zone** on fisheries.

Sensitivity of receptor

Sensitivity and intensity herein consider the extent of fishing ground, ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations (linked in part to fishing gear type and vessel manageability), as well as the vulnerability of the targeted fish species.

The traditional line fishery primarily targets snoek (*Thyrsites atun*) as well as yellowtail, silver kob, dusky kob, and sharks. Snoek availability to the fishery is seasonal, peaking in late summer. Operationally the fishery is limited in extent to Walvis Bay, Swakopmund and Henties Bay, and due to the small size of vessels does not operate much further than 12 NM offshore (i.e., 22 km). There is also a small component of the fishery operating out of Lüderitz in the south. Nearshore transshipment operations, as well as vessel transit, may overlap with the linefish fishing sectors' activities.

Linefish sector vessels are typically small to medium-sized and highly manoeuvrable, allowing them to navigate efficiently in nearshore environments. Unlike several other fishing sectors, the linefish sector is not restricted in its movement.

Fish without swim bladders, such as the target species Snoek (*T. atun*) and crustaceans are less susceptible to noise-induced reaction on behaviour than fish with swim bladders. However, by-catch or secondary target species such as the dusky kob (*Argyrosomus japonicus*), silver kob (*A. inodorus*) and yellowtail (*Seriola lalandi*) do have swim bladders (Woolley, Stewart Fielder, & Qin, 2014).

Due to these factors, the sensitivity of the linefish sector is considered to be **medium**.

Magnitude

Overall, the impact magnitude to the linefish fishery is considered to be **low**. This is based on the following overall ratings:

- **Very Low** intensity: as the potential disruption to fishery operations is considered a minor disturbance as the operational overlap is very low (< 0.2%), and the fishery could focus efforts elsewhere for the duration of the production operations. Additionally, the nearshore transshipment area is located in close proximity to existing marine traffic routes into and out of Walvis Bay Port.
- **Local** extent: as the impact zones related to exclusion (maximum 1.7 km radius) and behavioural disturbance (maximum 1.2 km) which are confined to within the vicinity of the transshipment area and its surrounds.
- **Permanent** duration: as the impacts are unlikely to continue after project operations, which are expected to take place over a maximum 31-year production period.

Notably, as outlined above impacts to this fishery are restricted to the production phase and associated nearshore transshipment operations. These above ratings are discussed for each project aspect below.



Implementation of restricted area (nearshore)

Considering the impact zones for exclusion detailed in Section 7.3.1.2, the disruption to the linefish fishery operations is considered a minor disturbance as the overlap is very low (~9 km² exclusion zone; 1.2 km transshipment zone and 500 m safety exclusion zone, see Table 7-32).

Notably, no linefish catches have been recorded within the nearshore transshipment area itself (i.e. within a 1.7 km radius around the transshipment buoy), based on historical catch data. However, between 2007 and 2020, only 0.09% of the annual average catch reported by the Namibian linefish fishery occurred within the broader Walvis Bay area, which includes inshore waters from Pelican Point to Swakopmund (Table 7-32).

Table 7-32: Annual average linefish catch reported within larger nearshore transshipment area reported as a percentage of the national totals.

Pole-line	Within Walvis Bay Area	Proportion of National Total
Annual average catch (tonnes)	1.13	0.09%
Annual average effort (no. of lines)	29.57	0.16%

Considering the very low historical catch and effort recorded in the nearshore transshipment area (1.2 km radius) and associated 500 m safety exclusion zone, as well as limited catch and effort within the larger Walvis Bay area, the impact to the linefish fishery as a result of displacement of fishing activities is considered to be of **very low** intensity, with fisheries operations largely concentrated in deeper waters, to the east of the transshipment buoy and outside of Walvis Bay.

The impact is expected to be confined to the vicinity of the transshipment area and is, therefore, considered **local** in extent. While each transshipment event is short-term (±24 – 48 hours), the assessment is based on a conservative approach assuming the restricted area will be enforced throughout the production timeline (31-years; **permanent**). It is expected that vessels will remain outside the designated nearshore transshipment area and its associated safety exclusion zone, during this time, with fishing activities able to continue in adjacent areas.

Taking into account the intensity, duration, and spatial extent of the activity, the overall impact magnitude is assessed to be **very low**.

Underwater noise from vessel operations (non-impulsive)

Potential behavioural disturbance to fish from non-impulsive underwater noise is predicted to occur up to **1.2 km** from the source. This relates to noise generated during nearshore transshipment operations, specifically when vessels employ dynamic positioning systems during mooring activities, as detailed in Section 7.1.1 (Scenario UP-2) (SLR Consulting Canada, 2025). Notably, offshore transfer operations are anticipated to take place over 24 hours/one day per week, particularly during the peak production period, which is expected to last several years after the start up. Following this peak phase, the frequency of transfer operations will gradually decline. Since the safety exclusion zone is 1.7 km in extent, the potential avoidance of this area due to noise by the targeted species would not be considered to result in any additional impact on this sector.

Figure 7-12 shows the largest zones of behavioural disturbance to fish with and without a swim bladder (1.2 km) resulting from increased non-impulsive noise levels, as estimated by underwater noise modelling (UP-2; Section 7.1.1). The impacts to fish from non-impulsive noise were limited to behavioural responses only, with no physiological and/or physical impacts (e.g. non-recoverable, recoverable and/or TTS) modelled.



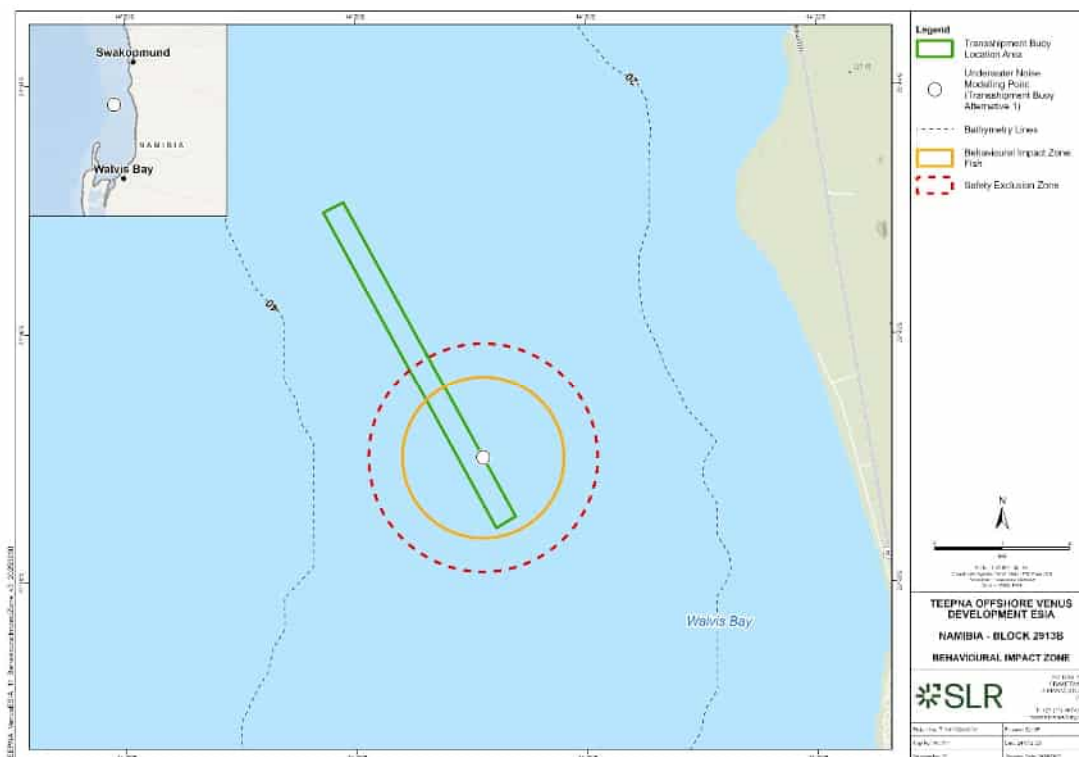


Figure 7-12: Maximum behavioural impact zone to fish (underwater noise modelling scenario UP-2) and nearshore transshipment exclusion zone during transshipment operations.

Not all fish species are expected to respond in the same way, as some may exhibit greater tolerance to disturbance or may even be attracted to vessels and associated infrastructure. However, within the vicinity of the operation and the predicted impact zones, the availability of target species for the linefish sector may be lower as compared to surrounding areas.

It should be kept in mind that the nearshore transshipment area is located within a major marine traffic route, and as such, is already subject to elevated levels of vessel activity and associated noise.

Given the nearshore location of the transshipment area in relation to main marine traffic routes, specifically moving in and out of Walvis Bay harbour, limited overlap of the behavioural impact zone and linefish operations, as well as the fact that the behavioural impact zone falls within the nearshore marine restricted area, the intensity of the impact is considered **very low**.

Populations would be affected intermittently throughout the 31-year production operations with potential population-level behavioural impacts (such as behavioural avoidance) and associated effects extending across the production phase (**permanent**) due to the proximity to nearshore spawning grounds (see Section 7.2.3.4 for further information). Effects would extend to a **local** scale (behavioural disturbances would be expected within a maximum of 1.2 km from the transshipment operations). Thus, the impact magnitude based on intensity, duration and extent is considered to be **very low**.

Significance

Based on the sensitivity of the receptor (medium) and impact magnitude (very low), the overall potential impact to the line fish sector is assessed to be of **very low** significance.



Residual Impact

The potential impacts cannot be eliminated due to the nature of the activities and the associated safety exclusion zone. Considering the management and mitigation measures listed in Section 7.3.1.6, the intensity will reduce and the residual impact significance will remain **very low** (Table 7-33).

Table 7-33: Assessment for the overall impact to the linefish fishery.

Impact to the Linefish Fishery		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	
Magnitude	Very Low	Very Low
Intensity	Very Low	Very Low
Extent	Local	Local
Duration	Permanent	Permanent
Significance	Very Low	Very Low
Additional Assessment Criteria		
Probability	Likely	The impacts cannot be completely eliminated due to the nature of the activities.
Confidence	High	The assessment used quantitative catch and effort logbook data from the MFMR (no called MAFWLR) and it was also informed by modelling results.
Reversibility	Fully reversible	The sector can operate within the safety exclusion zones as soon as production/project activities are complete. Additionally, the behavioural impacts will cease following the end of nearshore transshipment operations.
Loss of resources	None	The fisheries resource is not being removed. There is no mortality expected on the resource only possible displacement.
Avoidance Potential	Low	Some impacts can be avoided by communication to the fisheries allowing for operational planning.
Mitigation Potential	Low	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Possible	Should multiple operators, vessels and/or port operations be enforcing safety exclusion zones and/or working within the area at the same time, then these impacts could be exacerbated.

7.3.1.5 Impact Assessment: Impact on Small-Scale Fishing Sector

Sensitivity of receptor

The coastal SSF is largely limited to the areas offshore of Walvis Bay, Henties Bay, Swakopmund, and Lüderitz, with restricted fishing zones in the Namib-Naukluft National Park, the Sperrgebiet National Park, and the NIMPA.

Often referred to as artisanal fisheries, coastal SSFs primarily operate nearshore, within 20 NM of the coast, utilizing traditional fishing methods (e.g. ski-boats, nets, and hook and line) to harvest a variety of marine species, and with vessel sizes being less than 25 tonnes. Various marine resources are harvested, including shellfish collected in Walvis Bay, Swakopmund, and Lüderitz; line fish caught through line fisheries operating out of Henties



Bay, Lüderitz and Swakopmund (including snoek, kabeljou, galjoen, and elf or shad); and mullet and rock lobster fisheries in Lüderitz. Estimates of the catch are still to be determined for coastal SSF, owing to their recent official recognition (MFMR & FAO, 2022).

While SSF operations are spread along the Namibian coastline many fishers, particularly those without access to transport, face limitations in their mobility, which restricts their ability to fish or collect resources in areas farther from their communities.

Considering the range of target species, restricted ability to focus efforts elsewhere, as well as year-round seasonality and operations, the sensitivity of the SSF sector is considered to be **medium**.

Magnitude

Overall, the impact magnitude to the SSF is considered to be **very low**, restricted to the production phase of the Project. This is based on the following overall ratings:

- **Low** intensity: as the potential disruption to fishery operations is considered a minor disturbance as the operational overlap is very low, the project area is not a key fishing and harvesting ground, with fisheries able to focus efforts outside the nearshore transshipment restricted area. In addition, the nearshore transshipment area is located close to Walvis Bay Port and nearshore anchoring areas, experiencing high levels of vessel traffic.
- **Local** extent: as the impact zones related to exclusion (maximum 1.7 km radius) and behavioural disturbance (maximum 1.2 km) are confined to within the vicinity of the transshipment area and its surrounds.
- **Permanent** duration: as the impacts are unlikely to continue after project operations, which are expected to take place over a maximum 31-year production period.

These ratings are discussed for each project aspect below.

Implementation of restricted area (nearshore)

Considering the impact zone for exclusion the disruption to the SSF activities is considered a minor disturbance as the overlap is very low (~9 km² exclusion zone; 1.2 km transshipment zone and 500 m safety exclusion zone), considering available nearshore fishing grounds. Notably, coastal harvesting grounds do not overlap with the nearshore transshipment area and proposed restricted area.

SSF in Walvis Bay are primarily limited to shellfish collection within the intertidal zone and seaweed harvesting in shallow coastal waters, with minimal boat-based activity (MFMR & FAO, 2022). Shore-based fishing is not anticipated to extend into the nearshore transshipment area and is therefore unlikely to be affected. Given the spatial separation between SSF activities and the proposed transshipment operations, the potential for displacement of fishing activity is considered to be of **very low** intensity.

The impact is expected to be confined to the vicinity of the nearshore transshipment buoy and associated restricted area and is therefore considered **local** in extent. While the exclusion period for each transshipment event is short-term (±24 – 48 hours), the restricted area will be enforced throughout the production timeline (31-years; **permanent**). Taking into account the intensity, duration, and spatial extent of the activity, the overall impact magnitude is assessed as **very low**.

Underwater noise from vessel operations (non-impulsive)

Target species of SSF activities including snoek, kabeljou, galjoen, and elf or shad, may show behavioural responses due to increased underwater noise as previously described (Section 7.3.1.2). The impact magnitude discussion in Section 7.3.1.4 is also relevant for this impact assessment. Since the safety exclusion zone is 1.7 km in extent, the potential



avoidance of this area due to noise by the targeted species would not result in any additional impact on this sector.

Given the nearshore location in main marine traffic routes, the limited overlap with SSF operations as well as the fact that the behavioural impact zone falls within the nearshore restricted area the intensity of the impact is considered **very low**. The duration of the effects on the populations would be **permanent** (nearshore transshipment operations taking place intermittently throughout the 31-year production phase) and extend to a **local** scale (behavioural disturbances would be expected within a maximum of 1.2 km from the nearshore transshipment buoy) as outlined above (Section 7.1.1). Thus, the impact magnitude based on intensity, duration and extent is considered to be **very low**.

Significance

Based on the sensitivity of the receptor (medium) and impact magnitude (very low), the overall potential impact to the SSF sector is assessed to be of **very low** significance.

Residual Impact

The potential impacts cannot be eliminated due to the nature of the activities and the associated restricted area. Considering the management and mitigation measures listed in Sections 7.3.1.6, the intensity and residual impact remains very low (Table 7-34).

Table 7-34: Assessment for the overall impact to the small-scale fishery during the production phase.

Impact to the Small-Scale Fishery		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	
Magnitude	Very Low	Very Low
Intensity	Very Low	Very Low
Extent	Local	Local
Duration	Permanent	Permanent
Significance	Very Low	Very Low
Additional Assessment Criteria		
Probability	Likely	The impacts cannot be completely eliminated due to the nature of the activities.
Confidence	High	The assessment used quantitative catch and effort logbook data from MFMR (now called MAFWLR) and it was also informed by modelling results.
Reversibility	Fully reversible	The sector can operate within the exclusion zone as soon as the project activities are complete. Additionally, the behavioural impacts are temporary.
Loss of resources	None	The fisheries resource is not being removed.
Avoidance Potential	Low	Some impacts can be avoided by communication to the fisheries allowing for operational planning.
Mitigation Potential	Low	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Possible	Should multiple operators' offshore vessels and/or port operations be enforcing safety exclusion zones and/or working within the area at the same time, then these impacts could be exacerbated.



7.3.1.6 Mitigation and Management Measures

The potential for mitigation includes effective communications with fishing sectors which could allow vessel operators the opportunity to plan fishing operations in areas unaffected by the development and production activities. Thus, it may be possible for fishing operators to relocate fishing effort into alternative areas if adequate information is provided prior to and during the project. The recommended mitigation measures to reduce the impacts of temporary and/or long-term **displacement** are listed in Table 7-35.

Mitigation measures to reduce the impacts to fish and marine ecosystems related to **underwater noise (non-impulsive and impulsive) and drilling discharges** are outlined in Table 7-20, Table 7-21 and Table 7-15, respectively.

Table 7-35: Recommended measures to mitigate the impact of displacement of fishing operations.

No.	Mitigation measure	Classification
Drilling and Installation Phase		
1	Notify key stakeholders, via the Directorate of Maritime Affairs, at least three weeks prior to mobilisation of the drilling unit, installation vessels and FPSO, respectively. The Notice to Mariners should give notice of (1) the vessel name and co-ordinates of the drilling, installation and construction locations, (2) an indication of the estimated operational timeframes, (3) the dimensions of the safety zone around the drilling units and installation / construction vessels, as well as the maritime exclusion / restricted marine areas (which will be in place during construction and operation) and nearshore transshipment safety exclusion zone, and (4) details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to the following fishing industry associations: • Confederation of Namibian Fishing Association. • Large Pelagic and Hake Longlining Association. • Namibian Large Pelagic Association. • Namibian Hake Association. • Namibian Deep Water Trawling Association. • Walvis Bay Pelagic Fishing Association. Other key stakeholders for notification include: Ministry of Works and Transport, South African Navy Hydrographic Office (SANHO), Namibian Ports Authority (NamPort), Department of Maritime Affairs and the MAFWLR Monitoring, Control and Surveillance Unit in Walvis Bay (Vessel Monitoring System in particular). These stakeholders should again be notified at the completion of drilling and installation activities when the drilling units and vessels (construction, installation and support) are off location.	Avoid/reduce at source
Operation Phase		
2	Notify key stakeholders (as above) at least three weeks prior to operation of the FPSO in the Venus offshore project area and operations in nearshore transshipment area (i.e. oil transfer from the DPST to a conventional tanker). The Notice to Mariners should give notice of (1) the name and co-ordinates of the vessel locations (2) an indication of the proposed production timeframe, (3) the dimensions of the safety zones around the FPSO and nearshore transshipment and maritime exclusion / restricted marine areas (which will be enforced during operation), and (4)	Avoid/reduce at source



No.	Mitigation measure	Classification
	details on the movements and frequency of support vessels and DPST servicing the project between the FPSO and nearshore transshipment area.	
All Phases		
3	Request, in writing, the Ministry of Works and Transport and Department of Maritime Affairs, as well as SANHO, to issue a navigational warning as appropriate (e.g. via Navigational Telex (Navtext) and navigational warnings twice daily on Channel 16 VHF).	Avoid
4	Manage the lighting on the drilling units, FPSO and other project vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations.	Abate on site
5	During operations, monitor the Maritime Surveillance Area and notify fishing vessels likely to enter the Maritime Restricted Area via radio regarding the safety requirements.	Abate on site
6	Develop and implement a Stakeholder Engagement Plan which ensures continual liaison with small-scale and commercial fisheries, cooperatives, government bodies and relevant stakeholders throughout operations (drilling, installation, operation and decommissioning) to ensure other vessels adhere to the terms of the safety zones and maritime exclusion / restricted marine areas and thereby create minimal impact on shipping traffic, as well as fishing operations/activities.	Abate on site
7	Implement a grievance mechanism that allows stakeholders to register specific grievances related to operations, by ensuring they are informed about the process and that resources are mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

7.4 Socio-Economic Impacts

This section provides a summary of the impacts assessed in the Socio-Economic Impact Assessment report provided in Appendix N.

7.4.1 Contribution to GDP

7.4.1.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Increased Gross Domestic Product (GDP)	X	X	X

7.4.1.2 Impact Description

The project makes a:

- Direct contribution to the economy: when the project is in production. This direct contribution to the economy, specifically the oil and gas sector, is calculated as the gross revenue from oil sales minus the intermediate consumption required to produce this oil.



- Indirect contribution to value added in the economy: during the project, Namibian suppliers¹¹⁶ of goods and services to the Venus development also generate value added in the economy but they are likely to be classified under other industries rather than as part the oil and gas sector. Thus, for example, Venus may employ a separate Namibian aviation services company to transport staff which generates value added in Namibia's transport sector. This additional indirect value added needs to be included in any economic impact assessment and in estimates of the impact of Venus on Namibian GDP. The greater the value of local goods and services Venus development makes use of, the greater the indirect value added generated by the project will be.

The gross value of output can be estimated based on production volumes and the price of oil. Intermediate consumption is harder to estimate given that ratios for local spending are not yet known. The following figures show the impact of Venus on Namibia's GDP over the life of the project under the following assumptions (in addition to those listed in Section 3.2):

- The capital investment is allocated mainly to imports from outside Namibia but it is assumed to give rise to local value added worth 5% based on local procurement of 20% of project investment spend excluding the FPSO¹¹⁷.
- Intermediate consumption is assumed to be 15% of gross revenue and indirect value added is assumed to be 5% of gross revenue. Intermediate consumption is lower than operational expenditure as it only includes purchased goods and services required for production and excludes expenditure on wages and salaries.
- The non-oil and gas economy is assumed to grow by 3% a year throughout the 21 years of Venus field production. This has been the average long-term growth of the economy during the past two decades.

Figure 7-13 and Figure 7-14 present the estimated value that the Venus development adds to the Namibian GDP based on the assumptions cited above and for the two oil price scenarios. Figure 7-13 shows the estimated Venus project-related GDP contribution to total estimated GDP over the project timeframe, amounting to between ~N\$ 536 billion and N\$ 800 billion (~USD 30 billion to USD 46 billion) over a 25-year project lifetime.¹¹⁸

The Venus project will have a significant impact on Namibia's GDP, especially during the immediate years following FO. GDP can be expected to grow by between 11-16% in the year of FO. Its contribution to GDP declines thereafter until production peaks in 2031. At that point, oil production contributes such a large share to overall GDP that a decline in oil production actually leads to a decline in overall GDP despite the rest of the economy continuing to grow by an assumed 3%.

¹¹⁶ Definition of Namibian supplier has been taken from the Namibian Industrial Baseline Survey (IBS) (published in August 2024 and conducted by Deloitte Namibia in partnership with Survey Warehouse and Monasa Advisory and Associates): a local company is a company incorporated or registered under the Companies Act 2004 in which Namibian citizens own at least 51 percent equity, and with its principal place of business in Namibia.

¹¹⁷ The socio-economic study (Appendix N) assumes 5% value added, which is equivalent to 20% of project procurement (excluding FPSO) being local procurement, where 25% of the locally procured goods are locally made content (and 75% of locally procured goods is imported content). This results in 5% local value added (20% local procurement x 25% locally made content in locally procured goods = 5% value add).

¹¹⁸ These calculations are based on FID in 2026 (as indicated in Figure 7-13 and Figure 7-14). As such, any delay in FID would, in turn, postpone the associated GDP impacts.



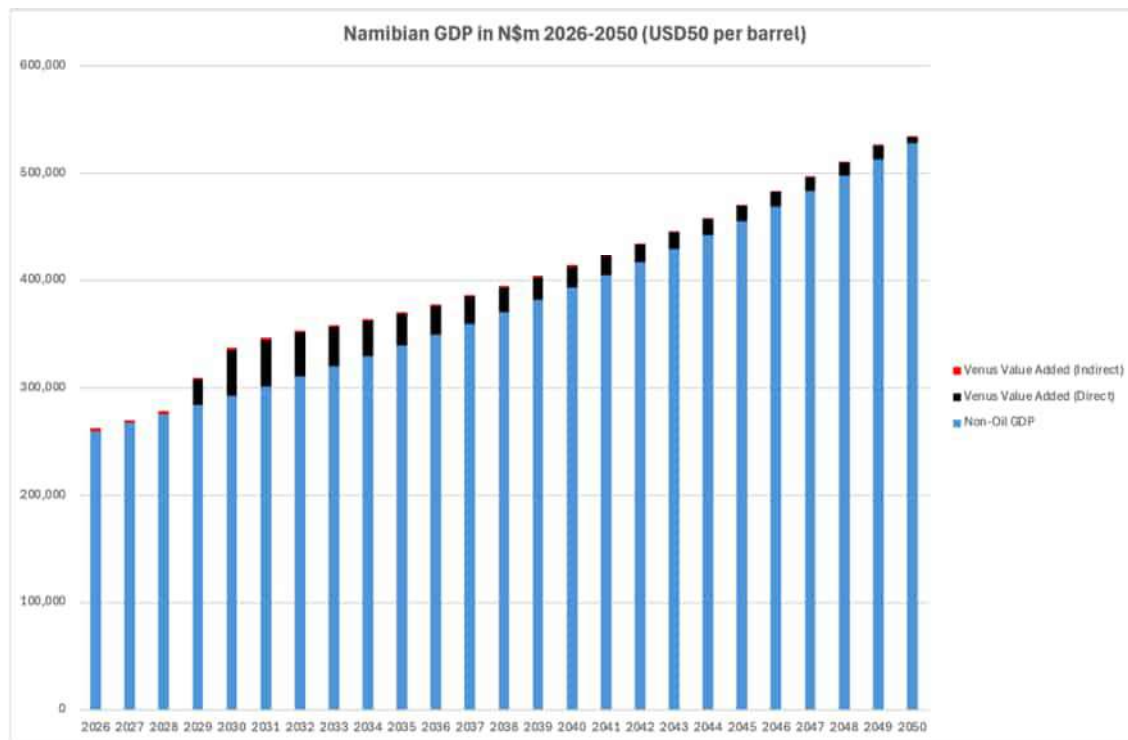


Figure 7-13: Namibian GDP in N\$ million assuming FID in 2026 and oil price of US\$50 per barrel

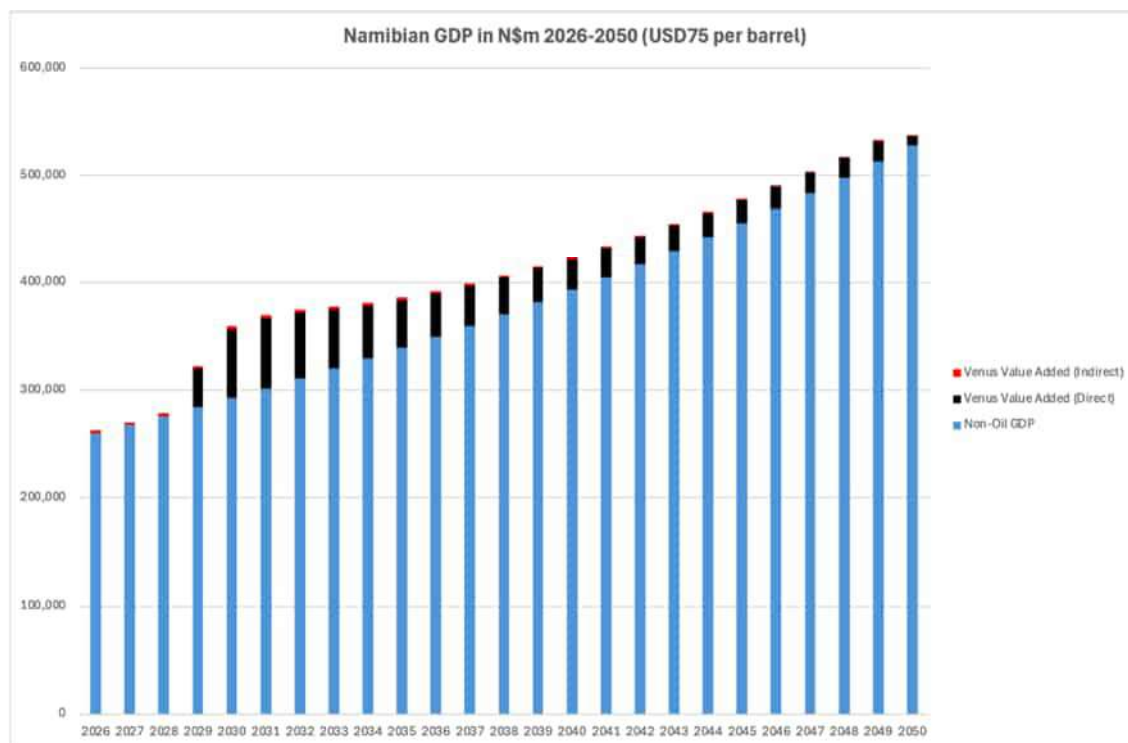


Figure 7-14: Namibian GDP in N\$ million assuming FID in 2026 and an oil price of US\$75 per barrel



Table 7-36: Estimated Venus project-related share of GDP relative to total estimated GDP in N\$ million, assuming FID in 2026

Year assuming FID in 2026	US\$50/bbl scenario		US\$75/bbl scenario	
	TOTAL GDP	PROJECT-RELATED GDP PORTION	TOTAL GDP	PROJECT-RELATED GDP PORTION
2026	262 336	0.9%	262 336	0.9%
2027	270 137	0.9%	270 137	0.9%
2028	278 171	0.8%	278 171	0.8%
2029	309 416	8.2%	321 941	11.7%
2030	337 391	13.3%	359 642	18.6%
2031	346 990	13.1%	369 766	18.5%
2032	353 480	12.2%	374 980	17.2%
2033	358 463	10.8%	377 796	15.4%
2034	363 822	9.5%	381 038	13.6%
2035	370 325	8.4%	385 852	12.1%
2036	377 775	7.5%	391 938	10.8%
2037	385 918	6.7%	398 910	9.8%
2038	394 597	6.0%	406 529	8.8%
2039	404 047	5.5%	415 143	8.0%
2040	414 073	5.0%	424 455	7.3%
2041	424 445	4.6%	434 114	6.7%
2042	435 213	4.1%	444 189	6.1%
2043	446 673	3.8%	455 121	5.6%
2044	458 553	3.5%	466 494	5.1%
2045	471 015	3.2%	478 546	4.7%
2046	484 078	3.0%	491 301	4.4%
2047	497 397	2.7%	504 235	4.1%
2048	511 245	2.5%	517 751	3.8%
2049	526 552	2.5%	533 108	3.7%
2050	534 380	1.1%	537 171	1.6%

The numbers show that the Venus project is likely to make a greater contribution to Namibia's GDP than Namibia's entire mining sector (comprised of diamond mining, uranium mining, metal ores and other mining and quarrying in Figure 7-15), which has historically been a major contributor to Namibian economic activity and GDP, and any other individual sector GDP contribution over a considerable timeframe. As shown in Figure 7-15, the mining sector makes a combined NAD ~35 million contribution to GDP in 2023, compared to a Venus project contribution of NAD ~43 million to ~65 million at peak year for the two oil price scenarios respectively.



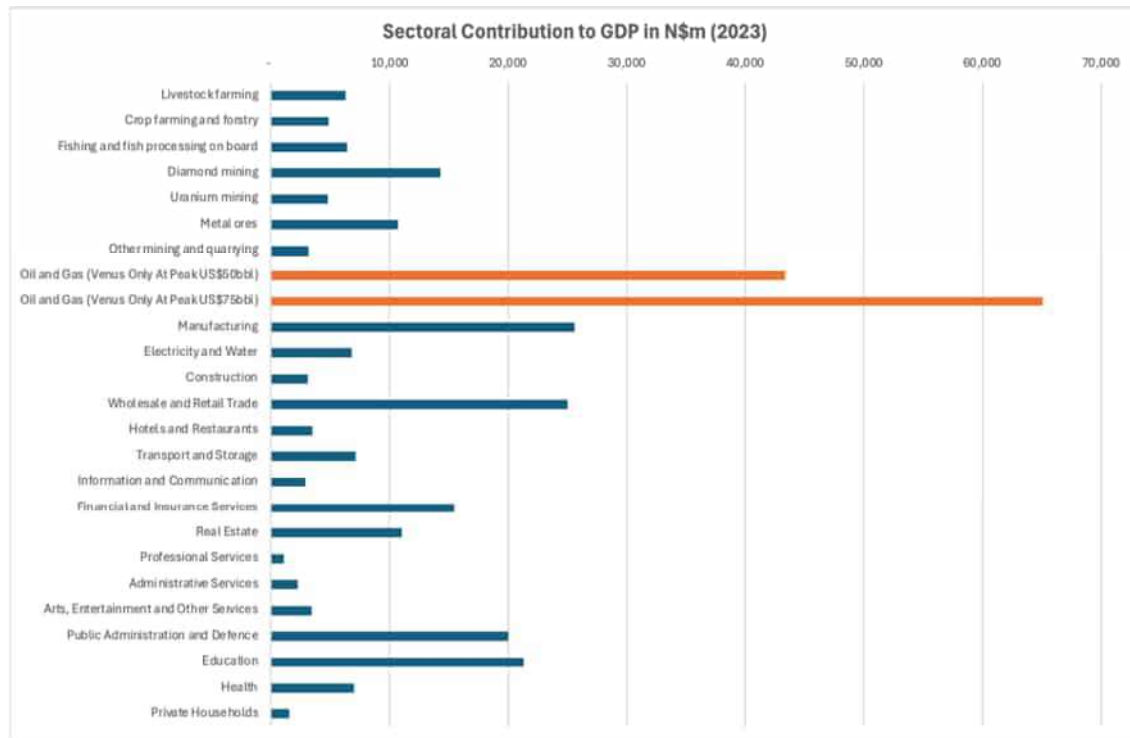


Figure 7-15: Contributions to GDP in N\$ million by sector in 2023 compared to peak contribution to GDP by Venus project at US\$50 and US\$75 per bbl (approx. 5 years after FO)

Source: NSA and Author's calculations

7.4.1.3 Impact Assessment: Contribution to GDP

Sensitivity of receptor

Receptor sensitivity is not directly applicable to an economy, but as an economy is reasonably diversified the sensitivity to change is deemed **low**.

Magnitude

The potential impact (benefit) of the project on the Namibian economy is deemed of **high intensity** for both oil price scenarios as the potential contribution of the project to the Namibian GDP potentially exceeds that of any other sector during the peak oil production period. The project-related GDP contribution is estimated to exceed 10% for four years in the lower oil price scenario and eight years under the higher oil price scenario modelled during peak production. Before and after that period contribution is considerably lower.

Benefits would persist over the **long-term** from project construction to decommissioning, albeit to varying degrees depending on the production profile, local procurement and contributions and other factors.

Benefits would extend **nationally** as the economy as a whole would benefit.

Overall, the impact of the project on the Namibian GDP is considered to be of **very high (positive)** magnitude for both oil price scenarios.



Significance

Based on the **very high** magnitude rating and **low** sensitivity rating, the impact significance is considered **high** for both oil price scenarios (see Table 7-37).

Residual impact

Macro-economic impacts depend on a large number of variables that are beyond the control of the project operator. Increasing the local content in procurement will likely increase the project's contribution to Namibian GDP but can also intensify some other (negative) impacts discussed later in this report and local content depends on a large number of other variables. As such, no feasible mitigation can be implemented by the operator.

If the project is granted a 10-year extension of production, then contribution to GDP will continue for a longer period. As the expansion will be at the end of the forecast period, based on the trends shown in Table 7-36 the contribution in later years is expected to grow smaller relative to GDP.

Table 7-37: Impact rating for the project impact on Namibia's GDP

Impact on Namibia's GDP		
Type of Impact	Direct and Indirect	
Nature of Impact	Positive	
Phases	All	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	n/a
Magnitude	Very High	n/a
Intensity	High	n/a
Duration	Long-term	n/a
Extent	National	n/a
Significance	High +	n/a
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	Partially reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	Low	
Mitigation / management measures		
Not applicable		



7.4.2 Contribution to Exports and Trade Balance

7.4.2.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Contribution to exports and trade balance	X	X	X

7.4.2.2 Impact Description

The Venus development will sell all the crude oil produced to the global market where prices are set by the interplay of global demand and supply. Considering that no refinery is currently available, it is assumed that all produced crude oil will be exported. Crude oil exports from Venus will add very significantly to the existing basket of goods that Namibia exports.

Figure 7-16, Figure 7-17 and Table 7-38 show the estimated Venus project-related goods (not services) export value over the life of the Venus development for the two oil price scenarios, amounting to between ~N\$ 593 billion and N\$ 888 billion (~USD 34 billion to USD 51 billion) over a 25-year project lifetime.

This assumes Namibia's non-oil merchandise exports grow at the same 3% annual rate as the non-oil economy. It should be noted that this is an assumption and there is no reason why non-oil exports should grow at the same rate as the non-oil economy. In reality, Namibia's export performance has been poor and its export basket relatively unchanged over many years.

Furthermore, it is assumed that oil production will have no adverse effects on non-oil export sectors which is by no means certain. There is an extensive economic literature describing the well-known phenomenon of "Dutch disease" where, through a variety of economic mechanisms, oil and gas exports lead to a decline of a country's non-oil export sectors. This is discussed later in Section 7.4.6.

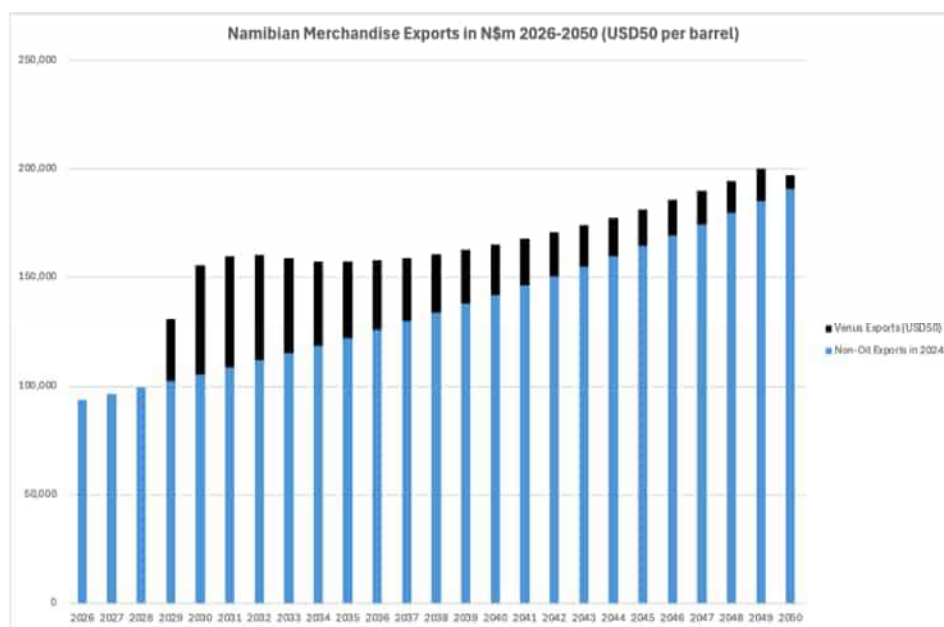


Figure 7-16: Goods exports in N\$ million assuming FID in 2026 and oil price at US\$50 per barrel.



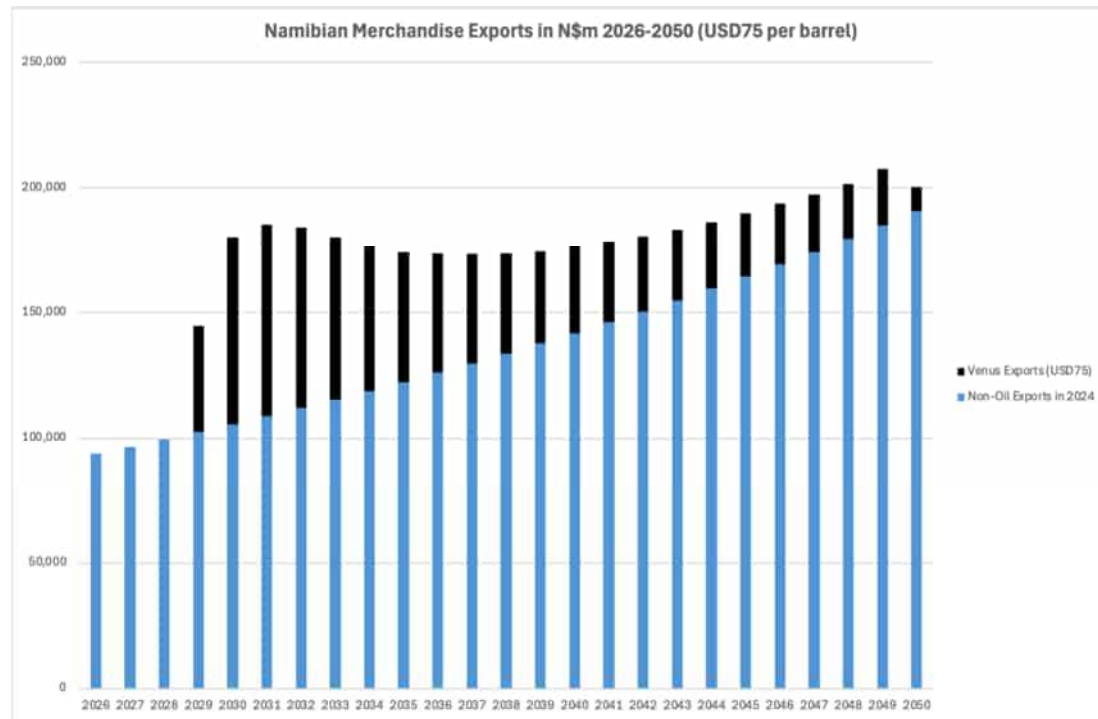


Figure 7-17: Goods exports in N\$ million assuming FID in 2026 and oil price at US\$75 per barrel.

Table 7-38: Estimated value of exports related to the Venus development relative to estimated overall exports.

Year assuming FID in 2026	US\$50/bbl scenario		US\$75/bbl scenario	
	Total Exports	Project-related Exports	Total Exports	Project-related Exports
2026	93 803	0.0%	93 803	0.0%
2027	96 617	0.0%	96 617	0.0%
2028	99 515	0.0%	99 515	0.0%
2029	130 568	21.5%	144 602	29.1%
2030	155 437	32.1%	180 368	41.5%
2031	159 781	31.9%	185 300	41.3%
2032	160 183	30.1%	184 272	39.2%
2033	158 690	27.3%	180 352	36.0%
2034	157 405	24.5%	176 695	32.8%
2035	157 185	22.1%	174 582	29.9%
2036	157 800	20.1%	173 668	27.4%
2037	158 959	18.3%	173 516	25.2%
2038	160 480	16.7%	173 850	23.1%
2039	162 619	15.3%	175 052	21.3%
2040	165 150	14.1%	176 783	19.7%
2041	167 808	12.9%	178 641	18.2%
2042	170 640	11.8%	180 696	16.7%



Year assuming FID in 2026	US\$50/bbl scenario		US\$75/bbl scenario	
	Total Exports	Project-related Exports	Total Exports	Project-related Exports
2043	173 971	10.9%	183 435	15.5%
2044	177 487	10.0%	186 383	14.3%
2045	181 360	9.3%	189 798	13.3%
2046	185 605	8.7%	193 698	12.5%
2047	189 824	8.1%	197 486	11.6%
2048	194 316	7.5%	201 606	10.8%
2049	200 112	7.5%	207 458	10.8%
2050	197 187	3.3%	200 314	4.8%

In both scenarios:

- Oil exports grow and then decline according to the production schedule described above. In both cases exports peak at FO + 2 years when they account for between 32% and 41% of total goods exports for oil at US\$50 and US\$75 per barrel respectively.
- Crude oil from Venus becomes Namibia's most important single export product by value exceeding the total value of exports from the mining sector (which reached N\$52.3 billion in 2024) for the best part of the first decade of production.
- Crude oil exports significantly reduce Namibia's trade deficit in goods and services (which in 2024 stood at N\$64.5 billion as imports of goods and services reached an unprecedented N\$166.6 billion or 68% of GDP) for the period of time when crude oil production is high. However, this deficit in 2024 was partly the result of higher than usual imports which in large part was due to the oil and gas exploration programmes of various companies including TotalEnergies and the JV itself. Thus, once the import intensive construction phase of Venus project is over, the production phase is likely to turn Namibia's merchandise trade deficit into a trade surplus.

7.4.2.3 Impact Assessment: Contribution to Exports and Trade Balance

Sensitivity of receptor

Receptor sensitivity is not directly applicable to an economy or exports, but as an economy and exports are reasonably diversified the sensitivity to change is deemed **low**.

Magnitude

The potential impact (benefit) of the project on Namibian exports is deemed of **high intensity** for both oil price scenarios as the project-related exports would make up a very large proportion of total exports and have a material impact on the trade balance.

Benefits would persist over the **long-term** during production, albeit to varying degrees depending on the production profile and oil price.

Benefits would extend **nationally** as the economy and country as a whole would be affected.

Overall, the impact (benefit) of the project on Namibian exports is considered to be of **very high (positive)** magnitude for both oil price scenarios.

Significance

Based on the **very high** magnitude rating and **low** sensitivity rating, the impact significance is considered **high** for both oil price scenarios (see Table 7-39).



Residual impact

Export-related impacts depend on a large number of variables that are beyond the control of the project operator. As such, no feasible mitigation can be implemented by the operator.

If the project is granted a 10-year extension of production, then contribution to exports will continue for a longer period. As the expansion will be at the end of the forecast period, based on the trends shown in Table 7-38 the contribution in later years is expected to grow smaller relative to overall exports.

Table 7-39: Impact rating for the project impact on Namibia's exports and trade balance

Impact on Namibia's exports and trade balance		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	n/a
Magnitude	Very High	n/a
Intensity	High	n/a
Duration	Long-term	n/a
Extent	National	n/a
Significance	High +	n/a
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	Fully reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	None	
Mitigation / management measures		
Not applicable		

7.4.3 Contribution to Government Revenue

7.4.3.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Procurement of facilities and services	X	X	X
State income from taxes and levies	X	X	X
Loss of income from local procurement and spending			X
Loss of state income from taxes and levies			X



7.4.3.2 Impact Description

The contribution made by the Venus development to government revenue will depend crucially on Namibia's petroleum taxation regime¹¹⁹. NAMCOR revenues from its share in the development also accrue as revenue to the State of Namibia.

During the first years of production after FO, costs will be deducted and losses will be carried forward and the project will not generate taxable profits, and thus there will be no petroleum income tax (PIT) revenue to government. During this phase, government revenue will consist mainly of royalty and export levy income, and both will be relatively high because production will be high.

Once investment costs have been recovered, the project will start paying PIT to government, and revenues from PIT will far exceed revenues from the royalty and export levy which continue to flow as long as oil production and export take place.

Revenues from oil production are significant and make up as much as between 7.9% and 14.2% of total revenue to government at US\$50 and US\$75 a barrel respectively. Based on the below estimates, they would amount to a total of ~N\$ 127 billion to N\$ 229 billion (~USD 7 billion to USD 13 billion) over a 25-year project timeframe.

If during this period oil prices and revenues turn out to be higher than anticipated while operating costs remain unchanged, the Additional Profit Tax (APT) may kick in and generate additional tax revenues (this possibility has not been modelled). Because production starts to decline over time, revenues from the royalty and the export levy also decline.

¹¹⁹ Namibia's petroleum taxation regime at the time of writing is summarised below:

- A petroleum income tax (PIT) is levied at a rate of 35% of taxable income. The PIT is levied separately for each licence area.
- Exploration expenditure is accumulated throughout the exploration phase and claimed in full in the year of first production. On-going exploration expenditure after first production is deductible in the year incurred.
- Development expenditure is accumulated throughout the development phase and claimed over three years, starting in the year of first production. On-going development expenditure after first production is deductible over three years from the year the costs are incurred.
- Losses can be carried forward.
- An incremental three-tiered Additional Profit Tax (APT) is charged on the after-tax net cash flow from petroleum operations in each license area only if the inflation-adjusted after-tax returns exceed 15%, 20% or 25%. The first tier rate is set at 25% but the second and third tier rates set in the Petroleum Agreement of each license.
- Exploration, development and operating expenditures, as well as Royalty and PIT, are all fully deductible in the year they are paid in the computation of the APT net cash flow for the year.
- A royalty of 5% is paid on gross revenue regardless of profitability.
- An export levy of 1.5% is paid on gross exports regardless of profitability.



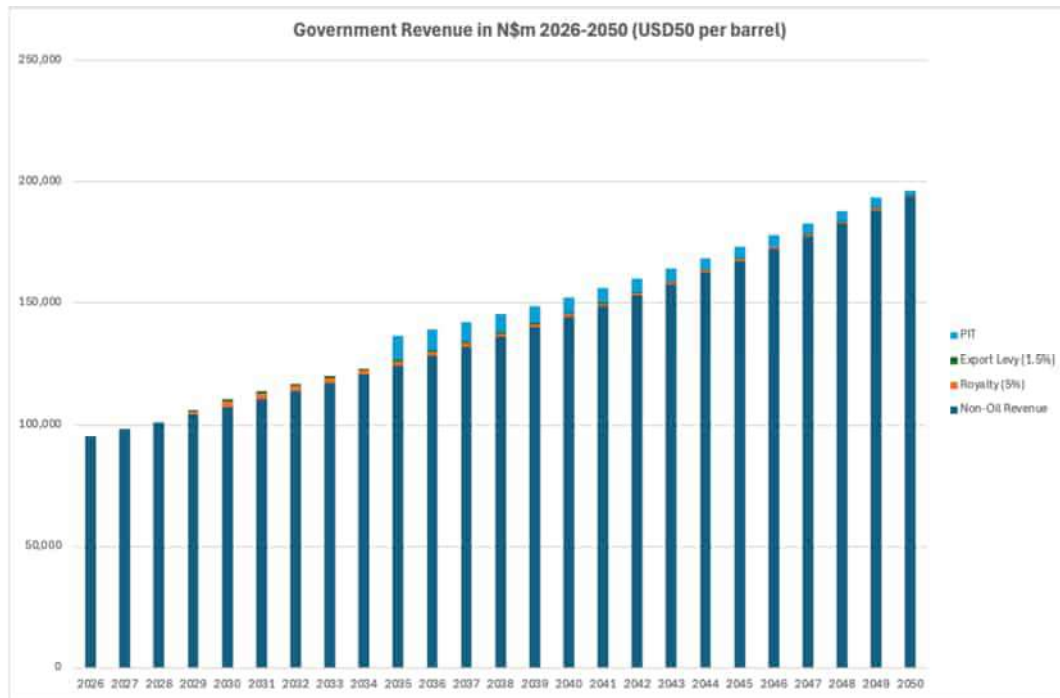


Figure 7-18: Government revenue in N\$ million assuming FID in 2026 and oil price at US\$50 per barrel

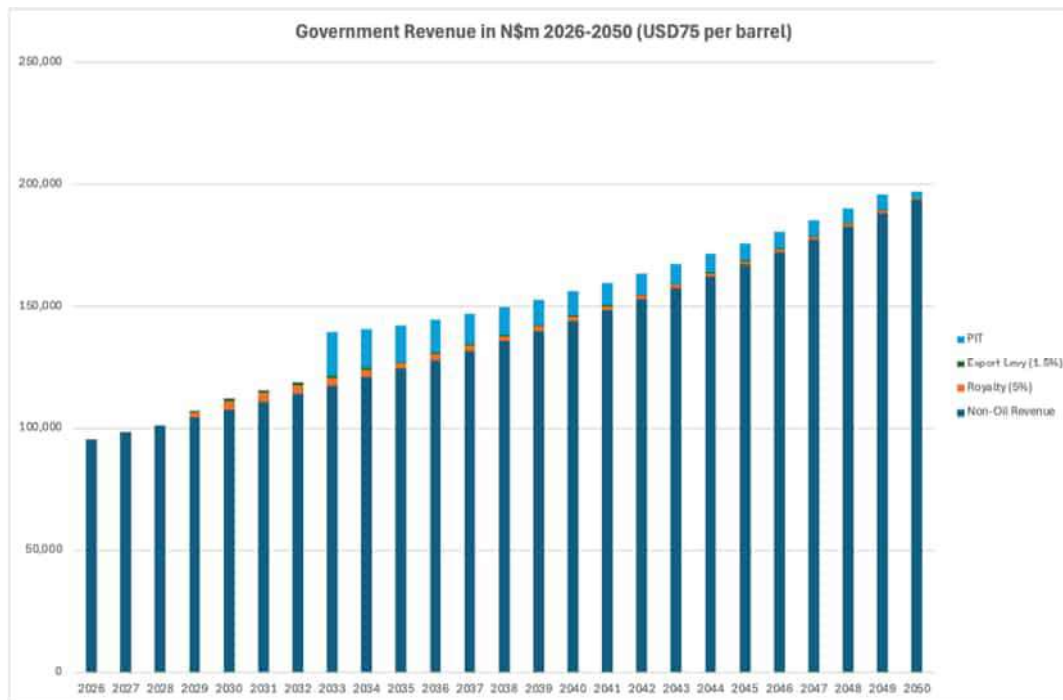


Figure 7-19: Government revenue in N\$ million assuming FID in 2026 and oil price at US\$75 per barrel



Table 7-40: Estimated government revenue from the Venus project relative to estimated total revenue assuming FID in 2026

Year assuming construction from 2026	US\$50/bbl scenario		US\$75/bbl scenario	
	Total government revenue	Project-related government revenue	Total government revenue	Project-related government revenue
2026	95 378	0.0%	95 378	0.0%
2027	98 239	0.0%	98 239	0.0%
2028	101 187	0.0%	101 187	0.0%
2029	106 047	1.7%	106 959	2.6%
2030	110 590	2.9%	112 210	4.3%
2031	113 887	2.9%	115 545	4.3%
2032	117 018	2.7%	118 584	4.0%
2033	120 119	2.3%	136 424	14.0%
2034	123 330	2.0%	140 787	14.2%
2035	131 284	5.2%	142 453	12.6%
2036	139 129	7.9%	144 604	11.4%
2037	142 070	7.1%	147 092	10.2%
2038	145 211	6.4%	149 824	9.2%
2039	148 645	5.8%	152 934	8.4%
2040	152 294	5.3%	156 308	7.7%
2041	156 071	4.8%	159 808	7.0%
2042	159 993	4.3%	163 463	6.4%
2043	164 176	4.0%	167 441	5.9%
2044	168 514	3.6%	171 583	5.4%
2045	173 068	3.4%	175 980	5.0%
2046	177 848	3.1%	180 640	4.6%
2047	182 718	2.9%	185 361	4.3%
2048	187 784	2.7%	190 299	4.0%
2049	193 406	2.7%	195 941	3.9%
2050	196 128	1.1%	197 207	1.7%

7.4.3.3 Impact Assessment: Contribution to Government Revenue

Sensitivity of receptor

Receptor sensitivity is not directly applicable to government revenues, but as government revenues are reasonably diversified the sensitivity to change is deemed **low**.

Magnitude

The potential impact (benefit) of the project on Namibian government revenue is deemed of **medium intensity** for both oil price scenarios as the project-related income would generate a significant proportion of and have a material impact on government revenue.

Benefits would persist over the **long-term** during production, albeit to varying degrees depending on the production profile and oil price.

Benefits would extend **nationally** as the economy and country as a whole would be affected.



Overall, the impact of the project on Namibian government revenue is considered to be of **very high (positive)** magnitude for both oil price scenarios.

Significance

Based on the **very high** magnitude rating and **low** sensitivity rating, the impact significance is considered **high** for both oil price scenarios (see Table 7-41).

Residual impact

Government revenue depends on variables that are outside of the control of the project operator. As such, no feasible mitigation can be implemented by the operator.

If the project is granted a 10-year extension of production, then contribution to Government revenue will continue for a longer period. As the expansion will be at the end of the forecast period, based on the trends shown in Table 7-40 the contribution in later years is expected to grow smaller.

Table 7-41: Impact rating for the project impact on Namibia's government revenue

Impact on Namibia's government revenue		
Type of Impact	Direct	
Nature of Impact	Positive	
Phases	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	n/a
Magnitude	Very High	n/a
Intensity	Medium	n/a
Duration	Long-term	n/a
Extent	National	n/a
Significance	High +	n/a
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	Fully reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	Low	
Mitigation / management measures		
Not applicable		

7.4.4 Potential Benefits from Utilisation of Government Revenue

Revenues can be used in three broad ways by the Government of Namibia:

1. Spend on **consumption** (which includes spending on government services). For example, it could raise social grants or public sector salaries. It is this aspect of Venus development that is likely to have the greatest immediate social impact since social grants, including social pensions for the elderly, children's maintenance grants, disability grants, grants for vulnerable children, and the Conditional Basic Income Grant reach a large number of the country's poorest people.



2. Spend on **investment** (infrastructure spending). For example, government could choose to boost public infrastructure such as roads, railways, airports or port infrastructure. The National Budget 2025/26 envisages development spending (capital spending) of N\$12.8 billion. Revenues from Venus development could amount to N\$11-19 billion at peak which means the potential exists to substantially increase investment spending.
3. **Save** rather than spend these revenues, for example, in the Welwitschia Sovereign Wealth Fund (SWF) managed by the Bank of Namibia which has already been created. This fund was formally launched on 13 May 2022 by former President Geingob together with the Governor of the Bank of Namibia and seeded with N\$262 million from the National Budget. The Fund as proposed consists of two funds: the Stabilisation Fund and the Intergenerational Savings Account. At the time of drafting this report, the impression was given by government that revenues from resource rents (including oil and gas and green hydrogen) would be channelled into the Fund. Legislation to govern the Fund has been drafted but has not been passed by Parliament. In her maiden State of the Nation Speech, President Nandi-Ndaitwah revealed the Fund had grown to N\$453 million by January 2025. However, there is no mention of the Fund in the SWAPO Party Manifesto Implementation Plan.

A combination of these three options could be chosen, in other words some consumption, some investment and some saving.

Government spending on consumption and investment (alternatives 1 and 2 above) would boost GDP in the shorter term. The multiplier would depend on the precise balance, nature and efficiency of the projects the money is spent on, as well as the split of any money allocation between alternatives 1, 2 and 3 above. Such spending multiplier has not been incorporated into the GDP estimates presented above, as it is highly speculative. There is also a danger that pumping too much money too quickly into domestic consumption or investment could lead to inflation.

Saving the money in a SWF would avoid such inflationary risks because the funds would not boost aggregate demand in the economy.

Government could also consider borrowing on the strength of future revenues once the FID is taken. The effect thereof would depend on how borrowed funds are used. However, Namibia's experience with two Eurobonds suggests that such borrowing does not always lead to higher growth and/or repayment can pose challenges.

This impact is qualitatively discussed and not formally rated.

7.4.5 Impact on Inflation

In principle, Venus development could have an inflationary impact on the Namibian economy but, without very sophisticated and detailed modelling, it is not possible to quantify this with any precision. The impact of the Venus development on inflation in Namibia is likely to vary from the construction phase to the operation phase as the nature of demand for goods and services and the ability of local suppliers to meet that demand varies.

In the construction phase, the impact will depend primarily on the extent to which demand created for those goods and services required for the construction of Venus such as engineering and manufacturing is met by local suppliers. The greater the degree of local content, the greater the likelihood that local suppliers may raise prices to the rest of the economy. This would raise producer prices and affect the Producer Price Index (PPI) calculated monthly by the Namibian Statistics Agency (NSA). Particular industries, such as the fishing and the mining industries, are likely to be more affected than others, such as services, because they require similar goods and services to the oil and gas industry. However, these price affects are unlikely to make a significant impact on consumer inflation which is determined by a far broader range of goods and services produced not only in



Namibia but also in South Africa and beyond. However, there may be certain niche markets, such as the housing market in Walvis Bay, Lüderitz and Windhoek or the market for particular kinds of skilled labour, which are particularly sensitive to the demand created by Venus development.

The greatest inflationary risk from Venus development is likely to be connected to how government manages the revenues generated by the development given the very substantial sums of money involved. If revenues are used to finance consumption, for example by raising public sector salaries or cash transfers, this may have consequences for consumer inflation. If revenues are used to finance investment, for example by building public infrastructure such as roads, this may have consequences for producer inflation. Government can minimise inflationary dangers by ensuring any additional spending takes place gradually and with an eye on the supply response of the economy.

This impact is qualitatively discussed and not formally rated.

7.4.6 Dutch Disease

“Dutch Disease” is the well-known and much studied economic phenomenon which most commonly occurs in natural resource-rich economies where the exploitation of the natural resource gives rise to significant inflows of foreign currency and real exchange rate (the ratio of nominal exchange rates to prices) appreciation which in turn leads to a loss of competitiveness in other tradable sectors, such as agriculture and manufacturing, ever greater dependence on the natural resource, and the growth of non-tradable sectors. This Dutch Disease ends up stunting long-term economic development. The term was coined in 1977 by *The Economist* to describe the decline of the manufacturing sector in the Netherlands after the discovery of the large Groningen natural gas field in 1959.

Namibia's existing currency arrangement with the South African Rand shields the Namibia dollar from undue currency appreciation. As long as Namibia maintains the peg to the Rand, the impact of foreign currency inflows will be diluted due to the much larger size of the South African economy which is approximately 30 times larger than the Namibian economy. By maintaining the peg as an anchor, currency inflows will lead to the accumulation of foreign exchange reserves rather than currency appreciation.

This situation would change if Namibia were to abandon the peg to the Rand and the challenge would then become one of either finding an alternative anchor or managing a free float of the currency in a way that did not lead to damaging currency appreciation.

The classic phenomenon of Dutch Disease operates through the channel of the foreign exchange market and the exchange rate. However, even with a fixed peg, Namibia will not be immune from potential Dutch Disease-like impacts on the non-oil economy. Thus, for example, if government uses revenue from oil to boost public sector salaries, this may have a ripple effect throughout the economy and raise the wages that private sector employers have to pay which could also impact on export sectors. The presence of a highly-remunerated oil industry is likely to attract the most skilled workers which other sectors, including other export sectors, will then have to match to retain workers. Revenues, therefore, will have to be carefully managed to avoid such negative consequences but this is a challenge for government and policymakers not the JV.

This impact is qualitatively discussed and not formally rated.

7.4.7 Financing of NAMCOR

Namibia's state-owned National Petroleum Corporation of Namibia (NAMCOR) is a 10% partner in the Venus development Joint Venture. In theory this means NAMCOR has to raise 10% of the development costs of the project but in exchange stands to benefit from 10% of the profits.



Given development costs are estimated at US\$12 billion, NAMCOR's share in CapEx is approximately US\$1.2 billion (N\$22.2 billion), a substantial amount compared to Namibia's entire national budget for 2025/26 of N\$96 billion.

NAMCOR's stake is carried, which means that other JV partners plan to finance the Venus development entirely from their own resources and NAMCOR would have to repay its share to the JV partners out of its revenue from the Venus development once it accrues. This means that NAMCOR or Namibia do not have to raise a loan to finance the stake, but that revenue arises to NAMCOR later, once the share is repaid.

Based on NAMCOR's share of 10% stake in the JV, a simple calculation suggests that NAMCOR could repay US\$1.2 billion within a period of 4 years at an oil price of US\$75 and 6 years at an oil price of US\$50.

Thereafter, revenues accrue to NAMCOR in full and the question then becomes whether NAMCOR pays out its profits to its shareholder (the government) or retains profits for future operations. This decision lies many years in the future.

This impact is qualitatively discussed and not formally rated.

7.4.8 Social Cost of Carbon

The social cost of carbon (SCC) attempts to measure the monetized value of damages to society caused by incremental CO₂ emissions resulting in climate change. SCC values have been estimated and refined for several decades, but no universally accepted value has emerged to date, and studies continue to report wide ranges of SCC values. Rennert et al (2022) report a range USD \$44 – USD 413 per tCO₂, with their preferred mean SCC estimate at USD 185 per tCO₂ (which is 3.6 times higher than the US government's value of \$51 per tCO₂ at the time of publication).

However, there are several concerns with using SCC at project level:

- SCC values have a very wide range, and there is no agreement on which values is correct. Any specific SCC value is thus speculative.
- SCC were primarily calculated and used to inform policy decisions by governments and are less well suited to the assessment of the impact of a specific project, which should be considered within a larger policy context.
- SCC places a value on emissions irrespective of context and does not take into account the principle of "Common but Differentiated Responsibilities and Respective Capabilities", i.e. that emissions from developing countries are not held to the same standard as those from a developed country.
- It is difficult to differentiate between incremental damage caused by climate change relative to events that would have occurred in the absence of climate change and additional damage from increased (value of) development that can be affected and development in unsuitable areas.
- SCC are borne globally and unequally distributed across different regions, depending on the nature of regional climate change, state of local infrastructure and economy etc. Thus, emissions associated with the Venus project would impose an SCC on countries other than Namibia, while conversely Namibia currently bears the SCC from emissions produced and/or emitted in other countries.

The importance of considering SCC at a national and policy – rather than project – level is evidenced in the fact that global oil supply and use are a function of market demand, which in turn is a function of the availability and effectiveness of alternative energy sources and economic activity. If there is sufficient global capacity to adapt oil supply to demand (which appears to be the case at present) then global demand would not be materially affected by



whether oil is produced at the Venus development or not. In this case any oil not produced in Namibia would likely be produced in another country, and Namibia would still bear the SCC of associated global emissions without benefiting from income associated with domestic production.

It is possible that countries directly benefiting from oil revenue may pursue decarbonisation efforts less vigorously, though many oil producing nations are making considerable strides in developing alternative low- or no-carbon energy sources, partly funded by revenue from past or current oil production.

This impact is qualitatively discussed and not formally rated.

7.4.9 Generation of Employment Opportunities and Income from Local Procurement

7.4.9.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Procurement of facilities and services	X	X	X
Employment of staff	X	X	X
Loss of income from local procurement and spending			X
Retrenchment of staff			X

7.4.9.2 Impact Description

According to the 2023 Population and Housing Census, the broad levels of unemployment in the //Kharas and Erongo Regions was 40.1% and 41.9% respectively while it was more than 54.8% in Namibia. The key concerns raised by stakeholders strongly reflected the importance of the generation or creation of employment opportunities for local communities. Although it is anecdotal, it was reported that in one business example in Lüderitz, on average one employed person takes cares of 17 dependants.

Employment provides many socio-economic benefits, the obvious ones of which are improved standard of living, access to resources and services and the ability to improve living conditions. Less obvious ones are related to self-actualisation and improved perceptions of self-worth and dignity. The IBS (Deloitte, 2024) estimated the number of direct, indirect and induced jobs that the project is likely to generate during the various stages.

Direct jobs are defined as jobs generated by industries developing and supporting O&G projects development on-site (e.g., upstream production activities). **Indirect jobs** are jobs generated by companies supporting O&G projects off-site (e.g., freight activities, road construction, etc.) and activities subcontracted by the main contractor to other companies). **Induced jobs** are direct and indirect jobs generated by the oil and gas industry revenues being re-invested (or spent) in the local economy (e.g., hotels, banking, IT & Communication, etc.) and economic activity because of the spending of the O&G project related workforce.

During the **construction phase** (including drilling and installation), a total of 5 000 jobs is expected to be created, of which 500 will be direct jobs, 2 000 indirect jobs and 2 500 induced jobs according to the Industrial Baseline Survey (Deloitte, 2024). Primary drivers would be transport industry (+953 jobs), wholesale and retail trade (+598 jobs), and private households services (+595 jobs). Most of the workforce involved in the drilling activities will comprise highly specialised skilled staff.



During the **production phase**, an estimated 7 000 jobs are expected to be created of which 600 will be direct jobs, 600 indirect jobs and 5 800 induced jobs. Primary drivers would be private household services (+1 707 jobs), wholesale and retail trade (+1 671 jobs), and transport industries (+880 jobs) (Deloitte, 2024).

The JV is committed to work with the communities within the area of impact to encourage and facilitate as much local employment and inclusion of as many local contractors as possible. However, the IBS found that little upstream oil and gas products and services are available in Namibia while availability of civil construction services, transportation and logistics, workforce services and metalworks and metal equipment production were better represented. The areas where quick wins for Namibian entities are possible are shown in the figure below and shows that 13 supply chains have minimal shortcomings and provide quick wins for Namibian entities. However, there are another 18 supply chains where supply volume and compliance with standards in these industries were too low to participate in the oil and gas sector at the time of the survey. Nevertheless, some of these can be supported to improve on capacity and compliance to also benefit from the Oil and Gas sector in the medium term.

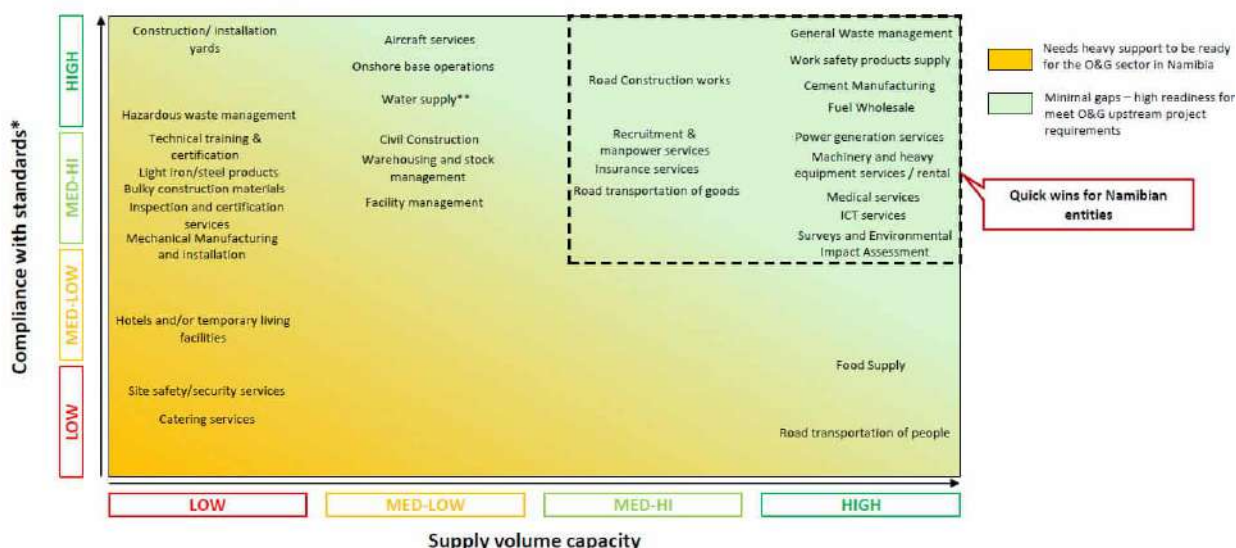


Figure 7-20: Supply Chains offering quick wins for Namibia.

Source: (Deloitte, 2024)

Realistically it is clear that the vast majority of offshore employment related to the drilling campaign, the installation of subsea infrastructure, the commissioning of the FPSO and the operation of the FPSO will comprise highly specialised and skilled staff which will in all probability be international crews. However, drilling contracts will be longer in duration than exploration drilling, and this will allow more Namibians to access these opportunities as skills are built over time. Similarly, it is likely that many Namibians may, over the 20+ years of operation, find employment on the FPSO or onshore support activities.

Business and employment opportunities in the quick win sectors may capture some of the indirect and induced jobs but there are many sectors where more skills development and training are required before access to such employment opportunities can be expected. With the commitment of the JV to strongly support Namibia's Local Content Policy and to assist and contribute to training and skills development, more Namibian workers will find their way into the more complex and rewarding jobs within the oil and gas sector.



On a national level, Figure 7-21 compares estimated employment generation by the Venus development with sectoral employment provided by the 2023 Labour Force Report. The direct, indirect and induced employment impact of Venus development is small at national level compared to direct employment by sector, and between 0.9% and 1.3% of the total number of employed people. Such numbers are typical for offshore oil and gas projects.

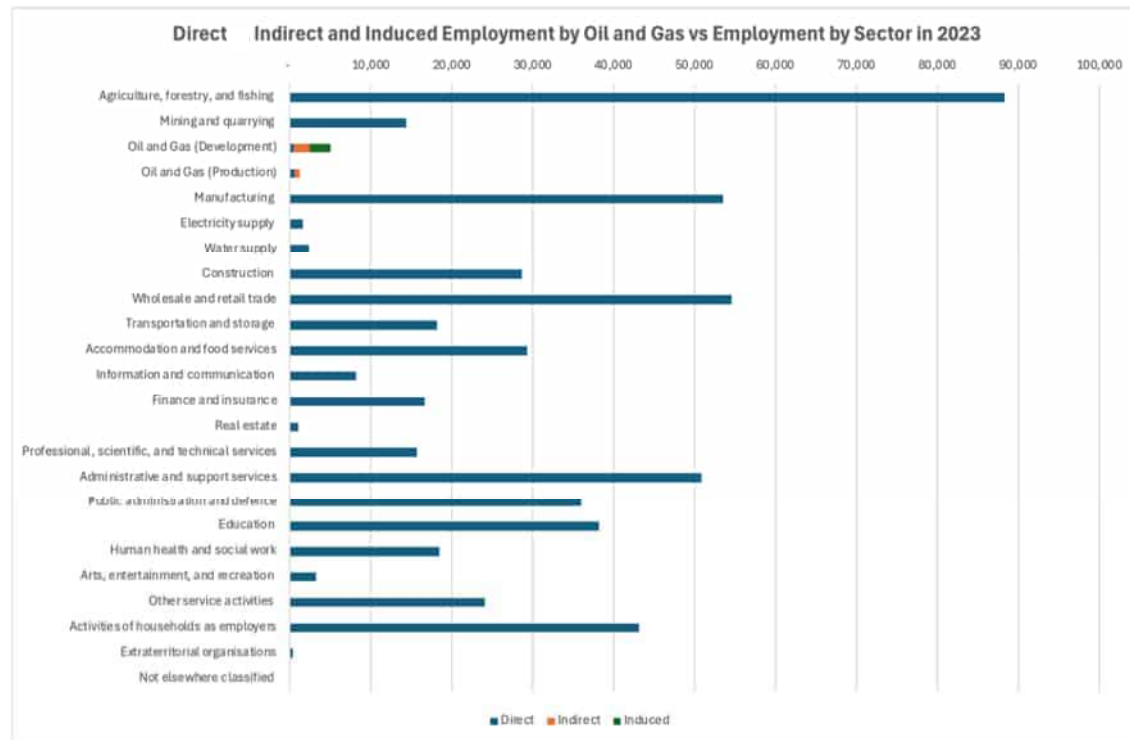


Figure 7-21: Direct, indirect and induced employment by Venus versus employment by sector in 2023

Source: IBS and Labour Report 2023

To contextualise the numbers of employment opportunities that would potentially be created by the project on a regional level: in 2023 there were 1 713 and 5 285 people in the //Kharas and Erongo Regions respectively directly employed in the fishing industry – similar to the total projected direct, indirect and induced employment numbers for the Venus field during operation. In 2023 there were 5 469 employed people in the !Namiñūs Constituency and 31 747 in the Walvis Bay Rural and Urban Constituencies combined.

7.4.9.3 Impact Assessment: Generation of Employment Opportunities and Income from Local Procurement

It is highly likely that this impact will occur if the project proceeds. If it is assumed that half of the indirect and induced jobs will accrue to local people in the quick-win industries, it is likely to have a substantial impact on the local economies that may be the seat of the various supply chains. In Lüderitz, it is likely to outperform employment in the fishing industry while it will nearly match fisheries employment numbers in Walvis Bay.

Sensitivity of receptor

While the sensitivity of the receptor is not directly applicable but since the levels of unemployment and youth unemployment is so high, the sensitivity to employment creation is deemed **medium**.



Magnitude

The **intensity** of the potential impact within the context of the coastal towns is rated as **medium** since the extent of potential employment creation is significant in the context of the local economies.

Employment opportunities will persist over the life of the project. This will be 25 to 35 years (should a 10-year extension be granted). However, the duration is conservatively assessed as **long-term**.

Impacts would extend to the regions and is therefore rated as of **regional extent**.

Overall, the **magnitude** of the impact employment opportunities and income from local procurement is rated as **high**.

Significance

Based on the **high** magnitude rating and **medium** sensitivity rating, the impact significance is considered **high**.

Residual impact

With the implementation of enhancement measures listed below the residual benefit remains **high**.

The **cumulative impact** that may be caused by the growth in the oil and gas sector and the development of more fields will have a considerable positive effect in the medium to long term.

If the project is granted a 10-year extension of production, then employment opportunities would continue for a longer period.

Table 7-42: Impact summary: generation of employment opportunities and income from local procurement

Generation of Employment Opportunities and Income from Local Procurement		
Impact Description	Generation of Employment Opportunities and Income from Local Procurement	
Type	Direct	
Nature	Positive	
Phases	ALL	
Criteria	Without Enhancement	With Enhancement
Sensitivity of Receptor	Medium	Medium
Magnitude	High	High
Intensity	Medium	High
Duration	Long Term	Long Term
Extent	Regional	National
Significance	High +	High +
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	n/a positive impact	
Loss of Resources	n/a	
Avoidance Potential	n/a	
Enhancement Potential	Medium	
Cumulative Impacts	Possible	



7.4.9.4 Enhancement

During most public engagements, meetings and discussions, attendants expressed a clear concern that they may not be able to access the opportunities presented by the project due to a lack of knowledge, lack of skill or the failure of the procurement process. Nevertheless, the JV already partnered with local companies during the exploration phase and already employed about 200 local people (including employees of direct contractors) during this phase. It can also be assumed that more emphasis can be placed on this aspect once FID is taken as opposed to during exploration, which is at risk expenditure with no long term visibility.

The following other potential issues were observed:

- While acknowledging the JVs policy on local content and procurement principles, some stakeholders are of the opinion that larger contractors bring their own staff to the exclusion of local people.
- The ability for prospective service providers to register on the website is acknowledged but a more user friendly and transparent system should be developed for registration with the objective of facilitating the link between larger international companies, local companies and local individual employment seekers.
- Questions from stakeholders with regard to sectors and opportunities for work and contracting are often referred to the IBS and the specific suppliers required for the project. While the IBS identifies all of the supply chains and evaluated capacities, the document is not user friendly to lesser skilled and educated contractors and individuals.

The impact of employment creation and income from local procurement could be enhanced by the following actions:

- Develop and widely communicate a **dedicated information portal** for prospective service providers with clear explanations of required standards of performance, compliance and qualification.
- Use local partners as much as possible for information dissemination. Involve local partners and government agencies to help in disseminating information to their stakeholders through their regular outreach and information sharing sessions throughout the country. This will also help manage expectations regarding employment opportunities.
- Support implementation of the recommendations in the IBS relating to local contracting and employment. These are listed in the IBS and include: increase awareness of the Oil and Gas Industry procurement and employment requirements, define project-level local content policies and incentives, assist with the establishment of a national talent register, set up critical platforms and processes to provide guidance on addressing O&G opportunities and support development of the local workforce ecosystem, establish a national supplier database, develop supplier capabilities and prioritise supply changes for development.
- Develop a project-level **local content policy** with clear guidance, requirements and monitoring mechanisms to ensure that the JV and its contractors are obliged to include local content in their tender offers and their teams. Care must be taken that such obligations are not framed in a way (such as “if possible”) that provides an “easy out” for contractors by claiming that no suitable compliant local content could be found. It must also include a component of capacity building where skill and experience levels of local companies are improved. In addition, the Local Content Policy should make specific provision for employment of people without formal qualifications, especially those from vulnerable groups and communities. This should be aligned with Namibia’s National Upstream Petroleum Local Content Policy (which is currently under development)



7.4.10 Impact on Skill Levels and Skills Development

7.4.10.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Procurement of facilities and services	X	X	X
Employment of staff	X	X	X
Loss of income from local procurement and spending			X
Retrenchment of staff			X

7.4.10.2 Impact Description

The IBS analysed the supply and demand of qualifications that are of importance for the oil and gas industry and found that in the skilled category, it is mostly specialised engineering qualifications such as electrical, mechanical, chemical, industrial and petroleum engineering qualifications that are lacking. In the semi-skilled fields, insufficient qualified people are available in maritime studies, diving certificates, laboratory/chemistry technicians, pipefitting and welding – specific to Oil and Gas standards-, industrial processes and petroleum studies.

Qualifications that are in high supply and medium to high supply are shown in Figure 7-22. However, while some qualifications were found to have sufficient local availability, further upskilling will be required in some cases to meet Oil & Gas standards.

However, these qualifications are virtually absent in local communities, and it was made clear that there are concerns amongst the youth and the general population that the benefits of gaining employment in the oil and gas industry will largely pass them by and that they would in all likelihood only have access to low paying general jobs.

The JV has expressed its commitment to training and skills development for local people and the youth. To this end, it contributes to the Petrofund, which provides scholarships for Oil and Gas related qualifications. JV members provide job opportunities and on the job training and about 15 Namibians are for example currently working for TotalEnergies EP Namibia. During the exploration phase on PEL 56/Block 2913B about 200 local Namibians have been employed to support offshore exploration activities.

The JV supports institutions such as UNAM to develop courses in fields that are not currently available but needed in the Oil and Gas industry.

A critical policy component that would help to ensure appropriate skills development is the local content policy. Since most of the indirect and induced opportunities will be contracted out, the local content requirements will demand skilled workers that meet requirements and this will force contractors to also invest in skills development and training to enhance their competitiveness in tendering for applicable services.

There is a large percentage of graduates in Namibia who cannot find employment or the opportunity to gain experience. The oil and gas sector in general and the project in particular provides an opportunity to young people to focus their education on careers in the petroleum sector with a realistic opportunity to be employed and gain experience for some of them. Once these skills have been developed in country, they can also be transferred to other economic sectors such as mining to further enhance national development.



	High supply qualifications	Medium - High Supply qualifications	Low supply qualifications	No local supply qualifications
Criteria	Supply / Demand ratio >200% For each year After FID ¹	100% < Supply / Demand ratio <200% On at least a year After FID ¹	Supply / Demand ratio <100% On at least a year After FID ¹	Supply / Demand ratio =0% For each year After FID ¹
Skilled	- Accounting / finance studies - Architecture - Business studies - Computer engineering - Environmental health sciences - HR studies - Law studies - Marketing studies - Transport and logistics engineering	- Civil engineering* - Geology	- Electrical engineering* - Mechanical engineering* - Chemical / industrial engineering*	Petroleum engineering
Semi-skilled	- Accounting & Finance - Business Administration/Services - Bricklaying and Plastering - Carpentry & Joinery - Construction Engineering - Data technician - Electrical technician - Food and Beverage - Forklift - Instrumentation	- Mechanical - Occupational Health and safety - Office Administration - Paralegal - Paramedics - Plumbing - Real Estate - Surveying - Tractor Loader Backhoe (TLB) - Welding (construction)	- Civil Construction management - Commercial Cookery - Construction carpentry - Logistics management - Tiling	Maritime Studies
	- Diving certificate - Laboratory / chemistry - Pipefitting - Welding (specific to O&G) - Industrial process - Petroleum studies			

Figure 7-22: Local Availability of Qualifications

Source: (Deloitte, 2024)



7.4.10.3 Impact Assessment: Contribution to Local Skills Development and Levels

Given the high levels of unemployment in general and youth unemployment in particular (56.8% in Namibia, 48.6% in //Kharas and 50.6% in Erongo – broad definition) the addition of a completely new economic sector in Namibia that mostly affords good and well-paying employment presents significant opportunities for skills development and enhancement that are focussed on the oil and gas sector. It also provides opportunities for people who are not academically inclined to pursue vocational skills to be able to access employment opportunities in the oil and gas sector. Skills development can also benefit other economic sectors over time. Both the Universities in Namibia have already started to focus on the oil and gas industry while the VTCs already offer training in skills that can be used in the industry.

Support to educational institutions further strengthen this positive impact and provide the opportunity for focused studies in the science and mathematics fields. The JV already contributed toward training and capacity building of local Namibians during the exploration phase of the project. TEEPNA has communicated the intention of the JV to increase these efforts once (if) FID is taken and the project proceeds.

Sensitivity of receptor

The sensitivity of the receptor is not directly applicable to training and capacity building, but since the need is so high, the sensitivity to training and skills development is deemed **medium**.

Magnitude

The **intensity** of the potential impact is rated as **medium** since there is such a great need within the local communities to improve skills and get access to appropriate training targeted at specific jobs.

Training and Skill development opportunities will persist over the life of the project. This will be 25 to 35 years (should an extension be granted). This assessment conservatively selects the shortest period over which potential benefits may occur (25 years) and therefore the duration is assessed as long term.

Impacts would extend to the regions and is therefore rated as of **regional extent**.

Overall, the **magnitude** of the impact of training and skill development is rated as **high**.

Significance

Based on the **high** magnitude rating and **medium** sensitivity rating, the impact significance is considered **high**.

Residual impact

With the implementation of enhancement measures listed below the residual benefit remains **high**.

The **cumulative impact** that may be caused by the growth in the oil and gas sector and the development of more fields will have a considerable positive effect in the medium to long term.



Table 7-43: Impact summary: impact on skill levels and skills development

Impact on Skill Levels and Skills Development		
Impact Description	Contribution towards improving local skills through skills development and educational support	
Type	Direct	
Nature	Positive	
Phases	ALL	
Criteria	Without Enhancement	With Enhancement
Sensitivity of Receptor	Medium	Medium
Magnitude	High	High
Intensity	Medium	Medium
Duration	Long Term	Long Term
Extent	Regional	National
Significance	High +	High +
Additional Assessment Criteria		
Probability	Highly Likely	
Reversibility	n/a positive impact	
Loss of Resources	n/a	
Avoidance Potential	n/a	
Enhancement Potential	Low	
Cumulative Impacts	Possible	

7.4.10.4 Enhancement

The JV intends to contribute to the development of local skills and training to enable local Namibians to fill as many of the positions required for the operation as possible. It also followed up with contributions to Petrofund and employment and capacitation of young people within the sector. It is also harnessing cooperation and support from the Government to work towards the development of skills in this important new sector. The impact on skill levels and skills development should be enhanced by the actions outlined in Section 7.4.9.4.

7.4.11 Impacts on Livelihoods in the Fishing Industry

7.4.11.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Presence and Implementation of safety zones	X	X	X
Changes in catch availability due to behavioural change in fish	X	X	

7.4.11.2 Impact Description

A Maritime Exclusion Zone (3 NM around subsea infrastructure and FPSO) and Marine Restricted Area (10 NM around the FPSO) will be enforced at all times at the offshore Venus project area, (~1.7 km) and will be described in a Notice to Mariners as a navigational warning. In addition, a safety exclusion zone (~1.7 km radius) will be enforced around the nearshore transshipment buoy.

Clear protocols with respect to marine traffic, in cases where the seabed is exploited or where particular vessels such as drilling or mining units operate, exist in Namibian waters at present and are followed by mariners as a matter of course. Such exclusion zones may “displace” fishing vessels from fishing grounds and other marine traffic from their normal



routes. The project area is located well offshore of the coastal upwelling system where fishing is concentrated. Water in the vicinity of the field is nutrient poor and therefore not a very productive fishing area.

The fisheries assessment found that small pelagic purse-seine fisheries, mid-water trawl fisheries, demersal trawl fisheries and demersal longline fisheries do not overlap with the Venus project area or PEL 56/Block 2913B area. It is therefore anticipated that the safety zones during drilling, installation and operation is unlikely to have any impact on these types of fishing activities.

Some overlap between Tuna pole line catch effort and pelagic longline effort were found but large pelagic longline effort indicated less than 5 000 hooks per annum (which is a very low effort) while Tuna pole effort occurred around the site but not actually overlapping with it. The restricted areas may therefore impact the large pelagic longline fisheries with little to no impact on other fisheries.

The nearshore transshipment area exclusion zone overlaps with some nearshore linefish fishing grounds, ski-boat based small-scale fisheries (SSF) operations and an area zoned (but not currently used) for mariculture (see Figure 5-80). Depending on the final transshipment buoy location within the proposed area, the safety exclusion zone may overlap with the zoned aquaculture area, as per the example of Alternative 2. Therefore, depending on the final agreed transshipment buoy location, it is possible that this (currently un-used) aquaculture zone cannot be used if it lies within the exclusion zone.

With respect to the impact on SSFs, the exclusion zone covers a very small area of the total fishing grounds used by SSF. It will not impact any shore based and line fisheries, and overlaps with a small area accessed by the ski-boat fisheries active closest to shore.

7.4.11.3 Impact Assessment: Potential Disruption to Fishing Industry

While the safety zones potentially restrict fishing activity where it overlaps with offshore activities and installations, the fact that the Venus project area is so far offshore, located in deep and less productive waters and the very limited overlap in catch and effort indicate that the impact is not significant.

Sensitivity of receptor

The sensitivity of the receptor is rated as **medium** since fish may change behaviour as a result of the activities, releases and noise of the activity.

Magnitude

The potential Intensity of impact of the safety / restricted zones on the fishing industry and fishing activity is rated as **very low** because the safety exclusion zones are likely to have a negligible disturbance or nuisance which will be barely noticeable by the fishing industry.

The safety zones will be in place for as long as the project exists and will only cease at the end of the operational life of the field. This will be 25 to 35 years and is therefore rated as **permanent** (i.e. longest period over which negative effects may occur, considering 10-year extension is granted).

The safety / restricted zones are relatively limited in extent and are therefore rated as **site only** given the context of distance from shore and size of the fishing grounds.

Overall, the magnitude of the impact of the safety exclusion zones on fishing vessels and the industry is rated as **very low**.



Significance

Based on the **very low** magnitude rating and **medium** sensitivity rating, the impact significance is considered **very low** for both fishing vessel movement and the disruption of the fishing industry.

Residual impact

The residual impact remains **very low**.

The **Cumulative Impact** of exclusion zones as a result of oil and gas and other potential projects is likely to be negligible due to its relatively insignificant size.

Table 7-44: Impact summary: impacts of safety zones on fishing and disruption of the industry

Impact of safety zones on fishing and disruption of the industry		
Impact Description	Impact of safety zones on fishing and disruption of the industry	
Type	Direct	
Nature	Negative	
Phases	ALL	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	n/a
Magnitude	Very Low	n/a
Intensity	Very Low	n/a
Duration	Permanent	n/a
Extent	Site	n/a
Significance	Very Low	n/a
Additional Assessment Criteria		
Probability	Definite	
Reversibility	Reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	Low	
Cumulative Impacts	Possible	
Cumulative impacts possible if more similar safety zones cover larger areas and extend into the fishing grounds.		

7.4.11.4 Mitigation and Management Measures

Alternative 2 (Figure 4-29) may be preferred by authorities, in which case the mariculture area zoning of the affected (unused) area should be revised - this is deemed feasible especially in the light that there are no current mariculture activities at this site.

With the significance of the impact being negligible, no mitigation is required.



7.4.12 Impact on Shipping Traffic

7.4.12.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Presence and Implementation of safety zones	X	X	X
Presence of vessels and Implementation of safety zones	X	X	X

7.4.12.2 Impact Description

There are various international shipping routes along the Namibian coastline. The majority of the international shipping traffic is routed along the outer edge of the continental shelf. Traffic inshore of the continental shelf largely comprises fishing and mining vessels.

The Venus offshore project area lies within a medium to high intensity vessel route that passes around southern Africa as shown in Figure 5-81. To provide more perspective, Figure 7-23 provides a snapshot of vessels on 3 July 2025.

The field is located on the maritime route of cargos and tankers outside the continental shelf (Figure 7-23) while the vessels along the continental shelf are mostly fishing vessels, interspersed with some cargo vessels.

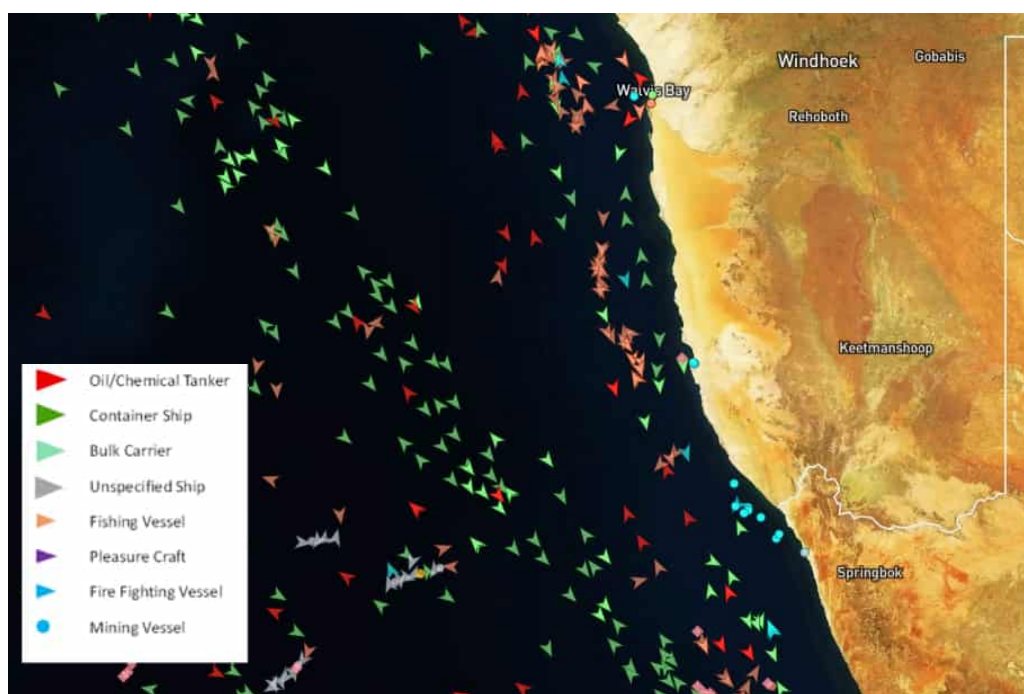


Figure 7-23: Vessel positions on 3 July 2025 along the Namibian Coast

Source: <http://www.marinetraffic.com/> accessed July 2025

Both the safety zones around the Venus infrastructure as well as vessel traffic between the Venus offshore project area and Lüderitz and Walvis Bay may have an impact on shipping traffic. Vessels with a route that crosses the exclusion zone around the drilling units and construction vessels during construction phase and the FPSO during production phase would need to adjust their course to avoid the restricted area. This could cost time and contribute to additional cost and reduction in profit. However, the exclusion zone at the development field is relatively small and remains in the same place – vessels can thus plan their route adjustment well in advance.



If the safety exclusion zones during Venus field development activities are communicated timeously to mariners and the position of the safety exclusion zone around the FPSO is institutionalised in marine traffic mapping, it is unlikely to have any meaningful impact on the commercial shipping industry.

By the same token, the additional traffic that will be added to existing traffic through the 6 to 9 support vessels during construction phase and possibly 2 to 3 support vessels during production phase is negligible and unlikely to impact on fishing vessels or commercial marine traffic. The routes of the support vessels from the Venus offshore project area to Lüderitz is evident in Figure 5-81.

7.4.12.3 Impact Assessment: Disruption of Shipping Traffic and Industry

Sensitivity of receptor

Sensitivity of commercial shipping to the safety exclusion zones as well as vessel traffic between the field and the onshore base and the DPST between the FPSO and the nearshore transshipment area just north of Walvis Bay is rated as **low** because it is somewhat sensitive but not threatened by the safety exclusion zones or the additional vessel traffic within the context of the vastness of the ocean and the COLREG protocols aimed at avoiding collisions at sea.

Magnitude

The **intensity** of the potential impact is rated as **low**. Change can easily be tolerated and would not affect the functioning of the commercial shipping industry in any significant way.

The **duration** of the impacts from the drilling and subsea equipment installation safety exclusion zones are medium term (taking place up to 5 years) while that of the field during operation will be 21 to 31 years, hence classified as permanent. Overall, it is rated as **permanent** considering the safety exclusion zones/maritime restricted areas are enforced throughout the project (up to 35 years).

The impacts are likely to be confined to the Venus field but will also extend along the routes from the Venus Field to Lüderitz and to Walvis Bay where the Nearshore Transshipment will take place. The **extent** is therefore rated as **local**.

Overall, the **magnitude** of the impact of safety zones and vessel traffic is rated as **low**.

Significance

Based on the **low** magnitude rating and **low** sensitivity rating, the impact significance is considered **very low**

Residual impact

With the implementation of mitigation measures listed below the residual impact remains **very low**.

The **Cumulative Impact** of increased development of offshore oil and gas projects is likely to increase in significance as oil and gas related traffic increases. It is likely that similar technology and operations will be used in deepwater extraction projects.



Table 7-45: Impact summary: impact on shipping traffic and disruption of the industry

Impact on Commercial Shipping and Disruption of the Industry		
Impact Description	Impact on Commercial Shipping and Disruption of the Industry	
Type	Direct	
Nature	Negative	
Phases	ALL	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	Low
Magnitude	Low	Low
Intensity	Low	Low
Duration	Permanent	Permanent
Extent	Local	Local
Significance	Very Low -	Very Low -
Additional Assessment Criteria		
Probability	Likely	
Reversibility	Partially Reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	Medium	
Cumulative Impacts	Possible	
Cumulative impacts possible if more field development projects come on stream and traffic and safety zones increase in size and distribution		

7.4.12.4 Mitigation and Management Measures

Mitigation measures listed in the Fisheries Impact Assessment (see Section 7.3.1.6), pertaining to SANHO and Maritime notifications and markings on navigational charts, are relevant in this section and not repeated here.

7.4.13 Impacts on Community Health and Safety

7.4.13.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Crew presence in local communities during rotation	X	X	X
In-migration	X	X	X

7.4.13.2 Impact Description

The Venus Project is largely an offshore project but, through its onshore base and procurement, also has a link to the onshore communities. As such, it will have some impact on the onshore communities from where services and facilities will be provided to the project.

The project is likely to attract different people and groups to the onshore bases from where services to the offshore installations will be provided. This will have an impact on the harbour towns of Lüderitz and Walvis Bay, where most support services are likely to be located.



During the construction phase (e.g. drilling and installation of offshore infrastructure) crew members on the drilling units, installation vessels and support vessels will rotate regularly, and international crew members (which are likely to represent a high proportion of the staff) may overnight in Lüderitz, Walvis Bay and/or Windhoek before flying to their home destinations, or when arriving in Namibia.

The prospect of employment opportunities is likely to attract more prospective job seekers to Lüderitz and Walvis Bay, adding to recent high levels of in-migration. The movement of such people is generally uncontrolled, and it is expected they would be predominantly unskilled and likely to settle for longer periods in the poorer sections of settlements in the area, where facilities are already inadequate.

During the production phase, the dynamics may change somewhat over time. It is anticipated that over the years, an increasing number of Namibians will be directly employed in offshore roles on the FPSO, support vessels and DPST, and in onshore support bases.

Short term influx into Walvis Bay or Lüderitz as a result of the project may result in conflict and competition for resources in the local communities. Residents of the //Kharas Region already have the perception that “incomers” from other regions in Namibia capture most employment opportunities. Such short-term influx may lead to changes in community health and safety in the host town(s).

Conflict in the communities as a result of competition for employment may occur because they all compete for the same jobs. This will mostly apply to the unskilled labour force but also in the semi-skilled categories, with the local population fearful of such competition because of lower skill levels being present in the local communities and therefore a high probability that they may not be successful in securing employment and contracts.

Port cities and towns are known for their higher incidence of sex work related to social problems such as alcohol abuse, gender-based violence and crime. Health consequences such as sexually transmitted disease and the spread of communicable diseases tend to occur more frequently. Any significant influx of new people into an area may aggravate the problem, and/or put increased pressure on health services in the area.

A growth in the population is likely to increase pressure on social services such as health and education where existing health and education infrastructure are already under pressure.

International crew is likely to have little contact with local communities because of the manner in which crew changes are structured and codes of conduct they must adhere to.

7.4.13.3 Impact Assessment: Potential Impacts to Community Health and Safety

Sensitivity of receptor

Sensitivity of the host communities is rated as **medium** because there is already competition for employment and resources. Poverty levels are high and social ills such as alcohol abuse, prostitution and violence are already high. More influx and more competition are likely to increase these.

Magnitude

The **intensity** of the potential impact is rated as **medium**. Moderate change in the local communities may be expected and the impacts may cause more disturbance and discomfort to the local coastal communities, especially through more pressure on livelihoods and ability to procure social services.

However, people and communities are generally resilient and learn to deal with challenges over time. Given the likelihood of an improvement in the local economy, more employment



opportunities and increased spending, the balance is likely to be re-established over time. The **duration** of the impact is therefore rated as **medium term**.

The impacts are likely to be confined to the coastal towns mainly and may extend to the //Kharas and Erongo Regions. The **extent** is therefore rated as **regional**.

Overall, the magnitude of the impact of the community health and safety impacts of the project is rated as **low**.

Significance

Based on the **low** magnitude rating and **medium** sensitivity rating, the impact significance is considered **medium**

Residual impact

With the implementation of mitigation measures listed below the residual impact reduces to **low**.

The **Cumulative Impact** of increased development of offshore oil and gas and other ancillary and related projects is likely to increase in significance as influx and pressure on resources increase.

Table 7-46: Impact summary: community health and safety impacts

Community Health and Safety Impacts		
Impact Description	Community Health and Safety Impacts	
Type	Direct	
Nature	Negative	
Phases	All	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	Medium
Magnitude	Low	Low
Intensity	Medium	Low
Duration	Medium Term	Medium Term
Extent	Regional	Regional
Significance	Medium -	Low -
Additional Assessment Criteria		
Probability	Likely	
Reversibility	Partially Reversible	
Loss of Resources	None	
Avoidance Potential	None	
Mitigation Potential	Low	
Cumulative Impacts	Possible	
Cumulative impacts possible if more field development projects come on stream		

7.4.13.4 Mitigation and Management Measures

Migration to towns like Lüderitz and Walvis Bay is expected due to perceived opportunities in the oil and gas sector. To mitigate the impact of this in-migration, it is essential to plan for population growth by ensuring adequate health and educational services. Both towns have developed urban structure plans to guide future development and are committed to leveraging the economic benefits of the Venus Field. Successful implementation of these



plans and infrastructure development can reduce negative impacts on community health and safety. Social responsibility initiatives may also help by supporting urban and social services.

The operators can assist local authorities, and the following measures are recommended:

- Develop and implement a Code of Conduct Protocol applicable to both JV and contractor staff, which provides a framework to guide behaviour of employees when onshore. As a minimum, it should include:
 - o Training on health and safety principles, disease awareness, prevention programmes, regular inductions,
 - o Measures and provisions to ensure that local residents and their cultures are respected,
 - o No tolerance for engaging in activities such as prostitution and substance abuse and other types of antisocial behaviour,
 - o No tolerance for activities that may compromise the health and well-being of the local community, and
 - o Provision of health services and screenings for staff.
- Implement a grievance procedure for the JV and all contractors. This must be well known in the host communities and must be sensitive to human rights, clear and transparent, afford complete confidentiality and responsive and transparent in terms of how grievances are dealt with.
- Provide local town authorities with forward-looking information on project implementation, planning and resource requirements throughout the project to support effective local planning for land, services and utilities by the local authorities. All engagements with Project's stakeholders will be managed through the Stakeholder Management Plan (SEP)

Successful implementation of the mitigation measures will reduce the impact significance because it will soften and help manage the impact of influx on the one hand while also preventing behaviour that would compromise community health and safety.

7.4.14 Impact on Governance and Conflict

7.4.14.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Exploitation of natural resources (resource curse)		X	

7.4.14.2 Impact Description

The exploitation of oil and gas resources in Namibia presents both opportunities and risks. International experience has shown that resource-rich countries may face economic stagnation and political instability—a phenomenon known as the resource curse. This typically arises from poor governance and mismanagement of revenues generated from non-renewable extractive industries.

Namibia, however, has a longstanding history of resource extraction (e.g., diamonds, gold, uranium) and has generally maintained governance standards sufficient to avoid large-scale negative outcomes. In anticipation of oil and gas development, the country is actively strengthening its regulatory frameworks. Notably, the sector has been placed under the direct oversight of the Office of the President to ensure effective governance, transparency, and responsiveness.



The Venus project is expected to be Namibia's first oil and gas project. Its implementation will serve as a foundational case for refining regulatory approaches and ensuring that the sector contributes positively to national development and the well-being of Namibians.

7.4.14.3 Impact Assessment: Potential Disruption to Governance and Generation of Conflict

Sensitivity of receptor

Receptor sensitivity is not directly applicable to governance and conflict, but as citizens and civil society have a keen interest in how the development of the sector will be managed by government, the sensitivity is rated as **medium** given high levels of poverty and inequality in Namibia and expectations of improved levels of well-being as a result of increased revenue.

Magnitude

The **intensity** of the potential impact is rated as **low** because it is not expected that government will deviate in any significant way from the way in which it approaches the extractive natural resource industry in Namibia.

The impact will only cease after the operation life of the project, which will last at least 21 years (31-years if a 10-year extension is granted). The duration of the impact is therefore rated as **permanent** (considering the 31-year production phase).

The impacts are likely to be **national** in extent since it will influence the entire country.

Overall, the magnitude of the impact of the project on governance and conflict is rated as **high**.

Significance

Based on the **high** magnitude rating and **medium** sensitivity rating, the impact significance is considered **high**.

However, the probability that the impact will occur is unlikely.

Residual impact

With the implementation of mitigation measures listed below the residual impact reduces to **very low**.

The **Cumulative Impact** of the development of more oil and gas projects is likely to increase in significance as oil and gas related income and resultant resource allocation increases.



Table 7-47: Impact summary: governance and conflict

Governance and Conflict		
Impact Description	Governance and Conflict	
Type	Direct	
Nature	Negative	
Phases	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	Medium
Magnitude	High	Very Low
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	National	National
Significance	High -	Very Low -
Additional Assessment Criteria		
Probability	Unlikely	
Reversibility	Partially Reversible	
Loss of Resources	None	
Avoidance Potential	High	
Mitigation Potential	Low	
Cumulative Impacts	Unlikely	

7.4.14.4 Mitigation and Management Measures

Conflict and governance failures can be avoided by the development and implementation of a comprehensive regulatory framework for the oil and gas sector whereby all protocols, regulations and cooperative agreement frameworks are set up with checks and balances to ensure that these are followed and that it will result in real broad-based development will result from the revenue from the exploitation of the nation's oil and gas resources. This would reduce the significance rating to medium but the probability of the impact actually occurring remains unlikely.

The operators can assist in the avoidance of governance failure and conflict by implementing the following measures:

- Adhere to Namibian legal and regulatory requirements
- Comply with international good practice standards and guidelines relating to reporting and governance
- Ensure transparent reporting of Project payments to government in line with the Extractive Industries Transparency Initiative (EITI) expectations
- Adhere to Operator's compliance procedures



7.4.15 Impacts on Coastal Towns

7.4.15.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Procurement of facilities and services	X	X	X
Employment of staff	X	X	

7.4.15.2 Impact Description

The development of the Venus Field requires an onshore base and a substantial number of services from shore through contractors. The IBS found that Namibia cannot supply all of the various goods and services and that some will (at least for the time being) be provided from outside the country. Nevertheless, the growth in potential business and employment may overwhelm the coastal towns of Lüderitz and Walvis Bay through high levels of population influx in search of better opportunities and increased demand for industrial land and housing.

The Coastal Towns are already under pressure from population growth and have been unsuccessful in accommodating its current population in formal settlement arrangements. According to the 2023 Population and Housing Census, 36% of households in Walvis Bay live in improvised shacks, either illegally or in the backyards of formal houses. In Lüderitz, 38.4% of households live in shacks. The same is true for the ability of government to deal with the provision of social services as is evidenced by changes in the learner teacher ratios as reported earlier.

Waste management is another problematic infrastructure component in Namibian Towns in general and much is being done across the country to improve waste management sites and infrastructure. However, there is no oil and gas focussed infrastructure in either of the two towns. A hazardous waste management facility is planned for development by a private contractor and there are also plans afoot to develop oil and gas specific waste management facilities, should the development proceed.

Failure to manage these two important aspects may have a negative impact on the towns with growing informal settlement, low levels of access to utility and social services and lack of suitably planned land to support the project.

7.4.15.3 Impact Assessment: Potential Impacts to Coastal Towns

Sensitivity of receptor

Both Lüderitz and Walvis Bay currently find it difficult to keep up with the supply of land and services for their growing populations. The sensitivity of the towns to an accelerated influx and demand for land is deemed to be **high**.

Magnitude

The intensity of the potential impact is rated as **medium** because it will cause disturbance and probably discomfort to the current residents of the towns and negatively impacts its amenity to residents.

The impact will in all likelihood accelerate on FID and then taper off over time as people become more familiar with opportunities and local authorities adapt and implement suitable development projects to deal with the challenges. It will probably endure until the start of operations and then recede. The duration of the impact is therefore rated as **long term**.

The impacts are likely to be **local** in extent since it will influence the two towns where the onshore base will be established and the services provided from.

Overall, the magnitude of the impact of the project on coastal towns is rated as **medium**.



Significance

Based on the **medium** magnitude rating and **high** sensitivity rating, the impact significance is considered **medium**.

The probability that the impact will occur is likely.

Residual Impact

With the implementation of mitigation measures listed below the residual impact reduces to **low**.

The **Cumulative Impact** of the development of more oil and gas projects and ancillary business and service providers are likely to increase in significance as influx is likely to increase further on the back of perceived availability of economic and employment opportunities.

Table 7-48: Impact summary: impact on coastal towns

Impact on the Coastal Towns		
Impact Description	Impact on the Coastal Towns	
Type	Direct	
Nature	Negative	
Phases	ALL	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	High
Magnitude	High	Low
Intensity	Medium	Low
Duration	Long Term	Long Term
Extent	Local	Local
Significance	Medium -	Low -
Additional Assessment Criteria		
Probability	Likely	
Reversibility	Partially Reversible	
Loss of Resources	None	
Avoidance Potential	Low	
Mitigation Potential	High	
Cumulative Impacts	Possible	

7.4.15.4 Mitigation and Management Measures

The only effective way in which to deal with these impacts is to understand the potential levels of influx and the demand for land required by the project and to prepare for it. Both towns recently procured urban structure plans which anticipate and project the expected growth rates, identify the extent and best spatial arrangement of land to accommodate the growth and land demand for other land uses and provide a basis for compiling budget and land development programmes. With respect to waste management, the required waste management infrastructure must be in place before waste from the drilling, field development and operations commence.

The missing link is the financial resources to actually implement the land development programmes and they need to seek support from government to help accommodate the growth of an industry that benefits the entire country. If the towns, with the assistance of



government, can plan ahead and ensure that suitably zoned land is planned and developed to accommodate the additional demand, the significance of the impact is reduced to low.

The following measures are recommended for implementation by the operators:

- Provide local town authorities with forward-looking information on project implementation, planning and resource requirements throughout the project to support effective local planning. All engagements with Project's stakeholders will be managed through the Stakeholder Management Plan (SEP).
- Develop a focused waste management plan as recommended in the waste management study with emphasis on filling the gap in number and size of O&G focused waste management companies.

7.4.16 Impact of Decommissioning on Income and Livelihoods

7.4.16.1 Source of Impact

Aspect	Drilling & Installation	Production	Decommissioning
Presence and Implementation of safety zones			X
Retrenchment of staff			X
End of procurement			X

7.4.16.2 Impact Description

The IBS estimated that the project will generate about 5 000 direct, indirect and induced jobs during the construction phase and 7 000 direct, indirect and induced jobs during the production phase. This positive impact was assessed in Section 7.4.9. However, once the project reaches end of construction and end of life, these jobs will be lost, and this can cause great hardship and difficulty among these families who became used to stable and well-paying jobs.

On the other hand, it would be possible for such employees to move on to other projects, other industries or start their own businesses to provide services to the oil and gas sector or other sectors for that matter. Their experience and skill will endure and will in all likelihood help them to secure alternative employment.

While it is not realistic to assume that all will be seamlessly accommodated in similar projects or jobs or will find jobs at all, under normal circumstances the decommissioning of the project is highly foreseeable and will not come suddenly or as a surprise, allowing staff to prepare for the end of the project and transition to other jobs or retirement.

Companies who secured contracts during the production phase will see their activity associated with the project decline, as supplier agreements end and business activities contract. Smaller suppliers - who may rely on the Project as their key or only client - will be particularly vulnerable.

Both the JV and its contractors will be bound by the Namibia Labour Act which regulates employment and retrenchment matters in such cases.

7.4.16.3 Impact Assessment: Potential Loss of Income and Livelihoods following Decommissioning

Sensitivity of receptor

The employees of the JV and its contractors and suppliers at the end of construction and at the time of closure and decommissioning are likely to be highly sensitive to the loss of their livelihood. However, because it is foreseeable and can be planned for. The level of sensitivity of the receptor is deemed to be **medium**.



Magnitude

The intensity of the potential impact is rated as **high** because it will in all likelihood reduce their incomes and livelihoods substantially, even with retrenchment payments and access to pension contributions.

The impact will probably endure for a period of 1 to 5 years and be reversible over time as people find new employment. The duration of the impact is therefore rated as **medium term**.

The impacts are likely to be **local** (but may also be felt at regional level) in extent since they will affect workers in the key supply centres whose contracts will end / not be renewed.

Overall, the magnitude of the impact of the project decommissioning on income and livelihoods is rated as **medium**.

Significance

Based on the **medium** magnitude rating and **medium** sensitivity rating, the impact significance is considered **medium**.

The probability that the impact will occur is certain.

Residual Impact

With the implementation of mitigation measures listed below the residual impact reduces to **low**.

The **Cumulative Impact** of the development of more oil and gas projects is likely to decrease in significance as more employment opportunities becomes available to replace lost employment from decommissioned or even temporary employment during drilling and field development.

Table 7-49: Impact summary: impact of decommissioning on income and livelihoods

Impact of Decommissioning on Income and Livelihoods		
Impact Description	Impact of decommissioning on Income and Livelihoods	
Type	Direct	
Nature	Negative	
Phases	Decommissioning	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	Medium
Magnitude	Medium	Low
Intensity	High	High
Duration	Medium Term	Short Term
Extent	Local	local
Significance	Medium -	Low -
Additional Assessment Criteria		
Probability	Likely	
Reversibility	Partially Reversible	
Loss of Resources	Medium	
Avoidance Potential	Low	
Mitigation Potential	High	
Cumulative Impacts	Unlikely	



7.4.16.4 Mitigation and Management Measures

The following mitigation measures are recommended:

- Prepare a decommissioning plan for the project that addresses potential end of work or service contracts.
- Share the decommissioning plan with employees so that they have advance warning of the planned shut down and are in a position to start searching for alternative employment.
- Comply with labour law requirements and compensate employees for their retrenchment as a result of the closure of the project.
- Provide employment certificates and testimonials for retrenched staff to facilitate alternative employment. The skills and experience that were acquired during the employment as well as the potential of other similar employment opportunities if the oil and gas sector was to grow in Namibia as anticipated will also contribute to improved ability to find alternative employment.
- Provide opportunities for capacity-building and training for employees to enable them to find alternative employment after decommissioning.

These mitigation measures may reduce the time to find alternative employment and therefore the duration of the impact to short term but is unlikely to change the assessment of the other criteria.

7.5 Cultural Heritage Impacts

7.5.1 Deterioration of Cultural Heritage

This section provides a summary of the impacts assessed in the Cultural Heritage specialist study provided in Appendix O.

7.5.1.1 Source of Impact

The following project aspects may result in direct and/or indirect impacts on intangible cultural heritage in the following project phases.

Aspect	Drilling & Installation	Production	Decommissioning
Discharges to sea from drilling units and project vessels (support / supply / installation/ DPST, FPSO & CT)	X	X	X
Seabed disturbance from drilling & installation of anchors	X		
Discharge of drill cuttings and mud and residual cement to the seabed	X		
Discharge at sea surface of various substances during commissioning	X		
Discharge near seabed of various substances used for cleaning and testing	X		
Discharge of treated produced water		X	
Infrastructure on seabed		X	X
Presence of nearshore mooring buoy		X	

The contractor will ensure that the proposed project activities are undertaken in a manner consistent with good international industry practice. In addition, contractors will ensure that the proposed activities are undertaken in compliance with the applicable requirements in MARPOL 73/78.



Project controls will also ensure the safety of oil transfer at the nearshore transshipment area.

7.5.1.2 Impact Description

Any impact on the integrity of the coastal and marine ecosystem through disturbance, pollution, noise, etc. could impact various aspects which makes up people's Intangible Cultural Heritage (ICH) (indirect negative impact). The right to culture and to cultural expression is also enshrined in the Namibian Constitution.

The potential impact of normal operations on various cultural heritage receptors is summarized below:

- *Small-Scale Fishing*: Impact on seawater quality from normal operational discharge, if any, may impact the use of the sea by SSF. SSF include people who fish for subsistence, livelihood or leisure. Coastal communities use the sea largely for these purposes.
- *Ancestral / spirituality*: The research did not uncover any stories or accounts of ancestors being in the sea/seabed, and few ritual/cultural heritage uses of the sea were reported. However, based on interviews conducted, communities perceive the ocean as part of a larger ecological whole.
- *Archaeology/Tangible Heritage*: The sea is part of the Namibian coastline, including the Namib Sea Sand dunes. Impact on seawater quality from normal operational discharge, if any, may impact this natural and cultural heritage (indigenous and European settler peoples perceive the desert as having cultural significance). The coastal towns also have valuable (European) tangible heritage but these will not be affected as the project does not include onshore facilities.
- *Sense of Place*: The sea also provides and enhances unique 'senses of place'. This is the unique, social, aesthetic, and cultural value of the place in the sea or next to the sea which may include ICH practices and beliefs.

The sense of place is not likely to be affected by normal operations at the Venus offshore project area as the development area is far from the shore. Although Lüderitz has perhaps the strongest coastal sense of place (given the history of Shark Island), the project does not include onshore facilities.

The sense of place at Walvis Bay and nearby Swakopmund is not likely to be affected by normal operations at the nearshore transshipment area, as similar anchoring and port-related operations already take place within the vicinity of the nearshore transshipment area, and vessels move into and out of Walvis Bay port. Namibians are more interested in, and value more highly, the sense of place offered by the deserts, especially the Namib Sand Sea.

- *Livelihoods*: The cultural dimension of livelihoods (i.e., the ritual aspect of fishing and the cultural-social relations that arise from such activity) are unlikely to be affected by normal operations, as SSF activity takes place close to the shore and the Venus project area is approximately 300 km from the coast. The nearshore transshipment area overlaps with both commercial, SSF and artisanal line fisheries operating out of or periodically living in Walvis Bay, Swakopmund and Henties Bay.
- *Natural heritage*: People have a relationship with the ocean and coast (i.e., nature) and this results in high valuation of nature. Coastal sporting / leisure / tourism activities have become ICH for these communities, since the activities contain strong cultural elements (i.e., social grouping, ritual practices, commensality, unique identity, shared histories, etc.). Any impact on the integrity of natural heritage (i.e. natural environment)



could in turn impact people's natural heritage. Leisure activities have also become a ritualized and cultural activity for many non-indigenes along the Namibian coast.

7.5.1.3 Impact Assessment: Deterioration of Intangible Cultural Heritage Links to the Sea

Sensitivity of Receptors

The composite sensitivity of receptors relevant to the Venus development is considered to be **low** because most of these receptors are associated with onshore areas, but there are cultural relations and cultural heritages with the sea:

- *Small-Scale Fishing*: Receptor sensitivity is **medium to low** given the reliance of coastal communities on fishing for livelihood and the use of the coast in rituals and processes of healing yet considering the wide distribution of accessible sites along the Namibian coastline.
- *Ancestry / spirituality*: Receptor sensitivity is **low to very low** since those interviewed did not indicate ancestors being in the ocean or seabed. However, this receptor cannot be disregarded because there is a holistic valuation of nature in Namibia and the protection of human rights to culture.
- *Archaeology/Tangible Heritage (TH)*: Receptor sensitivity is **low to very low**, as heritage sites are generally onshore and avoided by the project.
- *Sense of Place*: Receptor sensitivity is **low** because although Shark Island off the coast of Lüderitz is gaining value and importance in the cultural heritage of indigenous Namibians, no onshore facilities are associated with this project. The coastal towns of Swakopmund and Henties Bay are valued for their leisure and tourism potential, but project activities at the nearshore transshipment area are largely congruent with existing vessel traffic in the area to the Port of Walvis Bay. Walvis Bay is mainly an industrial port town.
- *Natural heritage*: Receptor sensitivity is **low to medium** because Dorob National Park is located between Walvis Bay and Swakopmund onshore of the nearshore transshipment area.

Magnitude

Overall, the potential impact magnitude of normal operations on receptors prior to mitigation is considered to be **medium**. This is based on the following ratings:

- **Intensity**: the intensity is assessed to be low, due to the anticipated limited impact of the project on cultural heritage pre-mitigation.
- **Duration**: The duration of the impact is assessed to be Permanent (> 25-years). However, impacts are expected to cease following completion of the Project (maximum project timeline estimated at 35-years, if a 10-year production extension is granted).
- **Extent**: The extent is assessed to be regional.

With regards to specific areas along the coast:

- Otiwarongo, Tsumeb, Tsintsabis to Bethanie: Overall potential impacts will be negligible to low for this area, since the area is far inland covering several regions including Hardap and Karas. Residents in this area have irregular contact with the ocean for ritual purposes. Many of the ritual practices occur inland and involve elements such as fire and wind. While inland inhabitants do visit the sea and coast for ritual purposes, these visits are infrequent and most ritual activities, including the development of cultural metaphors and cultural narrative, tend to take place inland.



- Lüderitz: Identity of this place includes a strong “Buchter identity” and reliance on seafood, and opportunities for leisure and culture tourism, and needs to be carefully balanced with development. In view of the distance of the proposed operations from the shore, there is low probability of impact on cultural heritage for Lüderitz.
- Walvis Bay: Increasingly, Walvis Bay is becoming an industrialized / commercialized area and has an active commercial port. The once weekly transshipment activity (at peak production) is likely to have a minimal visual impact on the Bay, as similar activities are already taking place in this location.
- Swakopmund: Coastal sites experience tourism and SSF activity. The Namib Sand Sea, a World Heritage Site (WHS), is located nearby. Communities of Namibian and European settlers cultivate a spiritual relation with the ocean. As noted for Walvis Bay, existing commercial fishing and shipping activity along these shores are not dissimilar to the proposed transshipment activity at Walvis Bay.

Overall, normal operations at the Venus offshore project area should not impact cultural heritage receptors, as:

- The Venus offshore project area will not be visible from the shore or within proximity of the coastal leisure activities noted above.
- The nearshore transshipment area and the intermittent presence (once a week at peak production) of the two tankers some 5 km from the Walvis Bay shore is largely congruent with the existing activity around the Walvis Bay harbour.

Significance

Based on the sensitivity of receptors and the **medium magnitude**, the potential impact of the proposed project activities (both at the Venus offshore project and nearshore transshipment area) on cultural heritage is considered to be of **low significance** without mitigation.

Residual Impact

Ensuring that potential cultural heritage impacts and mitigations are discussed as part of the Stakeholder Engagement Plan and implementation of the agreed resolutions with relevant stakeholders (as per the proposed mitigation measures, see Section 7.5.1.4) may alleviate potential project impacts on cultural heritage. The proposed mitigation measures would reduce the significance of the impact to **negligible**.

Table 7-50: Normal operations impacts on cultural heritage

Impacts on cultural heritage from normal operations		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	Medium	Very Low
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Regional	Regional
Significance	Low	Negligible



Additional Assessment Criteria	
Probability	Unlikely
Reversibility	Fully reversible
Loss of resources	Low
Degree to which impact can be avoided	High - project controls are in place
Mitigation Potential	High - mitigation measures provided
Cumulative impacts	Possible

7.5.1.4 Mitigation and Management Measures

The following measures should be implemented to mitigate impact on cultural heritage:

Table 7-51: Mitigation and management measures to reduce the impact on cultural heritage

No.	Mitigation measure	Classification
Drilling & Installation Phase		
1	Adjust the well and subsea infrastructure location to avoid any marine underwater cultural heritage (shipwrecks) identified by surveys. If any historic shipwreck objects are found during surveys which could potentially be impacted by the activity, avoid the specific area and notify the NHC.	Avoid on site
All Phases		
2	Ensure that discussion of potential cultural heritage impacts and mitigation thereof is included in the SEP implemented for the duration of the project. Ensure that such aspects are discussed with stakeholders including SSF operating in the project area of influence, representatives of NHC and MEFT, and other relevant stakeholders in the Lüderitz, Walvis Bay and/or Swakopmund towns. The aim of such discussions is to determine the form and extent of engagement necessary to mitigate potential impacts on cultural heritage arising from normal operations at the Venus offshore area and nearshore transshipment area.	Avoid / abate offsite
3	Implement any resolutions related to cultural heritage that are outcomes of discussions and engagements. These may be part of long-term programmes implemented during production.	Avoid / abate on site
4	Establish a functional grievance mechanism that allows stakeholders to register specific grievances related to operations; by ensuring they are informed about the process and that resources are mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure.	Abate on site

7.6 Human Rights Impacts

This section was compiled by Synergy, an international human rights consultant company, and provides an overview of the human rights aspects linked to the Project's activities and mitigation measures identified. Synergy reviewed each of the following specialist studies for human rights-related issues:

- Fisheries Impact Assessment (Appendix M).
- Socio-Economic Impact Assessment (Appendix N).
- Cultural Heritage Impact Assessment (Appendix O).
- Air Quality Impact Assessment (Appendix P).



- Climate Change Risk Assessment (Appendix Q).
- Waste Management Study (Appendix R).

Key **potential** human rights related impacts identified included those related to:

- Livelihoods: Project activities could affect existing livelihoods, notably small-scale fisheries and tourism, dependent on Namibian waters.
- Cultural heritage and Indigenous Peoples: Indigenous peoples' connections with coastal areas and impact on cultural heritage practices.
- Community health and safety: Air quality, waste management and project-driven in-migration could affect public health and safety.
- Climate change: GHG emissions can have significant human rights implications if they directly or indirectly affect rights to life, health, livelihood, a healthy environment, and equity across generations and regions.
- Government conflict: Lack of accountability and transparency, as well as corruption, can have human rights implications.
- Meaningful participation and access to information: Inadequate access to information for engagement to be meaningful, or where people may be unaware of, or excluded from, engagement processes can result in potential risk of adverse human rights impacts.
- Access to remedy: People's rights may be infringed upon if adequate access to remedy is not easily available, e.g. an effective Grievance Mechanism.
- Supply Chains: human rights risks and impacts related to supply chains, e.g. forced labour, child labour, unsafe working conditions, and discrimination.
- Worker Health and Safety: Inadequate adherence to worker health and safety provisions could lead to serious injuries, long-term health issues or fatalities.
- Workplace Equality and Inclusivity, Discrimination, Harassment and Gender-Based Violence: Human rights violated through bullying, intimidation, discrimination, harassment or gender-based violence.
- Security and Conflict: Management of protests or community grievances by public security or private security personnel may raise human rights concerns.
- Human Rights Defenders: Human rights defenders in Namibia, who may express criticism against the project, may face challenges and risks in their work, including harassment, intimidation, abuse of process, and even violence.

TotalEnergies has publicly committed to the UNGPs, the Universal Declaration of Human Rights, the Fundamental Conventions of the International Labour Organisation and the VPSHR, and its commitment to human rights is articulated through its framework for addressing human rights within its operations, in accordance with a set of internal requirements which form the Company's internal rules. Respect for human rights is embedded in TotalEnergies' internal processes through its various requirements and guidance.

A set of general recommendations is included to ensure that these Company standards, policies and commitments are implemented at project level, to ensure integration of human rights and integration of human rights due diligence across the project:



- Integration of human rights:
 - o Integrate human rights policies and standards across the Project and ensure alignment in the understanding of human rights across all Project areas and value chain.
 - o Ensure human rights risks are integrated into Project risk registers and risk assessment processes.
- Human rights governance:
 - o Establish explicit responsibilities for human rights across all relevant functions.
 - o Build human rights competency at leadership levels, with Human Rights Due Diligence training.
- Ongoing tracking and review:
 - o Ensure regular, formal, review of human rights impacts and risks.
 - o Ensure internal performance reporting includes human rights risks, plans and performance.

The sections below further elaborate on the potential human rights impacts. Additional mitigation measures and recommendations directly addressing human rights considerations are presented below. These recommendations aim to embed human rights throughout the Project's implementation and management, in alignment with international good practices.

Additionally, the project's Stakeholder Engagement Plan (SEP) was reviewed to ensure alignment with human rights and specialist study findings, supporting meaningful participation and inclusion of marginalized groups. The ESIA and project grievance mechanisms incorporate human rights aspects and have been designed in alignment with the UN Guiding Principles (UNGPs) on Business and Human Rights effectiveness criteria.

Aspects covered in Sections 7.6.1 to 7.6.5 reflect Human Rights aspects that are considered and integrated into ESIA specialist studies and are summarised in this section. Sections 7.6.6 and 7.6.7 consider the adequacy of the ESIA stakeholder engagement and grievance procedures from a Human Rights perspective. Sections 7.6.8 to 7.6.12 discuss additional aspects associated with the project implementation from a Human Rights perspective.

7.6.1 Human Rights Related to Fisheries and Tourism Livelihoods

The dominant human rights livelihood concern, in relation to Project activities, is for potential loss of livelihoods related to fisheries and tourism economies.

A Fisheries Impact Assessment (see Section 7.3 and Appendix M) and a Socio-Economic Assessment (see Section 7.4 and Appendix N) were conducted to evaluate how project activities could affect existing fisheries and tourism livelihoods dependent on Namibian waters, both offshore (Venus offshore project area) and nearshore (transshipment area). The Project's overall impact on the large pelagic fishery as well as associated fisheries income, during operations, is rated following a precautionary approach, as very low with mitigation. The potential livelihood impact, with any associated potential human rights implications, is thus also likely to be **very low**.

In the nearshore area, it is expected that there will be a very low impact on existing fisheries and mariculture (see Section 7.4.11 and 7.3.1.5). While the impact of safety zones on fishing and potential loss of income is deemed of **very low** significance (see Section 7.4.11.3), there is no anticipated impact on tourism from normal project activities both offshore and nearshore.

Unplanned events such as offshore well blow-outs or nearshore oil spills are considered highly unlikely, yet their potential impacts could be severe. Such events would directly and



indirectly harm water quality, marine life and coastal economies, especially affecting small-scale fishers and tourism operators who depend on nearshore resources for income and food security and have limited ability to relocate (see Chapter 8 for assessment of these unplanned events).

7.6.2 Human Rights Related to Cultural Heritage and Indigenous People

Tangible and Intangible Cultural Heritage, identifying ties to the coast and sea, and assessing how project activities might impact these connections are considered in the Cultural Heritage Impact Assessment (see Section 7.5 and Appendix O). Of significance to a human rights' context, Indigenous Peoples are not formally recognised through national legislation. This can obscure the specific vulnerabilities and cultural claims of groups such as the San, Nama and Himba, who continue to self-identify as indigenous and assert rights to land, language and traditional knowledge. Also relevant, Indigenous Peoples' connections with coastal areas were forcibly severed under colonial rule likely contributing to Indigenous Peoples' reduced physical, spiritual and cultural connections to the sea. Some 'return to sea' practices have been identified (see full Cultural Heritage Impact Assessment in Appendix O for further information).

Within this context and considering the location of the Venus offshore project area (> 300 km offshore) and the Project's coastal and land-based areas of impact, the Project is unlikely to significantly impact the cultural heritage practices or human rights of Indigenous Peoples, impacts were deemed **negligible**.

Considering the impact significance rating in conjunction with the findings of Section 7.5, the project does not appear to have significant enough impacts on the rights or claims of Indigenous Peoples to trigger IFC Performance Standard 7, which is intended to avoid adverse project impacts on Indigenous Peoples' communities living in the Project's area of influence.

Given the fluidity of this cultural landscape, the mitigation measures in Section 7.5.1.4 must be implemented with explicit focus on Indigenous Peoples' participation. It is appropriate to monitor developments related to ocean rights claims by self-identifying Indigenous Peoples and to implement responsive action where they may interact with Project areas.

Additional Mitigation Measures

In addition to the mitigation and management measures proposed in Section 7.5.1.4, the following mitigation and management measure is proposed:

- Ensure inclusion of all relevant population and community groups, including those identifying as indigenous, in stakeholder engagement.

7.6.3 Human Rights Related to Community Health and Safety

Human Rights Considerations Related to Air Quality Impacts

Air quality is a relevant human rights consideration, as project-related emissions could affect public health and safety, particularly for sensitive coastal receptors.

Dispersion modelling shows that international Air Quality Guidelines (AQG) are unlikely to be exceeded at sensitive land-based / coastal receptors (see Section 7.1.5 and Appendix P). Although air emissions are particularly relevant to already sensitive receptors (e.g. people experiencing respiratory, cardiovascular, reproductive and nervous system health issues), potentially impacting their right to health, the Air Quality Guidelines take public health sensitivities into account, and the overall significance of air quality impacts from nearshore transshipment activities is rated as **low** (see Section 7.7.1).



Air quality monitoring nearshore is identified as a proactive measure to verify that transshipment activities do not result in adverse impacts, particularly for sensitive receptors (Section 7.7.1.5). Additionally, such monitoring will provide a baseline against which any unplanned events and their impacts could be verified and remedied as necessary.

Human Rights Considerations Related to Waste Management

The Waste Management Study (Appendix R) is not an impact assessment, it rather identifies waste management options and defines requirements, so as to reduce any impacts on community health and safety, and associated Human Rights, in relation to waste management.

The study confirms the need to implement Good International Industry Practices (GIIP) to prevent pollution, specifically water pollution, and highlights the use of only approved waste disposal facilities. This is necessary to avoid potential harm to marine ecosystems and human health that could translate into human rights impacts for communities dependent on clean water and a healthy environment for their livelihoods and well-being.

It identifies a need for the development of a comprehensive Waste Management Plan and proposes an approach that ensures transparent lifecycle management, consistent with human rights standards. Although the Project is not an IFC funded project, the Waste Management Study also highlights the requirements of the IFC's Environment, Health and Safety Guidelines for Oil and Gas (2015) as international good practice to safeguard community health, amongst other aspects. These emphasise that projects should establish performance indicators and monitoring for waste generation and disposal volumes.

Human Rights Considerations Linked to In-Migration

A project can contribute to population influx, which carries potential human rights implications, particularly in relation to public (community) health and safety (see Section 7.4.13 and Appendix N). Given the potential in-migration and associated social pressures from project activities, the Socio-economic Impact Assessment rates community health and safety impacts as being of **low** significance with mitigation across all project phases (see Section 7.4.13).

The proposed project is expected to generate additional direct, indirect and induced jobs, especially during the drilling / installation and production phases. The level of economic activity may attract in-migration, leading to competition for jobs and potential social issues such as alcohol abuse, gender-based violence, sex work and communicable diseases, increasing pressure on health and social services.

According to the Socio-economic Impact Assessment, both Lüderitz and Walvis Bay have recently developed urban structure plans to guide growth, in anticipation of possible identified future projects (e.g. Oil and Gas, Green Hydrogen, etc).

If the implementation of these plans is successful and the necessary infrastructure is provided to accommodate growth, the impacts of in-migration and population increase on community health and safety may be reduced. According to the Socio-economic Impact Assessment, social responsibility projects could be directed toward strengthening urban and social services to help mitigate these impacts. In this context, the project could also explore collaboration with national and local government, and other operations in the area, to better manage the related impacts.

Based on good practice of the application of the UNGPs it is increasingly common practice to undertake a local health baseline to establish existing conditions in the project areas. For the Venus project, a baseline using existing health data (e.g. pre-project health infrastructure capacity, predominant illnesses and diseases reported to local clinics and hospitals, key crime statistics especially prevalence of domestic and gender-based violence) is deemed



appropriate as residual impacts on community health are expected to be low following mitigation measures. Adopting this precautionary approach can safeguard the rights of local residents and of the project. Future updating of data and monitoring of indices would also need to recognise changes related to other development in the project's area of influence.

Additional Mitigation Measures

In addition to the mitigation measures proposed in Sections 7.4.13.4, 7.4.15.4 and 7.7.1.5 the following additional human rights-related mitigation measures are identified regarding air quality, waste management and in-migration impacts on community health and safety:

Waste Management

- Establish a monitoring programme in alignment with the IFC's EHS guidelines for the oil and gas industry regarding waste monitoring and reporting. This must be detailed in the Waste Management Study's recommended Waste Management Plan.

Project Induced In-Migration

- Engage with national and local government, and other operations in the area, to better understand and manage influx impacts.

7.6.4 Human Rights Related to Climate Change and GHG Emissions

The Climate Change Risk Assessment evaluated impacts from planned project activities, considering direct GHG emissions (Scope 1) (see Section 7.7.2 and Appendix Q). GHG emissions can have significant human rights implications, if they indirectly affect rights to life, health, livelihood, a healthy environment, and equity across generations and regions by contributing to climate change.

The Climate Change Risk Assessment emphasises the project's need to annually calculate and publicly report the following:

- Scope 1 emissions: Direct emissions from Project facilities.
- GHG emissions intensity: Expressed as kilograms of carbon dioxide equivalent per barrel of oil equivalent.
- Selected scope 3 emissions: From refining and end-use of petroleum products (with TotalEnergies global reporting).

TotalEnergies publishes its Sustainability & Climate Progress Reports which consider *inter alia* GHG emissions, contribution to climate change and human rights aspects associated with operations. TotalEnergies has a climate transition strategy with a stated ambition to reach Net Zero by 2050 together with society. All operations, including the prospective Venus project, will be reported under that framework and are thus part of the broader transition planning and corporate strategy for accounting for climate change and human health impacts.

The ongoing ESIA-related stakeholder engagement activities include sharing the assessment findings to answer questions and gather feedback, aligning with human rights expectations on access to information and meaningful participation. Furthermore, the ESMP lists the need to ensure that a SEP is maintained throughout the project lifecycle (refer to Appendix F). Facilitating and encouraging such robust discussions going forward will form part of a responsible industry player's broader contribution to the energy transition and human rights.



7.6.6 Human Rights Related to Governance and Conflict

TotalEnergies' Code of Conduct strictly prohibits all forms of fraud, including bribery, corruption, influence peddling and antitrust violations. Whilst Namibia is currently not an Extractive Industries Transparency Initiative (EITI) member, as an EITI Supporting Company¹²⁰, TotalEnergies is expected to ensure transparent project-level reporting of payments to government. The Socio-economic Impact Assessment recognises risks such as the 'resource curse'¹²¹ and corruption impacting service delivery and citizens' rights (see Section 7.4.14 and Appendix N).

The proposed project is likely to be the first oil and gas development project in Namibia, should the ECC be granted, and has the potential to generate significant government revenues that can be invested in public services and infrastructure, promoting economic growth through job creation and local business development. However, the lack of accountability and transparency can have human rights implications. Corruption and weak governance can divert resources intended for education, healthcare and social welfare, undermining communities' rights to an adequate standard of living. In the Socio-economic Impact Assessment, it is noted that stakeholders expressed concerns about risks to governance and conflict, including poor governance of the industry, potential mismanagement of project revenues and disputes over benefit distribution.

Additional Mitigation Measures

From a human rights perspective, the following additional mitigation measures are proposed to enhance accountability, good governance and equitable revenue management.

- In line with TotalEnergies' code of conduct, ensure implementation of zero-tolerance systems and processes relating to corruption at project level, that is applicable across the project, including business partners, downstream suppliers, and across the value chain. This should focus on transparent procurement processes and effective controls across high-risk areas, including social investment, local employment and procurement.
- Ensure that social investment, local employment and procurement opportunities are transparently communicated and available to all stakeholders, including vulnerable groups.

7.6.7 Human Rights Related to Meaningful Participation and Access to Information

People potentially affected by the proposed project may face the potential risk of adverse human rights impacts where they have inadequate access to information for engagement to be meaningful, or where they may be unaware of, or excluded from, engagement processes.

The notion of meaningful participation and access to information cuts across planning and implementation activities for the proposed project. People's right to project information and to have their opinions included in project planning starts from the early stages of the ESIA and should continue throughout the life of the project, if it is implemented. The process of stakeholder engagement is an integral component of any ESIA but is discussed here as a human right.

¹²⁰ Section 4 of Part 1 of the 2023 EITI Standard sets out the expectations that companies are committed to observing when they support the EITI.

¹²¹ Sachs, J. D., & Warner, A. M. (2001). *Natural Resources and Economic Development: The Curse of Natural Resources*. *European Economic Review*, 45(4–6), 827–838 refer to the "resource curse" or the "paradox of plenty" as the counterintuitive phenomenon where countries or regions rich in natural resources (like oil, gas, or minerals) often experience slower economic growth, weaker democratic institutions, and worse development outcomes than countries with fewer natural resources.



The specialist notes that the SEP which has been developed for the ESIA process adopts a human rights-based approach with stakeholder mapping, including potentially vulnerable groups such as fisheries, tourism stakeholders and Indigenous Peoples. It facilitates the inclusion of stakeholder-identified risks, impacts, and concerns through an inclusive and representative process. The plan incorporates a commitment to align the grievance procedure to the UNGP effectiveness criteria and considers the needs of vulnerable or marginalised groups. The SEP also has a comprehensive schedule of engagement activities aimed at providing ESIA feedback to the various stakeholders.

The sharing of specialist study findings and the overall ESIA enables affected parties to question the findings and submit comments for the Project's licensing applications. This feedback process aligns with the SEP's stated principles of accessibility and meaningful participation for all stakeholders. Furthermore, the ESMP lists the need to ensure that a SEP is maintained throughout the project lifecycle (refer to Appendix F), which includes the implementation and monitoring of an accessible grievance procedure and access to remedies.

Mitigation and Management Measures

The future SEP applicable during project implementation and operation should assist with the identification and mitigation of potential human-right impacts by providing access to information and meaningful participation, and should include:

- Ongoing project stakeholder mapping assessment of stakeholder vulnerability based on exposure, sensitivity and adaptiveness to risks, and incorporation thereof into the SEP approach.
- Regularly and formally engage external stakeholders in relation to human rights risk assessments, performance, and identification and assessment of risks.

7.6.8 Human Rights Related to Access to Remedy

Stakeholders may have their rights infringed upon if adequate access to remedy is not easily available.

The ESIA process has a generic Grievance Redress Mechanism in its SEP which is intended to systematically log and respond to grievances related to the ESIA process itself. Grievances outside of this ambit are not considered. The ESMP requires that a SEP be maintained throughout the project lifecycle (refer to Appendix F), which includes the implementation and monitoring of an accessible grievance procedure and access to remedies. TEEPNA has a grievance mechanism with a management procedure outlining the process, steps, roles, and responsibilities for registering, investigating, resolving, and remedying grievances from local stakeholders at the operational level. This reflects a human rights-based approach aligned with the UNGPs effectiveness criteria.

The accessibility and robustness of the grievance mechanism is important across all potential human rights impact areas and is intrinsically linked to stakeholder engagement, ensuring that all voices are heard even after formal meetings conclude, including vulnerable or marginalised groups who might not feel safe or empowered to speak publicly.

Throughout the ESIA process, and moving forward if the project proceeds, the project ought to acknowledge responsibility where appropriate for grievances received and provide remedies if harm has occurred because of the project. As the effectiveness of grievance procedures are relevant across the breadth of the project as a safeguard against potential human rights impacts, the project should ensure ongoing awareness of and accessibility to concerns or grievances that could be raised across all the potential human rights impact areas identified above.



7.6.9 Human Rights Related to National and International Supply Chains: Forced Labour, Modern Slavery, Human Trafficking and Child Labour

Supply chains for large projects are complex, multi-tiered, and often global in nature, involving multiple layers of suppliers across different regions, industries, and companies. This can make it difficult for businesses to trace all actors and conditions involved and challenging to identify, address and monitor for human rights risks and impacts.

Labour abuses such as forced labour, human trafficking¹²², child labour, unsafe working conditions and discrimination can often be hidden in deeper tiers. Furthermore, when using smaller local suppliers to spread procurement benefits of a project several similar risks arise. Smaller local suppliers may, amongst other risks, lack formal human rights policies, due diligence capacity, or awareness of international labour and human rights standards, which can lead to increased risks of labour abuses such as poor working conditions, forced labour, or child labour.

TotalEnergies has policies on human rights and labour, guided by standards such as the Universal Declaration of Human Rights, the Fundamental Conventions of the International Labour Organization (ILO), the UNGP on Business and Human Rights, the Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises, and the Voluntary Principles on Security and Human Rights (VPSHR), and publicly opposes discrimination, forced labour and child labour.

The company's suppliers and their suppliers are required to comply with its Code of Conduct and its Fundamental Principle of Purchasing, which emphasise human rights. This, therefore, applies to all supply chain workers, requiring contractors, and their sub-contractors, to meet similar standards.

With strict implementation of these policies and controls, the Human Rights impacts on the national and international supply chain are deemed **very low**.

Mitigation and Management Measures

Mitigation and management measures proposed to mitigate potential impacts due to forced labour, modern slavery, human trafficking and child labour include:

- Adopt a human rights risk-based approach to ongoing human rights due diligence with contractors and suppliers, especially concerning modern slavery, forced labour, trafficking, and child labour.
- Share with prospective contractors and suppliers the Operator's Code of Conduct and Fundamental Principles of Purchasing.
- Ensure contractors are aware of and meet TEEPNA's human rights policy and expectations.
- Include contract clauses stipulating respect for human rights and the company's right to monitor and audit contractors and suppliers to ensure ongoing compliance oversight.

¹²² United Nations Human Rights Office of the High Commissioner. Protocol to Prevent, Suppress and Punish Trafficking in Persons Especially Women and Children, supplementing the United Nations Convention against Transnational Organized Crime, 2000



7.6.10 Human Rights Related to Worker Health and Safety

There is a potential risk that inadequate adherence to worker health and safety provisions could lead to serious injuries, long-term health issues or fatalities. The risk affects both TEEPNA employees and contractor workers during all project phases.

Health and safety performance of prospective contractors is a key criterium during contractor selection, and TEEPNA applies a risk-based approach to audits to ensure compliance with project-specific management systems and processes that are aligned with TotalEnergies' existing due diligence, safety clauses, audits, and supervision procedures. Robust monitoring of contractors will be essential for enforcing international standards. Where local procurement prioritises small providers, employment conditions, monitoring, and reporting on Health and Safety aspects must be included in contracts.

The project will have grievance mechanisms for use by internal and external stakeholders (refer to ESMP in Appendix F). An internal grievance mechanism must be available for all employees to log grievances, have them attended to, and to receive a remedy where appropriate.

With strict implementation of these policies and controls in relation to safe working conditions, the Human Rights-related impacts on worker health and safety are deemed **very low**.

Mitigation and Management Measures

Mitigation and management measures to mitigate and manage impacts to worker health and safety include:

- Ensure contractor standards align with standards espoused IFC EHS Guidelines for the Oil and Gas Sector where appropriate to the activity conducted.
- Ensure international and local procurement contracts include provisions for compliance monitoring and reporting aligned with project requirements.
- Ensure risk-based monitoring and evaluation of identified contractors to uphold international standards.
- Undertake random risk-focussed monitoring and evaluation of smaller, local suppliers to ensure aligned implementation of the project's HSE standards.

7.6.11 Human Rights Related to Workplace Equality, Inclusivity, Discrimination, Harassment and Gender-Based Violence

TEEPNA employees and contractors may have their human rights violated through bullying, intimidation, discrimination, harassment or gender-based violence (GBV).

TEEPNA's Code of Conduct and Human Rights Policy prohibit harassment, discrimination, forced labour and child labour. The Code of Conduct also highlights a focus on promoting diversity. It is recognised, however, that the offshore oil and gas industry tends to be male dominated, with women making up only about 23% of the industry, one of the lowest inclusion rates of any major industry¹²³. This limited representation can make inclusion more difficult and increase the risk of discrimination. In addition, this underrepresentation can present increased risks for women and people with disabilities who are part of an offshore crew stationed 300 km from shore. These indirect, negative impacts could affect worker

¹²³ Consultancy-me.com. 2023. Global oil & gas sector struggles with advancing diversity agenda. Available at: <https://www.consultancy-me.com/news/global-oil-gas-sector-struggles-with-advancing-diversity-agenda> [Accessed 02 October 2025].



safety, well-being and bodily integrity, with potential for criminal misconduct. Forcing diversity in such environments might not always benefit under-represented groups, but opportunities exist to improve diversity and inclusivity as TEEPNA considers local suppliers.

The project should ensure and enforce a zero-tolerance policy on all forms of workplace harassment, bullying, gender-based violence, and sexual exploitation, abuse and harassment. The policy should be part of the project's labour and human rights management system and apply to all employees, contractors and third parties.

An internal grievance mechanism is available to employees, contractors and suppliers and ensure it has multiple reporting channels; includes the non-retaliation principle and includes a clear and detailed definition of human rights grievances.

On the basis of the above discussion the Human Rights-related risk is deemed **negligible**.

Mitigation and Management Measures

Proposed mitigation and management measures include:

- Ensure an internal grievance mechanism is available to TEEPNA employees, contractors and suppliers and that it has multiple reporting channels and also includes the non-retaliation principle and a clear and detailed definition of human rights grievances.

7.6.12 Human Rights Related to Security and Conflict

The management of protests or community grievances by public security or private security personnel may raise human rights concerns. Potential human rights impacts on the public, including protestors, bystanders, and criminal suspects, may arise from misuse of force or mistreatment during arrest or detention. These indirect, negative impacts could occur in all Project phases.

TotalEnergies follows its 2022 Code of Conduct and publicly affirms its commitment to the VPSHR. Protecting employees and facilities remains a top priority, while public and private security providers are expected to handle risks to the Project in a way that respects the rights of local communities. TotalEnergies strives to ensure adherence to these Principles, which offer guidance for protecting human rights in security operations and promote dialogue among governments, NGOs and businesses.

TotalEnergies' security providers are trained and experienced in the VPSHR. Sometimes human rights risks occur in situations when public security providers (e.g. the Namibian Police Force), acting in their jurisdiction and beyond the domain of private security providers, do so without adhering to the VPSHR. Where possible, TEEPNA should use its leverage in relationships with public security providers to increase awareness of the Voluntary Principles (VPs) where gaps may exist. In addition, the Project's grievance mechanism should be available and responsive to anyone wishing to lodge a security-related complaint, and where appropriate, remedy to the complainant must be provided.

The overall Human Rights-related impact is assessed to be **negligible**.

Mitigation and Management Measures

Mitigation and management measures include:

- Ensure that project security management aligns with VPSHR and includes a process for regular updates on VPSHR risk assessment and action planning.
- Conduct a first VPSHR risk assessment prior to construction phase.
- Ensure all third-party security providers comply with the VPSHRs, through stipulations in procurement contracts.



- Engage with relevant government agencies, law enforcement, and regulators to promote awareness of human rights and VPSHR principles as well as the Company's Code of Conduct and commitment to human rights, to promote respect for human rights and rule of law.

7.6.13 Human Rights Related to Human Rights Defenders

Human rights defenders¹²⁴ can come from diverse backgrounds, including community leaders, journalists, lawyers, trade unionists and activists, and work to uphold civil, political, economic, social and cultural rights for all people. They can play an important role in ensuring accountability for human rights abuses linked to large-scale projects.

Human rights defenders in Namibia, who may express criticism against the project, TotalEnergies or TEEPNA, or the Namibian government in relation to the project, may face challenges and risks in their work from organs of state, or other civilian interest groups, including harassment, intimidation, abuse of process, and even violence.

Given that TotalEnergies commits publicly to respecting human rights and abiding by national and international laws through its public commitment to the UNGPs, it also holds a responsibility to encourage state protection for human rights defenders. TotalEnergies has recognised the legitimacy and importance that human rights defenders play in these projects promoting accountability and advocating for the protection and respect for the rights of rightsholders. In 2024 and 2025, respectively, it published Statements on Human Rights Defenders related to its projects in Uganda (TEPU) and Tanzania (EACOP) in this regard.

In keeping with human rights principles of inclusive participation, the ESIA's SEP maps stakeholder groups such as community organisations and NGOs amongst others. Furthermore, the ESMP requires that a SEP be maintained throughout the project lifecycle (refer to Appendix F), which includes the implementation and monitoring of an accessible grievance procedure and access to remedies. The Socio-economic Impact Assessment (Appendix N) notes that stakeholders have raised issues related to governance, benefit distribution, conflict, decommissioning and pressures on coastal towns, highlighting potential social and economic risks with human rights implications. Human rights defenders in Namibia, who may express criticism of the Project, TotalEnergies, TEEPNA or the government, could face challenges such as harassment, intimidation, abuse of process or even violence from authorities or civilian groups for whom the Project's implementation is a priority.

TEEPNA should uphold human rights principles, including freedom of expression. As stakeholders are mapped and engagement methods defined as part of the ESIA, potential human rights defenders and groups should also be identified and included in the Project's ongoing engagement and SEP (refer to Appendix F). Potential risks to these defenders should be highlighted and addressed, and the project's grievance mechanism should remain accessible, sensitive and responsive to concerns raised by all stakeholders.

Potential human rights impact on this project are deemed of **low** magnitude.

¹²⁴ "Human rights defender" is a term used to describe people who, individually or with others, act to promote or protect human rights in a peaceful manner. It's also defined in the UN Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognised Human Rights and Fundamental Freedoms (<https://www.ohchr.org/en/special-procedures/sr-human-rights-defenders/about-human-rights-defenders>).



Mitigation and Management Measures

Proposed mitigation and management measures include:

- Identify and include potential human rights defenders or groups in ongoing engagement activities through the project's SEP. Highlight and integrate potential human rights risks for defenders into the SEP.
- As part of the grievance mechanism, implement clear protocols to respond to allegations or incidents of harm to human rights defenders, including who is responsible for receiving reports, investigating, and responding to them; and remedy impacts when they do occur.

7.7 Atmospheric Emissions Impacts

7.7.1 Increase in Atmospheric Pollutants and Associated Health Risks

This section provides a summary of the assessment included in the Air Quality Impact Assessment report provided in Appendix P.

7.7.1.1 Source of Impact

The main sources of air emissions (continuous or intermittent) from the proposed project will include:

- Liquid and gaseous fuel combustion by vessels, support helicopters and power generation units;
- Flaring of hydrocarbons (i.e. well testing and clean-up, non-routine safety requirements); and
- Fugitive releases (i.e. degassing of drilling fluid, equipment leaks, and product loading).

The following project aspects may cause the impact in the following project phases:

Aspect	Drilling & Installation	Production	Decommissioning
Air emissions from DPST, FPSO, drilling units and vessels (offshore and transit)	X	X	X
Air emissions from DPST and tugs during transshipment operations (nearshore)		X	
Non-routine flaring of hydrocarbons (offshore)	X	X	

Project Controls

Project vessels will be fuelled by marine gas oil (MGO). MGO is a distillate fuel commonly used in ship engines due to its low sulphur content (0.5%) and for compliance with global maritime environmental standards.

In accordance with the IMO's International Convention for the Safety of Life at Sea (SOLAS), petroleum product tankers (including crude oil tankers) are equipped with inert gas systems to maintain oxygen concentrations in the cargo headspace below 5% by volume so as to prevent ignition (since hydrocarbon vapours cannot burn in an atmosphere with less than 11% oxygen) (OCIMF, 2017).

7.7.1.2 Impact Description

The release of gaseous pollutants associated with project activities, principally, sulphur oxides (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter (PM), non-methane volatile organic compounds (NMVOC) and benzene have the potential to impact local air quality close to the emissions source.



Project activities with potential to increase air emissions are summarised below:

- **Fuel Combustion:** Liquid fuel combustion by vessels and helicopters used during drilling, installation, production, and decommissioning phases. Key pollutants include SO₂, NO_x, CO, NMVOCs, and PM.
- **Stationary Power generation:** Liquid and gaseous fuel combustion for the Drilling Units and FPSO. Drilling units typically rely on reciprocating engines fuelled by MGO which will operate during drilling and decommissioning phases. Power for the FPSO (production phase) will be provided by open-cycle gas turbines (OCGT). During FPSO start-up (six-months), the power generation will use gas oil (i.e. diesel), after which a portion of the natural gas extracted from the Venus field through the subsea wells will be used to power the production process in the long-term. Primary pollutants include SO₂, NO_x, CO, NMVOC and PM.
- **Non-routine Flaring:** Punctual flaring occurs during wells testing (to assess performance), wells clean-up (to remove fluids, debris, and contaminants from the wellbore), and FPSO commissioning/start-up. Non-routine flaring may also occur during production as a safety measure to relieve pressure in the closed loop system. Emissions include small portion of unburnt hydrocarbons (e.g. CH₄, VOCs) and combustion by-products (SO₂, NO_x, CO, CO₂, PM).
- **Degassing of Drilling Fluids:** During well drilling, emissions are released from the degassing of non-aqueous drilling fluid (API, 2021). The gases, which become entrained in the drilling fluid (associated with cuttings), escape from the cutting treatment process before fluids are recirculated into the well, with gases released directly to atmosphere. These gases include methane (CH₄) and non-methane hydrocarbons (conservatively assumed in the Air Quality Impact Assessment to be volatile organics and therefore applicable to the assessment of NMVOC emissions).
- **Fugitive Emissions:** Result from equipment leaks and evaporation during storage and transfer. In the Venus offshore project area, the FPSO is equipped with a closed loop system coupled to a venting recovery unit (VRU), also known as a vapour recovery unit, to minimise fugitive emissions, including those associated with DPST loading at the offshore production area. The VRU is expected to be operational minimum 97% of the time. At the nearshore transshipment area, however, product is transferred from the DPST to conventional tankers operated by third parties. As it cannot be confirmed whether these vessels are fitted with VRUs, it is conservatively assumed they are not and loading losses at the nearshore location are considered unmitigated (i.e. no vapour recovery or vapour balancing occurs during nearshore loading activities) despite the bottom loading process and conventional tanker tanks filled with inert gas on arrival.

A summary of total project emissions grouped by activity were calculated (see Appendix P for further information). Although offshore and nearshore operations form part of the same project, they occur in different airsheds and were therefore segregated. Emissions from transit (e.g. fuel combustion by mobile support vessels and helicopters moving between the Venus offshore project area, nearshore transshipment area and ports) were conservatively allocated to the Venus offshore project area airshed, as assessed in Section 7.7.1.3. Fuel combustion by the DPST was apportioned according to time spent at the nearshore transshipment area (see Section 7.7.1.4).



7.7.1.3 Impact Assessment: Increase in Ambient Air Pollutant Concentrations at Venus Offshore Project Area

Sensitivity of receptor

The sensitivity of receptors is rated **very low** as the coastline where sensitive receptors reside is over 300 km from the Venus offshore project area and well beyond the range of the expected impact.

Magnitude

The proposed project activities in PEL0056/Block 2913B will result in increased ambient pollutant concentrations, with NO_x identified as the primary pollutant across all project phases. SO₂ and PM are also elevated during the construction phase. Key emission sources include fuel combustion by support vessels, power generation, and flaring during well flow testing and clean-up ahead of production operations.

Pollutants will dilute and disperse based on meteorological conditions at the time of release, decreasing in concentration over distance. A meteorological overview of PEL0056/Block 2913B indicates moderate average wind speeds and a low frequency (1.8% - 7.6%) of onshore winds (i.e. from the NW, WNW, W, WSW, SW or SSW), capable of transporting pollutants toward the coastline. Given prevailing synoptic conditions, emissions from PEL0056/Block 2913B are expected to disperse seaward under normal and berg wind scenarios. The potential for surface-level transport of offshore emissions to the Namibian coastline that would also result in ambient pollutant concentrations of significance is therefore considered very unlikely.

Overall, the impact magnitude for an increase in ambient air pollutant concentrations at the Venus Offshore Project Area during **all phases** is considered to be **very low**. This is based on the following ratings:

- **Very low intensity**, as no exceedances of WHO AQG would be expected at the coastline located >300 km away.
- **Regional extent** (considering all project phases) reflecting the assessment of potential effects on coastal receptors located more than 300 km from PEL0056/Block 2913B.
- **Permanent duration** (> 25-years), as the offshore activities are continuous and projected to extend beyond 25 years.

Significance

Based on the **very low** magnitude and receptor sensitivity, the significance of increased emissions resulting from routine operations at the Venus offshore project is assessed to be **negligible**.

Residual Impact

Mitigation measures will minimise emissions, however will not alter the duration, extent or intensity of the impact. As such the residual impact significance remains **negligible**.

Air quality management should align with best practice for offshore hydrocarbon developments, with a focus on operational efficiency, emissions minimisation, and proactive monitoring. Key proposed mitigation measures include the use of low-sulphur fuels, optimisation of combustion processes, implementation of a Leak Detection and Repair (LDAR) programme, and routine maintenance to limit emissions from fuel combustion, flaring, and fugitive sources. Emission offsets or ambient air quality monitoring is not deemed necessary within the Venus offshore project area.



Table 7-52: Impact significance ratings for emissions from PEL0056/Block 2913B activities

Increase in ambient air pollutant concentrations for onshore sensitive receptors		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Offshore – Drilling, installation, production and decommissioning phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Very Low	
Magnitude	Very Low	Very Low
Intensity	Very Low	Very Low
Extent	Regional	Regional
Duration	Permanent	Permanent
Significance	Negligible	Negligible
Additional Assessment Criteria		
Probability	Definite	Project activities will result in atmospheric emissions.
Confidence	High	
Reversibility	Fully reversible	Impacts will cease once the decommissioning phase concludes. However, it is noted that, health impacts associated with pollutant exposure is potentially irreversible.
Loss of resources	None	Pollutants will disperse rapidly, and impact will cease on completion of the decommissioning phase.
Avoidance Potential	None	The impact cannot be avoided.
Mitigation Potential	None	Some mitigation (i.e. GIIP) will minimise emissions, however this will not materially affect the impact intensity, which is already very low.
Cumulative impacts	Unlikely	Onshore ambient air quality may be impacted by existing sources such as road traffic, industrial activity, etc. Given the large separation distance and infrequent onshore winds no guideline exceedances are anticipated. Therefore, the cumulative impact is conservatively assessed to be negligible.

7.7.1.4 Impact Assessment: Increase in Ambient Air Pollutant Concentrations due to Nearshore Transshipment Operations

Sensitivity of receptor

The sensitivity of receptors is rated **low**. While sensitive individuals may be present within the general population, they are located beyond the predicted zones of AQG exceedance (see Section 7.1.5).

Magnitude

Overall, the impact magnitude for an increase in ambient air pollutant concentrations during nearshore transshipment operations is considered to be **medium**. This is based on the following ratings:

- **Low intensity** based on the compliance with applicable AQG guidelines. The proposed product transfer activities ~20 km north of Walvis Bay will result in



increased ambient pollutant concentrations. Pollutant dispersion was simulated with the assessment of air quality impacts on land-based sensitive receptors from the proposed transshipment activities based on quantitative data (see Section 7.1.5). The assessment remains conservative, as it assumes no vapour recovery or vapour balancing occurs during nearshore loading activities. NO_x/NO_2 from fuel combustion was identified as the primary pollutant. Fugitive NMVOC and benzene emissions associated with loading activities were assessed but not found to be a material impact (i.e. peak benzene concentrations are less than 1% of the applicable guideline). While sensitive individuals may be present within the general population and ambient concentration increases are predicted at sensitive receptors these however remain **below applicable guidelines** and are, therefore, not expected to affect overall functioning. From a public health perspective, it is acknowledged that air pollution impacts occur along a continuum, and even concentrations below guideline values may pose some risk. While this nuance does not alter the assigned significance rating, it introduces a degree of interpretive complexity not captured by the threshold-based classification system applied in this assessment.

- **Permanent duration** to reflect the project's production life of 21-31 years even though potential exposures are episodic (i.e. 24 hours per week at peak, declining to around once per month by project end). As such, the duration of short-term impacts (i.e. 1-hour and 24-hour average) is conservatively classified as permanent.
- **Regional extent**, reflecting the assessment of potential effects on land-based receptors located ~4 km to 20 km from the nearshore transshipment area, with the closest sensitive residential receptor ~6.2 km (Table 7-8).

Significance

Based on the **medium** magnitude and **low** receptors sensitivity the significance for emissions from routine nearshore transshipment activities is assessed to be **low**.

Residual Impact

Emissions from vessels during product transfer are inherent to operations and cannot be fully avoided however, air quality management should align with best practice for offshore hydrocarbon developments, with a focus on operational efficiency, emissions minimisation, and proactive monitoring. Key mitigation measures should include the use of low-sulphur fuels, optimisation of combustion processes, implementation of an LDAR programme, and routine maintenance to limit emissions from fuel combustion.

The implementation of mitigation measures (Section 7.7.1.5) will not alter the duration, extent of intensity of the impact. As such the residual impact significance remains **low**.



Table 7-53: Impact significance ratings for emissions from PEL0056/Block 2913B activities

Short-term increase in ambient air pollutant concentrations for land-based sensitive receptors		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Nearshore – Production Phase (transshipment activities)	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	Medium	Medium
Intensity	Low	Low
Extent	Regional	Regional
Duration	Permanent	Permanent
Significance	Low	Low
Additional Assessment Criteria		
Probability	Definite	Project activities will result in atmospheric emissions.
Confidence	High	
Reversibility	Fully reversible	Impacts will cease when loading concludes however intermittent emissions are expected to continue throughout the project lifespan until decommissioning. While health impacts from pollutant exposure might not be reversible at the individual level, with cessation of transfer activities, community level baseline health will tend towards pre-activity levels.
Loss of resources	None	Pollutants will disperse rapidly, and impact will cease when loading concludes noting that short-term impacts will occur intermittently until the project is decommissioned.
Avoidance Potential	None	The impact cannot be avoided.
Mitigation Potential	None	Some mitigation (i.e. GIIP) will minimise emissions, however this will not materially affect the impact intensity.
Cumulative impacts	Unlikely	Land-based ambient air quality may be impacted by existing sources such as road traffic, industrial activity, etc. Short-term guideline exceedances are possible and therefore the cumulative impact is conservatively assessed to be medium.

7.7.1.5 Mitigation and Management Measures

The mitigation and data management measures listed in Table 7-54 is based on GIIP and BAT for offshore gas and oil development provided by the IFC EHS Guidelines (World Bank Group, 2015) and the European Commission (European Commission, 2019).



Table 7-54: Mitigation, monitoring and data management recommendations to reduce project related air emissions

Activity	Mitigation and data management measures
General	• Maintain operational controls and adhere to all equipment repair and maintenance requirements. • Conduct training at all levels (workers, foremen, managers) to raise awareness of air emissions. This should be integrated into induction training and should promote understanding of why operational controls exist and the importance of compliance. • Keep detailed records of project activities (e.g. production rates, fuel use, flare volumes, loading durations) to support accurate emissions tracking and inventory updates if future assessments are required. • Implement a grievance procedure for the JV and all contractors. This must be well known in the host communities and must be sensitive to human rights, clear and transparent, afford complete confidentiality and responsive and transparent in terms of how grievances are dealt with.
Fuel combustion (vessels and power generation)	• Exhaust gas emissions from fuel combustion are the primary source of air pollution from this project. Emissions can be reduced by optimising equipment performance and minimising fuel consumption rates through routine maintenance, load management, and operational scheduling. Implementation of the energy and fuel efficiency measures outlined in the project's <i>Energy and Carbon Management Plan</i> will indirectly reduce ambient air pollutant emissions. • Use distillate fuels with low sulphur content to reduce SO₂ and PM emissions. • Minimise vessel idling and optimise positioning time, particularly in the nearshore transshipment area. • Where third-party vessels are used, clearly communicate environmental performance expectations (e.g. compliance with MARPOL Annex VI).
Flaring (non routine)	While the project is designed to avoid routine flaring, flaring (non routine) during well testing, clean-up and safety events will occur. In such cases, • Minimise the volume and duration of flaring to the lowest practicable level. • Optimise combustion to reduce emissions: - o Maintain high combustion efficiency via proper fuel-to-air ratios and high-efficiency flare tips. - o Ensure reliable ignition systems and protect pilot flames from blow-out. - o Control flare stability to avoid black smoke and odour (e.g. avoid flame lift-off). • Install pressure protection systems to reduce overpressure events and avoid upset flaring. • Undertake inspection and maintenance of flare burners during planned full field shut down.
Fugitive emissions	• General design and operational measures: - o Avoid open-ended lines. - o Use double mechanical seals on VOC-critical pumps where feasible. - o Minimise the number of flanged connections in hydrocarbon systems. • LDAR Programme: - o Establish an LDAR programme to identify and address VOC emissions from valves, flanges, pumps, and compressors. - o Conduct periodic inspections using gas detection instruments. - o Log leaks exceeding thresholds (e.g. 500 ppmv) and prioritise repairs within defined timeframes (e.g. 15–30 days).



Activity	Mitigation and data management measures
	- o Allow exceptions only where access is unsafe or shutdown is required. • Deployment of AUSEA (Airborne Ultralight Spectrometer for Environmental Applications) drone campaigns to identify fugitive emissions. • The installation of CH₄ IoT (Internet of Things) sensors enables continuous monitoring and real-time detection of fugitive methane (and indirectly NMVOC) emissions supporting early leak identification and rapid response. • The use of meter vents will provide controlled measurement and routing of emissions to recovery systems rather than uncontrolled release. • Minimise VOC losses during crude oil loading, particularly at transfer hoses and connections: - o Use closed loading systems (e.g. vapour recovery) where possible. - o Use dry-break couplings to prevent vapour and liquid release. - o Control loading rates to avoid overpressure and venting. - o Include hoses and seals in the LDAR programme.
Monitoring	• Deploy passive diffusion tube samplers to monitor ambient NO₂, SO₂ and VOC (with benzene speciation) along the coastline (nearshore) and at proximate receptors during nearshore transshipment operations. If results consistently measure below guideline thresholds, monitoring could be discontinued. At minimum, the monitoring programme should include: - o A 1-month baseline survey to establish ambient pollutant levels prior to commencement of any transshipment activities; - o Monthly monitoring campaigns during the 48-hour nearshore transfer window (i.e. 24 hours for vessel manoeuvring and 24 hours for active cargo transfer). These campaigns should continue for 12 months to capture seasonal variability, after which the need for continued monitoring can be reassessed; and - o Monitoring should include proximate shore-based receptors (e.g. in the region of Langstrand, Swakop river mouth; and in the northern outskirts of Walvis Bay). • If reliable and representative weather data for the Swakopmund/Walvis Bay area are unavailable, the programme should include the installation of a suitably sited weather station during baseline and monitoring phases to support data interpretation. • Develop an air quality monitoring programme defining the monitoring protocols once the transshipment location is confirmed.

7.7.2 Contribution to Green House Gas Emissions

This section provides a summary of the assessment included in the Climate Change Risk Assessment report provided in Appendix Q.

7.7.2.1 Source of Impact

The main sources of GHG emissions (continuous or intermittent) from the proposed project will include:

- Liquid and gaseous fuel combustion by vessels, support helicopters and power generation units;
- Flaring of hydrocarbons (i.e. well testing and clean-up, non-routine safety requirements); and
- Fugitive releases (i.e. equipment leaks).



The following project aspects may cause the impact in the following project phases:

Aspect	Drilling & Installation	Production	Decommissioning
Air emissions from DPST, FPSO, drilling units, conventional tanker and vessels	X	X	X
Air emissions from helicopters	X	X	X
Non-routine flaring of hydrocarbons	X	X	

7.7.2.2 Impact Description

Some of the gaseous pollutants released from the normal operations of the project could contribute to global GHG emissions. The release of GHG includes mainly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect.

In terms of boundaries, the GHG emissions associated with an organisation's operations are identified and characterised as either direct or indirect emissions (The Greenhouse Gas Protocol, 2015). Three 'scopes' are used for GHG emissions accounting and reporting to characterise direct and indirect emission sources. The use of scopes not only improves transparency and consistency in reporting but also ensures that organisations do not account for different emissions in the same scope (i.e., double counting).

A brief description of the three scopes is provided below:

- **Scope 1: Direct GHG emissions:** Occur from sources that are owned or controlled by the organisation. This includes for example, GHG emissions from the combustion of liquid fuels in drilling unit, FPSO, DPST, support vessels, and helicopter, as well as flaring during well testing, cleaning and production start-up.
- **Scope 2: Indirect GHG emissions from purchased energy:** Occur from the generation of purchased electricity or steam that is brought onto the organisation's property.¹²⁵
- **Scope 3: Other indirect GHG emissions:** Occur from sources that are not owned or controlled by the organisation. This includes for example, purchased goods and services, upstream transportation and distribution, and the use of sold products.¹²⁶

Scope 1 GHG emission sources from normal operations of the project life, quantified within the specialist assessment, include:

- **Stationary combustion** from drilling units (well testing and clean up), FPSO start up operations (flaring and power generation) as well as FPSO production activities (power generation and non-routine flaring);
- **Mobile combustion** from drilling units and vessels as well as helicopter operations; and
- **Fugitive emissions** from FPSO and associated equipment leaks.

¹²⁵ No Scope 2 emissions were identified for the Venus development project.

¹²⁶ Selected indirect or scope 3 GHG emissions sources were also quantified in the specialist CCRA (see Appendix Q). While the quantification of scope 3 emission sources is not a requirement in terms of both the IFC PSs or the EP4, these emissions sources were quantified to acknowledge and account for the downstream, indirect impacts of the Project. Nevertheless, the below Impact Assessment focuses on the direct (scope 1) GHG emissions of the Project.



7.7.2.3 Impact Assessment: Contribution to GHG Emissions

Project's Calculated Direct (Scope 1) GHG Emissions

Table 7-55 presents a summary of the Project's calculated GHG emissions. The Project's total direct (scope 1) GHG emissions are calculated to 12 935 547 tCO₂e over the 25-year life of the Project, with an average of 517 422 tCO₂e per annum (tCO₂e/a).

Table 7-55: Summary of the Project's calculated GHG emissions (25 years)

Emissions category	Emissions source	Activities	Values (tCO ₂ e)	Percentage contribution (%)
Mobile combustion	Vessels	Drilling	623 222	4.8%
		Installation	186 026	1.4%
		Production logistics	375 623	2.9%
		Transshipments	837 263	6.5%
		Decommissioning	191 805	1.5%
	Helicopter	All phases	44 558	0.3%
Sub-total			2 258 496	17.5%
Stationary combustion	Gas combustion	Drilling	177 051	1.4%
		Installation	103 781	0.8%
		Production	9 900 535	76.5%
	Diesel combustion	Installation	23 077	0.2%
	Oil combustion	Drilling	470 821	3.6%
Sub-total			10 675 265	82.5%
Fugitive		Production	1 786	0.01%
Sub-total			1 786	0.01%
Total			12 935 547	100.0%
Life of Project (years)			25	
Average annual GHG emissions			517 422	

Stationary combustion is the predominant contributor, accounting for approximately 82.5% of total calculated emissions. This is followed by mobile combustion at 17.5%, and fugitive emissions contributing the remaining 0.01%.

A detailed breakdown of emissions by specific sources and operational activities is as follows:

- **Combustion of natural gas (raw or processed) associated with well drilling activities, including well testing and clean-out operations, as well as FPSO start-up, non-routine flaring during production, and power generation,** collectively account for 78.7% of the Project's total GHG emissions. These activities are primarily categorised under stationary combustion sources.
- **MGO combustion in vessels** supporting drilling, installation, production logistics, transshipment, and decommissioning operations contributes approximately 17.1% of total emissions. These emissions fall under mobile combustion sources.
- **Diesel combustion in FPSO start-up** contributes approximately 0.2% of total emissions.
- **Combustion of crude oil during drilling operations (well testing and clean-up)** contributes an estimated 3.6% of total emissions. This source is also classified under stationary combustion.
- **Fugitive emissions from oil production processes** represent 0.01% of the total GHG emissions. These are typically associated with leaks from valves, flanges, and other pressurised equipment.



- **Jet A-1 fuel combustion from helicopter operations** across all project phases contributes 0.3% of total emissions. These emissions are categorised under mobile combustion.

Table 7-56 provides a summary of the estimated GHG emissions associated with a potential 10-year extension of the Project's production phase, should it be granted. Based on these calculations the 10-year extension of the Project would potentially increase the Project's direct (scope 1) GHG emissions by approximately 36.8% to 17 693 486 tCO₂e (i.e. 12 935 547 + 4 757 939 tCO₂e). This extension would, however, decrease the average annual emissions to 505 528 tCO₂e.

Table 7-56: Calculation of the additional GHG emissions associated with a potential 10-year extension of the production phase

Activity	Quantities	Emission source	Conversions and Emission factors	GHG emissions (tCO ₂ e)
Production	820 mmscf gas	Non-routine Flaring	74.3 tCO ₂ e/mmscf	60 912
	4 978 mmscf gas	Power generation	74.3 tCO ₂ e/mmscf	369 664
	3 650 t MGO	Production logistics	3.247 tCO ₂ e/t	11 850
	1 950 t MGO	Maintenance vessels	3.247 tCO ₂ e/t	6 331
	7 936 t MGO	Transshipments	3.247 tCO ₂ e/t	25 765
	15 067 000 boe	Fugitive	0.00000059 t CH ₄ /m ³	42
	387 t Jet A1	Helicopter	3.179 tCO ₂ e/t	1 230
Annual GHG emissions				475 794
Duration (years)				10
Total GHG emissions for 10-year extension of production phase				4 757 939

Assessment of the Project's GHG Emissions

The specialist assessment did not apply the standard SLR impact assessment methodology as this approach is not deemed to be appropriate for assessing the Project's GHG emissions.

The Project's direct GHG emissions are, therefore, mainly assessed in terms of three criteria, as detailed below:

1. Benchmarking the Project's annual GHG emissions with pre-defined thresholds.
2. Benchmarking the Project's GHG emissions intensity with the average GHG emissions intensity of selected countries.
3. Contribution of the Project's GHG emissions to Namibia's national GHG inventory.

Benchmarking Against Pre-Defined Thresholds for Annual Operational Emissions

The European Bank for Reconstruction and Development (EBRD) developed thresholds to screen investments and provide an early indication of a project's potential impact on the Bank's GHG inventory and the GHG intensity of its investment portfolio (European Bank for Reconstruction and Development, 2010).

In the context of this ESIA, these thresholds provide a useful means for differentiating between projects with very low, low, medium-low, medium-high, and high annual GHG emissions. Moreover, these thresholds also generally align with those of the IFC Performance Standards on Environmental and Social Sustainability (International Finance Corporation, 2012) and EP4 (Equator Principles Association, 2020).



Table 7-57 presents the thresholds used in this assessment as a benchmark to determine the order of magnitude of the Project's annual GHG emissions during the operational phase (excluding scope 3 or downstream GHG emissions).

The Project's operational (i.e. production phase associated) GHG emissions are calculated to be 11 149 168 tCO₂e over the 21-year duration of the production phase, with an average of 530 913 tCO₂e per annum. Based on the pre-defined thresholds (i.e., > 100,000 and < 1 million tCO₂e/a), the significance of the Project's annual operational GHG emissions over the 21-year duration of the production phase is classed as **Medium-High**.

Table 7-57: Thresholds for assessing the significance of a Project's GHG emissions (EBRD 2010)

Benchmark thresholds (tCO ₂ e/a)	Significance rating
Negligible	Very low
< 20 000	Low
> 20 000 and < 100 000	Medium-low
> 100 000 and < 1 million	Medium-high
> 1 million	High
Note: Bold text indicates the category into which the proposed project falls	

Benchmarking with the Weighted-Average GHG Emissions Intensity of Selected Oil Producing Countries

The second criteria for assessing the Project's GHG emissions is benchmarking the Project's GHG emissions intensity during the production phase with the weighted-average GHG emissions intensity of crude oil production plants of selected oil producing countries.

Overall, the Project's GHG emissions intensity during the production phase is calculated to be **2.9 grams of carbon dioxide equivalent per megajoule of energy produced (gCO₂e/MJ)**. Based on this, the Project's GHG emissions intensity per megajoule of energy produced was found to be lower than the 2015 weighted-average GHG emissions intensity of crude oil production from selected countries considered in this assessment as shown in Figure 7-24. The countries selected for inclusion in the assessment are countries where the majority of crude oil production is from offshore facilities.

Contribution to Namibia's National GHG Emissions Inventory

The third criteria for assessing the Project's GHG emissions is the potential contribution to Namibia's national GHG emissions inventory. Specifically, the assessment calculated the contribution of the Project's GHG emissions to Namibia's GHG inventory in the year 2030 target for two scenarios:

- **Business-as-usual:** Without the implementation of the mitigation measures contained in the updated NDC 2023.
- **Mitigation:** With the successful implementation of the mitigation measures contained in the updated NDC 2023.

To address variability in the Project's greenhouse gas (GHG) emissions, the assessment evaluated both the average annual emissions over the production phase (530 913 tCO₂e/a based on 21-year production life) and the peak annual emissions, projected to occur around the third year after the start of the project at the Venus offshore area where drilling, installation, and production activities will be occurring concurrently (1 087 703 tCO₂e/a).

Using average annual production phase GHG emissions, it was calculated that the **Project's operational GHG emissions would reduce Namibia's net sink capacity in the business-as usual scenario by 0.585%** from -90.713 MtCO₂e to -90.182 MtCO₂e. With the



mitigation scenario, it was calculated that the **Project's GHG emissions would reduce Namibia's net sink capacity by 0.517%** from -102.615 MtCO₂e to -102.084 MtCO₂e.

Using the highest annual GHG emissions, it was calculated that the **Project's GHG emissions would reduce Namibia's net sink capacity in the business-as usual scenario by 1.199%** from -90.713 MtCO₂e to -89.625 MtCO₂e. With the **mitigation scenario**, it was calculated that the **Project's GHG emissions would reduce Namibia's net sink capacity by 1.06%** from -102.615 MtCO₂e to -101.527 MtCO₂e.

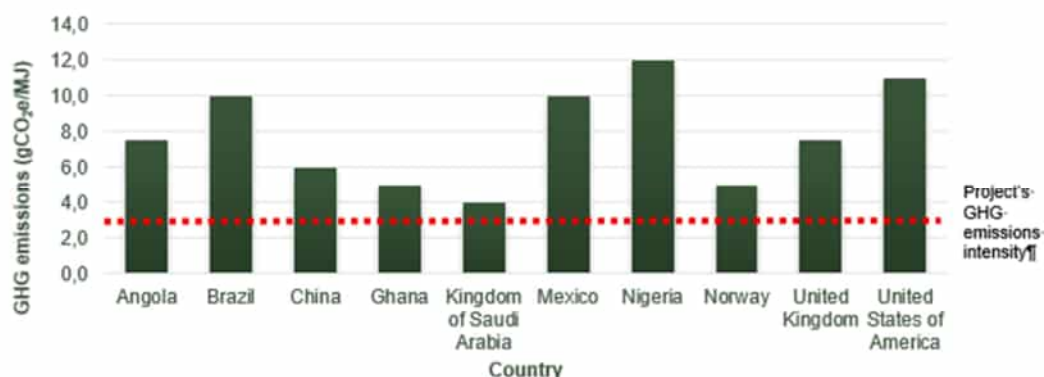


Figure 7-24: Benchmarking the Project GHG emissions production phase intensity against the 2015 average GHG emissions intensity of crude oil production for selected countries

7.7.2.4 Mitigation and Management Measures

In addition to mitigation measures recommended to reduce emissions at the source (refer to Section 7.7.1.5) the following measures are recommended to reduce GHG emissions:

- Develop and implement an Energy and Carbon Management Plan (see Appendix Q for Preliminary Energy and Carbon Management Plan) to optimise energy use and reduce methane emissions, reducing the Project's scope 1 emissions during the production phase.

7.7.3 Climate Risks and Opportunities

In accordance with the requirements of the IFC Performance Standards, EP4, and legal precedent, the Climate Change Risk Assessment (Appendix Q) assessed the potential risks and opportunities for the Project with a changing climate (Section 7.7.3.1). The potential impact of the Project on communities that are adversely affected by climate change, as well as sites of demonstrated importance to climate change mitigation and adaptation are dealt with below in Section 7.7.3.2.

7.7.3.1 Climate-Related Risks and Opportunities for the Project

The following section presents a summary of the physical and transitional climate-related risks for the Project assessed within the Climate Change Risk Assessment (Appendix Q).

Physical Climate-Related Risks

- Severe Storms: Rising temperatures and sea levels may increase storm intensity, posing a threat to offshore infrastructure. However, robust design and calm transshipment areas reduce vulnerability. (Risk rating: Low)



- **Extreme Heat:** Higher temperatures could lead to heat-related illnesses among workers, affecting productivity and health. (Risk rating: Low)

Transition Climate-Related Risks

- **Policy Restrictions:** Future climate policies could limit oil development, reducing revenue. Namibia currently shows no restrictive plans. (Risk rating: Moderate)
- **Climate Litigation:** Growing global trend of lawsuits against oil projects could cause delays and legal costs. (Risk rating: Moderate)
- **Carbon Pricing:** Introduction of carbon taxes or trading schemes could significantly raise operational costs if implemented. (Risk rating: Moderate)
- **Market Changes:** Declining global oil demand and prices due to energy transition may reduce revenue. (Risk rating: Moderate)

7.7.3.2 Climate Risks to Communities, Priority Ecosystem Services, and Biodiversity

In accordance with the requirements of IFC Performance Standards, the Climate Change Risk Assessment (Appendix Q) considered the implications of climate change, as summarized below, for:

- **Communities that are already impacted by climate change, which may experience an acceleration and/or intensification of various impacts due to Project activities** – The potential impact of the Project on communities already affected by climate change is considered **low** and has, therefore, not been assessed further. This conclusion is based on findings from the Marine Ecology Impact Assessment (Appendix L), which indicate that the offshore part of the Project is unlikely to significantly affect small pelagic fish species (e.g., sardine, anchovy, mackerel, and herring) that are important to these communities. Although vessel traffic between the FPSO and the ports of Lüderitz and Walvis Bay may occur, its impact is also considered negligible for the purposes of this assessment.
- **Impacts on priority ecosystem services which may be exacerbated by climate change** – The potential impact of the Project on priority ecosystem services which may be exacerbated by climate change is considered **low** and has, therefore, not been assessed further. This conclusion is based on findings from the Marine Ecology Impact Assessment (Appendix L) and Fisheries Impact Assessment (Appendix M), which indicate that the Project is unlikely to significantly affect the provision of priority ecosystem services.
- **Forest areas and marine and coastal habitats that are vulnerable to the effects of climate change or which contribute to climate change mitigation** – **Not applicable** as the Project is located approximately 300 km off the southwest coast of Namibia. The transshipment zone is also located offshore (~5 km).
- **Sites of demonstrated importance to climate change adaptation for either species or ecosystems** – The potential impact of the Project on sites of demonstrated importance to climate change adaptation is considered **low** and has, therefore, not been assessed further. This conclusion is based on findings from the Marine Ecology Impact Assessment (Appendix L), which indicate that the Project is unlikely to significantly affect critical habitats.



7.8 Transboundary Impacts

A transboundary impact is an environmental or socio-economic impact that originates in one country (e.g. where the project takes place) but affects the biophysical or socio-economic environment in another country.

As noted in Section 2.4, there are various obligations for a State, in this instance the Namibian Government, to consider transboundary impacts, including the Abidjan Convention, Benguela Current Convention and UNCLOS.

Although these obligations fall on the State and there is no requirement in the Environmental Management Act, 2007 or the EIA Regulations 2012 compelling an applicant to conduct a transboundary impact assessment when applying for an ECC, this ESIA does also consider potential transboundary sensitive receptors (e.g. South African fisheries, MPAs, transboundary EBSAs, etc. – refer to Chapter 5.0) and impacts on them (in terms of extent, duration, sensitivity, etc.). This section summarises the findings related to potential impacts of normal operations on receptors located outside of Namibia.

7.8.1 Marine Ecology

- **Seabed and Benthic Fauna:** The primary impact on the seabed arises from the discharge of cuttings from the drilling units. Modelling indicates that the depositional footprints with significant risk are highly localised and confined to a maximum of 270 m from each well bore (see Table 7-5). The furthest distance at which thickness exceeded 0.1 mm was 1.8 km. **No transboundary impact on South African or international waters related to drilling discharges is expected since the:**
 - o South African EEZ is located over 105 km to the south at its closest point; and
 - o Boundary of the Namibian EEZ with international waters is 78 km to the west at its closest point.
- **Water Column Effects:** The primary impacts on the water column arise from the discharge of drill cuttings, subsea lines commissioning effluents, and produced water from the FPSO. Modelling indicates that the plume in the water column with significant risk would extend up to ~31 km in a north-westerly direction, away from the South African EEZ (see Table 7-5). **No transboundary impact on South African or international waters is expected.**
- **Marine Fauna Behavioural Disturbance and Injury Effects:** The primary source of behavioural disturbance and injury to marine fauna is underwater noise. Underwater noise modelling indicates that the zone of impact for disturbance of marine fauna (specifically marine mammals) during *drilling / installation* extends up to ~100 km for a short-term (1 month) scenario when up to 16 vessels operate in the vicinity of the FPSO at the same time (see Table 7-4). This zone of impact marginally extends to international waters (see Figure 35 in Appendix G) but does not reach South African waters. During *production*, the behavioural zone of impact is smaller than during the drilling / installation phase, extending up to ~38 km from the FPSO. It does not extend into South African or international waters. The zones of impact for potential injury to marine fauna is less than that for behaviour and do not extend into South Africa or international waters. **A very limited and short-term (1 month) transboundary impact on the behaviour of some marine mammals in international waters (but not South African) is thus expected during the drilling / installation phase only.**

7.8.2 Socio-Economic

The zones of impact on fish associated with operational discharges or noise do not extend to South African or international waters, as outlined in Section 7.8.1. **No transboundary impact on fishing activities in South African or international waters is expected.**



No other socio-economic impacts (including human rights) are expected in South Africa, though some goods and services could be imported from South Africa (and a host of other countries).

7.8.3 Atmospheric Emissions

Air emissions (continuous or intermittent) from fuel combustion, non-routine flaring and fugitive emissions in the Venus offshore project area will dilute and disperse based on meteorological conditions at the time of release, decreasing in concentration over distance. A meteorological overview of PEL0056/Block 2913B indicates that winds are generally from a south-easterly to southerly direction during most of the year. Although winter remains dominated by southerly winds, north-westerly winds are more frequent. Indeed, the winds capable of transporting pollutants toward South Africa have a low frequency (1.8%). Considering the dominant winds, distance to the South African coast and sensitive receptors and pollutant dispersion, no transboundary impact on sensitive South African receptors is expected.

7.9 Cumulative Impacts Assessment

7.9.1 Introduction

Cumulative effects are commonly understood as the potential impacts which combine from different actions and which result in significant change larger than the sum of all the impacts. The consideration of the 'cumulative impact' should include "past, present and reasonably foreseeable future developments or impacts". This requires a holistic view, interpretation and analysis of the biophysical, social and economic systems. Cumulative impact assessment is limited and constrained by the method used for identifying and analysing cumulative effects. As it is not practical to analyse the cumulative effects of an action on every environmental receptor, the list of environmental effects being considered to inform the decision-maker and inform interested parties should focus on those that can be evaluated meaningfully (DEAT, 2004).

While it is foreseeable that further exploration (seismic and well-drilling) and future production activities could arise offshore southern Namibia, and consideration can be given to previously approved exploration activities, there is currently insufficient information available to make reasonable assertions as to nature of such future production activities in surrounding blocks. This is primarily due to the current lack of relevant geological and resource potential information, which proposed and ongoing oil and gas exploration projects offshore Namibia aim to address.

Cumulative impacts due to ongoing and future vessel operations (including commercial, recreational, fishing, mining, oil/gas, etc.) are also foreseeable within the nearshore transshipment area, especially considering the nearshore transshipment is in close proximity to an existing anchorage area and the Walvis Bay port.

This cumulative assessment thus focuses on activities proposed as part of current production project, in conjunction with other 'reasonably foreseeable' activities that may result in a cumulative impact. In this context, the assessment of normal operations in Sections 7.2 to 7.7 already, by its nature, considers the:

- Cumulative impact of the total project, i.e. assesses the impact of the drilling, installation, production and decommissioning activities; and
- Interaction of the project with past and current activities and impacts, as these are captured in the baseline. In particular, when rating the sensitivity of the receptors, the status of the receiving environment (benthic ecosystem threat status, protection level, protected areas, etc.) or threat status of individual species is taken into consideration,



which is based to some degree on past and current actions and impacts (e.g., the IUCN conservation rating is determined based on criteria such as population size and rate of decline, area of geographic range / distribution, and degree of population and distribution fragmentation).

The cumulative impact assessment thus focuses on the potential cumulative impact of the project, with other concurrent and reasonably foreseeable future activities.

7.9.2 Activities Potentially Generating Cumulative Impacts with the Project

Activities that could lead to cumulative impacts are those whose impacts may overlap with those of the project, e.g. affect the same or similar features or areas. Of the key **offshore** activities discussed in the baseline (Section 5.7.6), mining and recreational use are primarily situated in nearshore areas and do not overlap with the **Venus offshore project area** within PEL0056/Block 2913B, and undersea cables do not pass through the Venus offshore project area (Section 5.7.6.5), and are *not* expected to contribute to cumulative impacts with the proposed drilling, installation, production and decommissioning activities within the Venus offshore project area.

Activities that *could* possibly lead to cumulative impacts within the **Venus offshore project area** include:

- Shipping, as PEL0056/Block 2913B overlaps with a busy shipping route off the African West Coast (see Section 5.7.6.1), leading to potential cumulative noise impacts on marine fauna;
- Fishing, as the large pelagic longline sector overlaps with the Venus offshore project area, leading to potential cumulative noise and behavioural impacts on marine fauna (see Section 5.7.5.2);
- Oil and gas exploration / appraisal, which is underway in the southern Namibian and northern South African West Coast regions (see Section 5.7.6.2 and Table 5-28), including a proposed exploration drilling in Block NCUD (in South Africa) to the south of PEL0056/Block 2913B. Concurrent activities could lead to potential cumulative impacts on marine fauna and habitats related to noise, physical disturbance and changes in water quality. In addition, associated exclusion and restricted areas may add to the cumulative impacts on fisheries.

Exploration activities (and any well drilling as part of any appraisal and production development) are temporary, and it cannot be predicted which activities in other Blocks will take place at the same time as the implementation of this project in PEL0056/Block 2913B. Based on current levels of exploration and appraisal activity in the region, as well as duration of the proposed project (up to 25- 35 years), it is likely that some exploration activities (e.g. drilling and/or seismic surveys) will take place in the wider region concurrently with this project.

Although the location of proposed wells in the Venus offshore project area is currently known, any new wells in neighbouring blocks are not yet known. Nevertheless, considering the proposed location of the GI and OP wells within the Venus offshore project area, potential exploration and appraisal wells in neighbouring blocks are likely to be located at least several kilometres from the Venus offshore project area.

Of the key **nearshore** activities discussed in the baseline (Section 5.7.6), shipping and recreational use are primarily situated in nearshore areas and may overlap with the **nearshore transshipment area** potentially resulting in cumulative impacts. Undersea



cables and nearshore mining operations do not pass through the nearshore transshipment area and are *not* expected to contribute to cumulative impacts with the proposed nearshore transshipment activities.

Activities that *could* possibly lead to cumulative impacts within the **nearshore transshipment area** include:

- Shipping, as the nearshore transshipment area is located in a busy shipping route, being located near the entrance to the Walvis Bay Port (see Section 5.7.6.1), with high levels of vessel traffic related to passenger, shipping and fisheries expected in the vicinity of the transshipment area, leading to potential cumulative noise impacts on marine fauna; and
- Fishing, as the commercial linefish sector and SSF activities overlap with the nearshore transshipment area, leading to potential cumulative noise and behavioural impacts on marine fauna (see Section 5.7.5.2 and 5.7.5.3). Furthermore, the proposed nearshore transshipment area (including safety exclusion zone) overlaps with an area currently zoned for mariculture activities (but not currently in use). Although this proposed mariculture zone may need to be revised based on the final nearshore transshipment buoy location, future mariculture activities could also lead to potential cumulative noise impacts on marine fauna.

Furthermore, onshore energy projects and port expansion may primarily lead to **cumulative socio-economic** impacts due to significant labour requirements in a remote and sparsely populated area. Notably, several large-scale developments are planned or underway in the Lüderitz region, *inter alia*:

- Hyphen Hydrogen Energy Project in the Tsau Khaeb National Park and surrounding areas, which would require a considerable construction and operation labour force (not yet approved);
- Four wind farms approved in the Tsau/Khaeb National Park; and
- Angra Point Port Expansion to expand and deepen the Lüderitz port.

Likely impact footprints / magnitudes of the activities that could generate cumulative impacts with the project are summarised in Table 7-58.



Table 7-58: Impact footprints / magnitude of project activities

Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
Physical seabed disturbance	Long-term impact in immediate well, subsea infrastructure and anchor footprints	Drilling: Similar to project Seismic: None	Anchorage (for shipping and mariculture activities)	None	None, no demersal trawl activities take place within the Venus offshore project area	None
	Potential Cumulative Impact					
	Impact footprints of different exploration / appraisal wells offshore southern Namibia are not expected overlap with the area of impact due to well drilling and installation activities in the Venus offshore project area. However, even if possible similar impacts in the vicinity are additive, impact footprints are small relative to the region and high homogeneity of the seabed in the deep offshore area. Nearshore anchorage in vicinity of the nearshore transshipment are not expected to overlap with the direct area impacted by the nearshore transshipment buoy anchors, with safety zones around the nearshore transshipment buoy and marine spatial planning, preventing overlap of anchor positions / locations.					
Benthos change	Long-term impact up to 296 m from each well (related to grain size change, see Table 7-5). Long-term change from drilling of 20 well pairs (i.e. up to 40 wells) in area of up to 3.2 km ² (related to effective thickness, Table 7-5).	Drilling: Similar to project Seismic: None	Anchorage (for shipping and mariculture activities)	None	None, no demersal trawl activities take place within the Venus offshore project area	None
	Potential Cumulative Impact					
	Impacts footprints of different exploration / appraisal wells are not expected to not overlap but are additive. Impact footprints are small relative to the region and high homogeneity of the seabed in the deep offshore area. Impact footprints from nearshore anchorage and/or future mariculture operations are not expected to overlap with nearshore anchor installation impacts, with the impacts small relative to the region and limited in extent.					



Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
Changes in water quality	Short-term changes due to drilling discharges, extending up to 31.2 km from discharge point (Table 7-5). Water quality impacts due to discharges during commissioning extending up to 19.2 km from discharge point (Table 7-6). Impact throughout production phase due to produced water discharge. Effects extending up to 62.3 km from FPSO (Table 7-7).	Drilling: Similar to project Seismic: None	Releases, assumed to be in line with MARPOL requirements Accidental spills, e.g. during bunkering	Very limited to releases, assumed to be in line with MARPOL requirements	Very limited releases, assumed to be in line with MARPOL requirements	None
	Potential Cumulative Impact					
	Impact footprints of different exploration / appraisal wells could overlap if nearby wells are drilled at the same time, but overlap is unlikely as particle plumes do not spread evenly around the well and are very short-term. No additive impact over time as plumes disperse quickly. No significant additive impact is expected with shipping / fishing.					
Underwater noise	Behavioural effects on mammals up to 70 km – 100 km and fish up to 1.8 km at Venus offshore project area, during drilling and installation phase. Behavioural effects on marine mammals at nearshore transshipment area during intermittent transshipment operations up to 8.9 km (Table 7-4). AUD-INJ up to 1.6 km and TTS up to 20.9 km for LF mammals, during concurrent drilling and installation activities (i.e. maximum vessel activity) at Venus offshore project area.	Drilling: Similar to project Seismic: Different but transient impact zones (moving sound source), restricted to certain times of the year	Nearshore transshipment area is located in a high shipping area (see Figure 5-81) as such a shipping noise component of the ambient noise environment.	Venus offshore project area is located in a high shipping area (see Figure 5-81) as such a shipping noise component of the ambient noise environment is expected to be	Some noise related to vessel movement	None



Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
	Reduced TTS up to 3.7 km for VHF mammals and 1.6 km for turtles.			present over the block area.		
	Potential Cumulative Impact					
	Impact footprints of different exploration / appraisal wells on mammals in the offshore marine environment could overlap if wells are drilled within 70 km – 100 km of the Venus offshore project area at the same time as drilling and installation operations / phase or within 38 km during intermittent offshore transfer operations, which is possible and may affect mammal behaviour in between the two areas / wells (depending on the direction of noise travel). As drilling units, installation vessels and DPST are the main source of noise impacts during drilling and installation as well as offshore transfer operations (production), respectively, impacts from concurrent exploration well drilling in other areas would be additive and cumulatively increase the portions of the ocean where mammal behaviour in particular may be affected. The overlap with seismic surveys may be less significant, as the seismic sound source travels and the impact is thus very short-term in any one area, but seismics do add to the overall portion of the ocean where mammal behaviour in particular may be affected at the time. Seismic surveys are generally restricted to periods of the year when fewer migrating whales are present. Shipping noise present in PEL0056/Block 2913BPEL0056/Block 2913B the nearshore transshipment area overlaps with, but is lower than project noise, so that the impact is not additive but dominated by project noise when present. At other times shipping noise can also affect fauna behaviour.					
Other activities causing injury and mortality	Possibility of collision with vessels in transit	Drilling: Similar to project Seismic: Similar to project	Collisions with shipping vessels	Collisions with shipping vessels	Collisions with fishing vessels (Unintended) injury and mortality due to bycatch)	None
	Potential Cumulative Impact					
	As the project area is located in a busy shipping route (Figure 5-81), vessel strikes from shipping are likely to occur and will cumulatively contribute to fauna mortality from collisions. Fishing in the region will cumulatively contribute to fauna injury and mortality.					



Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
Infrastructure remaining on the seabed	Long-term impact in immediate well and subsea infrastructure footprint, which create hard substrata in an otherwise uniform area of unconsolidated sediments	Drilling: Similar to project Seismic: None	Anchorage (for shipping and mariculture activities) Subsea infrastructure for mariculture activities	None	None	None
	Potential Cumulative Impact					
	Impact footprints of different exploration / appraisal wells and subsea infrastructure do not overlap, but are additive. Footprints are small.					
Exclusion zone	Long-term impact of up to 10 NM around FPSO (Maritime Exclusion Area) and 1.7 km around the nearshore transshipment buoy (safety exclusion zone) Standard shipping safety distances for supply vessels	Drilling: Similar to project Seismic: Exclusion zones measuring several km from survey vessel, moving with the vessel	Anchorage Mariculture operations Shipping lanes	Standard shipping safety distances	Standard shipping safety distances Areas may be inaccessible to other vessels while fishing nets or lines are deployed and drifting	None
	Potential Cumulative Impact					
	Impacts footprints of different exploration / appraisal wells in neighbouring Licence Blocks are unlikely to overlap, but safety zones of 2 km around nearby wells drilled concurrently could cumulatively reduce accessibility to a region of ~ 12.57 km ² diameter for up to ~3 months. Several concurrent exploration / appraisal activities would result in narrowing navigation routes while drilling takes place. Seismic survey and fisheries drift net exclusion zones will add to areas that are inaccessible to other vessels.					



Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
	No significant additive impact is expected with shipping at Venus offshore project area. Areas designated for anchorage, shipping lanes and mariculture operations in vicinity of nearshore transshipment buoy (and associated safety exclusion zone), would cumulatively reduce the accessibility of fishing grounds within the area.					
Employment and procurement	~Up to ~5 000 jobs during the construction phase (drilling and installation), with ~7 000 jobs estimated during the production phase, at a range of skill levels	Drilling: Reduced/lower local employment and procurement Seismic: minimal local employment and procurement		Local employment at ports and shipping services	Considerable source of employment for local people, though often low income	Considerable labour force requirements, resulting in potential in-migration and pressure on coastal towns
	Potential Cumulative Impact					
	Project and other concurrent exploration / appraisal activities will contribute somewhat to employment and more noticeably to procurement spend in Namibia in the short-term.					
Atmospheric pollutant emissions	No exceedance of ambient NO _x , SO ₂ , CO and PM concentrations in the Venus offshore project area and potentially at nearshore sensitive receptors from vessels, helicopters, aircrafts, power generation, drilling fluids and non-routing flaring (in Venus offshore project area only). No exceedances of short-term WHO AQG (1-hour or 24-hour averages) at sensitive coastal receptors from nearshore transshipment operations.	Drilling: lower emissions than project Seismic: Emission levels akin to other vessels	Mariculture and anchorage activities Shore-based road traffic, industrial and recreational, tourism activities, etc.	Emissions associated with vessel fuel consumption, cruise liners, recreational vessels, container vessels, etc.	Emissions associated with vessel fuel consumption	Emissions associated with energy-related projects and port expansions



Impact aspect	Impact of Project	Impact of other projects				
		Other offshore exploration	Other nearshore activities	Shipping	Fishing	Lüderitz onshore energy and port expansion
	Potential Cumulative Impact					
	Cumulative impacts with concurrent offshore drilling /exploration activities are highly unlikely. Emission concentrations from subsequent nearby drilling and/or exploration activities will likely reduce quickly in the offshore environment and will not persist long enough to create cumulative impacts. Emissions from seismic, shipping and fishing vessels are mobile and make a negligible contribution to pollutant concentrations in region/ vicinity of Venus offshore project area. Cumulative impacts on ambient air quality from nearshore transshipment operations may occur, particularly where emissions from nearshore transshipment activities may coincide with existing land-based sources (e.g. road traffic, vessel movements, and urban activities). Helicopter operations from Lüderitz will make a negligible contribution to pollutant concentrations in the Lüderitz area.					
GHG emissions	12 935 547 tCO ₂ e over the 25-year life of the Project, with an average of 517 422 tCO ₂ e per annum (tCO ₂ e/a).	Drilling: Lower emissions than project Seismic: Emission from vessel fuel	Anchorage and mariculture activities Shore-based road traffic, industrial and recreational, tourism activities, etc.	Emissions from vessel fuel (gCO ₂ / t cargo / nm ¹²⁷): Container: ~12 Tankers: ~9 Bulk/cargo: ~7	Emissions from vessel fuel	Emissions associated with energy-related projects and port expansions
	Potential Cumulative Impact					
	GHGs persist in the atmosphere for many years. Impacts are global irrespective of where the GHG are emitted. All emissions will thus generate a cumulative impact with all other global GHG emissions.					

¹²⁷ REVIEW OF MARITIME TRANSPORT 2023 - Chapter 3: Decarbonizing shipping (unctad.org). Total global emissions of ~650 Mt CO₂e from container, tankers and dry bulk and general cargo in March 2023, and ~850 Mt CO₂ from all shipping



7.9.3 Potential Biophysical Cumulative Impacts

7.9.3.1 Cumulative Impact on Benthos

The installation of wells, subsea infrastructure and anchor moorings would directly impact the immediate footprint of the infrastructure with increased turbidity and associated impacts restricted to the vicinity of the operations. Impacts to the benthos can thus be considered an insignificant percentage of the ecoregion as a whole, with the nearshore and offshore marine environment both being in ecosystem types rated as 'Least Threatened'.

There is no current development or production from the offshore southern African west coast. The Kudu Gas Field (off southern Namibia) has been identified for development, with Rhino Resources considering production in Block 2914A in southern Namibia.

Cumulative impacts considering drilling discharge modelling results, based on drilling of 20 well pairs, indicated a potential area of 320 ha being occupied by significant risk related to sediment thickness of > 6.5 mm (i.e. the threshold above which potential harm to the ecosystem might be observed) (Table 7-5).

In reality the total cumulative impacted area at any one time is likely less, due to the natural dispersion and recovery of benthic communities in unconsolidated sediments over the short to medium (shallow waters) and long term (deeper waters). Furthermore, as the Venus offshore project area and the associated depositional footprints avoids MPAs, impacts will mostly affect communities in unconsolidated habitats, which are less sensitive to disturbance and recover more quickly than those inhabiting hardgrounds. However, environmental and geophysical surveys undertaken within PEL0056/Block 2913B have confirmed that the Venus offshore project area is typically homogenous, devoid of features with an impoverished (low diversity and abundance) macrofauna, typical for deep water soft sediments. No colony forming corals and structural features (e.g., rocky outcrops) were identified.

Infrastructure remaining on the seabed after decommissioning also presents an impact on benthos. Despite the number of wells drilled in the Namibian and South Africa offshore environment, there is no evidence of long-term negative change (cumulative impacts) to faunal population sizes or irreparable harm as a direct result of these exploration drilling activities. In fact, Atkinson (2009) reported that in South Africa, abandoned wellheads in the vicinity demersal trawling grounds provide some *de facto* "protection" to marine infaunal, epifaunal and fish assemblages (see also Wilkinson & Japp 2005).

Given the relative uniformity, lower biodiversity richness and vast extent of the deep water habitat primarily affected by this project, and the small cumulative seabed footprint of current offshore activities, together with mitigation and project controls to avoid more sensitive areas, the overall cumulative impact of offshore activities on the benthos located within PEL0056/Block 2913B is considered to be no more significant than assessed in the preceding sections (Table 7-9 to Table 7-11).

Similarly, the overall cumulative impact of the nearshore transshipment buoy anchors on the benthos located within the impacted area is considered to be no more significant than assessed in preceding sections, with limited overlap with concurrent nearshore activities (anchorage and mariculture operations) due to safety restriction zones and spatial planning within this nearshore area.

The project contribution to any overall cumulative impact is deemed moderate, as drilling all 40 wells and installation of subsea infrastructure would contribute a considerable portion of currently anticipated offshore drilling and production activities that impact the seabed. However, the ongoing impacts from trawling activities inshore of the Venus offshore project area are likely more intense (as is evidenced by the Vulnerable to Critically Endangered



benthic habitat status along the shelf edge), compared to the potential benthic impacts related to the Venus offshore project activities and subsea infrastructure.

7.9.3.2 Cumulative Impact on the Behaviour of Marine Fauna

Noise associated with the proposed project would also have a cumulative impact on marine fauna. Sensitive receptors and faunal species (cetaceans, turtles and certain fish) are likely to be affected by cumulative noise impacts within the Venus offshore project area as faunal behaviour will be affected beyond 70 km and 100 km (marine mammals) during drilling only and concurrent drilling and installation operations, respectively. Once drilling and installation phase is complete, noise levels at the Venus offshore project site would reduce back to ambient levels, with lower levels of increased underwater noise occurring intermittently throughout production operations, during weekly oil transfer and vessel operations where behavioural impact can be expected up to 8.9 km (nearshore transshipment operations) and 38.2 km (transfer operations at Venus offshore project area) both related to LF marine mammals.

Data on behavioural reactions to noise acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term and with multiple exposures, i.e. what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population, particularly when combined with other acoustic and non-acoustic stressors (e.g. temperature, competition for food, climate change, shipping noise) (Przeslawski, Byrne, & Mellin, 2015; Erbe, Dunlop, & Dolman, 2018; Erbe, et al., 2019; Booth, Sinclair, & Harwood, 2020; Deros, Ten Doeschate, Brownlow, Davidson, & Lusseau, 2020). Physiological stress, for example, may not be easily detectable in marine fauna, but can affect reproduction, immune systems, growth, health, and other important life functions (Rolland, et al., 2012; Lemos, et al., 2021). Confounding effects are, however, difficult to separate from those due to increased underwater noise.

Although surveys have revealed a steady population increase since the protection of the species from commercial whaling, more recent results, however, indicate changes in the prevalence of southern rights on the South African breeding ground, including a marked decline of unaccompanied adults since 2010 and extreme fluctuations in the number of cow-calf pairs since 2015. Vermeulen et al. (2020), however, contribute the change in demographics to likely spatial and/or temporal displacement of prey due to climate variability, and not increased offshore oil and gas activities. To date no trophic cascades off the South African coast have been documented despite the completion of numerous exploration activities.

In addition to offshore oil and gas related activities, shipping is another significant source of underwater noise that can affect marine fauna, particularly marine mammals. Of all anthropogenic sound sources, shipping noise is the most continuous and pervasive in the ocean (Erbe et al. 2018, 2019).

In the neighbouring South African EEZ, shipping and climate-related stressors are increasing more rapidly than other anthropogenic pressures (Purdon et al. 2020b). Despite these growing stressors—particularly along the shelf and shelf edge of the West Coast—this region supports the highest cetacean species richness in South African waters (Purdon et al. 2020b). Where drilling and vessel DPS-related noise is present, such noise will dominate (and shipping-related noise will not further increase the cumulative impact in those areas).

It is highly likely that other exploration / development activities in the region will take place concurrently to the Venus offshore project area, resulting in cumulative noise impacts, particularly on mammal behaviour and, to a lesser degree, on fish and turtles. The areas affected by exploration / development noise, and intensity of such noise, will change as exploration / development activities progress, requiring adaptation by fauna. However, given the cost of well drilling and the limited supply of drilling units, it is expected that the number



of wells being drilled concurrently in the region will be restricted, thus limiting the overall noise impact footprint at any one time. Additionally, seismics surveys can only be conducted during certain periods of the year when sensitive migrating mammals are mostly absent.

Concurrent vessel and anchorage activities within the vicinity of the nearshore transshipment buoy will likely result in cumulative noise impacts, particularly on marine mammal behaviour. However, shipping noise present in the nearshore transshipment area is likely lower than the underwater noise generated due to DPS, so that the impact is not additive but dominated by project noise when present.

Lighting can also cause behavioural impacts, and there are numerous light sources from vessels operating within and transiting through the area, although each is isolated in space and most are mobile. Given the extent of the ocean and the point source nature of the lighting, the prevalence of sensitive receptors and faunal species interactions with the light sources is expected to be low. Light levels would return to ambient once operations are completed, and no detectable cumulative effects are anticipated. Similarly, given the proximity to port operations and ongoing vessel/shipping activities as well as intermittent nature of nearshore transshipment operations, lighting cumulative impacts due to nearshore transshipment operations are limited/negligible.

The overall cumulative noise impact of offshore and nearshore activities on faunal behaviour is considered to be no more significant than assessed in the preceding sections (Table 7-16 to Table 7-18).

The project contribution to any overall cumulative impact is deemed low to moderate, as drilling and installation activities would contribute notably to offshore activities that generate noise for up to 4 years, after which weekly offshore transfer and nearshore transshipment operations throughout the production phase will be limited in their cumulative impact, with nearshore transshipment taking place in an area of high vessel traffic.

7.9.3.3 Cumulative Impact on Physiological Injury to Marine Fauna

Noise, as well as collisions and/or entanglement with mooring chains and vessels, is the main aspects that could lead to physiological and/or physical injury of marine fauna. Distances at which injuries (AUD-INJ) from project noise can occur are relatively close to the drilling unit and/or project activities (i.e. local to within/near site), with injury due to collisions and/or entanglement are restricted to the chains/vessel itself (site). Overall, the likelihood of faunal injuries is deemed low given the low density and high mobility of fauna in the area.

Distances at which permanent (AUD INJ) and temporary effects (TTS) from project noise in the Venus offshore project area can occur are considerably larger for LF mammals up to 1.6 km to 20.9 km, respectively, **considering the maximum impact zones modelled during the second installation campaign (i.e. peak vessel activity)**. Within the nearshore project area, non-impulsive noise can result in AUD INJ and TTS up to 1 km and 6.4 km for LF mammals, respectively. The non-impulsive drilling unit and vessel noise (which is generated due to DPS employed throughout project activities) is expected to be of greater concern for mammal-related impacts. Impulsive noise (which only takes place during VSP operations (well drilling) for a very short period) is more significant in the potential non-recoverable and recoverable injury and TTS onset for fish (within less than 500 m for TTS-onset) as compared impact zones related to non-impulsive noise. Cumulative impacts, in the form of a greater number of possible TTS impact zones from increased underwater noise, are likely if other concurrent exploration, appraisal and production activities take place.

Shipping noise is deemed too low to generate AUD-INJ or TTS impacts and would thus not contribute to cumulative impacts of physiological injury.

Another important source of (unintended) physiological injury and mortality of marine fauna is fishing, which often results in bycatch (catching of non-targeted animals). Physiological injury and mortality of marine fauna can also arise from collisions with vessels.



The overall impact of (unintended) faunal injury and mortality offshore Namibia is likely dominated by the fishing industry (bycatch, though much reduced in the last 10 years) and shipping (due to the larger number and large size of shipping vessels compared to the number of project vessels). Rating the overall cumulative impact of faunal injury and mortality offshore Namibia from all of these sources exceeds the scope of this study.

Given the relatively low density of fauna in the vast deepwater environment, the short distance over which the more concerning AUD-INJ (marine mammals and turtles) and non-recoverable (fish only) injury impacts can arise, and limitations on the number of possible concurrent offshore exploration / appraisal activities that would contribute to a cumulative impact, the overall cumulative impact of offshore activities on faunal injury and mortality is considered no more significant than assessed in the preceding sections (Table 7-24 to Table 7-26). The cumulative impact of all offshore activities, including shipping and fishing (notably bycatch), is difficult to estimate due to limitation in data, but will be somewhat higher.

Considering the short distance over which AUD-INJ impacts may arise (i.e. 1 km in LF cetaceans), the frequency of nearshore transshipment operations (one day per week during peak production) and the current marine traffic (and thus high ambient sound levels) within the vicinity of the nearshore transshipment area, the cumulative impact of nearshore activities on faunal injury and mortality is considered no more significant than assessed in the preceding sections.

The project contribution to any overall cumulative impact on faunal injury and mortality is deemed low, as other offshore activities (e.g. shipping and by-catch through fisheries) have a higher potential to cause injury and mortality of marine fauna.

7.9.4 Potential Cumulative Impact on Fisheries

Approved activities on the West Coast and in southern Namibia could take place concurrently with TEEPNA's planned development and production programme should an ECC be granted. There is currently not sufficient information available to make reasonable assertions as to nature of such future activities. This is primarily due to the ongoing ESIA processes and current lack of relevant geological and resource potential information of neighbouring southern Benguela licence blocks. While there are many other rights holders in the offshore environment (e.g. marine diamonds and gemstones, heavy minerals, precious metals and ferrous and base metals), these are located well inshore of and in deeper waters, offshore the nearshore transshipment area.

Nevertheless, potential future aquaculture, mariculture as well as prospecting, mining and port-related operations within the Walvis Bay region and vicinity of the nearshore transshipment buoy may result in future, cumulative impacts.

The possible range of the future prospecting, mining, exploration and production activities that could arise will vary significantly in scope, location, extent, and duration depending on whether a resource(s) is discovered, its size, properties and location, etc. As these cannot at this stage be reasonably defined, it is not possible to undertake a reliable assessment of the potential future cumulative environmental impacts. However, recent hydrocarbon discoveries from the area indicate that further oil and gas exploration and potentially production will likely occur. Alternatively, it is also possible that the proposed, or future, exploration fails to identify an economic petroleum resource, in which case the potential impacts associated with the production phase would not be realised. Concurrent activities such as other planned exploration drilling in the southern Benguela region could add to the cumulative impact on fisheries.

The inaccessibility of areas to fishing vessels due to the implementation of the required safety / exclusion zone could become more important should there be multiple concurrent exploration, appraisal and/or future production activities within productive fishing areas. This would result in a cumulatively larger (fragmented) area that is either temporarily or



permanently inaccessible to fisheries. As indicated in Section 7.9.2, much of the currently or recently approved exploration / appraisal activities are taking place in deepwater areas with limited overlap with fishing areas, limiting the cumulative effect on fisheries. The same holds true for any infrastructure that remains on the seabed.

With respect to potential impacts on fish due to underwater noise, in the Benguela region, it has been suggested that the seasonal movement of longfin tuna northwards from the West Coast of South Africa into southern Namibia may be disrupted by the noise associated with an increasing number of seismic surveys. While the potential exists to disrupt the movement of albacore tuna in the Benguela, this disruption, if it occurs, would be localised spatially and temporarily and would be compounded by environmental variability. In Australia, no direct cause and effect in changes in movement or availability of bluefin tuna could be attributed to seismic surveys (Evans, McCauley, Eveson, & Patterson, 2018), with observed changes being attributed to inter-annual variability. Due to the dearth of information on the impacts of seismic noise on truly pelagic species links between changes in migration patterns and subsequent catches thus remains speculative.

In addition to the above, the following should also be considered to take account of catch variability and stock declines (e.g. for tuna species), which can be attributed to the following (Shomura, Majkowski, & Harman, 1995; Lan K. , et al., 2011; Lehodeya P. , et al., 2006; Punt, Penney, & Leslie, 1996):

- Increasing fishing effort exacerbated by improved fish finding technology (vessel monitoring systems, use of sonar, sea surface temperature (SST) spatial mapping using satellite technology);
- Climate change and environmental variability such as cold and warm water events e.g. Benguela El Niño events have been shown to result in a change in the vertical distribution of tuna stocks within the water column, resulting in reduced catch rates;
- Migration and feeding patterns that change abundance levels annually and are linked to the environment; and
- Inconsistent or irregular catch reporting.

Regarding possible cumulative climate change impacts on fisheries, the Climate Change Risk Assessment compiled for this ESIA stated that given the nature, extent or area of influence, and duration (i.e. 35-years), it is highly unlikely that the project will materially exacerbate the impacts of climate change on communities, biodiversity and priority ecosystem services which includes fishing (SLR, 2025). Thus, material cumulative climate change impacts directly arising from the proposed project are not anticipated.

Considering cumulative impacts from other hydrocarbon ventures in the area may increase in future, as well as the proposed 35-year Project timeline, the cumulative impacts of the proposed construction and production activities in PEL0056/Block 2913B can be considered of medium significance.

7.9.5 Potential Socio-Economic Cumulative Impacts

7.9.5.1 Cumulative Impact on Employment Income and Skill Development

The Hyphen Hydrogen Energy Project, four wind farms in the Tsau Khaeb National Park and Angra Point Port Development have an estimated cumulative labour requirement of more than 15 500 people during construction and 3 050 during operation, many of which would need to be located at Lüderitz, where a (small) portion of Venus project-related indirect jobs would also be located.

However, while the four wind farms were approved, the Hyphen and Port projects remain at relatively early stages, and implementation timeframes for any of these projects are not clear. If all projects were to construct at the same time this would create a more significant



cumulative impact and may result in labour shortages. However, since projects are at different design, financing and permitting stages it is more likely that they will not be implemented concurrently.

The cumulative impact of these projects to local employment and income generation is considered high, in context of the 5 469 employed people in the !Nami#nūs Constituency and 31 747 in the Walvis Bay Rural and Urban Constituencies in 2023. The cumulative impact would be particularly notable during construction of the green hydrogen and renewable energy projects, which require more labour during that phase and are located in the smaller Lüderitz community.

The contribution of the Venus Project to the cumulative impact on local employment and income generation is rated as high particularly during the operational phase, when the overall number of longer-term direct and induced jobs will be notably adding to the number of jobs generated by the other envisaged projects combined.

7.9.5.2 Impacts on Community Health and Safety and Coastal Towns

Large construction labour forces required particularly for the Hyphen and, to a much lesser extent, wind farm projects would result in substantial and at least temporary influx of labourers and job seekers into Lüderitz. This will put pressure on community health and safety and town service provision and require additional dedicated facilities.

Only some of the direct and indirect jobs associated with the Venus project (notably those related to onshore service provision) are physically based in Lüderitz or Walvis Bay. Many of the jobs associated with the project are based offshore, in Windhoek or distributed across the supply chain of service providers. However, high expectations and visibility of the project may result in substantial numbers of people or contractors moving to Lüderitz or Walvis Bay to increase their chances of getting a job or contracts.

The cumulative impact of these projects to local in-migration, and possibly associated impacts on community health and safety, is considered high, particularly during the construction phase of the green hydrogen and renewable energy projects, which require more labour during that phase.

The cumulative impacts would be higher in Lüderitz, which is a much smaller and more isolated town with less income and fewer resources to cope with an influx. Walvis Bay is larger, less isolated (a number of other settlements are located in the vicinity that may absorb some influx) and better resourced due to a larger existing economic base. Projects anticipated in the Walvis Bay area are smaller and more diverse and their impacts may thus be more distributed over time and space.

The contribution of the Venus Project to the cumulative impact (assuming all other projects materialise) on local in-migration, and possibly associated impacts on community health and safety is rated as low, as the jobs physically based in Lüderitz or Walvis Bay are much fewer than those of other projects and may increase only gradually, which provides an opportunity to manage the process better and to improve facilities to deal with the pressure that is likely to come from the cumulative impact.

7.9.6 Cumulative Impact on Cultural Heritage

Offshore activities are deemed to have a limited impact on intangible cultural heritage due to limited ritual connectivity to the offshore environment in southern Namibia, with no impact to tangible cultural heritage sites anticipated as a result of normal project activities. Terrestrial and near-shore areas are more important in that regard and may be affected by a range of activities taking place along the Namibian coastline, including (diamond) mining, fishing, port operations and tourism. Offshore operations may contribute towards some of those pressures, such as increased activity at established ports.



The ethnographic research conducted in Namibia indicates existing / cumulative impacts of other industrial activity in the country, potentially impacting cultural heritage receptors. It is also foreseeable that other offshore operations could happen within Namibian waters and potentially other oil and gas development projects.

Thus, while there is possibility of cumulative impacts over time, the project contribution is likely to be very low, since most cultural heritage practices occur inland rather than at the coast.

7.9.7 Cumulative Impact on Atmospheric Pollutants and GHG

Potential cumulative impacts are considered possible due to other shipping traffic, activities within other Licence Blocks and vicinity of nearshore transshipment buoy, as well as the simultaneous emissions from project activities (e.g. non-routine flaring and power generation at the Venus offshore project area).

Overall, significant cumulative impacts with other concurrent offshore activities are highly unlikely as pollutants concentrations will likely reduce quickly in the offshore environment, with emissions from seismic, shipping and fishing vessels being mobile. As such potential cumulative impacts with other offshore operations is considered negligible, as pollutant concentrations are unlikely to persist long enough to create cumulative impacts with offshore project activities.

Onshore ambient air quality may be impacted by existing sources such as road traffic, industrial activity etc. However, cumulative impacts on onshore ambient air quality as a result of emissions from the **Venus offshore project area** are expected to be negligible, as no exceedances of WHO AQG are anticipated at the coastline, considering the distance of the Venus offshore project area from shore (~300 km) as well as infrequency (1.8 – 7.6%) of onshore winds.

Cumulative impacts on ambient air quality from **nearshore transshipment operations** are considered possible, particularly where emissions from these activities may coincide with existing land-based sources (e.g. road traffic, vessel movements, and urban activities). In the absence of ambient air quality monitoring data for Walvis Bay and Swakopmund, these cumulative impacts have been qualitatively and conservatively assessed as medium. This classification assumes a baseline level of urban emissions but does not anticipate exceedances of short-term WHO Air Quality Guidelines (1-hour or 24-hour averages).

With respect to GHGs, they persist in the atmosphere for many years and the associated impacts are deemed to be global irrespective of where the GHG are emitted. All emissions will thus generate a cumulative impact with all other global GHG emissions.



8.0 Impact Assessment of Unplanned Events

8.1 Summary of Modelling Results

8.1.1 Oil Spill Dispersion Modelling

This section summarises the results of the oil dispersion modelling study (Appendix K) for use in assessing the impacts of unplanned events, including a:

- Loss of marine diesel from rig and/or vessel tank offshore (assessed in Section 8.1.2)
- Loss of crude oil due to well blow-out offshore (assessed in Section 8.3)
- Loss of marine diesel or crude oil during transshipment nearshore (assessed in Section 8.5).

The extent of the area potentially impacted by an underwater gas release from an injection line rupture (assessed in Section 8.4) is much more limited to the vicinity of the leakage and is not comparable to the extent of the potentially impacted area by oil. The approach of assuming that the immediate vicinity of the leak would be impacted in the event of a gas leak is considered sufficient for assessment purposes.

The modelling, which used the Oil Spill Contingency and Response (OSCAR) modelling tool and SAT-OCEAN hindcast dataset (2017 – 2024), and based on the project description in Chapter 4.0 considered the following parameters:

- **Two oil types:** crude oil (unprocessed and processed) and marine diesel.
- **Two release locations** with two **scenarios each** (Figure 8-1). These locations are considered to be representative “worst-case” taking cognisance of the project layout, distance from the coast, proximity of protected areas (including MPAs, EBSAs and Tripp Seamount), water depth and the metocean dataset:
 - o Nearshore transshipment area near Walvis Bay (L2), around 5 km from the coast:
 - Scenario O1 (Production Phase): Loss of 1 000 m³ of processed crude oil at sea surface during transfer from DPST to conventional tanker, without response.
 - Scenario O2 (Production Phase): Loss of 300 m³ of marine diesel at sea surface from a vessel tank rupture, without response.
 - o Venus offshore project area in offshore PEL0056/Block 2913B (L1), around 350 km from the coast:
 - Scenario O3 (Drilling / Production Phase): Loss of 5 000 m³ of marine diesel at sea surface from a rig tank rupture, with and without surface spill response.



- **Scenario O4 (Drilling Phase):** Accidental release of 5 921 standard cubic meters per day (Sm^3/day) of crude oil from a well blowout at the seafloor for 13 days (until the well is capped), with and without spill response¹²⁸.
- **Seasonal periods:** Four seasons were considered, namely Season 1: December to February, Season 2: March to May, Season 3: June to August, and Season 4: September to November.
- **Two modelling simulations approaches** were considered:
 - **Stochastic simulations** show the probability of an area being affected by an oil spill for all simulations combined. The area presented is, therefore, larger than the extent of a single spill.
 - **Deterministic simulations** show an oil spill spread for a single spill at a specific time.
- **Modelling thresholds:**
 - **Sea surface:**
 - o **Oil:** A threshold of 5 μm thickness was selected as a margin to the thickness that would impart a lethal dose to an intersecting wildlife individual (10 μm) according French McCay (2009). This value is also the minimum thickness for surface response (including dispersant application).
 - o **Marine Diesel:** A threshold of 0.3 μm thickness was adopted, which is based on values catalogued in the Bonn Agreement Oil Appearance Code (Bonn, 2009 and 2011). This value aligns with established visibility criteria for oil slicks (silvery sheen).
 - **Water column:** A threshold of 58 ppb was selected for both crude oil and marine diesel, following the OLF (the Norwegian Oil Industry Association) Guideline for risk assessment of effects on fish from acute oil pollution (2008) that indicate the value proposed by Neilson et al. (2005) for acute exposure to dispersed oil to various aquatic species.
 - **Shoreline oiling:** A threshold of 10 g/m^2 was selected for both crude oil and marine diesel, which is based on the literature reviews and analyses described in French McCay (2016) and French McCay *et al.* (2018).

Table 8-1 below only presents the season with the largest (worst case) modelled extent of the spill for each scenario over the four seasons. The maps show the probability of contamination above defined threshold values.

¹²⁸Modelled response included both Subsea Dispersant Injection (SSDI) and surface response measures. SSDI was applicable only in a well blowout scenario.



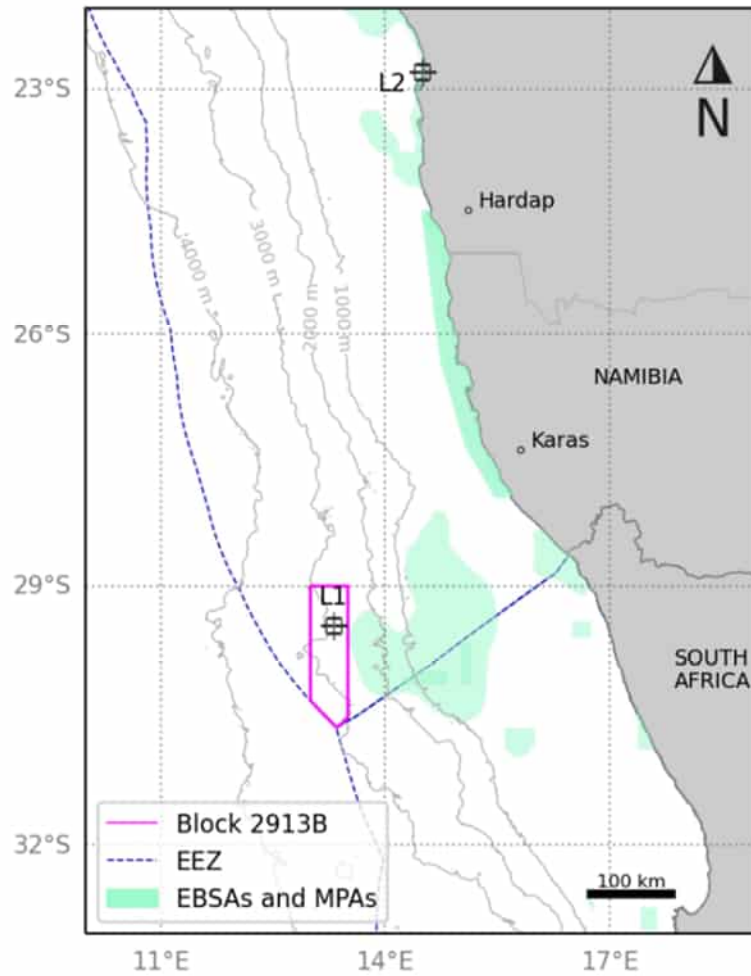
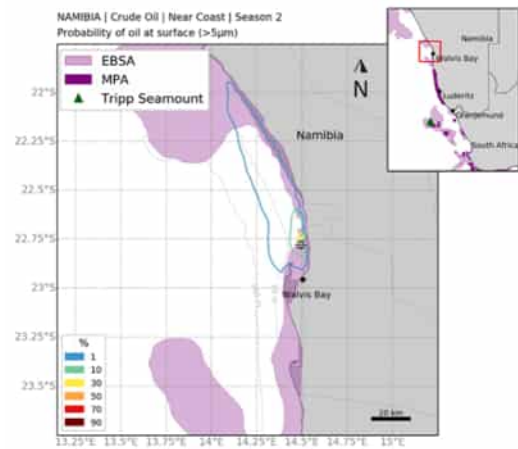
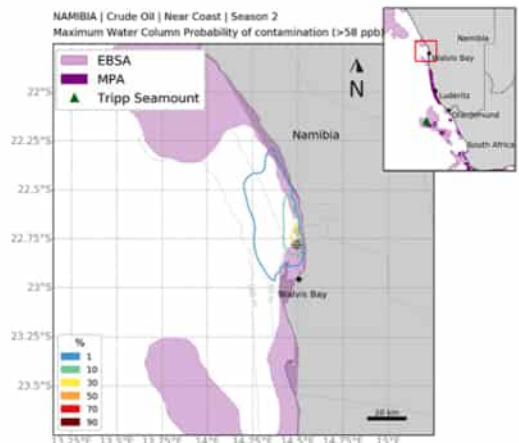
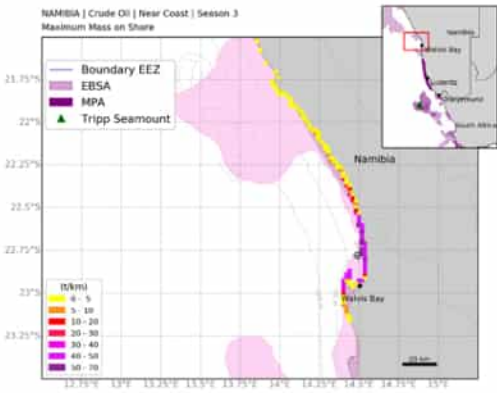


Figure 8-1: Location of oil spill modelling release points: L1 in the Venus offshore project area and Point L2 in the Nearshore Transshipment Area

Source: CLS Basil

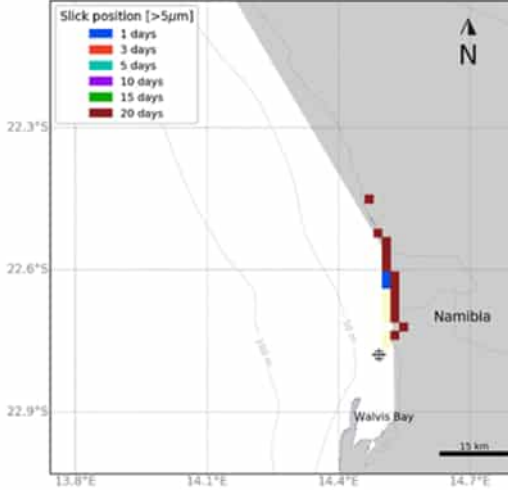
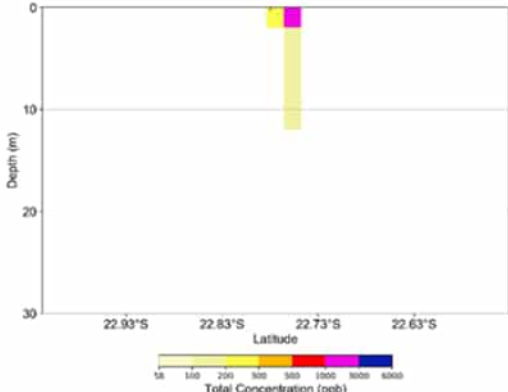
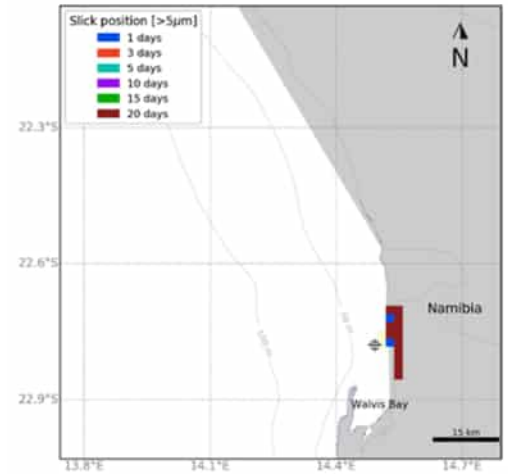


Table 8-1: Summary of Oil Spill Modelling Results

No.	Model type	Oil on surface	Oil in water column	Oil onshore
1	Scenario O1: Loss of 1 000 m³ Processed Crude Oil During Transfer at Nearshore Transshipment Area			
1.1	Stochastic ¹²⁹ (combined spill scenarios)	Due to the proximity of the spill site to the coastline, oil on the surface drifts towards N and S, with greater dispersion towards the N, as well as to the E reaching the coast in all seasons. The greatest dispersion was up to 101 km from the release point during Season 2. Surface oil evaporates quickly, expected to be present for up to 0.75 days (18 hrs).  Oil surface probability area (> 5 µm) (Season 2)	Oil in the water column also drifts towards N, S and E, with greater dispersion towards the N. In all seasons, there is up to a 50% probability of oil remaining within the water column, with the highest concentrations observed in the upper 12 m.  Water column probability (> 58 ppb) (Season 2)	Shoreline oiling is predicted to occur during all season, with up to 51.5 t/km of oil stranded affecting the coastline between up to ~263 km north of Walvis Bay and ~26 km south of Walvis Bay with a maximum extent of 281 km for Season 3. The minimum time to shoreline oiling is ~1.7 hrs in Season 4.  Maximum mass onshore (>10 g/m²) (Season 3)

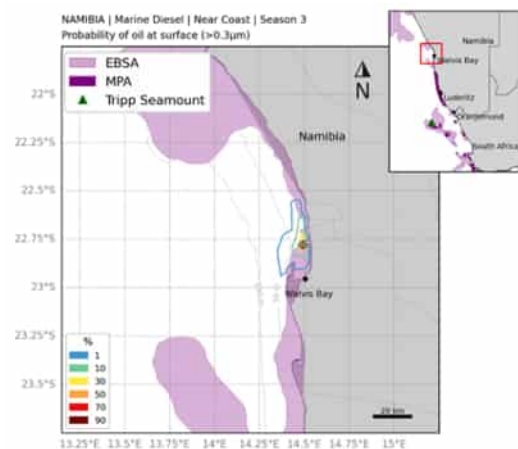
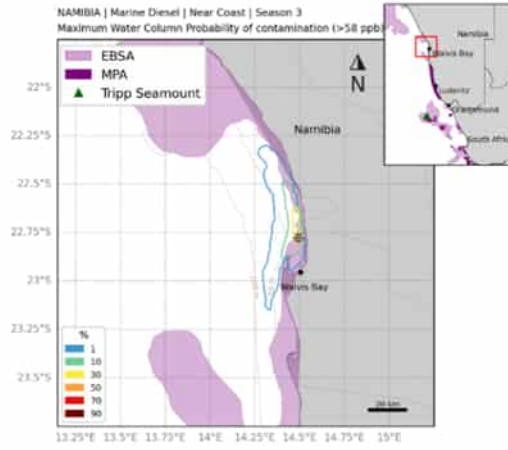
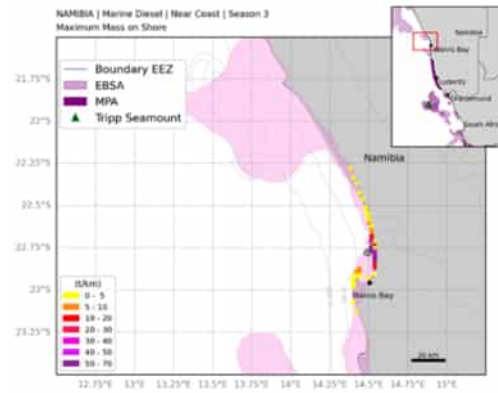
¹²⁹ Shows the probability (%) of oiling when combining all the modelled spill simulations. Colours show oiling probability percentage ranging from red (70%) to Light Blue (1%).



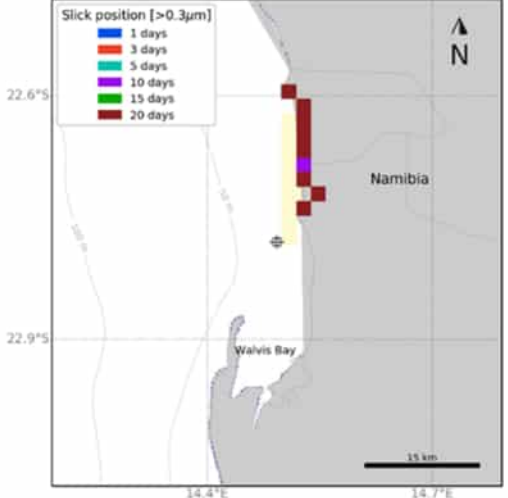
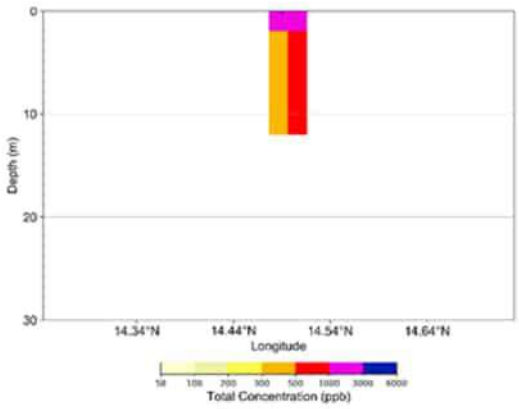
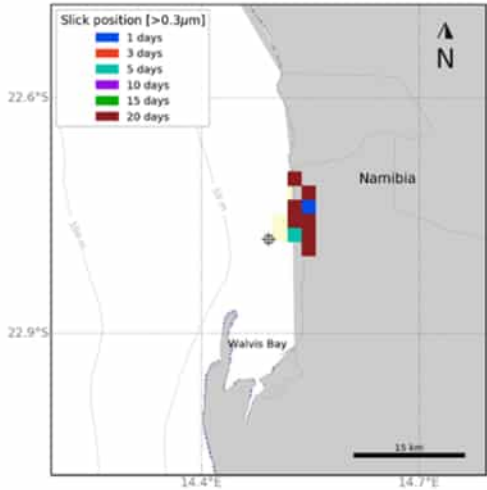
No.	Model type	Oil on surface	Oil in water column	Oil onshore
1.2	Deterministic ¹³⁰ (2 individual spill scenario by season)	Oil drift follows dominant current for each season towards N and S, with greater dispersion towards the N. Due to proximity to the coast oil was found to spread to the E as well, reaching the coast across all seasons.  Surface spill drift evolution (Season 3)	In the water column, oil concentrations were observed near the release point, reaching depths of up to 15 m with maximum values reaching 3 000 ppb.  Water column concentration after 1 day (Season 3)	Shoreline oiling can occur as quickly as <2 hrs (in Season 4), while the largest mass of oil on coast is expected to be 411.7 tonnes in Season 3. The oil extent along the coast can reach up to 45 km north of Walvis Bay in Season 3. The minimum time to shoreline oiling is ~1.7 hrs.  Surface spill drift evolution for the simulation with highest mass of oil reaching the coast (Season 3)

¹³⁰ Shows snapshots of oil distribution from a spill at specific times (e.g. on Days 5, 10, 15, 20, etc). Light yellow shows the total area affected at some point during the 60-day simulation.

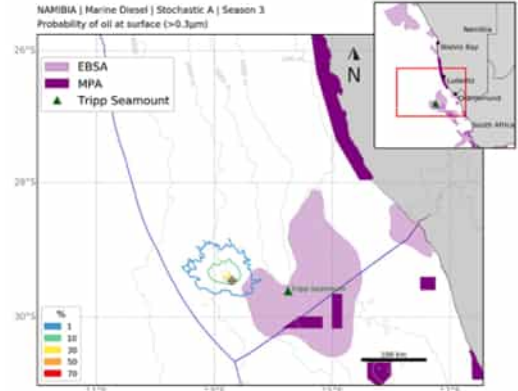
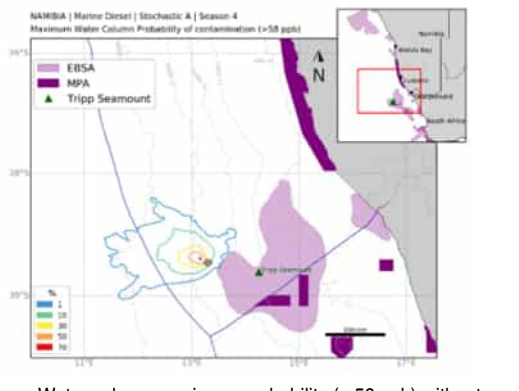


No.	Model type	Oil on surface	Oil in water column	Oil onshore
2	Scenario O2: Loss of 300 m³ Marine Diesel at Nearshore Transshipment Area			
2.1	Stochastic (combined spill scenarios)	Due to the proximity of the spill site to the coastline, diesel on the surface drifts mainly towards N and S, as well as to the E reaching the coast in all seasons. The greatest dispersion is towards the N up to 26 km from release point during Season 3 and 4. As surface diesel evaporates quickly, oil is expected to be present for up to 0.75 days (18 hrs).  Oil surface probability area (> 0.3 µm) (Season 3)	Diesel in the water column also drifts towards N and S, with greater dispersion towards the NW. In all seasons, there is up to a 50% probability of diesel remaining within the water column, with the highest concentrations observed in the upper 12 m.  Water column maximum probability (> 58 ppb) (Season 3)	Shoreline “oiling” is predicted to occur during all season, with up to 52.3 t/km of oil stranded affecting the coastline between up to ~83 km north of Walvis Bay (between Wlotzkasbaken and Jakkalsputz) and ~22 km south of Walvis Bay depending on the season with a maximum extent of 95 km for Season 3. The minimum time to shoreline oiling is ~1.7 hrs in Season 4.  Maximum mass onshore (>10 g/m²) (Season 3)

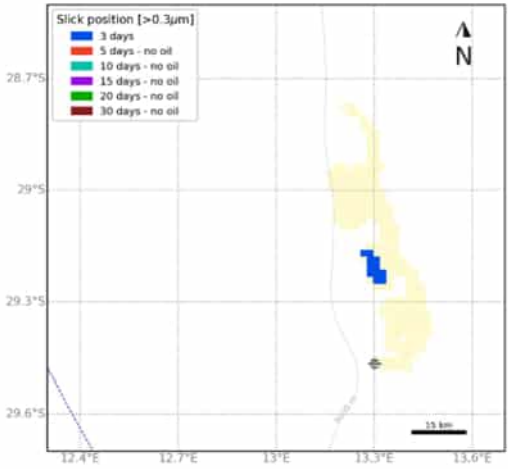
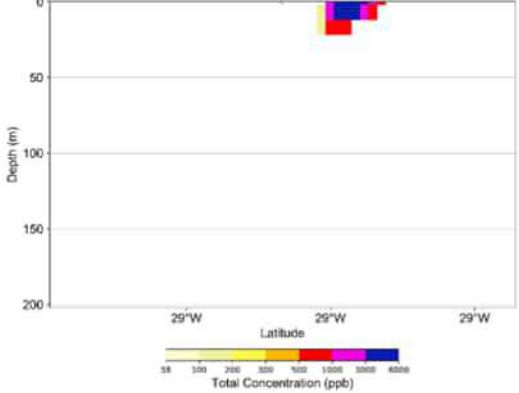


No.	Model type	Oil on surface	Oil in water column	Oil onshore
2.2	Deterministic (2 individual spill scenario by season)	Diesel drift follows dominant current for each season, spreading predominantly to the N, with some seasonal variability in its spread and extent.  Surface spill drift evolution (Season 3)	Diesel concentrations were observed near the release point, reaching depths of up to 15 m with maximum values reaching 1 000 ppb.  Water column concentration after 1 day (Season 3)	Shoreline “oiling” can occur as quickly as <2 hrs (in Season 4), while the largest mass of oil on coast is expected to be 59.5 tonnes in Season 3. The oil extent along the coast can reach up to 35 km north of Walvis Bay. The minimum time to shoreline oiling is ~1.7 hrs.  Surface spill drift evolution for the simulation with highest mass of oil reaching the coast (Season 3)

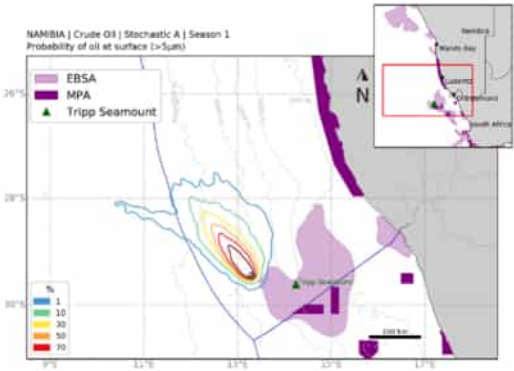
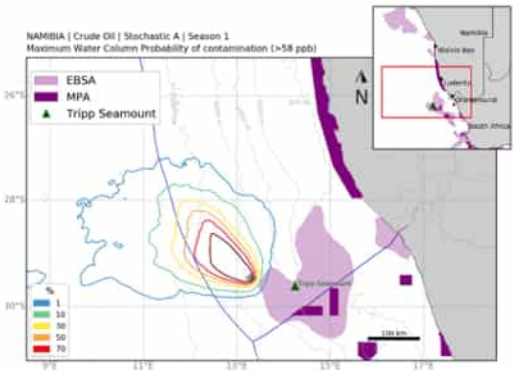


No.	Model type	Oil on surface	Oil in water column	Oil onshore
3 Scenario O3: Loss of 5 000 m³ marine diesel from a drilling unit tank at Venus offshore project area				
3.1	Stochastic (combined spill scenarios)	Diesel on the surface drifts towards NW with dominant winds and currents. Model predicts the 1% probability extending up to 89 km from release point (Season 3) in a NW direction. No 90% surface probability is observed due to the high evaporation rate of marine diesel. Diesel is not expected to reach South African waters, Tripp Seamount or MPAs. There is a 1% probability that diesel reaches portions of the Orange Seamount and Canyon Complex EBSA. On the surface, the percentage of the total volume released in all seasons is less than 0.05% at the end of the 30-day simulation. Response has a very small effect on the area affected by a diesel spill.  Oil surface probability area (> 0.3 µm) without response (Season 3)	Diesel drifts towards NW and W with dominant currents and winds. Model predicts 1% probability of contamination presence in water column up to 212 km from the release point (Season 4). Due to the spill occurring at the surface, the shallower layers were found to have a greater spread, as compared to deeper layers. Diesel is not expected to reach South African waters, MPAs or Tripp Seamount. There is a 1% probability that oil reaches portions of the Orange Seamount and Canyon Complex EBSA. Response has a very small effect on the area affected by a diesel spill.  Water column maximum probability (> 58 ppb) without response (Season 4)	Diesel is not expected to reach shore (no shoreline "oiling").

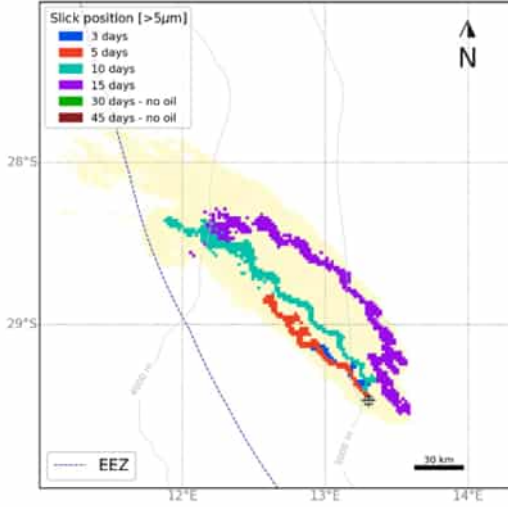
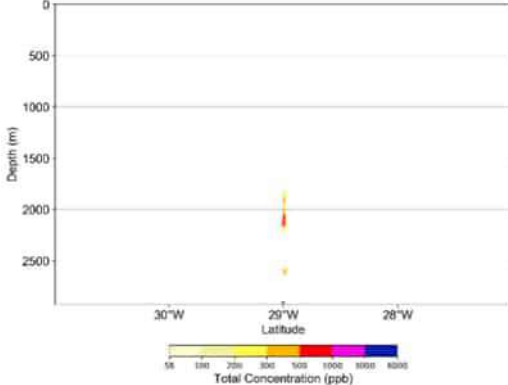


No.	Model type	Oil on surface	Oil in water column	Oil onshore
3.2	Deterministic (1 individual spill scenario by season)	Diesel drift follows dominant current for each season towards NW, with some seasonal variability in its spread and extent. In these deterministic scenarios, the spread of the spill trajectory is away from any EBSAs, Tripp Seamount and MPAs. Diesel is modelled to reach up to 80 km from the release point, with the largest surface area during season 1 and 2, and remains on the sea surface for up to 3 days. In all seasons, there was no surface oil above 0.3 μm thickness threshold. Response has a very small effect on the area affected by a diesel spill.  Surface spill drift evolution (Season 1)	The vertical profiles of diesel in the water column after 1 day showed concentrations above the threshold from the surface up to 22 m deep. The highest concentrations, between 3 000 and 6 000 ppb, occurred between 2 and 12 m deep in Seasons 2 and 4.  Water column concentration after 1 day (Season 4)	Diesel is not expected to reach shore (no shoreline "oiling").



No.	Model type	Oil on surface	Oil in water column	Oil onshore
4	Scenario O4: Release of Crude Oil from a 13-day Well Blow-Out at Venus offshore project area			
4.1	Stochastic (combined spill scenarios)	Oil drifts towards NW / N at surface with dominant winds and currents. Model predicts 90% probability of oiling up to 85 km from release point and 1% probability of oiling up to 323 km from release point (Season 1) in a NW direction. Oil is not expected to reach South African waters, Tripp Seamount or MPAs. There is a 30% probability that oil reaches portions of the Orange Seamount and Canyon Complex EBSA in Season 3. In all seasons, the percentage of the total volume released is less than 0.05% at the end of the simulation. Response has a very small effect on the area affected by an oil spill.  Oil surface probability area (> 5 µm) without response (Season 1)	Oil drifts towards NW and W with dominant currents and winds. Model predicts 1% probability of oil presence in water column up to 489 km from the release point (Season 1). The shallower layers showed a wider spread of oil above the 58 ppb threshold compared to the deeper layers. Oil is not expected to reach South African waters, Tripp Seamount or MPAs. There is a 30% probability that oil reaches portions of the Orange Seamount and Canyon Complex EBSA at Season 3. Response has a very small effect on the area affected by an oil spill.  Water column maximum probability (> 58 ppb) without response (Season 1)	Oil is not expected to reach shore (no shoreline oiling).



No.	Model type	Oil on surface	Oil in water column	Oil onshore
4.2	Deterministic (1 individual spill scenario by season)	Oil drift follows dominant current for each season towards NW, with some seasonal variability in its spread and extent.. In these deterministic scenarios, the spread of the spill trajectory is away from Tripp Seamount, but there is overlap with the EBSA in Season 2 and 3. Oil is modelled to reach up to 250 km from the release point, with the largest surface area during Season 2. At the end of the simulation, there was no surface oil above 5 μm thickness threshold. Response has a very small effect on the area affected by an oil spill.  Surface spill drift evolution without response (Season 2)	The vertical profiles of oil in the water column after 13 days showed concentrations above the threshold between approximately 1 500 and 2 700 m depth. The highest concentrations, reaching up to 3 000 ppb, were observed between 2 000 and 2 500 m depth.  Water column concentration after 13 days (Season 3)	Oil is not expected to reach shore (no shoreline oiling).



8.1.2 Air Quality Modelling for nearshore crude oil spill

A CALPUFF dispersion modelling assessment was conducted for one nearshore location within the transshipment area (namely Alternative 1 in Figure 4-29) to understand the dispersion of emissions from an accidental spill of 1 000 m³ of crude oil during this transfer (Specialist Oil Spill Modelling - Scenario O1 – CLS Brasil 2025), as the representative “worst-case” spill scenario near sensitive human receptors.

As outlined in Section 7.1.5 sensitive receptors within ~20 km of the nearshore transshipment area (Alternative 1) were selected for discrete modelling (see Figure 7-4 and Table 7-8).

Ambient pollutant concentrations from an accidental crude oil spill at the nearshore transshipment area are presented in Table 8-2. Where applicable, predicted concentrations have been evaluated against the short-term (i.e. 1-hour) TCEQ guidelines.

Key findings are as follows:

- **NMVOC:** 1-hour concentrations **do not exceed** the TCEQ AEGL-1 for benzene (168 000 µg/m³). This is considered conservative because NMVOC includes multiple compounds, while TCEQ applies only to benzene.
- **Benzene:** 1-hour concentrations **do not exceed** the TCEQ ^{EM}HBAL acute exposure guideline of 1 160 µg/m³ (a “safe” level for acute exposure).

Table 8-2: Ambient pollutant concentrations associated with emissions from an accidental crude oil spill at nearshore transshipment area

Pollutant		NMVOC	Benzene
Averaging period		1-hour	1-hour
Percentile		P100	P100
Unit		µg/m ³	µg/m ³
Isopleth map		Not mapped	Not mapped
Guideline	TCEQ	168 000 ^(a)	1 160
Domain peak			
Peak		43.9	0.19
Distance from approximate point of spill origin (km)		6.4	6.4
Latitude (°S)		-22.7290	-22.7290
Longitude (°E)		14.4643	14.4643
Receptor ID		Model simulated concentration for sensitive receptors	
SR1		6.41	0.03
SR2		3.94	0.02
SR3		3.68	0.02
SR4		6.11	0.03
SR5		5.01	0.02
SR6		6.11	0.03
SR7		2.28	0.01
SR8		4.20	0.02
SR9		3.17	0.01
SR10		5.23	0.02
SR11		2.05	0.01
SR12		1.92	0.01
SR13		1.73	0.01
SR14		1.51	0.01
SR15		1.56	0.01
Notes: (a) - Applicable to benzene fraction			



8.2 Offshore Surface Hydrocarbon Spill (Marine Diesel and/or Crude Oil)

8.2.1 Source of Impact

The project activities that could result in accidental spills from vessels during drilling, installation, production and decommissioning are summarised in the table below, with the rupture of a drilling unit tank being estimated as the worst case scenario with a release of 5 000 m³ modelled, compared to a potential release of 1 000 m³ of export crude oil during offloading from the FPSO to the DPST. Thus, the marine diesel spill has been modelled as worst case scenario and would cover a crude oil spill during loading as well as bunkering at the Venus offshore project area. An offshore spill *en route* to the Venus offshore project area would only occur in the unlikely event of a vessel collision.

Aspect	Drilling & Installation	Production	Decommissioning
Marine diesel spill due to loss from a drilling unit / vessel tank (collision)	X	X	X
Bunkering activities	X	X	X
Crude oil spill during offloading from the FPSO to the DPST		X	

Project Controls

As per the project description, the following management measures that will reduce impacts of an operational spill are already proposed as part of the project description (but are also captured in the ESMP). Implementation thereof has thus been considered in the pre-mitigation impact rating:

- Compliance with International Regulations for Preventing Collisions at Sea (COLREGS) and International Convention for the Safety of Life at Sea (SOLAS). A minimum 500 m safety zone will be enforced around the drilling unit within which fishing and other vessels would be excluded. In addition, a larger Marine Exclusion Area (3 nm around subsea infrastructure and FPSO) and a Maritime Restricted Area (10 nm around the FPSO) will be enforced throughout the Project timeline.
- Regulation 37 of MARPOL Annex I will be applied, which requires that all vessels of 400 gross tonnage and above carry an approved SOPEP. The purpose of a SOPEP is to assist personnel in dealing with unexpected discharge of oil on board, to set in motion the necessary actions to stop or minimise the discharge to the sea and to mitigate its effects on the marine environment. Thus, project vessels will be equipped with appropriate spill containment and clean-up equipment, e.g. dispersants and absorbent materials. All relevant vessel crews will be trained in spill clean-up equipment use and routine spill clean-up exercises.
- To be prepared in the event of a spill incident, the project will implement an emergency response system to mitigate the consequences of the spill. As standard practice, the Emergency Response Plan (ERP) will include crisis contacts and protocols and an OSCP and associated wildlife response plan will be prepared and available at all times during operations.
- A “multi-barrier” approach (i.e., mitigation) in dealing with risks (particularly the risk of oil spills) will be implemented. This involves implementing multiple layers of preventative controls to reduce the likelihood of incidents and limit potential impacts.



- In line with the standard industry practice, the Operator will be ready to deal with all levels of potential spills, including equipment for spills from routine operations on site (Tier-1) as well as agreements and additional responses in place to manage oil spill situations of higher magnitude which are dealt with by industry co-operation and external intervention (Tier 2 and Tier 3). The use of standby vessels with spill response capability (both booms and dispersant spraying equipment) would ensure that a first-tier response is always available at both the Venus offshore project area.

8.2.2 Impact on Marine Ecology / Environment

8.2.2.1 Impact Description

Diesel and/or crude oil released into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna. These could range from mortality (due to toxicity or suffocation) to sub-lethal physiological damage and long-term effects including disruption of behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson et al., 2000).

8.2.2.2 Impact Assessment

Sensitivity of receptor

The Venus offshore project area is located more than 300 km offshore, far from coastal MPAs and sensitive coastal receptors (e.g., key faunal breeding/feeding areas, bird or seal colonies, and nursery areas for commercial fish stocks). Marine diesel is highly toxic and would negatively affect any marine fauna it comes into contact with.

The taxa most vulnerable to hydrocarbon spills are coastal and pelagic seabirds. Some species potentially occurring within the Venus offshore project area are considered regionally 'Endangered' (e.g., Atlantic yellow-nosed albatross and black-browed albatross) or 'Vulnerable' (e.g., white-chinned petrel). In addition, pelagic seabird species listed as 'Endangered' (e.g., African Penguin, Bank Cormorant, Cape Cormorant and Cape Gannet), 'Near threatened' (e.g. African Black Oystercatcher and Crowned Cormorant) or 'Vulnerable' (e.g. Damara Tern) may potentially occur inshore of the Venus offshore project area, although their presence within the Venus offshore project area is considered unlikely.

Marine mammals species that may be encountered within the Venus offshore project area (see Section 5.5.3.6) and larger water column impact zone are considered regionally or globally 'Critically Endangered' (e.g. Fin whale), 'Endangered' (e.g. Sei whale) 'Vulnerable' (e.g. Sperm whale and Humpback whale) or 'Least Concern' (e.g. Dusky dolphin) (see Section 5.5.3.6).

The pelagic fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Venus project area and potential impact zone are large migratory species, including various tunas, billfish and sharks, some of which are considered, 'Endangered' (e.g. shortfin mako shark), 'Vulnerable' (e.g. bigeye tuna) or 'Near Threatened' (e.g. blue shark), primarily due to overfishing and bycatch (see Section 5.5.3.3).

Five turtle species occur in Namibian waters, namely Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*) and Leatherback (*Dermochelys coriacea*) (Bianchi, et al., 1999). Of these the two species most likely to be found within the deeper offshore waters of the Venus project area are the Leatherback ('Critically Endangered') and Loggerhead ('Vulnerable') turtles, with Green turtles ('Endangered') potentially encountered within shallower, inshore regions.



Overall marine mammals, fish, seabirds and turtles are highly sensitive to oil spills with the overall sensitivity of receptors to an offshore surface hydrocarbon spill incident thus considered to be **high**.

Magnitude

The magnitude of a marine diesel spill following the unlikely loss of marine diesel from a drilling unit tank or crude oil during offloading from the FPSO to the DPST is considered **very high** for both the marine environment, as well as all faunal groups (pelagic). This is based on the following ratings:

- **High** intensity as the oil spill may impact sensitive and/or vulnerable pelagic habitats and species, especially birds. Notably though, impacts were not modelled to extend over Tripp Seamount, MPAs and/or EBSAs.
- **Long-term** duration, with the consequence of the marine diesel or crude oil spill effects extending beyond the impact duration of the exposure and ceasing following natural processes and recruitment.
- **Regional** extent as oil spill modelling results show that a spill (5 000 m³ of marine diesel) may extend up to 212 km in the water column and 89 km at the surface for the 1% probability of occurrence. Notably, oil does not extend into South African waters.

These ratings are discussed below.

Being highly toxic, marine diesel or crude oil released during an accidental spill will negatively affect any marine fauna in which it comes into contact with. Chronic and acute oil pollution is a significant threat to seabirds. Diving seabirds, that spend most of their time on the surface of the water, are particularly likely to encounter floating oil and will likely die as a result of even moderate oiling, which damages plumage and eyes. Notably, while pelagic seabirds may be encountered within the offshore waters of the Venus project area, and potential spill area, their abundance is expected to be low, thereby limiting potential population-wide impacts/ effects.

Adult free-swimming fish in the open sea seldom suffer long-term damage from oil spills as oil concentrations in the water column decline rapidly following a spill and rarely reach levels sufficient to cause mortality or significant harm. The large pelagic fish likely to be encountered within the Venus offshore project area and potential impact zone are expected to actively avoid very contaminated waters, with documented cases of fish-kills in offshore waters sparse (ITOPF, 2014).

Overall, tolerances to diesel and hydrocarbons vary between life stages, with larvae and juvenile stages generally being more sensitive to the water-soluble fractions of oil than adults. Key spawning and recruitment areas for commercially valuable fish species (e.g. hake, horse mackerel and sardine) lie well inshore of the Venus offshore project area. Similar to surface oil results dissolved diesel in water column (> 58 ppb) was modelled to predominantly disperse in a northwest and west direction across all seasons, and away from key, coastal spawning and recruitment areas. In addition, the vertical profiles of the total concentration in the water column, after 1 day, showed concentrations above the limit of 58 ppb from surface layers down to 22 m deep, with the highest concentrations found in the shallower layers (2 to 12 m deep). As such water column impacts are found to be largely restricted to the upper, shallower layers of the water column with impacts to benthic and/or demersal communities reduced.

The impact of a marine diesel or crude oil spill on local and migrating cetacean populations will depend on the timing and extent of the spill. It is assumed that the majority of cetaceans will be able to avoid oil pollution, though effects on the population could occur should the region of avoidance be critical to population survival. Oil pollution in areas of cetacean



critical habitat (areas important to the survival of the population), such as the extreme near-shore calving / nursing grounds may result in population impacts. However, based on the modelling results the marine diesel is modelled to disperse predominantly to the northwest and west at the surface and within the water column, across all seasons. As such potential impacts to important near-shore calving/nursing grounds is unlikely to occur.

Nevertheless, migratory species may be encountered within the Venus offshore project area and impact zone, with potential individual-level impacts.

Migrating marine turtles potentially encountered within the Venus offshore project area and surrounding impact zones may experience individual-level effects. Although the number of marine turtles likely to occur in offshore Namibian waters is relatively low, globally and regionally low population numbers suggest that individual-level impacts could have broader population-level consequences, related to the conservation status and ecological sensitivity of these species. Importantly, the Venus offshore project area does not overlap with critical nesting or breeding habitats, which are located well to the north (e.g. Angola) and south (e.g. South African east coast). As such, impacts to these key habitats are considered unlikely.

The potential impact of a marine diesel spill in the Venus offshore project area is assessed to be of **medium intensity** for most pelagic fauna groups. This assessment considers the mobility of these species, their generally low expected abundance in the offshore waters of the project area as well as the distance from key spawning, calving, and recruitment areas.

In contrast, the impact on seabirds is considered to be of **high intensity**, due to their greater vulnerability to surface oiling and limited ability to avoid contaminated areas.

In all cases diesel would likely only persist, within the water column (> 58 ppb) and surface ($> 0.3 \mu\text{m}$), over the very short-term (days), with no probability of oil on the surface above the threshold after the 30-day simulation and with 0.05% of the total volume released remaining on the surface after the 30-day simulation. However, should the diesel spill result in mortality of individuals, such as seabirds, effects would extend beyond the impacts with the population level effects of the marine diesel spill ceasing following natural processes and recruitment (**long-term**). Surface oiling was found to remain largely within the Namibian EEZ, extending up to a maximum of 89 km from the release point for the 1% probability (**regional**).

Considering the regional extent, high intensity and long-term nature of the potential impacts, the impact of operational spills would be of **very high** magnitude.

Significance

Based on the **very high** magnitude rating and **high** sensitivity the impact of a offshore surface hydrocarbon spill is considered to be of **very high** significance.

Residual Impact

With the implementation of mitigation measures listed in Section 8.2.2.3, the residual impact to pelagic fish and larvae, seabirds, marine mammals and turtles would have a lower intensity (**medium; seabirds**), and the residual impact significance is reduced to **high**.



Table 8-3: Impact rating for an offshore surface hydrocarbon spill (marine diesel and/or crude oil) on marine ecology / environment¹³¹

Ecological Impacts due to Offshore Hydrocarbon (Marine Diesel and/or Crude Oil) Spill		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	All Phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Very High	High
Intensity	High	Medium
Duration	Long term	Medium term
Extent	Regional	Regional
Significance	Very High	Medium
Additional Assessment Criteria		
Probability	Unlikely	Unlikely
Reversibility	Fully Reversible	Fully Reversible
Loss of resources	Low	Low
Degree to which impact can be avoided	High	High
Mitigation Potential	-	Medium
Cumulative impacts	Unlikely	Unlikely

8.2.2.3 Mitigation and Management Measures

The following mitigation measures are recommended:

Table 8-4: Mitigation to reduce impacts for an offshore surface hydrocarbon spill (marine diesel and/or crude oil).

No.	Mitigation measure	Classification
1	Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.	Abate on and off site
2	As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill.	Abate on and off site
3	Use low toxicity dispersants when required and as approved by relevant Namibian authorities.	Abate on and off site
4	Ensure adequate resources are available to collect and transport oiled birds to a cleaning station as per specific protocols for capturing and transporting oiled seabirds as outlined in the OSCP and associated wildlife response plan.	Restore
5	Ensure operating limits and restrictions are defined for offshore bunkering operations. Such operating limits shall be based upon a risk assessment, which takes into account weather conditions, sea conditions, activities to be performed and vessel characteristics.	Avoid / Reduce at source

¹³¹ The highest impact ratings across all faunal groups are shown in the table, indicating the maximum intensity, extent, duration, magnitude, and significance of the associated impact.



No.	Mitigation measure	Classification
	Connection and start of offloading, transshipment or bunkering operations shall only be conducted during daylight. Ensure bunkering operations are only performed after approval of both captain / Master involved.	
6	Give preference to vessels using MGO, which (if spilled) is less persistent in the marine environment than heavy fuel oil (HFO).	Avoid / abate at source
7	Ensure all vessel process areas are banded to ensure drainage water flows into the closed drainage system. Use drip trays to collect run-off from equipment that is not contained within banded areas and route contents to the closed drainage system.	Avoid / abate at source
8	Secure insurance policy, including coverage for third party liability.	Restore

8.2.3 Impacts on Fisheries

8.2.3.1 Impact Description

For small spills of hydrocarbons during normal operations, the dominant weathering processes are evaporation and dispersion over the short-term. In the unlikely event of an operational spill, the intensity of the impact would depend on whether the spill occurred in offshore waters (i.e. during bunkering) or closer to the shore (e.g. vessel accident) where encounters with sensitive receptors will be higher.

Diesel, hydraulic fluid and/or crude oil released into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna (assessed in Section 8.2.2). These could range from mortality (due to toxicity or suffocation) to sub-lethal physiological damage and long-term effects including disruption of behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson D. R., et al., 2000).

A potential unplanned event associated with the proposed project is the possible catastrophic instantaneous release of marine diesel from a drilling unit tank as a result of vessel and/or equipment failure. This assessment therefore considers this worse-case scenario (see Section 8.1.18.1 for a summary of oil spill modelling results).

There are several possible direct and indirect impacts of hydrocarbon spills on fisheries and mariculture operations:

- Oil contamination of mobile finfish species, in particular of juveniles in nursery areas could result in displacement of species from normal feeding and protective areas as well as possible physical contamination and/or physiological effects such as clogging of gills, both of which would lead to fish mortality;
- Oiling of sessile or sedentary species would result in physical clogging on individuals, disturbance and or removal of habitat for these species and gill clogging for filter-feeding species such as mussels, all of which is likely to result in mortality;
- Oiling of passively drifting spawn products (eggs and larvae) would result in their contamination and mortality (the extent of mortality would depend on the nature and extent of the contaminants) leading to reduced recruitment and loss of stock;
- Exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of seawater by the oil or for example the chemicals used for cleaning oil spills;
- Damage to fishing gear due to oil contamination; and
- Reduction in overall production rates and mortality of stock for mariculture farms.



8.2.3.2 Impact Assessment

Sensitivity of receptor

Accidental spills and loss of marine diesel could occur in the Venus offshore project area. The area is located more than 300 km from the coast, and offshore from key fishing grounds and spawning areas. Following a conservative approach, the potential receptors (fisheries sector and associated resources) are considered to be of **high** sensitivity.

Magnitude

Based on modelling results summarised in Section 8.1.1, an unplanned instantaneous release of marine diesel is likely to result in offshore oil contamination of a **regional** scale. Due to the prevailing wind and currents in the region, the surface oiling is predicted to largely disperse in a north-westerly direction away from coastal fishing areas, spawning and recruitment areas, and mariculture operations (no shoreline “oiling”). Large-scale effects on fishing operations would include area closures and exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of surface waters by oil or the chemicals used for cleaning oil spills. Based on the extent of surface oiling with respect to the operations of Namibian fisheries, **the large pelagic longline is the only sector that may be impacted.**

Modelling results indicate that in all seasons, the surface oiling probability area reaches regions with a water depth greater than 3 000 m. The model predicts a 1% probability extending up to 89 km from the release point (Season 3) in a NW direction. In the water column, the probability areas extend toward the northwest and west across all seasons, and thereby into deeper offshore waters, with the presence of oil in the water column mainly within the shallower layers (CLS, 2025). The model predicts a 1% probability of contamination presence in water column up to 212 km from the release point (Season 4). As such, additional fisheries sectors are not expected to be impacted, operating predominantly along the continental shelf in waters less than 1 000 m deep.

The diesel would remain at the surface for a limited time period (days), with no probability of oil on the surface ($> 0.3 \mu\text{m}$) after 3 days. In addition, surface oil is not modelled to reach sensitive habitats such as coastal nursery grounds and spawning areas. Thus, a diesel spill in the Venus offshore project area is unlikely to impact recruitment to the fishery, and as a result the impacts would likely persist over the short-term.

Table 8-5 lists the predicted area of contaminated fishing ground probability of surface oiling as determined by the modelling. The scenario which represents the highest likelihood of surface oil was considered for the calculations (L1, Season 3). The spill simulations showed that surface oil had a 50% probability of overlapping with the fishing grounds of the **large pelagic longline** in Namibia. In these cases, less than 0.001% of the fishing grounds were affected. No impact is anticipated on the other fishery sectors, including mariculture.

Table 8-5: Summary of potential oil spill contamination of fishing grounds (km²) based on stochastic modelling results (release position L1, Season 3).

Sector	Oil spill contamination	Probability of surface oiling			
Namibia		1%	10%	30%	50%
Large Pelagic Longline	Contaminated surface area of fishing ground (km ²)	6 607	1 511	95	5
	Proportion of total fishing ground (%)	1.35%	0.31%	0.02%	0.001 %

Figure 8-2 shows the probability of surface oiling contours in relation to the fishing grounds of the large pelagic longline fishery in Namibia and South Africa.



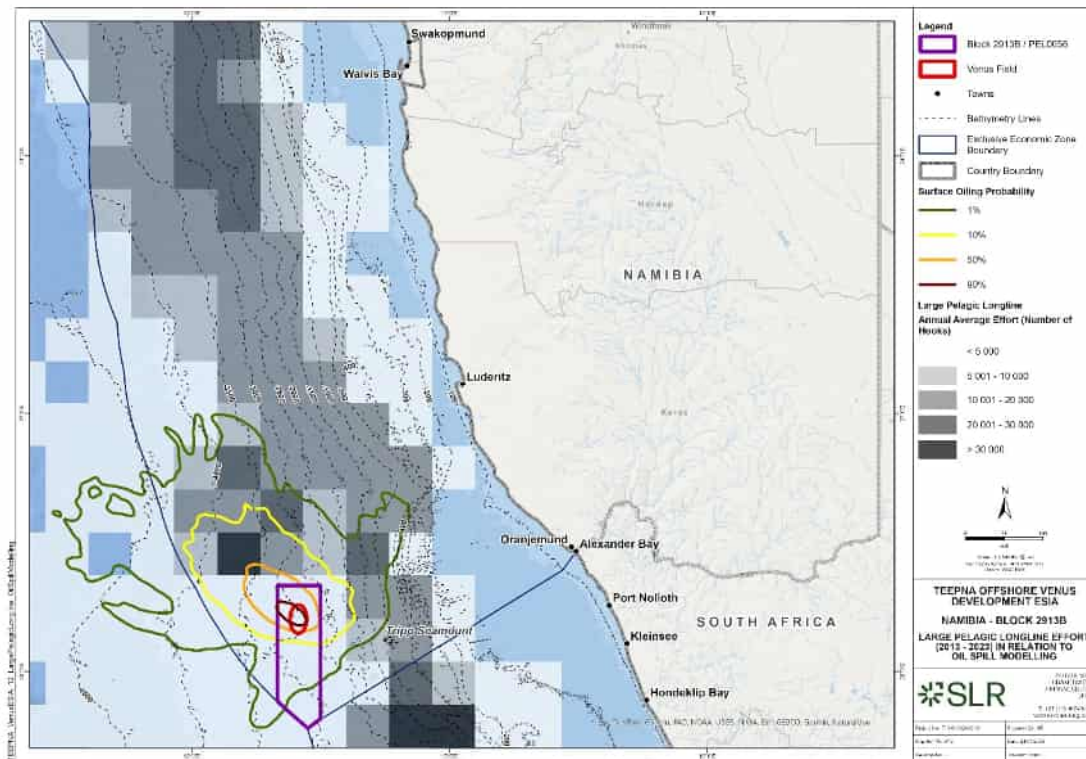


Figure 8-2: Probability of surface oiling as estimated by stochastic oil spill modelling in relation to effort expended by the large pelagic longline fishery (release position L1, Season 3).

Considering the results presented in Table 8-5 the intensity of a marine diesel spill on the large pelagic longline fisheries is expected to be **medium**. Given the intensity, duration (**short-term**) and extent (**regional**) ratings, the magnitude of a marine diesel spill is considered **low**.

Significance

Based on the sensitivity of the receptor (high) and impact magnitude (low), the overall potential impact to fisheries from a minor oil spill at the Venus offshore project area is assessed to be of **low** significance.

Residual Impact

With the implementation of the mitigation measures, which would reduce the intensity (low) of the impact, the residual impact significance remains **low**.



Table 8-6: Impact to Fisheries and Mariculture from an offshore Hydrocarbon (Marine Diesel and/or Crude Oil Spill).

Impact to Fisheries and Mariculture from an Offshore Hydrocarbon (Marine Diesel and/or Crude Oil) Spill		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	All Phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Low	Low
Intensity	Medium	Low
Extent	Regional	Regional
Duration	Short-term	Short-term
Significance	Low	Low
Additional Assessment Criteria		
Probability	Possible	Should a minor spill occur, it is possible that fisheries in the area would be affected.
Confidence	Medium	Oil spill modelling is a prediction based on metocean data from satellites. These methods have limitations.
Reversibility	Partially reversible	The impact is somewhat reversible due to response, mitigation measures and natural degradation of oil.
Loss of resources	Low	A small spill is unlikely to cause substantial loss of resources.
Avoidance Potential	Medium	Communication to authorities and fisheries can allow for operational planning for the avoidance of the affected area.
Mitigation Potential	Low	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Possible	Should multiple operators be drilling at the same time, then the risk of spills in the region may increase and these impacts could be exacerbated.

8.2.3.3 Mitigation and Management Measures

In addition to the best industry practices and project standards as well as mitigation measures outlined in Section 8.2.2.3, the following measures are recommended to mitigate and manage impacts related to an offshore hydrocarbon spill.

- Plan for and implement responses in terms of International Petroleum Industry Environmental Conservation Association – International Association of Oil & Gas Producers (IPIECA-IOGP) guideline document for the economic assessment and compensation for marine oil releases.

8.2.4 Impacts on Fishing Livelihoods

8.2.4.1 Impact Description

During the 2020/21 season, the total value of the pelagic longline fisheries was slightly more than NAD 98 million (see Table 8-7), with an average daily value of NAD 270 000.

If the entire industry had to cease catches for five days as a result of a diesel spill, the cost would be about NAD 1.35 million. The spill simulations showed that surface oil from a marine diesel spill at the Venus offshore project area had a 1% probability of overlapping with less than 1.5% of the fishing grounds of the large pelagic longline in Namibia. As a result, it can



be assumed that the loss of fishing opportunity and landings is likely to be valued at about NAD 13 500 per day.

Table 8-7: Catch and values of the pelagic bait boat and longline fisheries

Species	Reported landings in mt	Price /kg	Total Value (NAD)
Albacore	807.7	22	17 769 400
Bigeye Tuna	336.8	22	7 409 600
Yellowfin Tuna	101.3	22	2 228 600
Swordfish	215.5	49	10 559 500
Blue Shark	2 017.8	22	44 391 600
Shortfin Mako	718.7	22	15 811 400
Blue Marlin	5.5	24	132 000
Total per annum	4 203.3		98 302 100

Source: (Ministry of Fisheries and Marine Resources, 2021)

8.2.4.2 Impact Assessment

Sensitivity of receptor

Fishing is an important livelihood and source of income in Namibia. However, the offshore fishing industry has a wide range of fishing locations, and the **receptor (commercial fishing industry)** is deemed to have **medium** sensitivity¹³².

Magnitude

The intensity is rated as **medium** since the dispersion is away from the main fishing ground and activity, though the fishing industry may be disturbed and fishing activities may be impeded in the area close to the spill. Mainly pelagic longline fishing will be impacted with little if any impact on the other sectors.

The impact duration is rated as **short term** since any spill will in all likelihood be resolved in a few days and fishing can continue. The loss in revenue and product is therefore likely to be limited.

The extent of the impact is rated as **regional**.

Overall, the magnitude of the impact is rated as **low**.

Significance

Based on the low magnitude rating and medium sensitivity rating, the impact significance is considered **low**.

Residual Impact

With the implementation of mitigation measures listed below the residual impact reduces to **very low**.

¹³² The SSF sector is more vulnerable to shocks and disturbances. Since a marine diesel spill at the Venus field will not reach the areas used for SSF, this assessment focuses on the commercial fishing sector. Potential impacts on SSF are dealt with in the assessment of an unplanned event at the nearshore transshipment area where most SSF activities take place.



Table 8-8: Impact rating for impact of major offshore hydrocarbon (marine diesel and/or crude oil spill) on fisheries livelihoods

Impact on Fishing and the Fishing Industry due to Offshore Hydrocarbon (Marine Diesel and/or Crude Oil) Spill		
Impact Description	Impact on fishing and the fishing industry.	
Type	Direct	
Nature	Negative	
Phases	All Phases	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	Medium
Magnitude	Low	Very Low
Intensity	Medium	Low
Duration	Short Term	Short Term
Extent	Regional	Regional
Significance	Low -	Very Low -
Additional Assessment Criteria		
Probability of an impact if an unplanned event occurs, not probability of the unplanned event occurring	Possible	
Reversibility	Fully Reversible	
Loss of Resources	Low	
Avoidance Potential	High	
Mitigation Potential	Low	
Cumulative Impacts	Possible	

8.2.4.3 Mitigation and Management Measures

Should a marine diesel spill occur, the mitigation measures as detailed in the fisheries assessment should be implemented. These relate to adequate staff training in and planning of prevention and adequate response strategies, and preparation for implementing such strategies at short notice.

Operator will secure insurance policy including coverage for third party liability. Further measures to address potential socio-economic impacts include:

- Develop and implement a Stakeholder Engagement Plan to ensure that local and national stakeholders are effectively informed about the nature, causes and effects of major spills (such as considered in this assessment) and measures to contain it and to address impacts.
- Implement a grievance mechanism that allows stakeholders to register specific grievances related to operations, by ensuring they are informed about the process and that resources are mobilised to manage the resolution of all grievances, in accordance with the Grievance Management procedure. The Grievance Mechanism and procedures are part of the SEP (Stakeholder Engagement Plan) of the Project.
- Operator to secure insurance policy including coverage for third party liability, in the event of an unplanned pollution event.



8.2.5 Impact on Cultural Heritage

8.2.5.1 Impact Description

Any impact on the integrity of the coastal and marine ecosystem through an accidental hydrocarbon (marine diesel and/or crude oil) spill could have an immediate detrimental effect on the marine environment which could then impact aspects that make up people's ICH (indirect negative impact).

The impacts of an accidental hydrocarbon (marine diesel and/or crude oil) spill on cultural heritage are considered to be lower than those of a major oil spill at the Venus offshore project area, which are assessed in Section 8.3.5. Those impact ratings are thus deemed worst-case scenario for an offshore diesel spill and refer here.

8.2.6 Impact on Atmospheric pollutants Emissions

8.2.6.1 Impact Description

The impacts of an offshore surface marine diesel or crude spill on atmospheric pollutant emissions are considered to be lower than those of a major crude oil spill from a well blow out at the Venus offshore project area, which are assessed in Section 8.3.6. Those impact ratings are thus deemed worst-case scenario and refer here.

Nevertheless, estimation of NMVOC and Benzene emissions for this scenario is provided in Table 8-15 (see Section 8.3.6).

8.3 Major Oil Spill (Well Blow-Out) in the Venus Offshore Project Area

IMPORTANT NOTES:

- The oil spill modelling study assumed a representative worst-case scenario of a spill from a continuous blow-out of 5 912 m³/day of oil (with an associated dissolved gas release rate of 2.88×10^6 Sm³/day) for a period of 13 days assuming the characteristics of OSELVAR 2011 oil (47.4 API) from the OSCAR database, as the closest equivalent of the fluid expected from the development wells in the Venus offshore project area based on the oil discovered during previous exploration and appraisal drilling by TEEPNA.
- Although a well blow-out is highly unlikely, the impact probability presented below assumes that a spill has occurred.
- The impact assessment below is based on a representative worst-case scenario of assuming **capping only** in the event of a blow-out (DET-A and STO-A). Although deployment of surface responses and the Subsea Dispersant Injection (SSDI) kit were also modelled, they were found to have a small effect on the extent (surface area and water column plume) affected by a major oil spill across all seasons (see Section 8.1.1).



8.3.1 Source of Impact

The project activities that could result in a major accidental release of crude oil mixed with gas are summarised below.

Aspect	Drilling	Production	Decommissioning
Loss of well control / well blow-out	X		

The greatest environmental threat from offshore drilling operations is the risk of a major spill of crude oil and associated gas occurring either from a blow-out or loss of well control. A blow-out is the uncontrolled release of crude oil and/or natural gas from a well after pressure control systems have failed.

Although the probability of a well blow-out is extremely low (global data maintained by Lloyds Register, cited in IOGP Report 434-02, indicates that frequency of a blowout from development drilling (deep and normal wells) wells is in the order of 3.9×10^{-5} per well drilled¹³³), it is a worst-case scenario that provides the greatest environmental risk during drilling operations. Thus, the impacts associated with a well blow-out are, therefore, considered to be worst case.

Project Controls

The Operator and drilling contractor will ensure that the drilling campaign is undertaken in a manner consistent with good international industry practice and BAT. The Operator will have a Blow-Out Contingency Plan (BOCP) in place, that sets out its detailed response plan and intervention strategy, to be implemented in this unlikely event.

In line with the standard industry practice, the Operator will be equipped and organised to be ready to deal with all levels of potential spills, including spills from routine operations on site (Tier-1) and oil spill situations of higher magnitude which are dealt with by industry co-operation and external intervention (Tier 2 and Tier 3).

A “multi-barrier” approach (i.e., mitigation) in dealing with risks (particularly the risk of oil spills) will be implemented. This approach involves defining multiple preventative barriers (or avoidance mitigation measures) to manage environmental risk. The first step and most important priority in applying the Mitigation Hierarchy to manage the risk of a catastrophic oil spill is avoidance (or prevention). If these preventative technical and control barriers fail or are not effective under certain conditions, then response capabilities (minimisation barriers) will be implemented. Multiple response barriers are defined to deal with such an event after its occurrence.

The primary safeguard against a blow-out during well-drilling is the column of drilling fluid in the well, which maintains hydrostatic pressure on the wellbore. Under normal drilling conditions, this pressure should balance or exceed the natural rock formation pressure to help prevent an influx of gas or other formation fluids. As the formation pressures increase, the density of the drilling fluid is increased to help maintain a safe margin and prevent “blow-outs.” However, if the density of the fluid becomes too heavy, the formation can be damaged and fracture. If drilling fluid is lost in the resultant fractures, a reduction of hydrostatic pressure occurs. Maintaining the appropriate fluid density for the wellbore pressure regime is therefore critical to safety and wellbore stability. Abnormal formation pressures are detected by primary well control equipment (pit level indicators, return mud-flow indicators and return mud gas detectors) on the drill unit. The drilling fluid is also tested frequently during drilling operations and its composition can be adjusted to account for changing downhole conditions.

¹³³ This equates to $3.9 \times 10^{-5} = 0.000039\%$.



The likelihood of a blow-out is further minimised by installation of a BOP on the wellhead at the start of the riser drilling stage. The BOP is a secondary control system, which contains a stack of independently operated cut-off mechanisms, to ensure redundancy in case of failure. The BOP is designed to close in the well to prevent the uncontrolled flow of hydrocarbons from the reservoir. The BOP will undergo a thorough inspection prior to installation and will be subsequently pressure and function tested on a regular basis during operations aligned with industry best practices. A blow-out occurs in the highly unlikely event of these pressure control systems failing.

If the BOP does not successfully shut off the flow from the well, the drilling unit would disconnect and move away from the well site while crews mobilise a capping system. The capping system would be lowered into place from its support barge or vessel and connected to the top of the BOP to stop the flow of hydrocarbons.

TEEPNA is a member of Oil Spill Response Limited (OSRL), which provides expertise, equipment, oiled wildlife recovery and access to the global dispersant stockpile. TEEPNA will thus have access to a capping stack, in the event of a well blow-out, compatible with the installed wellhead. Capping Stacks are designed to shut-in an uncontrolled subsea well in the unlikely event of a blow-out and are located in key global locations for fast mobilisation and onward transportation by sea. This would significantly reduce the spill period. OSRL has one of its 10K¹³⁴ capping stacks housed at its Saldanha Bay base on the West Coast of South Africa (~610 km southeast of Venus offshore project area).

Well plugging and abandonment will be undertaken to ensure safe closure of the wells at the end of the production phase in accordance with international best practice and TotalEnergies referential. Wells will be sealed, plugged, tested for integrity and abandoned (refer to Conceptual Decommissioning and Closure Strategy in Appendix S). The integrity of cement plugs will be validated either by physical tests (i.e. tag or weight test) or pressure tests according to the international standards and recommended best practice (API RP 65-3). Notably, following the end of the production phase, the reservoir will be largely/fully depleted, resulting in low pressure, and thereby reducing the risk of leaks from plugged and abandoned wells.

Additionally, the Operator will prepare and implement emergency response and oil spill contingency plans (e.g. SOPEP and OSCP). These controls have been considered in the pre-mitigation impact rating.

8.3.2 Impact on Marine Ecology / Environment

8.3.2.1 Impact Description

Oil spilled in the marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage) (see Section 8.2.2.1). If a large spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

8.3.2.2 Impact Assessment

Sensitivity of receptor

Although the Venus offshore project area is located in the marine environment, more than 300 km offshore, far removed from coastal MPAs and any sensitive coastal receptors (e.g., key faunal breeding/feeding areas, bird or seal colonies and nursery areas for commercial fish stocks) where the pelagic habitat/ecosystem type is classified as 'Least Threatened', a

¹³⁴ 10 k refers to a pressure rating of 10 000 pounds force per square inch (psi).



large spill could still directly affect these sensitive coastal receptors, if they are reached, as well as migratory pelagic species transiting through the impacted area.

Coastal and pelagic seabirds, fish, turtles and cetaceans are highly sensitive to oil spills, with several species, likely to be encountered within the broader project vicinity listed as 'Endangered' or 'Vulnerable' (see Section 8.2.2.2 for further information).

Additionally, while soft-sediment macrofauna is considered to have low sensitivity, potential VME species associated with deep-water hard substrata are highly sensitive to oil spills, and the associated effects thereof. However, environmental and geophysical surveys undertaken within PEL0056/Block 2913B have confirmed that the Venus offshore project area is typically homogenous, devoid of features with an impoverished (low diversity and abundance) macrofauna, typical for deep water soft sediments. No colony forming corals and structural features (e.g., rocky outcrops) were identified.

The overall sensitivity of marine fauna (benthic, pelagic and coastal) to a large oil spill is, therefore, considered **high**.

Magnitude

The magnitude of a major oil spill following the unlikely event of a well blow-out is considered **very high** for both the marine environment, as well as all faunal groups (benthic and pelagic). This is based on the following ratings:

- **High intensity**, as the oil spill may impact sensitive and/or vulnerable benthic and pelagic habitats and species.
- **Long-term duration**, with the consequence of the oil spill effects extending beyond the impact exposure, yet ceasing following natural processes and recruitment.
- **International extent**, as oil spill modelling results show that oil extends beyond the Namibian EEZ and into international waters. Although, oil is not expected to reach South African waters.

These ratings are discussed for each receptor below.

Impacts on Marine Environment

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. The physical properties that affect the behaviour and persistence of an oil spilled at sea are specific gravity (API), viscosity and pour point, all of which are dependent on the oil's chemical composition (e.g. the amount of asphaltenes, resins and waxes).

As soon as oil is spilled, it undergoes physical and chemical changes (collectively termed 'weathering') (Figure 8-3A), which in combination with its physical transport, determine the spatial extent of oil contamination and the degree to which the environment will be exposed to the toxic constituents of the released product. It is estimated that of the oil forming surface layers during a spill, ~40% is rapidly lost to weathering (McNutt, et al., 2012). Although the individual weathering processes may act simultaneously, their relative importance varies with time (Figure 8-3B). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer-term processes of oxidation, sedimentation and biodegradation.



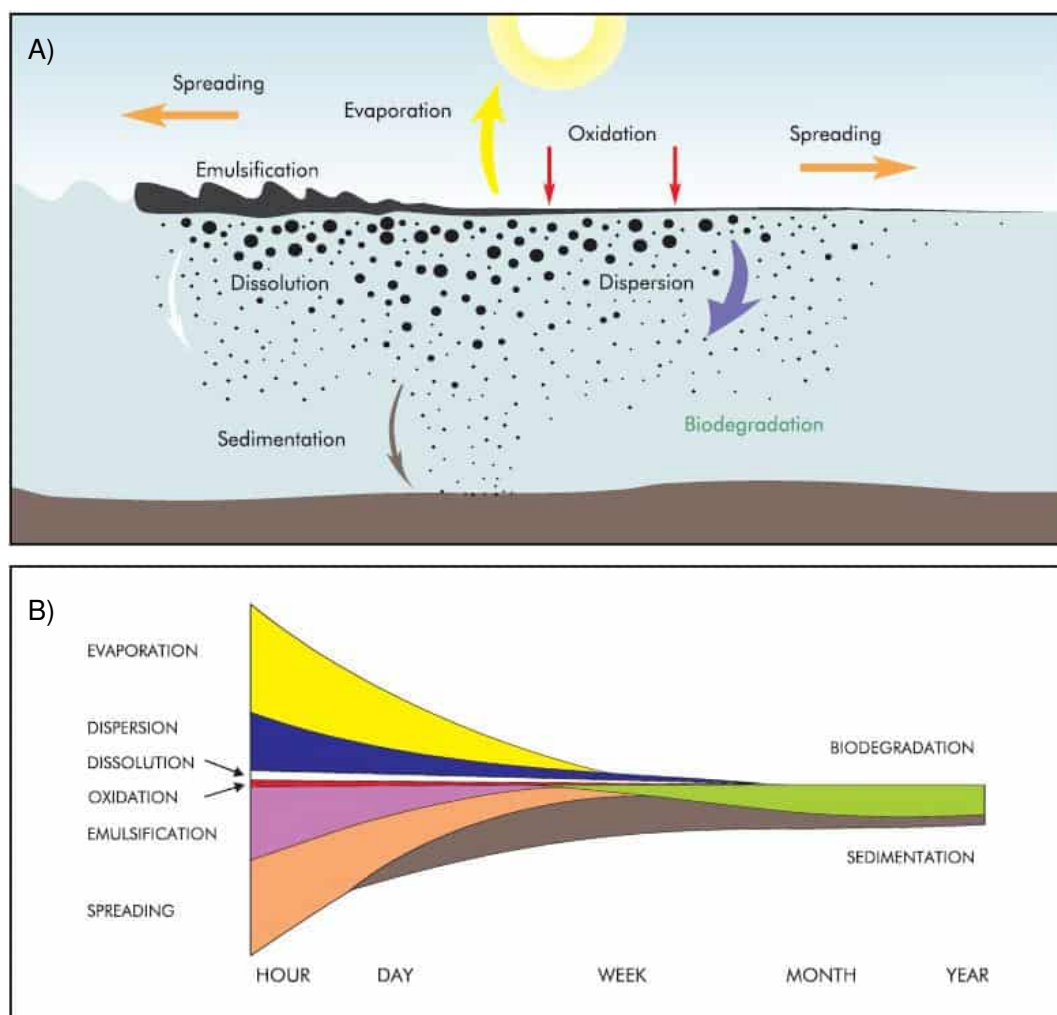


Figure 8-3: A) The weathering processes acting on spilled crude oil, and B) the fate of a typical medium crude oil under moderate sea conditions - the width of each band indicates the importance of the process (ITOPF 2002).

The components of oil known to be toxic to marine organisms include volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene, collectively known as BTEX, as well as PAHs, which are known for their persistence in the environment. The polar components of oil (defined as the nitrogen-sulfur-oxygen (NSO)-containing compounds), have a less established toxicity, but can account for ~70% of all oil compounds dissolved in water and are therefore thought to be more toxic to marine organisms and more persistent in the environment than other crude oil components (Liu & Kujawinski, 2015).

When considering the impact of oil on marine organisms, it is important to consider the composition and comparative toxicity of the specific oil compounds that are present as well as the amount and duration of the oil exposure and the bioavailability of the oil (Saadoun, 2015). Oil is most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify (Reddy, Arey, Jeffrey, Sean, & Karin, 2012; Gros, et al., 2014). Most of the toxic effects are associated with the monoaromatic compounds and low molecular weight polycyclic hydrocarbons, as these are the most water-soluble components of the oil (NRC 2003). When the additive toxic levels of hydrocarbons exceed the threshold concentration, their effects can lead to mortality. On **ingestion**, oil hydrocarbons travel to the liver where the resulting metabolites of PAHs become highly toxic and carcinogenic due to their ability to attack and bind to DNA and proteins.



As hydrocarbons are highly volatile, the **inhalation** of concentrated petroleum vapours by mammals, turtles and birds can result in the inflammation of and damage to the mucus membranes of airways, lung congestion or even pneumonia. Inhalation of benzene and toluene, results in these volatiles being rapidly transferred into the bloodstream where accumulation in the brain and liver, can cause neurological disorders (e.g. narcosis) and hepatic damage (Saadoun, 2015). **Physical contact** with the oil is the major route of exposure, usually affecting birds and furred mammals at the sea surface. As these rely on their coats and feathers for buoyancy and warmth, they typically succumb to hypothermia, drowning and smothering when oil adheres to them.

Oil spilled in the marine environment will have an immediate detrimental effect on water quality. Any release of liquid hydrocarbons thus has the potential for direct, indirect and cumulative effects on the marine environment. The catastrophic Deepwater Horizon (DWH) blow-out in the Gulf of Mexico in 2010 provided opportunity for increasing the understanding of how an oil spill impacts the marine environment. Beyer et al. (Environmental effects of the Deepwater Horizon oil spill: a review, 2016) provide an excellent review of the plethora of research papers emanating from the research programmes initiated following the spill. The biological effects of the DWH spill are summarised in the conceptual Figure 8-4, below. This figure illustrates the biological effects as a constellation of relationships between oil exposure and toxicological effects in organisms affected by the spill. All exposure and effect elements shown are supported by information in the DWH oil spill research literature (Beyer, et al., 2016).

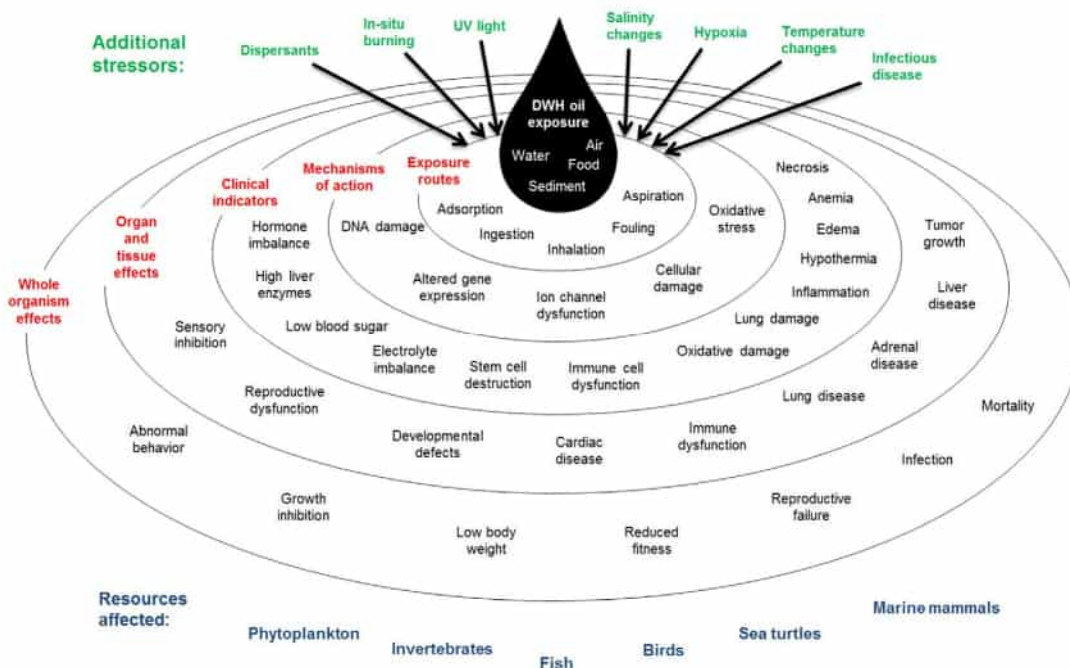


Figure 8-4: Conceptual figure illustrating the biological effects of the Deepwater Horizon oil spill

Source: Beyer et al. 2016

The fate of the released hydrocarbons during DWH was influenced by an array of factors including the great depth, the composition and magnitude of the blow-out, high sea surface temperature, strong solar irradiation, the presence of a community of indigenous oil degrading microbes, the oceanic circulation pattern in deep and surface waters during the spill and the extensive use of dispersants (both deep and surface applied). It must be pointed out that, as the factors influencing the fate of the hydrocarbons were thus fairly site specific, some of the biological effects described for the DWH spill may not be applicable to



a potential blow-out off the continental slope off the southern Namibian coast. For example, sea surface temperatures off the West Coast are likely to be lower, and communities of oil degrading microbes less well established (if present at all) (Blaizot, 2019).

Impacts on Plankton

Crude oil spills affect **phytoplankton** communities in a variety of ways and estimates of toxicity varies widely depending on the species involved (Abbriano, et al., 2011; Zhou, Tang, & Sun, 2013; Buskey, White, & Esbaugh, 2016). Oil toxicity can impact both phytoplankton community composition and abundance. While productivity and growth may be reduced (Hallare, et al., 2011), some species appear to be highly tolerant of oil exposure, and in some cases it may even stimulate their growth (Ozhan, Parsons, & Bargu, 2014; D'Souza, et al., 2016; Tang, et al., 2019).

Zooplankton similarly respond to oil in a variety of ways ranging from significant but short-term impacts on zooplankton assemblages (Almeda, et al., 2013a; Almeda, Baca, Hyatt, & Buskey, 2014a; R, Hyatt, & Buskey, 2014b; Carassou, Hernandez, & Graham, 2014; Cohen, McCormick, & Burkhardt, 2014) with some taxa decreasing in density, while others increased. The stimulation of microbial activity in response to oil may also result in increased production of zooplankton. Small ciliates and copepods are particularly sensitive to oil exposure responding with reduced egg and faecal pellet production rates, as well as egg hatching. Copepods, euphausiids and mysids will ingest emulsified oil droplets leading to acute toxicity, bioaccumulation and transfer of hydrocarbon contaminants to higher order consumers (Buskey, White, & Esbaugh, 2016) and benthic detritivores (Almeda, Connelly, & Buskey, 2015). Larger gelatinous zooplankton are also sensitive to bioaccumulation effects (Almeda, et al., 2013b), potentially acting as vehicles for contaminant transfer up the food web to apex predators such as turtles. However, there is still insufficient evidence of the extent to which oil transfers to the next trophic level.

A further consideration regarding impacts on plankton is photo-enhanced toxicity, especially where drilling is proposed in areas known to be important fish spawning habitats. Certain PAHs are classified as phototoxic, raising an additional level of complexity regarding the exact chemical composition of different oils. Photo-enhanced toxicity occurs when certain wavelengths enhance the observed toxicity of a compound, thereby posing additional risks to the buoyant eggs of pelagic fish and the shallow spawning habitat of many nearshore species, as these areas are likely to receive higher intensities of ultraviolet light. However, in nearshore habitats off the Namibian coast, water turbidity may mitigate some of this concern.

The time of year during which a large spill takes place will significantly influence the magnitude of the impact on plankton and pelagic fish eggs and larvae. Should the spill coincide with a major spawning peak in the kingklip, squid, hake, anchovy and kob spawning areas (see Figure 5-22) during spring and summer, it could result in severe mortalities and consequently a reduction in recruitment (Baker, et al., 1990; Langangen, et al., 2017), although Neff (1991) maintains that temporally variable and environmental conditions are likely to have a far greater impact on spawning and recruitment success than a single large spill. Sensitivity of fish eggs and larvae was thought to be primarily associated with exposure to fresh (unweathered) oils (Teal & Howarth, 1984; Neff J. , 1991) but recent studies have demonstrated that the weathered water accommodating a fraction of the spill results in increased toxicity (Esbaugh, et al., 2016).

Considering the oil spill modelling results, which indicate a predominant drift towards the NW and W, such impacts to nearshore and coastal spawning areas are unlikely to occur, with oil spreading offshore and away from such sensitive habitats. Dissolved oil in the water column (> 58 ppb) was found to spread further at shallower depths compared to deeper regions/layers, spreading predominantly towards the NW and W, along and offshore. As such, impacts to the water column were also not found to overlap with key spawning and nursery areas, located inshore of the modelled spill area.



Impacts on Benthic fauna

A wide range of effects of oil on **benthic invertebrates** has been recorded, with much of the research focussing on meiofauna and the various life stages of polychaetes, molluscs and crustaceans (Elmgren, Hanson, Larson, Sundelin, & Boehm, 1983; Frithsen, Elmgren, & Rudnick, 1985; Volkman, Miller, Revill, & Connell, 1994).

Following the DWH spill Montagna et al. (2013) reported a severe reduction in abundance and diversity of soft-bottom benthic macrofauna and meiofauna extending 3 km from the wellhead in all directions and covering an area of 24 km² with moderate impacts extending over 148 km² (Fisher, et al., 2014). Effects over larger spatial scales were, however, also reported (Salcedo, Soto, Estradas-Romero, & Botello, 2017).

Considering the large variation in tolerances and sensitivities of potentially impacted species and habitats, generalisations cannot be confidently made. For example, some burrowing infauna shows high tolerances to oils, as the weathered product serves as a source of organic material that is a suitable food source. Deposit- and suspension-feeding polychaetes in particular can take advantage of bioturbation and degradation of oiled sediments (Scholtz, et al., 1992; Kotta, et al., 2007). Volkman et al. (1994) suggest that some epifauna produce complex responses to oiling and that bioaccumulation of petroleum hydrocarbons can in some cases readily occur, with cascade effects to higher order consumers.

Sessile and motile mussels and crustaceans are frequent victims of direct oiling or coating, although the latter appear capable of metabolising and excreting accumulated hydrocarbons quite rapidly due to a well-developed mixed-function oxygenase system. Filter-feeders in particular are susceptible to ingestion of oil in solution, in dispersion or adsorbed on fine particles (Saadoun, 2015).

Tolerances to oil also vary between life stages, with larvae and juvenile stages generally being more sensitive to the water-soluble fractions of oil than adults. Overall, chronic oiling is known to cause a multitude of sub-lethal responses in taxa at different life stages, variously affecting their survival and potential to re-colonise oiled areas. This results in highly modified benthic communities with (potentially lethal) 'knock-on' effects for higher order consumers.

Abundance and diversity of **benthic megafauna** (Valentine & Benfield, 2013; Felder, et al., 2014; McClain, Nunnally, & Benfield, 2019) were also reported to be negatively affected by oiling, with significant toxicity effects from both oil and dispersants reported for deep-water corals (White, et al., 2012; Fisher, et al., 2014; Prouty, Fisher, Demopoulos, & Druffel, 2014; DeLeo, Ruiz-Ramos, Baums, & Cordes, 2015). Environmental and geophysical surveys undertaken within PEL0056/Block 2913B have confirmed that the Venus offshore project area is typically homogenous, devoid of features with an impoverished (low diversity and abundance) macrofauna, typical for deep water soft sediments. No colony forming corals and structural features (e.g., rocky outcrops) were identified. The fauna inhabiting the dominant unconsolidated sediments is expected to be relatively ubiquitous, usually comprising fast-growing species able to rapidly recruit into disturbed areas. In contrast, benthic biota associated with hard grounds are typically more vulnerable to disturbance due to their long generation times.

Based on blow out modelling results, dissolved oil in the water column is not expected to reach Tripp Seamount across all seasons, as such potential impacts to the vulnerable benthic biota associated with potential hardground habitats is unlikely/reduced. Considering the location of the Orange Seamount and Canyon Complex EBSA, there is a 30% probability of oil reaching a small portion of this EBSA during Season 3 (June to August), both on the surface and within the water column. This EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species, focussing primarily on the conservation of benthic biodiversity and threatened benthic habitats.



Impacts on coastal habitats and communities

Based on the oil spill modelling results, shoreline oiling is not observed in any of the seasons simulated for a well blow-out in the Venus offshore project area (CLS, 2025). Refer to Section 8.5 for an assessment of potential shoreline oiling resulting from a nearshore unplanned hydrocarbon spill.

Impacts on Pelagic fauna

Adult free-swimming **fish** in the open sea seldom suffer long-term damage from oil spills as oil concentrations in the water column decline rapidly following a spill and rarely reaching levels sufficient to cause mortality or significant harm. Adult pelagic fish are expected to actively avoid very contaminated waters, and consequently documented cases of fish-kills in offshore waters are sparse (ITOPF, 2014). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and opportunistic pathogens, and incorporation of PAHs through ingestion of contaminated sediments or prey that have accumulated oil (Thomson D. , et al., 2000; Beyer, Trannum, Bakke, Hodegeson, & Collier, 2016).

Following the DWH spill, high PAH metabolites were recorded in the bile of certain fish species, with higher concentrations closer to the spill. However, as metabolites (chemical markers of oil exposure) were inconsistent among species surveyed and the metabolites measured, their validation is required before use as an indicator of oil contamination (Weisberg, et al., 2016). In contrast, gene expression and potential effects on sex determination, sexual differentiation, growth regulation and DNA damage in fish was found to be a robust indicator of oil exposure in fish (Beyer, et al., 2016).

Furthermore, the well-developed hepatic mixed function oxygenase (MFO) system in fish ensures that accumulation and retention of high concentrations of petroleum hydrocarbons does not occur and hydrocarbons are thus unlikely to be transferred to predators (Saadoun, 2015). Experimental exposure of fish to oil-contaminated sediments was found to reduced fitness and thereby increase the potential for population-level impacts, however field studies of population-level impacts related to sediment contamination are lacking (Pearson W. , 2014). In a comprehensive field study to determine PAH exposures in demersal fish species in the Gulf of Mexico, Pulster et al. (2020) concluded that complex interactions exist between multiple hydrocarbon input sources and possible re-suspension or bioturbation of oil-contaminated sediments.

The embryonic and larval life stages of fish, however, show acute toxicity to PAHs, even at low concentrations, although effects vary depending on the species and the extent of exposure. Toxicity effects on the early life stages of fish are generally defined by the occurrence of pericardial edema, which is often accompanied by reduced heart rate and atrial contractility, particularly in large predatory pelagic species such as tunas and billfish (Incardona, et al., 2014; Esbaugh, et al., 2016). The cardiotoxic effect may also be accompanied by spinal curvature, finfold damage, and craniofacial malformations (Incardona, et al., 2014). Impaired cardiovascular development in fish embryos, thought to reduce individual cardiovascular performance and swimming performance in later life, therewith present a high risk for reduced productivity of these commercially important species.

Key spawning and recruitment areas for commercially valuable species (e.g. hake, anchovy and kob) lie well inshore of the Venus offshore project area. Notably surface oil is modelled to disperse largely to the NW and away from key, coastal spawning and recruitment areas located along both the Namibian and South African West Coast. Similarly, dissolved oil in the water column (> 58 ppb) was modelled to predominantly disperse in a NW and W direction across all seasons.

Oil is not found to spread over Tripp Seamount, ~84 km southwest of PEL0056/Block 2913B, with Orange roughy spawning areas in the vicinity of Tripp Seamount unlikely to be



impacted by an oil spill based on oil spill modelling results. Notably, the fishery has been closed since 2007 due to over exploitation.

As such, population-level impacts are considered to be limited with effects reversible over time through natural recovery and limited to the short-term (< 1 year) owing to high generation rates. Impacts would extend internationally, based on oil spill modelling, and be of high intensity (i.e. large degree of disturbance and/or degradation that materially impairs and/or impedes functioning) resulting in a **high** impact magnitude for pelagic fish.

Acute oil pollution is a significant threat to **pelagic seabirds**, many of which feed along and offshore of the western coastline of southern Africa, and which could be impacted by a large spill. Diving seabirds, that spend most of their time on the surface of the water, are particularly likely to encounter floating oil and will likely die as a result of even moderate oiling, which damages plumage and eyes.

The majority of associated deaths are as a result of the properties of the oil and damage to the water repellent properties of the birds' plumage. This allows water to penetrate the plumage, decreasing buoyancy and leading to sinking and drowning. In addition, thermal insulation capacity is reduced requiring greater use of energy to combat cold. Oil is also ingested as the birds preen in an attempt to clear oil from plumage and may furthermore be ingested over the medium to long term as it enters the food chain (Integral Consulting Inc. 2006). The effects of ingested oil include anaemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs (Scholz, Michel, Shigenaka, & Hoff, 1992; Finch, Wooten, & Smith, 2011; Finch, Wooten, Faust, & Smith, 2012). Pelagic seabirds potentially encountered feeding or migrating through the Venus offshore project area and blow out spill impact zone are considered regionally 'Endangered' (e.g., Atlantic yellow-nosed albatross and black-browed albatross) or 'Vulnerable' (e.g., white-chinned petrel). As such, potential impacts are considered to be of high intensity, owing to the species vulnerability and considering their relevant IUCN/conservation status, with potential long-term population effects, extending beyond the impact exposure. Impacts would extend into international waters, resulting in a **very high** impact magnitude.

Impacts of oil spills on **turtles** is thought to primarily affect hatchling survival (CSIR & CIME 2011), but direct coating of nesting females, contamination of nests and absorption of oil by eggs and hatchlings will occur with heavy shoreline oiling (Hale, et al., 2017), potentially with far-reaching effects on recruitment success and population status (Putman, et al., 2015) status. As the nearest turtle nesting sites on the South African East Coast and in Angola are all located well over 1 000 km from the project site, these would not be affected in the event of a spill, but hatchlings carried southwards in the Agulhas Current and into the southern Benguela or adults transiting through the area may become oiled.

As turtles spend much of their time at the surface, inhalation of the volatile oil fractions will occur leading to respiratory stress, while coating of eyes, nostrils and mouths with oil will cause vision loss, inhalation and ingestion. Indirect ingestion of oil through contamination of their gelatinous prey or coastal foraging sites is also possible. Direct miring in oil is the most likely impact, decreasing an animal's ability to move and dive, causing exhaustion, dehydration, overheating, and eventually death. Any turtle deaths from oil exposure would remove them from the breeding population. For species considered 'Endangered' or 'Critically Endangered', such a loss can be significant.

Overall, potential oil spill in the Venus offshore project area may result in long-term impacts on vulnerable marine turtle populations, particularly due to their slow generation times and low global and regional numbers. While nesting sites are unlikely to be directly affected, migrating adults and hatchlings transported by ocean currents may be exposed to oil. There individual level impacts, especially for species listed as Vulnerable, Endangered, or Critically Endangered, may translate into population-level consequences due to the high intensity of



effects and the population vulnerability of affected species, thereby resulting in an impact of **very high** magnitude.

Little work has been done on the effect of an oil spill on **fur seals** and sea lions (pinnipeds), but they are expected to be particularly vulnerable as oil would clog their fur and depending on how they maintain their core body temperature, they may die of hypothermia.

The following description is summarised from Helm et al. (Overview of Effects of Oil Spills on Marine Mammals, 2015). Although pinnipeds should be able to detect oil through vision and/or smell, they apparently do not actively avoid oil and are therefore likely to come in contact with it if it comes into their habitat. Acute and long-term chronic exposure to oil in pinnipeds negatively affects the mucous membranes, eyes, ears, external genitalia, and internal organ systems. However, due to small sample sizes, the magnitude of the harm and its long-term consequence to individuals and local populations remain unknown.

For those pinnipeds that rely primarily on blubber for insulation (sea lions, seals, walrus), external oiling does not significantly impact their ability to maintain their core body temperature. In fur seals, which may occur within shallower waters to the east/inshore of PEL0056/Block 2913B, the vulnerability to an oil spill will likely be determined by the degree and time of exposure. Fur seals rely mostly on air trapped in their fur, rather than blubber for insulation. Individuals would therefore likely face a serious challenge in maintaining their core body temperature if oiled.

Population-level impacts are also likely if spilled oil reaches the haul-out sites and rookeries where these seals rest or annually mass to breed. A number of Cape fur seal colonies occur within the broader project area along the southern Namibian coastline including colonies at van Reenen Bay and Baker's Bay approximately 280 km inshore and to the north-east of PEL0056/Block 2913B, in the Tsau//Khaeb (Sperrgebiet) National Park.

Based on oil spill modelling results, there is a 1% probability of oil within the water column and on the surface reaching inshore waters, shallower than the 1 000 m isobath, with surface oil spreading into waters less to 1 000 m depth contour taking place in Season 3, yet remaining in water greater than the 1 000 m isobath in the remaining seasons.

As such, direct impacts from a major oil spill on Cape fur seals are unlikely to occur keeping in mind that the probability of oil spreading to these shallower waters was found to be limited (1% probability in Season 3), based on the STO-A scenario. Consequently, while individual impacts may occur, albeit highly unlikely, longer lasting population level impacts are not anticipated.

The effects of oil pollution on **cetaceans** are poorly understood (White, Gillon, Black, & Reid, 2001), but their low vulnerability to oil has also been attributed to their ability to detect and avoid slicks (Helm, et al., 2015), although conflicting reports do exist (see for example Evans, 1982; Smultea & Würsig, 1995; Matkin, et al., 2008; Helm, et al., 2015). Field observations record few, if any, adverse effects among cetaceans from direct contact with oil, and some species have been recorded swimming, feeding and surfacing amongst heavy concentrations of oil (Scholz et al., 1992) with no apparent effects. As oil does not adhere to the skin of cetaceans, it is not expected to accumulate in or around the eyes, mouth, blow hole, or other potentially sensitive external areas. Direct oiling of cetaceans is thus not considered a serious risk to their thermoregulatory capabilities. Dispersants added to oil spills have, however, been found to be cytotoxic and genotoxic to whale skin fibroblast cells (Wise et al., 2014a; 2014b).

The most likely immediate impact of an oil spill on cetaceans is the risk of inhalation of volatile, toxic benzene fractions when the oil slick is fresh and unweathered (Geraci & St Aubin, 1990, cited in Scholz, et al., 1992). Common effects attributable to the inhalation of such compounds include absorption into the circulatory system leading to narcosis and drowning (St Aubin & Geraci, 1994; Matkin, et al., 2008), inflame mucous membranes, lung congestion leading to pneumonia, neurological damage and liver disorders (Matkin et al.,



2015), compromised health status and increased disease prevalence (Venn-Watson et al., 2015), as well as mild irritation to permanent damage to membranes of eyes, mouth and respiratory tract. In highly mobile, wide-ranging species, the contact with an oil spill is expected to be relatively brief.

The impact of oil pollution on local and migrating cetacean populations will depend on the timing and extent of the spill. It is assumed that the majority of cetaceans will be able to avoid oil pollution, though effects on the population could occur should the region of avoidance be critical to population survival. Oil pollution in areas of cetacean critical habitat (areas important to the survival of the population), such as the extreme near-shore calving / nursing grounds could be the most likely to result in population impacts. Considering the blow out spill modelling results, potential impacts to important nearshore calving/nursing grounds are unlikely to occur.

Potential oil spills in the Venus offshore project area may result in high-intensity impacts on cetaceans, primarily due to the risk of inhaling toxic volatile compounds from fresh oil slicks, which can lead to respiratory distress, neurological damage, and increased disease susceptibility. While population-level impacts are generally considered limited, a conservative approach, accounting for potential individual mortality, reduced fitness, and the IUCN/conservation status of species potentially impacted, suggests that long-term population effects cannot be ruled out. As such, the overall impact may be considered of **very high** magnitude, particularly if vulnerable species are impacted.

Significance

Whilst there is a remote chance of a well blow-out occurring, the overall impact on marine fauna and communities before mitigation is considered to be of **very high** significance, based on the highest impact magnitude (**very high**) and sensitivity (**high**) rating across all potential receptors (Table 8-9).

Residual Impact

While the duration of impacts, with the implementation of best management practices, would reduce the effects to deep-sea benthic macrofauna, effects to potentially impacted pelagic seabirds, marine mammals and turtle populations would remain **long term**. The extent and intensity would decrease, however effects would remain **international**. The overall residual impacts would remain of **very high** significance (Table 8-9).



Table 8-9: Impact rating for ecological impacts due to a major offshore spill following a well blow-out (worst case scenario)¹³⁵.

Ecological Impacts due to Major Offshore Spill (Well Blow-Out)		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Drilling	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Very High	Very High
Intensity	High	Medium
Duration	Long term	Long term
Extent	International	International
Significance	Very High	Very High
Additional Assessment Criteria		
Probability	Unlikely	Unlikely
Reversibility	Partially Reversible	Partially Reversible
Loss of resources	High	High
Degree to which impact can be avoided	High	High
Mitigation Potential	-	High
Cumulative impacts	Unlikely	Unlikely

8.3.2.3 Mitigation and Management Measures

Table 8-10 lists the recommended mitigation measures to reduce impacts related to a major oil spill.

Table 8-10: Mitigation to reduce impacts of a major oil spill offshore.

No.	Mitigation measure	Classification
1	Develop a response strategy and plan (OSCP and BOCIP), aligned with the National OSCP, that identifies the resources and response required to minimise the risk and impact of oiling ¹³⁶ . This response strategy must take cognisance to the local oceanographic and meteorological seasonal conditions, local environmental receptors and local spill response resources. The development of the site-specific response strategy and plans must include the following:	Avoid / Abate on and off site / Restore
1.1	Assessment of onshore and offshore response resources (equipment and people) and capabilities for the duration of drilling and production operations, location of such resources (in-country or international), and associated mobilisation / response timeframes.	
1.2	Selection of response strategies that reduce the mobilisation / response timeframes as far as is practicable. Use the best combination of local and international resources to facilitate the fastest response.	
1.3	Updated oil spill modelling should there be any significant changes to the input data and well architecture to guide the final response strategy.	

¹³⁵ The highest impact ratings for the marine environment as well as across all faunal groups are shown in the table, indicating the maximum intensity, extent, duration, magnitude, and significance of the associated impact

¹³⁶ Note crude oil and marine diesel spill modelling conducted for the offshore Venus offshore project area indicates that shoreline oiling is not predicted under the simulated spill scenarios, with oil remaining well offshore.



No.	Mitigation measure	Classification
2	Develop an oiled wildlife response plan developed in collaboration with specialist wildlife response organisations with experience in oiled wildlife response. The plan should include detailed protocols on the collection, handling and transport of oiled marine fauna.	Abate on site / Restore
3	Undertake oil spill response exercises as specified in the OSCP.	Abate on site
4	Ensure oil spill equipment is mobilised and installed on vessels in line with the OSCP. Ensure a standby vessel is within 30 minutes of the drilling unit during well drilling operations, equipped for dispersant spraying and can be used for mechanical dispersion (using the propellers of the ship and/or firefighting equipment). It should have at least 5 m ³ of dispersant onboard for initial response. Dispersants and relevant responses to be used based on site/spill assessments, and as approved by relevant authorities (see point 6 on use of dispersants).	Abate on site / Restore
5	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g. capping stack, SSDI kit, surface response equipment (e.g. booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc. Dispersants and relevant responses to be used based on site/spill assessments (see point 6 on use of dispersants).	Abate on site / Restore
6	Use low toxicity dispersants that rapidly dilute to concentrations below most acute toxicity thresholds. Dispersants should be used cautiously, based on a site/spill specific assessment, and in line with Namibian regulations, including relevant authorities' approval.	Abate on and off site
7	As far as possible, and whenever the sea state and safety conditions permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill.	Abate on site
8	In the event of a major spill, implement methods to monitor and track the behaviour and size of the spill and optimise available response resources (e.g. Synthetic Aperture Radar (SAR), drift buoys, surveillance planes and satellite imaging).	Abate off site
9	Secure an insurance policy (by the Operator), including coverage for third party liability	Restore
10	Plan for and implement responses in terms of IPIECA-IOGP guideline document for the economic assessment and compensation for marine oil releases.	Restore

8.3.3 Impacts on Fisheries

8.3.3.1 Impact Description

There are several possible direct and secondary impacts of hydrocarbon spills on fisheries and mariculture operations:

- **Contamination of Product:** Oil spills in marine environments can lead to the contamination of fish and seafood products. Fish exposed to oil spills may absorb toxic substances, such as polycyclic aromatic hydrocarbons (PAHs), which can accumulate in their tissues (Gracia, Murawski, & Vázquez-Bader, 2020). This contamination poses significant risks to human health if contaminated fish are consumed. Studies have shown that PAHs can cause various health issues, including carcinogenic effects and reproductive toxicity (Short, 2017; Sandifer, 2021). Furthermore, the presence of oil residues can render fish visually unappealing and unsuitable for sale, leading to financial losses for fishing operations (Pascoe & Innes, 2018).
- **Avoidance of Contaminated Fishing Areas:** Impacts on fisheries livelihoods from oil spills have included periodic closure of fishing grounds for clean-up and



rejuvenation, long-term displacement from fishing areas to minimize pollution effects, lost jobs and unemployment, and lost seafood markets and revenues (Levy & Gopalakrishnan, 2010; Watts & Zalik, 2020). Following an oil spill, fishing vessels may avoid areas affected by contamination to prevent the capture of contaminated fish and ensure product safety (Gracia, Murawski, & Vázquez-Bader, 2020; Andrews, et al., 2021). This avoidance behaviour can disrupt fishing operations, as vessels may need to relocate to alternative fishing grounds, resulting in increased fuel costs and reduced catch efficiency (Gracia, Murawski, & Vázquez-Bader, 2020). Studies have documented the displacement of fishing activities away from oil-affected areas following major spills, such as the Deepwater Horizon oil spill in the Gulf of Mexico (Pascoe & Innes, 2018; Andrews, et al., 2021). Avoidance of contaminated areas may also lead to competition among fishing vessels for access to unaffected fishing grounds, exacerbating resource conflicts and management challenges. Additionally, fish species have been shown to avoid areas contaminated with PAHs (Schlenker, et al., 2019).

- **Loss of Marketable Product:** In cases where fish are exposed to oil spills and subsequently captured by fishing operations, there is a risk of product rejection due to contamination. Fish contaminated with oil residues may fail to meet quality standards set by regulatory agencies and seafood markets, resulting in the rejection of entire catch batches (Challenger & Mausest, 2011; Gracia, Murawski, & Vázquez-Bader, 2020). This rejection not only leads to financial losses for fishing operations but also undermines consumer confidence in seafood products sourced from affected regions. Studies have shown that seafood market demand can decline significantly in the aftermath of oil spills, particularly in regions directly impacted by contamination (Challenger & Mausest, 2011; Gracia, Murawski, & Vázquez-Bader, 2020). Loss of market access can have long-term economic consequences for fishing communities reliant on seafood trade.
- **Indirect Impact on Fisheries from Contamination:** The introduction of oil into marine ecosystems can lead to a range of adverse effects on phytoplankton. Petrogenic carbon may contain toxic compounds such as PAHs and heavy metals, which can inhibit photosynthesis, disrupt cellular processes, and impair growth and reproduction in phytoplankton species (Tang, et al., Ecological response of phytoplankton to the oil spills in the oceans, 2019; Gracia, Murawski, & Vázquez-Bader, 2020; Quigg, et al., 2021). Additionally, the physical presence of oil slicks can block sunlight, thereby reducing light availability for photosynthesis and further suppressing phytoplankton productivity species (Tang, et al., Ecological response of phytoplankton to the oil spills in the oceans, 2019; Gracia, Murawski, & Vázquez-Bader, 2020; Quigg, et al., 2021). The reduced productivity is likely to lead to reduced productivity on higher trophic levels, such as economically important fish species.

The Marine Ecology Impact Assessment for this ESIA provides a review of the effects of a large-scale oil blow-out on marine fauna and are summarised in Section 8.3.2 above.

8.3.3.2 Impact Assessment

Sensitivity of receptor

The drill area is located more than 300 km from the coast, and offshore from key fishing grounds and spawning areas. However, major oil spills could result in a large area being affected, potentially impacting fisheries which operate within the impacted area and vicinity of Venus offshore project area. Detrimental effects on ichthyoplankton (spawn products) on recruitments to fisheries would affect all fishing sectors. Following a conservative approach, the potential receptors (fisheries sector and associated resources) are considered to be of **high** sensitivity.



Magnitude

Based on modelling results summarised in Section 8.1, an unplanned, large-scale blow-out of 13-days duration is likely to result in offshore oil contamination of an **international** scale, crossing the Namibian maritime border and extending into international waters. Due to the prevailing wind and currents in the region, the surface is predicted to largely disperse in a north-westerly direction away from coastal fishing areas, spawning and recruitment areas, and mariculture operations. **The spill, however, is also not expected to reach South African waters.** Modelling results predicts 90% probability of oiling up to 85 km from release point and a 1% probability of oiling up to 326 km from the release point (Season 1) in a NW direction (CLS, 2025). Implementation of response measures has a very small effect on the area affected by an oil spill.

As previously discussed, large-scale impacts on fishing operations, such as area closures due to surface water contamination from oil or spill response chemicals, could affect access to fishing grounds. While the modelling for the Venus project area does not predict shoreline oiling, the potential for temporary disruption remains. Based on the extent of surface oiling with respect to the operations of Namibian fisheries, the following could be affected:

- Large pelagic longline;
- Tuna pole fisheries;
- Demersal longline;
- Demersal trawl fisheries; and
- Deep-Water trawl.

No impact is anticipated on the other fishery sectors, including mariculture operations within the vicinity of Walvis Bay and Lüderitz (based on modelled oil spill impact areas).

Not only is it likely that fishery resources would move out of an area, but operators would be forced to avoid polluted areas due to risk of fishing gear damage and product contamination. Table 8-11 lists the predicted area of contaminated fishing ground based on the modelled probability of surface oiling. The scenario which represents the highest likelihood of surface oil reaching inshore areas, and spreading to the east and northeast, was considered for the calculations (L1, Season 3). The oil spill simulations showed that surface oil had 90% probability of overlapping with the fishing grounds of the **large pelagic longline** fishery in Namibia, with less than 1% of the fishing grounds affected. Figure 8-5 shows the probability of surface oiling contours in relation to the fishing grounds of the large pelagic longline fishery in Namibia.

Surface oil had a 50% probability of overlapping with **tuna pole** fishing grounds, representing < 1 % of the fishing grounds within the Namibian EEZ. Simulated surface oil had 1% probability of overlapping with the **demersal trawl** and **demersal longline** fisheries.

The oil spill simulations showed that surface oil had a 1% probability of reaching the “Johnnies” deep water trawl QMA and overlapping with an estimated 3 770 km² (~14%) of the QMA area.

Since it is not expected for oil to reach South African waters, no impact on South African fisheries is anticipated.

Spawning areas for the main commercial fish species occur northward and inshore of the impacted area and general ichthyoplankton abundance is expected to be low. Based on the modelling results (extent and direction of drift), it is unlikely that a large spill would have a significant biological impact on the key spawning areas and the main commercial fish species. Due to the nature of the origin of these spawn products, they are expected to be widely dispersed and unlikely to significantly impact recruitment to the fishery, as a result the impacts would likely persist over the **short term**.



Table 8-11: Summary of potential oil spill contamination of fishing grounds (km²) based on stochastic modelling results (release position L1, season 3).

Sector	Oil spill contamination	Probability of surface oiling			
Namibia		1%	10%	50%	90%
Large Pelagic Longline	Contaminated surface area of fishing ground (km ²)	77 130	21 519	4 821	635
	Proportion of total fishing ground	15.79 %	4.41%	0.99%	0.13%
Tuna Pole	Contaminated surface area of fishing ground (km ²)	2 660	129	31	-
	Proportion of total fishing ground	14.88 %	0.72%	0.17%	-
Demersal Trawl	Contaminated surface area of fishing ground (km ²)	1 356	-	-	-
	Proportion of total fishing ground	1.65%	-	-	-
Demersal longline	Contaminated surface area of fishing ground (km ²)	763	-	-	-
	Proportion of total fishing ground	1.66%	-	-	-
Deep-Water Trawl	Contaminated surface area of fishing ground (km ²)	3 770	-	-	-
	Proportion of total fishing ground	14%	-	-	-

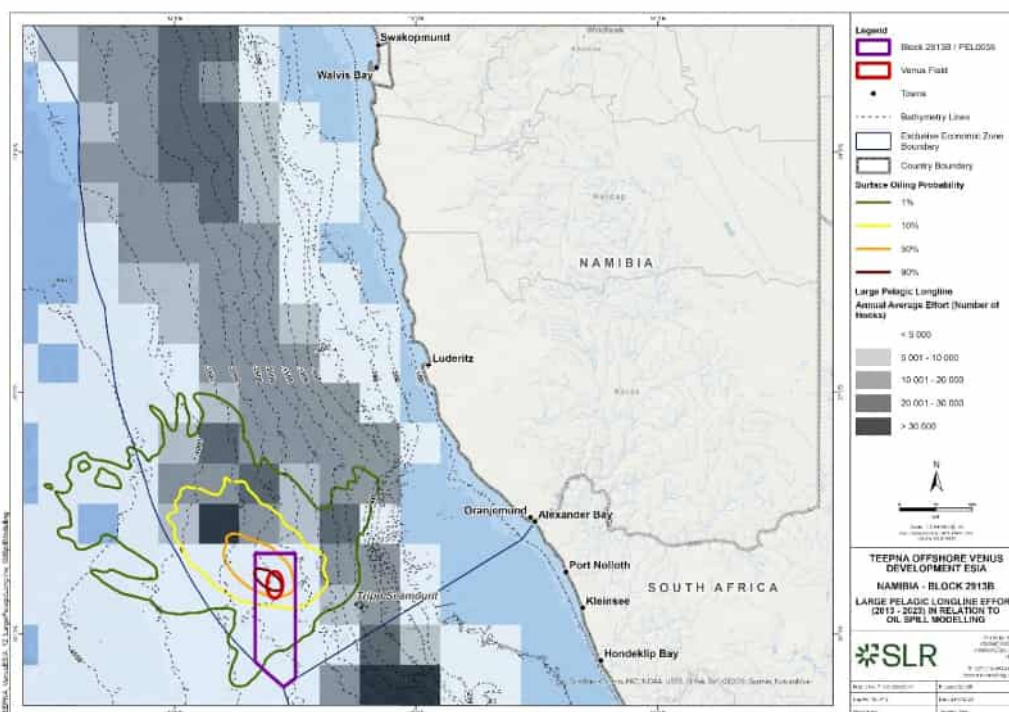


Figure 8-5: Probability of surface oiling as estimated by stochastic oil spill modelling in relation to effort expended by the large pelagic longline fishery (release position L1, Season 3).

Source: CLS Brasil (2025); DFFE; MAFWLR.

Assuming the worst-case scenario, the intensity of the potential impact of a major oil spill on these fisheries is **high**. The impacts would likely persist over the **short-term**, and extend **internationally**, crossing the EEZ boundary into the high seas. As noted above, based on oil spill modelling results Angolan and South African fisheries are not likely to be affected. The impacts of a blow-out can, therefore, be expected to be of **high** magnitude.



Significance

Based on the sensitivity of the receptor (high) and impact magnitude (very high), the overall potential impact to fisheries from a major oil spill is assessed to be of **very high** significance.

Residual Impact

With the implementation of the mitigation measures, which would reduce the intensity (medium) of the impact and the residual impact significance will reduce (**medium**).

Table 8-12: Impact to fisheries and mariculture from a major oil spill following a well blow-out (worst case scenario).

Impact to Fisheries and Mariculture from a Major Oil Spill (Well Blow-Out)		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	Drilling	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Very High	Very High
Intensity	High	Medium
Extent	International	International
Duration	Short Term	Short Term
Significance	High	Medium
Additional Assessment Criteria		
Probability	Likely	Should a well blow-out occur, it is likely that fisheries will be negatively affected.
Confidence	Medium	Oil spill modelling is a prediction based on metocean data from satellites. These methods have limitations.
Reversibility	Partially reversible	The impact is somewhat reversible due to response, mitigation measures and natural degradation of oil.
Loss of resources	High	A large spill is likely to cause substantial loss of resources.
Avoidance Potential	High	Communication to authorities and fisheries can allow for operational planning for the avoidance of the affected area.
Mitigation Potential	Medium	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Unlikely	Should multiple operators be drilling at the same time, then the risk of spills in the region may increase, however two blow-out events are considered highly unlikely, with the likelihood of potential cumulative impacts considered unlikely.

8.3.3.3 Mitigation and Management Measures

In addition to the best industry practices and project standards as well as mitigation measures outlined in Section 8.3.2.3, the following measures are recommended to mitigate and manage impacts related to an offshore well blow-out event.

- Plan for and implement responses in terms of International Petroleum Industry Environmental Conservation Association – International Association of Oil & Gas Producers (IPIECA-IOGP) guideline document for the economic assessment and compensation for marine oil releases



8.3.4 Impact on Fishing Livelihoods¹³⁷

8.3.4.1 Impact Description

The Fisheries Impact Assessment (see Section 8.3.3) considered the impact of an offshore crude oil spill on fisheries and mariculture and listed the direct and indirect impacts of a hydrocarbon spill as follows:

- Oil contamination of mobile finfish species, in particular of juveniles in nursery areas could result in displacement of species from normal feeding and protective areas as well as possible physical contamination and/or physiological effects such as clogging of gills, both of which would lead to fish mortality;
- Oiling of sessile or sedentary species would result in physical clogging on individuals, disturbance and or removal of habitat for these species and gill clogging for filter feeding species such as mussels, all of which is likely to result in mortality;
- Oiling of passively drifting spawn products (eggs and larvae) would result in their contamination and mortality (the extent of mortality would depend on the nature and extent of the contaminants) leading to reduced recruitment and loss of stock;
- Exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of sea water by the oil or for example the chemicals used for cleaning oil spills;
- Damage to fishing gear due to oil contamination; and
- Reduction in overall production rates of mariculture farms.

A 13-day blow-out has some probability of impacting on pelagic longline, Tuna pole, demersal trawl and longline fisheries (see Section 8.3.3).

According to the NSA, the fishing sector contributed between 2.9% to GDP in 2024, about 14% of the country's export revenue and is the source of employment for approximately 15 000 people.

The fishing sector is thus very important for the national and the coastal economies and livelihoods of Lüderitz and Walvis Bay.

8.3.4.2 Impact Assessment

Sensitivity of receptor

Fishing is an important livelihood and source of income in Namibia. However, the offshore fishing industry has a wide range of fishing locations, and the receptor (fishing industry) is deemed to have **medium** sensitivity.

Magnitude

The intensity of the impact, should it occur, is rated as **high** since there is a notable probability that the oil may reach more important fishing grounds in the Orange Seamount and Canyon Complex EBSA, affecting livelihoods more significantly.

The impact duration is rated as **short term** since any spill will in all likelihood be resolved in 30 to 45 days and fishing can continue. The loss in revenue and product is therefore likely to be limited.

¹³⁷ A spill at the Venus offshore area is not expected to impact coastal areas and hence the tourism sector and associated livelihoods.



The extent of the impact is rated as **regional** since the impact would affect the fishers who (plan to) operate in the affected area during that time.

Overall, the magnitude of the impact is rated as **medium**.

Significance

Based on the medium magnitude rating and medium sensitivity rating, the impact significance is considered **medium**.

Residual Impact

With the implementation of mitigation measures listed below the residual impact reduces to **very low**.

Table 8-13: Impact rating for impact of due to a major offshore spill following a well blow-out (worst case scenario) on fisheries livelihoods

Impact of Major Offshore Spill (Well Blow-Out) on Fisheries Livelihoods		
Impact Description	Impact on fishing and the fishing industry.	
Type	Direct	
Nature	Negative	
Phases	Drilling	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	Medium
Magnitude	Medium	Very Low
Intensity	High	Low
Duration	Short Term	Short Term
Extent	Regional	Regional
Significance	Medium -	Very Low -
Additional Assessment Criteria		
Probability of an impact if an unplanned event occurs, not probability of the unplanned event occurring	Possible	
Reversibility	Fully Reversible	
Loss of Resources	Low	
Avoidance Potential	High	
Mitigation Potential	Low	
Cumulative Impacts	Possible	

8.3.4.3 Mitigation and Management Measures

The mitigation measures in Section 8.2.4.3 also apply here.

8.3.5 Impact on Cultural Heritage

8.3.5.1 Impact Description

Any impact on the integrity of the coastal and marine ecosystem from a large oil spill could impact various aspects that make up people's ICH (indirect negative impact).

In the case of ICH, the *perceived impact* of a large oil spill on cultural receptors matters as well as the probability of impact on the receptors themselves.



8.3.5.2 Impact Assessment

Sensitivity of receptor

Overall, the sensitivity of receptors is deemed **low**, as per the discussion in Section 7.5.1.3.

Magnitude

Based on the results of the oil-spill modelling, it is unlikely that cultural heritage resources are impacted in the event of a well-blowout at the Venus offshore project area, since the oil would travel north and northwest. No shoreline oiling is predicted.

The magnitude of an impact from a well blowout on intangible and tangible coastal cultural heritage is assessed to be **low**. This is based on the following ratings:

- Intensity: **Low** as ICH and TH receptors are generally onshore in Namibia, not offshore, and thus outside the potential oil spill area of impact.
- Duration: **Medium-term**, as in a worst-case scenario the spill volume could be large and clean-up operations / recovery may take time; the use of marine life for subsistence, livelihood and cultural heritage will depend on how polluted or denuded those life forms are.
- Extent: **Regional** as the TH and ICH that does exist is relevant to stakeholders along most of Namibia's coastline.

Significance

The probability of an impact on cultural heritage *in the event of a blow-out* is of **very low** significance (Table 8-14).

Residual Impact

The proposed mitigations would reduce the intensity and thereby the overall magnitude of the unplanned event impact. This in turn would reduce the residual impact to **negligible** significance.

Table 8-14: Impact rating for deterioration of cultural heritage links to the sea due to a major offshore spill following a well blow-out (worst case scenario).

Impacts on Cultural Heritage due to Major Offshore Spill (Well Blow-Out)		
Type of Impact	Direct & Indirect	
Nature of Impact	Negative	
Phases	Drilling	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	Low	Very Low
Intensity	Low	Very Low
Duration	Medium term	Short term
Extent	Regional	Regional
Significance	Very Low	Negligible



Additional Assessment Criteria	
Probability	Unlikely - as cultural heritage resources are outside of areas modelled to be affected by oil (if a spill occurs).
Reversibility	Reversible
Loss of resources	Medium
Degree to which impact can be avoided	High
Mitigation Potential	High
Cumulative impacts	Unlikely

8.3.5.3 Mitigation and Management Measures

In addition to the mitigation measures listed in Section 8.3.2.3 additional mitigations include:

- Ensure that concerns and potential impacts on cultural heritage are addressed through the Stakeholder Engagement Plan set up for the project.

8.3.6 Impact on Atmospheric Pollutants and GHG Emissions

8.3.6.1 Impact Description

A well-blow out event will lead to an increase in atmospheric pollutants and GHG emissions through:

- Evaporative emissions from the associated oil spilled, and
- Fuel combustion by response vessels and aircraft.

These emissions have the potential to impact air quality, which may in turn have negative effects on human health (e.g. respiratory effects), and affect climate change due to additional GHG concentrations.

8.3.6.2 Impact Assessment

Sensitivity of receptor

The sensitivity to pollutants of potential receptors is rated as **very low**, as the coastline lies over 300 km from PEL0056/Block 2913B, well beyond the expected range of impact.

Magnitude

Emissions associated with the following blow-out/spill scenarios (simulated by CLS Brasil, see Section 8.1.1) were calculated (see Appendix P for further information). The modelling scenarios considered in this assessment include:

- Scenario O3 (Construction phase): Loss of 5 000 m³ of marine diesel at sea surface from a rig tank rupture.
- Scenario O4 (Drilling phase): Accidental release of 2 880 000 cubic meters per day (m³/day) of raw natural gas and 5 921 m³/day of crude oil from a well at the seafloor for 13 days (until the well is capped).



Table 8-15 presents evaporative emissions calculated in the Air Quality Impact Assessment Report (Appendix P) resulting from these unplanned events¹³⁸.

Table 8-15: Evaporative pollutants emissions for well blow-out, and marine diesel spill scenarios

	Scenario O3	Scenario O4 (Well blow-out)	
	Marine diesel	Raw natural gas	Crude oil
Fugitive release (m ³ /day)	-	2 880 000	5 921
Duration (days)	-	13	13
Total release (m ³)	5 000	37 440 000	76 973
Density (kg/m ³)	845	0.89	868
% of oil evaporated (maximum)	75.9% ^(a)	-	38.9% ^(b)
Total emissions (kg)	3 206 775	33 321 600	25 990 087
Proportion NMVOC by mass	99.8%	33.1%	91.1%
NMVOC emissions (kg)	3 201 159	11 018 488	23 664 308
Proportion benzene by mass	0.42%	1.54%	0.39%
Benzene emissions (kg)	13 352	513 006	100 749
Notes:			
(a) CLSBrasil MGO at Rig STO-A Season 2			
(b) CLSBrasil Blow-out STO-A Season 2			

Based on the above results an accidental well blow-out or MGO spill scenario will result in increases in ambient pollutant concentrations, with benzene identified as the primary pollutant of concern. Emissions would arise from two main sources: the release of volatile gases directly from the well and the evaporation of constituent compounds from the surface of the oil or MGO slick on the sea surface.

Pollutants will dilute and disperse based on meteorological conditions at the time of release, decreasing in concentration over distance. A meteorological overview of PEL0056/Block 2913B indicates moderate average wind speeds and a low frequency (1.8% - 7.6%) of onshore winds (i.e. from the NW, WNW, W, WSW, SW or SSW), capable of transporting pollutants toward the coastline. Given prevailing synoptic conditions, emissions from PEL0056/Block 2913B are expected to disperse seaward under normal and berg wind scenarios. The potential for surface-level transport of offshore emissions to the Namibian coastline that would also result in ambient pollutant concentrations of significance is considered very unlikely.

Overall, the impact magnitude of atmospheric pollutant emissions from a major oil spill following the unlikely event of a well blow-out is considered to be **very low**. This is based on the following ratings:

- **Very low intensity** as no exceedances of TCEQ guidelines would be expected at the coastline sensitive receptors located >300 km away.
- **Regional extent** reflecting the assessment of potential effects on coastal receptors located more than 300 km from PEL0056/Block 2913B.
- **Short-term duration** as a blown well would be capped within 13 days and any deterioration in air quality within the zone of influence is fully reversible once capping and clean up procedures conclude. While atmospheric pollutants will disperse

¹³⁸ The composition of the gas and oil (in molar percentages) was provided by TEEPNA and used to calculate the NMVOC and benzene proportions by mass (Amorcho and DeVries 1980). Worst-case (i.e. maximum evaporation rates provided by the oil spill modelling specialist CLS Brasil) for each scenario were applied.



rapidly, it is recognised that exposure-related health effects may be irreversible for sensitive individuals.

An estimated 715 235 tCO₂e of GHG emissions would result from a well blow-out as per the scenario described above. Natural gas releases account for most of the GHG emissions from this scenario (91%), followed by evaporation of the oil portion (8%), recovery and dispersant vessels (0.6%), and dispersant aircraft (0.4%). With regards to GHG emissions an unlikely well blow-out event would result in the release of ~1.3 time the average annual Venus project GHG emissions (517 422 tCO₂e/a; Table 7-55).

Significance

Overall, based on the **very low** magnitude and receptor sensitivity the significance of air quality impacts is rated **negligible**.

Residual Impact

Mitigation in the form of spill containment systems and contingency/emergency response procedures will reduce the probability of a blow-out/spill event occurring and streamline capping procedures to minimise the emission potential. Nevertheless, the impact intensity remains very low. The overall residual impact on air quality, therefore, remains unchanged (**negligible**).

Table 8-16: Impact significance ratings for pollutant emissions due to Major Offshore Oil Spill (Well Blow-Out) in Venus Offshore Project Area.

Increase in ambient air pollutant concentrations for onshore sensitive receptors		
Type of Impact	Direct & Indirect	
Nature of Impact	Negative	
Phases	Drilling	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Very Low	
Magnitude	Very Low	Very Low
Intensity	Very Low	Very Low
Duration	Short term	Short term
Extent	Regional	Regional
Significance	Negligible	Negligible
Additional Assessment Criteria		
Probability	Definite: Major oil spill will result in atmospheric emissions.	
Degree of confidence of the assessment	High	
Reversibility	Fully reversible: Impacts will cease once capping and clean up procedures conclude. However, it is noted that, health impacts associated with pollutant exposure is potentially irreversible.	
Loss of resources	None: Pollutants will disperse rapidly, and impact will cease on capping of the well.	
Degree to which impact can be avoided	None: The impact cannot be avoided.	
Mitigation Potential	None: Some mitigation (i.e. spill containment systems and contingency/emergency response procedures) will reduce the probability and minimise emission potential, however this will not affect the impact intensity, which is already very low.	
Cumulative impacts	Unlikely: Onshore ambient air quality may be impacted by existing sources such as road traffic, industrial activity, etc. Given the large	



	separation distance and infrequent onshore winds no guideline exceedances are anticipated. Therefore, the cumulative impact is conservatively assessed to be negligible.

8.3.6.3 Mitigation and Management Measures

In addition to the mitigation measures listed in Section 8.3.2.3 additional mitigations include:

- Investigate root causes after spills or near-miss events and implement corrective actions.
- Ensure emergency response plans for capping and containment consider potential air emissions (e.g. from surface gas/oil release and downwind exposure).

8.4 Gas Injection Line Rupture in the Venus Project Area

8.4.1 Source of Impact

An unlikely gas injection line rupture could result in the release of gas during the production phase of the project, as summarised in the table below.

Aspect	Drilling & Installation	Production	Decommissioning
Gas Injection Line Rupture		X	

Flowline leaks are found to be very rare, with an annual frequency of average pipeline failure of 0.00042 failures per km-year in 2012, a slight decrease from 0.00049 failures per km-year in 2001 (PARLOC, 2001, 2012, 2015) cited in (Kenny S. , 2018)¹³⁹. Gas injection line leaks are similarly expected to be rare/unlikely.

Failures are most likely during and shortly after pipeline construction and installation (where the cause may be attributed to inherent defects, errors, and omissions that are generally identifiable, and for the most part, preventable) and at the end of life period (due to fatigue) (Kenny S. , 2018).

The major hazards for offshore pipelines include corrosion failure (e.g., internal, external - ~50% for pipelines in the Gulf of Mexico), mechanical damage (e.g., trawl gear, anchors, dropped objects - ~15%), construction and material failure (e.g., weld, fitting, clamp - ~10%), natural hazards (e.g., wave, geotechnical – 10%), and other unknown factors (Kenny S. , 2018).

The northern and southern sections of the Venus offshore project areas subsea system will each have a gas injection line. Gas is compressed (injected) at pressure that exceeds the hydrostatic pressure at the seabed. As such, the rupture of a **gas injection flowline** would mean that gas escapes. The estimated gas loss related to a flowline rupture could amount up to 267 000 m³ before the compressor on the FPSO is shut down.

Project Controls

The FPSO production operations will be monitored and controlled through an Integrated Control and Safety System (ICSS). The ICSS will include process shutdown, emergency shutdown, and fire and gas systems to protect the facilities and personnel. Amongst other

¹³⁹ According to the UK Health and Safety Executive (HSE UK, 2011) there were about 1 978 incidents involving offshore hydrocarbon releases between 2001 and 2011 in the UK continental shelf (Aljaroudi, 2015), which has an offshore pipeline network of ~15 000 km (Gordon & Paterson, 2020).

As per the US Pipeline & Hazardous Materials Safety Administration (PHMSA, 2014), there were about 306 offshore pipeline incidents in the U.S in the past 10 years, of which 71 involved hydrocarbon releases (Aljaroudi, 2015), for an offshore pipeline network of ~45 000 km in the Gulf of Mexico (Kenny S. , 2018).



functions, the Safety Instrumented System (SIS) will implement functions for emergency shutdown, fire and gas detection, and process shutdown for FPSO and subsea systems. The SIS will provide detection, logic sequencing, and actuation of devices to place the facility in a safe state.

In addition, external visual inspections of the subsea equipment and pipelines via ROV will be implemented at periodic intervals (within a maximum frequency of 3 years) based on risk-based approach.

8.4.2 Impact on Marine Ecology / Environment

8.4.2.1 Impact Description

When natural gas is released from a ruptured subsea pipeline, it escapes in the form of bubbles that rise through the water column, forming a gas plume. As the gas ascends, it may dissolve partially into the water column or reach the surface, potentially forming a visible fountain. Water depth plays a critical role in this process, with deeper water significantly increasing the time it takes for the gas to reach the surface. This is due to increased hydrostatic pressure and longer travel distance, which also affect bubble size and density (Ellethy et al., 2021).

The release of natural gas into the marine environment, particularly from subsea pipeline ruptures, may have immediate and localized effects on water quality and associated pelagic fauna. These impacts are primarily driven by the physical disturbance of the seabed, the formation of gas plumes, and the chemical effects of dissolved gases and VOCs, such as methane, ethane, propane, and butane. These compounds can alter the physicochemical properties of the water column, and result in changes in oxygen levels, increased turbidity, and localized acidification (Masyutin et al., 2023; Pozzer et al., 2022).

The effects on marine fauna can range from acute mortality due to hypoxia or physical trauma (e.g., from blast waves or bubble plumes) to sub-lethal physiological stress, including oxidative stress, disruption of sensory and behavioural functions, and interference with reproductive processes. Fish and invertebrates may experience gill irritation, narcosis, or gas bubble disease when exposed to high concentrations of dissolved gases (Pozzer et al., 2022). Marine mammals, particularly those surfacing in contaminated areas, may suffer from respiratory distress due to inhalation of VOCs (Sanderson et al., 2023).

8.4.2.2 Impact Assessment

Sensitivity of receptor

The sensitivity of receptors to a gas line rupture is considered **medium**, reflecting the IUCN/conservation status of species that may occur within the Venus offshore project area and the broader affected water column, while also accounting for the mobility of and number of pelagic species that could be encountered within the area of impact.

Magnitude

The magnitude of a gas injection line rupture at the Venus offshore project area is considered **very low** for both the marine environment as well as all faunal groups. This is based on the following ratings:

- **Medium intensity** for pelagic species, as impacts to sensitive and/or vulnerable pelagic species may occur. However, being highly mobile, it is likely that pelagic species in the offshore habitat of the operations would avoid contaminated water and move away from the source before mortality occurs. **Low** intensity in the case of benthic fauna inhabiting unconsolidated sediments within offshore marine environments classified as 'Least Threatened' ecosystem types.



- **Short-term duration**, with the consequence of the effects ceasing following natural processes and recruitment, shortly after exposure.
- **Local extent**, with impacted areas likely reduced as compared to an unplanned large scale oil spill, owing to anticipated high evaporation rates as well as regional currents.

These ratings are discussed for each receptor below.

Impacts on Marine Environment

Impacts of potential line ruptures depend on several factors including the depth and pressure of the rupture site, current speed and direction as well as water column stratification (Ellethy et al., 2021).

While methane is relatively inert, other VOCs such as butane and propane can be toxic at elevated concentrations. These compounds may bioaccumulate in lower trophic organisms, potentially entering the food web and affecting higher predators, including commercially important fish species (Pozzer et al., 2022). Given the offshore location of the Venus project area and associated currents, the released gas due to a line rupture is expected to disperse rapidly, with similar dispersion towards the NW and W, based on predominant offshore currents and wind patterns. The extent of a potentially impacted area by an underwater gas injection line rupture is anticipated to be limited to the vicinity of the leakage (local), and not comparable to the extent of an unplanned large scale well blow-out, with the majority of the gas expected to rise to the surface and escape to the atmosphere within a limited area around the leak (INEOS, 2022)

The microbial oxidation of methane and other hydrocarbons can lead to localised hypoxia, and oxygen depletion particularly in stratified or poorly ventilated waters. This can stress or kill sensitive species and reduce habitat suitability for demersal fish and invertebrates (Pozzer et al., 2022). The bulk of the seawater in the area comprises South Atlantic Central Water (SACW), which has depressed oxygen concentrations (~80 % saturation value), with lower oxygen concentrations (<40 % saturation) occurring frequently due to nutrient remineralisation in bottom waters. The benthic communities will, therefore, be adapted to low oxygen conditions and will be characterised either by species able to survive chronic hypoxia, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. Given the anticipated short duration and limited spatial extent of reduced oxygen levels resulting from a gas release, significant long-term or chronic environmental impacts to the water column, and associated marine environment, are not expected.

Impacts on Benthic fauna

The physical release of gas from the seabed can disturb benthic habitats, particularly in soft sediment areas. In the European Bornholm Basin, for example, gas plumes from the Nord Stream rupture, at 75 to 100 m deep (notably shallower than the Venus offshore project area) caused sediment resuspension and localized mortality of benthic organisms (Masyutin et al., 2023). Notably, this pipeline rupture resulted in the release of an estimated 485 000 tonnes (~677.73 million m³) of gas over the entire leakage period (6 days), with three leaks occurring in total across the pipeline. This volume is significantly greater than what would be anticipated from an unplanned gas injection line leak at the Venus offshore project area. As a result, the potential impacts at Venus are expected to be considerably less severe than those observed during the large-scale Nord Stream leak in the Baltic Sea.

Nevertheless, a gas injection line rupture may disturb benthic habitats through both physical disruption and increased turbidity or sediment resuspension. Considering the availability of similar unconsolidated sediment habitat on and off the edge of the continental shelf the 'Least Threatened' status thereof, this disturbance of and reduction in benthic biodiversity in unconsolidated sediments would be of limited intensity (low intensity) owing to their short



generation times and availability of similar unconsolidated sediments within the broader PEL0056/Block 2913B, with impacts limited to the immediate area of the leak (site) and effects extending over the short-term.

Impacts on pelagic fauna

Several direct and indirect impacts on marine fauna have been identified as a result of gas line ruptures, including avoidance behaviour and displacement. Pelagic fish and marine mammals have been observed to avoid areas affected by gas plumes and elevated VOC concentrations. This can lead to temporary displacement from feeding or spawning grounds, potentially altering species distributions (Masyutin et al., 2023; Pozzer et al., 2022).

Adult pelagic fish and migratory marine mammals potentially encountered within the waters of the Venus offshore project area, and the potential impact zone, are expected to actively avoid contaminated waters, thereby reducing their vulnerability (ITOPF, 2014; Helm et al., 2015). Key spawning and recruitment areas for commercially valuable species, as well as cetacean critical habitats (e.g. nearshore calving and nursing grounds), lie well inshore of the Licence Block and Venus offshore project area. Given that the potential area of impact is anticipated to remain localised, effects to these inshore breeding, spawning and nursing grounds are not expected.

While the spatial extent of impact from a gas injection line leak may be limited, studies have documented mortality and sublethal effects on zooplankton and pelagic fish within the immediate vicinity of gas release (INEOS, 2022). Laboratory and field investigations have reported symptoms of intoxication in fish, including impaired movement, damaged cell membranes, and weakened muscle tone, following exposure to elevated concentrations of natural gas (Glabrybvob, 1983; AzNIRKH, 1986; Patin, 1993). As such, while exposure to elevated VOCs may result in mortality in impacted fish species, population recovery would occur over the short-term owing to high generation rates.

While the long-term ecological consequences of such gas releases are still being studied, preliminary assessments suggest that impacts are most severe in the immediate vicinity of the release and diminish with distance and time, due to dilution and volatilization. Considering the mobility of pelagic marine mammals likely to be encountered in the Venus offshore project area, resulting lethal effects (e.g. mortality) from exposure are expected to be limited, with subsequent population-level effects thus limited to the short-term.

Significance

Based on the sensitivity of the receptor (**medium**) and impact magnitude (**very low**), the overall potential impact to marine fauna and habitats from a gas injection line is assessed to be of **very low** significance (Table 8-17).

Residual Impact

While the implementation of the mitigation measures (Section 8.4.2.3), will assist to reduce the probability of a gas leak, as well as volume released, thereby reducing the area and number of individuals potentially impacted, the intensity (medium; moderate change, disturbance or discomfort caused to receptors that affects overall functioning) and thus residual impact significance remains unchanged.



Table 8-17: Impact rating for ecological effects from a subsea gas injection line rupture.

Ecological Impacts due to Gas Injection Line Rupture		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Medium	
Magnitude	Very Low	Very Low
Intensity	Medium	Medium
Duration	Short term	Short term
Extent	Local	Local
Significance	Very Low	Very Low
Additional Assessment Criteria		
Probability	Unlikely	Unlikely
Reversibility	Partially Reversible	Partially Reversible
Loss of resources	Low	Low
Degree to which impact can be avoided	High	High
Mitigation Potential	-	High
Cumulative impacts	Unlikely	Unlikely

8.4.2.3 Mitigation and Management Measures

Table 8-18 lists the recommended mitigation measures to reduce impacts related to a gas injection line rupture.

Table 8-18: Recommended measures to mitigate the impact of a gas injection line rupture.

No.	Mitigation measure	Classification
1	Use appropriate design, wall thickness with corrosion allowance and high-quality welding techniques to prevent pipeline rupture.	Avoid / Reduce at source
2	Design gas pipeline to allow for the undertaking of non-routine inline inspections when necessary.	Avoid / Reduce at source
3	Minimise internal corrosion through the use of corrosion inhibitors, methanol, scale inhibitor and water-based hydraulic fluid.	Avoid / Reduce at source
4	Use flow meters and monitor pressure/mass balance to detect any leaks.	Avoid / Reduce at source
5	Undertake external pipeline inspection every 3 years.	Avoid / Reduce at source
6	Install remote-controlled valves to isolate the ruptured segment quickly.	Abate on and off site
7	Ensure FPSO personnel are adequately trained in both accident prevention and immediate response.	Abate on and off site
8	Secure an insurance policy (by the Operator), including coverage for third party liability.	Restore



8.4.3 Impacts on Fisheries

8.4.3.1 Impact Description

Impacts on the marine environment and fauna due to a potential line ruptures depend on several factors including: the depth and pressure of the rupture site, current speed and direction as well as water column stratification. In addition, the timing of gas line ruptures in relation to key spawning periods may influence the relative impact on fisheries resources.

Fish and invertebrates may experience gill irritation, narcosis, or gas bubble disease when exposed to high concentrations of dissolved gases (Pozzer et al., 2022).

There are several possible direct and secondary impacts of subsea gas release due to a gas injection line rupture on fisheries and mariculture operations, including the potential displacement and avoidance of contaminated fishing areas.

Fish and other marine species have been observed to avoid areas affected by gas plumes and elevated concentrations of VOCs, which can result from subsea gas releases. This avoidance behaviour may lead to the temporary displacement of species from key feeding or spawning grounds, potentially altering species distributions and reducing catch rates and availability to fisheries (Pozzer et al., 2022; Masyutin et al., 2023). Evidence of such displacement was documented by Masyutin et al. (2023) following the Nord Stream pipeline rupture in the Baltic Sea. Notably, this pipeline rupture resulted significantly greater volume of released gas than what would be anticipated from an unplanned gas injection line leak at the Venus offshore project area. As a result, the potential impacts at Venus offshore project area are expected to be considerably less severe than those observed during the large-scale Nord Stream leak in the Baltic Sea. Nevertheless, the study reported that ichthyofauna and marine mammals likely vacated the affected area in response to oxygen displacement and water quality degradation caused by the gas release.

In addition to ecological impacts, such events may necessitate the periodic closure of contaminated fishing grounds, leading to reduced access, loss of catch, and associated loss of income for affected fisheries.

In cases where fish are exposed to VOCs and subsequently captured by fishing operations, there is a risk of product rejection due to contamination. While methane is relatively inert, other VOCs such as butane and propane can be toxic at elevated concentrations. These compounds may bioaccumulate in lower trophic organisms, potentially entering the food web and affecting higher predators, including commercially important fish species (Pozzer et al., 2022). Consequently, fish contaminated with high levels of VOCs may fail to meet quality standards, leading to a loss of marketable product.

In addition to direct impacts on fisheries operations, indirect impacts on fisheries due to impacts to food webs and trophic structure, through toxicity and bioaccumulations, as well as localized hypoxia and oxygen depletion may reduce productivity, leading to possible reduced productivity in higher trophic levels including commercially important fish species.

8.4.3.2 Impact Assessment

Sensitivity of receptor

As described in Sections 8.2.3.2 and 8.3.3.2 the sensitivity of receptors to a gas line rupture is similarly considered **high**.

Magnitude

Large scale effects on fishing operations would include area closures and exclusion of fisheries from areas that may be polluted or closed to fishing due to contamination of surface waters by chemicals. Not only is it likely that fishery resources would move out of the



contaminated area, but operators may be expected to avoid polluted areas due to risk of product contamination.

Given the offshore location of the Venus project area and associated offshore currents, the gas rupture is expected to disperse rapidly, with similar dispersion towards the NW and W, based on predominant offshore currents and wind patterns, as modelled for offshore hydrocarbon spills. The extent of a potentially impacted area by an underwater gas injection line leak is anticipated to be largely limited to the vicinity of the leakage (**local**), and not comparable to the extent of the potentially impacted area of an unplanned large scale well blow-out, with the majority of the gas expected to rise to the surface and escape to the atmosphere within a limited area around the leak (INEOS, 2022)

Considering the impacted area is expected to spread in a general northwest to westerly direction, the fisheries most likely impacted by a gas injection line rupture includes the **large pelagic longline**, with possible overlap with **tuna pole** and possibly **demersal trawl and longline fisheries**, although highly unlikely. Potential impacts to these fisheries are anticipated to be reduced, as compared to those outlined in Table 8-11, owing to the reduced gas release as well as high evaporation rates anticipated. No impacts to nearshore SSF operations and mariculture operations are anticipated.

Spawning areas for the main commercial fish species occur northward and inshore of the impacted area and general ichthyoplankton abundance is expected to be low. Based on the modelling results (extent and direction of drift), it is unlikely that a large spill would have a significant biological impact on the key spawning areas and the main commercial fish species. Thus, recruitment to the fishery is unlikely to be impacted and any impact to these sectors would likely persist over the short term.

The intensity of the potential impact of a gas line rupture on fisheries is **medium**. Considering the potential release of 267 000 m³ before the compressor on the FPSO is shut down, the impacts to fisheries likely persist over the **short term** (< 1 year) and possibly extend **locally** (i.e. restricted to area of leak). The impacts of a gas reinjection line rupture and instantaneous release can therefore be expected to be of **very low** magnitude.

Significance

Based on the sensitivity of the receptor (high) and impact magnitude (very low), the overall potential impact to fisheries and mariculture from a gas injection line rupture is assessed to be of **low** significance.

Residual Impact

With the implementation of the mitigation measures, which would reduce the intensity (low) of the impact, the residual impact will remain **low**.



Table 8-19: Impact to fisheries and mariculture from a gas injection line rupture.

Impact to Fisheries and Mariculture from a Gas Injection Line Rupture		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	High	
Magnitude	Very Low	Very Low
Intensity	Medium	Low
Extent	Local	Local
Duration	Short-term	Short-term
Significance	Low	Low
Additional Assessment Criteria		
Probability	Likely	Should a flowline rupture occur, it is likely that fisheries will be negatively affected.
Confidence	Medium	Results are based on the literature and oil spill modelling results of a well blow out event. These methods have limitations.
Reversibility	Partially reversible	The impact is somewhat reversible due to response, mitigation measures and natural degradation of gas.
Loss of resources	High	A large spill is likely to cause substantial loss of resources.
Avoidance Potential	High	Communication to authorities and fisheries can allow for operational planning for the avoidance of the affected area.
Mitigation Potential	Medium	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Possible	Should multiple operators be drilling or producing at the same time, then the risk of spills in the region may increase and these impacts could be exacerbated.

8.5 Nearshore Surface Hydrocarbon (Marine Diesel and / or Crude Oil) Spill

IMPORTANT NOTES:

- Shoreline oiling was observed across all seasons for both a crude oil and marine diesel spill scenario in the nearshore transshipment area.
- Although a hydrocarbon spill during these operations is unlikely, the impact probability presented below assumes that a spill has occurred.

8.5.1 Source of Impact

The project activities that could result in the accidental release of hydrocarbons (light crude oil or marine diesel) are summarised below.

Aspect	Drilling & Installation	Production	Decommissioning
Light crude oil spill due to oil transfer from DPST to conventional tanker		X	
Marine diesel spill due to loss from vessel tank or bunkering	X	X	X



The greatest environmental threat from nearshore transshipment operations is a potential loss of crude oil and /or marine diesel at the nearshore buoy.

Project Controls

The same project controls as outlined in Section 8.2.1 will be implemented to reduce the impacts of a potential, unplanned, operational spill at the nearshore.

In addition, a 1.7 km safety exclusion zone around the nearshore transshipment buoy will be enforced.

8.5.2 Impact on Marine Ecology / Environment

8.5.2.1 Impact Description

Hydrocarbons spilled in the nearshore marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage). If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

8.5.2.2 Impact Assessment

Sensitivity of receptor

Coastal and pelagic seabirds, fish, turtles, and cetaceans are highly sensitive to hydrocarbon spills, with several species, likely to be encountered within the broader project vicinity listed as 'Endangered' or 'Vulnerable' (see Section 8.2.2.2 and 8.3.2.2 for further information).

Marine mammals likely to be encountered within the shallower, coastal waters in the vicinity of the nearshore transshipment area include Humpback whales various dolphin species (e.g. Dusky dolphin, Heaviside's dolphin and common dolphin) and seals (e.g. Cape fur seal), with a higher abundance of individuals likely to be encountered within the nearshore transshipment area, as compared to the offshore Venus offshore project area, and with a potential overlap with nearshore feeding, breeding and migratory habitats.

In addition, coastal ecosystem types and key wetlands potentially impacted by a nearshore hydrocarbon spill are highly vulnerable to water pollution and potential shoreline oiling. Specifically, the nearshore transshipment zone lies within the vicinity of Walvis Bay, a region recognised as an IBA (Section 5.6.3) due to its exceptional avian biodiversity.

The nearshore transshipment operations take place within the biologically important Namib Flyway EBSA, with the Walvis Bay lagoon located to the south and within the potentially impacted area.

The overall sensitivity of marine fauna, both benthic, pelagic and coastal, as well as coastal and wetland ecosystems to a hydrocarbon spill is therefore considered **very high**.

Magnitude

The magnitude of a nearshore hydrocarbon spill during transshipment is considered **very high** for both the marine and coastal environment as well as all faunal groups (benthic and pelagic). This is based on the following ratings:

- **High intensity**, as the oil spill may impact sensitive and/or vulnerable pelagic and coastal habitats and species.
- **Long-term duration**, with the consequence of the hydrocarbon spill effects extending beyond the impact exposure yet ceasing following natural processes and recruitment.



- **Regional extent**, as modelling results show that the oil probability on the surface extends up to 101 km for the release point, with shoreline oiling affecting the coastline up to 263 km north of Walvis Bay.

These ratings are discussed for each receptor below.

Impacts on coastal habitats and communities

Based on modelling results, shoreline oiling is observed across all seasons for both nearshore spill scenarios (CLS, 2025), affecting the coastline between 263 km north of and 26 km south of Walvis Bay in the case of a crude oil spill. The extent is reduced for a marine diesel spill, affecting the coastline between 83 km north and 22 km south of Walvis Bay. Shoreline oiling can occur as quickly as <2 hrs (in Season 4) under both spill scenarios.

While only a portion of the hydrocarbon spilled may reach the shoreline, even small amounts can cause widespread contamination of coastal habitats and ecosystems, including estuaries and wetlands. Landfall of oil is generally considered an unfavourable situation as stranding causes a multitude of new environmental impacts compared to those experienced in the offshore environment.

Following a spill, weathered oil can appear on beaches as tar mats, and despite clean-up efforts can remain on sandy shorelines for a number of years, as smaller oil fragments and mats can become buried in the sediments to depths of over a metre through accretion (Fernández-Fernández, Bernabeu, Bouchette, Rey, & Vilas, 2011). Heavy weather conditions and littoral drift can re-expose these deposits, redistributing the oil particles and mats along the shore and resulting in the re-oiling of beaches even three years after the initial oil stranding (Bejarano & Michel, 2010; Beyer, Trannum, Bakke, Hodegeson, & Collier, 2016). On sheltered sandy beaches, buried oil can persist for decades (Bejarano & Michel, 2010; Bernabeu, et al., 2013). Overall, oil burial and persistence are strongly influenced by beach erosion and deposition cycles, with the grain characteristics and degree of shoreline exposure influencing the penetration and weathering of the oil.

From the comprehensive review of Bejarano and Michel (2016) it becomes evident that oil spilled on beaches results in significant declines in abundance, biomass and diversity of meiofaunal and macrofaunal communities, with recovery of macrofaunal communities typically occurring at between 2-5 years but with recovery of burrowing and long-lived species potentially taking up to 10 years on heavily oiled beaches. Recovery of meiobenthos is typically more rapid.

In the case of oiling of rocky shores, natural recolonisation begins after the processes of physical and chemical degradation have started, with recovery of benthic communities typically occurring within three years. In high-energy environments, where the natural removal and degradation of oil is relatively rapid, non-intervention is considered the most effective means of ensuring recovery. Alternatively, adding nutrients to the affected area enriches oil-degrading microorganisms thereby enhancing biodegradation of the oil while preserving the substratum (Serrano et al., 2011). Sessile and motile mussels and filter-feeders in particular are susceptible to ingestion of oil in solution, in dispersion or adsorbed on fine particles (Saadoun, 2015).

Notably, onshore oiling may accumulate in the Namib Flyway EBSA, when released from the nearshore spill location across all seasons. The main coastal features in the EBSA includes two sheltered bays: Sandwich Harbour and Walvis Bay. Based on oil spill modelling results there is a 1% probability of hydrocarbons within the water column and on the surface reaching the inshore waters within the vicinity of the Walvis Bay wetland, across all seasons, and a 1% probability of hydrocarbons within the water column spreading towards Sandwich Harbour Bay and the associated wetland in Season 3, only. Shoreline oiling was found to occur within the sensitive Walvis Bay Wetlands Ramsar site.



Based on the modelling results, shoreline oiling may affect inshore (east), northern and southern stretches of the coast, potentially impacting the confirmed Walvis Bay IBA and the proposed Walvis–Swakopmund IBA. These areas support nesting, feeding, and roosting habitats for various pelagic and coastal seabird species, having been designated for the protection of several key species, including the Cape Cormorant, Kelp Gull, and breeding populations of Damara and Caspian Terns. As such potential shoreline oiling and associated impacts to these key roosting, feeding and nesting sites may have population-level impacts, extending beyond the duration of the oiling effects (i.e. long-term). (see 'Impacts on pelagic fauna' below for further information on potential impact to pelagic and coastal seabirds).

Overall based on oil spill modelling results the probability of hydrocarbons within the water column and on the surface will spread over and potentially impact/effect the 'Least Threatened' Kuiseb inshore, immediate sandy beach and reflective sandy beach ecosystem types, as well as the 'Endangered' Kuiseb lagoon coast and mixed shore ecosystem types.

Impacts to these coastal habitats and associated coastal and pelagic species are therefore considered to be of **high** intensity.

Impacts on Marine Environment

As described in Section 8.2.2 and 8.3.2, hydrocarbon spills can have a range of direct and indirect effects on the marine environment. The extent and severity of these effects are influenced by environmental conditions such as sea state, temperature, and currents, which govern the transport, dispersion, and persistence of the spilled hydrocarbons.

Oil spill modelling results suggest that a hydrocarbon release could spread across the Namib Flyway EBSA, identified as an important area for marine mammals, providing critical habitat for feeding, migration, and breeding. The EBSA also supports a wide range of seabirds, shorebirds, and waterbirds some of which are threatened species. Its high productivity is largely driven by the Lüderitz upwelling cell, located to the south of Walvis Bay and the nearshore transshipment area, which transports nutrient-rich waters northward through longshore drift and prevailing onshore winds, resulting in the central Namibian coast (including Walvis Bay and the EBSA) being one of the most productive areas in the Benguela Current system.

Given its ecological significance, any hydrocarbon spill in this EBSA could have **high** intensity impacts on marine biodiversity, particularly on vulnerable marine mammal populations.

Impacts on Plankton

As outlined in Section 8.2.2 and 8.3.2, hydrocarbon spills can significantly affect plankton communities, with impacts varying by species and life stage.

The timing of an oil spill plays a critical role in determining its impact on plankton and the early life stages of pelagic fish. Spills that coincide with peak spawning periods, particularly in spring and summer, can result in high mortality rates and reduced recruitment for key species (Baker, Clark, Kingston, & Jenkins, 1990; Langangen, et al., 2017). While natural environmental variability also influences recruitment success, both fresh and weathered oil have been shown to be toxic to fish eggs and larvae (Teal & Howarth, 1984; Neff, 1991; Esbaugh, et al., 2016).

As outlined above the nearshore transshipment area lies within a region of high phytoplankton abundance owing to coastal upwelling and longshore drift (Figure 5-17, Section 5.5.3.1). Based on modelling results, a potential crude oil as well as marine diesel spill at the nearshore transshipment buoy was found to spread predominantly to the north and south, and over nearshore spawning and recruitment areas for commercially important fish species such as sardine, horse mackerel, kob and monk fish (Figure 5-22). As such impacts to these highly productive regions and key spawning and recruitment area would be of **high** intensity.



Impacts on Pelagic Fauna

As outlined in Section 8.2.2 and 8.3.2, adult **pelagic fish** are generally resilient to oil spills due to their mobility and the rapid dilution of hydrocarbons in open water. However, in severe coastal spills, inshore and benthic species may suffer lethal effects, particularly if oil coats their gills. Sub-lethal impacts, such as physiological stress, behavioural changes, and bioaccumulation of toxic compounds like PAHs can also occur (Thomson, et al., 2000; Beyer, et al., 2016).

As outlined above, hydrocarbons are modelled to disperse over key inshore spawning and recruitment areas for commercially valuable species within the vicinity of the nearshore spill location. In the crude oil deterministic modelling scenario, the highest concentrations reached up to 3 000 ppb during Season 3, within the upper 15 m of the water column.

Chronic and acute oil pollution is a significant threat to both **pelagic and inshore seabirds**, many of which breed and feed along and offshore of the central Namibian coastline, which could be impacted through a nearshore hydrocarbon spill. Even small concentrations of oil transferred from adult birds to the eggs can cause embryo mortalities and significantly reduce hatching rate. Oil spills can thus affect shorebirds through direct acute mortality, as well as indirectly or long-term through sub-lethal effects on bird health and behaviour. Habitat degradation of distant feeding or breeding areas may affect bird populations in ways that carry over to subsequent seasons. As noted above, shoreline oiling may impact the Walvis Bay and proposed Walvis–Swakopmund IBAs and associated roosting, feeding and nesting sites, with coastal breeding sites and guano platforms/islands within less than 20 km of the nearshore transshipment area, thus leading to potential population-level impacts (see 'Impacts on coastal habitats and communities').

As outlined in Section 8.2.2 and 8.3.2, sea **turtles**, particularly hatchlings and surface-dwelling individuals, are vulnerable to oil spills. Although nesting beaches are located far from the project area, turtles migrating through or carried by ocean currents may be exposed.

The three turtle species most likely to be found within the nearshore waters and potential oil spill impact area are the Leatherback (*D. coriacea*), Loggerhead (*C. caretta*), and Green (*C. mydas*) turtles. Global Leatherback and Loggerhead turtle populations are listed as 'Vulnerable,' and the Green turtle is classified as 'Endangered' by the IUCN, while Leatherback subpopulations (Southwest Indian and Southwest Atlantic) possibly encountered within the Namibian waters are classified as 'Critically Endangered'. As such these species may be impacted by a potential oil spill, with potential population-level effects considered to be high owing to their low population numbers.

Fur seals and sea lions (pinnipeds), are expected to be particularly vulnerable as oil would clog their fur and depending on how they maintain their core body temperature, they may die of hypothermia.

Population-level impacts are likely if spilled oil reaches the haul-out sites and rookeries where seals rest or annually mass to breed. An ill-timed large spill in the vicinity of a fur seal breeding colony would thus likely be devastating

A number of Cape fur seal colonies occur within the broader project area. The closest northern Namibian seal colony and haul out sites to the nearshore transshipment operations, are located at Conception Bay, over 120 km south, and Cape Cross, over 100 km north. Based on oil spill modelling results, there is a 1% probability of crude oil reaching inshore waters up to 101 km from the spill location in Season 2. In addition, shoreline oiling was modelled to extend between 83 km (marine diesel spill) to 263 km (crude oil spill) to the north of Walvis Bay, thus reaching Cape Cross. As such, direct impacts from a nearshore hydrocarbon spill may occur, with oil potentially overlapping with the offshore foraging ranges of Cape fur seals, as well as directly impacting haul out sites and colonies, located across the central Namibian coastline, and in the vicinity of the release point.



The impact of oil pollution on local and migrating **cetacean** populations will depend on the timing and extent of the spill. It is assumed that the majority of cetaceans will be able to avoid oil pollution (Helm, et al., 2015), though effects on the population could occur should the region of avoidance be critical to population survival. Oil pollution in areas of cetacean critical habitat (areas important to the survival of the population), such as the extreme near-shore calving / nursing grounds, could be the most likely to result in population impacts.

Specifically, the potential for oil disrupting reproductive behaviour is a concern for inshore reproducers, particularly in highly social species, where the disruption of social groups through loss of some key individuals could impact reproductive success over the long-term (see for example Matkin, et al., 2008). For example, populations of coastal-oriented odontocetes that show strong site fidelity restricted to nearshore habitats could be significantly impacted by a nearshore spill. If those habitats were oiled, the animals would experience both acute and chronic exposure through their respiratory system and through ingestion of oil-contaminated prey. This may have long-term effects on population structure and size (Matkin, et al., 2008; Beyer, et al., 2016; Frasier, et al., 2019). Marine mammals likely to be encountered within the shallower, coastal waters of the nearshore transshipment zone includes various dolphin species (i.e. odontocetes), such as the Dusky dolphin, Heaviside's dolphin and Common dolphin. Therefore, dolphins migrating and/or breeding along the coastline and in the vicinity of the operations may be impacted by a nearshore hydrocarbon spill, with potential long-term population impacts.

Humpback whales migrating along the Namibian coastline may be encountered within the nearshore transshipment area, and associated impact zone. However, suggested Humpback whale summer feeding grounds occur in the vicinity of Lüderitz, with nearshore calving/nursing grounds in Elizabeth Bay, south of the modelled nearshore hydrocarbon spill impact zone.

For highly mobile, wide-ranging species, the contact with an oil spill would be relatively brief.

Significance

Whilst there is a remote chance of a nearshore hydrocarbon spill taking place, the impact on marine fauna, coastal and pelagic communities before mitigation is considered to be of **very high** significance, based on the highest impact magnitude (**very high**) and **very high** sensitivity ratings (Table 8-20).

Residual Impact

While the duration of impacts, with the implementation of best management practices, would likely reduce the population-level effects to pelagic fish and larvae, coastal and pelagic seabirds, marine mammals and turtles, with recovery occurring over the **medium** term. The extent would decrease, however effects would remain **regional**. The overall residual impacts would remain of **very high** significance (Table 8-20).



Table 8-20: Impact rating for nearshore hydrocarbon spill ¹⁴⁰.

Ecological Impacts due to Nearshore Hydrocarbon Spill		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Very High	
Magnitude	Very High	High
Intensity	High	High
Duration	Long term	Medium term
Extent	Regional	Regional
Significance	Very High	Very High
Additional Assessment Criteria		
Probability	Unlikely	Unlikely
Reversibility	Partially Reversible	Partially Reversible
Loss of resources	High	High
Degree to which impact can be avoided	High	High
Mitigation Potential	-	High
Cumulative impacts	Unlikely	Unlikely

8.5.2.3 Mitigation and Management Measures

Table 8-21 lists the recommended mitigation measures to reduce impacts related to a nearshore hydrocarbon spill.

Table 8-21: Mitigation to reduce impacts of a nearshore hydrocarbon spill.

No.	Mitigation measure	Classification
1	Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.	Abate on and off site
2	As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill.	Abate on and off site
3	Use low toxicity dispersants as approved by relevant Namibian authorities.	Abate on and off site
4	Ensure operating limits and restrictions are defined for offshore bunkering operations. Such operating limits shall be based upon a risk assessment, which takes into account weather conditions, sea conditions, activities to be performed and vessel characteristics. Connection and start of offloading, transshipment or bunkering operations shall only be conducted during daylight. Ensure bunkering operations are only performed after approval of both captain / Master involved.	Avoid / Reduce at source

¹⁴⁰ The highest impact ratings for the marine environment as well as across all faunal groups are shown in the table, indicating the maximum intensity, scale, duration, consequences, and significance of the associated impact



No.	Mitigation measure	Classification
5	Ensure shoreline response equipment is on standby during transshipment operations (e.g. response trailers, shoreline flushing equipment, shoreline skimmers, storage tanks, shoreline booms, skirt booms, shore sealing booms, etc.) to cover key locations for the full duration of the production phase to protect sensitive coastal habitats and areas.	Avoid / Abate on and off site / Restore
6	Develop and prioritize intervention plans for the most sensitive areas to minimise risks and impacts and integrate these into the response strategy and associated plans.	Avoid / Abate on and off site / Restore
7	Develop and implement an oiled wildlife response plan in collaboration with specialist wildlife response organisations with experience in oiled wildlife response. The plans should include detailed protocols on the collection, handling and transport of oiled marine fauna.	Avoid / Abate on and off site / Restore
8	Use breakaway couplings with shut-off valves during transshipment operations. As a result, any spill during transshipment is likely to be of a relatively small volume before it is detected and stopped.	Avoid / Reduce at source
9	Secure an insurance policy (by the Operator), including coverage for third party liability.	Restore
10	Plan for and implement responses in terms of IPICEA-IOGP guideline document for the economic assessment and compensation for marine oil releases.	Restore

8.5.3 Impacts on Fisheries and Mariculture

8.5.3.1 Impact Description

The release of hydrocarbons (marine diesel and/or crude oil) into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna, as described in Sections 8.2.3 and 8.3.3. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

Mariculture activities are highly sensitive to water quality variability. The effects of hydrocarbon spills would potentially have the greatest impact on sessile filter feeding (e.g. mussels and oysters) and grazing species (e.g. abalone) resulting in mortality through physical clogging and or direct absorption. For shore-based collection of mussels, oysters and any (other) mariculture activities, any pollution associated with oil and/or diesel reaching the shoreline could be devastating for the industry resulting in complete loss of stock. Oil reaching the shoreline could contaminate any water intake for aquaculture activities at the various shore-based aquaculture facilities referenced in Section 5.7.5.4. Any discharge into the Walvis Bay area may affect both natural fish populations and bivalve stocks as well as mariculture. Impacts on juvenile and adult fish can be lethal, as gills may become coated with oil. The result of which would cause severe decrease in overall production rates of any farm within the vicinity of the contaminated area.

As outlined in Sections 8.2.3 and 8.3.3 there are several possible direct and secondary impacts of hydrocarbon spills on fisheries and mariculture operations, including; contamination of products, avoidance of contaminated fishing areas, loss of marketplace product as well as indirect impacts through fisheries and resource contamination.

8.5.3.2 Impact Assessment

Sensitivity of receptor

The nearshore transshipment area is located in coastal waters between Walvis Bay and Swakopmund, approximately 20 km north of Walvis Bay. This area is approximately 5 km from shore in water depths of 30 to 40 m.



Nearshore hydrocarbon spills could result in a large area being affected, potentially impacting the nearshore spawning and recruitment areas, fisheries which operate closer to the coast (e.g. small-scale fishers and linefish) and coastal mariculture operations. Detrimental effects on ichthyoplankton (spawn products) and recruitments to fisheries would affect all fishing sectors. The potential receptors are thus considered to be of **very high** sensitivity.

Magnitude

Based on the modelling results summarised in Section 8.1.1, an unplanned, hydrocarbon spill during nearshore transshipment operations is likely to result in oil or marine diesel contamination of a **regional** scale, extending to the north and south of the nearshore transshipment zone (with greater dispersion towards the north) of the spill location overlapping with coastal fishing areas, spawning and recruitment areas, and mariculture operations.

A hydrocarbon spill in nearshore waters would have significant consequences for fisheries and mariculture activities. Key impacts would include the closure of affected areas and the suspension of fishing, farming, and harvesting operations. These disruptions would extend to nearshore fisheries, coastal mariculture facilities, and traditional (SSF) harvesting grounds.

In the context of Namibian coastal operations, the extent of surface and water column contamination could severely affect several sectors. These include mariculture activities within the Port of Walvis Bay, SSFs operating in nearshore zones, and the harvesting of shellfish and seaweed by SSF women along the coastline. Additionally, commercial linefish operations may also experience substantial disruptions due to contamination and access restrictions.

Not only is it likely that fishery resources would move out of an area and/or be negatively impacted through smothering and toxic impacts, but operators and artisanal fishermen and women would be forced to avoid polluted areas due to risk of fishing gear damage and product contamination. SSF fishers are considered to be more vulnerable to the potential impacts of a nearshore hydrocarbon spill as compared to commercial fisheries operations, with fishermen and women reliant on resources for income as well as food security yet limited in their ability to focus operations outside of the impacted area.

The oil spill simulations showed that surface oil had 1% probability of extending into the Walvis Bay port/harbour area, in which **mariculture operations** (as well as fish factories) take place (Section 5.7.5.4). In addition, neighbouring areas identified for potential future mariculture operations, as outlined in Section 3.5, are likely to be impacted should these become operational. Table 8-22 lists the predicted area of contaminated **commercial fishing** ground based on the modelled probability of surface oiling. The scenario which represents the greatest surface oiling was considered for the calculations (L2, Season 2, crude oil spill). The oil spill simulations showed that surface oil had a 30% probability of overlapping with the fishing grounds of the linefish fisheries in Namibia. In these cases, less than 0.05% of the fishing grounds were affected. Considering the largest modelled surface area spread, surface oiling had a 1% probability of overlapping with ~3% of linefish fishing grounds.

In addition to impacts on linefish fishing grounds, nearshore fishing grounds used by boat-based **SSF** may be impacted. Furthermore, coastal shellfish, mussels and oysters, harvested by SSF, particularly women, would be impacted due to predicted shoreline oiling, with the largest stranded mass on the coast (51.5 t/km) occurring in Season 3, resulting in a



Table 8-22: Summary of potential oil spill contamination of fishing grounds (km²) based on stochastic modelling results (release position L2, Season 2, crude oil spill).

Sector	Oil spill contamination	Probability of surface oiling		
Namibia		1%	10%	30%
Line Fish	Contaminated surface area of fishing ground (km²)	1947	164	12
	Proportion of total fishing ground	3.05%	0.26%	0.02%

Significance

Based on the sensitivity of the receptor (very high) and impact magnitude (high), the overall potential impact to fisheries and mariculture from a nearshore hydrocarbon spill is assessed to be of **very high** significance.

Residual Impact

The implementation of the mitigation measures would assist in reducing the intensity and of the impact, with the residual impact significance reduced to **high**.

Table 8-23: Impact to fisheries and mariculture from a nearshore hydrocarbon spill.

Impact to Fisheries and Mariculture from a Nearshore Hydrocarbon Spill.		
Type of Impact	Direct and Indirect	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Very High	
Magnitude	High	Medium
Intensity	High	Medium
Extent	Regional	Regional
Duration	Medium-term	Medium-term
Significance	Very High	High
Additional Assessment Criteria		
Probability	Likely	Should a nearshore hydrocarbon spill occur, it is likely that fisheries and mariculture will be negatively affected.
Confidence	Medium	Results are based on literature and oil spill modelling results. These methods have limitations.
Reversibility	Partially reversible	The impact is somewhat reversible due to response, mitigation measures and natural degradation of oil.
Loss of resources	High	A spill is likely to cause substantial loss of resources and could affect spawning success.
Avoidance Potential	High	Communication to authorities and fisheries can allow for operational planning for the avoidance of the affected area.
Mitigation Potential	Medium	Mitigation measures can reduce the intensity of the impact.
Cumulative impacts	Possible	Should multiple vessels and nearshore operators be bunkering, operating and/or transferring hydrocarbons at the same time, then the risk of spills in the region may increase and these impacts could be exacerbated.



8.5.3.3 Mitigation and Management Measures

In addition to the best industry practices and project standards as well as mitigation measures outlined in Section 8.5.2.3, the following measures are recommended to mitigate and manage impacts related to an offshore hydrocarbon spill.

- Plan for and implement responses in terms of International Petroleum Industry Environmental Conservation Association – International Association of Oil & Gas Producers (IPIECA-IOGP) guideline document for the economic assessment and compensation for marine oil releases

8.5.4 Impacts on Fishing and Tourism Livelihoods

8.5.4.1 Impact Description

The spill modelling predicts that any large spill would reach the shore during all seasons, within hours and affect the coastline for a considerable distance from Walvis Bay, where it would persist for less than a month.

Namibia's **fishing** industry targets a range of species and areas and is an important source of employment, income and exports. The following fisheries occur close to the nearshore transshipment area and could potentially be affected by a spill:

- Small pelagic fish such as sardine and anchovies
- Mariculture near coastal towns

Three areas are currently “zoned” for or allocated to mariculture offshore Walvis Bay and Swakopmund (see **Figure 5-80**).

The northern areas zoned for mariculture are not in use, while the southern two mariculture areas, one in the harbour area and one at Donkeys Bay, are currently in use. For this assessment it is assumed that, even though not all mariculture areas are in use, they may be operational in future¹⁴¹.

Small-scale fisheries

Artisanal or Small-Scale Fisheries (SSF) in Namibia has to some extent been neglected in policy making and regulations and is an important fishery activity with a substantial impact on and importance to the well-being of a substantial number of coastal dwellers. In 2020, Namibia adopted the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) and developed Namibia's National Plan of Action for Small-Scale Fisheries (NPOA-SSF) for the period 2022- 2026. SSF in Namibia is defined as women, men (and sometimes children) who make use of various fishing methods (e.g., canoes, small fishing vessels) on a daily or regular basis, to catch fish as a source of income, for own consumption or livelihoods and sale of surplus for most parts of the year but within weight or number of fish limits. SSF contributes to income, employment, socio-economic benefits, food and nutrition security.

Most SSF is associated with inland fisheries in dams, rivers and oshanas (shallow drainage channels), which generates some 45 000 self, seasonal or paid employment opportunities. Compared to that, a limited 1 500 people are active in the coastal small-scale fisheries sector (Ministry of Fisheries and Marine Resources, 2022).

¹⁴¹ Though note that, as per Section 7.4.11, the northern-most area may not be viable if located within the nearshore transshipment exclusion zone.



Coastal SSF are predominantly located in the Erongo and southern //Karas Regions, in major coastal fishing towns of Walvis Bay, Henties Bay, Swakopmund and Lüderitz. Coastal SSF fall into various categories, including:

- Shellfish collection in Walvis Bay, Swakopmund and Luderitz (an activity which is predominantly undertaken by women)
- Line fishery in Henties Bay and Luderitz
- Mullet and Rock lobster fisheries in Luderitz
- Namibia's Ski Boat fishery can also be classified as a SSF in line with the NPOA-SSF definition.

At the time of preparing the National Action Plan for Small Scale Fisheries, the main species harvested by area are as shown in Table 8-24.

Table 8-24: Predominant Catches for Coastal SSFs

Coastal Area	Predominant Species Harvested
Walvis Bay	• Shellfish Collection • Seaweed Harvesting
Henties Bay Line Fishery	• Kabeljou • Galjoen • Steenbras • Black Tail • Sea Barbel • Rock Lobster
Lüderitz Line Fishery	• Snoek • Mullet • Kabeljou • Steenbras • Shad
Lüderitz Marine Capture and recreation Fisheries	• Mullet • Rock Lobster • Limpets and Mussels • Seaweed

Namibia has very few established, recognized SSF organisations. During the consultation for the preparation of the National Action Plan for Small Scale Fisheries in 2021, the coastal SSF organisations / initiatives in Table 8-25 were identified and their membership numbers and employment opportunities determined. An additional organisation since established in Lüderitz is also included in Table 8-25 (Brand, 2025).



Table 8-25: Coastal SSF Organisations in 2021.

Region / Locality	Small-Scale Fisheries Organisation/Initiative	Membership and jobs
Erongo Region Henties Bay	Hanganeni Artisanal Fisheries Organisation (HAFA)	140 Members
Erongo Region	Namibia Shore Angling Association (NSAA)	410 Members 6 – 40 part time and fulltime jobs
Erongo Region Swakopmund	Benguela Ski-boat Association (BSBFS)	35 boats 45 Members 140 direct jobs
////Kharas Region, Lüderitz	Benguela Infinite Fisheries and Harvesting Association (BIFHA)	211 Members (2025)
////Kharas Region, Lüderitz	Namibian Women's Fisheries Network (NAMFISHNET)	60 Members

Coastal SSFs is very important for the mostly poor and more vulnerable fishermen and women who survive and subsist from SSF. The reported values of coastal SSFs in 2021 are shown in Table 8-26.

Table 8-26: Estimate of the value of Namibia's Coastal SSF sector

Region / Locality	Estimated production	Estimated Value (N\$)	Direct Employment
Small-Scale Fishers (mostly Henties Bay, Swakopmund, Walvis Bay and Lüderitz)	Not available	Not known	1 300
HAFA	300 tons per annum	N\$ 2.6 million annually	100 fishers (15 persons part time commission based)
Benguela Ski Boat Association	Not available	Estimated at N\$ 25 million per annum	140
Total Estimates for Coastal SSF		N\$ 27.6 million	1 500

However, this estimate is regarded as low: since it was made in 2021, it did not quantify line fisheries and harvesting or the mullet and crayfish harvesting in Lüderitz. Personal communication with HAFA staff indicates that HAFA now has about 40 to 70 permanent members and about 70 to 120 associate members. HAFA now operates 2 to 3 ski-boats (each with 8 to 12 crew) and also acquired a 25 ton vessel which is currently under repair and not yet in operation. The vessel is intended to catch and process salted snoek (Honeb, 2025).

Some of the BIFHA members have access to small dinghies and ski boats, mainly harvesting Mullet and Crayfish.

It is important to recognise the high levels of vulnerability of the SSF sector, which is due to its small scale and often subsistence nature, without financial backing and resilience that one would find in the formal fishing sector. Safety nets are fewer and weaker, and this results in a reduced ability to handle shocks to the sector.

In terms of the spatial extent of SSF, Kabeljou, Steenbras, Black Tail, Galjoen, Mullet and crayfish are mostly harvested from the shore or from close to shore, within 3 km from the shore. This includes the entire coastline from Paaltjies to the south of Walvis Bay up to the mouth of the Ugab River and the coast to the south and north of Lüderitz.



However, snoek is generally harvested by boat up to 25 km from shore. Any pollution or disturbance within the coastal area will most likely impact SSF and harvesting along the shore and nearshore waters while the influence on snoek catches is likely to be further away from shore.

A spill **may** affect those nearshore fisheries and mariculture operations based onshore and operated from boats by SSFs.

Based on oil spill modelling results, the crab fisheries (located to north), rock lobster fisheries (located to the south) and demersal hake fisheries (along the shelf at 200 m water depth) would **not** be impacted.

While the MFMR Annual Report 2020/21 provides values of nearshore fisheries, most of those reported are not expected to be impacted and overall value of catch affected by a diesel or crude oil spill is expected to be quite low.

Namibia also has a very important **tourism** industry. The last Tourism Satellite Accounts in 2022 estimated tourism made a direct contribution of almost 7% to GDP and directly employed nearly 58 000 people. The nearshore transshipment area is located close to coastal tourism sites near Walvis Bay between Sandwich Harbour to the south of Walvis Bay Henties Bay to the north.

Students from the University of Namibia (UNAM) supported by the Namibia Nature Foundation carried out a survey with recreational anglers (fishing tourism) to find out how much they invest in their sport. Their research findings were recently published in a report showing that recreational angling generates an estimated N\$1 billion Namibian dollars worth of direct and indirect expenditure annually, largely spent on accommodation, groceries, tackle, and restaurants (Kahn, 2023).

An unplanned event at the nearshore transshipment area may affect coastline-based tourism through deposition of diesel or oil on the shore and water column.

A spill may also affect birds and marine mammals at the seal colony on Pelican Point and the Lagoon and recreational and tourist fishing and harbour cruises, kayaking trips and trips to sandwich harbour as well as activities on the shoreline of Walvis Bay, Swakopmund, Wlotzkasbaken and Henties Bay.

A significant spill may also find its way into the salt works in Walvis Bay and north of Swakopmund.

8.5.4.2 Impact Assessment

Sensitivity of receptor

Fishing, SSF, mariculture and tourism receptors depend on a healthy environment and have few alternative locations for their activities. The sensitivity of receptors is rated as **very high**.

Magnitude

The intensity of the impact is rated as **high** with a large degree of disturbance and degradation that will impair the functioning of the SSF, mariculture, and tourism (including recreational fishing) sectors. It is especially the SSFs who are highly dependent on the resource for their subsistence and livelihood who would suffer most and, even during the short impact duration of three days in the water column and 20 days on the shore, have a problem to meet their daily needs and that of their families for nearly three weeks.

The duration of the impact from a spill as modelled will be **short term** and would likely not last for more than a month in total.

The extent of the impact is rated as **regional** since it extends along the Walvis Bay coast and includes several urban, tourist and fishing areas. However, such a regional scale impact



in the nearshore water column and on shore will have a intensive effect on SSF and their families.

Overall, the magnitude of the impact is rated as **medium**.

Significance

Based on the medium magnitude rating and very high sensitivity rating, the impact significance is considered **high**.

Residual Impact

With the implementation of mitigation measures listed below the residual impact reduces to **medium**.

Table 8-27: Impact rating for impact of nearshore hydrocarbon spill on livelihoods

Impact on livelihoods due to a nearshore spill		
Impact Description	Impact on livelihoods due to a nearshore spill	
Type	Direct	
Nature	Negative	
Phases	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Very High	Very High
Magnitude	Medium	Low
Intensity	High	Medium
Duration	Short Term	Short Term
Extent	Regional	Regional
Significance	High -	Medium -
Additional Assessment Criteria		
Probability of an impact if an unplanned event occurs, not probability of the unplanned event occurring	Possible	
Reversibility	Fully reversible	
Loss of Resources	Medium	
Avoidance Potential	High	
Mitigation Potential	Medium	
Cumulative Impacts	Possible	
Cumulative impacts likely to occur.		

8.5.4.3 Mitigation and Management Measures

The mitigation measures in Section 8.2.4.3 also apply here.

8.5.5 Impact on Cultural Heritage

8.5.5.1 Impact Description

Any impact on the integrity of the coastal and marine ecosystem through an accidental spill of diesel, hydraulic fluid and/or oil could have an immediate detrimental effect on the marine environment and thus in turn could impact various aspects which make up people's intangible cultural heritage (indirect negative impact).



8.5.5.2 Impact Assessment

Sensitivity of receptor

Overall, the sensitivity of receptors is deemed **low**, as per the discussion in Section 7.5.1.3.

Magnitude

Based on the results of the oil-spill modelling, an unplanned hydrocarbon spill at the nearshore area during transshipment operations was found to result in shoreline oiling, spreading both to the north and south of Walvis Bay. As such the probability of impacts on ICH in the event of a spill is considered highly likely (notably no registered/declared TH resources are located in the potential area of influence). Furthermore, even though there is a long history of onshore mining in Namibia which has affected sense of place, an unplanned event at the nearshore transshipment area is likely to negatively affect the sense of place and tourism interest, especially in places such as Swakopmund, where there is leisure use of the coast, as well as recently (2025) observed cultural uses, evident in *Returns to the Sea* at the beach in this town.

The magnitude of an unplanned event on intangible and tangible coastal cultural heritage is assessed to be **high**. This is based on the following ratings:

- Intensity: **High** as several ICH resources are located within the likely area of coastal water and shoreline oiling from a nearshore transshipment spill.
- Duration: **Medium-term**, as the potential spill quantity is limited by the transfer hose volume, the oil or diesel would evaporate and dissipate within a matter of days or weeks in the dynamic environment, and clean-up operations and recovery of resources can reasonably be expected to conclude within a year, though actual or perceived restoration of ICH resources may take longer.
- Extent: **Regional** as the coastal water and shoreline oiling may extend over ~100 km.

Significance

The probability of an impact on cultural heritage *if an unplanned nearshore hydrocarbon spill occurs* will be of **medium** significance (Table 8-28).

Residual Impact

The proposed mitigations would reduce the intensity and thereby the overall magnitude of the unplanned event impact. This in turn would reduce the residual impact to **very low** significance.



Table 8-28: Impact rating for deterioration of cultural heritage links to the sea due to nearshore hydrocarbon spill.

Impacts on intangible cultural heritage from unplanned Nearshore Hydrocarbon Spill events		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	High	Low
Intensity	High	Medium
Duration	Medium term	Short term
Extent	Regional	Regional
Significance	Medium -	Very Low -
Additional Assessment Criteria		
Probability	Likely as ICH resources are within areas modelled to be affected by oil (if a spill occurs)	
Reversibility	Reversible	
Loss of resources	Medium	
Degree to which impact can be avoided	High	
Mitigation Potential	High	
Cumulative impacts	Unlikely	

8.5.5.3 Mitigation and Management Measures

No additional mitigation is proposed other than the implementation of the project controls and mitigation in Sections 8.5.2.3 and 8.3.5.3.

8.5.6 Increase in Atmospheric Pollutants and Associated Health Risks

8.5.6.1 Impact Description

A nearshore spill will lead to an increase in atmospheric emissions through evaporative emissions from the associated hydrocarbons spilled. These emissions have the potential to impact air quality, which may in turn have negative effects on human health (e.g. respiratory effects).

8.5.6.2 Impact Assessment

Sensitivity of receptor

The sensitivity of receptors is rated **low**. While sensitive individuals may be present within the general population, they are located beyond the expected range of impact.

Magnitude

Emissions associated with the following spill scenarios (simulated by CLS Brasil, see Section 8.1.1) were calculated (see Appendix P for further information). The scenarios applicable to this assessment related to the nearshore transshipment area are:



- **Scenario O1** (Production phase): Loss of 1 000 m³ of crude oil at sea surface during transfer from DPST to conventional tanker.
- **Scenario O2** (Production phase): Loss of 300 m³ of marine diesel at sea surface from a vessel tank rupture.

Table 8-29 presents evaporative pollutant emissions resulting from these unplanned events¹⁴².

Based on these calculations an accidental crude oil or MGO spill will result in increases in ambient pollutant concentrations, with benzene identified as the primary pollutant of concern. Emissions would arise from the evaporation of constituent compounds from the surface of the oil or MGO slick on the sea surface. Pollutant dispersion from a crude oil spill was simulated as the worst-case scenario (See Section 8.1.2) and therefore this assessment of spills in the nearshore transshipment area is quantitative.

Table 8-29: Evaporative pollutant emissions for crude oil and marine diesel spill scenarios

	Scenario O1	Scenario O2
	Crude oil	Marine diesel
Fugitive release (m ³ /day)	-	-
Duration (days)	-	-
Total release (m ³)	1 000	300
Density (kg/m ³)	868	845
% of oil evaporated (maximum)	51.4% ^(a)	71.4% ^(b)
Total emissions (kg)	446 152	180 999
Proportion NMVOC by mass	91.1%	99.8%
NMVOC emissions (kg)	406 227	180 682
Proportion benzene by mass	0.39%	0.42%
Benzene emissions (kg)	1 729	754
Notes: (a) CLS Brasil Crude Nearshore STO-A Season 3 (b) CLS Brasil MGO Nearshore STO-A Season 2		

Overall, the impact magnitude of atmospheric pollutant emissions from a nearshore hydrocarbon spill is considered to be **very low**. This is based on the following ratings:

- **Very low intensity** as no exceedances of TCEQ guidelines are predicted (Table 8-2).
- **Regional extent**, reflecting the assessment of potential effects on land-based receptors located ~4 km to 20 km from the nearshore transshipment area.
- **Short-term duration**, as a crude oil spill is expected to evaporate within 18 hours. If a spill were to occur, emissions cannot be avoided. However, any deterioration in air quality within the zone of influence is fully reversible once the slick evaporates and disperses. While atmospheric pollutants will disperse rapidly, it is recognised that exposure-related health effects may be irreversible for sensitive individuals.

Significance

Considering the **very low** magnitude and **low** receptor sensitivity, the significant of air quality impacts due to a nearshore hydrocarbon spill is assessed as **negligible**.

¹⁴² The composition of the gas and oil (in molar percentages) was provided by TEEPNA and used to calculate the NMVOC and benzene proportions by mass (Amorcho and DeVries 1980). Worst-case (i.e. maximum evaporation rates provided by the oil spill modelling specialist CLS Brasil) for each scenario were applied.



Residual Impact

Mitigation in the form of spill containment systems and contingency/emergency response procedures will reduce the probability of a spill event occurring, though the impact intensity will remain very low. The residual impact significance therefore remains **negligible**.

Table 8-30: Impact of increased ambient air pollutant concentrations from a nearshore hydrocarbon spill

Increase in Ambient Air Pollutant Concentrations for Onshore Sensitive Receptors due to nearshore hydrocarbon spill		
Type of Impact	Direct	
Nature of Impact	Negative	
Phase	Production	
Criteria	Pre-Mitigation	Residual Impact
Sensitivity of Receptor	Low	
Magnitude	Very Low	Very Low
Intensity	Very Low	Very Low
Extent	Regional	Regional
Duration	Short-term	Short-term
Significance	Negligible	Negligible
Additional Assessment Criteria		
Probability	Definite: Spills will result in atmospheric emissions.	
Confidence	High	
Reversibility	Fully reversible: Impacts will cease once clean up procedures conclude. However, it is noted that, health impacts associated with pollutant exposure is potentially irreversible.	
Loss of resources	None: Pollutants will disperse rapidly, and impact will cease on evaporation of the slick.	
Avoidance Potential	None: The impact cannot be avoided.	
Mitigation Potential	None: Some mitigation (i.e. spill containment systems and contingency/emergency response procedures) will reduce the probability and minimise emission potential, however this will not affect the impact intensity.	
Cumulative impacts	Unlikely: Onshore ambient air quality may be impacted by existing sources such as road traffic, industrial activity, etc. However, no guideline exceedances are anticipated. Therefore, the cumulative impact is conservatively assessed to be low.	

8.5.6.3 Mitigation and Management Measures

No additional mitigation is proposed other than the implementation of the project controls and mitigation measures in Section 8.3.6.3 as well as relevant mitigation measures (related to response training, reduction of oil spill area/containment) in Section 8.5.2.3.





8.6 Transboundary Impacts

A major oil spill (13-day well blow-out) has the greatest geographic extent of the potential worst credible case unplanned events. Modelling of a major oil spill without response shows that oil would drift towards NW / N with dominant winds and currents. The model predicts a 90% probability of oiling up to 85 km from release point and 1% probability of oiling up to 323 km from release point (Season 1) in a NW direction at the surface. The model predicts a 1% probability of oiling up to 489 km from release point (Season 1) in a NW direction in the water column.

Oil from a well blow-out is not expected to reach South African waters. Transboundary impacts on international waters can be expected under the oil modelling scenarios, with less than 70% maximum water column probability at season 1 and less than 10% probability for oil at surface for all seasons. Oil on the surface in international waters would be short-lived: due to the light and dispersible nature of this particular hydrocarbon, the mass balance showed high values for evaporation (between 30% and 33%) and natural biodegradation (between 38% and 41%) at the end of the simulation. In all seasons, less than 0.05% of the total volume released is still present in the water at the end of the simulation. No oil above the threshold of 5 μm is expected to remain on the surface 30 days after the end of the crude oil release.

In the case of a surface hydrocarbon (marine diesel) spill in the Venus offshore project area, transboundary impacts on international water column can be expected with a likelihood of less than 10%. Diesel on the sea surface above the threshold of 0.3 μm is modelled to reach up to 89 km from the release point, but remaining within Namibian waters, for up to 3 days due to high evaporation rates. Marine diesel is not expected to reach South African waters.

Modelled spills at the nearshore transshipment area are not expected to result in transboundary impacts.

In summary, no oil is expected to reach South-Africa waters and coast in the unlikely event of an oil spill. Considering the scenario of an unlikely well blow-out, there is up to 10% probability that surface oil could enter international waters and up to 70% probability of oil in the water reaching international waters depending on the season.





9.0 Need and Desirability

This chapter analyses the need for, and desirability of, the proposed activities based on its ‘fit’ with the policy and planning framework adopted by the Namibian administration, as discussed in Section 1.0. In this context it is noted that:

- The evaluation of merits of national government policy, global trends, geopolitics and feasibility of the proposed activities are complex, evolving and sometimes contradictory, and fall outside of the scope of this project-level ESIA. The analysis thus relies on relevant current commitments, policies and targets as markers against which to evaluate the need and desirability of the proposed activities;
- The analysis does not evaluate the need and desirability from the applicant’s perspective and assumes that the applicant is confident of the economic feasibility of the proposed activities; and
- Need and desirability can relate to different aspects, e.g. social, economic, and environmental aspects, which are not always aligned, and the proposed activities may be needed and desirable in terms of some but not other such aspects.

9.1 Fit of Petroleum Production with the Namibian Planning Framework

Summarising upfront, the following sections show that Namibia’s policies recognise the need to progressively reduce GHG emissions, especially from fossil energy, while, at the same time, ensuring a stable, sufficient and affordable energy supply and enabling economic growth to address the critical challenges of unemployment and poverty.

As part of that approach, Namibian policy (including NDP6) also promotes the viable and sustainable exploration and production of local petroleum resources to promote greater economic and income diversity, growth and transition to lower-carbon energy sources (such as gas-derived electricity and supplementation of renewables).

The compatibility of project emissions (notably Scope 1 emissions) with Namibia’s climate change commitments depends on the nature of commitments, plans and policies and emission contributions from other sources.

9.1.1 Energy-Related Plans and Policies

The energy-related plans and policies discussed in Section 2.3.1 have identified an existing and continuing demand for hydrocarbon products in Namibia, with an aim of promoting the country’s exploration and production potential.

Policies are careful to frame the need for locally produced hydrocarbon products in the Namibian economy in the context of, and as a supplement to, the desired increase in renewable energy generation capacity. In this sense the use of petroleum products is not deemed contradictory to, and rather supportive of, the continued development of renewable energy in Namibia.

Although gas receives special mention in Namibian policies, it will not be produced as part of the currently proposed Venus development, as the produced gas needs to be re-injected to enhance the production of the oil. Similarly, the present lack of refining capacity in Namibia means that the oil that would be produced by the proposed project cannot be bought by a Namibian refinery for the time being. However, energy policies such as Namibia’s National Energy Policy 2017 expressly promote exploration and production in the oil and gas sector.

This means the Venus development project – as currently proposed – may not directly impact domestic energy consumption, but it contributes to the furtherance of exploration and production-related aims of energy plans and policies. It would also, through demonstrating



the viability of developing offshore resources, supporting the establishment of energy specialist companies and generating national income, contribute to the future investment on specific aspects of the energy policy.

The project is deemed to be in direct and indirect furtherance of specific energy-related plans and policy in Namibia.

9.1.2 Economy-Related Plans and Policies

Economic policies are naturally complex in that they relate to and seek to combine a wide range of objectives, tools and desired outcomes. Promoting economic growth is a key proclaimed focus of the Namibian Government, with a focus on increased energy security, in conjunction with a declared intent to mitigate the effects of climate change and diversify the energy mix away from fossil fuels while exploring the use of natural gas, including local resources, as a less carbon intensive transitional fuel.

Policy clearly lays out the social need for economic development and opportunities, and that this should be achieved through a managed energy transition that includes a mix of energy sources, including fossil fuels for some time. The recent update of Namibia's NDP clearly identifies oil and gas projects as a focus area to boost economic growth and employment and defines a desired oil production of 150 million barrels of oil equivalent by 2030.

The viable and sustainable production of local resources is expected to create a range of economic benefits that directly and indirectly stimulate government income and economic growth. The socio-economic study expects that the Venus project will materially contribute to Namibia's national GDP, export value and Government revenue; the exact magnitude will depend on oil prices, taxation regimes etc. Employment is expected to be regionally important. Government's decisions around economic policy and the use of the project-related income will be an important determinant of the ultimate long-term magnitude of the project impact on the Namibian economy (see Section 7.4).

The project is deemed to be in keeping with and in furtherance of the most recent economy-related plans and policy in Namibia.

9.1.3 Climate Change-Related Plans and Policies

Similar to economic policies, climate change-related policies seek to accommodate a number of goals, notably low-carbon and socially just and equitable economic growth. Namibia has stated its commitment to reduce GHG emissions through its National Policy on Climate Change and its Second Updated NDC 2023. The country aims to reduce greenhouse gas emissions through accelerating renewable energy adoption, expanding climate-smart agriculture practices and enhancing afforestation and reforestation. These policies emphasize sustainable development, resilience building, and reducing the vulnerability of its population to climate impacts.

Namibia must balance these priorities with its active promotion of oil and gas exploration and production, as it seeks to leverage its natural resources for economic growth, while also addressing the need to reduce GHG emissions. Fundamental issues around the strategy to achieve Namibia's NDC targets are too complex to comprehensively and conclusively analyse at a project level – priorities and strategies need to be decided at a national policy level.

The compatibility of the project with Namibia's climate change-related plans and policies cannot be fully determined at present as such plans and policies are not detailed enough on how to counterbalance increased emissions from production with decreased emissions from other sources.



Project emissions that contribute to Namibia's GHG inventory would include Scope 1 and 2 emissions¹⁴³ from production. Scope 3 emissions from oil produced in Namibia but used elsewhere would not be reported in Namibia's emissions and thus not reflect in Namibia's commitments under the Paris Agreement (and compliance therewith). The project GHG emissions would reduce Namibia's net sink capacity by up to 1.21%, and the acceptability thereof must be considered more broadly by government with a view to sectoral, national and international targets, rather than at project-level.

9.2 Broader Context of Petroleum Exploration and Production

As it is understood, considering that there are no oil refineries in Namibia, the oil produced at the Venus field is destined for export, at least initially. This section provides a broader overview and context of other global and Namibian key aspects in principle associated with the need for and desirability of viable and sustainable hydrocarbon exploration and production, including:

- Context of global and Namibian GHG emissions (Section 9.2.1);
- Status of and outlook for global oil and gas demand and supply (Sections 9.2.1 to 9.2.4); and
- Other considerations (Section 9.2.5).

Summarising upfront, the following sections show that Asia, Europe and North America each account for approximately one third of global CO₂ emissions released from fossil fuels and industry since 1750. Asia accounted for 62% of the global share of CO₂ and 56% of GHG emissions in 2023, with a continued upward trajectory. European and North American CO₂ emissions declined by 37% and 15% relative to their peaks in 1990 and 2005, and in 2023 stood at 14% and 17% of global emissions (or 13% and 15% of total GHG emissions).

Namibia has contributed a negligible amount to global GHG emissions.

Global oil and gas production and consumption is unevenly distributed, and between four and six countries accounted for half of overall oil and gas production and/or consumption in 2023; the United States, Canada, the Russian Federation, China and Saudi Arabia are the overall key suppliers and/or consumers.

There is no universally accepted energy transition path or one-size-fits-all approach, and countries and regions continue to search for, and explore, different means of reaching national and global targets. An energy transition is well underway and underpinned by a variety of factors.

However, empirical evidence shows that hydrocarbon resources continue provide more than half of the world's energy, with stable (oil) or increasing (gas) consumption and production growth trends at present. It is not evident that new oil and gas discoveries in themselves swell oil and gas demand, except where gas discoveries can displace high-carbon-intensity coal in the power sector. Global oil and gas demand growth since 2000 far exceeded exploration activity (Wood Mackenzie, 2024). Renewables, despite impressive growth in

¹⁴³ Scope 1 Emissions: These are direct GHG emissions from sources that are owned or controlled by an organisation.

Scope 2 Emissions: These are indirect GHG emissions associated with the purchase of electricity, heat, cooling, etc. Although these emissions occur at the facility where they are generated, they are accounted for in an organisation's GHG inventory because they result from the organisation's energy use.

Scope 3 Emissions: These are all other indirect emissions that occur in the value chain of the reporting company, both upstream and downstream. This includes emissions from activities such as the production of purchased goods and services, business travel, waste disposal, and the use of sold products.



recent decades, contributed only the equivalent of 13% of the global energy sourced from petroleum resources, and 9% of the energy sourced from all fossil fuels.

Renewable electricity generation, and reliability thereof, must increase many-fold to replace the energy currently produced from fossil fuels (not accounting for rising electricity demand due to electrification of sectors, e.g. transport, and from higher-income / more energy-intensive lifestyles across the world). For renewables (and/or other low-carbon sources) to replace (rather than supplement) current fossil fuel sources will likely take some time, and hydrocarbon resources are likely to continue to play a significant role in the interim.

Transition paths and speed will vary across global regions depending on the nature of the economy and current resource use, indigenous or otherwise securely available energy sources, cost of implementing or switching to alternative technologies and capacity to financially or otherwise incentivise or prescribe transitions in energy-intensive sectors.

9.2.1 Context of GHG Emissions

9.2.1.1 Global GHG Emissions

The build-up of GHG in the atmosphere is accepted as the key driver of climate change, which is resulting in variable increases in average temperatures across the globe (see Figure 9-1).

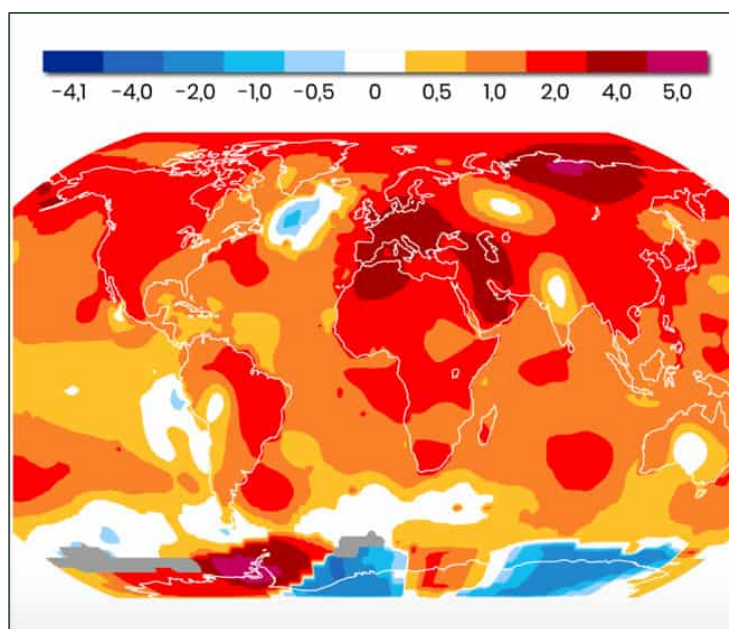


Figure 9-1: Global change in temperatures in the period of June 2017-June 2022 compared to the period of 1951-1980 (in °C).

Source: NASA, cited in The Pioneer (2022)

Annual CO₂ emissions from fossil fuels and industry – which provide an indicator of mostly man-made GHG emission from energy use – have increased from virtually none prior to 1850 to 37.80 billion t in 2023, with the most pronounced increase in CO₂ emissions since the 1950s (see Figure 9-2).



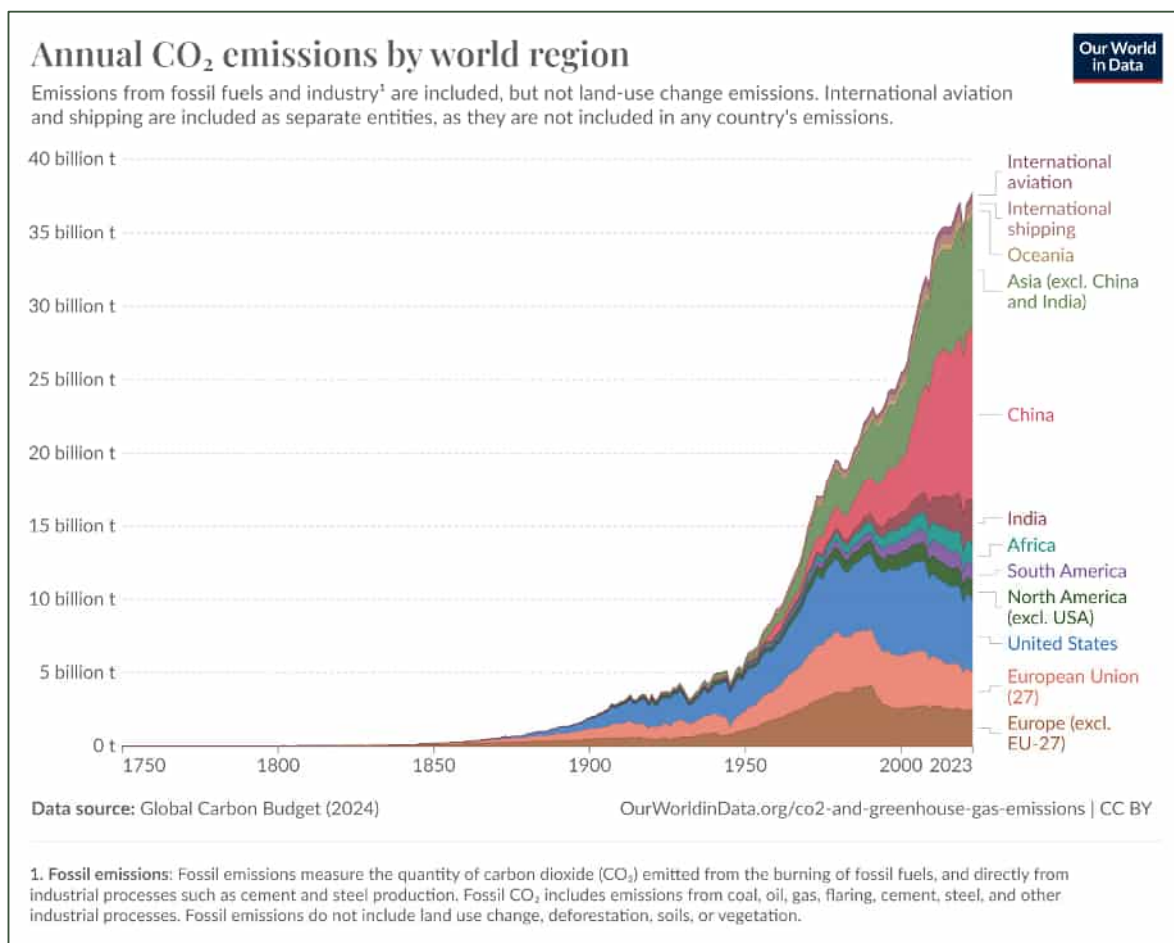


Figure 9-2: Annual CO₂ emissions by region, in absolute volumes

Source: Our World in Data (2024)

Europe and North America dominated CO₂ emissions pre-1950s (see Figure 9-2), emitting a total of 208 billion t CO₂ between 1750 and 1950, which is equivalent to 95% of the 225 billion t CO₂ emitted during that time (see Table 9-1).

By 1950, Asia's share of CO₂ emissions had steadily increased, and the region became the greatest CO₂ emitter in 1992. Since 1992, Asian emissions have tripled, while European and North American emissions declined by 37% and 15% relative to their peaks in 1990¹⁴⁴ and 2005, respectively.

By 2023, Asian emissions accounted for 60% of global emissions, in line with its share of the global population. Due to the slight actual reduction in European and North American emissions, and due the considerable increase in Asian (and hence overall) emissions, the share of European and North American emissions has reduced to 14% and 17%, respectively, still above their world population share of 9.1% and 4.7%, respectively. African and South American emissions are low at 4% and 3%, respectively, and well below their world population shares of 18.6% and 8.1% (see Table 9-1).

¹⁴⁴ At least half of the ~19% decline in European emissions between 1990 and 2012 was associated with the decommissioning of many industries and restructuring of agriculture in Eastern Europe (including East Germany) after the fall of the Berlin Wall, and the liberalisation of energy markets in the UK which resulted in a fuel switch from oil and coal to gas in electricity production (European Environment Agency, 2014).



Between 2022 and 2023, nominal emissions declined for Europa, North America and Oceania, remained almost the same for Africa and increased for Asia and South America. Global emissions declined by 1.3% from 37 150 to 36 675 million t CO₂.

Emissions from coal account for 41% of global emissions in 2023, followed by oil (32%) and gas (21%) (see Figure 9-6 and Table 9-4).

Over the total recording period (1750 – 2023), Asia, Europe and North America each account for approximately or close to one third of global emissions (see Table 9-1).

Table 9-1: Total CO₂ emissions by region from 1750 to 2023, in million t CO₂

Region	pre-1950	%	post-1950	%	Total	%	2023	%	% of world population in 2024
Africa	1 643	1%	50 788	3%	52 431	3%	1 419	4%	18.6%
Asia	11 938	5%	589 086	38%	601 024	34%	22 600	62%	58.9%
Europe	112 739	50%	434 713	28%	547 452	31%	4 993	14%	9.1%
North America	95 272	42%	401 094	26%	496 366	28%	6 124	17%	4.7%
Oceania	1 722	1%	20 440	1%	22 162	1%	430	1%	0.6%
South America	1 526	1%	44 644	3%	46 170	3%	1 109	3%	8.1%
Total	224 840		1 540 765		1 765 605		36 675		

Source: Our World in Data (2024)

Total GHG emissions, which mainly include CO₂, methane¹⁴⁵ and nitrous oxide¹⁴⁶ from all sources (including land-use change), are approximately double total CO₂ emissions over the reporting timeframe¹⁴⁷. In 2023, total GHG emissions exceeded CO₂ emissions by 47% (see Table 9-1 vs Table 9-2).

The most notable difference between the relative contributions to total GHG and CO₂ emissions is the higher relative contribution to GHG by Africa and South America (see Table 9-2 and Figure 9-3). This most likely reflects lower fossil fuel use, but higher incidence of land use changes (such as deforestation), agricultural activities that contribute to higher methane and nitrous oxide emissions, higher methane emissions from waste, and higher incidence of biomass burning, which releases methane and nitrous oxide.

¹⁴⁵ Methane is primarily produced by agriculture (notably livestock and rice cultivation), biomass burning, decomposition of organic waste in landfills and as fugitive emission in fossil fuel production. Methane is a much stronger greenhouse gas than CO₂: over a 100-year timescale it is 28 times as potent as CO₂. Despite contributing a small amount of greenhouse gas emissions in terms of mass, methane has been responsible for around one-quarter of radiative forcing since 1750. Methane is a very 'short-lived' greenhouse gas: the average 'lifetime' of methane in the atmosphere is around 12 years. This means that reductions in methane *emissions* quickly result in reductions in the methane *concentrations* in the atmosphere (Our World in Data, 2024).

¹⁴⁶ Most nitrous oxide emissions come from agriculture, notably the application of (synthetic and organic) nitrogen fertilizers to soils, which makes more nitrogen readily available for microbes to convert to N₂O (because not all of the applied nutrients are taken up by crops). Nitrous oxide is a much stronger greenhouse gas than CO₂: over a 100-year timescale it is 265 times as potent as CO₂. The average 'lifetime' of nitrous oxide in the atmosphere is around 121 years, typically shorter than CO₂ (which can persist for centuries or even thousands of years), but longer than methane (Our World in Data, 2024).

¹⁴⁷ Measured in CO₂-equivalents over a 100-year timescale. Carbon dioxide is the most important greenhouse gas, but not the only one. To capture all greenhouse gas emissions, researchers express them in "carbon dioxide equivalents" (CO₂eq). This takes all greenhouse gases into account, not just CO₂. To express all greenhouse gases in carbon dioxide equivalents (CO₂eq), each one is weighted by its global warming potential (GWP) value. GWP measures the amount of warming a gas creates compared to CO₂. CO₂ is given a GWP value of one. If a gas had a GWP of 10 then one kilogram of that gas would generate ten times the warming effect as one kilogram of CO₂. (Our World in Data, 2024)



Table 9-2: Total GHG emissions by region from 1850 to 2023, in million t CO₂-equivalent

Region	pre-1950	%	post-1950	%	Total	%	2023	%	% of world population in 2024
Africa	52 107	6%	226 270	9%	278 377	8%	4 662	9%	18.6%
Asia	201 231	23%	1 013 586	38%	1 214 817	34%	29 987	56%	58.9%
Europe	273 680	31%	589 350	22%	863 030	25%	6 734	13%	9.1%
North America	264 523	30%	535 056	20%	799 579	23%	7 849	15%	4.7%
Oceania	18 341	2%	48 362	2%	66 703	2%	727	1%	0.6%
South America	64 383	7%	235 264	9%	299 648	9%	3 858	7%	8.1%
Total	874 266		2 647 889		3 522 155		53 817		

Source: Our World in Data (2024)

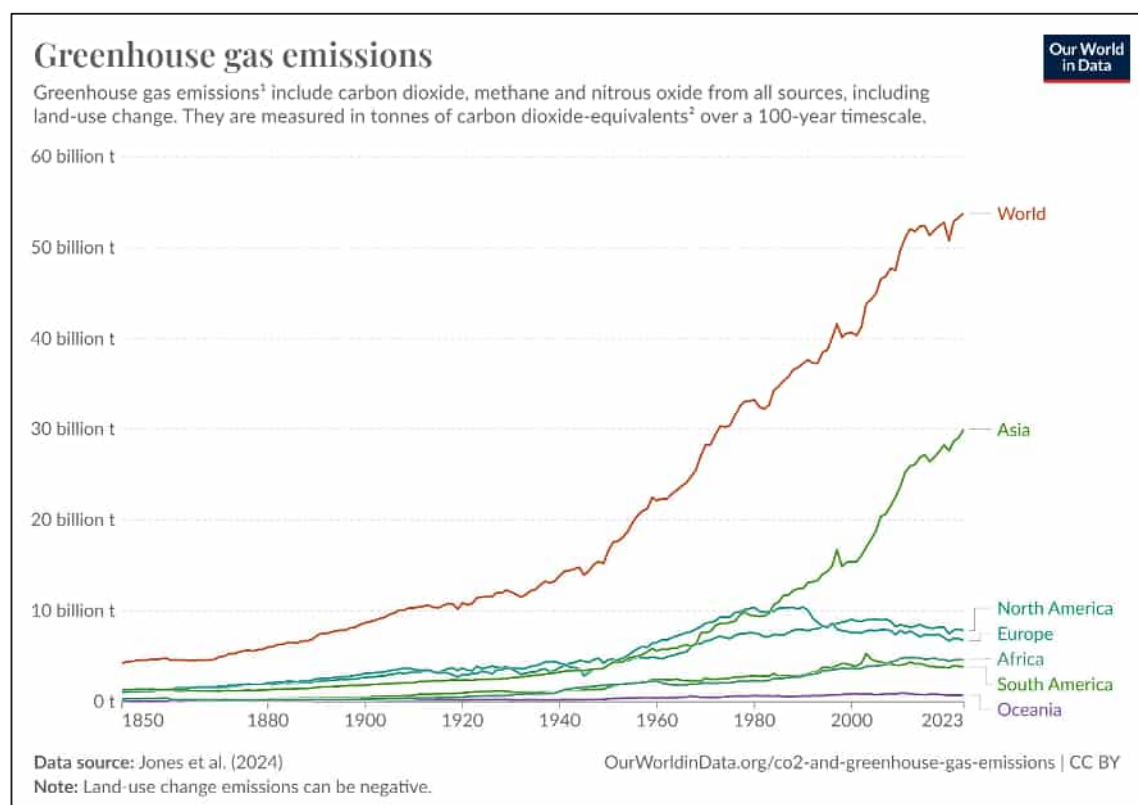


Figure 9-3: Annual GHG emissions by region, in absolute volumes

Source: Our World in Data (2024)

9.2.1.2 Namibian GHG Emissions

Namibia's recorded contribution to global CO₂ emissions is 0.01% (90 million t CO₂), while total GHG account for ~0.03% of global (991 million t CO₂-e). In 2023, Namibia's CO₂ emissions of 4.17 million t were 0.01% of the global emissions for that year, while total GHG emissions of 22.6 million t CO₂-e accounted for 0.04% of global (see Table 9-3). Figure 9-4 shows first a gradual increase in Namibian GHG emissions which becomes more pronounced from the 1940s onwards, with fluctuations but an overall upward trend.



Average *per capita* GHG emissions in 2023 were 1.4 t in Namibia (7.5 t for total GHG), down from a high of 1.7 t per capita in 2015 (or 19.9 t in 1970 for GHG).

Table 9-3: Namibian total CO₂ and GHG emissions in million t CO₂-e

	pre-1950 ¹⁴⁸	%	post-1950	%	Total	%	2023	%	% world population
CO ₂	0	0.00%	90	0.01%	90	0.01%	4.2	0.01%	0.03%
GHG	140	0.02%	851	0.03%	991	0.03%	22.6	0.04%	

Source: Our World in Data (2024)

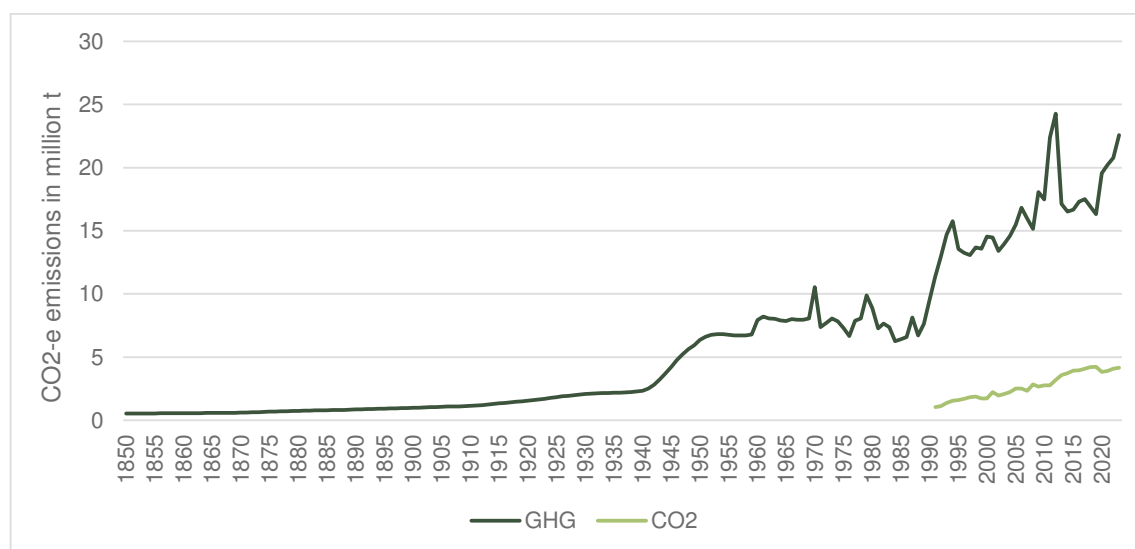


Figure 9-4: Namibian annual CO₂ and GHG emissions in million t CO₂-e

Source: Our World in Data (2024)

Due to its small population, low industrialisation and limited agricultural activities, Namibia has not materially contributed to African CO₂ emissions, which have grown 1 395% since 1950 (see Figure 9-5).

Some 84.7% of Namibian CO₂ emissions are from oil consumption (see Section 9.2.2.2), which is more than double the world average of 32.3% of CO₂ emissions arising from oil. Coal contributes a very small percentage to Namibian CO₂ emissions (3.4%), as most electricity – much of it coal-based from South Africa – is imported and emissions thus arise elsewhere. Cement production contributed a relatively high share (12%) to national CO₂ emissions (see Table 9-4 and Figure 9-6).

¹⁴⁸ CO₂ from 1991, GHG from 1850



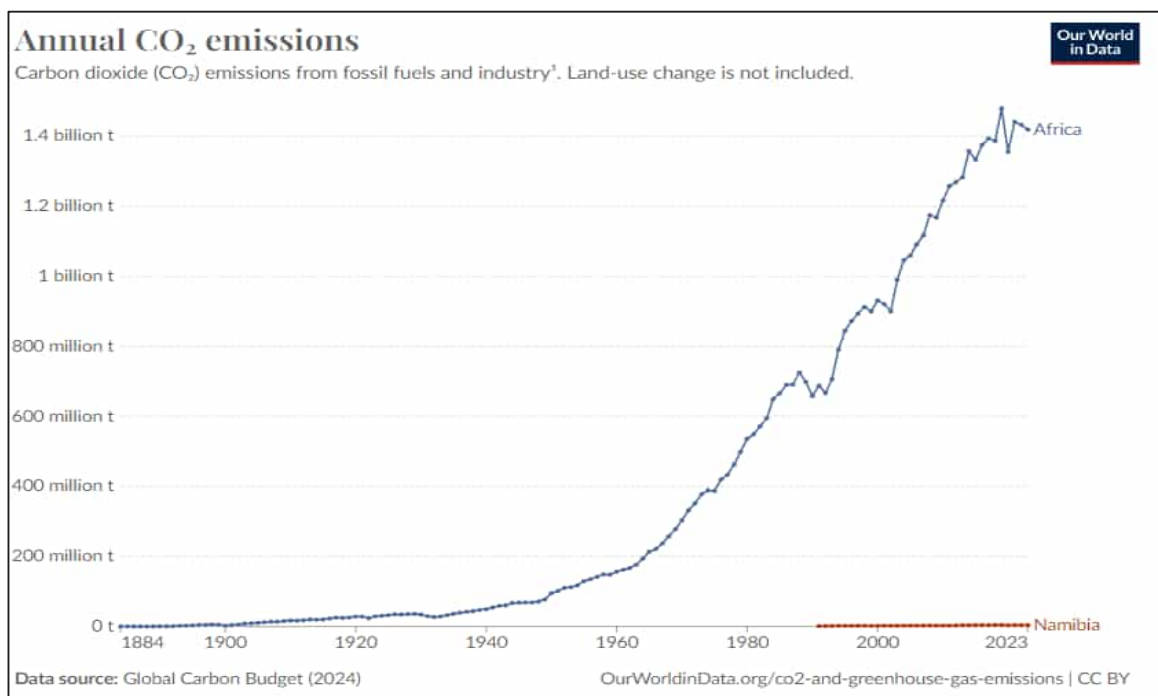


Figure 9-5: Namibian and African CO₂ emissions 1884 – 2023

Source: Our World in Data (2024).

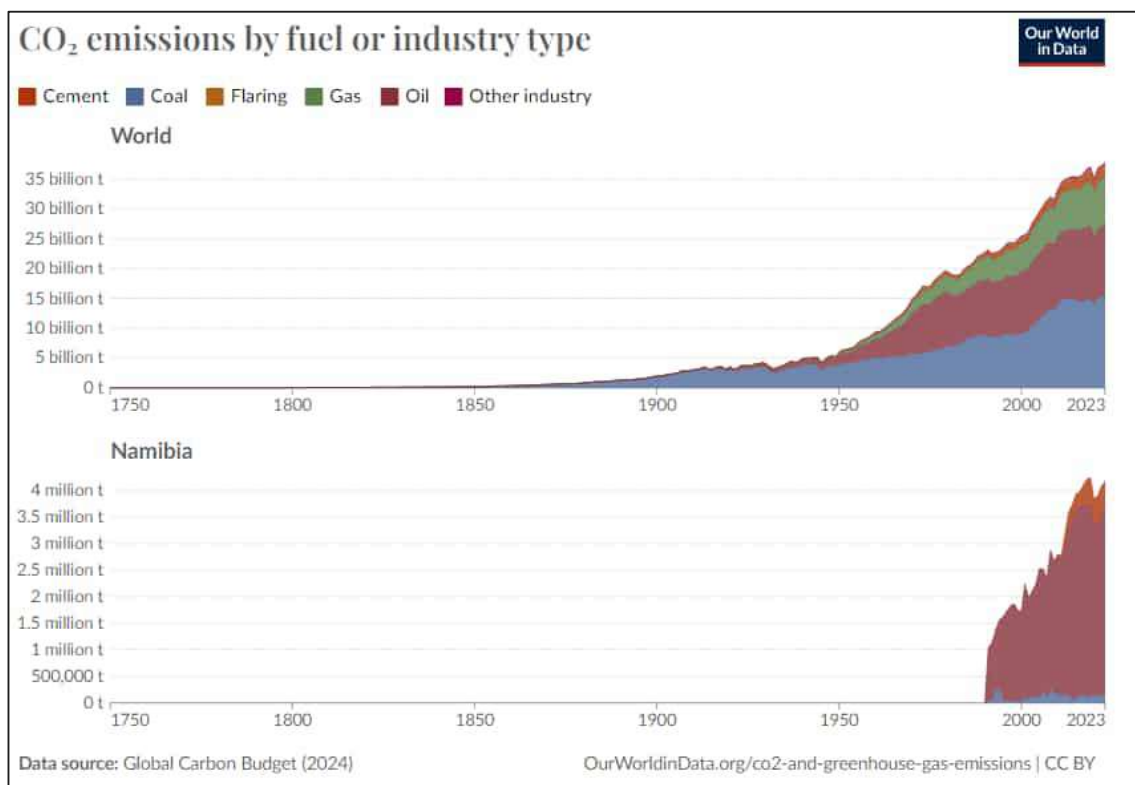


Figure 9-6: CO₂ emissions by fuel or industry type – World and Namibia

Source: Our World in Data (2024)



Table 9-4: CO₂ emissions by fuel or industry type – World and Namibia, 2023 (in million t CO₂)

Emission source	World	%	Namibia	%
Coal	15 401	40.8%	0.14	3.4%
Oil	12 209	32.3%	3.53	84.7%
Gas	7 900	20.9%	-	0%
Cement	1 569	4.2%	0.50	12.0%
Flaring	410	1.1%	-	0%
Other industry	301	0.8%	-	0%
Total	37 790		4.17	

Source: Our World in Data (2024)

Namibia reports that it remains a net carbon sink, primarily due to carbon sequestration in the Land Use, Land Use Change, and Forestry (LULUCF) sector. The updated GHG Inventory for the period 1990–2022, prepared using IPCC 2006 guidelines, provides detailed emissions and removal data across sectors (MEFT, 2023). Key reported trends include (Government of Namibia, 2024):

- Total Emissions - Emissions have remained stable at approximately 20 million t CO₂e.
- Energy Sector - Fossil fuel use in electricity generation and transportation contributed to a significant rise in emissions, underscoring the need for renewable energy deployment.
- LULUCF Sector - Carbon removals increased by 45% over the reporting period, driven by afforestation, sustainable forest management, and reduced deforestation.
- Agriculture - Methane and nitrous oxide emissions from livestock and fertilizer use have shown moderate growth.
- Waste Sector - Emissions from solid waste disposal and wastewater treatment have also grown but remain a smaller proportion of total emissions.

Namibia's Second Updated NDCs are laid out in Section 2.3.4.4 and envisage a reduction of GHG emissions by 24% relative to the business-as-usual scenario by the year 2030 from its base year (2010) levels, while maintaining its net sink status (Republic of Namibia, 2023), partly through accelerating renewable energy adoption and enhanced carbon sink effect from the Agriculture, Forestry and Other Land Use (AFOLU) sector.

9.2.2 Current Energy, Oil and Gas Consumption

9.2.2.1 Global Consumption

Fossil fuel consumption remains high globally, and the share of fossil fuels in overall energy provision remained steady at 81.5% in 2023 (slightly down from 81.8% in 2022, but slightly increased contribution of 505 Exajoules compared to 494 Exajoules in 2022 due to overall growth of energy consumption) (see Figure 9-7 and Table 9-5):

- Oil continues to provide nearly one third (31.7%) of the world's energy consumed, and consumption remained stable with a 0.1% increase in 2023;
- Coal provided 26.5% of global energy in 2023, with a small decrease of 0.2% in 2023; and
- Natural gas provided 23.3% of energy in 2023 and consumption remained stable with 0.2% decrease in 2023.



Low-carbon energy sources (renewables, nuclear and hydro) jointly produced 18.5% of global energy in 2023 (or 115 Exajoules), a slight increase from 18.2% in 2022:

- Renewables provided 8.2% of overall energy consumed in 2023 and have become the fourth largest energy source – but provide less than a 10th of the energy produced by fossil fuel sources (see Table 9-5). Renewables showed the largest growth of 12% from 2022 to 2023, albeit off a small basis and down from 13% growth the year before. Renewables (primarily solar) accounted for some ~75% of *new* capacity installed globally in 2021, followed by gas, which accounted for ~10% of new installed capacity (see Figure 9-8).
- Other low-carbon energy sources include hydropower (6.4% of energy production in 2023) and nuclear power (4% in 2023).

Table 9-5: Energy sources globally 2022 – 2023, in Exajoules

Energy source	2022	% of total	2023	% of total	Growth 2022-2023
Oil	190.69	31.6%	196.43	31.7%	3.01%
Coal	161.47	26.7%	164.03	26.5%	1.59%
Natural Gas	141.89	23.5%	144.37	23.3%	1.75%
Renewables	45.18	7.5%	50.58	8.2%	11.95%
Hydro electric	40.68	6.7%	39.65	6.4%	-2.53%
Nuclear energy	24.13	4%	24.57	4.0%	1.82%
Total	604.04		619.63		2.58%

Source: Energy Institute (2024)

Regionally, fossil fuels provided between 69% (in Europe) and 98% (in the Middle East) of energy in 2023 (see Table 9-6 and Figure 9-9), with energy predominant sourced from:

- Coal in the Asia Pacific Region;
- Oil in North America, South and Central America, Europe and Africa; and
- Natural Gas in the Commonwealth of Independent States (CIS) Region and the Middle East.

Table 9-6: Share of fossil, renewable and low-carbon energy sources by region in 2023

Fuel source	North America	South and Central America	Europe	CIS	Middle East	Africa	Asia Pacific
Fossils	79%	64%	69%	89%	98%	90%	84%
Renewables	9%	13%	15%	0%	1%	3%	8%
Hydro and nuclear	12%	23%	16%	11%	2%	8%	8%

Source: Energy Institute (2024)



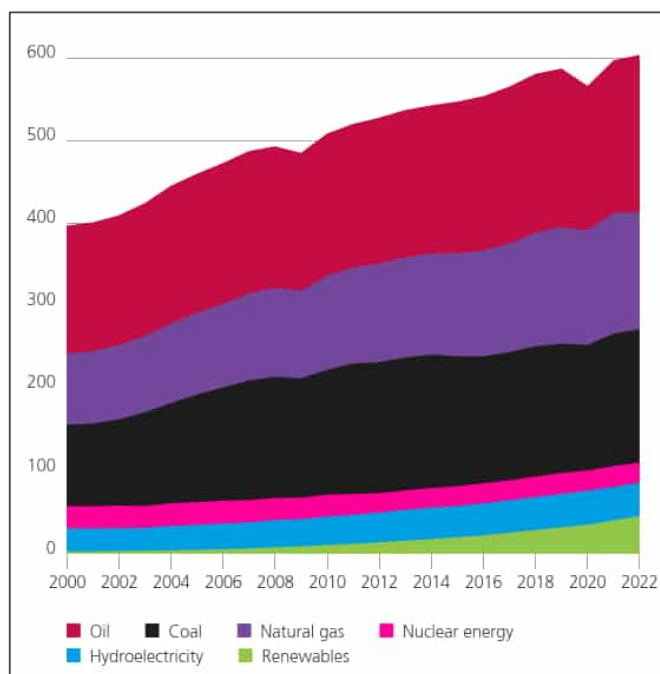


Figure 9-7: Global energy sources 2000-2023, in Exajoules

Source: Energy Institute (2024)

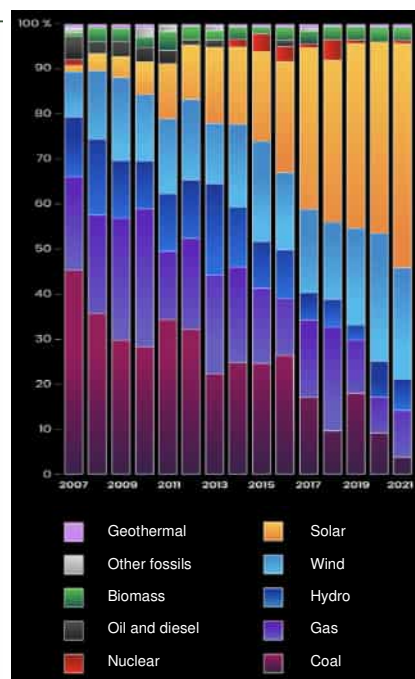


Figure 9-8: New generation capacity installed globally (percent), 2007-21

Source: The Pioneer (2022)

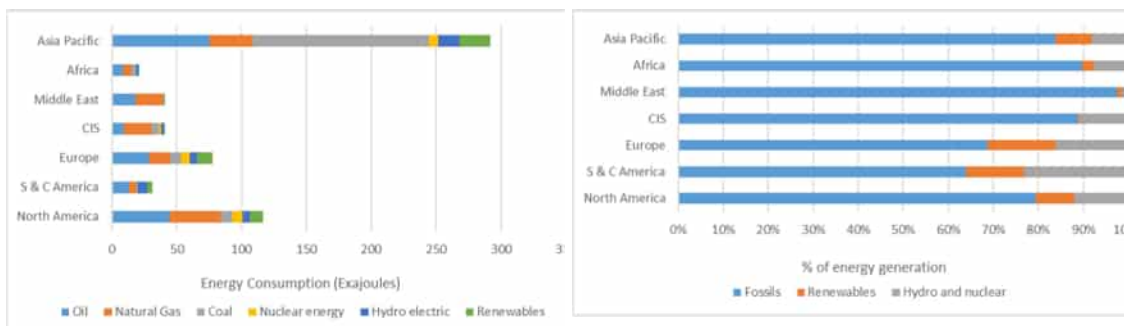


Figure 9-9: Energy sources per region in 2022 (absolute and relative)

Source: Energy Institute (2024)

Oil and gas consumption have increased considerably. From 1965 to 2023, global oil consumption grew by 224% from 31 to 100 million bbl/day and gas consumption grew by 536% from 61 to 388 bcf/day (see Figure 9-10).

Year-on-year consumption growth remains somewhat volatile, as it is heavily influenced by global economic activity, but year-on-year consumption growth rate has generally declined from ~5% in the mid-1960s to closer to ~0% – 2% in 2023 (see Figure 9-11). As such, while growth has slowed, it has remained overall positive. Oil consumption has remained stable in recent years, while gas consumption still continues to grow.



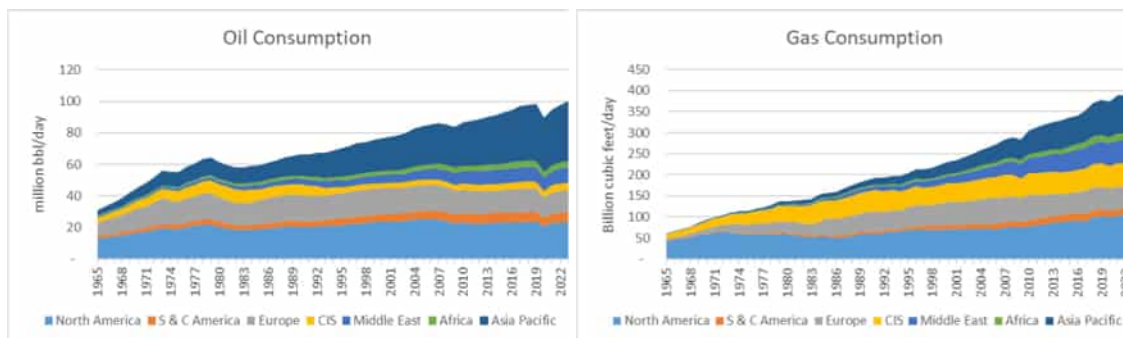


Figure 9-10: Global oil and gas consumption 1965 to 2023

Source: Energy Institute (2024)

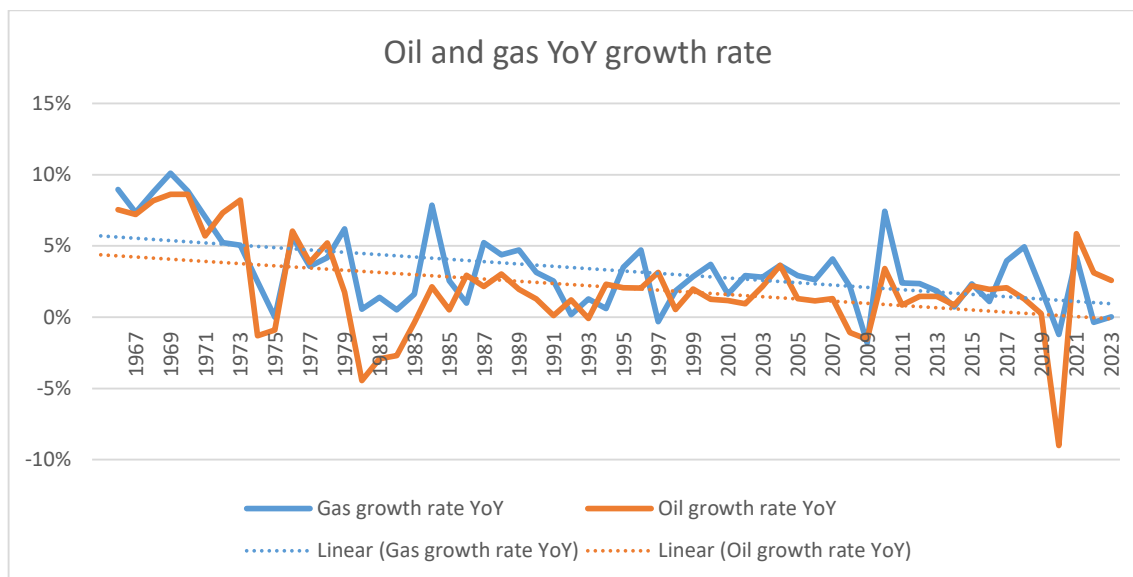


Figure 9-11: Year on year growth rate of oil and gas consumption globally

Source: Energy Institute (2024)

Six countries (the United States, China, India, Saudi Arabia, Russian Federation and Japan) accounted for half of the world's oil consumption in 2023, with the 20 largest oil consumers accounting for 75% of total consumption. Half of the top 20 consumers had average annual increases in oil consumption between 2013 and 2023, while 11 of them showed an increase from 2022 to 2023, likely as a result of economic recovery after the Covid-19 pandemic (see Table 9-7).

The United States account for a quarter of global oil consumption between 1965 and 2023, followed by China at 7.1%, Japan at 6.6%, the Russian Federation (including USSR) at 6.3% and Germany at 3.7%. All other countries contributed less than 3% to global oil consumption of that timeframe.



Table 9-7: List of 20 largest oil consumers in 2023

Country	Consumption in 2023 (million bbl/day)	Share of global Consumption 2023	Growth (pa) in consumption 2013-23	Total consumption 1965 – 2023 (million bbl/day)	Share of global consumption 1965 - 2023
United States	19	18.9%	0.5%	1 030	24.7%
China	17	16.5%	4.6%	305	7.3%
India	5	5.4%	3.8%	120	2.9%
Saudi Arabia	4	4.0%	1.6%	103	2.5%
Russian Federation	4	3.6%	1.2%	134	3.2%
Japan	3	3.4%	-3.1%	278	6.7%
South Korea	3	2.8%	1.3%	87	2.1%
Brazil	3	2.6%	-0.3%	92	2.2%
Canada	2	2.3%	-0.3%	116	2.8%
Mexico	2	2.0%	-1.0%	89	2.1%
Germany	2	2.0%	-1.8%	153	3.7%
Iran	2	1.8%	-0.4%	65	1.6%
Indonesia	2	1.6%	0.2%	50	1.2%
France	1	1.3%	-1.7%	108	2.6%
United Kingdom	1	1.3%	-1.1%	100	2.4%
Thailand	1	1.2%	0.6%	36	0.9%
Spain	1	1.2%	0.6%	63	1.5%
Italy	1	1.2%	-0.3%	99	2.4%
Singapore	1	1.4%	1.7%	35	0.8%
United Arab Emirates	1	1.1%	3.0%	23	0.6%

Source: Energy Institute (2024)

Five countries (the United States, Russian Federation, China, Iran and Canada) accounted for half of the world's gas consumption in 2023, with the 20 largest oil consumers accounting for 72% of total consumption. Fifteen of the top 20 consumers had average annual increases in oil consumption between 2013 and 2023 (see Table 9-8), while only seven of them showed an increase from 2022 to 2023.

The United States account for more than a quarter of global gas consumption between 1965 and 2023, followed by the Russian Federation (including USSR) at 12.1%, China at 3.4% Canada at 3.3%, and Iran at 3.2%. All other countries accounted for less than 3% of global gas consumption in that timeframe.

Table 9-8: List of 20 largest gas consumers in 2023

Country	Consumption in 2023 (bcf/day)	Share of global Consumption 2023	Growth (pa) in consumption 2013-23	Total consumption 1965 – 2023 (bcf /day)	Share of global consumption 1965 - 2023
United States	86	22.1%	2.3%	3429	27.2%
Russian Federation	44	11.3%	0.7%	1526	12.1%
China	39	10.1%	8.9%	426	3.4%
Iran	24	6.1%	4.8%	404	3.2%
Canada	12	3.0%	1.4%	415	3.3%
Saudi Arabia	11	2.8%	1.8%	261	2.1%
Mexico	9	2.4%	2.3%	232	1.8%



Country	Consumption in 2023 (bcf/day)	Share of global Consumption 2023	Growth (pa) in consumption 2013-23	Total consumption 1965 – 2023 (bcf /day)	Share of global consumption 1965 - 2023
Japan	9	2.3%	-2.9%	336	2.7%
Germany	7	1.9%	-1.2%	371	2.9%
United Arab Emirates	7	1.7%	0.3%	164	1.3%
United Kingdom	6	1.6%	-1.8%	354	2.8%
India	6	1.6%	2.5%	131	1.0%
South Korea	6	1.5%	0.9%	111	0.9%
Egypt	6	1.5%	1.9%	118	0.9%
Italy	6	1.5%	-1.3%	271	2.1%
Turkey	5	1.2%	1.0%	93	0.7%
Thailand	5	1.2%	-0.4%	108	0.9%
Uzbekistan	5	1.2%	0.1%	160	1.3%
Algeria	5	1.2%	3.7%	112	0.9%
Malaysia	5	1.1%	0.3%	115	0.9%

Source: Energy Institute (2023)

9.2.2.2 Namibian Consumption

Namibia's energy consumption profile is dominated by oil and biofuels, followed by hydropower and renewables. Coal only plays a negligible role in the consumption profile because the majority of Namibia's electricity is currently imported, most of it coal-generated electricity from South Africa, which does not reflect in the Table 9-9.

Table 9-9: Energy sources Namibia 2021 – 2022 in Exajoules

Energy source	2021	% of total	2022	% of total	Growth 2021-2022
Oil	0.0500	62.1%	0.0440	60.2%	-12.0%
Bioenergy (biomass)	0.0228	28.3%	0.0241	32.7%	5.7%
Hydropower	0.0057	7.1%	0.0028	3.8%	-50.9%
Renewables	0.0015	1.9%	0.0021	2.9%	40%
Coal	0.0005	0.6%	0.0003	0.4%	-40%
Total	0.0805		0.0730		-8.9%

Source: IEA (2023)

Namibia consumes ~26 000 barrels of oil per day or ~9.5 million barrels annually. This is a nearly four-fold increase from 1991, when oil consumption was 6 900 barrels per day (Worldometers, n.d.).

In Namibia, oil and petroleum products - including petrol, diesel, illuminating paraffin, jet fuel, and liquefied petroleum gas (LPG) - are consumed across various sectors:

- **Transportation:** The transport sector is the largest consumer of petroleum products, with petrol and diesel used extensively in vehicles transporting people and goods across Namibia's vast distances. Jet fuel is critical for aviation, particularly at Hosea Kutako International Airport and regional airports. Fuel oil is also extensively used for marine transport, especially in Walvis Bay's shipping and fishing industries.
- **Electricity Generation:** Namibia imports most of its electricity, mainly coal generated from South-Africa, but relies on diesel-powered backup generators, particularly in off-grid and rural areas. Diesel is also used in emergency power supply situations.



- **Industrial Use:** LPG is used in manufacturing, mining, and agricultural processing. The mining sector, a major contributor to Namibia's economy, depends on petroleum products for machinery operation and power generation in remote sites.
- **Household Use:** Illuminating paraffin is used in some rural households for lighting and cooking, while LPG is a popular choice for heating and cooking in urban and semi-urban areas, particularly where electricity access is limited or unreliable.
- **Construction:** Bitumen, derived from petroleum, is critical for road construction, essential to connect Namibia's distant communities.

Namibia's natural gas consumption is negligible despite proven (but untapped) natural gas reserves.

9.2.3 Current Oil and Gas Supply

9.2.3.1 Global Supply

Overall global oil and gas supply mirror the consumption patterns described in Section 9.2.1.1 and have increased by 203.1% from 32 to 96 million bbl/day respectively between 1965 to 2023 for oil and by 315% from 94 to 394 bcf/day between from 1970 to 2023 for gas (see Figure 9-10). This is not surprising, and small differences in the pattern would account for storage of surplus produced resources.

Year-on-year production growth remains somewhat volatile, as it is heavily influenced by global economic activity, but year-on-year production *growth* rate trend has generally declined from ~4% per annum in 1970 to ~0% – 2% in 2023 (see Figure 9-12). As such, while the production *growth trend* has slowed, it has remained overall positive. While oil production has become more stable, gas production trend is still continuing to grow.

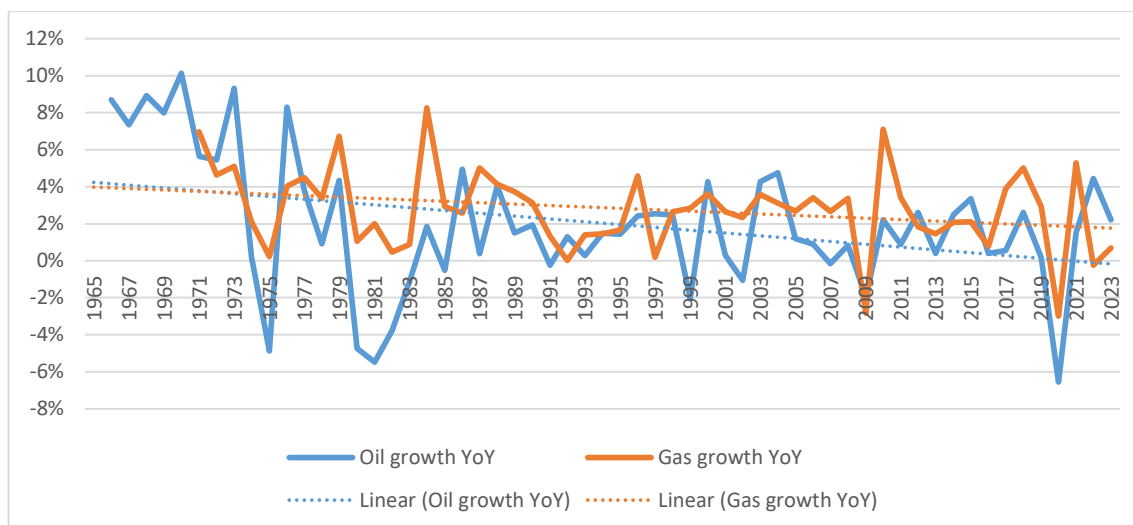


Figure 9-12: Year on year growth rate of oil and gas production globally

Source: Energy Institute (2024)

Oil production is regionally uneven. Four countries (the United States, Saudi Arabia, Russian Federation and Canada) accounted for half of the global oil production in 2023, and 20 countries accounted for 90% of global oil production in 2023. The United States, Saudi Arabia and the Russian Federation have produced the most oil between 1965 and 2023, accounting for a 36% of global oil production over that timeframe (see Table 9-10 and Figure 9-13).



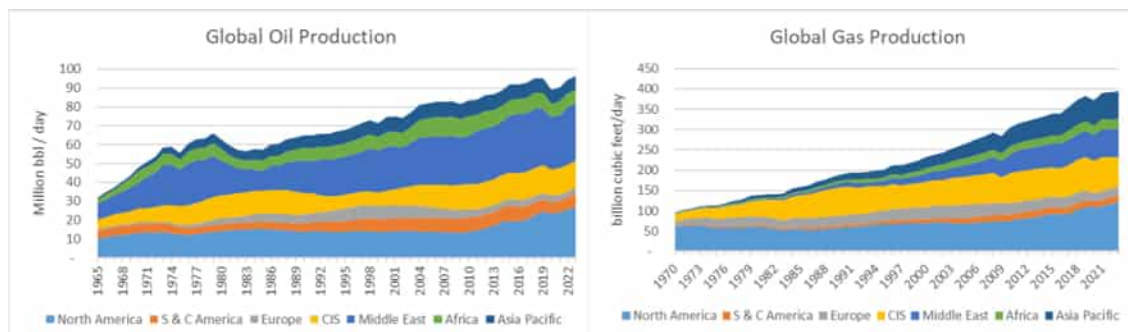


Figure 9-13: Global oil and gas production 1965 / 1970 to 2022

Source: Energy Institute (2024)

Between 2013 and 2023, 12 of the 20 largest gas producers increased their average annual production rates, including the largest oil producers, notably the United States (annual average increase of 6.7%), Brazil (5.2%) and Argentina (5.2%). Per annum production decreased most in Nigeria (-3.8%), Mexico (-3.4%), and Angola (-4.0%) during that time (see Table 9-10).

Table 9-10: List of 20 largest oil producers in 2023

Country	Production in 2023 (million bbl/day)	Share of global production 2023	Growth (pa) in production 2013-23	Total production 1965 – 2023 (million bbl/day)	Share of global production 1965 - 2023
US	19.4	20.1%	6.7%	600	14.6%
Saudi Arabia	11.4	11.8%	-	498	12.1%
Russian Federation	11.1	11.5%	0.2%	371	9.0%
Canada	5.7	5.9%	3.5%	159	3.9%
Iran	4.7	4.8%	2.6%	220	5.4%
Iraq	4.4	4.5%	3.5%	134	3.3%
China	4.2	4.4%	-	162	3.9%
UAE	3.9	4.1%	1.0%	136	3.3%
Brazil	3.5	3.6%	5.2%	68	1.7%
Kuwait	2.9	3.0%	-0.7%	135	3.3%
Mexico	2.0	2.1%	-3.4%	139	3.4%
Norway	2.0	2.1%	0.9%	94	2.3%
Kazakhstan	1.9	2.0%	1.0%	45	1.1%
Qatar	1.8	1.8%	-0.9%	51	1.3%
Nigeria	1.5	1.6%	-3.8%	106	2.6%
Algeria	1.4	1.5%	-0.5%	79	1.9%
Libya	1.3	1.3%	2.0%	89	2.2%
Angola	1.2	1.2%	-4.0%	44	1.1%
Argentina	1.1	1.1%	5.2%	37	0.9%
Oman	1.0	1.1%	1.1%	38	0.9%

Source: Energy Institute (2024)

Gas production is even more regionally uneven than oil production. Two of the four largest oil producers, the United States and the Russian Federation, accounting for over 40% of 2023 production. The 20 largest gas producers jointly accounted for 86% of global gas production in 2023. The United States and the Russian Federation also account for 42% of all gas produced between 1965 and 2023 (see Table 9-11 and Figure 9-14).



All except four of the 20 largest gas producers have continued to increase their average annual production rates between 2013 and 2023, most significantly in Australia, China. Gas production has only declined in Indonesia, Mexico, Uzbekistan and the Russian Federation between 2013 and 2023 (see Table 9-11).

Table 9-11: List of 20 largest gas producers in 2023

Country	Production in 2023 (bcf/day)	Share of global production 2023	Growth (pa) in production 2013-23	Total production 1965 – 2023 (bcf/day)	Share of global production 1965 - 2023
US	100.2	25.5%	4.7%	3043.5	24.7%
Russian Federation	56.7	14.4%	-0.5%	2180.5	17.7%
Iran	24.4	6.2%	4.8%	414.1	3.4%
China	22.7	5.8%	6.8%	300.9	2.4%
Canada	18.4	4.7%	2.3%	672	5.5%
Qatar	17.5	4.5%	0.8%	293.6	2.4%
Australia	14.7	3.7%	9.6%	220.4	1.8%
Norway	11.3	2.9%	0.7%	290.3	2.4%
Saudi Arabia	11.0	2.8%	1.8%	260.2	2.1%
Algeria	9.8	2.5%	2.5%	303.5	2.5%
Malaysia	7.8	2.0%	1.1%	199.1	1.6%
Turkmenistan	7.4	1.9%	2.6%	214.7	1.7%
Indonesia	6.2	1.6%	-1.9%	261.0	2.1%
Egypt	5.5	1.4%	0.6%	129.5	1.1%
UAE	5.4	1.4%	0.4%	157.6	1.3%
Uzbekistan	4.3	1.1%	-2.3%	185.1	1.5%
Nigeria	4.2	1.1%	2.8%	88.3	0.7%
Oman	4.2	1.1%	3.4%	69.6	0.6%
Argentina	4.0	1.0%	1.9%	133.5	1.1%
Mexico	3.4	0.9%	-3.8%	165.1	1.3%

Source: Energy Institute (2024)

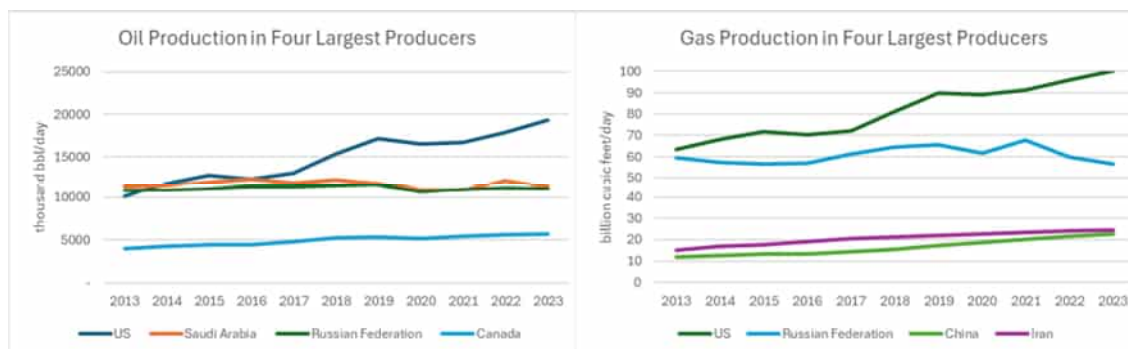


Figure 9-14: Global oil and gas production 2013 to 2023 in the four largest producers

Source: Energy Institute (2024)

Overall exploration activity has declined in recent years compared with previous decades, as fewer wells were drilled (see Figure 9-15), while the average volume of resource found per well drilled (including dry wells) remains stable at ~30 million boe. Wood Mackenzie (2024) states that global oil and gas demand growth since 2000 far exceeded exploration activity. Since 2000, an overwhelming majority of large discoveries lie in deepwater basins (see Figure 9-16) (Wood Mackenzie, 2024).



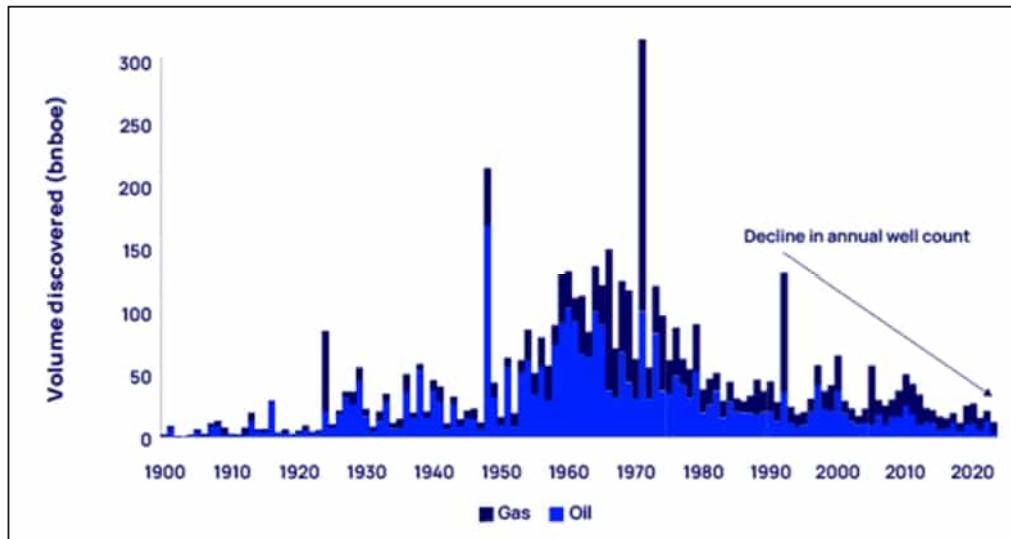


Figure 9-15: Volume of conventional oil and gas discoveries since 1900

Source: Wood Mackenzie (2024)

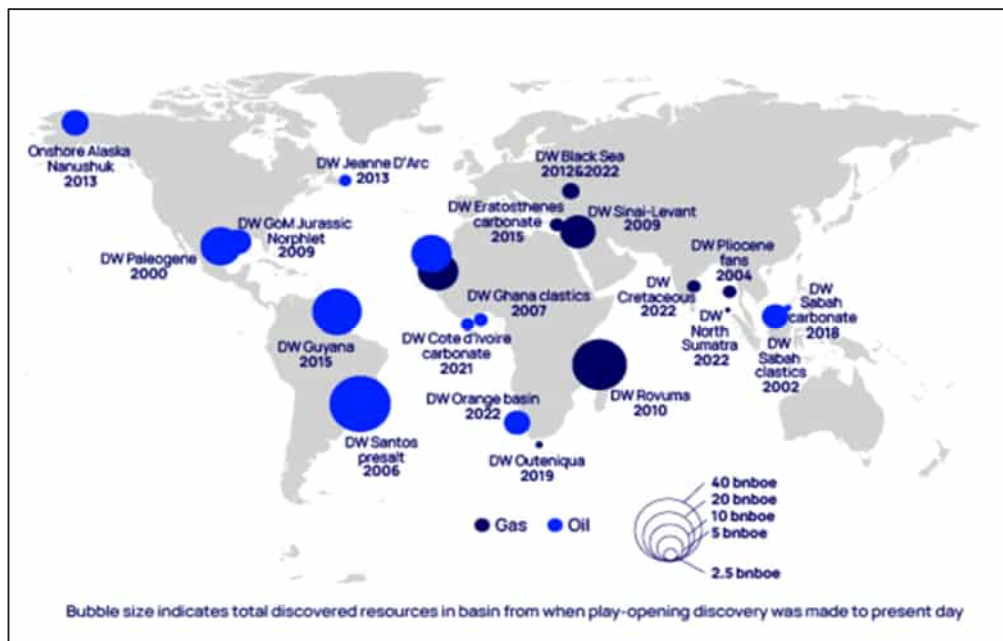


Figure 9-16: Location and volume of oil and gas discoveries since 2000

Source: Wood Mackenzie (2024)

Note: DW means Deep Water



High impact exploration¹⁴⁹ is expected to remain stable in 2025 compared to previous years, with 65-75 high impact wells expected to be drilled worldwide in 2025 (compared to 66 to 83 high impact wells drilled annually between 2020 and 2024, see Figure 9-17) (Offshore Magazine, 2025).

Exploration focus areas in 2025 include the West Coast of central and southern Africa, east and north coasts of South America, the Gulf of Mexico, the North / Norwegian Sea, the China South Sea, Bengal Sea and the Black Sea (see Figure 9-18).

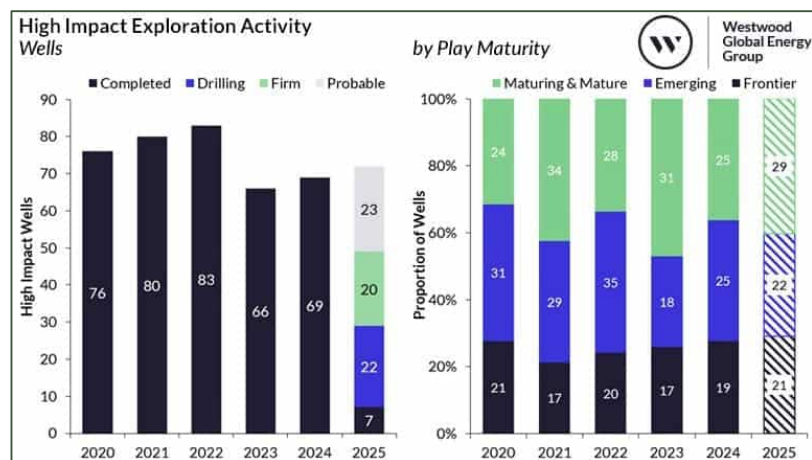


Figure 9-17: High impact well drilling activity 2020 – 2025¹⁵⁰

Source: Offshore Magazine (2025)

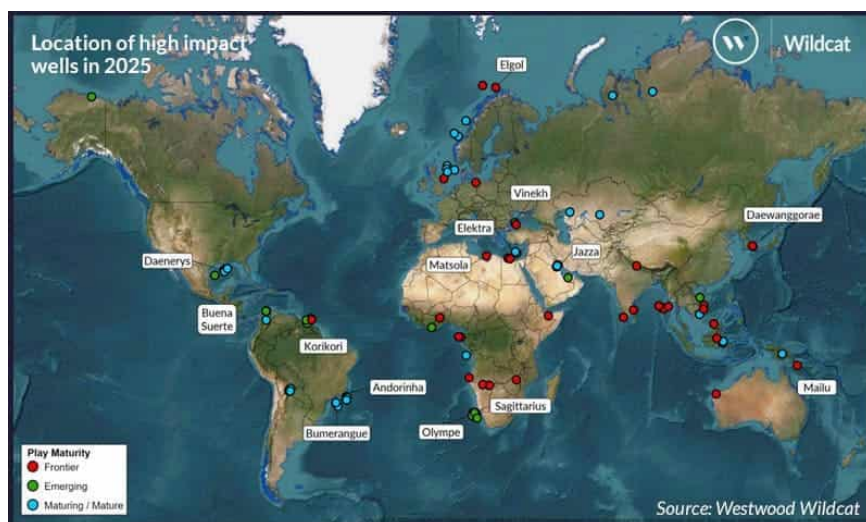


Figure 9-18: Expected high impact well drilling focus in 2025

Source: Offshore Magazine (2025)

¹⁴⁹ High impact exploration refers to drilling activities aimed at discovering large, commercially viable quantities of oil and gas. These explorations target significant resources that can justify the development of new infrastructure and have the potential to transform the energy landscape of a region, and that only begin to add revenues several years into the future.

¹⁵⁰ Frontier is defined as having no production from similar reservoirs in the same basin. Emerging relates to areas where initial exploration has identified potential hydrocarbon resources. Mature refers to formations that have been extensively explored and developed over a long period.



Reasons for continued high impact exploration cited by (Wood Mackenzie, 2024) include:

- Improvement of portfolio quality by adding more “advantaged barrels” (oil and gas resources that are economically attractive and environmentally favourable) even with retreat from oil and gas under an accelerated energy transition scenario (with production growth or replacement secondary considerations in many cases); and
- Lower scope 1 and 2 emissions in new fields thanks to modern decarbonisation technologies and higher facilities throughput¹⁵¹, while retrofitting old fields is expensive.

The IEA also notes that nearly 90% of annual upstream oil and gas investment since 2019 has been dedicated to offsetting production declines rather than to meet demand growth. Filling the remaining supply gap to maintain today’s production through to 2050 would require annual discoveries of 10 billion barrels of oil and around 1 000 bcm of natural gas. These amounts are just above what has been discovered annually in recent years. Developing these resources would add around 18 mb/d and 650 bcm of new oil and gas production by 2050 (IEA, 2025).

9.2.3.2 Namibian Supply

Namibia imports virtually all oil consumed in the country, primarily through the Port of Walvis Bay. In 2023, petroleum imports through Walvis Bay increased to 1 192 286 tons, from 796 277 tons in 2022, highlighting the growing role of fuel imports (New Era, 2024). Oil is imported primarily from South Africa, the Middle East, Asia, and Europe. As Namibia has no refining capacity, it is dependent on the import of refined petroleum products (ICLG, 2023).

Historic and recent offshore oil and gas discoveries have not yet translated into domestic production and supply.

9.2.4 Outlook for Oil and Gas Consumption and Energy Supply

Demand for oil and gas is difficult to forecast, as it depends on a wide range of factors such as economic activity and (energy) consumption (as a function of population growth and per capita income / consumption), performance of other energy technologies and degree of electrification of various sectors.

At the 28th Convention of Parties (COP28) held in September 2023, parties adopted a decision on the first Global Stocktake under the Paris Agreement, which recognizes the need for deep, rapid, and sustained reductions in GHG emissions in line with 1.5°C pathways and inter alia calls on parties to contribute, in a nationally determined manner, to global efforts on:

- Tripling renewable energy capacity globally and doubling the global average annual rate of energy efficiency improvements by 2030;
- Accelerating efforts towards the phase down of unabated coal power;
- Accelerating efforts globally towards net zero emission energy systems, utilizing zero- and low-carbon fuels well before or by around mid-century;

¹⁵¹ With minimal influence on demand, such benefits are limited to upstream scope 1 and 2 emissions rather than the order-of-magnitude larger scope 3 emissions. New fields about to begin production in the next few years will average scope 1 and 2 emissions intensity of 17 kgCO₂e/boe over 2025-30, compared with existing supply from mature fields averaging 28 kgCO₂e/boe. If exploration through the current decade provides the anticipated 12% of global oil and gas supply and displaces existing supply options with emissions intensity typical of older fields, then global scope 1 and 2 emissions in 2030 would reduce by ~6%, or 100 Mtpa CO₂e. Deepwater projects on average enjoy high recovery per well and tend to have lower emissions intensity than shelf and onshore projects (Wood Mackenzie, 2024).



- Transitioning away from fossil fuels in energy systems, in a just, orderly, and equitable manner, accelerating action in this critical decade, so as to achieve net zero by 2050 in keeping with the science;
- Accelerating zero- and low-emission technologies, including, *inter alia*, renewables, nuclear, abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors, and low-carbon hydrogen production;
- Accelerating and substantially reducing non-carbon-dioxide emissions globally, including in particular methane emissions by 2030;
- Accelerating the reduction of emissions from road transport on a range of pathways, including through development of infrastructure and rapid deployment of zero and low-emission vehicles; and
- Phasing out inefficient fossil fuel subsidies that do not address energy poverty or just transitions, as soon as possible with developing countries taking the lead (IISD, 2023) (UNFCCC, 2023).

COP29, held in November 2024, further developed a number of the themes discussed at COP28, and reached agreement on (UNFCCC, 2024) (WEF, 2024):

- Tripling climate finance to developing countries, from the previous goal of USD 100 billion annually to USD 300 billion annually by 2035, for which delivery is led by developed countries. Further, parties should secure efforts of all actors to cooperate and scale up finance to developing countries, from public and private sources, to USD 1.3 trillion per year by 2035; and
- How carbon markets will operate under the remaining sections of Article 6 of the Paris Agreement, to make country-to-country trading and a carbon crediting mechanism fully operational.

Key decisions on agreements around fossil fuel transition, mechanisms for scaling and distributing funds, and linking biodiversity with climate action remained unresolved and were postponed to COP30 scheduled for November 2025.

The United States Energy Information Agency (US EIA) published an International Energy Outlook in 2023, which is based on a set of policy-neutral baselines that focus on the current trajectory of the global energy system (US EIA, 2023).

The Outlook expects global energy intensity (energy required for a unit of production) will decline by 35%¹⁵² from 2020 to 2025. It also predicts that energy-related carbon intensity (the amount of CO₂ emitted per energy unit) will reduce by 14%¹⁵³. At the same time, the Outlook expects increasing population and incomes (see Figure 9-19) to offset the effects of declining energy and carbon intensity on emissions.

¹⁵² From ~48 000 to ~31 000 British thermal units (Btu) per 2015 purchasing power parity (PPP) dollars of Gross Domestic Product (GDP)

¹⁵³ From ~56 to 48 t CO₂ per billion Btu



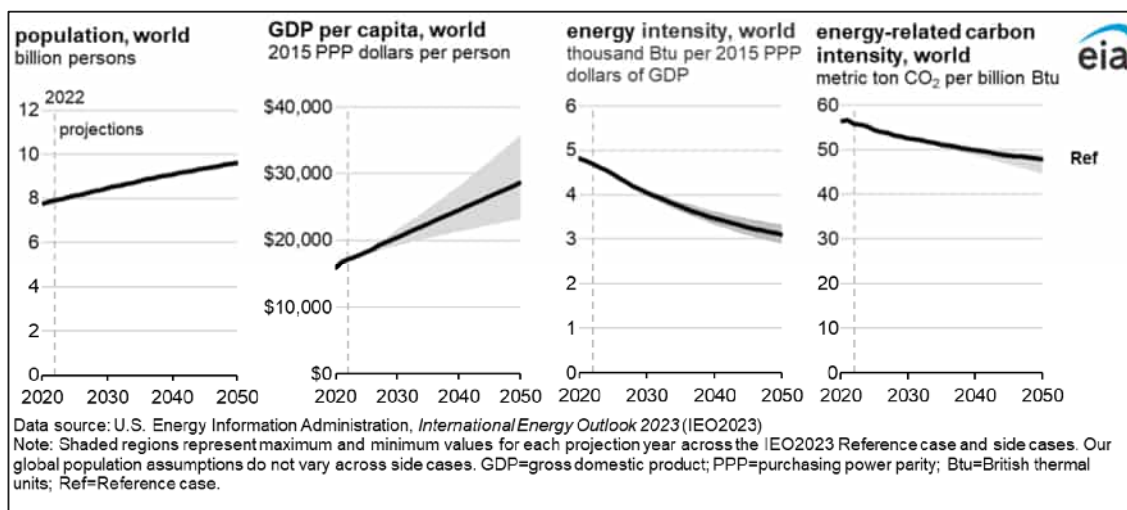


Figure 9-19: Predicted outlook for global population, GDP per capita, energy intensity and energy-related carbon intensity to 2050

Source: US EIA (2023)

While energy provided by non-fossil fuels is expected to more than double by 2050 relative to 2022 (from ~110 quads¹⁵⁴ to ~250 quads), fossil fuel use is also expected to remain at least equal to 2022 levels in the low projection (at ~500 quads), and to grow by ~20% (to ~600 quads) in the reference case (see Figure 9-20).

Compared to 2022, coal consumption is expected to remain approximately the same or reduce slightly by 2050, while oil (and oil products) and gas would provide the majority of energy supply, coupled with pronounced growth in wind and solar (see Figure 9-21).

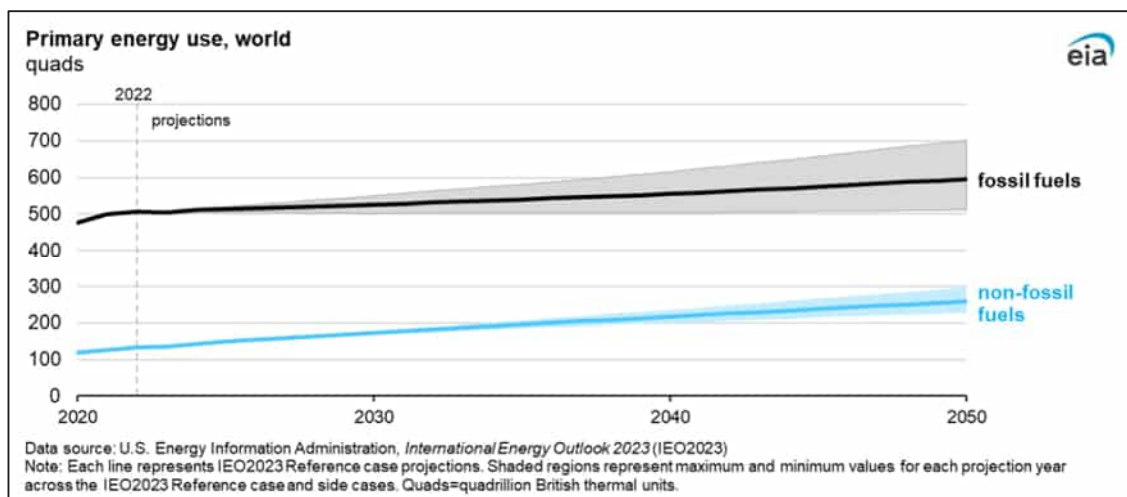


Figure 9-20: Outlook for global primary energy use to 2050

Source: US EIA (2023)

¹⁵⁴ 1 quad = 1 quadrillion (10¹⁵) BTUs = 1.055 exajoules (EJ)



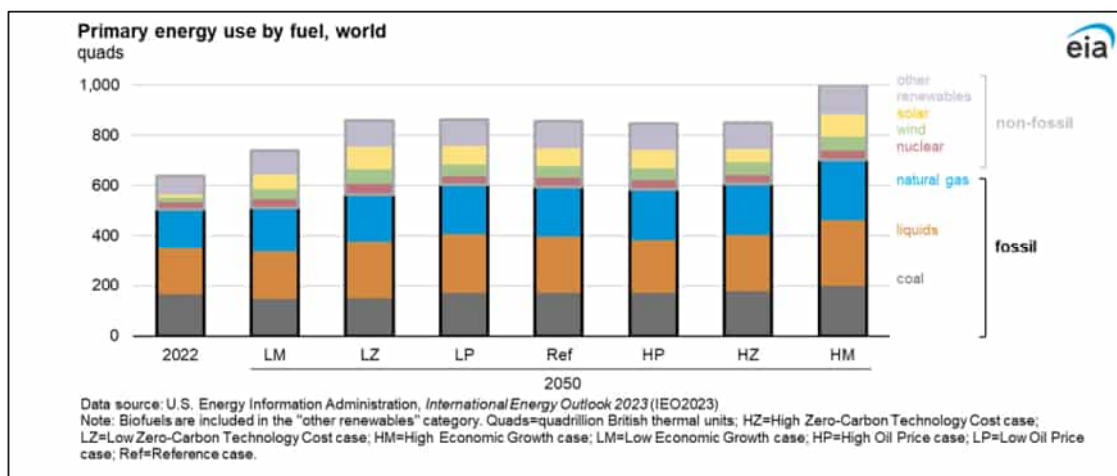


Figure 9-21: Outlook for the global primary energy mix for different scenarios in 2050

Source: US EIA (2023)

This Outlook further notes that:

- The shift to renewables to meet growing electricity demand is driven by regional resources, technology costs and policy. For example, the speed and level of electric vehicle penetration will depend on policy incentives, battery costs, efficiency standards and electricity prices (see Figure 9-22). While coal-fired and liquid-fired electricity generation capacity¹⁵⁵ is expected to decrease by 2050, the degree to which new renewable electricity generation capacity will outweigh new fossil fuel (particularly gas)-based generation depends on economic growth, technology and price factors (see Figure 4-23). Similarly, the BCG notes that there is no single transition, but multiple country and regional transitions unfolding with differences in pace and technology choices (BCG, 2025);
- Energy security concerns hasten a transition from fossil fuels in some countries, although they drive increased fossil fuel consumption in others, e.g. due to poor (remaining) indigenous fossil fuel resources a transition to low carbon resources is faster in Western Europe, India and China than in Africa (see Figure 9-24), while Asia and Europe may import more natural gas to meet growing demand, mostly supplied from the Middle East (see Figure 9-25); and
- New policies, geopolitical events, and technology breakthroughs will happen that shift the trajectory of the global energy system and add uncertainty to any projection.

¹⁵⁵ Electricity generation only accounts for a portion of overall energy consumption, currently in the region of ~20%; this will increase as sectors and processes are increasingly electrified, which also increases the absolute demand for electricity.



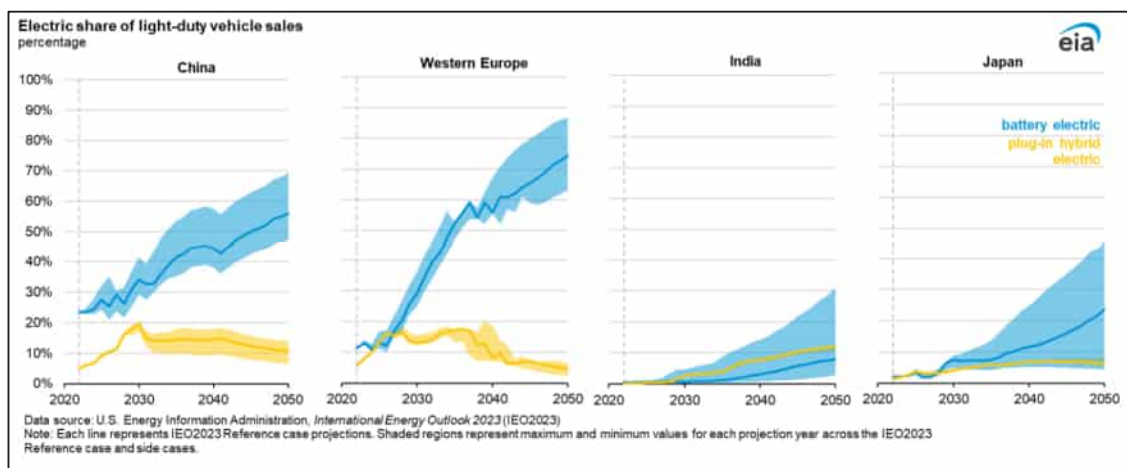


Figure 9-22: Projection for electric vehicle penetration in selected regions by 2025

Source: US EIA (2023)

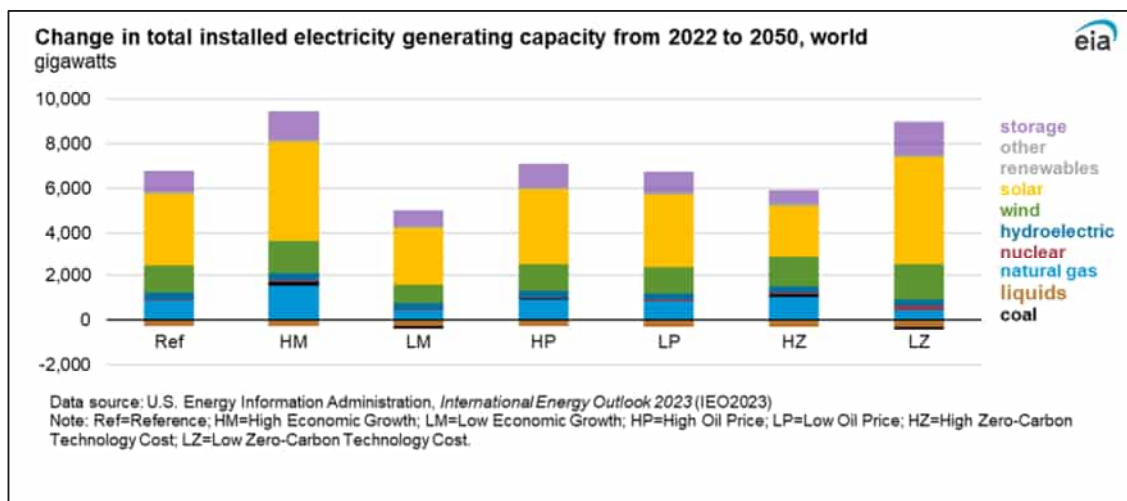


Figure 9-23: Projection for change in global electricity generating capacity (2050)

Source: US EIA (2023)

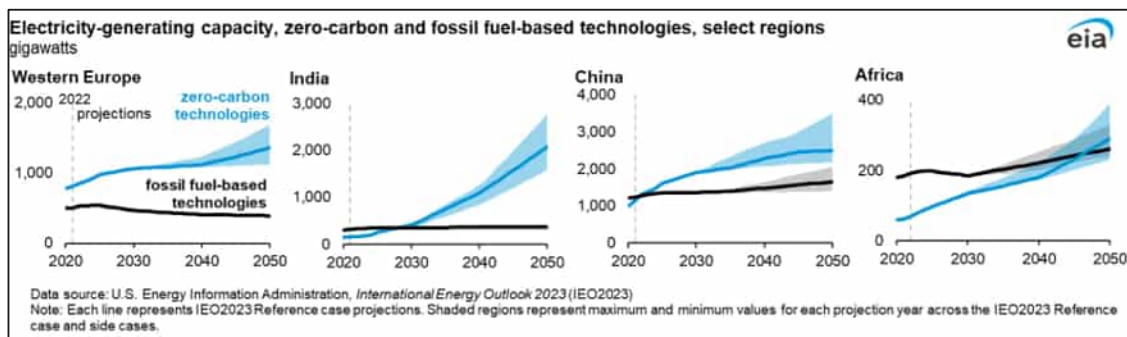


Figure 9-24: Possible technologies trajectories in selected regions 2020 – 2050

Source: US EIA (2023)



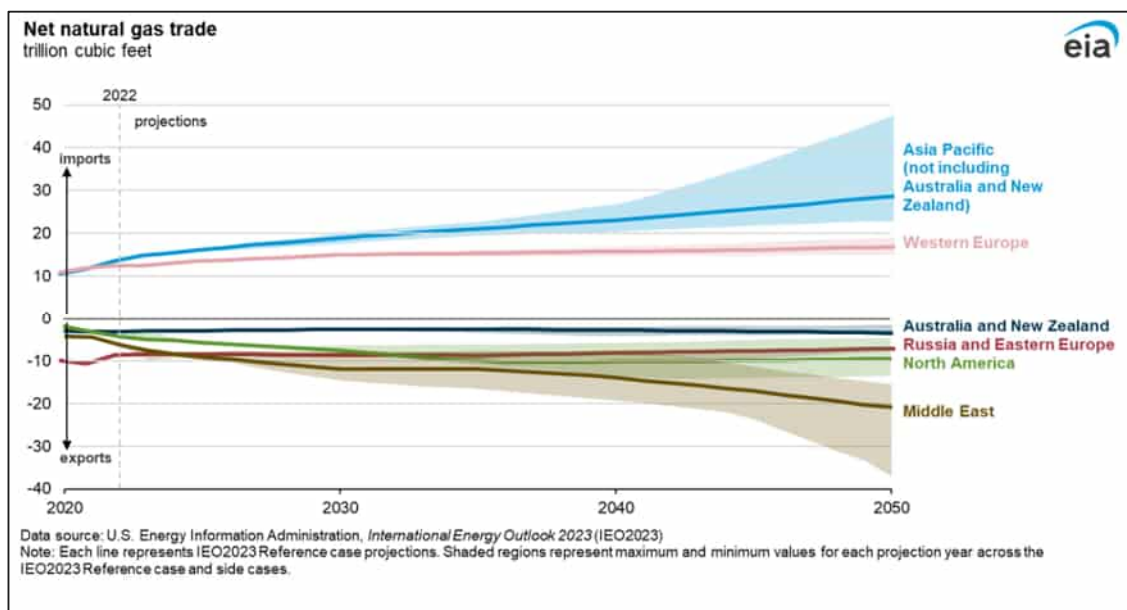


Figure 9-25: Outlook for natural gas trade 2020 – 2050

Source: US EIA (2023)

Wood Mackenzie (2024a) also anticipates that energy intensity will reduce in future: while GDP growth of 96% between 2000 and 2024 resulted in end-use energy demand growth by 64%, anticipated further GDP growth of 81% between 2024 and 2050 is expected to further increase end-use energy demand by only 19%, of which ~40% each are used in the Asia Pacific region and Europe, Middle East and Africa region, with the remainder 20% used in the Americas.

Wood Mackenzie (2024a) reports a somewhat lower global energy demand of ~450 EJ (~426 quads) in 2025 than US EIA (2023), and projects overall energy demand by 2050 to either increase by ~15% to ~515 EJ (488 quads) in the base case or decrease by ~15% to ~380 EJ (~360 quads) in the net zero case. This is considerably lower than US EIA (US EIA, 2023) projections and based on an assumption that each unit of electricity generated from renewable sources displaces three times as much in fossil fuel demand (see Figure 9-26), possibly due to efficiency gains, though such a displacement ratio (i.e. renewables reducing overall energy demand) is not universally accepted.

On that basis, Wood Mackenzie (2024a) predicts a steeper decline in oil and gas use to 2050 than US EIA (2023), but anticipates oil and biofuels demand of ~30 to ~95 million bbl per day and gas demand of ~2 000 to 4 500 billion m³ per day in 2050 (see Figure 9-27).



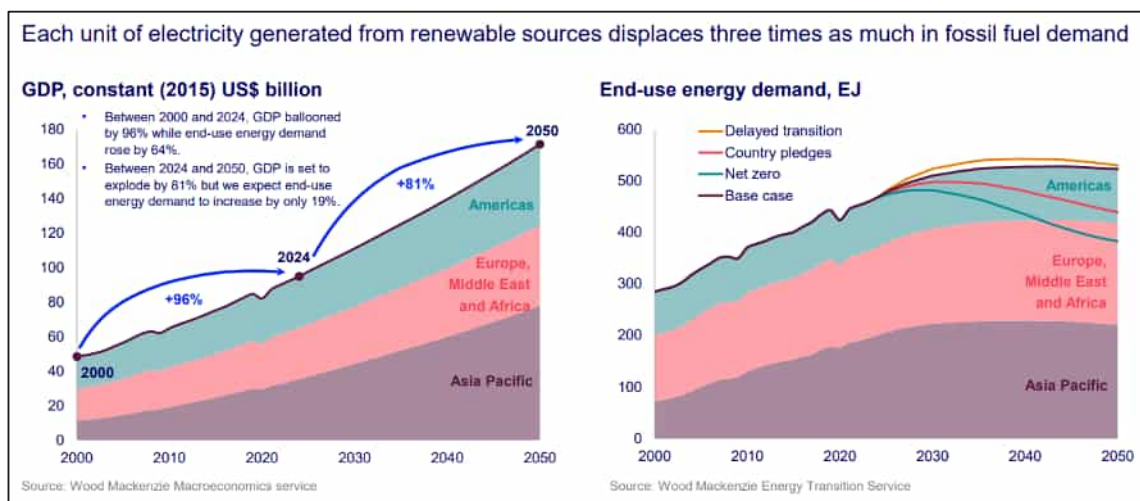


Figure 9-26: Projected development of energy demand to 2050

Source: Wood Mackenzie (2024)

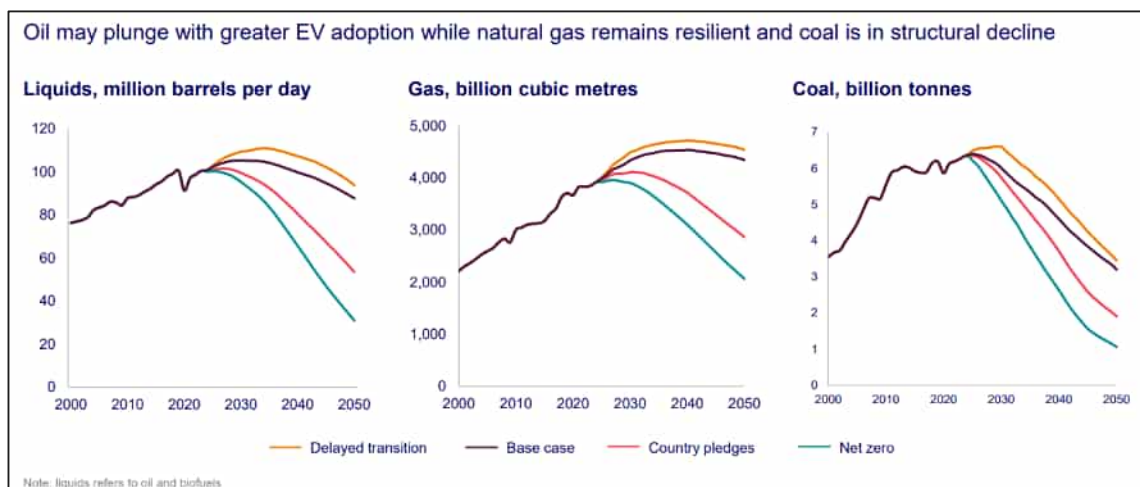


Figure 9-27: Projected development of oil and gas demand to 2050

Source: Wood Mackenzie (2024)

More recently and somewhat conversely – highlighting the challenge in forecasting future demand – BCG (2025) expect that “oil and gas will very likely continue to play a significant role in the global energy mix for longer than many previous estimates had predicted. Even in accelerated transition scenarios, sectors such as aviation, heavy transport, and petrochemicals lack scalable alternatives, keeping oil demand structurally resilient. The 2024 IEA World Energy Outlook projects that oil production in 2040 will remain at 96% of 2023 levels under the Stated Policies Scenario (STEPS) and at 71% under the Announced Pledges Scenario (APS). Projections of peak oil demand continue to be pushed out further in time. Meeting this demand will require sustained upstream investment of, on average, \$350 billion per year through 2050, with new resource development needed under most scenarios. Only under the normative Net Zero Emissions scenario would discovered and economically viable resources be sufficient to meet projected oil demand through 2050.

Meanwhile, gas—particularly LNG—is seeing a more robust and strategic expansion. Global LNG demand is expected to rise 80% by 2040, with 38 new importing countries projected joining the market. LNG is now seen as a geopolitical fuel, with flows increasingly shaped by



national alliances. The US has emerged as the leading exporter, overtaking legacy suppliers. Continued gas reliance makes addressing methane emissions critical, given that its short-term warming potential is 80 times greater than CO₂."

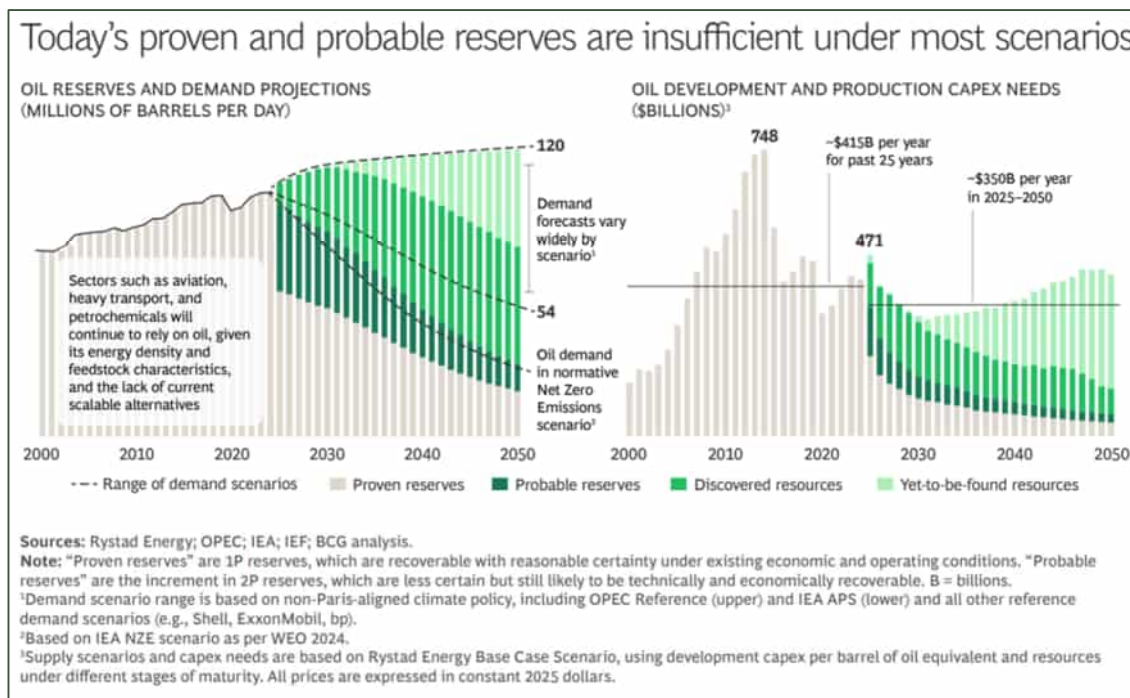


Figure 9-28: Predicted oil demand vs proven reserves, and required investment

Source: (BCG, 2025)

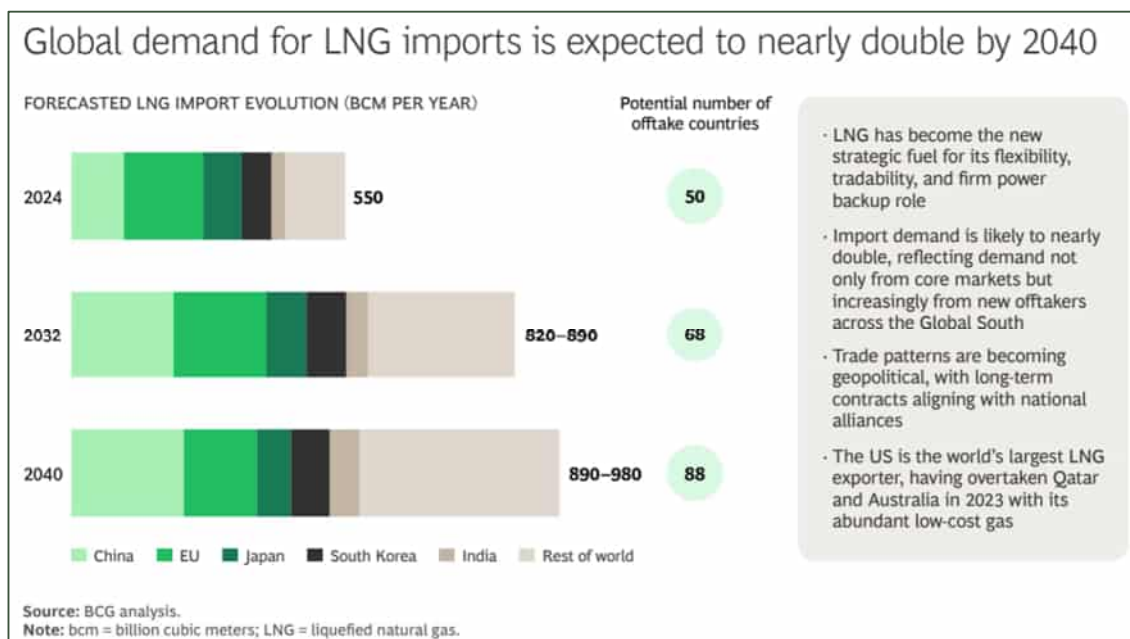


Figure 9-29: Predicted LNG demand growth

Source: (BCG, 2025)



9.2.5 Other Considerations

Other potential considerations that inform the desirability of certain energy forms and sources are briefly discussed below; they are complex and continuously evolving topics that affect a range of national policy aspects and decisions.

9.2.5.1 Energy Security

Recent geopolitical events have again demonstrated the vulnerability of countries highly dependent on energy imports to fluctuating supply and prices and possible associated shocks. As noted in Section 9.2.4, energy security concerns are likely to hasten a transition from fossil fuels to low carbon resources in those countries without an indigenous or otherwise secure supply of such resources, while they drive increased fossil fuel consumption in other countries (notably those with an indigenous or secure supply).

In a similar vein, BCG states that “Energy security, energy affordability, and economic resilience and competitiveness are tightly linked. As the geopolitical landscape becomes more fragmented, altering the economic dynamics in many countries, energy security has taken on even greater urgency. This development has profound implications for the energy transition. Increasingly, countries are focusing on expanding the share of their energy that comes from indigenous sources.” (BCG, 2025) It further notes that trade barriers for some green technologies are now reaching similar levels as those for oil products (especially for lithium batteries, solar PV and electric vehicles) and that many clean technologies are highly exposed to global supply chains (BCG, 2025), decreasing relative security of supply of the technology (irrespective of generation reliability).

Determining the appropriate future energy mix for a country is thus a key task of national governments.

9.2.5.2 Economic Contribution

While importing energy effectively represents a leak of national funds to suppliers of the resource, domestic production could contribute to some job and income creation in Namibia, as well as government income in the form of taxation and royalties, provided that indigenous production is competitive, which must be determined by the producers. Determining appropriate contractual and taxation regimes of any extractive industry is a key task of national governments.

9.2.5.3 Stranded Assets and Liabilities

Companies should make financial provision for the closure and decommissioning of projects at any time of its lifecycle, and/or to attend to potential pollution events, as per company, industry and national standards and requirements¹⁵⁶.

The risk of not being able to fully recover investment in the project is that of the company. As noted in Section 9.2.4, there is very limited sight of new policies, geopolitical events and technology breakthroughs that shift the trajectory of the global energy system.

¹⁵⁶ In Namibia the Petroleum (Exploration and Production) Act, 1991, amended by the Petroleum Laws Amendment Act, 1998, requires the operator to 1) establish a decommissioning trust fund once 50% of estimated recoverable reserves are produced, where annual payments into the fund are calculated using a unit of production method and funds are used exclusively for decommissioning petroleum installations, and 2) submit a decommissioning plan with the production licence application that is reviewed and updated no later than one year before reaching the 50% production threshold.



9.3 Conclusion on Need and Desirability

Fundamental issues around energy mix and transition are too complex to comprehensively and conclusively analyse at a project level – policy priorities and appropriate energy mix and transition pathways must be decided and set at a national policy level considering specificities in local and regional supply and demand, local resources, affordability and technology availability.

The analysis of Namibian policy shows that it aims to progressively reduce GHG emissions while, at the same time, ensuring a stable and sufficient energy supply and enabling just and inclusive economic growth, in part through exploitation of local petroleum resources. Production of local hydrocarbon resources is in principle compliant with and in direct or indirect furtherance of several energy, economy and resource-related policies and plans. Compatibility with climate change-related policies and targets depends on the nature of commitments, plans and policies and progress in decreasing emissions from other sources.

Given the importance of energy to economic activity and growth, and the importance of economic growth to ensuring a prosperous and stable society in Namibia, coupled with the complexity and fluidity of global trends and supply chains, retaining optionality and diversification in national income, economy and energy supply appears desirable in itself.

Empirical data indicates that hydrocarbon resources are critical to the global and Namibian energy supply at present, and that they are likely to remain an important source of energy for some time to come, even in the light of intense efforts to develop alternative low- or no-carbon energy sources, given the low penetration thereof in the energy mix at present.

Notwithstanding the likely continued demand for (and supply of) hydrocarbon resources globally and in Namibia, and the in-principle compliance of the project with Namibian policies, the need and desirability of a *particular* activity (or project) is also determined by the acceptability of residual environmental and social impacts of the proposed activities; these indicate the sustainability of a specific activity or project, which is an important criterium of policy.

While Section 9.1 discusses the in principle fit of the proposed project with Namibian policy and principles, and Section 9.2 discusses the broader context and outlook of petroleum demand and supply, the potential biophysical and socio-economic impacts of the proposed project are in Section 7.0 for normal operations and in Section 8.0 in the event of a highly unlikely unplanned event, such as a major oil spill.

Based on the impact assessment, all residual negative environmental impacts of normal operations are deemed to be of Low, Very Low or Negligible significance, except the project contribution to GHG emissions, which is assessed as a Medium – High negative impact (based on EBRD criteria). The estimated project GHG emissions will contribute to the global inventory, reduce Namibia's net sink capacity and lower the remaining amount of GHG emissions permissible under Namibia's international commitments. The decision to proceed with the project will need to balance its GHG emissions against broader policy objectives—such as climate commitments, economic growth, and project's overall benefits—rather than evaluating it solely at the project level.

For socio-economic and cultural aspects, during normal operations, certain negative impacts (e.g. reduction in fishing livelihood, maritime traffic and community health and safety) are rated as Low to Negligible significance, whereas other aspects, such as contribution to GDP, contribution to exports and trade balance, contribution to government revenue or employment are expected to be highly beneficial in the context of Namibia's current economic activity level and unemployment characteristics, and are assessed to be of High positive significance.



Project impacts related to normal operations are thus deemed environmentally and socially acceptable and sustainable in that they do not threaten the viability of any populations or habitats.

As noted above, GHG emissions are the most significant negative impact of this project during normal operations. Since emissions affect a “global resource” of atmospheric GHG levels that is also contributed to by other global actors, this aspect must be considered in a different context than the other project impacts (which are more singularly affected by the project). If global oil supply and use are governed by a wider market demand that is driven by factors such as the availability, effectiveness and affordability of alternative energy sources (which seems to be the case at present), and if there is sufficient global production capability to meet future oil demand (which also seems to be the case at present with new production replacing existing declining fields being required for the foreseeable future), then global oil supply and use will not be constrained or affected by whether oil is produced by the Venus Development project or not. The proposed Venus Development project is then not a limiting (or enabling) factor for global oil use (and associated GHG emissions). It would not significantly influence global oil use or related GHG emissions. If the project does not proceed, other countries would likely produce the oil instead to meet global demand. Global GHG emissions would then not be affected by whether the Venus Development project goes ahead, but rather by other factors that determine the trajectory of global adoption of other energy sources.

While some impacts associated with reasonable worst-case unplanned events are of Very High negative significance, they are not normal operational scenarios, and measures will (and must) be put in place to actively prevent these events from occurring. The potentially very high significance of impacts highlights the importance of preparing strong and immediate response measures to minimise the volume and spread of any hydrocarbons, and reduce any impact associated with an unplanned event (should it occur). No irreplaceable resources would be lost in the event of a major incident as assessed.

This analysis shows that:

- The project type is compatible with key needs and desires identified in Namibian policy.
- Socio-economic benefits expected from the proposed project are highly significant and respond to needs and desires identified in Namibian policy.
- Environmental and socio-economic impacts can be mitigated to tolerable levels.
- GHG emissions, the main negative impact, will lower the remaining amount of GHG emissions permissible under Namibia’s international commitments, and will need to be weighed in the project decision-making against Namibian policies, including climate commitments and economic growth, and the project’s overall benefits.
- If the project does not proceed, other countries would likely produce the oil instead to meet global demand.





10.0 Conclusions and Recommendations

This chapter presents the general conclusions drawn from the ESIA process, which should be considered in evaluating the project. It should be viewed as a supplement to the detailed assessment of individual impacts and other aspects in preceding chapters.

The ESIA has examined the proposed project information and baseline data to identify and assess environmental (biophysical and socio-economic) impacts of the proposed project and identify mitigation measures to manage these impacts. The ESIA Report aims to inform stakeholders and decision-makers by providing an objective and comprehensive analysis of the potential impacts and benefits of the project.

10.1 Summary and Evaluation of Impacts from Normal Operations

The impact assessment and evaluation were undertaken in the context of the project information provided by the JV, assumptions stated for the ESIA Report and specialist studies, and understanding that industry standards and best practice, as well as the identified project controls and mitigation measures will be implemented effectively.

Table 10-1 summarises the significance ratings of assessed impacts before and after the application of mitigation and/or optimisation measures.

10.1.1 Marine Ecology Impacts

The predicted marine ecology impacts result primarily from physical impacts to the seabed from well drilling and equipment installation, release of effluent or substances to the sea, FPSO operation, and noise emitted by drilling activities and project vessels. These can affect marine fauna that frequent the Venus offshore project area, areas through which project vessels travel between ports and project site and/or the nearshore transshipment area.

Underwater sound transmission loss, drill cuttings discharge and liquid effluent dispersion modelling were undertaken for this ESIA and informed the impact assessment of normal operations. The Venus offshore project area is located far offshore in an area classified as 'Least Threatened', where biodiversity and fauna density are relatively low and where marine habitats are largely uniform (unconsolidated sediments, devoid of features). Marine ecology impacts are thus deemed to be of **Low to Negligible** significance after mitigation and briefly summarised below:

- *Smothering and disturbance of seabed animals:* During the drilling and installation of equipment on the seabed, some benthic fauna may be disturbed or covered by discharges from the drilling process. However, the impact is expected to be limited in extent, with the deposition of drill cuttings >6.5 mm thickness (i.e. the threshold above which potential harm to the ecosystem might be observed) modelled to be located 270 m from wells. Most of the seabed in the Venus offshore project area is made up of unconsolidated, soft sand and mud, which is inhabited by fast-growing species that can recover quickly after being disturbed. Over time, the affected areas are expected to recover naturally.
- *Effects on seabed animals due to turbidity, toxicity and hypoxic effects:* During drilling activities in the Venus offshore project area, some marine animals that live in soft seabed sediments may be affected by drilling mud and chemicals released onto the seafloor and into the water column. The drilling mud and cuttings can make the water cloudy (turbid), which may affect how some animals feed or breathe, and chemicals in the mud can reduce oxygen levels in the seabed sediments over time. However, these effects are expected to be limited in extent, with recovery expected over the long-term.



- *Change of seabed habitat due to infrastructure on the seabed:* The installation and presence of subsea infrastructure – such as pipelines, anchors and wellheads – on the seabed can change the natural habitat of benthic fauna, especially in areas with soft, unconsolidated sediments. Due to the nature of the seabed and water depth in the Venus offshore project area, the benthic fauna diversity is low, and the project area is small in comparison to similar seabed habitat off the edge of the continental shelf off the southern and central Namibian coast.
- *Effects on pelagic and demersal fauna due to turbidity, toxicity and hypoxic effects:* During the drilling and production phases of the Venus offshore project, substances such as drill cuttings, mud and treated water will be discharged into the ocean, potentially affecting pelagic and demersal marine fauna. However, the intensity of these impacts is considered low due to several factors: the deep offshore location (approximately 3 000 m deep), the rapid dilution and dispersion of discharge plumes, and the high mobility of pelagic species, which allows them to avoid affected areas, with no overlap with inshore key spawning zones or sensitive habitats like Tripp Seamount.
- *Behavioural changes in marine mammals:* Marine mammals may change their behaviour if exposed to higher underwater noise from vessels, drilling operations, and VSP, as well as increased lighting and occasional helicopter flyovers. These impacts are expected to be of low to medium intensity, dependant on the location of project activities (i.e. nearshore transshipment area versus Venus offshore project area). Behavioural impacts due to underwater noise could extend up to 100 km during peak drilling and installation phases, reducing to smaller zones during production and transfer / transshipment activities (up to 8.9 km from the nearshore transshipment mooring and up to 38.2 km from the FPSO). These impact durations vary from short-term events to the full project lifespan. Once the activity ceases, the associated noise levels will rapidly dissipate. Marine mammals are highly mobile, allowing them to avoid disturbance.
- *Behavioural changes in fish:* Noise from drilling and vessel operations may cause the fish to avoid the affected area, while lighting could attract fish and increase their chances of becoming prey. These effects are generally localised, with impact zones ranging from a few hundred metres to a few kilometres (up to 5.5 km for VSP), and durations varying from short-term events to the full project lifespan.
- *Behavioural changes in turtles:* Underwater noise from drilling and vessel operations is not expected to reach levels that cause behavioural disturbance in turtles, and lighting impacts are limited to the immediate vicinity of vessels and equipment. behavioural disturbance to turtles due to VSP is predicted to occur up to 360 m from the source. As turtles are highly mobile and the project areas are very far from nesting beaches in Angola and South Africa, the impacts are considered to be of low intensity.
- *Behavioural changes in seabirds:* Seabirds may change their behaviour in the short-term if exposed to helicopter noise and artificial lighting from vessels, particularly near breeding colonies along the Namibian coast and offshore islands. However, these impacts are considered relatively limited.
- *Injury to marine mammals:* Underwater noise from drilling and vessel operations may cause temporary hearing effects in marine mammals, but these are generally short-lived and limited to areas close to the sound source (up to 6.4 km during production), although effects could occur in low frequency cetaceans within 21.1 km (during construction phase) assuming continuous exposure, which is unlikely. The risk of more permanent hearing impacts due to underwater noise mostly applies to baleen whales (e.g. humpback whales), which are sensitive to certain sound frequencies at



close range (500 m to 1.6 km during construction campaigns). Vessel collisions and entanglement with mooring lines / chains pose a risk for injury and / or mortality, but these impacts are expected to be rare and reversible over time.

- *Injury to fish and ichthyoplankton:* Underwater noise from VSP may cause injury or mortality to fish and ichthyoplankton, but only within close range (<60 m from the source), with impacts short-term. MMOs will keep watch and use PAM to detect whether cetaceans (whales and dolphins) are present during VSP and stop the activity if animals are within the 500 m mitigation zone. Non-impulsive noise from vessels and drilling equipment is not expected to cause physiological harm to fish. During production, seawater abstraction may trap small fish and plankton, but the intensity is considered very low, with impacts confined to the immediate area and unlikely to affect population-level dynamics, considering the Venus offshore project area is located very far from key inshore spawning areas and drift pathways.
- *Injury to turtles:* Temporary hearing effects may occur within 1.6 km of offshore operations during peak / concurrent offshore drilling and installation operation, but would reduce to 500-600 m based on drilling and transshipment / transfer activities. Permanent injury due to increased underwater noise is not expected. Vessel collisions and entanglement with mooring lines pose a risk, though such events are expected to be rare.

10.1.2 Fisheries Impacts

The predicted impacts on fisheries result primarily from the implementation of safety zones around the Venus offshore project area and nearshore transshipment area (vessels cannot enter these areas to fish) and from potential impacts on fish, if any (as assessed in the Marine Ecology Impact Assessment). Such impacts could potentially reduce the catch for fisheries operating offshore and nearshore.

The Venus offshore project area is located far offshore in an area where fishing effort is very low and only targeted by the large pelagic longline sector. The nearshore transshipment area is located relatively close to the Port of Walvis Bay and its safety zone has very limited overlap with active nearshore fishing (including linefish and traditional SSF), harvesting and mariculture areas. Fisheries impacts are thus deemed to be of **Very Low** significance after mitigation and briefly summarised below:

- *Impact on catch of large pelagic longline sector:* Fishing vessels must stay outside the safety zones around the FPSO and subsea infrastructure (including 3 NM maritime exclusion and 10 NM maritime restricted area). For the large pelagic longline sector, the effective exclusion zone is likely larger (± 16 NM) due to the length of the longlines used, which may further displace fishing effort. However, the overlap of these safety zones with important large pelagic fishing grounds is very small (<0.2% of annual average catch recorded within safety zones). Increased underwater noise and discharges may cause minor behavioural changes in fish, but these effects occur within the exclusion zones that are not accessible to other vessels.
- *Impact on catch of linefish sector:* The implementation of a restricted area of 1.7 km radius around the nearshore transshipment buoy may result in localised disturbances to the linefish sector. However, these impacts are expected to be minimal, as the overlap of the restricted area with active linefish fishing grounds is very small. Underwater noise generated during transshipment operations may temporarily influence fish behaviour, but these effects are confined to a small area (up to 1.2 km) and occur within an already busy marine traffic route to and from the Port of Walvis Bay.



- *Impact on catch of small-scale fishing sector:* Nearshore transshipment operations may have a limited impact on the small-scale fisheries (SSF) in the Walvis Bay area. The proposed restricted area has a very small overlap with active SSF grounds, which are mostly limited to intertidal shellfish collection and shallow water seaweed harvesting – these activities occur well outside the transshipment area. Boat-based fishing in the restricted area is minimal.

10.1.3 Socio-Economic Impacts

The predicted impacts on socio-economic aspects result primarily from the project requirements for staff, services and goods from Namibians, from the sale of produced oil and associated income and from safety zones around project areas. On the macro-economic side, these aspects increase the general economic activity (GDP), Namibian export value and government revenue. They also provide new job and income opportunities or may reduce income from other activities if those are negatively affected by the proposed project. The proposed project may also trigger in-migration to coastal towns due to people looking for jobs or business opportunities, which may affect service delivery and health and safety in communities. A new industry with large revenue can also create governance risks or conflict.

The proposed Venus Development would require large investment by the JV and inputs from national and international suppliers and staff. The benefit on GDP, personal job and income generation and skills development is deemed to be **High (positive)** significance. The value of oil sales and associated revenue depends on oil prices, volumes and tax regimes, but benefits of export value and government revenue are deemed to be of **High (positive)** significance.

Safety zones are not expected to materially impact shipping routes and fishing (as noted above) and potential negative impacts on associated livelihoods and costs are **Very Low**. In-migration by people looking for jobs or business opportunities to coastal harbour towns is likely, given the high need for jobs and income, even though many project-related opportunities will be outside of coastal towns. This requires monitoring and management especially in smaller communities. With effective mitigation residual impacts are deemed to be of **Low** significance. Namibia has extensive experience with resource extracting industries (e.g., diamonds, gold, uranium) and an active civil society sector. With implementation of good practice (e.g. EITI) standards the risk to governance and conflict is deemed to be **Very Low**. Impacts are briefly summarised below:

- *Contribution to GDP:* The project generates economic activity through procurement of a portion of goods and services in Namibia. Based on conservative assumptions (as many goods and services are not produced or provided in Namibia), the project will contribute between ~13% to 18% of GDP in early high-production years, and ~2% to 7% in later years when production is lower (depending on production volumes, oil price and actual local content and use of the revenues by the GRN). The project is estimated to contribute between ~N\$ 536 billion and N\$ 800 billion to Namibia's GDP for the anticipated minimum 25-year project lifetime.
- *Contribution to exports and trade balance:* JV members will sell their share of the crude oil produced at the Venus Development to global markets. The oil will thus be a new Namibian export commodity. The value of oil exports depends on volume and oil prices and could amount to ~10% to 40% of total Namibian export value during most of the production timeline. The total oil export value is estimated at ~N\$ 593 billion to N\$ 888 billion for the anticipated minimum a 25-year project lifetime.
- *Contribution to government revenue:* The proposed project will pay money to the government through taxes, levies and other direct or indirect changes. Revenues from oil production are expected to contribute as much as ~8% to 14% of total government revenue at peak, and ~2% to 5% throughout most of the project lifetime.



Total government revenue may total ~N\$ 127 billion to N\$ 229 billion considering a 25-year project timeframe.

- Potential project impacts and benefits associated with the use of government revenue, inflation, Dutch disease, NAMCOR and the Social Cost of Carbon are discussed, but not formally rated, as they depend on government decisions and performance of other economic sectors.
- *Employment and income generation:* Drilling and installation is expected to generate some 5 000 jobs (500 direct (employees), 2 000 indirect (suppliers) and 2 500 induced (wider economy)). During production, an estimated 7 000 jobs will be created (600 direct, 600 indirect and 5 800 induced). Jobs will be distributed in various parts of Namibia, and are important compared to the high demand for jobs especially in coastal towns.
- *Development of skills:* The project creates demand for skilled people who can work in the oil and gas industry and other industries. The JV is already committed to upskilling Namibians, which will continue during all project phases.
- *Reduction in fishing livelihoods:* Fishing and mariculture cannot take place within project safety zones. However, the overlaps between safety zones and active fishing and mariculture areas in the offshore and nearshore areas is very limited. The expected impact on livelihoods associated with those fisheries is thus also very limited.
- *Disturbance of shipping traffic:* Vessels must avoid project safety zones and may thus need to amend their normal routes. However, although the project is located in a busy shipping zone, the safety zones are very small in relation to shipping routes, and will not materially impact the duration of vessels at sea. COLREG protocols ensure safe avoidance.
- *Deterioration of community health and safety:* The project is likely to attract people to towns with existing onshore bases, notably Lüderitz and Walvis Bay, where poverty levels and incidence of some social ills are high. A larger and more diverse population may intensify any competition for employment and resources in those towns, as well as social ills associated with transient populations.
- *Governance and conflict:* New revenue sources can create risks in relation to governance and conflict. Namibia has a long history of resource extraction and generally avoided large-scale negative outcomes. Regulatory frameworks are being strengthened in anticipation of oil and gas development. Citizens and civil society have a keen interest in the management of the sector and high expectations of as a result of increased revenue.
- *Pressure on coastal towns:* Both Lüderitz and Walvis Bay currently struggle to keep up with the supply of land and services for their growing populations. While the proposed project itself will not result in large numbers of workers settling in these towns—since offshore personnel will return home after their shifts—there may be some in-migration linked to indirect economic activities and service industries that develop in support of the project. This places additional pressure on municipal services, and pro-active municipal management thereof is required.
- *Reduction of employment and income at decommissioning:* Direct employment at the JV and supplier contract opportunities will decline and then stop during decommissioning, reducing job and income opportunities. This is a natural part of resource extraction and foreseeable, and can thus be planned for appropriately.



10.1.4 Cultural Heritage Impacts

The predicted impacts on cultural heritage result primarily from any interference of project-related disturbance, pollution or noise with cultural practices or resources. In this manner the project could impact ancestral / spiritual aspects, cultural activities such as fishing and recreation, sense of place, archeological resources and natural heritage areas.

However, most cultural links were reported with onshore or coastal features, which are not expected to be affected by the offshore project. As such, the project impact on cultural heritage is deemed to be **Negligible**.

10.1.5 Human Rights Impacts

Human rights aspects linked to the Project's activities and mitigation measures were identified and whenever possible embedded within these specialist studies:

- Fisheries Impact Assessment (Appendix M).
- Socio-Economic Impact Assessment (Appendix N).
- Cultural Heritage Impact Assessment (Appendix O).
- Air Quality Impact Assessment (Appendix P).
- Climate Change Risk Assessment (Appendix Q).
- Waste Management Study (Appendix R).

Key **potential** human rights related impacts identified included: livelihoods, cultural heritage and Indigenous Peoples, community health and safety, climate change, Government conflict, meaningful participation and access to information, access to remedy, supply chains, worker health and safety, workplace diversity, equity and inclusivity, discrimination, harassment and Gender-Based Violence, security and conflict and human rights defenders.

All the above human rights impacts considered salient to the project context were assessed and described in Section 7.6, with potential impacts considered to be of negligible to low impact.

10.1.6 Air Quality and Climate Impacts

The predicted impacts on air quality and GHG emissions result primarily from the release of emissions to the air as a result of fuel combustion by vessels, air transport and on the FPSO, flaring at discrete project stages (especially drilling phase), and fugitive emissions. These can affect air quality and health if pollutant levels were increased at receptors and increase the amount of GHG emitted globally.

The Venus offshore project area where most activities will take place (e.g. high vessel density during construction, FPSO operation and flaring when required) is located far offshore (>300 km) and far away from people (i.e. sensitive coastal receptors). While the nearshore transshipment area is closer to communities, activity levels are lower with concentrations being below international public health guidelines. The impact of emissions on air pollution and health effects is deemed **Low to Negligible**.

The estimated project GHG emissions would reduce Namibia's net sink capacity by up to 1.2% and are quantified and rated as **Medium-High** using EBRD investment criteria. GHG emissions are subject to national strategies and commitments and should be considered in relation to sectoral, national and international targets and anticipated project benefits. Impacts are briefly summarised below:

- *Increase in ambient air pollution at Venus offshore project area:* Vessels will release air pollutants associated with fuel use, power generation and occasional flaring (non-routine). Pollutants released offshore will disperse rapidly under prevailing metocean



conditions. Since winds in the project area predominantly blow seaward and onshore winds are rare (less than 8% of the time), emissions are expected to dissipate away from the coast without affecting Namibian air quality.

- *Increase in ambient air pollution at nearshore transshipment area:* Air emissions from vessel fuel use and oil transfer result in short-term increases in air pollution while vessels are at the nearshore transshipment area. Pollution levels are expected to stay within international public health guidelines.
- *Contribution to National GHG emissions:* The project GHG emissions would reduce Namibia's net sink capacity by up to 1.2%. The project's GHG emissions *intensity* is expected to be lower than the 2015 weighted-average GHG emissions intensity of crude oil production from 10 major producers' countries. Emissions fall within the Medium-High category applied by the EBRD, which was referenced for this project.



Table 10-1: Summary of the potential impact significance associated with normal operations

	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Marine Ecology				
Smothering and disturbance of benthic fauna on benthic fauna	- Seabed disturbance from well drilling and installation of well infrastructure (Drilling & Installation) - Discharge of drill cuttings, mud and residual cement (Drilling & Installation) - Seabed disturbance from installation and commissioning of subsea infrastructure at Venus offshore project area (Drilling & Installation) - Seabed disturbance from installation of anchors (at Venus offshore project area and nearshore) (Drilling & Installation) - Seabed disturbance from decommissioning of well and subsea infrastructure (Decommissioning)	Very Low (Drilling & Installation) Negligible (Production & Decommissioning)	- Seabed survey prior to drilling and installation, if infrastructure falls outside existing geophysical survey area, to identify objects, seafloor inconsistencies or structural features (e.g. colony forming corals, rocky outcrops) - Discharge cuttings at greater than ~10 m below surface - Monitor cement returns to seafloor - Install anchors and chains prior to FPSO arrival using ROV to confirm anchor placement	Very Low (Drilling & Installation) Negligible (Production & Decommissioning)
Modification of Benthic Habitat	Infrastructure on seabed (All Phases)	Very Low (All phases)	Final ROV clearance survey	Very Low (All phases)
Acute and chronic effects on benthic fauna due to turbidity, toxicity and hypoxic effects	Discharge of drill cuttings and mud and residual cement to the seabed (Drilling & Installation)	Very Low (Drilling & Installation)	- Use low toxicity Group III NADF during riser drilling and treatment of cuttings to reduce average oil content - Ensure only low-toxicity, low bioaccumulation potential and partially biodegradable additives (included in drilling fluids, drilling muds and cement) are used, where practicable - Discharge cuttings at greater than ~10 m below surface	Negligible (Drilling & Installation)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Acute and chronic effects on pelagic and demersal fauna	- Discharge of drill cuttings and mud (Drilling & Installation) - Non-routine flaring of hydrocarbons (hydrocarbon drop-out) (Drilling & Installation) - Discharge at sea surface of various substances during commissioning (Drilling & Installation) - Discharge near seabed of various substances used for cleaning and testing (Drilling & Installation) - Anti-fouling paint used on the FPSO hull (Production) - Discharges to sea from FPSO (i.e. produced water discharge) (Production)	Very Low (Drilling & Installation) Low (Production)	- As above - Treatment of drill cuttings and produced water prior to discharge - Discharge produced water at greater than ~15 m below surface - Monitor produced water discharge (oil concentration) and cooling water (temperature) - Use high design efficiency burners for flaring - Optimise well test programme to reduce flaring - Prohibit routine discharges in the nearshore transshipment area (in line with MARPOL) and NIMPA during transit	Very Low (Drilling & Installation) Very Low (Production)
Behavioural disturbance of marine fauna	- Underwater noise from drilling operations (non-impulsive) (Drilling & Installation) - Underwater noise from vessels operations, manoeuvring and positioning (non-impulsive) (All Phases) - Underwater noise from vertical seismic profiling operations (impulsive) (Drilling & Installation) - Non-routine flaring (light and heat) of hydrocarbons (Drilling & Installation & Production) - Vessel / drill unit lighting (All Phases) - Helicopter atmospheric and underwater noise (All Phases)	Marine mammals & seabirds: Low (Drilling & Installation; Decommissioning) Fish and turtles: Very Low (Drilling & Installation; Decommissioning) Marine mammals, fish & seabirds: Medium (Production) Turtles: Low (Production)	- Implement maintenance plan for engines - Enforce vessel operational speed limits - Reduce vessel power and duty cycle to lowest safe operational level when using dynamic positioning systems - VSP: - Marine Mammal Observer during surveying - Pre-shoot watch (visual and possible acoustic) "Soft-start" procedures - Shut-downs - Specified helicopter flight paths to avoid seal and bird colonies and low altitude flights - Comply fully with aviation and authority guidelines and rules - Optimise and monitor well test programme - Commence with well testing during daylight hours, as far as possible - Reduce the lighting on the vessels, drilling unit and FPSO to a minimum compatible with	Marine mammals, fish & seabirds: Very Low (Drilling & Installation; Decommissioning) Marine mammals, fish & seabirds: Low (Production) Turtles: Very Low (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
			safe operations whenever and wherever possible	
Physical and/or physiological injury of marine fauna	- Underwater noise from drilling operations (non-impulsive) (Drilling & Installation) - Underwater noise from vessels operations, manoeuvring and positioning (non-impulsive) (All Phases) - Underwater noise from vertical seismic profiling operations (impulsive) (Drilling & Installation) - Presence of mooring chains (Production) - Abstraction of seawater offshore (Production) - Increased vessel traffic (All Phases)	Marine mammals & turtles Medium (All phases) Fish & Ichthyoplankton Very Low (Drilling & Installation, Production)	- VSP - Marine Mammal Observer during surveying - Pre-shoot watch (visual and possible acoustic) "Soft-start" procedures - Shut-downs - Enforce vessel operational speed limits - Keep constant watch from all vessels for cetaceans and turtles in path of the vessel - Fit seawater intakes with grid system to prevent entrainment of small fish and turtle hatchlings	Marine mammals & turtles Low (All phases) Fish & Ichthyoplankton Very Low (Drilling & Installation, Production)
Fisheries				
Overall impact to the large pelagic longline fishery	- Implementation of safety zones (i.e. Maritime Restricted Area) (All Phases) - Underwater noise from drilling operations (non-impulsive) (Drilling & Installation) - Underwater noise from vessels operations, manoeuvring and positioning (non-impulsive) (All Phases) - Underwater noise from vertical seismic profiling operations (impulsive) (Drilling & Installation) - Discharge of treated drill cuttings from the drilling unit (Drilling & Installation) - Discharges to sea from FPSO, DPST and vessels (Production)	Low (Drilling & Installation, Decommissioning) Medium (Production)	- Notify key stakeholders, via the Directorate of Maritime Affairs, prior to the mobilisation of the drilling unit, installation vessels and FPSO in the Venus offshore project area as well as operations in the nearshore transshipment area, respectively - Request, in writing, the Ministry of Works and Transport and Department of Maritime Affairs, as well as SANHO to issue navigational warnings as appropriate - Manage the lighting on the FPSO and other vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations.	Very Low (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Overall impact to the Line fish fishery	- Implementation of safety zones around nearshore transshipment buoy (Production) - Underwater noise from vessel and drilling operations (non-impulsive) (Production)	Very Low (Production)	- Monitor the Maritime Surveillance Area and enforce safety zones - Develop and implement a Stakeholder Engagement Plan - Implement a grievance mechanism	Very Low (Production)
Overall impact to Small-Scale fishery	- Implementation of safety zones around nearshore transshipment buoy (Production) - Underwater noise from vessel and drilling operations (non-impulsive) (Production)	Very Low (Production)		Very Low (Production)
Other Socio-Economic				
Contribution to GDP	Increased Gross Domestic Product (GDP)	High (+) (All phases)	No enhancement and/or mitigation measures are applicable to these assessed impact	High (+) (All phases)
Contribution to exports and trade balance	Contribution to state income (All Phases)	High (+) (Production)		High (+) (Production)
Contribution to government revenue	- Procurement of facilities and services (All Phases) - State income from taxes and levies (All Phases) - Loss of income from local procurement and spending (Decommissioning) - Loss of state income from taxes and levies (Decommissioning)	High (+) (Production)		High (+) (Production)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Generation of employment opportunities and income from local procurement	• Procurement of facilities and services (All Phases) • Employment of staff (All Phases) • Loss of income from local procurement and spending (Decommissioning) • Retrenchment of staff (Decommissioning)	High (+) (All phases)	• Enhancement through: - o Raise awareness of oil and gas procurement and employment requirements - o Create an information portal for service providers - o Leverage local partners and government agencies to help in disseminating information - o Develop a project-level Local Content Policy	High (+) (All phases)
Contribution to local skills development and levels		High (+) (All phases)		High (+) (All phases)
Disruption in the fishing industry	• Presence and Implementation of safety zones (All Phases) • Changes in catch availability due to behavioural change in fish (All phases)	Very Low (All phases)	See mitigations related to impacts to fisheries above	Very Low (All phases)
Disruption of shipping traffic and industry	• Presence and Implementation of safety zones (All Phases)	Very Low (All phases)	• Request, in writing, the Ministry of Works and Transport and Department of Maritime Affairs, as well as SANHO to issue navigational warnings • Monitor the Maritime Surveillance Area and enforce safety zones	Very Low (All phases)
Impacts on community health and safety	• Crew presence in local communities during rotation • In-migration	Medium (All phases)	• Develop and implement a Code of Conduct • Implement a grievance mechanism • Provide local authorities with forward planning information on project implementation, resource needs and timelines to support effective planning • Develop and implement a Stakeholder Engagement Plan	Low (All phases)
Disruption to governance and generation of conflict	• Resource curse (Production)	High (All phases)	• Comply with international good practice standards and guidelines relating to reporting and governance • Ensure transparent reporting of Project payments to government	Very Low (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Impacts to coastal towns	• Procurement of facilities and services (All Phases) • Employment of staff (Drilling & Installation, Production)	Medium (All phases)	• Provide local town authorities with forward-looking information on project implementation, planning and resource requirements throughout the project to support effective local planning. • Develop and implement a Stakeholder Engagement Plan and Waste Management Plan	Low (All phases)
Loss of income and livelihoods following decommissioning	• Presence and Implementation of safety zones (Decommissioning) • Retrenchment of staff (Decommissioning) • End of procurement (Decommissioning)	Medium (Decommissioning)	• Prepare a Closure and Decommissioning Plan to be shared with employees to provide sufficient advance warning • Comply with labour law requirements and compensate employees • Provide employment certificates and testimonials • Provide opportunities for capacity-building and training for employees	Low (Decommissioning)
Deterioration of cultural heritage links to the sea	• Discharges to sea from drilling units and project vessels (support / supply / installation/ DPST, FPSO & Conventional Tanker) (All phases) • Seabed disturbance from drilling & installation of anchors (Drilling & Installation) • Discharge of drill cuttings and mud and residual cement to the seabed (Drilling & Installation) • Discharge at sea surface of various substances during commissioning (Drilling & Installation) • Discharge near seabed of various substances used for cleaning and testing (Drilling & Installation) • Discharge of treated produced water (Production)	Low (All phases)	• Adjust the well and subsea infrastructure location to avoid any marine underwater cultural heritage (shipwrecks) identified by surveys • Develop and implement a Stakeholder Engagement Plan, which include cultural heritage considerations • Implement agreed resolutions on cultural heritage that arise from stakeholder engagement • Establish a grievance mechanism	Negligible (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
	- Infrastructure on seabed (Production & Decommissioning) - Presence of nearshore mooring buoy (Operation)			
Human Rights impacts related to meaningful participation and access to information	Inadequate access to information	NA	- The future SEP applicable during project implementation and operation should include: - Ongoing project stakeholder mapping assessment of stakeholder vulnerability based on exposure, sensitivity and adaptiveness to risks, and incorporation thereof into the SEP approach. - Assist key external stakeholders to improve their understanding of relevant human rights issues. - Regularly and formally engage external stakeholders in relation to human rights risk assessments, performance, and identification and assessment of risks	NA
Human Rights Related to National and International Supply Chains: Forced Labour, Modern Slavery, Human Trafficking and Child Labour	Labour abuses	Very Low (All phases)	- Adopt a human rights risk-based approach to ongoing human rights due diligence with contractors and suppliers, especially concerning modern slavery, forced labour, trafficking, and child labour. - Share, with prospective contractors and suppliers, the company's Code of Conduct and Fundamental Principles of Purchasing. - Ensure contractors are aware of and meet TEEPNA's human rights policy and expectations. - Include contract clauses stipulating respect for human rights and the company's right to monitor and audit contractors and suppliers to ensure ongoing compliance oversight.	Very Low (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Human Rights Related to Worker Health and Safety	Inadequate adherence to worker health and safety provisions	Very Low (All Phases)	- Ensure contractor standards align with standards espoused IFC EHS Guidelines for the Oil and Gas Sector where appropriate to the activity conducted. Ensure international and local procurement contracts include provisions for compliance monitoring and reporting aligned with project requirements. - Ensure risk-based monitoring and evaluation of identified contractors to uphold international standards. - Undertake random risk-focussed monitoring and evaluation of smaller, local suppliers to ensure aligned implementation of the project's HSE standards	Very Low (All Phases)
Human Rights Related to Workplace Equality, Inclusivity, Discrimination, Harassment and Gender-Based Violence	Bullying, intimidation, discrimination, harassment or gender-based violence (GBV)	Negligible (All phases)	Ensure an internal grievance mechanism is available to TEEPNA employees, contractors and suppliers and that it has multiple reporting channels, includes the non-retaliation principle and a clear and detailed definition of human rights grievances	Negligible (All phases)
Human Rights Related to Security and Conflict	Misuse of force or mistreatment during arrest or detention	Negligible (All phases)	- Ensure that project security management aligns with VPSHR and includes a process for regular updates on VPSHR risk assessment and action planning. - Conduct a first VPSHR risk assessment prior to construction phase. - Ensure all third-party security providers comply with the VPSHRs, through stipulations in procurement contracts. - Engage with relevant government agencies, law enforcement, and regulators to promote awareness of human rights and VPSHR principles as well as the Company's Code of Conduct and commitment to human rights, to promote respect for human rights and rule of law.	Negligible (All phases)



	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Human Rights Related to Human Rights Defenders	Challenges and risks to human right defenders	Low (All phases)	- Identify and include potential human rights defenders or groups in ongoing engagement activities through the project's SEP. Highlight and integrate potential human rights risks for defenders into the SEP. - As part of the grievance mechanism, implement clear protocols to respond to allegations or incidents of harm to human rights defenders, including who is responsible for receiving reports, investigating, and responding to them; and remedy impacts when they do occur	Low (All phases)
Increase in ambient air pollutant concentrations	- Air emissions from DPST, FPSO, drilling units and vessels (All phases) - Non-routine flaring of hydrocarbons (Drilling & Installation; Production)	Negligible (All phases)	- Implement onshore air quality monitoring programme - Optimise equipment performance and minimising fuel consumption.	Negligible (All phases)
Increase in ambient air pollutant concentrations	Air emissions from DPST and tugs during nearshore transshipment operations (Production)	Low (Production)	Implementation of the energy and fuel efficiency measures outlined in the project's Energy and Carbon Management Plan	Low (Production)
Contribution to GHG emissions	- Vessel / drilling unit air emissions (Drilling & installation, Production, Decommissioning) - Flaring of gas and liquid hydrocarbons (Production)	Medium-High (Production)	- Use distillate fuels with low sulphur content - Minimise vessel idling and optimise positioning time - Optimise well test programme to reduce flaring - Use high design efficiency burners for flaring - Establish an LDAR programme to identify and address fugitive emissions from valves, flanges, pumps and compressors. - Conduct periodic inspections using gas detection instruments - Establish a grievance mechanism	Medium-High (Production)



10.2 Summary and Evaluation of Potential Impacts from Unplanned Events

Potential risks associated with unplanned events were also considered, i.e. accidents or incidents that are not expected to occur as part of normal operations, that are very rare and for which measures are in place to actively prevent them from happening. Consideration of unplanned events is, however, important to inform prevention and response preparation and to determine whether any irreplaceable resources would be lost in the event of a major incident.

summarises the significance ratings of potential impacts associated with unplanned events, before and after application of mitigation measures. The significance ratings in the summary table assume *that the unplanned event occurs* (which is very unlikely). Therefore, one **cannot** directly compare the impact significances in Table 10-1 (impacts are expected to occur as part of normal operations) with those in Table 10-2 (impacts would only occur in a very rare worst-case accident scenario – they have an extremely low likelihood of occurrence).

All vessels and offshore installations will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill discharges would be managed under an OSCP, based on the Tiered response principle, which the Operator will be required to develop and share with relevant Authorities prior to offshore activities. All vessel owners will have emergency procedures in place identifying accident scenarios and responses.

10.2.1 Hydrocarbon Spill at Venus Offshore Project Area

This assumes the accidental instantaneous release of marine diesel from a vessel or crude oil during transfer from the FPSO to the DPST in the Venus offshore project area. The rupture of a drilling unit diesel tank was modelled as a reasonable worst-case scenario, with a release of 5 000 m³ of marine diesel, compared to a potential worst-case release of 1 000 m³ of export crude oil during offloading from the FPSO to the DPST.

Oil spill modelling indicates that the area affected by a diesel spill would be much smaller than for a well blow-out (the total release volume is much smaller). A diesel plume would drift in a predominantly north-westerly direction away from the sensitive coast, EBSA and coastal fishing, spawning and fish recruitment areas. No diesel from such an accidental release would reach the coast or affect coastal activities.

Hydrocarbons released into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna. These could range from mortality (due to toxicity or suffocation) to sub-lethal physiological damage and long-term effects including disruption of behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain. Seabirds are most vulnerable to hydrocarbon spills, and marine mammals, fish and turtles are also deemed highly sensitive. Residual impacts of a hydrocarbon spill on marine ecology are deemed to be of **Medium** significance if it occurs (and mitigation is implemented), though key ecologically sensitive areas are not affected.

The area where diesel is *most* likely to reach (90% likelihood) does not overlap with key fishing grounds. The area where oil is *least* likely to reach (1% likelihood – i.e. a larger area than where diesel would spread with a 90% likelihood) overlaps with ~1.4% of the large pelagic longline fisheries. As such, impacts on the marine ecology are most significant in this event. Residual impacts of an offshore hydrocarbon spill on fisheries are deemed to be of **Low** significance if it occurs.



Impacts on fishing livelihoods are deemed **Very Low** due to the limited overlap. Similarly, any cultural heritage and air quality impacts in the event of a spill are deemed **Negligible** due to the far offshore location of the Venus offshore project area.

10.2.2 Major Well Blow-Out at Offshore Project Area

This scenario assumes a major release of oil from a well blow-out at the seabed in the Venus offshore project area, resulting in the release of 5 912 m³/day of oil continuously for 13 days until the well is sealed (or capped).

Oil spill modelling indicates that the oil from a major well blow-out in the Venus offshore project area would drift in a predominantly north-westerly direction – out of the Namibian EEZ into the high sea and away from the sensitive coast, EBSA and coastal fishing, spawning and fish recruitment areas. No oil from such a blow-out is predicted to reach the coast or affect coastal activities.

Oil released into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna. Oil is most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify. Impacts vary and depend on the volume and state (weathering) of the oil, season (presence and activity of animals) and species. Coastal and pelagic seabirds, fish, turtles and cetaceans are highly sensitive to oil spills. Residual impacts of a major well blow-out on marine ecology are deemed to be of **Very High** significance if it occurs, but key ecologically sensitive areas are not affected.

The area where oil is *most* likely to reach (90% likelihood) overlaps with only 0.13% of the large pelagic longline fishing grounds. The area where oil is *least* likely to reach (1% likelihood – i.e. a larger area than where diesel would spread with a 90% likelihood) overlaps with ~15% of the large pelagic longline, tuna pole and deep-water trawl fishing grounds, and ~2% of the demersal trawl and longline fisheries. Residual impacts of a major well blow-out on fisheries are deemed to be of **Medium** significance if it occurs.

Residual impacts on fishing livelihoods are deemed **Very Low**, as there are alternative fishing areas for the industries operating this far offshore. Similarly, any cultural heritage and air quality impacts in the event of a blow-out are deemed **Negligible** due to the far offshore location of the Venus offshore project area.

10.2.3 Gas Injection Line Rupture at Offshore Project Area

This scenario assumes the accidental instantaneous release of 267 000 m³ of gas to the water column from a ruptured gas injection flowline in the Venus offshore project area. The extent of a potentially impacted area by an underwater gas injection line leak is anticipated to be largely limited to the vicinity of the leakage (local), and not comparable to the extent of the potentially impacted area of an unplanned large scale well blow out, with the majority of the gas expected to rise to the surface and escape to the atmosphere within a limited area around the leak.

The release may have immediate and localised effects on water quality and associated pelagic fauna, which can range from acute mortality to sub-lethal physiological stress, disruption of sensory and behavioural functions and interference with reproductive processes.

Given the offshore location of the Venus offshore project area and associated currents, the released gas due to a line rupture is expected to disperse rapidly, with dispersion towards the north-west. The extent of the area potentially impacted is anticipated to be limited to the vicinity of the leakage. Residual impacts of a gas leak on marine ecology are deemed to be of **Very Low** significance if it occurs.



Impacts on offshore fisheries are expected to be limited due to the low fishing effort and limited extent of the affected area. Nearshore fisheries and recruitment areas would not be affected. Residual impacts of a gas leak on fisheries are deemed to be of **Low** significance if it occurs.

10.2.4 Hydrocarbon Spill at Nearshore Transshipment Area

This scenario assumes the accidental instantaneous release of hydrocarbons at the nearshore transshipment area, resulting in the release of up to 1 000 m³ of crude oil and 300 m³ of marine diesel at the sea surface.

Oil spill modelling shows that crude oil or marine diesel would reach the shore within ~2 hours and affect the coast for up to ~263 km north and ~26 km south of Walvis Bay. Oil on the water surface can extend for up to ~100 km and would evaporate within ~1 day, but may remain longer in the water column.

Hydrocarbons released into the marine environment would have an immediate and direct effect on water quality and detrimental effects on marine fauna. Coastal and pelagic seabirds, fish, turtles and cetaceans are highly sensitive to spills. The nearshore transshipment area lies close to the biologically important IBA, Namib Flyway EBSA and Walvis Bay lagoon. Shoreline oiling would cause widespread contamination of coastal habitats and ecosystems, including estuaries and wetlands. Landfall of oil is generally considered an unfavourable situation, as stranding causes a multitude of new environmental impacts compared to those experienced in the offshore environment. Residual impacts of a large spill at the nearshore transshipment area on marine ecology are deemed to be of **Very High** significance, if it occurs.

Nearshore fisheries, coastal mariculture and traditional SSF would need to avoid affected areas or cease harvesting in affected areas, which would temporarily affect livelihoods. Oil reaching the shoreline could also contaminate any water intake for aquaculture activities at the various shore-based aquaculture facilities in the Walvis Bay area. Linefish fishing grounds are less affected, as the largest modelled oil spill extent (1% probability) overlapped with only 3% of linefish fishing areas. Tourism activities focussed on the coast and associated income would also be temporarily depressed. Residual impacts of a large spill at the nearshore transshipment area on fisheries are deemed to be of **High** significance and impacts on livelihoods are deemed to be of **Medium** significance if it occurs.

Air quality impacts in the event of an accidental spill are deemed **Negligible**.



Table 10-2: Summary of the potential impact significance associated with unplanned events *if they occur*

Potential impact	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Offshore Surface Hydrocarbon (Marine Diesel and/or Crude oil) Spill				
Impact on marine ecology / environment	- Marine diesel spill due to loss from a drilling unit / vessel tank - Bunkering activities - Crude oil spill during offloading from the FPSO to the DPST	Very High	- Oil Spill Contingency Plan - Operating limits and restrictions defined for offshore loading operations - Use low toxicity, authority approved dispersants - Secure an insurance policy, including coverage for third party liability	Medium
Impact on fisheries		Low	- As above - Develop and implement a Stakeholder Engagement Plan, which includes a grievance mechanism procedure - Secure an insurance policy, including coverage for third party liability - Plan for and implement responses in terms of IPIECA-IOGP guideline document for the economic assessment and compensation for marine oil releases	Low
Impact on fishing livelihoods		Low		Very Low
Impact on cultural heritage		Very Low	Ensure that concerns and potential impacts on cultural heritage are addressed through the Stakeholder Engagement plan, which includes a grievance procedure	Negligible
Impact on air quality		Negligible	As above re. impacts on marine ecology / environment	Negligible
Major Oil Spill (Well Blow-Out) in Venus Offshore Project Area				
Impact on marine ecology / environment	Loss of well control / well blow-out	Very High	- Design and Technical Integrity management “Multi-barrier” approach, e.g. blow-out preventer - Oil Spill Contingency Plan and Blow-Out Contingency Plan - Emergency Response Plan - Contracts to have access to capping and containment equipment - Secure an insurance policy, including coverage for third party liability	Very High



Potential impact	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
Impact on fisheries		High	- Develop and implement a Stakeholder Engagement Plan, which includes a grievance procedure - Plan for and implement responses in terms of IPIECA-IOGP guideline document for the economic assessment and compensation for marine oil releases	Medium
Impact on fishing livelihoods		Medium		Very Low
Impact on cultural heritage		Very Low	Ensure that concerns and potential impacts on cultural heritage are addressed through the Stakeholder Engagement Plan	Negligible
Impact on air quality		Negligible	As above re. impacts on marine ecology / environment from a major oil spill	Negligible
Gas Injection Line Rupture				
Impact on marine ecology / environment	Gas Injection Line Rupture	Very Low	- Use appropriate design, wall thickness with corrosion allowance and high-quality welding techniques to prevent pipeline rupture. - Minimise internal corrosion through the use of corrosion inhibitors, methanol, scale inhibitor and water-based hydraulic fluid - Undertake inspections - Secure insurance policy, including coverage for third party liability	Very Low
Impact on fisheries		Low		Low
Nearshore Hydrocarbon Spill				
Impact on marine ecology / environment	- Light crude oil spill due to oil transfer from DPST to conventional tanker - Marine diesel spill due to loss from vessel tank or bunkering	Very High	- Oil Spil Contingency Plan, including shoreline response equipment on standby during transshipment operations - Develop and prioritize intervention plans for the most sensitive areas to minimise risks and impacts and integrate these into the response strategy and associated plans - Use breakaway couplings with shut-off valves during transshipment operations. - Secure insurance policy, including coverage for third party liability	Very High
Impact on fisheries and mariculture		Very High		High
Impact on fishing and tourism livelihoods		High		Medium



Potential impact	Aspects potentially resulting in impact	Pre-mitigation significance	Project controls / key mitigation	Post-mitigation significance
			- Develop and implement a Stakeholder Engagement Plan, which includes a grievance procedure - Plan for and implement responses in terms of IPICEA-IOGP guideline document for the economic assessment and compensation for marine oil releases	
Impact on cultural heritage		Medium	As above re. impacts on cultural heritage due to major oil spill in Venus offshore project area	Very Low
Impact on air quality		Negligible	As above re. mitigations for impacts to marine ecology / environment, fisheries and fishing livelihoods and tourism.	Negligible



10.3 Cumulative Impacts

Activities that could lead to cumulative impacts include:

- Shipping, as the Venus offshore project and nearshore transshipment areas overlap with a busy shipping route off the African West Coast and vicinity of Walvis Bay port, respectively, leading to potential cumulative noise impacts on marine fauna.
- Fishing, as the large pelagic longline sector, and linefish and SSF activities overlap with the Venus offshore project and nearshore transshipment areas, respectively, leading to potential cumulative noise and behavioural impacts on marine fauna.
- Oil and gas exploration / appraisal, which is underway in the southern Namibian and northern South African West Coast regions. Concurrent activities could lead to potential cumulative impacts on marine fauna and habitats related to noise, physical disturbance and changes in water quality. This could add to the cumulative impact on fisheries due to related safety exclusion zones.
- Several proposed large-scale developments in Lüderitz (and to a lesser extent Walvis Bay) region, including large-scale green hydrogen projects and wind farms, which would require a considerable construction and operation work forces that could create cumulative pressures on coastal communities and service provision.
- Mining and recreational use, which are primarily situated in nearshore areas, yet are unlikely to lead to significant cumulative impacts within the nearshore transshipment area.

10.3.1 Cumulative Biophysical Impacts

The proposed project, together with other existing and planned activities in the region, may contribute to cumulative impacts on the marine environment. These impacts are assessed across three key areas: benthic habitats, marine fauna behaviour, and physiological injury to marine fauna as summarised below:

- *Cumulative Impacts on Benthos:* Installation of wells, subsea infrastructure and anchor moorings will disturb the seabed within the immediate footprint of operations, causing localised turbidity and sediment deposition. While drilling discharge modelling for 20 well pairs indicate a potential cumulative footprint of up to 320 ha being occupied by significant risk related to sediment thickness of > 6.5 mm, actual cumulative impacts at any one time are expected to be smaller due to natural dispersion and recovery of benthic communities. The affected habitats are largely deep-water unconsolidated, soft sediments with low biodiversity and no sensitive features such as corals or rocky outcrops. Given the vast extent of these 'Least Threatened' habitats, limited cumulative seabed footprint of current offshore activities, as well as mitigation measures in place, cumulative impacts on benthos are considered no more significant than that assessed under normal operations, with trawling activities in the region posing a comparatively greater long-term risk. Similarly, the cumulative impact of nearshore transshipment buoy anchors on benthic habitats is considered minimal, as effects remain localised and overlap with other nearshore activities (such as anchorage and mariculture) is limited due to safety zones and spatial planning.
- *Cumulative Impacts on Behaviour of Marine Fauna:* Underwater noise from drilling, installation, and vessel operations may affect the behaviour of marine mammals, turtles and fish. Behavioural impacts could extend up to 100 km during peak drilling and installation phases, reducing to smaller zones during production and transfer / transshipment activities. It is highly likely that other exploration / development



activities in the region will take place concurrently to the Venus offshore project, resulting in cumulative noise impacts, particularly on mammal behaviour and, to a lesser degree, on fish and turtles. However, it is expected that the number of wells being drilled concurrently in the region will be restricted, thus limiting the overall noise impact footprint at any one time. While short-term effects may appear minor, repeated exposure combined with other stressors (e.g., climate change, shipping noise) could have longer-term consequences. Concurrent vessel and anchorage activities near the transshipment buoy may add to cumulative noise impacts on marine mammal behaviour. However, shipping noise in the area is likely lower than project-related DPS noise, with project-related noise dominating when present. Overall, cumulative behavioural impacts are considered no more significant than that assessed under normal operations.

- *Cumulative Impacts on Physiological Injury*: Potential physiological injury to marine fauna may result from underwater noise, vessel collisions or entanglement with mooring chains. Injury zones for marine mammals are relatively small (up to 1.6 km for permanent auditory injury during peak vessel activity offshore) and the likelihood of such impacts is low due to the sparse distribution and high mobility of fauna. While cumulative effects could occur if multiple projects operate concurrently, fishing bycatch and shipping pose a far greater risk of injury and mortality than the proposed project. Overall, cumulative impacts on physiological injury are considered no more significant than that assessed under normal operations, with the project contributing minimally compared to other regional activities.

10.3.2 Cumulative Fisheries Impacts

Approved and future activities along the West Coast and southern Namibia could overlap with the proposed project if environmental clearance is granted. Potential cumulative impacts on commercial and small-scale fisheries may arise from ongoing and/or future mariculture, mining and port operations, as well as additional oil and gas developments, particularly if multiple projects operate concurrently. These could include temporary or permanent exclusion zones, affecting access to fishing grounds by fisheries, as well as localized noise impacts on target species such as tuna. Overall, broader variability in fish stocks is more strongly linked to factors such as climate change, fishing effort and environmental conditions. Overall, given the 21 – to 35-year project timeline and likelihood of future offshore hydrocarbon ventures, as well as nearshore activities, cumulative impacts of the proposed project are considered to be of **medium** significance.

10.3.3 Cumulative Socio-Economic Impacts

Cumulative impacts on socio-economic aspects are most likely on cumulative employment and income generation (benefit) and in-migration into coastal towns that create pressures on coastal communities and service provision (negative impact). Given the requirements of onshore energy projects proposed in coastal regions for locally based labour, the cumulative impacts are deemed **high positive** significance for local employment and income generation and **high negative** significance for in-migration and possibly community health and safety.

The contribution of the Venus project to the cumulative impact is **low (negative)** significance in the case of coastal town pressures, as the Venus-related opportunities are more geographically distributed (Venus offshore project area, Walvis Bay and Lüderitz).



10.3.4 Cumulative Cultural Heritage Impacts

Research conducted in Namibia indicates that existing activities along the Namibian coastline, including (diamond) mining, fishing, port operations and tourism, may affect cultural heritage receptors. While there is possibility of cumulative impacts over time, the project contribution is likely to be very low, since most cultural heritage practices occur inland rather than at the coast. Offshore activities are deemed to have a limited impact on cultural heritage due to limited ritual connectivity to the offshore environment. As such, the project contribution to any cumulative impact is deemed to be **very low**.

10.3.5 Cumulative Air Quality and GHG Impacts

Cumulative impacts on offshore and nearshore air quality from shipping and production is deemed very limited as emission concentrations are low and will reduce quickly in time and distance. The overall cumulative impact on air pollution due to operations in the Venus offshore project area is thus considered **low** and the project contribution is also deemed very limited.

Cumulative air quality impacts from nearshore transshipment are possible where emissions combine with existing urban sources like traffic, port operations and vessel movements. Due to the lack of monitoring data for Walvis Bay and Swakopmund, these impacts are conservatively rated as **medium**, assuming some existing urban emissions.

GHGs persist in the atmosphere for many years. Impacts are global irrespective of where the GHG are emitted. All emissions will thus generate a cumulative impact with all other global GHG emissions. The project contribution to such emissions is very **limited**.

10.4 Implications of the No-Go Alternative

The No-Go alternative represents the option to not proceed with the proposed Venus Development project. This would leave the project area of influence in its current state, except for ongoing natural variations and changes caused by other human activities (e.g., fishing, commercial shipping, approved exploration and possibly production activities, mining, cable laying, etc.). It thus represents the current status quo against which all potential project-related impacts are assessed.

Opting for the No-Go alternative means that none of the impacts anticipated from normal operations would occur. Although none of the adverse impacts of normal operations are considered unacceptably significant and can be effectively mitigated.

The No-Go alternative would also preclude the risks associated with accidental unplanned events (although highly unlikely), which are of very high significance. However, these are risk scenarios, and measures will be put in place to actively prevent these events from happening and, should they happen, minimise their effects to levels well below those assessed in this ESIA. No irreplaceable resources would be lost in the event of a major incident as assessed.

The No-Go alternative also precludes the opportunity of materialising the major benefits associated with the project, mostly of an economic nature, and associated with significantly increased government revenue, economic activity and job, income and skills development opportunities that will cascade through the wider Namibian society for decades to come, though the ultimate nature of the impacts will depend materially on how revenue is spent and the speed at which local provision of goods and services can be ramped up.

The No-Go alternative precludes the realisation of aspects associated with the need and desirability of the project, including the present desirability of economic growth, fiscal income growth and diversification.

While GHG emissions are one of the more significant impacts of this project, an important consideration is whether the No-Go alternative would result in lower *global* GHG emissions.



(The location where GHG are emitted is not relevant for the climate change impact, though it is relevant in relation to commitments made by countries).

If global oil supply and use are governed by a wider market demand that is driven by factors such as the availability, effectiveness and affordability of alternative energy sources (which seems to be the case at present), and if there is sufficient global production capability to meet future oil demand (which also seems to be the case at present with new production replacing existing declining fields being required for the foreseeable future), then global oil supply and use will not be constrained or affected by whether oil is produced by the Venus Development project or not. The proposed Venus Development project is then not a limiting (or enabling) factor for global oil use (and associated GHG emissions). It would not significantly influence global oil use or related GHG emissions. If the project does not proceed, other countries would likely produce the oil instead to meet global demand. Global GHG emissions would then not be affected by whether the Venus Development project goes ahead, but rather by other factors that determine the trajectory of global adoption of other energy sources.

Further in this scenario Namibia, which has been responsible for a very small proportion of historic GHG emissions, would continue to bear the effects of global carbon emissions without benefiting from income associated with the oil. The decision to forego a significant development opportunity that is otherwise environmentally and socially acceptable, and highly desirable on some grounds, only on the basis of GHG emissions that would likely be emitted globally in any case is not necessarily justifiable or a reasonable recommendation for a project-level ESIA. GHG emissions are subject to national strategies and commitments, their overall acceptability must be considered by government in relation to sectoral, national and international targets and anticipated project benefits. Thus, the decision to proceed with the project will need to balance its GHG emissions against broader policy objectives—such as climate commitments, economic growth, and project's overall benefits—rather than evaluating it solely at the project level.

It is possible that countries directly benefiting from oil revenue may pursue decarbonisation efforts less vigorously, though many historically oil producing nations are making considerable strides in developing alternative energy sources, partly funded by revenue received from past oil production. Being a producer places additional onus on the country to use proceeds in a responsible and sustainable manner.

The No-Go Alternative appears less desirable on the basis that impacts of normal operations are deemed low, that benefits are expected to significantly outweigh impacts, that unplanned events of the magnitude assessed in this ESIA are extremely rare and would not result in the loss of irreplaceable resources, and that oil production foregone in Namibia would likely be compensated by higher production elsewhere.

10.5 Evaluation and Concluding Statement

The work undertaken in support of this application for an ECC has been completed in line with the applicable regulatory framework. The assessment included the undertaking of technical modelling studies and specialist impact assessments to adequately identify and assess potential impacts.

Project Setting

As is to be expected, the proposed Venus Development project has the potential to cause impacts, both negative and positive. The project is located far offshore in an area where biodiversity and human activity are relatively low. The predominant currents in the project region move in a broadly north-westerly direction, which would ensure project emissions to the water column move in a generally north-westerly direction, away from more sensitive ecological and fishing areas located on the continental shelf and shelf edge, as well as the coastal zone.



The nearshore transshipment area is located near coastal areas and human activities, but the level of project activities at this site is much lower than in the Venus offshore project area. The periodic presence of two tankers and transfer of oil between them (weekly during peak production) is broadly similar with existing activities (e.g. liquid petroleum transfer) near the Walvis Bay port.

The oil and gas industry has stringent global safety, operating and equipment standards that operators and specialised contractors must adhere to, in addition to Namibian requirements and other project-specific recommendations made in this ESIA Report and associated ESMP.

Impact Summary

For these reasons, all project-related negative impacts from **normal operations** on biophysical (marine ecology) and socio-economic (including fishing, cultural heritage and air pollution) aspects are predicted to be of **Low, Very Low or Negligible residual significance**. Benefits of the project, such as contribution to GDP, contribution to exports and trade balance, contribution to government revenue or employment, are expected to be highly positive in the context of Namibia's current economic activity level and unemployment characteristics and are assessed to be of **High positive significance**.

A project of this nature generates GHG emissions, which were quantified and rated as **Medium-High** (using EBRD investment criteria as a proxy in the absence of generally accepted criteria). These GHG emissions will be controlled, through an Energy and Carbon Management Plan, and reported by the Operator during the project-life.

Potential risks associated with key unlikely **unplanned events** were also considered in the ESIA, i.e. accidents or incidents that are not expected as part of normal operations, that are very rare and for which measures are in place to actively prevent them from occurring. Consideration of unplanned events is, however, important to inform prevention and response preparation and to determine whether any irreplaceable resources would be lost in the event of a major incident. The unplanned events with the most significant impacts are:

- A major well blow-out at the Venus offshore project area that results in sustained release of oil at the seabed for up to 13 days until the well is sealed (capped), since this results in the release of large volumes of oil into the sea. The overlap with fishing grounds in areas most likely affected by oil is minimal. As such, impacts on the marine ecology are of most significance *if* this event occurs (**Very High**), though more ecologically sensitive areas such as EBSAs, Tripp Seamount and the coast are essentially not impacted. Such an event would not be expected to cause loss of irreplaceable resources.
- A hydrocarbon spill during oil transfer between tankers at the nearshore transshipment area, since this spill would occur closer to the coast even though spill volume would be lower. Nearshore fisheries, coastal mariculture, traditional SSF and recreational activities would need to avoid affected areas, which would temporarily affect normal operations and associated livelihoods. Ecologically sensitive coastal areas would also be affected. As such, impacts on the marine ecology (**Very High**), fishing (**High**) and coastal livelihoods (**Medium**) would be most significant *if* this event occurs. Such an event would not be expected to cause loss of irreplaceable resources.

Impact Evaluation

None of the adverse impacts of normal operations are considered unacceptably significant and can be effectively mitigated, with **Low to Negligible** residual significance ratings. Benefits of the project are deemed to be of **High positive** significance, and on that basis favour implementation of the project. Future oil demand and prices will affect the magnitude of future income to Namibia, but present projections indicate that global oil demand may



remain robust for some time, and that new production replacing existing declining fields will be required for the foreseeable future.

GHG emissions will contribute to the global inventory, reduce Namibia's net sink capacity and lower the remaining amount of GHG emissions permissible under Namibia's international commitments. The decision to proceed with the project will need to balance its GHG emissions against broader policy objectives—such as climate commitments, economic growth, and project's overall benefits—rather than evaluating it solely at the project level. Similarly, fundamental issues around energy mix and transition are too complex to comprehensively and conclusively analyse at a project level – policy priorities and appropriate energy mix and transition pathways must be decided and set at a national policy level considering specificities in local and regional supply and demand, local resources, affordability and technology availability.

Oil production foregone in Namibia would likely be compensated by higher production elsewhere, since global oil use is driven by the availability, effectiveness and affordability of alternative energy sources, and the Venus development is not a limiting factor for global oil use (and associated GHG emissions). However, becoming a producer country should place an additional onus on Namibia to use proceeds in a responsible and sustainable manner.

While some impacts associated with reasonable worst-case unplanned events are of Very High negative significance, they are not normal operational scenarios, and measures will be put in place to actively prevent these events from occurring. The potentially very high significance of impacts highlights the importance of preparing strong and immediate response measures to minimise the volume and spread of any hydrocarbons, and reduce any impact associated with an unplanned event (should it occur) to levels well below those assessed in this ESIA. No irreplaceable resources would be lost in the event of a major incident as assessed.

Other Aspects

The project is aligned with Namibian policy, which aims to progressively reduce GHG emissions while, at the same time, ensuring a stable and sufficient energy supply and enabling just and inclusive economic growth, in part through exploitation of local petroleum resources. Production of local hydrocarbon resources is in principle compliant with and in direct or indirect furtherance of several energy, economy and resource-related policies and plans, including NDP6 which recognises the use of Namibia's natural resources in achieving its goal of economic growth, transformation and resilience.

Stakeholders have shown great interest and participated extensively in the ESIA process to date. They attended public, focus group and/or dedicated meetings and (to a lesser extent) submitted written comments. To date, the overarching themes raised by stakeholders relate to work opportunities, potential project impacts on the marine environment and fisheries, especially if an unplanned event occurred, and climate change risks. These and other questions have been comprehensively considered, assessed and responded to.

Based on the findings of the ESIA, SLR is of the opinion that this ESIA Report is robust and provides sufficient information for to make an informed decision on the proposed project, taking into consideration the significance of potential impacts and National strategic policy issues relating to energy, climate change and economic development. The commitments presented in the ESMP should be conditional to the ECC if granted.



11.0 References

- Abbriano, R., Carranza, M., Hogle, S., Levin, R., Netburn, A., Seto, K., . . . Franks, P. (2011). Deepwater Horizon oil spill: a review of the planktonic response. *Oceanography*(24), 294–301.
- AECOM. (2019). *Environmental and Social Impact Assessment (ESIA) process for the proposed Offshore Exploration Drilling – Namibia Block 2913B. Final Environmental Impact Report. May 2019.* .
- African Development Bank Group. (2024). *Namibian Economic Outlook*. Retrieved from African Development Bank Group: <https://www.afdb.org/en/countries/southern-africa/namibia/namibia-economic-outlook>
- Aldredge, A., Elias, M., & Gotschalk, C. (1986). Effects of drilling muds and mud additives on the primary production of natural assemblages of marine phytoplankton. *Mar. Environ. Res.* (19), 157-176.
- Aljaroudi, A. A. (2015). *Risk assessment of offshore crude oil pipeline failure*. Retrieved January 2025, from https://www.academia.edu/109672194/Risk_assessment_of_offshore_crude_oil_pipeline_failure
- Almeda, R., Baca, S., Hyatt, C., & Buskey, E. (2014a). Ingestion and sublethal effects of physically and chemically dispersed crude oil on marine planktonic copepods. *Ecotoxicology*, 988–1003.
- Almeda, R., Connelly, T., & Buskey, E. (2015). How much crude oil can zooplankton ingest? Quantification of dispersed crude oil defecation by planktonic copepods. *Environmental Pollution* (208), 645–654.
- Almeda, R., Wamaugh, Z., Wang, Z., Hyatt, C., Liu, Z., & Buskey, E. (2013a). Interactions between zooplankton and crude oil: toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. *Plos One*(8), 21.
- Almeda, R., Wambaugh, Z., Chai, C., Wang, Z., Liu, Z., & Buskey, E. (2013b). Effects of crude oil exposure on bioaccumulation of polycyclic aromatic hydrocarbons and survival of adult and larval stages of gelatinous zooplankton. *Plos One*(8), 15.
- Amorim, K., & Zettler, M. (2023). Gradients and instability: Macrozoobenthic communities in the Benguela Upwelling System off Namibia. *Estuarine, Coastal and Shelf Science*, 108421.
- Amorin, K., & Zettler, M. (2023). Gradients and instability: Macrozoobenthic communities in the Benguela Upwelling System off Namibia. *Estuarine, Coastal and Shelf Science*, 108421.
- Andrews, N., Bennet, N. J., Le Billion, P., Green, S. J., Cisneros-Montemayor, A. M., Amongin, S., . . . Rashid Sumaila, U. (2021). Oil, fisheries and coastal communities: A review of impacts on the environment, livelihoods, space and governance,. 75.
- API. (2021). Compendium of Greenhouse Gas Emissions Methodologies for the Natural Gas and Oil Industry. Retrieved from www.api.org
- ASME. (2014). *VIV Assessment of Deepwater Lazy-Wave Risers*. Retrieved January 2025, from <https://computingengineering.asmedigitalcollection.asme.org/OMAE/proceedings-abstract/OMAE2014/45400/V002T08A082/270744>



- Atkinson, L. (2009). *Effects of demersal trawling on marine infaunal, epifaunal and fish assemblages: studies in the southern Benguela and Oslofjord*. PhD Thesis. University of Cape Town.
- Atkinson, L. J. (2009). *Effects of demersal trawling on marine infaunal, epifaunal and fish assemblages: studies in the southern Benguela and Oslofjord*. Cape Town: Univeristy of Cape Town.
- Atkinson, L. J., & Sink, K. J. (2018). *Field Guide to the Offshore Marine Invertebrates of South Africa*. Pretoria: Malachite Marketing and Media.
- Augustyn, C., Lipinski, M., & Roeleveld, M. (1995). Distribution and abundance of sepioidea off South Africa. *S. Afr. J. Mar. Sci.* , 16: 69-83.
- Baan, P., Menke, M., Boon, J., Bokhorst, M., Schobben, J., & Haenen, C. (1998). *Risico Analyse Mariene Systemen (RAM). Verstoring door menselijk gebruik*. Delft: Waterloopkundig Laboratorium.
- Bailey, G. (1991). Organic carbon flux and development of oxygen deficiency on the modern Benguela continental shelf south of 22°S: spatial and temporal variability. (R. Yson, & T. Pearson, Eds.) *Geol. Soc. Spec. Publ.*(58), 171-183.
- Bailey, G. (1999). *Severe hypoxia and its effect on marine resources in the southern Benguela upwelling system*. Namibia: Abstract, International Workshop on Monitoring of Anaerobic processes in the Benguela Current Ecosystem off Namibia.
- Bailey, G., Beyers, C., De, B., & Lipschitz, S. (1985). Seasonal variation of oxygen deficiency in waters off southern South West Africa in 1975 and 1976 and its relation to catchability and distribution of the Cape rock-lobster *Jasus lalandii*. *S. Afr. J. Mar. Sci.*, 197-214(3).
- Baker, J., Clark, R., Kingston, P., & Jenkins, R. (1990). Natural recovery of cold water marine environments after an oil spill. Edmonton, Alberta: 13th Annual Arctic and Marine Oil spill Program Technical Seminar.
- Bakun, A., & Weeks, S. J. (2006, December). Adverse feedback sequences in exploited marine systems: Are deliberate interruptive actions warranted? *Fish and Fisheries*, 7(4).
- Banks, A., Best, P., Gullan, A., Guissamulo, A., Cockcroft, V., & Findlay, K. (2011). Recent sightings of southern right whales in Mozambique. . *Document SC/S11/RW17 submitted to IWC Southern Right Whale Assessment Workshop*. Buenos Aires.
- Barendse, J., Best, P., Thomson, M., Pomilla, C., Carvalho, I., & Rosenbaum, H. (2010). Migration redefined ? Seasonality, movements and group composition of humpback whales *Megaptera novaeangliae* off the west coast of South Africa. *Afr. J. mar. Sci.*, 3(1):1-22.
- Barnard, P. (1998). *Biological Diveristy in Namibia: A Country-Wide Study*. Windhoek: Namibian National Biodiveristy Task Force.
- Barnes, J., & Alberts, M. (2008). *Sustainable natural resource use on the coast of Namibia*. . DEA Research Discussion Paper 78, Environment Economics Unit, Ministry of Environment and Tourism, .
- BCG. (2025). *The Energy Transition's Next Chapter*. Retrieved October 2025, from <https://web-assets.bcg.com/5c/4d/5796b7ef46beb3110c30feed6216/the-energy-transitions-next-chapter-sep-2025-edit-04.pdf#:~:text=This%20publication%2C%20developed%20by%20BCG%E2%80%99s%20Center%20for%20Energy,global%20energy%20system%20and%20navigate%20its%20>



- Bejarano, A., & Michel, J. (2010). Large-scale risk assessment of polycyclic aromatic hydrocarbons in shoreline sediments from Saudi Arabia: environmental legacy after twelve years of the Gulf war oil spill. *Environmental Pollution*(158), 1561-1569.
- Bejarano, A., & Michel, J. (2016). Oil spills and their impacts on sand beach invertebrate communities: A literature review. *Environmental Pollution*(128), 709-722.
- Bejder, L., Samuels, A., Whitehead, H., & Gales, N. (2006). Interpreting short-term behavioral responses to disturbance within a longitudinal perspective. *Animal Behavior*(72), 1149-1158.
- Belkin, I. M. (2009). Rapid warming of Large Marine Ecosystems. *Progress in Oceanography*, 81(1-4), 207-213.
- Berg, J., & Newell, R. (1986). Temporal and spatial variations in the composition of seston available to the suspension-feeder *Crassostrea virginica*. *Estuar. Coast. Shelf. Sci.*, 23: 375–386.
- Bernabeu, A., Fern-Andez, S., Bouchette, F., Rey, D., Arcos, A., Bayona, J., & Albaiges, J. (2013). Recurrent arrival of oil to Galician coast: the final step of the Prestige deep oil spill. *J. Hazard. Mater*, 82-90.
- Best, P. (2001). Distribution and population separation of Bryde's whale *Balaenoptera edeni* off southern Africa. *Mar. Ecol. Prog. Ser.*, 220: 277 – 289.
- Best, P. (2007). *Whales and Dolphins of the Southern African Subregion*. Cape Town, South Africa: Cambridge University Press.
- Best, P. B., Meÿer, M. A., & Lockyer, C. (2010). Killer whales in South African waters — a review of their biology. *African Journal of Marine Science*, 32(2), 171-186.
- Best, P., & Allison, C. (2010). Catch History, seasonal and temporal trends in the migration of humpback whales along the west coast of southern Africa. *IWC sc/62/SH5*.
- Best, P., & Lockyer, C. (2002). Reproduction, growth and migrations of sei whales *Balaenoptera borealis* off the west coast of South Africa in the 1960s. *South African Journal of Marine Science*, 24: 111-133.
- Beyer, J., Trannum, H., Bakke, T., Hodegeson, P., & Collier, T. (2016). Environmental effects of the Deepwater Horizon oil spill: a review. *Marine Pollution Bulletin*(110), 28–51.
- Bianchi, G., Carpenter, K., Roux, J., Molloy, F., Boyer, D., & Boyer, H. (1999). FAO species identification guide for fishery purposes. In *Field guide to the Living Marine Resources of Namibia* (p. 256).
- Bianchi, G., Hamukuaya, H., & Alvheim, O. (2001). On the dynamics of demersal fish assemblages off Namibia in the 1990. *South African Journal of Marine Science*, 23(1), 419-428.
- Biccard, A., Gihwala, K., Clark, B., Mostert, B., Brown, E., Hutchings, K., . . . Melidonis, M. (2018). *Desktop study of the potential impacts of marine mining on marine ecosystems and marine biota in South Africa – Final report* . Report prepared by Anchor Research and Monitoring (Pty) Ltd for Council of Geosciences, Report no. 1795/1.
- Biccard, A., Gihwala, K., Clark, B., Sedick, S., Brown, E., Mostert, B., . . . Dawson, J. (2020). *De Beers Marine Namibia Environmental Monitoring Programme: Atlantic 1 Mining Licence Area: 2018 Benthic Sampling Campaign*. Anchor Environmental Consultants Pty (Ltd.).



- Bijkerk, R. (1988). Ontsnappen of begraven blijven. De effecten op bodemdieren van een verhoogde sedimentatie als gevolg van baggerwerkzaamheden., RDD Aquatic Systems.
- Birch, G. (1990). *Phosphorite deposits on the South African continental margin and coastal terrace. Phosphate deposits of the world, Vol. 3, Neogene to modern phosphorites.* (W. Burnett, & R. Riggs, Eds.) Cambridge, UK: Cambridge University Press.
- Birch, G., & Rogers, J. (1973). Nature of the seafloor between Lüderitz and Port Elizabeth. *S. Afr. ship. news fish. ind. rev.*, 39(7).
- Birch, G., Rogers, J., Bremner, J., & Moir, G. (1976). Sedimentation controls on the continental margin of Southern Africa. *First Interdisciplinary Conference Freshwater Resources South Africa*, (pp. C1-D12).
- BirdLife International . (2025). *Site factsheet: Walvis Bay*. . Retrieved from <https://datazone.birdlife.org/site/factsheet/walvis-bay> 25/06/2025
- Birdlife International. (2004). *Tracking ocean wanderers: the global distribution of albatrosses and petrels, results from the Procellariiform Tracking Workshop.* Cambridge, UK.
- Blaizot, C. (2019). Oil Seeps Detection in Offshore Frontier Areas Based on Multitemporal Satellite SAR Data and Manual Interpretation: Levantine and Natal Basins, Selected Historical and Recent SAR Data. . Cape Town, South Africa : 2018 International Conference and Exhibition.
- Blanchard, A., & Feder, M. (2003). Adjustment of benthic fauna following sediment disposal at a site with multiple stressors in Port Valdez, Alaska. . *Marine Pollution Bulletin*(46), 1590-1599.
- BOEM. (2020). 'Vessel Strike Avoidance and Injured/Dead Protected Species Reporting'. Bureau of Ocean Energy Management (BOEM) .
- BoN. (2024). *Bank of Namibia Reports*.
- Booth, C., Sinclair, R., & Harwood, J. (2020). Methods for Monitoring for the Population Consequences of Disturbance in Marine Mammals: A Review. . *Front. Mar. Sci.*(7), 115.
- Botha, J. A., Kirkman, S. P., Arnould, J. P., & Lombard, A. T. (2020). eographic variation in at-sea movements, habitat use and diving behaviour of female Cape fur seals. *Mar Ecol Prog Ser* , 649, 201-218.
- Botha, J. A., Trueman, C. N., S, K., Arnould, J. P., Lombard, A. T., Connan, M., . . . Pistorius, P. A. (2023). Geographical, temporal, and individual-based differences in the trophic ecology of female Cape fur seals. *Ecology and Evolution*, 13.
- Bothner, M., Rendigs, R., Campbell, E., Doughton, M., Parmenter, C., O'Dell, C., . . . Rait, N. (1985). The Georges Bank Monitoring Program: analysis of trace metals in bottom sediments during the third year of monitoring. Final report submitted to the U.S. Dept. of the Interior, Minerals Management Service, Vienna, VA. Prepared by the U.S. Geological Surve., (p. 99). Wood Hole, MA.
- Boyd, A. J., & Oberholster, G. P. (1994). Currents off the west and south coasts of South Africa. *South African Shippng News Fishing Industry Rev.*, 49(5), 26-28.
- Boyer, D. C., & Hampton, I. (2001). An Overview of the Living Marine Resources of Namibia. *South African Journal of Marine Science*, 23(1), 5-35.



- Boyer, D., & Boyer, H. (2015). Albatrosses, White-chinned Petrel and Northern Giant-Petrel. In R. E. Simons, C. J. Brown, & J. Kemper, *Birds to watch in Namibia: Red, rare and endemic species*. Windhoek, Namibia: National Biodiversity Programme.
- Boyer, D., Boyer, H., Fossen, I., & Kreiner. (2001). Changes in abundance of the northern Benguela sardine stock during the decades 1990–2000 with comments on the relative importance of fishing and the environment. . *Afr. J. of Mar. Sci.*, 23: 67–84.
- Branch, T. A. (2001). A review of orange roughy *Hoplostethus atlanticus* fisheries, estimation methods, biology and stock structure. *S. Afr. J. Mar. Sci.*, 181–203.
- Brand, A. (2025, September 16). Secretary BIFHA. (E. Simon, Interviewer)
- Brandao, A., Vermeulen, E., Ross-Gillepsie, A., Findlay, K., & Butterworth, D. (2017). Updated application of a photo-identification based assessment model to southern right whales in South African waters, focussing on inferences to be drawn from a series of appreciably lower counts of calving females over 2015 to 2017. *Paper SC/76B/SH/22 submitted to the scientific Committee of the International Whaling Commission*. Bled, Slovenia.
- Breeze, H., Davis, D., Butler, M., & Kostylev, V. (1997). *Distribution and status of deep sea corals off Nova Scotia*. . Marine Issues Special Committee. Halifax, NS: Ecology Action Centre.
- Breteler, R., Requejo, A., & Neff, J. (1988). Acute toxicity and hydrocarbon composition of a water-based drilling mud containing diesel fuel or mineral oil additives. In J. Lichtenberg, F. Winter, C. Weber, & L. Fradkin (Eds.), *Chemical and Biological Characterization of Municipal Sludges, Sediments, Dredge Spoils and Drilling Muds*. (pp. 375–390). Philadelphia, PA: American Society for Testing and Materials.
- Bricelj, V., & Malouf, R. (1984). Influence of algal and suspended sediment concentrations on the feeding physiology of the hard clam *Mercenaria mercenaria*. *Mar. Biol.* (84), 155–165.
- Brouwer, J., Mann, B., Lamberth, S., & Sauer, W. (1997). A Survey of Recreational Angling in Namibia. *South African Journal of Marine Science*.
- Brüchert, V., Barker Jørgensen, B., Neumann, K., Riechmann, D., Schlosser, M., & Schulz, H. (2003). Regulation of bacterial sulfate reduction and hydrogen sulfide fluxes in the central Namibian coastal upwelling zone. *Geochim. Cosmochim. Acta*, 23(67), 4505–4.
- BSL. (2019a). *Venus 1X Baseline Survey. 1841 Volume 2: Environmental Baseline Survey and Habitat Assessment Report*. Benthic Solutions Ltd.
- BSL. (2019a). *Venus 1X Environmental Baseline Survey. 1841 Volume 2: Environmental Baseline Survey and Habitat Assessment Report*. Benthic Solutions Ltd.
- BSL. (2019b). *Marine Mammal and Wildlife Report. Prepared for Total E&P Venus 1X, March*. Benthic Solutions Ltd.
- BSL. (2019c). *Marine Mammal and Wildlife Report (second Visit). Prepared for Total E&P Venus 1X May 2019*. Benthic Solutions Ltd.
- BSL. (2022). *Environmental Baseline Survey Block 2913B. Marine Mammal Observation Monitoring Report*. Benthic Solutions Ltd. .
- BSL. (2022a). *Multiblock Regional-Phase 2 Environmental Baseline Survey Block 2913B. Marine Mammal Observation Monitoring Report*. Benthic Solutions Ltd.
- BSL. (2022a). *Multiblock Regional-Phase 2 Environmental Baseline Survey Block 2913B. Marine Mammal Observation Monitoring Report*. Benthic Solutions Ltd.



- BSL. (2022b). *Multiblock Regional -Phase 2 Environmental Baseline Survey Block 2912. Marine Mammal Observation Monitoring Report*. Benthic Solutions Ltd.
- BSL. (2022b). *Multiblock Regional -Phase 2 Environmental Baseline Survey Block 2912. Marine Mammal Observation Monitoring Report*. Benthic Solutions Ltd.
- BSL. (2023a). *Environmental Baseline Survey Block 2913B. Environmental Baseline and Habitat Assessment Survey Report*. Benthic Solutions Ltd.
- BSL. (2023a). *Post-Drill Environmental Survey: Venus-1X (Block 2913B). Environmental Baseline and Habitat Assessment Survey Report*. Benthic Solutions Ltd.
- BSL. (2023b). *Post-Drill Environmental Survey: Venus-1X (Block 2913B). Environmental Post-Operations Survey Report*. Benthic Solutions Ltd.
- BSL. (2023b). *Post-Drill Environmental Survey: Venus-1X (Block 2913B). Environmental Post-Operations Survey Report*. Benthic Solutions Ltd.
- BSL. (2023c). *Environmental Baseline Survey: Block 2913B: Final environmental DNA Report*.
- Buchanan, R., Cook, J., & Mathieu, A. (2003). *Environmental Effects Monitoring for Exploration Drilling*. Alberta: Report for Environmental Studies Research Funds.
- Bull, A., & Kendall, J. (1994). Bull. Mar. Sci. *An indication of the process: offshore platforms as artificial reefs in the Gulf of Mexico*(55), 1086-1098.
- Buskey, E., White, H., & Esbaugh, A. (2016). Impact of oil spills on marine life in the Gulf of Mexico: Effects on plankton, nekton, and deep-sea benthos. *Oceanography* 29(3); 3(29), 174–181.
- Calvert, S., & Price, N. (1983). Geochemistry of Namibian Shelf Sediments. In E. Suess, & J. Thiede (Eds.), *Coastal Upwelling Its Sediment Record*. NATO Conference Series. Boston, MA.: Springer. doi:https://doi.org/10.1007/978-1-4615-6651-9_17
- CAPP . (2001). (Canadian Association of Petroleum Producers). *Offshore Drilling Waste Management Review. Report 2001-0007*. Halifax, Nova Scotia, Canada: Canadian Association of Petroleum Producers.
- Carassou, L., Hernandez, F., & Graham, W. (2014). Change and recovery of coastal mesozooplankton community structure during the Deepwater Horizon oil spill. *Environ. Res. Lett.*(9), 12.
- Challenger, G., & Mauseth, G. (2011). Chapter 32 - Seafood Safety and Oil Spills. *Oil Spill Science and Technology*, 1083-1100.
- Chandrasekara, W., & Frid, C. (1998). A laboratory assessment of the survival and vertical movement of two epibenthic gastropod species, *Hydrobia ulvae* (Pennant) and *Littorina littorea* (Linnaeus), after burial in sediment. *Journal of Experimental Ma.*
- Chapman, P., & Shannon, L. (1985). The Benguela Ecosystem. Part II. Chemistry and related processes. *Oceanogr. Mar. Biol. Ann. Rev.*(23), 183-251.
- Chivers, S., Leduc, R., Robertson, K., Barros, N., & Dizon, A. (2004). Genetic variation of *Kogia* spp. With preliminary evidence for two species of *Kogia* sima. . *Marine Mammal Science*(21), 619-634.
- Christie, N. (1974). *Distribution patterns of the benthic fauna along a transect across the continental shelf off Lamberts Bay, South Africa*. University of Cape Town.
- Clark, B., Hutchings, K., Biccard, A., Brown, E., Dawson, J., Laird, M., . . . Mostert, B. T. (2020). *The State of Saldanha Bay and Langebaan Lagoon 2020*. Anchor Environmental Consultants (Pty Ltd.



- Clark, M., O'Shea, S., Tracey, D., & Glasby, B. (1999, AUGUST). New Zealand region seamounts. *Aspects of their biology, ecology and fisheries*, 107.
- Clarke, D., & Wilber, D. (2000). Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOER_E9). U.S. Army Engineer Research and Development Center, Vicksburg, MS.
- Cockroft, A., Schoeman, D., Pitcher, G., Bailey, G., & Van Zyl, D. (2000). A mass stranding, or 'walk out' of west coast rock lobster, *Jasus lalandii*, in Elands Bay, South Africa: Causes, results and implications. In J. Von Vaupel Klein, & F. Schram (Ed.), *The Biodiversity Crisis and Crustacea: Proceedings of the Fourth International Crustacean Congress*. CRC Press.
- Coetzee, J. C., Van der lingen , C. D., & Hutchings, L. (2008). Has the fishery contributed to a major shift in the distribution of South African sardine? *ICES Journal of Marine Science*, 65, 1676–1688.
- Cohen, J., McCormick, L., & Burkhardt, S. (2014). Effects of dispersant and oil on survival and swimming activity in a marine copepod. *Bull. Environ. Contam. Toxicol.* (92), 381–387.
- Colman, J., Gordon, D., Lane, A., Forde, M., & Fitzpatrick, J. (2005). Carbonate mounds off Mauritania, Northwest Africa: status of deep-water corals and implications for management of fishing and oil exploration activities. In A. Friewald, & J. Roberts (Eds.), *Cold-water Corals and Ecosystems* (pp. 417-441). Berlin, Heidelberg: Springer-Verlag .
- Compagno, L., EBERT, D. A., & COWLEY, P. D. (1991). Distribution of offshore demersal cartilaginous fish (Class Chondrichthyes) off the West Coast of southern Africa, with notes on their systematics. *S. Afr. J. Mar. Sci*, 11, 43-139.
- Compton, J. S., & Bergh, E. W. (2016). Phosphorite deposits on the Namibian shelf. *Marine Geology*, 380, 290-314.
- Constantine, R. (2001). Increased avoidance of swimmers by wild bottlenose dolphins (*Tursiops truncatus*) due to long-term exposure to swim-with-dolphin tourism. *Marine Mammal Science* (17), 689-702.
- Cordes, E., Jones, D., Schlacher, T., Amon, D., Bernardino, A., Brooke, S., . . . Escobar-Briones, E. e. (2016). Environmental Impacts of the Deep-Water Oil and Gas Industry: A Review to Guide Management Strategies. *Fronteirs in Environmental Science* (4), 1-26.
- Costa, D., Schwarz, L., Robinson, P., Schick, R., Morris, P., Condit, R., & al., e. (2016). A bioenergetics approach to understanding the population consequences of disturbance: Elephant seals as a model system. In A. Popper, & A. Hawkins (Eds.).
- Crawford, R., Shannon, L., & Pollock, D. (1987). The Benguela ecosystem. 4. The major fish and invertebrate resources. *Oceanogr. Mar. Biol. Ann. Rev.* (25), 353 - 505.
- Crawford, R., Shannon, L., & Pollock, D. (1987). The Benguela ecosystem. 4. The major fish and invertebrate resources. *Oceanogr. Mar. Biol. Ann. Rev.* (25), 353 - 505.
- CSIR. (1996). *Elizabeth Bay monitoring project: 1995 review*. CSIR Report ENV/S-96066.
- Currie, D., & Isaacs, D. (2005). Impact of exploratory offshore drilling on benthic communities in the Minerva gas field, Port Campbell, Australia. *Mar. Environ. Res.* (59), 217-233.
- Currie, H., Grobler, K., & Kemper, J. (2009). *Namibian Islands' Marine Protected Area*. Minstry of Fisheries and Marine Resources, Namibia.



- Currie, H., Grobler, K., & Kemper, J. (2009). *Namibian Islands' Marine Protected Area. Ministry of Fisheries and Marine Resources, Namibia.* . Retrieved from [http://www.nacoma.org.na/ key_Activities/Marine Protected Areas.htm](http://www.nacoma.org.na/key_Activities/Marine%20Protected%20Areas.htm).
- Daan, R., & Mulder, M. (1993). *A study on possible environmental effects of WBM cuttings discharge in the North Sea, one year after termination of drilling.* . Texel, Netherlands.: NIOZ Report 1993-16 from the Netherlands Institute of Sea Research.
- David, J. (1989). Seals. In A. Payne, & R. Crawford (Eds.), *Oceans of Life off Southern Africa* . Halfway House, South Africa: Vlaeberg Publishers.
- De Cauwer, V. (2007). BEP/BAC/03/02 Mapping of the BCLME Shoreline, Shallow Water & Marine Habitats: Physical mapping project. Project in collaboration with the Benguela Environment Fisheries Interaction & Training Programme (BENEFIT) for the BCLME Program.
- de Rock, P., Elwen, S., Roux, J.-P., Leeney, R., James, B., Visser, V., . . . Gridley, T. (2019). Predicting large-scale habitat suitability for cetaceans off Namibia using MinxEnt. *Marine Ecology Progress Series*(619), 149-167.
- De Wet, A. (2013). *Factors affecting survivorship of loggerhead (Caretta caretta) and leatherback (Dermochelys corcia) sea turtles of South Africa.* Nelson Mandela University.
- DEAT. (2004). *Cumulative Effects Assessment, Integrated Environmental Management.* Department of Environmental Affairs and Tourism.
- DeLeo, D., Ruiz-Ramos, D., Baums, I., & Cordes, E. (2015). Response of deep-water corals to oil and chemical dispersant exposure. *Deep-Sea Res. II Top. Stud. Oceanogr.*
- Deloitte. (2016). *Global oil and gas tax newsletter - views from around the world.*
- Deloitte. (2024). *Industrial Baseline Survey (IBS) for the Namibian upstream oil and gas industry.* Deloitte.
- Deloitte. (2024). *Oil and Gas Industrial Baseline Survey - Namibia.* Windhoek: Deloitte.
- Department of Minerals and Energy. (1998). *White Paper on the Energy Policy of the Republic of South Africa.* Department of Minerals and Energy.
- Derous, D., Ten Doeschate, M., Brownlow, A., Davidson, N., & Lusseau, D. (2020). Toward New Ecologically Relevant Markers of Health for Cetaceans. *Front. Mar. Sci.*(7), 367.
- Derville, S., Torres, L., Zerbini, A., Oremus, M., & Carrigue, C. (2020). Horizontal and vertical movements of humpback whales inform the use of critical pelagic habitats in the western South Pacific. *Sci. Rep.* 10, 4871.
- Dingle, R. (1973). The Geology of the Continental Shelf between Lüderitz (South West Africa) and Cape Town with special reference to Tertiary Strata. . *J. Geol. Soc. Lond.*, 129, 337-263.
- DMPR. (2023). *2023 South African Energy Price Report.* Retrieved June 2024, from <https://www.energy.gov.za/files/media/explained/Energy-Price-Report-2023.pdf>
- DMPR. (2023a). *The South African Energy Trade Report 2022.* Retrieved June 2024, from <https://www.energy.gov.za/files/media/explained/2022-South-African-Energy-Trade-Report.pdf>
- DMPR. (2023b). *Overview of the Petrol and Diesel Market in South Africa between 2013 and 2022.* Retrieved June 2024, from <https://www.energy.gov.za/files/media/explained/Overview-of-Petrol-and-Diesel-Market-in-SA-between-2013-and-2022.pdf>



- Dodge, R., & Szmant-Froelich, A. (1985). Effects of drilling fluids on reef corals: a review. In I. Duedall, D. Kester, P. Park, & B. Ketchum (Eds.), *Wastes in the ocean* (p. 341–364). New York, NY: Wiley Interscience .
- Dow, F., Davies, J., & Raffaelli, D. (1990). The effects of drilling cuttings on a model marine sediment system. *Mar. Environ. Res.*(29), 103-124.
- Draft Committee. (1948). *Universal Declaration of Human Rights*. Paris: United Nations.
- Drewitt, A. (1999). Disturbance effects of Aircraft on birds. English Nature. Birds Network Information Note.
- D'Souza, N., Subramaniam, A., Juhl, A., Chekalyuk, A., Phan, S., Yan, B., . . . Montoya, J. (2016). Elevated surface chlorophyll associated with natural oil seeps in the Gulf of Mexico. *Nat. Geosci.*(9), 215–218.
- DTI. (2001). *AN OVERVIEW OF OFFSHORE OIL AND GAS*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/197799/SD_SEA2EandP.pdf
- Duncombe Rae, C. (2005). A demonstration of the hydrographic partition of the Benguela upwelling ecosystem at 26°40'S. *Afr. J. mar. Sci.*, 27(3), 617-628.
- Dundee, B. (2006). *The diet and foraging ecology of chick-rearing gannets on the Namibian islands in relation to environmental features: a study using telemetry*. . University of Cape Town, South Africa.
- Dunlop, R., Braithwaite, J., Mortensen, L., & Harris, C. (2021). Assessing Population-Level Effects of Anthropogenic Disturbance on a Marine Mammal Population. *Front. Mar. Sci.*, 1-12.
- EAB Engineering. (n.d.). *PLEM, PLET AND FLET*. Retrieved January 2025, from <https://www.eabeng.no/subsea-infrastructure/plem-plet-flet>
- Edge, K., Johnston, E., Dafforn, K., Simpson, S., Kutti, T., & Bannister, R. (2016). Sub-lethal effects of water-based drilling mud on the deep-water sponge *Geodia barretti*. *Environ. Pollut.*(212), 525-534.
- EEST. (n.d.). *Pipeline and Process*. Retrieved January 2025, from <https://eest-es.com/our-services/pipeline-and-process/>
- Ekau, W., & Verheye, H. (2005). Influence of oceanographic fronts and low oxygen on the distribution of ichthyoplankton in the Benguela and southern Angola currents. *Afr. J. mar. Sci.*, , 27(3), 629–639.
- Ellis, D., & Heim, C. (1985). Submersible surveys of benthos near a turbidity cloud. *Marine Pollution Bulletin*(16), 197-202.
- Ellis, J., Fraser, G., & Russel, J. (2012). Discharged drilling waste from oil and gas platforms and its effects on benthic communities. . *Mar. Ecol. Prog. Ser.*(456), 285–302.
- Ellis, M., Wilson-Ormond, E., & Powell, E. (1996). Effects of gas-producing platforms on continental shelf macroepifauna in the northwestern Gulf of Mexico: abundance and size structure. . *Can. J. Fish. Aquat. Sci.*(53), 2589-2605.
- Ellison, W., Racca, R., Clark, C., Streever, B., & al., e. (2016). Modeling the aggregated exposure and responses of bowhead whales *Balaena mysticetus* to multiple sources of anthropogenic underwater sound. *Endang. Species Res.*(30), 95–108.
- Elmgren, R., Hanson, S., Larson, U., Sundelin, B., & Boehm, P. (1983). The 'Tsesis' Oil SPill: Acute and long-term impact on the benthos. *Marine Biology*(73), 51-65.



- Elwen, S. H., Thornton, M., & Reeb, D. (2010). Near-shore distribution of Heaviside's (Cephalorhynchus heavisidii) and dusky dolphins (Lagenorhynchus obscurus) at the southern limit of their range in South Africa. *African Zoology*, 45(1), 78-91.
- Elwen, S., & Leeney, R. (2010). Injury and Subsequent Healing of a Propeller Strike Injury to a Heaviside's dolphin (Cephalorhynchus heavisidii). *Aquatic Mammals*, 4(36), 382-387.
- Elwen, S., & Leeney, R. (2011). Interactions between leatherback turtles and killer whales in Namibian waters, including predation. *South African Journal of Wildlife Research*(41(2)), 205-209.
- Elwen, S., Findlay, K., Kiszka, J., & Weir, C. (2011). Cetacean research in the southern African subregion: a review of previous studies and current knowledge. *African Journal of Marine Science*, 3(32).
- Elwen, S., Gridley, T., Roux, J., Best, P., & Smale, M. (2013). Records of Kogiid whales in Namibia, including the first record of the dwarf sperm whale (K. sima). *Marine Biodiversity Records*. doi:10.1017/S1755267213000213
- Elwen, S., Meyer, M., BEST, P., Kotze, P., Thornton, M., & Swanson, S. (2006). Range and movements of a nearshore delphinid, Heaviside's dolphin Cephalorhynchus heavisidii a determined from satellite telemetry. *Journal of Mammalogy*, 5(87), 866–877.
- Elwen, S., Snyman, L., & Leeney, R. (2009b). *Report of the Namibian Dolphin Project 2010: Ecology and conservation of coastal dolphins in Namibia*. Ministry of Fisheries and Marine Resources, Namibia.
- Elwen, S., Thornton, M., Reeb, D., & Best, P. (2009a). Near-shore distribution of Heaviside's (Cephalorhynchus heavisidii) and dusky dolphins (Lagenorhynchus obscurus) at the southern limit of their range in South Africa. *African Journal of Zoology* (45), 78.
- Elwen, S., Tonachella, N., Barendse, J., Collins, T., Best, P., Rosenbaum, H., . . . Gridley. (2014). Humpback Whales off Namibia: Occurrence, Seasonality, and a Regional Comparison of Photographic Catalogs and Scarring. *Journal of Mammalogy*, 5(95), 1064–76. doi:10.1644/14-MAMM-A-108
- Emanuel, B., Bustamante, R., Branch, G., Eekhout, S., & Odendaal, F. (1992). A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. *S. Afr. J. Mar. Sci.*(12), 341-354.
- Emeis, K., Bruchert, V., Currie, B., Endler, R., Ferdelman, T., Kiessling, A., . . . Vogt, T. (2004). Shallow gas in shelf sediments of the Namibian coastal upwelling ecosystem. *Continental Shelf Research*(24), 627-642.
- Energy Institute. (2023). *2023 Statistical Review of World Energy*. Retrieved May 2024, from <https://www.energyinst.org/statistical-review>
- Energy Institute. (2024). *2024 Statistical Review of World Energy*. Retrieved May 2024, from <https://www.energyinst.org/statistical-review>
- Environmental Information Service. (2022). *Atlas of Namibia-Climate*. Retrieved from Atlas of Namibia: <https://atlasofnamibia.online/chapter-3>
- Environmental Information Service. (2022). *Atlas of Namibia-Climate*. Retrieved from Atlas of Namibia: <https://atlasofnamibia.online/chapter-3>
- EPC Land (2). (n.d.). *How Does Pipeline Pigging Work?* Retrieved January 2025, from <https://epcland.com/pipeline-pigging/#:~:text=Pipeline%20pigging%20is%20an%20essential%20process%20in%2>



0the,slower%20movement%2C%20and%20in%20some%20cases%2C%20complete
%20blockages.

- EPC Land. (n.d.). *Christmas Trees in Oil & Gas: An Essential Overview*. Retrieved January 2025, from <https://epcland.com/christmas-tree-in-oil-gas/#:~:text=In%20the%20oil%20and%20gas%20industry%2C%20the%20term,the%20management%20and%20extraction%20of%20resources%20from%20wells.>
- Equator Principles Association. (2020). *Equator Principles: EP4*. Retrieved March 13, 2025, from <https://equator-principles.com/>
- Erasmus, V. .. (2021). Uncoupling the exploitation and climate change effects on the biology of Cape monkfish, *Lophius vomerinus* Valenciennes 1837 in Namibia. . *Thesis submitted in fulfilment of PhD, Rhodes University*.
- Erasmus, V. N. (2021). Uncoupling the exploitation and climate change effects on the biology of Cape monkfish, *Lophius vomerinus* Valenciennes 1837 in Namibia. *Thesis submitted in fulfilment of PhD, Rhodes University*.
- Erasmus, V., Currie, B., Roux, J., Elwen, S., Kalola, M., & et, a. (2021). Predatory species left stranded following the collapse of the sardine *Sardinops sagax* (Pappe, 1854) stock off the northern Benguela upwelling system: A review. *Journal of Marine Systems*.
- Erasmus, V., Hamutenya, S., Numwa, O., & Petrus, E. (2023). he Namibian Mariculture: Productivity, Challenges and Opportunities. In N. Gabriel, E. Omoregie, & K. Abasubong (Eds.), *Emerging Sustainable Aquaculture Innovations in Africa. Sustainability Sciences in Asia and Africa*. . Singapore: Springer.
- Erbe, C., Dunlop, R., & Dolman, S. (2018). Effects of Noise on Marine Mammals. In H. Slabbekoorn, R. Dooling, & A. Popper (Eds.), *Effects of Anthropogenic Noise on Animals* (pp. 277- 309). New York: Springer.
- Erbe, C., Marley, S., Schoeman, R., Smith, J., Trigg, L., & Embling, C. (2019). The effects of ship noise on marine mammals—a review. *Front. Mar. Sci.*(6), 606.
- Ernst and Young. (2016). *Global oil and gas tax guide*.
- Esbaugh, A., Mager, E., Stieglitz, J., Hoenig, R., Brown, T., & al., e. (2016). The effects of weathering and chemical dispersion on Deepwater Horizon crude oil toxicity to mahi-mahi (*Coryphaena hippu*).
- Essink, K. (1999). Ecological effects of dumping of dredged sediments; options for management. . *Journal of Coastal Conservation*.
- European Bank for Reconstruction and Development. (2010). EBRD Methodology for Assessment of Greenhouse Gas Emissions. Version 7, 6 July 2010. European Bank for Reconstruction and Development.
- European Commission. (2019). Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production.
- Evans, K., McCauley, R., Eveson, P., & Patterson, T. (2018). A summary of oil and gas exploration in the Great Australian Bight with particular reference to southern bluefin tuna. *Deep-Sea Research Part II*, 157-158: 190-202.
- EZConnect. (2023). *What you must know about umbilicals in oil and gas*. Retrieved January 2025, from <https://ezconnectfloats.com/the-role-of-umbilicals-in-oil-and-gas/#:~:text=Umbilicals%2C%20which%20are%20multi-function%20hoses%20or%20cables%20are,ensure%20the%20buoyancy%20and%20stability%20of%20underwater%20pipelines.>



- FAO. (2008). *International Guidelines for the Management of Deep-Sea Fisheries in the High Seas*. . SPRFMO-VI-SWG-INF01.
- Fechhelm, R., Gallaway, B., Hubbard, G., MacLean, S., & Martin, L. (2001). Opportunistic Sampling at a Deep-water Synthetic Drilling Fluid Discharge Site in the Gulf of Mexico. *Gulf of Mexico Science*(19), 97-106.
- Fegley, S., MacDonald, B., & Jacobsen, T. (1992). Short-term variation in the quantity and quality of seston available to benthic suspension feeders. *Estuar. Coast. Shelf Sci.*,(34), 393–412.
- Felder, D., Thoma, B., Schmidt, W., Sauvage, T., Self-Krayesky, T., Christoserdov, A., . . . Frederiq, S. (2014). Seaweeds and decapod crustaceans on Gulf deep banks after the Macondo oil spill. *BioScience*(64), 808–819.
- Felisita, A., Gudmestad, O., Karunakaran, D., & Martinsen, L. (2017). *Review of Steel Lazy Wave Riser Concepts for the North Sea*. Retrieved January 2025, from https://www.researchgate.net/publication/313148912_Review_of_Steel_Lazy_Wave_Riser_Concepts_for_the_North_Sea
- Fernández-Fernández, S., Bernabeu, A., Bouchette, F., Rey, D., & Vilas, F. (2011). Beach morphodynamic influence on long-term oil pollution: the Prestige oil spill. *J. Coast. Res.*(64), 890-893.
- Filander, Z., Smith, A. N., Cawthra, H. C., & Lamont, T. (2022). Benthic species patterns in and around the Cape Canyon: A large submarine canyon off the western passive margin of South Africa. *Front. Mari. Sci.*, 9.
- Finch, B., Wooten, K., & Smith, P. (2011). Embryo toxicity of weathered crude oil from the Gulf of Mexico in mallard ducks (*Anas platyrhynchos*). *Environ. Toxicol. Chem.*(30), 1885–1891.
- Finch, B., Wooten, K., Faust, D., & Smith, P. (2012). Embryotoxicity of mixtures of weathered crude oil collected from the Gulf of Mexico and Corexit 9500 in mallard ducks (*Anas platyrhynchos*). *Sci. Total Environ*(426), 155–159.
- Findlay, K., Best, P., Ross, G., & Cockroft, C. (1992). The distribution of small odontocete cetaceans off the coasts of South Africa and Namibia. . *S. Afr. J. Mar. Sci.* (12), 237-270.
- Finke, F., Gee, K., Gxaba, t., Sorgenfrei, R., Russo, V., Pinto, D., . . . Nsingi, K. K. (2020a). Marine Spatial Planning in the Benguela Current Large Marine Ecosystem. *Environmental Development*, 36.
- Finke, G., Gee, K., Kreiner, A., Amunyela, M., & Braby, R. (2020b). Namibia's way to Marine Spatial Planning – Using existing practices or instigating its own approach? *Marine Policy*, 121.
- Fisher, C., Demopoulos, A., Cordes, E., Baums, I., White, H., & Bourque, J. (2014). Coral communities as indicators of ecosystem- level impacts of the Deepwater Horizon spill. *BioScience*(64), 796–807.
- Forney, K. A., Southall, B. L., Slooten, E., Dawson, S., Read, A. J., Baird, R. W., & Brownwell, J. R. (2017). Nowhere to go: Noise impact assessments for marine mammal populations with high site infidelity. *Endanger. Species Res*, 32, 391-413.
- Fossing, H., Ferdelman, T., & Berg, P. (2000). Sulfate reduction and methane oxidation in continental margin sediments influenced by irrigation (South-East Atlantic off Namibia). *Geochim. Cosmochim. Acta.* , 5(64), 897–910.



- French-McCay, D. P. (2009). State-of-the-art and research needs for oil spill impact assessment modeling. *Emergencies Science Division* (pp. 601-653). Ottawa: Environment Canada.
- French-McCay, D., Crowley, D., Rowe, J., Bock, M., Robinson, H., Wenning, R., . . . Parkerton, T. (2018). Comparative risk assessment of spill response options for a deepwater oil well blowout: Part 1. *Marine pollution bulletin*, 1001-1015.
- Frithsen, J. B., Elmgren, R., & Rudnick, D. (1985). Responses of benthic meiofauna to long-term low-level additions of No. 2 fuel oil. *Mar. Ecol. Prog. Ser.*(23), 1-14.
- Fukushima, T., Tsune, A., & Sugishima, H. (2022). Comprehensive Understanding of Seafloor Disturbance and Environmental Impact Scenarios. In R. Sharma (Ed.), *Perspectives on Deep-Sea Mining*. Springer, Cham.
- Gates, A., & Jones, D. (2012). Recovery of Benthic Megafauna from Anthropogenic Disturbance at a Hydrocarbon Drilling Well (380 m Depth in the Norwegian Sea). *PLoS ONE* 7(10): e44114, 7(10). doi:10.1371/journal.pone.0044114
- Gomes, M., Pereira, F., & Line, A. (1994). *Pigging In Subsea Flexible Flowlines*. Retrieved January 2025, from <https://onepetro.org/OTCONF/proceedings-abstract/94OTC/All-94OTC/OTC-7574-MS/43833>
- Gordon, G., & Paterson, J. (2020). *Chapter XV - Decommissioning of Offshore Installations upon the UK Continental Shelf*. Retrieved January 2025, from <https://www.cambridge.org/core/books/abs/european-energy-law-report-xiii/decommissioning-of-offshore-installations-upon-the-uk-continental-shelf/EC063CF5A7621B17EBFB6846CBA5C3FE>
- Government of Namibia. (2024). *Namibia's Combined BTR1 and Fifth National Communication*. Retrieved February 2025, from https://unfccc.int/sites/default/files/resource/Namibia%27s%20BTR1_NC5%20Consolidated%20FINAL.pdf
- Gracia, A., Murawski, S. A., & Vázquez-Bader, A. (2020). Impacts of Deep Oil Spills on Fish and Fisheries. *Marine Science Faculty Publications*, 414-430.
- Gray, J. (1974). Animal-sediment relationships. . *Oceanography and Marine Biology Annual Reviews* (12), 223-261.
- Gray, J., Wu, R., & Or, Y. (2002). Effects of hypoxia and organic enrichment on the coastal marine environment. *Mar. Ecol. Prog. Ser.*(238), 249-279.
- Grémillet, D., Lewis, S., Drapeau, L., & van der Lingen, C. D. (2008). Spatial Match-mismatch in the Benguela upwelling zone: should we expect chlorophyll and sea surface temperature to predict marine predator distributions? *Journal of Applied Ecology*, 45, 610-621.
- Gros, J., Nabi, D., Wurz, B., Wick, L., Brussard, C., & al., e. (2014). First day of an oil spill on the open sea: early mass transfers of hydrocarbons to air and water. *Environ Sci Technol*(48), 9400-9411.
- Hall, S. (1994). Physical disturbance and marine benthic communities: life in unconsolidated sediments. *Oceanography and Marine Biology: An Annual Review*(32), 179-239.
- Hall, S. (2001). Is offshore oil exploration good for benthic conservation? *Trends in Ecology and Evolution*, 1(16), 58.
- Hall-Spencer, J., Allain, V., & Fosså, J. (2002). Trawling damage to Northeast Atlantic ancient coral reefs.



- Hamukuaya, H., O'Toole, M., & Woodhead, P. (1998). Observations of severe hypoxia and offshore displacement of Cape hake over the Namibian shelf in 1994. . *South African Journal of Marine Science*, 19, 57–59.
- Haney, J., Haury, L., Mullineaux, L., & Fey, C. (1995). Sea-bird aggregation at a deep North Pacific seamount. *Marine Biology*, 123, 1-9.
- Hansen, F., Cloete, R., & Verheye, H. (2005). Seasonal and spatial variability of dominant copepods along a transect off Walvis Bay (23°S) Namibia. *Afr. J. Mar. Sci.*, 27(1), 55-63.
- Hansen, K., Maxwell, A., Siebert, U., & al., e. (2017). Great cormorants (*Phalacrocorax carbo*) can detect auditory cues while diving. . *Sci Nat* .
- Harris, L. R., Holness, S. D., Kirkman, S. P., Sink, K. J., Majiedt, P., & Driver, A. (2022). *National Coastal and Marine Spatial Biodiversity Plan, Version 1.2 (Released 12-04-2022): Technical Report*. Nelson Mandela University, Department of Forestry, Fisheries and the Environment and South African National Biodiversity Institute.
- Harris, L., Nel, R., Oosthuizen, H., Meyer, M., Kotze, D., Anders, D., . . . Bachoo, S. (2018). Managing conflict between economic activities and threatened migratory species toward creating a multi-objective blue economy. . *Conservation Biology*(32).
- Hartley, J., Trueman, R., Anderson, S., Neff, J., Fucik, K., & Dando, P. (2003). *Drill Cuttings Initiative: Food Chain Effects Literature Review*. Aberdeen, Scotland: United Kingdom Offshore Operators Association.
- Harvey, M., Gauthier, D., & Munro, J. (1998). Temporal changes in the composition and abundance of the macro-benthic invertebrate communities at dredged material disposal sites in the Anse a Beaufils, Baie des Chaleurs, Eastern Canada. *Marine Pollution Bulletin*.
- Hashim, S., Waweru, B., & Muthumbi, A. (2024). Influence of oxygen minimum zone on macrobenthic community structure in the northern Benguela Upwelling System: a macro-nematode perspective . *Biogeosciences*.
- Hastie, G., Wilson, B., Tufft, L., & Thompson, P. (2003). Bottlenose dolphins increase breathing synchrony in response to boat traffic. *Marine Mammal Science* (19), 74-84.
- Hawkins, A., Roberts, L., & Cheesman, S. (2014). Responses of freeliving coastal pelagic fish to impulsive sounds. *Journal of the Acoustical Society of America*(135), 3101–3116.
- Hays, G., Houghton, J., Isaacs, C., King, R., Lloyd, C., & Lovell, C. (2004). First records of oceanic dive profiles for leatherback turtles, *Dermochelys coriacea*, indicate behavioural plasticity associated with long-distance migration. *Animal Behaviour*(67), 733-743.
- Helm, R., Costa, D., Debruyne, T., O'Shea, T., Wells, R., & Williams, T. (2015). Overview of Effects of Oil Spills on Marine Mammals. In M. Fingas (Ed.), *Handbook of Oil Spill Science and Technology* (pp. 455-475).
- Herbert, C., & Compton, J. (2007). Geochronology of Holocene sediments on the western margin of South Africa. *South African Journal of Geology*, 110, 327-338.
- Holness, S., Kirkman, S., Samaai, T., Wolf, T., Sink, K., Majiedt, P., . . . Lombard, M. (2014). *Spatial Biodiversity Assessment and Spatial Management, including Marine Protected Areas*. Final Report for the Benguela Current Commission Project .
- Holsman, K., Jameal Samhouril, J., Cook, G., Hazen, E., Olsen, E., Dillard, M., . . . Andrews, K. (2017). An ecosystem-based approach to marine risk assessment . *Ecosystem Health and Sustainability*, 1(3), e01.



- Honeb, H. (2025, September 16). Mr. (E. Simon, Interviewer)
- Houghton, J., Beyer, D., & Thielk, E. (1980). Effects of oil well drilling fluids on several important Alaskan marine organisms. (pp. 1017-1044). Proceedings of Symposium, Research on Environmental Fate and Effects of Drilling Fluids and Cuttings.
- Hovland, M., & Elsebeth, T. (1997). Cold-water corals—are they hydrocarbon seep related? *Marine Geology*, 137(1-2), 159-164.
- Hovland, M., Vasshus, S., Indreeide, A., Austdal, L., & Nilsen, Ø. (2002). Mapping and imaging deep-sea coral reefs off Norway, 1982-2000. *Hydrobiol*(471), 13-17.
- Howard, J., Jarre, A., Clark, A., & Molo, C. (2007). Application of the sequential t-test algorithm or analyzing regime shifts to the southern Benguela ecosystem. *African Journal of Marine Science*, 23(3), 437-451.
- Hubert, J., Campbell, J., Van Der Beek, J. G., Den Haan, M. F., Verhave, R., Verkade, L. S., & Slabbekoorn, H. (2018). Effects of broadband sound exposure on the interaction between foraging crab and shrimp – A field study. *Environmental Pollution*(243), 1923.
- Hughes, G. R. (1974). *The sea turtles of south-east Africa I: Status, morphology and distributions*. Oceanographic Research Institute.
- Hui, C. A. (1985). Undersea topography and the comparative distributions of two pelagic cetaceans. *Fishery Bulletin*, 83(3), 472-475.
- Human, J. (2024). Power to heat and thermal storage - the status of regional gas. *Presentation at EE Business Intelligence Webinar: Innovating process heat supply: Power to heat and thermal storage held 20 May 2024*.
- Hunt, D. (2024). *SAOGA Breakfast*. Retrieved April 25, 2024
- Hurley, G., & Ellis, J. (2004). Environmental Effects of Exploratory Drilling Offshore Canada: Environmental Effects Monitoring Data and Literature Review - Final Report. Prepared for the Canadian Environmental Assessment Agency - Regulatory Advisory Committee.
- Husky Oil Operations Limited. (2000). *White Rose Oilfield Comprehensive Study*. St. John's, NL: Submitted by Husky Oil Operations Limited as Operator.
- Husky Oil Operations Limited. (2001a). *White Rose Oilfield Comprehensive Study Supplemental Report Responses to Comments from Canada-Newfoundland Offshore Petroleum Board, Department of Fisheries and Oceans, Environment Canada, Natural Resources Canada and Canadian Environmental Assessment*. Husky Oil Operations Limited.
- Husky Oil Operations Limited. (2001b). *White Rose baseline characterization data report June 2001*. St. John's, NL: Jacques Whitford Environment Limited for Husky Oil Operations Limited.
- Hutchings, L., Beckley, L., Griffiths, M., Roberts, M., Sundby, S., & Van Der Lingen, C. (2002). Spawning on the edge: spawning grounds and nursery areas around the southern African coastline. *Marine and Freshwater Research*(53), 307-318.
- Hutchings, L., Beckley, L., Griffiths, M., Roberts, M., Sundby, S., & Van Der Lingen, C. (2002). Spawning on the edge: spawning grounds and nursery areas around the southern African coastline. *Marine and Freshwater Research*(53), 307-318.
- Hutchings, L., van der Lingen, C., Shannon, L., Crawford, R., Verheye, H., Bartholomae, C., . . . Monteiro, P. (2009). The Benguela Current: An ecosystem of four components. *Progress in Oceanography*(83), 15-32.



- Hyllenberg, J., Nateewathana, A., & Chatananthawej, B. (1985). Temporal changes in the macrobenthos on the west coast of Phuket Island, with emphasis on the effects of offshore tin mining. *Research Bulletin of the Phuket Marine Biological Center*(38), 32.
- ICCAT. (2023). *Statistical Bulletin Vol 48*. Retrieved from <https://www.iccat.int/sbull/SB48-2023/index.html>
- ICCAT. (2024). *Statistical Bulletin Vol 48*. Retrieved from <https://www.iccat.int/sbull/SB48-2023/index.html>
- ICLG. (2023). *Oil and Gas Laws and Regulations: Namibia*. Retrieved February 2025, from <https://iclg.com/practice-areas/oil-and-gas-laws-and-regulations/namibia>
- IEA. (2023). *Namibia - Countries & Regions*. Retrieved February 04, 2025, from International Energy Agency: <https://www.iea.org/countries/namibia>
- IEA. (2025). *The Implications of Oil and Gas Field Decline Rates*. Retrieved from <https://iea.blob.core.windows.net/assets/9ea2076e-5a0d-4a0d-9767-a1eec20aff23/TheImplicationsofOilandGasFieldDeclineRates.pdf>
- IISD. (2023, December 13). Retrieved June 2024, from Inside COP 28: <https://www.iisd.org/inside-cop-28>
- Incardona, J., Gardner, K., Linbo, T., Swarts, T., Esbaugh, A., Mager, E., . . . al., e. (2014). Deepwater Horizon crude oil cardiotoxicity to the developing hearts of large predatory pelagic fish. *Proceedings of the National Academy of Sciences of the United States of America* .
- INEOS. (2022). *Environmental Impact Assessment: Herje to South Arne Development Project* . COWI.
- Institution for Coastal and Marine Research . (2023). *Namibian EBSA Status Assessment and Management* . Retrieved January 2024, from <https://cmr.mandela.ac.za/Research-Projects/EBSA-Portal/Namibia/Namibian-EBSA-Status-Assessment-Management>
- Intergovernmental Panel on Climate Change. (2021). *Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Switzerland: Intergovernmental Panel on Climate Change.
- International Labour Organization. (1998). *Declaration on Fundamental Principles and Rights at Work*.
- International Finance Corporation. (2012). *Performance Standards on Environmental and Social Sustainability*. Retrieved March 13, 2025, from <https://www.ifc.org/>
- IOGP . (2003). *Environmental Aspects of use and disposal of non-aqueous drilling fluids associated with offshore oil & gas operations*. London, UK: IOGP (International Association of Oil and Gas Producers).
- IOGP. (2016). *Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations*. IOGP (International Association of Oil and Gas Producers).
- IPPR. (2021). *Namibia Quartely Economic Review Q2: 2021:special focus on tourism*. Institute for Public Policy Research.
- Iwamoto, T., & Anderson, M. (1994). Review of the grenadiers (Teleostei: Gadiformes) of southern Africa, with descriptions of four new species. *Ichthyological Bulletin*, pp. 1-18.



- IWC. (2012). *Report of the Scientific Committee. Annex H: Other Southern Hemisphere Whale Stocks Committee 11-23*.
- Jansen, T., Kainge, P., Singh, L., Wilhelm, M., Durholtz, D., Stromme, T., . . . Erasmus, V. (2015). Spawning patterns of shallow-water hake (*Merluccius capensis*) and deep-water hake (*M. paradoxus*) in the Benguela Current Large Marine Ecosystem inferred from gonadosomatic indices. *Fisheries Research*, 1;172:168-80.
- January, D. K. (2018). *Mapping Break-Back Thrust Sequence Developments of the Orange Basin (offshore) South Africa*. Cape Town: Univeristy of the Western Cape.
- Jarnegren, J., Brokke, S., & Jensen, H. (2020). Effects and recovery of larvae of the cold water coral *Lophelia pertusa* 9*Desmophyllum pertusum*) exposed to suspended bentonite, barite and drill cuttings. *Marine Environmental Research* (158), 104996.
- Jensen, O. P., Branch, T. A., & Hilborn, R. (n.d.). Marine fisheries as ecological experiments. *Theor Ecol*, 5, 3-22.
- Jensen, T., Palerud, R., Olsgard, F., & Bakke, S. (1999). *Dispersion and effects of synthetic drilling fluids in the Environment. Technical Report to the Ministry of Oil and Energy. Report no. 99-3507*.
- Jødestøl, K., & Furuholt, E. (2010). Will Drill Cuttings And Drilling Mud Harm Cold Water Corals? *International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, 12-14 April 2010*, (p. 11). Rio de Janeiro, Brazil.
- Johnson, S., & Collins, P. (2020). Subsea Umbilical Systems. Retrieved from https://sut-us.org/pages_data/files/SUT-SAC-16-Umbilicals_637302480461195015.pdf
- Jones, D. (2014). Brulpadda-1AX Megafaunal Report. Survey report for TOTAL E & P South Africa BV. *Global Marine Research Ltd*, 46.
- Jones, D., Gates, A., & Lausen, B. (2012). Recovery of deep-water megafaunal assemblages from hydrocarbon drilling disturbance in the Faroe–Shetland Channel. . *Marine Ecology Progress Series*(461), 71-82.
- Kahn, U. (2023). *Understanding the Value of NAMibia's Marine Recreational Fishery*. Windhoek: UNAM.
- Kainge, P., Kjesbu, O. S., Thorsen, A., & Salvanes, A. G. (2007). *Merluccius capensis* spawn in Namibian waters, but do *M. paradoxus*? *African Journal of Marine Science*, 29(3), 379-392.
- Karenyi, N., Sink, K., & Nel, R. (2016). Defining seascapes from marine unconsolidated shelf sediments in an eastern boundary upwelling region: The southern Benguela as a case study. . *Estuarine, Coastal and Shelf Science*, 195-206.
- Kendall, M., & Widdicombe, S. (1999). Small scale patterns in the structure of macrofaunal assemblages of shallow soft sediments. *Journal of Experimental Marine Biology and Ecology*(237), 127-140.
- Kenny, A., Rees, H., Greening, J., & Campbell, S. (1998). The effects of marine gravel extraction on the macrobenthos at an experimental dredge site off north Norfolk, U.K. (Results 3 years post-dredging). *ICES CM*, 14, 1-8.
- Kenny, S. (2018). *Offshore Pipelines*. Retrieved January 2025, from <https://www.sciencedirect.com/topics/engineering/offshore-pipelines>
- Kershaw, J., Ramp, C., Sears, R., Plourde, S., Brosset, P., Miller, P., & al., e. (2021). Declining reproductive success in the Gulf of St. Lawrence's humpback whales (*Megaptera novaeangliae*) reflects ecosystem shifts on their feeding grounds. *Glob. Change Biol.*(27), 1027–1041.



- King, D. P. (1977). Influence of temperature, dissolved oxygen and salinity on incubation and early larval development of the South West African pilchard *Sardinops ocellata* Invenstl. Rep. Sea Fish. Brch S. Afr., 114 (35 pp.).
- Kirchner, C. H., Bartholomae, C. H., & Kreiner, C. H. (2009). Use of environmental parameters to explain the variability in spawner recruitment relationships of Namibian sardine *Sardinops sagax*. *African Journal of Marine Science*, 31(2), 157-170.
- Kirkman, S. P., Costa, D. P., Harrison, A. L., Kotze, P. G., Oosthuizen, W. H., Weise, M., . . . Arnould, J. P. (2019). Dive behaviour and foraging effort of female Cape fur seals *Arctocephalus pusillus pusillus*. *Royal Science Open Science*, 6.
- Kirkman, S. P., Kotze, D., Mccue, S., Seakamela, M., Meyer, M., Hlati, K., & Oosthuizen, H. (2015). *Cape fur seal foraging behaviour*. In: VERHEYE, H., HUGGETT, J. & R. CRAWFORS (Eds) *State of the Oceans and Coasts Around South Africa - 2015 Report Card*.
- Kirkman, S., & Lavigne, D. (2010). Assessing the hunting practices of Namibia's commercial seal hunt. *S Afr J Sci*.
- Kirkman, S., Meyer, M., & Thornton, M. (2010). False Killer Whale *Pseudorca crassidens* mass stranding at Long Beach on South Africa's Cape Peninsula, 2009. *African Journal of Marine Science*, 1(31), 167–70. doi:10.2989/1814232X.2010.481168
- Kirkman, S., Oosthuizen, W., Meyer, M., Kotze, P., Roux, J., & Underhill, L. (2007). African Journal of Marine Science. *Making sense out of censuses and dealing with missing data: trends in pup counts of Cape fur seals Arctocephalus pusillus pusillus between 1972 and 2004*(29), 161–176.
- Kirkman, S., Yemane, D., Oosthuizen, W., Meyer, M., Kotze, P., Skrypzeck, H., . . . Underhill, L. (2012). Spatio-temporal shifts of the dynamic Cape fur seal population in southern Africa, based on aerial censuses (1972-2009). *African Journal of Marine Science*(29), 161–176.
- Klingelhoefter, E. (1994). Emphasis on distribution and abundance. . *Namibian Brief: Focus on Fisheries and Research*, 18: 79-81.
- Kök, M., Varfolomeev, M., & Nurgaliev, D. (2018, September). Wax appearance temperature (WAT) determinations of different origin. *Journal of Petroleum Science and Engineering*, 168, pp. 542-545. Retrieved January 2025, from <https://www.sciencedirect.com/science/article/pii/S092041051830439X#:~:text=The%20wax%20appearance%20temperature%20%28WAT%29%2C%20also%20known%20as,temperature%20at%20which%20a%20crude%20oil%20first%20precipitates.>
- Koper, R., & Plön, S. (2012). *The potential impacts of anthropogenic noise on marine animals and recommendations for research in South Africa*. . South Africa : Endangered Wildlife Trust .
- Koslow, J. A. (1996). Energetic and life history patterns of deep-sea benthic, benthopelagic and seamount associated fish. *Journal of Fish Biology*, 54-74.
- KPMG. (2020). *Petroleum Industry Bill (PIB) 2020 - A Game Changer*.
- Kranz, P. (1974). The anastrophic burial of bivalves and its paleoecological significance. *Journal of Geology*(82), 29.
- Lambardi, P., Lutjeharm, J., Menacci, R., Hays, G., & Luschi, P. (2008). Influence of ocean currents on long-distance movement of leatherback sea turtles in the Southwest Indian Ocean. . *Marine Ecology Progress Series*(353), 289–301.



- Lan, K., Lee, M., Lu, H., Sheih, W., Lin, W., & Kao, C. (2011). Ocean variations associated with fishing conditions for yellowfin tuna (*Thunnus albacares*) in the equatorial Atlantic Ocean. . *ICES Journal of Marine Science*, 6(68), 1063–1071.
- Lan, K., Lee, M., Lu, H., Sheih, W., Lin, W., & Kao, S. (2011). Ocean variations associated with fishing conditions of the yellowfin tuna (*Thunnus albacares*) in the equatorial Atlantic Ocean. *ICES J Mar Sci*, 68(6):1063 -1071.
- Lane, S., & Carter, R. (1999). *Generic Environmental Management Programme for Marine Diamond Mining off the West Coast of South Africa*. . Cape Town, South Africa.: Marine Diamond Mines Association .
- Langangen, Ø., Olsen, E., Stige, L., Ohlberger, J., Yaragina, N., Vikebo, F., . . . Hjermann, D. (2017). The effects of oil spills on marine fish: Implications of spatial variation in natural mortality. *Marine Pollution Bulletin*(119), 102-109.
- Larsson, A., & Purser, A. (2011). Sedimentation on the cold-water coral *Lophelia pertusa*: cleaning efficiency from natural sediments and drill cuttings. *Mar. Pollut. Bull.*(62), 1159–1168.
- Larsson, A., Van Oevelen, D., Purser, A., & Thomsen, L. (2013). Tolerance to long-term exposure of suspended benthic sediments and drill cuttings in the cold-water coral *Lophelia pertusa*. *Mar. Pollut. Bull.*(70), 176–188.
- Laws, R. (2009). *Antarctic Seals: Research Methods and Techniques*. Cambridge: Cambridge University Press.
- Le Gouvello, D., Hart-Davis, M., Backeberg, B., & Nel, R. (2020). Effects of swimming behaviour and oceanography on sea turtle hatchling dispersal at the intersection of two ocean current systems. . *Ecological Modelling*. 431. . 10.1016/j.ec, 1-12.
- Le Roux, L. (1997). Stock assessment and population dynamics of the deep-sea red crab *Chaceon maritae* (Brachyura, Geryonidae) off the Namibian Coast . *M.Sc. thesis, University of Iceland* , 88 pp.
- Leeney, R., Post, K., Hazevoet, C., & Elwen, S. (2013). Pygmy right whale records from Namibia. . *African Journal of Marine Science*, 1(35), 133-139.
- Lees, D., & Houghton, J. (1980). Effects of drilling fluids on benthic communities at the Lower Cook Inlet C.O.S.T. well. 1, pp. 309-350. Proceedings of Symposium, Research on Environmental Fate and Effects of Drilling Fluids and Cuttings.
- Lehodeya, P., Alheit, I., Barange, M., Baumgartner, T., Beaugrande, G., Drinkwater, K., . . . Werner, F. (2006). Climate Variability, Fish, and Fisheries. *Journal of Climate*(19).
- Lehodeya, P., Alheit, J., Barange, M., Baumgartner, T., Beaugrand, G., Drinkwater, K., . . . Roy, C. V. (2006). Climate Variability, Fish, and Fisheries. *Journal of Climate*, 5009-5030.
- Lett, C., Veitch, J., Van Der Lingen, C., & Hutchings, L. (2007). Assessment of an environmental barrier to transport of ichthyoplankton from the southern to the northern Benguela ecosystems. *Mar. Ecol. Prog. Ser.*(347), 247–259.
- Lett, C., Veitch, J., Van Der Lingen, C., & Hutchings, L. (2007). Assessment of an environmental barrier to transport of ichthyoplankton from the southern to the northern Benguela ecosystems. *Mar. Ecol. Prog. Ser.*(347), 247–259.
- Leung-Ng, S., & Leung, S. (2003). Behavioral response of Indo-Pacific humpback dolphin (*Sousa chinensis*) to vessel traffic. . *Mar. Env. Res.*(56), 555-567.



- Levin, L. A., Ekau, W., Gooday, A. J., Jorissen, F., Middelburg, J. J., Naqvi, S. W., . . . Zhang, J. (2009). Effects of natural and human-induced hypoxia on coastal benthos. *Biogeosciences*. doi:<https://doi.org/10.5194/bg-6>
- Levin, P., Fogarty, M., Murawski, S., & Fluharty, D. (2009). Integrated ecosystem assessments: developing the scientific basis for ecosystem-based management of the ocean. *PLoS Biology*, e1000014.
- Levy, J. K., & Gopalakrishnan, C. (2010). Promoting Ecological Sustainability and Community Resilience in the US Gulf Coast after the 2010 Deepwater Horizon Oil Spill'. *Journal of Natural Resources Policy Research*, 2(3), 297-315.
- Light, M., & Shimutwikeni, N. (1991). Namibia, practically unexplored, may have land, offshore potential. *Oil and Gas Journal (OGJ)*.
- Lipinski, M. (1992). Cephalopods and the Benguela ecosystem: trophic relationships and impacts. . *S. Afr. J. Mar. Sci*(12), 791-802.
- Lombard, A., Strauss, T., Harris, J., Sink, K., Attwood, C., & Hutchings, L. (2004). *National Spatial Biodiversity Assessment 2004*. South African Technical Report Volume 4: Marine Component.
- Longhurst, A. R. (2006). *Ecological Geography of the Sea*. (2 ed.). San Diego: Academic Press.
- Love, M., & York, A. (2006). The relationships between fish assemblages and the amount of bottom horizontal beam exposed at California oil platforms: fish habitat preferences at man-made platforms and (by inference) at natural reefs. *Fisheries Bulletin*(104), 542-549.
- Love, M., Schroeder, D., & Lenarz, W. (2005). Distribution of bocaccio (*Sebastes paucispinis*) and cowcod (*Sebastes levis*) around oil platforms and natural outcrops off California with implications for larval production. *Bulletin of Marine Science*, 77.
- Luderitz Town Council. (2025, 6 25). Retrieved from <https://www.luderitz-tc.com/>.
- Ludynia, K. (2007). *Identification and characterisation of foraging areas of seabirds in upwelling systems: biological and hydrographic implications for foraging at sea*. University of Kiel, Germany.
- Ludynia, K., Kemper, J., & Roux, J. (2012). The Namibian Islands' Marine Protected Area: Using seabird tracking data to define boundaries and assess their adequacy. . *Biological Conservation*, (156), 136-145.
- Lusseau, D. (2004). The hidden cost of tourism: Effects of interactions with tour boats on the behavioral budget of two populations of bottlenose dolphins in Fiordland, New Zealand. . *Ecology and Society* , 1(9).
- Lusseau, D. (2005). Residency pattern of bottlenose dolphins *Tursiops* spp. in Milford Sound, New Zealand, is related to boat traffic. *Marine Ecology Progress Series* (295), 265-272.
- Lusseau, D., Bain, D., Williams, R., & Smith, J. (2009). Vessel traffic disrupts the foraging behavior of southern resident killer whales *Orcinus orca*. *Endangered Species Research* (6), 211-221.
- Lynam, C. (2006). Jellyfish overtake fish in a heavily fished ecosystem. *Current Biology*.
- Maartens, L. (2023). *Environmental Assessment for the proposed farming of Atlantic Salmon *Salmo Salar* by African Aquaculture Company (PTY) Ltd, Luderitz, //Karas Region, Namibia*. Retrieved from <https://the->



eis.com/elibrary/sites/default/files/downloads/literature/1392_EAR_Proposed%20far ming%20of%20Atlantic%20Salmon%20Luderitz.pdf

- MacIassac, K., Bourbonnais, C., Kenchington, E., Gordon, J., & Gass, S. (2001). Observations on the occurrence and habitat preference of corals in Atlantic Canada. In J. Willison, H. J. S. Gass, E. Kechington, M. Butler, & P. Doherty (Ed.), *Proceedings of the First International Symposium on Deep Sea Corals*. . Halifax, Nova Scotia: Ecology Action Centre and Nova Scotia Museum.
- MacPherson, E., & Gordoa, A. (1992). Trends in the demersal fish community off Namibia from 1983 to 1990. *South African Journal of Marine Science*, 12(1), 635-649.
- Malme, C., Miles, P., Tyack, P., Clark, C., & Bird, J. (1985). *Investigation of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior*. BBN Report 5851, OCS Study MMS 85-0019. Report from BBN.
- Manning, P. R. (1998). Managing Namibia's marine fisheries: Optimal resource use and national development objectives. . *London School of Economics and Political Science (United Kingdom)*.
- MARISMA. (2020). *Ecologically or Biologically Significant Marine Areas in the Benguela Current Large Marine Ecosystem: Namibia*. Technical Report. MARISMA Project. Namibia. MARISMA EBSA Workstream.
- Mate, B., Best, P., Lagerquist, B., & Winsor, M. (2011). Coastal, offshore and migratory movements of South African right whales revealed by satellite telemetry. *Marine Mammal Science*, 3(27), 455-476.
- Matthews, J. P., & Smit, N. L. (1979). Trends in the size composition, availability, egg-bearing and sex ratio of the rock lobster *Jasus lalandii* in its main fishing area off South West Africa, 1958-1969. *Investl. Rep. Div. Sea Fish. S. Afr.*, 103, 1-38.
- Matthews, S., & Pitcher, G. (1996). Worst recorded marine mortality on the South African coast. In: YASUMOTO, T, OSHIMA, Y. & Y. FUKUYO (Eds), Harmful and Toxic Algal Blooms. . *Intergovernmental Oceanographic Commission of UNESCO*, 88-92.
- Maurer, D. K., Tinsman, J., & Leatham, W. (1986). Vertical migration and mortality of marine benthos in dredged material: A synthesis. *Int. Revue Ges. Hydrobiologia*(71), 49-63.
- Maurer, D., Keck, R., Tinsman, J., & Leatham, W. (1981a). Vertical migration and mortality of benthos in dredged material: Part I – Mollusca. . *Marine Environmental Research*(4), 299-319.
- Maurer, D., Keck, R., Tinsman, J., & Leatham, W. (1981b). Vertical migration and mortality of benthos in dredged material: Part II – Crustacea. *Marine Environmental Research*(5), 301-317.
- Maurer, D., Keck, R., Tinsman, J., & Leatham, W. (1982). Vertical migration and mortality of benthos in dredged material: Part III – Polychaeta. *Marine Environmental Research* (6), 49-68.
- Maurer, D., Leatham, W., Kinner, P., & Tinsman, J. (1979). Seasonal fluctuations in coastal benthic invertebrate assemblages. *Estuarine and Coastal Shelf Science*(8), 181-193.
- Mavetja Rukoro, R. (2005). *D10.3.a Country Report Namibia: Promotion and Management of Marine Fisheries in Namibia*. Windhoek: INCOFISH.
- McAlpine, D. (2018). Pygmy and Dwarf Sperm Whales: *Kogia breviceps* and *K. sima*. In *Encyclopedia of Marine Mammals* (3 ed., pp. 936-938).
- McCay, D., Li, Z. H., Crowley, D., Spaulding, M., Mendelsohn, D., & Turner, C. (2016). Modeling oil fate and subsurface exposure concentrations from the Deepwater



- Horizon oil spill. . *Proceedings of the 39th AMOP Technical Seminar on Environmental Contamination and Response*, (pp. 7-9). Ottawa.
- McClain, C., Nunnally, C., & Benfield, M. (2019). Persistent and substantial impacts of the Deepwater Horizon oil spill on deep-sea megafauna. *R. Soc. open sci.* 6: 191164. <http://dx.doi.org/10.1098/rsos.191164>.
- McHuron, E., Schwarz, L., Costa, D., & Mangel, M. (2018). A state-dependent model for assessing the population consequences of disturbance on income-breeding mammals. *Ecological Modelling*(385), 133- 144.
- McLachlan, A. (1980). The definition of sandy beaches in relation to exposure: a simple rating system. . *S. Afr. J. Sci.*, 137-138.
- McNutt, M., Camilli, R., Crone, T., Guthrie, G., Hsieh, P., Ryerson, T., . . . Shaffer, F. (2012). Review of flow rate estimates of the Deepwater Horizon oilspill. *Proceedings of the National Academy of Sciences*(109), 20260- 20267.
- Meadows, M., Dingle, R., Rogers, J., & Mills, E. (1997). Radiocarbon chronology of Namaqualand mudbelt sediments: problems and prospects. *South African Journal of Science*, 93, 321-327.
- Meadows, M., Rogers, J., Lee-Thorp, J., Bateman, M., & Dingle, R. (2002). Holocene geochronology of a continental-shelf mudbelt off southwestern Africa. *The Holocene*, 12, 59-67.
- Menn, I. (2002). Ecological comparison of two sandy shores with different wave energy and morphodynamics in the North Sea. *Berliner Polarforschung und Meeresforschung*(417), 1-174.
- MFMR & FAO. (2022). *National Plan of Action for Small-Scale Fisheries 2002-2026*. Republic of Namibia Ministry of Fisheries and Marine Resources.
- MFMR. (2019). *National Framework for Marine Spatial Planning in Namibia*. Windhoek, Namibia: Ministry of Fisheries and Marine Resources.
- MFMR. (2021). *Current Status Report: Knowledge Baseline for Marine Sptatial Planning in Namibia*. Windhoek, Namibia: Ministry of Fishieres and Marine Resources.
- MFMR; FAO. (2022). *National Plan of Action for Small-Scale Fisheries 2002-2026*. Republic of Namibia Ministry of Fisheries and Marine Resources.
- MIME. (2017). *National Energy Policy*. Ministry of Industries, Mines and Energy, Government of the Repulic of Namibia.
- Ministry of Education. (2018). *EMIS Education Statisitics 2018, Namibia*. Windhoek: MoE.
- Ministry of Education. (2019). *EMIS Education Statisitics 2019, Namibia*. Windhoek: MoE.
- Ministry of Education. (2020). *EMIS Education Statistics 2020, Namibia*. Windhoek: MoE.
- Ministry of Education. (2021). *EMIS Education Statistics 2021, Namibia*. Windhoek: MoE.
- Ministry of Education. (2022). *EMIS Education Statistics 2022, Namibia*. Windhoek: MoE.
- Ministry of Education. (2023). *EMIS Education Statistics 2023, Namibia*. Windhoek: MoE.
- Ministry of Fisheries and Marine Resources. (2021). *Annual Report 2020/2021*. Windhoek: MFMR.
- Ministry of Fisheries and Marine Resources. (2022). *National Plan of Action for Smal Scale Fisheries 2022 - 2026*. Windhoek: FAO.
- Molloy, F., & Reinikainen, T. (2003). *Namibia's Marine Environment*. Directorate of Environmental Affairs of the Ministry of Environment and Tourism.



- Montagna, P., & Harper, D. (1996). Benthic infaunal long-term response to offshore production platforms in the Gulf of Mexico. . *Can. J. Fish. Aquat. Sci.*(53), 2567–2588.
- Montagna, P., Baguley, J., Cooksey, C., Hartwell, I., Hyde, L., Hyland, J., . . . Rhides, A. (2013). Deep-sea benthic footprint of the Deepwater Horizon blowout. *PLoS ONE* 8:e70540.
- Monteiro, P. (1998). *Assessment of sediment biogeochemical characteristics in the Espirito Santo Estuary-Maputo, Bay system in order to devise a low risk dredging-disposal management plan linked to the proposed MOZAL Matola Terminal*. CSIR Report No: EN.
- Monteiro, P. M., & van der Plas, A. K. (2006). 5 Low oxygen water (LOW) variability in the Benguela system: Key processes and forcing scales relevant to forecasting. In *Large Marine Ecosystems* (Vol. 14, pp. 71-90).
- Monteiro, P. M., van der Plas, A. K., Bailey, G. W., Mallanote-Rizzoli, P., Duncombe Rae, C. M., Byrnes, D., . . . Florenchie, P. (2006). 13 Low Oxygen Water (LOW) forcing scales amenable to forecasting in the Benguela ecosystem. In *Benguela: Predicting a Large Marine Ecosystem* (pp. 295-308). Elsevier.
- Morant, P. (1999). Synthesis and assessment of information on the BCLME. BCLME Thematic Report 4: Integrated overview of the offshore oil and gas industry in the Benguela Current Region. CSIR Report. ENV-S-C 99057.
- Morant, P. (2013). Environmental Management Plan for the proposed marine phosphate prospecting in the Outeniqua West Licence Area on the eastern Agulhas Bank, offshore Mossel Bay. . *Prepared for Diamond Fields International Ltd*. CSIR/CAS/EMS/ER/2013/0000.
- Mortensen, P., Hovland, T., Fossa, J., & Furevik, D. (2001). Distribution, abundance and size of *Lophelia perusa* coral reefs in mid-Norway in relation to seabed characteristics. *Journal of the Marine Biological Association of the UK*, 4(81), 581-597.
- Moura, J., Acevedo-Trejos, E., Tavares, D., Meirelles, A., Silva, C., Oliviera, L., . . . Merico, A. (2016). Stranding events of *Kogia* whales along the Brazilian coast. . *PLoS ONE*,, 1(11), 1–15.
- MRA. (2008). *New marine phosphate sampling project in Namibia*. Retrieved from <https://www.miningreview.com/top-stories/new-marine-phosphate-sampling-project-in-namibia/>
- Munro, P., Croce, B., Moffat, C., Brown, N., McIntosh, A., Hird, S., & Stagg, R. (1998). Solid-phase test for comparison of degradation rates of synthetic mud base fluids used in the off-shore drilling industry. *Environmental Toxicology and Chemistry*, 10(17), 1951-1959.
- Mutra, G., & Kibria, G. (2017). *An emerging shellfish farming industry in Namibia*. Responsible Seafood Advocate.
- Namcor. (2017a). *Annual Report 2016/2017*. Retrieved from <https://www.namcor.com.na/wp-content/uploads/2020/02/namcor-annual-report-2017.pdf>
- NAMCOR. (2017b). *Namibian Fiscal regime*.
- Namibia Statistics Agency. (2014). *2011 Population and Housing Census: Erongo Region - Basic Analysis with Highlights*. Windhoek: NSA.
- Namibia Statistical Agency. (2024). *2023 Population & Housing Census Preliminary Report*.



- Namibia Statistics Agency. (2014). *2011 Population and Housing Census- Kharas Regional Profile*.
- Namibia Statistics Agency. (2014(a)). *2011 Population and Housing Census: Kharas Region - Basic Analysis with Highlights*. Windhoek: NSA.
- Namibia Statistics Agency. (2016). *Namibia Household Income and Expenditure Survey 2015/2016 Report*.
- Namibia Statistics Agency. (2017). *Namibia Household Income and Expenditure Survey (NHIES) 2015/16 Report*. Windhoek: NSA.
- Namibia Statistics Agency. (2024). *2023 Population and Housing Census: Labour Force Report*. Windhoek: NSA.
- Namibia Statistics Agency. (2024). *2023 Population and Housing Census: Main Report*. Windhoek: NSA.
- Namibia Statistics Agency. (2024(a)). *Annual National Accounts 2023*. Windhoek: Namibia.
- Namibia Statistics Agency. (2024(b)). *2023 Population and Housing Census: Labour Force Report*. Windhoek: NSA.
- Namibia Statistics Agency. (2024b). *2023 Population and Housing Census: Labour Force Report*. Windhoek: NSA.
- Namibia University of Science and Technology. (2025, September 15). Retrieved from www.nust.na.
- NAMISUN. (2023). *Environmental Management Plan for the proposed Giant Kelp Cultivation Project near Ludertiz, //Kharas Region*. Retrieved from <https://the-eis.com/elibrary/search/29777>
- NAMPORT. (2019). *Integrated Annual Report*.
- NAMPORT. (2025). *Integrated Annual Report 2024*.
- National Business Institute. (2021). *Just Transition and Climate Pathways Study for South Africa. Decarbonising South Africa's Power System. In partnership with Business Unity South Africa and the Boston Consulting Group*.
- National Planning Commission. (2021). *Economic Development Report 2020 – “Turning risks into opportunities*.
- National Planning Commission. (2021). *Namibia's Second Voluntary National Review Report on the Implementation of the Sustainable Development Goals Towards Agenda 2030*. Windhoek: Office of the President, National Planning Commission.
- National Statistics Agency. (2019). *The Namibia Labour Force Survey 2018*.
- Neff, J. (1991). *Water Quality in Prince William Sound and the Gulf of Alaska*. Arthur D Little, Cambridge, Massachusetts.
- Neff, J. (2005). *Composition, Environmental Fates, and Biological Effects of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography*. Prepared for Petroleum Environmental Research Forum (PERF).
- Neff, J., Bothner, M., Maciolek, N., & Grassle, J. (1989). Impacts of exploratory drilling for oil and gas on the benthic environment of Georges Bank. *Marine Environmental Research*(27), 77-114.
- Neff, J., Sauer, T., & Maciolek, N. (1992). Composition, fate and effects of produced water discharges to nearshore waters. In J. Ray, & F. Eneglehardt (Eds.), *Produced Water:*



- Technological/Environmental Issues* (pp. 371-386). New York: Plenum Publishing Co.
- Nelson, G. (1989). Poleward motion in the Benguela area. . In Neshyba (Ed.), *Poleward Flows along Eastern Ocean Boundaries* (pp. 110-130). New York: Springer (Coastal and Estuarine Studies).
- Nelson, G., & Hutchings, L. (1983). The Benguela upwelling area. *Prog. Oceanogr.*, 12, 333-356.
- Netto, S., Fonseca, G., & Gallucci, F. (2010). Effects of drill cuttings discharge on meiofauna communities of the shelf break in the southwest Atlantic. *Environ. Monit. Assess.*(167), 49–63.
- New Era. (2024). *Port of Walvis Bay fuel imports up as Red Sea attacks force ships to look for alternative route*. Retrieved February 2025, from <https://neweralive.na/port-of-walvis-bay-fuel-imports-up-as-red-sea-attacks-force-ships-to-look-for-alternative-route-3>
- Newman, G., & Pollock, G. (1971). Biology and migration of rock lobster *Jasus lalandii* and their effect on availability at Elands Bay, South Africa. *Investl. Rep. Div. Sea Fish. S. Afr.*, 1-24.
- NPC. (2017). *NDP 5*. Retrieved from National Planning Commission (Namibia): <https://www.npc.gov.na/national-plans/national-plans-ndp-5/>
- NPC. (2020). *Namibia's 30 years Developmental Journey*. Windhoek: National Planning Commission of Namibia.
- NSA. (2023). *National Infrastructure Atlas 2023*. Windhoek: NSA.
- NSA. (2025). *Unpublished regional tables*. Windhoek : NSA.
- O'Toole, M. J. (1977). Investigations into some important fish larvae in the south east Atlantic in relation to the hydrological environment. . *PhD thesis, University of Cape Town, South Africa*.
- OCIMF. (2017). Inert Gas Systems. *The use of inert gas for the carriage of flammable oil cargoes*.
- Offshore Magazine. (2025, February 5). Retrieved February 2025, from Westwood details offshore hotspots for high-impact drilling in 2025: [https://www.offshore-mag.com/drilling-completion/news/55266077/westwood-global-energy-group-westwood-details-offshore-hotspots-for-high-impact-drilling-in-2025?o_eid=6283H3777001D3A&oly_enc_id=6283H3777001D3A&rdx.ident\[pull\]=omeda|6283H3777001D3A&utm_camp](https://www.offshore-mag.com/drilling-completion/news/55266077/westwood-global-energy-group-westwood-details-offshore-hotspots-for-high-impact-drilling-in-2025?o_eid=6283H3777001D3A&oly_enc_id=6283H3777001D3A&rdx.ident[pull]=omeda|6283H3777001D3A&utm_camp)
- OffshoreMag. (2001). *FLOW ASSURANCE: Maintaining plug-free flow and remediating plugged pipelines*. Retrieved January 2025, from <https://www.offshore-mag.com/pipelines/article/16758980/flow-assurance-maintaining-plug-free-flow-and-remediating-plugged-pipelines>
- Ohde, T., Siegel, H., Reibmann, J., & Gerth, M. (2007). Identification and investigation of sulphur plumes along the Namibian coast using the MERIS sensor. *Continental Shelf Research*, 6(27), 744-756.
- Oil States (2). (n.d.). *PLEM/PLET Structures*. Retrieved January 2025, from <https://oilstates.com/subsea-pipeline-systems/deepwater/plem-plet-structures/>
- Oil States. (n.d.). *In-line Tee (ILT) Skids*. Retrieved January 2025, from <https://oilstates.com/offshore/subsea-pipeline-products/inline-tee-ilt-skids/#:~:text=The%20Oil%20States%20In->



line%20Tee%20%28ILT%29%20is%20an,for%20tie-
in%20points%20to%20fit%20future%20expansion%20plans.

- Oliver, J. (1992). Some spatial and temporal aspects of fog in the Namib. *SA Geographer*, 19(1/2), 106-126.
- Oliver, J. (1995). Spatial distribution of fog in the Namib. *Journal of Arid Environments*, 29, 129-138.
- Ombudsman: Namibia. (2008). *Guide to Indigenous Peoples' Rights in Namibia*. Windhoek: Ombudsman.
- Oosthuizen, W. (1991). General movements of South African (Cape) fur seals *Arctocephalus pusillus pusillus* from analysis of recoveries of tagged animals. *S. Afr. J. Mar. Sci.*(11), 21-30.
- Our World in Data. (2024). Retrieved May 2024, from Annual CO₂ emissions by world region.
- Our World in Data. (2024). Retrieved January 2025, from Annual CO₂ emissions by world region.
- Ozhan, K., Parsons, M., & Bargu, S. (2014). How Were Phytoplankton Affected by the Deepwater Horizon Oil Spill? . *BioScience* 64: (64), 829–836.
- Pabortsava, K., Purser, A., Wagner, H., & Thomsen, L. (2011). The influence of drill cuttings on physical characteristics of phytodetritus. *Marine Pollution Bulletin*(62), 2170-2180.
- Paine, M., Skinner, M., Kilgour, B., Deblois, E., & Tracy, E. (2014). *Repeated-measures Regression Designs and Analysis for Environmental Effects Monitoring Programs*.
- Palan, K. (2017). *Submarine canyon evolution of the Southwest Cape continental margin*. University of KwaZulu-Natal, South Africa.
- Parry, D., Kendall, M., Pilgrim, D., & Jones, M. (2003). Identification of patch structure within marine benthic landscapes using a remotely operated vehicle. *J. Exp. Mar. Biol. Ecol.*, 285– 286: 497–511.
- Parsons, T., Kessler, T., & Guanguo, L. (1986a). An ecosystem model analysis of the effect of mine tailings on the euphotic zone of a pelagic ecosystem. *Acta Oceanol. Sin.*(5), 425-436.
- Parsons, T., Thompson, P., Yong, W., Lallil, C., Shumin, H., & Huaishu, X. (1986b). The effect of mine tailings on the production of plankton. *Acta Oceanol. Sin.*(5), 417-423.
- Pascoe, S., & Innes, J. (2018). Economic Impacts of the Development of an Offshore Oil and Gas industry on Fishing Industries: A review of Experiences and Assessment Methods. *Reviews in Fisheries Science & Aquaculture*, 26(3), 350-370.
- Payne, A., & Crawford, R. (1989). *Oceans of Life off Southern Africa*. Cape Town: Vlaeberg.
- Pearson, T., & Rosenberg, R. (1978). Macrobenthic Succession in Relation to Organic Enrichment and Pollution of the Marine Environment. *Oceanogr. Mar. Biol. Ann. Rev.*(16), 229-311.
- Pearson, W. (2014). Comment on "multitissue molecular, genomic, and developmental effects of the Deepwater Horizon oil spill on resident gulf killifish (*Fundulus grandis*)". *Environ. Sci. Technol*(48), 7677–7678.
- Penney, A. J., Krohn, R. G., & Wilke, C. G. (1992). A description of the South African tuna fishery in the southern Atlantic Ocean. *Collve. Vol. scient. Pap. int. Commn Conserv. Atl. Tunas*(39(1)), 247-257.



- Penry, G. (2010). *Biology of South African Bryde's whales*. Scotland, UK: University of St Andrews.
- Perks, R. (2016). Namibia's Offshore Phosphate Mining: Environmental and Legal Challenges. *Journal of Environmental Management*.
- Perry, J. (2005). *Environmental Impact Assessment for Offshore Drilling the Falkland Islands to Desire Petroleum Plc*.
- Peterson, C., Laney, W., & Rice, T. (2001). *Biological impacts of beach nourishment. Workshop on the Science of Beach Renourishment, May 7-8, 2001*. North Carolina: Pine Knoll Shores.
- Pirotta, E., Booth, C., Costa, D., & al., e. (2018). Understanding the population consequences of disturbance. *Ecol Evol.*, 9934–9946. doi:10.1002/ece3.4458
- Pitcher, G. (1998). Harmful algal blooms of the Benguela Current. . *IOC, World Bank and Sea Fisheries Research Institute Publication*. , 20.
- Poopetch, T. (1982). Potential effects of offshore tin mining on marine ecology. Proceedings of the Working Group Meeting on environmental management in mineral resource development, M. *Mineral Resource Development Series*(49), 70-73.
- Prouty, N., Fisher, C., Demopoulos, A., & Druffel, E. (2014). Growth rates and ages of deep-sea corals impacted by the Deepwater Horizon oil spill. *Deep-Sea Res. II Top. Stud. Oceanogr.* <http://dx.doi.org/10.1016/j.dsr2.2014.10.021> .
- Przeslawski, R., Byrne, M., & Mellin, C. (2015). A review and meta-analysis of the effects of multiple abiotic stressors on marine embryos and larvae. *Glob. Chang. Biol.* (21), 2122–2140.
- Punt, A., Penney, A. J., & Leslie, R. W. (1996). Abundance indices and stock assessment of south Atlantic albacore (Thunnus alalunga. *Col. Vol. Sci. Pap. ICCAT*, Madrid, Spain. 43: 361-371.
- Purser, A. (2015). A time series study of Lophelia pertusa and reef megafauna responses to drill cuttings exposure on the Norwegian margin. *PLoS ONE* 10:e0134076. doi:10.1371/journal.pone.0134076.
- Purser, A., & Thomsen, L. (2012). Monitoring Strategies for drill cutting discharge in the vicinity of cold-water coral ecosystems. . *Mar. Pollut. Bull*(64), 2309-2316.
- Putman, N., Abreu-Grobois, F., Iturbe-Darkistade, I., Putman, E., Richards, P., & Verley, P. (2015). Deepwater Horizon oil spill impacts on sea turtles could span the Atlantic. *Biol. Lett.* .
- Quigg, A., Parsons, M., Bargu, S., Ozhan, K., Daly, K., Chakraborty, S., . . . Buskey, E. J. (2021). Marine phytoplankton responses to oil and dispersant exposures: Knowledge gained since the Deepwater Horizon oil spill. *Marine Pollution Bulletin*, 164.
- R, A., Hyatt, C., & Buskey, E. (2014b). Toxicity of dispersant Corexit 9500A and crude oil to marine microzooplankton. *Ecotoxicol. Environ. Saf.*(106), 76–85.
- Ranger. (1993). *Exploration Drilling Phase Environmental Impact Assessment; Licence block 2213, Namibia*. Ranger Oil Limited.
- Reddy, C., Arey, J., Jeffrey, S., Sean, P., & Karin, L. e. (2012). Composition and fate of gas and oil released to the water column during the Deepwater Horizon oil spill. *Proc Natl Acad Sci USA* (109), 20229-20234.
- Rennert, K., Errickson, F., Prest, B.C. et al. (2022). Comprehensive evidence implies a higher social cost of CO2. *Nature*, 610, pp. 687–692. Retrieved from <https://doi.org/10.1038/s41586-022-05224-9>



- Republic of Namibia. (2010). *National Policy on Climate Change for Namibia*. Retrieved May 30, 2025, from <https://www.adaptation-undp.org/>
- Richardson, A. J., Bakun, A., Hays, G. C., & Gibbons, M. J. (2009). The jellyfish joyride: causes, consequences and management responses to a more gelatinous future. *Trends Ecol Evol.*, 312-322.
- Richardson, W. J., Greene, C. R., Malme, C. J., & Thomson, D. H. (1995). *Marine Mammals and Noise*. Academic Press.
- Richardson, W. J., Greene, C. R., Malme, C. I., Thomson, D. H., Moore, S. E., & Wiirsig, B. (2013). *Marine Mammals and Noise*.
- Richardson, W. J., Greene, C. R., Malme, C. I., Thomson, D. H., Moore, S. E., & Wiirsig, B. (2013). *Marine Mammals and Noise*. Academic press.
- Richardson, W. J., Wursig, B., & Greene, C. R. (1986). Reactions of bowhead whales, *Balaena mysticetus*, to seismic explorations in the Canadian Beaufort sea. *J Acoust. Soc. Am.*, 79(4), 1117-1128.
- Richardson, W., Greene, C., Malme, C., & Thomson, D. (1995). *Marine Mammals and Noise*. San Diego, CA. : Academic Press.
- Richardson, W., Greene, C., Malme, C., & Thomson, D. (1995). *Marine Mammals and Noise*. San Diego, CA. : Academic Press.
- Roberts, J. M., & Gage, J. D. (2003). Workpackage 3 of ACES project: 'To describe the deep-water coral ecosystem, its dynamics and functioning; investigate coral biology and behaviour and assess coral sensitivity to natural and anthropogenic stressors.'. Scottish Association for Marine Science.
- Roberts, J., Wheeler, A., & Freiwald, A. (2006). Reefs of the deep: the biology and geology of cold-water coral ecosystems. *Science* (312), 543-547.
- Roberts, R., Murray, S., Gregory, R., & Foster, B. (1998). Developing an efficient macrofauna monitoring index from an impact study - A dredge spoil example. *Mar. Pollut. Bull.*(36), 231-235.
- Roel, B. (1987). Demersal communities off the west coast of South Africa. . *South African Journal of Marine Science*(5), 575-584.
- Rogers, A. (1994). The biology of seamounts. *Advances in Marine Biology*, 30, 305–350.
- Rogers, A. (1999). The biology of *Lophelia pertusa* (Linnaeus 1758) and other deep-water reef-forming corals and impacts from human activities. *International Review of Hydrobiology*, 4(84), 315-406.
- Rogers, A. (2004). The biology, ecology and vulnerability of seamount communities. p. 12. Retrieved from IUCN: www.iucn.org/themes/marine/pubs/pubs.htm
- Rogers, A., Clark, M. H.-S., & Gjerde, K. (2008). The Science behind the Guidelines: A Scientific Guide to the FAO Draft International Guidelines (December 2007) For the Management of Deep-Sea Fisheries in the High Seas and Examples of (December 2007) For the Management of Deep-Sea Fisheries in the High.
- Rogers, J. (1977). Sedimentation on the continental margin off the Orange River and the Namib Desert. . *Unpubl. Ph.D. Thesis, Geol. Dept., Univ. Cape Town.* , 212.
- Rogers, J., & Bremner, J. (1991). The Benguela Ecosystem. Part VII. Marine-geological aspects. *Oceanogr. Mar. Biol. Ann. Rev.*, 29, 1-85.
- Rose, B., & Payne, A. (1991). Occurrence and behavior of the Southern right whale dolphin *Lissodelphis peronii* off Namibia. *Marine Mammal Science*, 7, 25-34.



- Rosenbaum, H. C., Pomilla, C., Mendez, M., Leslie, M. S., Best, P. B., Findlay, K. P., . . . Kiszka, J. (2009). Population structure of humpback whales from their breeding grounds in the South Atlantic and Indian Oceans. *PLoS One*, 4(10), 1-11.
- Rosenbaum, H., Maxwell, S., Kershaw, F., & Mate, B. (2014). Long-range movement of Humpback Whales and Their Overlap with Anthropogenic Activities in the South Atlantic Ocean. *Conservation Biology*, 2(28), 604-615.
- Ross, G. (1979). Records of pygmy and dwarf sperm whales, genus *Kogia*, from southern Africa, with biological notes and some comparisons. *Annals of the Cape Province Museum (Natural History)* (11), 259-327.
- Rouault, M., Penven, P., & Pohl, B. (2009). Warming in the Agulhus Current system since the 1980's. *Geophysical Research Letters*, 36(12).
- Roux, J. P., van der Lingen, C., Gibbons, M. J., Moroff, N. E., Shannon, L. J., Smith, A. D., & Cury, P. M. (2013). Jellification of marine ecosystems as a likely consequence of overfishing small pelagish fishes: Lessons from the Benguela. *Bulletin of Marine Science*, 89(1), 249-284.
- Roux, J.-P., Best, P., & Stander, P. (2001). Sightings of southern right whales (*Eubalaena australis*) in Namibian waters, 1971-1999. *J. Cetacean Res. Manage. (Special Issue)*(2), 181–185.
- Roux, J.-P., Brady, R., & Best, P. (2011). Southern right whales off Namibian and their relationship with those off South Africa. *Paper SC/S11/RW16IWC Southern Right Whale Assessment Workshop*. Buenos Aires 13-16 Sept. 2011.
- Roux, J.-P., Brady, R., & Best, P. (2015). Does disappearance mean extirpation? The case of right whales off Namibia. *Marine Mammal Science*, 3(31), 1132-1152.
- RPS. (2022). *MetOcean Design Criteria Study - Namibia - 2913B*. Namibia: RPS.
- RPS. (2025). *MetOcean Design Criteria Study - Namibia - Block 2913B*. Namibia: RPS.
- RPS. (2025a). *MetOcean Design Criteria Study - Namibia - Block 2913B*. Namibia: RPS.
- RPS. (2025b). *MetOcean Design Criteria - Basis for Design Data, Transshipment Terminals - Namibia*. RPS.
- Saadoun, I. (2015). Impacts of Oil on Marine Life. In M. Larramendy, & S. Soloneski (Eds.), *Emerging Pollutants in the Environment - Current and Further Implications*.
- Salas, F., Marcos, C. N., Patricio, J., Perez-Ruzafa, A., & Marques, J. (2006). User-friendly guide for using benthic ecological indicators in coastal and marine quality assessment. *Ocean and Coastal management* (49), 308-331.
- Salcedo, D., Soto, L., Estradas-Romero, A., & Botello, A. (2017). Interannual variability of soft-bottom macrobenthic communities of the NW Gulf of Mexico in relationship to the Deepwater Horizon oil spill. *Marine Pollution Bulletin*(114), 987-994.
- Sandifer, P. A. (2021). Human health and socioeconomic effects of the Deepwater Horizon oil spill in the Gulf of Mexico. *Oceanography*, 34(1), 174-191.
- Schaanning, M., Trannum, H., Øxnevad, S., Carroll, J., & Bakke, T. (2008). Effects of drill cuttings on biogeochemical fluxes and macrobenthos of marine sediments. *Journal of Experimental Marine Biology and Ecology*(361), 49-57.
- Schlenker, L. S., Welch, M. J., Mager, E. M., Stieglitz, J. D., Benetti, D., Munday, P. L., & Grosell, M. (2019). Exposure to Crude Oil from the Deepwater Horizon Oil Spill Impairs Oil Avoidance Behavior without Affecting Olfactory Physiology in Juvenile Mahi-Mahi (*Coryphaena hippurus*). *environ Sci Technol*, 53(23), 14001-14009.



- Schoeman, R., Patterson-Abrolat, C., & Plon, S. (2020). A Global Review of Vessel Collisions With Marine Animals. *Frontiers in Marine Science*. doi:10.3389/fmars.2020.00292
- Scholz, D., Michel, J., Shigenaka, G., & Hoff, R. (1992). *Biological resources. In: An Introduction to Coastal habitats and Biological Resources for Oil Spill Response. Biological resources. In: An Introduction to Coastal habitats and Biological Resources for Oil Spill Response. Report HMRAD 92-4 Report HMRAD.*
- Schratzberger, M., Rees, H., & Boyd, S. (2000a). Effects of simulated deposition of dredged material on structure of nematode assemblages - the role of contamination. *Mar. Biol.* (137), 613-622.
- Schratzberger, M., Rees, H., & Boyd, S. (2000b). Effects of simulated deposition of dredged material on structure of nematode assemblages - the role of burial. *Mar. Biol.* (136), 519-530.
- Seakamela, S., Kotze, P., McCUE, S., De Goede, J., Lamont, T., Pieterse, J., . . . Anthony, T. (2022). Mortality event of Cape fur seals in South Africa during 2021. In S. Kirkman, J. Huggett, T. Lamont, & T. Haupt (Eds.), *Oceans and Coasts Annual Science Report 2021*. (p. 28). Department of Forestry, Fisheries and the Environment.
- Semantic Scholar. (2018). *Numerical Study on Estimation of Static Configuration of Steel Lazy Wave Riser Using Dynamic Relaxation Method*. Retrieved January 2025, from <https://www.semanticscholar.org/paper/Numerical-Study-on-Estimation-of-Static-of-Steel-Oh-Jung/67f649294daf8dda0b0b5a2d84186b722d62f316>
- Shannon, L., & Anderson, F. (1982). Application of satellite ocean colour imagery in the study of the Benguela Current system. *S. Afr. J. Photogrammetry, Remote Sensing and Cartography*, 3 (13), 153-169.
- Shannon, L., & O'Toole, M. (1998). BCLME Thematic Report 2: Integrated overview of the oceanography and environmental variability of the Benguela Current region. Unpublished BCLME Report. 58.
- Shannon, L., Moloney, C., Jarre, A., & Field, J. (2003). Trophic flows in the southern Benguela during the 1980s and 1990s. . *Journal of Marine Systems*, 83 - 116.
- Shannon, V. (1985). The Benguela Ecosystem. Part 1. Evolution of the Benguela, physical features and processes. *Oceanogr. Mar. Biol. Ann. Rev.*, 23, 105-182.
- Shaughessy, P. (1979). Cape (South African) fur seal. *Mammals in the Seas. F.A.O. Fish. Ser.*, 2(5), 37-40.
- Sherley, R., Ludynia, K., Dyer, B., Lamont, T., Makhado, A., Roux, J., . . . Votier, S. (2017). Metapopulation tracking juvenile penguins reveals an ecosystem-wide ecological trap. . *Current Biology* (27), 563-568.
- Shillington, F. A., Peterson, W. T., Hutchings, L., Probyn, T. A., Waldron, H. N., & Agenbag, J. (1990). A cool upwelling filament off Namibia, South West Africa: Preliminary measurements of physical and biological properties. *Deep-Sea Res.*, 37 (11A), 1753-1772.
- Shine, K. (2006). Biogeographic patterns and diversity in demersal fish off the south and west coasts of south Africa: Implications for conservation. *MSc thesis*. University of Cape Town.
- Shine, K. H. (2008). *Biogeographic Patterns and Assemblages of Demersal Fishes on the south and west coasts of South Africa*. Cape Town: Benguela Current Large Marine Ecosystem Programme.



- Shomura, R., Majkowski, J., & Harman, R. (1995). Summary report of the second FAO export consultation on interactions of Pacific tuna fisheries. *Summary report of the second FAO expert consultation on interactions of Pacific tuna fisheries*. Shimizu, Japan: FAO, Roma (Italia).
- Short, J. W. (2017). Advances in Understanding the Fate and Effects of Oil from Accidental Spills in the United. *Archives of Environmental Contamination and Toxicology*, 73(1), 5-11.
- Siciliano, S., De Moura, J., Barata, P., Dos Prazeres Rodrigues, D., Moraes Roges, E., Laine De Souza, R., . . . Tavares, M. (2013). An unusual mortality of humpback whales in 2010 on the central-northern Rio de Janeiro coast, Brazil. Paper to International Whaling Commission.
- Simmons, R., Brown, C., & Kemper, J. (2015). *Birds to watch in Namibia: red, rare and endemic species*. Windhoek: Ministry of Environment and Tourism and Namibia Nature Foundation.
- Sink, K., Holness, S., Harris, L., Majiedt, P., Atkinson, L., Robinson, T., . . . Halpern, B. (2012). *National Biodiversity Assessment 2011: Technical Report. Volume 4: Marine and Coastal Component*. Pretoria: South African National Biodiversity Institute.
- Sink, K., Van Der Bank, M., Majiedt, P., Harris, L., Atkinson, L., Kirkman, S., & Karenyi, N. (2019). *South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm*. Pretoria. South Africa: South African National Biodiversity Institute.
- Skern-Mauritzen, M., Kirkman, S., Olsen, E., Borge, A., Drapeau, L., Meyer, M., . . . Oosthuizen, W. (2009). Do inter-colony differences in Cape fur seal foraging behaviour reflect large-scale changes in the northern Benguela . *African Journal of Marine Science*(31), 399-408.
- Slabbekoorn, H., & Halfwerk, W. (2009). Behavioural ecology: Noise annoys at community level. *Current Biology*, R693–R695.
- Slabbekoorn, H., Dalen, J., De Haan, D., Winter, H., Radford, C., Ainslie, M., . . . Harwood, J. (2019). Population-level consequences of seismic surveys on fishes: An interdisciplinary challenge. *Fish and Fisheries*.
- Slabbekoorn, H., Dalen, J., De Haan, D., Winter, H., Radford, C., Ainslie, M., . . . Harwood, J. (2019). Population-level consequences of seismic surveys on fishes: An interdisciplinary challenge. *Fish and Fisheries*, 4(20), 653-658.
- SLR. (2020). *Proposed 3D Seismic Survey in Licence Block 2912 and 2913B, Orange Basin, Namibia. Final Environmental Impact Assessment Report and Environmental and Social Management Plan*. SLR Consulting .
- SLR. (2024). *ESIA: EXPLORATION DRILLING IN BLOCK 2914A, NAMIBIA-Socio-economic Impact Assessment*.
- SLR. (2024a). *Proposed Exploration Drilling in Block Northern Cape Ultra Deep, South Africa*. SLR Consulting South Africa .
- SLR. (2024b). *ESIA for Well Drilling in Licence Block 2914A, Orange Basin, off the Coast of Southern Namibia*. SLR Consulting.
- SLR Canada. (2025). *Underwater Sound Transmission Loss Modelling Study - Environmental and Social Impact Assessment for the Venus Development (Offshore PEL0056/Block 2913B), Namibia*.
- SLR Canada. (2025b). *Proposed Exploration Well Drilling in Block DWOB South, off the West Coast of South Africa - Underwater Sound Transmission Loss Modelling Study*.



- Smale, M., Roel, B., Badenhorst, A., & Field, J. (1993). Analysis of demersal community of fish and cephalopods on the Agulhas Bank, South Africa. *Journal of Fisheries Biology*(43), 169-191.
- Smit, M., Holthaus, K., Tamis, J., Jak, R., Karman, C., Kjeilen-Eilertsen, G., . . . Neff, J. (2006). *Threshold levels and risk functions for non-toxic sediment stressors: burial, grain size changes, and hypoxia - summary report-TNO*.
- Smit, M., Holthaus, K., Trannum, H., Neff, J., Kjeilen-Eilertsen, G., Jak, R., . . . Hendriks, A. (2008). Species sensitivity distributions for suspended clays, sediment burial, and grain size change in the marine environment. *Environmental Toxicology and Chemistry*(27), 1006-1012.
- Smith, G., & Mocke, G. (2002). Interaction between breaking/broken waves and infragravity-scale phenomena to control sediment suspension and transport in the surf zone. *Marine Geology*(187), 320-345.
- Smith, J., & Heemstra, P. C. (2003). *Smiths' Sea Fishes* (Illustrated ed.). Penguin Random House South Africa.
- Smultea, M., Mobley, J., Fertl, D., & Fulling, G. (2008). An Unusual Reaction and Other Observations of Sperm Whales Near FIXED wING aRICRAFT. *Gulf and Carribean Research* , 1(20), 75-80.
- Sørensen, K., Neumann, C., Dähne, M., Hansen, K., & Wahlberg, M. (2020). Gentoo penguins (*Pygoscelis papua*) react to underwater sounds. *R. Soc. open sci.*
- Spooner, E., Karnauskas, M., Harvey, C., Kelble, C., Rosellon-Druker, J., Kasperski, S., & al., e. (2021). Using Integrated Ecosystem Assessments to Build Resilient Ecosystems, Communities, and Economies. *Coastal Management*(49), 126-145. doi:10.1080/08920753.2021.1846152
- SPRFMA. (2007). Information describing seamount habitat relevant to the South Pacific Regional Fisheries Management Organisation.
- Steffani, C., & Pulfrich, A. (2004). Environmental Baseline Survey of the Macrofaunal Benthic Communities in the De Beers ML3/2003 Mining Licence Area. . *Prepared for De Beers Marine South Africa, April 2004*.
- Stenevik, E., Verheye, H., Lipinski, M., Ostrowski, M., & Stromme, T. (2008). Drift routes of Cape hake eggs and larvae in the southern Benguela Current system. *Journal of Plankton Research*, 30(10), 1147 – 1156.
- Stewart, B., Evans, W., & Awbrey, F. (1982). *Effects of man-made waterborne noise on behaviour of belukha whales (Delphinapterus leucas) in Bristol Bay, Alaska. Unpublished report for National Oceanic and Atmospheric Administration, Juneau, Alaska*. San Deigo, California.: Hubbs/Sea World Research Institute.
- Strømme, T., Lipinski, M., & Kainge, P. (2015). Life cycle of hake and likely management implications. *Rev. Fish. Biol. Fisheries*. doi:10.1007/s11160-015-9415-9
- Sundby, S., Boyd, A., Hutchings, L., O'Toole, M. J., Thorisson, K., & Thorsen, A. (2001). Interaction between Cape hake spawning and the circulation in the Northern Benguela upwelling ecosystem. *African Journal of Marine Science*(23), 317-336.
- Supreme Court of Appeal of South Africa. (2024). Minister of Mineral Resources and Energy and Others v Sustaining the Wild Coast NPC and Others (Case no 58/2023; 71/2023; 351/2023) [2024] ZASCA 84 (3 June 2024).
- Supreme Court of Norway. (2020, December 22). HR-2020-2472-P, (case no. 20-051052SIV-HRET) Appeal against Borgarting Court of Appeal's judgment 23 January 2020. Retrieved June 2024, from <https://climatecasechart.com/wp->



content/uploads/non-us-case-documents/2020/20201222_HR-2020-846-
J_judgment.pdf

- Tamborrino, L., Wienberg, C., Titschack, J., Wintersteller, P., Mienis, F., Freiwald, A., . . . Hebbeln, D. (2019). Mid-Holocene extinction of cold-water corals on the Namibian shelf steered by the Benguela oxygen minimum zone. *Geology*, 47(14).
- Tang, D., Sun, J., Zhou, L., Wang, S., Singh, R. P., & Pan, G. (2019). Ecological response of phytoplankton to the oil spills in the oceans . *Geomatics, Natural Hazards and Risk*, 10(1).
- Tang, D., Sun, J., Zhou, L., Wang, S., Singh, R., & Pan, G. (2019). Ecological response of phytoplankton to the oil spills in the oceans. *Geomatics, Natural Hazards and Risk*, 10(1): , 1(10), 853-872.
- Teal, J., & Howarth, R. (1984). Oil spill studies: a review of ecological effects. *Environmental Management*(8), 27-44.
- The Greenhouse Gas Protocol. (2015). *A Corporate Accounting and Reporting Standard*. Retrieved September 25, 2024, from <https://ghgprotocol.org>
- The Namibia Ministry of Health and Social Services (MoHSS) and ICF International. (2014). *The Namibia Demographic and Health Survey 2013*. Windhoek, Namibia and Rockville, Maryland, USA: MoHSS and ICF International.
- ThePioneer. (2022, July 18).
- Thomisch, K. (2017). Distribution patterns and migratory behavior of Antarctic blue whales. . *Reports on Polar and Marine Research* , 194. doi:10.2312/BzPM_0707_2017
- Thomisch, K., Boebel, O., Clark, C., Hagen, W., Spiesecke, S., Zitterbart, D., & Van Opzeeland, I. (2016). Spatio-temporal patterns in acoustic presence and distribution of Antarctic blue whales *Balaenoptera musculus intermedia* in the Weddell Sea.
- Thomson, D. R., Davis, R. A., Bellore, R., Gonzalez, E., Christian, J., Moulton, V., & Harris, K. (2000). *Environmental assessment of exploration drilling off Nova Scotia*. LGL Limited for Canada-Nova Scotia Offshore Petroleum Board.
- Thomson, D., Davis, R., Bellore, R., Gonzalez, E., Christian, J., Moulton, V., & Harris, K. (2000). *Environmental assessment of exploration drilling off Nova Scotia. Report by LGL Limited for Canada-Nova Scotia Offshore Petroleum Board. Mobil Oil Canad.*
- Tranum, H., Nilsson, H., Schaanning, M., & Øxnead, S. (2010). Effects of sedimentation from water-based drill cuttings and natural sediment on benthic macrofaunal community structure and ecosystem processes. *Journal of Experimental Marine Biology* .
- Tranum, H., Setvik, A., Norling, K., & Nilsson, H. (2011). Rapid macrofaunal colonization of water-based drill cuttings on different sediments. . *Mar. Pollut. Bull.*(62), 2145-2156.
- Trefry, J., Dunton, K., Trocine, R., Schonberg, S., McTigue, N., Hersh, E., & McDonald, T. (2013). Chemical and biological assessment of two offshore drilling sites in the Alaskan Arctic. *Marine Environmental Research*(86), 35-45.
- Turk, T., & Risk, M. (1981). Effects of sedimentation of infaunal invertebrate populations in Cobequid Bay, Bay of Fundy. *Can. J. Fish. Aquat. Sci.*(38), 642-648.
- Turner, M. (1988). *Shipwrecks & salvage in South Africa* . Cape Town: C Struik.
- UNFCCC. (2023, December 13). *COP28 Agreement Signals “Beginning of the End” of the Fossil Fuel Era*. Retrieved from <https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era>



- UNFCCC. (2024, November 24). *COP29 UN Climate Conference Agrees to Triple Finance to Developing Countries, Protecting Lives and Livelihoods*. Retrieved from <https://unfccc.int/news/cop29-un-climate-conference-agrees-to-triple-finance-to-developing-countries-protecting-lives-and>
- United Nations. (2011). *Guiding principles on business and human rights*. New York and Geneva.
- University of Namibia. (2025, September 15). Retrieved from www.unam.edu.na.
- US EIA. (2023). *International Energy Outlook 2023 with projections to 2050*. Retrieved June 2024, from https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.eia.gov%2Foutlooks%2Fieo%2Fppt%2FIEO2023_Release_Presentation.pptx&wdOrigin=BROWSELINK
- Utne-Palm, A. C., Salvanes, A. G., Currie, B., Kaartvedt, S., Nilsson, G. E., Braithwaite, V. A., . . . Flynn, B. (2010). Trophic structure and community stability in an overfished ecosystem. *Science*, 329, 333-336.
- Valentine, M., & Benfield, M. (2013). Characterization of epibenthic and demersal megafauna at Mississippi Canyon 252 shortly after the Deepwater Horizon oil spill. *Marine Pollution Bulletin* (77), 196–209.
- Van Dalsen, J., Essink, K., Toxvig, G., Madsen, H., Birklund, J., Romero, J., & Manzanera, M. (2000). Differential response of macrozoobenthos to marine sand extraction in the North Sea and the Western Mediterranean., *ICES J. Mar. Sci.*(57), 1439-1445.
- Vermeulen, E., Wilkonson, C., & Van Den Berg, C. (2020). *Report of the 2019 South African southern right whale aerial survey. Report to IWC. 10.13140/RG.2.2.29556.37766*.
- Villegas-Amtmann, S., Schwartz, L., Sumich, J., & Costa, D. (2015). A bioenergetics model to evaluate demographic consequences of disturbance in marine mammals applied to gray whales . *Ecosphere*, 10(6).
- Villegas-Amtmann, S., Schwarz, L., Gailey, G., Sychenko, O., & Costa, D. (2017). East or west: the energetic cost of being a gray whale and the consequence of losing energy to disturbance. *Endangered Species Research*(34), 167-183.
- Volkman, J., Miller, G., Revill, A., & Connell, D. (1994). Environmental implications of offshore oil and gas development in Australia – oil spills. In J. Swan, J. Neff, & P. Young (Eds.), *Environmental implications of offshore oil and gas development in Australia*. Sydney: Australian Exploration Association.
- Wallace, B., Posnik, Z., Hurley, B., DiMatteo, A., Bandimere, A., Rodriguex, I., & et, a. (2023). Marine turtle regional management units 2.0: an updated framework for conservation and research of wide-ranging megafauna species. *Endangered Species Research*.
- Wang, F., & Chapman, P. (1999). Biological implications of sulfide in sediment—a review focusing on sediment toxicity. *Environ. Toxicol. Chem.*(18), 2526-2532.
- Warwick, R. (1993). Environmental impact studies on marine communities: Pragmatical considerations. *Australian Journal of Ecology* (18), 63-80.
- Watkins, W. (1986). Whale reactions to human activities in Cape Cod waters. *Mar. Mamm. Sci.*, 4(2), 251-262.
- Watts, M., & Zalik, A. (2020). Consistently unreliable: Oil spill data and transparency discourse. *The Extractive Industries and Society*, 7(3), 790-795.

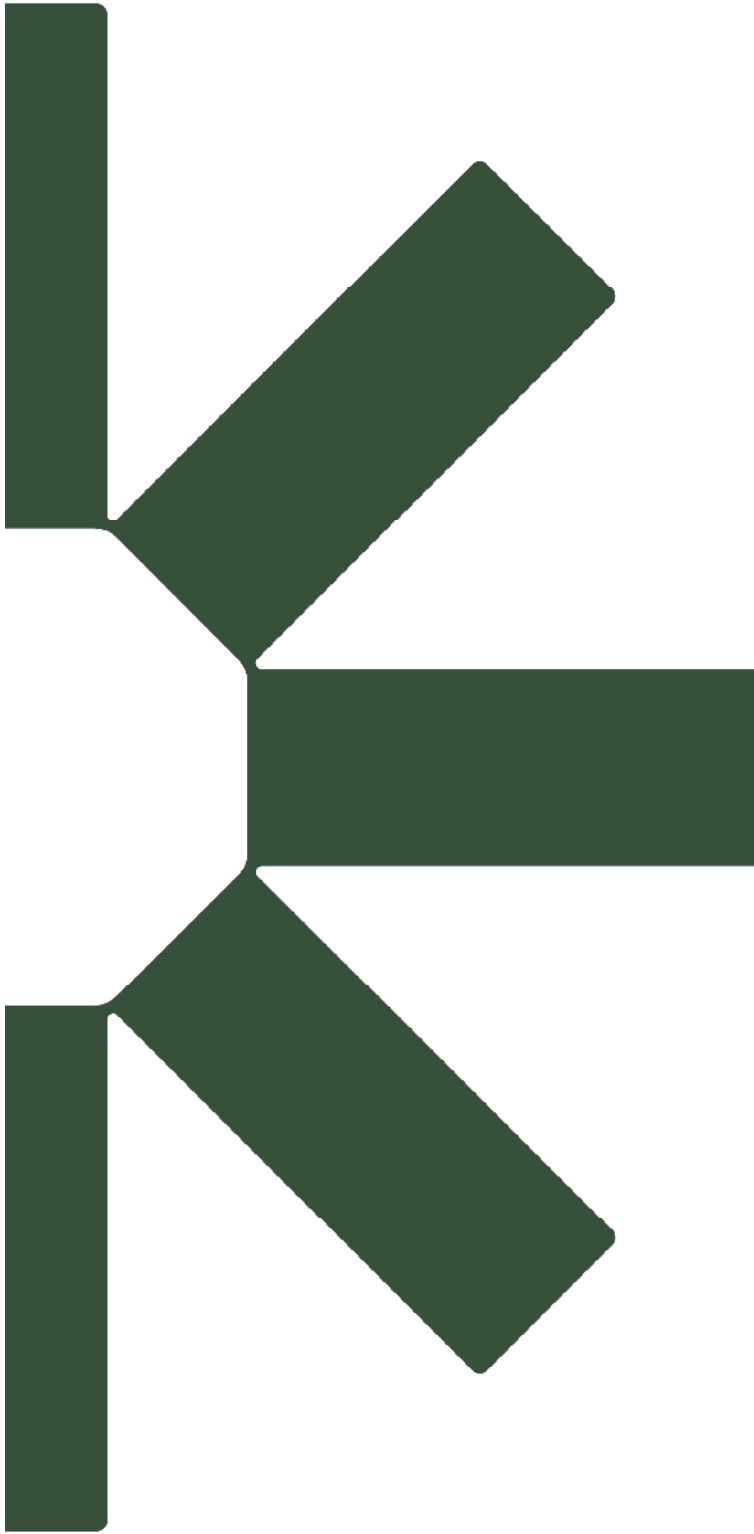


- WBTC. (2017). *Municipality of Walvis Bay*. Retrieved from https://www.walvisbaycc.org.na/?page_id=61
- WEF. (2024, November 26). *Climate finance, carbon markets and more: 4 key takeaways from COP29*. Retrieved from <https://www.weforum.org/stories/2024/11/cop29-4-key-takeaways/>
- Weir, C. (2011). African Journal of Marine Science . *Distribution and seasonality of cetaceans in tropical waters between Angola and the Gulf of Guinea*. , 1(33), 1-15.
- Weir, C. R., Collins, T., Carvalho, I., & Rosenbaum, H. c. (2010). Killer whales (Orcinus orca) in Angolan and Gulf of Guinea waters, tropical West Africa. *Journal of the Marine Biological Association of the United Kingdom*, 90(8), 1601-1611.
- Weisberg, R., Zheng, L., Liu, Y., Murawski, S., Hu, C., & Chuanmin, J. (2016). Did Deepwater Horizon hydrocarbons transit to the west Florida continental shelf? . *Deep-Sea Research II*(129), 259-272.
- Wermac. (n.d.). *Subsea methods for pipeline laying*. Retrieved from https://www.wermac.org/pipes/subsea_pipeline_laying.html#:~:text=J-Lay%20is%20used%20to%20install%20rigid%20pipelines%20in,the%20sea-going%20pipe%20in%20a%20nearly%20vertical%20slope.
- White, H., Hsing, P., Cho, W., Shank, T., Cordes, E., & al., e. (2012). Impact of the Deepwater Horizon oil spill on a deep-water coral community in the Gulf of Mexico. *Proceedings of the National Academy of Sciences of the United States of America*(109).
- White, R., Gillon, K., Black, A., & Reid, J. (2001). *Vulnerable concentrations of seabirds in Falkland Islands waters.. JNCC, Peterborough*.
- Whitehead, H. (2002). Estimates of the current global population size and. *Marine Ecology Progress Series*, 242, 295-304.
- Whitt, A., Warde, A., Blair, L., Deslarzes, K., & Chaineau, C. (2023). Recent occurrence of marine mammals and sea turtles off Angola and first report of right whales since the whaling era. *Journal of the Marine Biological Association of the United Kingdom*(103). doi:10.1017/S0025315422001084
- Wikipedia. (2024). *Suction caisson*. Retrieved January 2025, from https://en.wikipedia.org/wiki/Suction_caisson
- Williamson, T. (2014). *Offshore Pigging in Four Phases*. Retrieved January 2025, from <https://www.slideshare.net/slideshow/offshore-pigging-by-the-numbers/37236883>
- Wolfson, A., Van Blaricom, G., Davis, N., & Lewbe, G. (1979). The marine life of an offshore oil platform. *Marine Ecology Progress Series*(1), 81-89.
- Wood Mackenzie. (2024, November). Retrieved February 2025, from No country for old fields - Why high-impact oil and gas exploration is still needed: https://www.woodmac.com/horizons/high-impact-oil-gas-exploration/?__FormGuid=9cc01a3f-5784-4719-a268-9e82b1c21a12&__FormLanguage=en&__FormSubmissionId=4301d581-9845-4988-bfa5-4aced4dca646
- Wood Mackenzie. (2024a). *Energy transition outlook 2024*. Retrieved February 2025, from <https://www.woodmac.com/market-insights/topics/energy-transition-outlook/>
- Woolley, L., Stewart Fielder, D., & Qin, J. (2014). Swimbladder inflation, growth and survival of yellowtail kingfish *Seriola lalandi* (Valenciennes, 1833) larvae under different temperature, light and oxygen conditions. . *Aquaculture Research*., 9(45).



- World Bank Group. (2015). IFC EHS for Offshore Oil and gas Development. Retrieved from www.ifc.org
- World Bank Group. (2021). *Namibia*. Retrieved from Climate Change Knowledge Portal : <https://climateknowledgeportal.worldbank.org/country/namibia/climate-data-historical>
- World Bank Group. (2024, April 1). *The World Bank in Namibia*. Retrieved from World Bank: <https://www.worldbank.org/en/country/namibia/overview>
- Worldometers. (n.d.). Retrieved February 2025, from <https://www.worldometers.info/oil/namibia-oil/>
- Wu, R. (2002). Hypoxia: from molecular responses to ecosystem responses. *Mar. Pollut. Bull.*(45), 35-45.
- www.coralreef.noaa.gov/deepseacorals/threats. (n.d.).
- www.nta.com.na. (2025, September 165). Retrieved from Namibia Training Authority (NTA).
- Yemane, D. M. (2015). Spatio-temporal trends in diversity of demersal fish species in the Benguela current large marine ecosystem region. *Fisheries Oceanography*, 24(1), 102-121.
- Zajac, R., Lewis, R., Poppe, L., Twichell, D., Vozarik, J., & Digiacommo-Cohen, M. (2000). Relationships among sea-floor structure and benthic communities in Long Island Sound at regional and benthoscape scales. *J. Coast. Res*(16), 627– 640.
- Zhou, L., Tang, D., & Sun, J. (2013). Investigation of marine phytoplankton blooms after the oil spills in the seas. *Ecol. Sci.*(32), 692–702.
- Zonfrillo, B. (1992). *The menace of low-flying aircraft to Ailsa Craig*. *Scottish Bird News*.
- Zoutendyk, P. (1992). *Turbid water in the Elizabeth Bay region: A review of the relevant literature*. CSIR Report EMAS-I 92004.
- Zoutendyk, P. (1995). Gradients and instability: Macrozoobenthic communities in the Benguela Upwelling System off Namibia. *Estuarine, Coastal and Shelf Science*. In K. Amarin, & M. Zettler, *Turbid water in the Elizabeth Bay region; A review of the 1992 Elizabeth Bay Study* (p. 108421). *Estuarine, Coastal and Shelf Science*.





Making Sustainability Happen