10 IMPACT ASSESSMENT - UNPLANNED EVENTS

10.1 FAUNAL STRIKES

10.1.1 Impact on Marine Fauna

Source of Impact

The transit of the drilling unit to site and the movement of the support vessel between the area of interest and the port town could result in faunal strikes.

Project phase	Activity
Mobilisation	Transit of drilling unit and support vessels to drill site
Operation	Transit of support /supply vessels between the drilling unit and port
Demobilisation	Transit of drilling unit and support vessels from drill site

Potential Impact Description

The potential effects on marine fauna (and especially turtles and cetaceans) due to collisions with vessels, include physiological injury or mortality (**direct negative** impact). The impact assessment is summarised in Table 10-1.

Project Controls

TEEPSA will ensure that the contractors undertake the drilling operation in a manner consistent with good international industry practice and BAT.

All whales and dolphins are given protection under South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel may approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel.

Sensitivity of Receptors

The Leatherback and Loggerhead turtles that occur in offshore waters around southern Africa, and likely to be encountered in Block 5/6/7 are considered regionally 'Critically Endangered' and 'Near Threatened', respectively. However, due to their extensive distributions and feeding ranges, the numbers of individuals encountered during the drilling campaign are likely to be low. Consequently, the sensitivity of turtles is considered to be **low**.

Of the thirty-five species of cetaceans (whales and dolphins) that are known or likely to occur off the South-West Coast, the blue whale is considered 'Critically endangered', the sei whale is 'Endangered', and the fin and sperm whales are considered 'Vulnerable' (IUCN Red Data list Categories). Despite the block location far offshore, and the extensive distributions of the various species concerned and mobility of these animals to avoid project vessels, and that the numbers of individuals encountered during the drilling campaign are likely to be low, the sensitivity of cetaceans is considered to be **high**.

Overall, the sensitivity of marine fauna for collision is considered to be **high**.

Impact Magnitude (or Consequence)

Ship strikes are globally the biggest threat to large whales, having direct, long-term and population-level consequences (Schoeman *et al.* 2020). Although most scientific publications to date have focussed on collisions between vessel and whales and manatees, there is growing evidence that at least 75 marine species, including smaller whales, dolphins, porpoises, dugongs, manatees, whale sharks, sharks, seals, sea otters, turtles, penguins, and fish are at risk of collision, especially within coastal areas frequented by smaller vessels (Schoeman et al. 2020).

The transit of the drilling unit to site and support vessel traffic between area of interest and port could increase the likelihood of animal-vessel collisions, although any such collisions are likely to be small in number in comparison to the high vessel volumes associated with the major shipping route that passes though Block 5/6/7 (see Figure 7-93). This risk is not unique to the project, but common to the numerous vessels that operate in or pass through the area on a daily basis.

Any increase in vessel traffic through areas used as cetacean calving grounds or through which these species migrate will increase the risk of collision between a whale and a vessel. The inshore portions of Block 5/6/7 overlap with the Southern Coastal and Shelf Waters IMMA, and the chances of collisions would increase between June and December (inclusive) when humpback and fin whales are known to migrate through the area, and in the vicinity of False Bay, Walker Bay and St Helena Bay, which serve as calving grounds for Southern Right whales.

The potential for collision with adult turtles / cetaceans is highly dependent on the abundance and behaviour of turtles and cetaceans in the area at the time of drilling and vessel speed. However, due to the extensive turtle distributions and feeding ranges, and the extended distance from their nesting sites (>1 000 km), the numbers of individuals encountered during the drilling campaign are likely to be low. Similarly, cetacean numbers encountered are likely to be low for much of the year, due to the extensive distributions and feeding ranges. However, 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, Sei whales) and winter distributions of sperm whales off the shelf edge may occur. Thus, the impacts on turtles and cetaceans are considered to be of **low intensity** for the populations as a whole for vessel transit. Furthermore, as the duration of the impact would be limited to the **short-term** (3 -4 months per well) and be restricted to the transit route to port (**regional**), the potential for collision is, therefore, considered to be of **very low magnitude**.

Impact Significance

Based on the **high sensitivity** of receptors and the **very low magnitude**, the potential impact on marine fauna is considered to be of **low significance** without mitigation.

Identification of Mitigation Measures

The following measures will be implemented:

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 and avoid animals when necessary.	Abate on site
2	Ensure vessel transit speed between the drill site and port is a maximum of 12 knots (22 km/hr), except within 25 km of the coast where it is reduced further to 10 knots (18 km/hr), as well as when sensitive marine fauna are present in the vicinity.	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.	Abate on site

Residual Impact Assessment

With the implementation of the mitigation measures, which would reduce the intensity of the impact to very low, the residual impact will remain of **very low magnitude** and of **LOW significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** after mitigation and **fully reversible** when the operations cease. The mitigation potential is **medium**, the loss of resource is **low**, and the cumulative potential is **possible**.

TABLE 10-1: IMPACTS ON TURTLES AND CETACEANS FROM FAUNAL STRIKES

Project Phase:	Mobilisation, Operation & Decommissioning	
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY LOW**	**VERY LOW**
Intensity	LOW	VERY LOW
Extent	REGIONAL	REGIONAL
Duration	SHORT TERM	SHORT TERM
Significance	**LOW**	**LOW**
Probability	**POSSIBLE**	**UNLIKELY**
Confidence	**HIGH**	**HIGH**
Reversibility	**FULLY REVERSIBLE**	**FULLY REVERSIBLE**
Loss of Resources	**LOW**	**LOW**
Mitigation Potential	**-**	**MEDIUM**
Cumulative potential	**POSSIBLE**	**POSSIBLE**

10.2 LOSS OF EQUIPMENT AT SEA

Source of Impact

Activities and events that could result in lost equipment:

Project phase	Activity
Mobilisation	Transit of drilling unit and support vessels to drill site
Operation	Operation of drilling unit and project vessels and accidental loss of equipment to the water column or seabed during operation and transit
Demobilisation	Transit of drilling unit and support vessels from drill site

The following events are described further below:

- Accidental loss of unsecured equipment / waste on deck during transit;
- Accidental loss of equipment during vessel transfer with crane (i.e. waste / chemical containers, equipment, consumable package, etc.) or during operations (tools, equipment, etc.); and
- A vessel accident/collision could also result in the wreck remaining on the seafloor.

10.2.1 Impact on Marine Ecology/Environment

Potential Impact Description

The potential impacts associated with lost equipment or a wreck include (**direct negative** impact):

- Potential disturbance and damage to seabed habitats and associated fauna within the equipment footprint;
- Potential physiological injury or mortality to pelagic and neritic marine fauna due to collision or in equipment drifting on the surface or in the water column;
- The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate for colonisation by benthic organisms (assessed in Section 9.2.4.1)

The impact assessment is summarised in Table 10-2.

Project Controls

TEEPSA will ensure that the contractors undertake the drilling operation in a manner consistent with good international industry practice and BAT. Gear will be recovered, where possible, near the surface.

Sensitivity of Receptors

Refer to Section 9.2.1.1 for a description of receptor sensitivity. The overall sensitivity of benthic and pelagic receptors is considered **low**.

Impact Magnitude (or Consequence)

In the event of the accidental and irretrievable loss of equipment to the seabed, this could potentially disturb and damage seabed habitats and crush any epifauna and infauna within the equipment footprint. Considering the available area of similar habitat on and off the edge of the continental shelf in the Southeast Atlantic Deep Ocean ecoregion, this disturbance of, and reduction in, benthic biodiversity can be considered of **low** intensity, highly localised and limited to the footprint of the lost equipment (**site specific**). Any impacts would persist over the **short-term** only, as lost equipment will be retrieved or if left in place on the seabed would offer hard substratum for colonisation by sessile benthic organisms in an area of otherwise unconsolidated sediments or will likely sink into the sediments and be buried over time. The impact for equipment lost is thus considered to be of **very low** magnitude.

Impact Significance

Based on the **low sensitivity** of receptors and the **very low magnitude**, the potential impact on the marine fauna is considered to be of **negligible** without mitigation.

Identification of Mitigation Measures

The following measures will be implemented to manage accidental loss of equipment:

No.	Mitigation measure	Classification
1	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.	Avoid
2	Minimise the lifting path between vessels.	Avoid
3	Maintain an inventory of all equipment and undertake frequent checks to ensure these items are stored and secured safely on board each vessel.	Avoid

No.	Mitigation measure	Classification
4	Undertake a post drilling ROV survey to scan seafloor for any dropped equipment and other removable features around the well site. Retrieve these objects, where practicable, after assessing the safety and metocean conditions. Establish a hazards database listing the type of gear left on the seabed and/or in the licence area with the dates of abandonment/loss and locations, and where applicable, the dates of retrieval.	Repair / restore
5	Notify SAN Hydrographer 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.	Repair / restore

Residual Impact Assessment

With the implementation of the mitigation measures, which would reduce the intensity of the impact to very low, the residual impact will remain of **very low magnitude** and of **NEGLIGIBLE significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **fully reversible** to **partially reversible**. The mitigation potential is **low**, the loss of resource is **low**, and the cumulative potential is **unlikely**.

TABLE 10-2: IMPACTS ON MARINE ECOLOGY/ENVIRONMENT FROM LOSS OF EQUIPMENT AT SEA

Project Phase:	**Operation**	
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**LOW**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY LOW**	**VERY LOW**
Intensity	LOW	VERY LOW
Extent	SITE	SITE
Duration	SHORT TERM	SHORT TERM
Significance	**NEGLIGIBLE**	**NEGLIGIBLE**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**HIGH**	**HIGH**
Reversibility	**PARTIALLY TO FULLY REVERSIBLE**	**PARTIALLY TO FULLY REVERSIBLE**
Loss of Resources	**LOW**	**LOW**
Mitigation Potential	**-**	**LOW**
Cumulative potential	**UNLIKELY**	**UNLIKELY**

10.2.2 Impact on Fishing and Other Marine Traffic

Potential Impact Description

The potential impacts associated with lost equipment include (**indirect negative** impact):

- Potential snagging of demersal gear with regards to equipment that sinks to the seabed;
- Potential collision hazards with regards to lost equipment drifting on the surface or in the water column; and
- Potential risk of collision of vessels with free-floating equipment drifting at the water surface or in the water column (ship-strikes).

The impact assessment is summarised in Table 10-3.

Project Controls

TEEPSA will ensure that the contractors undertake the drilling operation in a manner consistent with good international industry practice and BAT. The drilling contractor will undertake a final clearance survey by ROV to confirm the status of seafloor around the well to ensure no dropped equipment remain. Gear and equipment will be recovered, where possible.

Sensitivity of Receptors

Sensitivity here refers to the ability of the sector to operate as expected considering a project-induced events. Considering lost equipment on the seafloor, the demersal trawl gear may be snagged or damage. Similarly, floating equipment (e.g., container) maybe become entangled with pelagic gear (e.g., pelagic long-lines, purse-seine). Thus, the **sensitivity** of these types of fishing gear to lost equipment is considered to be **high**.

Impact Magnitude (or Consequence)

The loss of equipment and floats could result in entanglement and collision hazards in the water column for the pelagic gear (e.g., pelagic longlines, which can be up to 100 km long, and purse-seine nets) before the object sinks under their own weight. In the unlikely event of lost equipment floating in the water column, the impact could be of **low intensity**, limited to the **site** (although would potentially float around regionally) over the **short-term**. The impact **magnitude** for equipment lost to the water column is, therefore, considered **very low** for the large pelagic longline sector.

The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The impact of a hard substrate on demersal trawl could be of **low intensity**, limited to the **site** over the **short-term** before being be buried over time. The impact **magnitude** of equipment lost on the seabed on the demersal trawl sector is, therefore, also considered **very low**.

Impact Significance

Based on the **high sensitivity** of the fishing gears and the **very low magnitude**, the potential impact on commercial fishing is **low significance** without mitigation.

Identification of Mitigation Measures

In addition to the mitigation described in Section 10.2.1 the following will be implemented.

No.	Mitigation measure	Classification
1	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

Residual Impact Assessment

The implementation of the mitigation measures will reduce the intensity of the impact to very low. The residual impact will, however, remain of **very low magnitude** and of **LOW significance**.

Additional Assessment Criteria

The impact is considered to be **possible before mitigation** and **fully reversible** (object is retrieved) to **partially reversible** (until object sinks or settles into the substrate). The mitigation potential is **low**, the loss of resource is **low**, and the cumulative potential is **unlikely**.

TABLE 10-3: IMPACTS ON FISHING FROM LOSS OF EQUIPMENT AT SEA

Project Phase:	**Operation**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY LOW**	**VERY LOW**
Intensity	LOW	VERY LOW
Extent	SITE	SITE
Duration	SHORT TERM	SHORT TERM
Significance	**LOW**	**LOW**
Probability	**POSSIBLE**	**UNLIKELY**
Confidence	**MEDIUM**	**MEDIUM**
Reversibility	**FULLY REVERSIBLE to PARTIALLY REVERSIBLE**	**FULLY REVERSIBLE to PARTIALLY REVERSIBLE**
Loss of Resources	**LOW**	**LOW**
Mitigation Potential	**-**	**LOW**
Cumulative potential	**UNLIKELY**	**UNLIKELY**

10.3 ACCIDENTAL OIL RELEASE TO THE SEA DUE TO VESSEL COLLISIONS, BUNKERING ACCIDENT AND LINE / PIPE RUPTURE

Source of Impact

Activities that could result in vessel collisions and operational spills are indicated below:

Project phase	Activity
Mobilisation	Transit of drilling unit and support vessels to drill site
Operation	Operation of drilling unit at the drill site and transit of support /supply vessels between the drilling unit and port
	Bunkering of fuel
Demobilisation	Transit of drilling unit and support vessels from drill site

These activities are further described below:

- The movement of the support vessel between the drill site and the port town, and presence of drilling unit, may result in limited interaction with commercial, recreational and fishing boats and other marine recreational activities during their approach to the ports. Such interaction may cause a vessel strikes or collision (although all normal operating procedures will be followed to avoid such an occurrence) resulting in oil tank damage and leakage to the sea.

- Small instantaneous spills of marine diesel at the surface of the sea can potentially occur during bunkering and such spills are usually of a low volume. Similarly, small spills of hydraulic fluid could result from accidental line / pipe ruptures.
- Bunkering as sea or in port could lead to accidental spills.
- Larger volume spills of marine diesel could occur in the event of a vessel collision or vessel accident.

10.3.1 Impact on Marine Ecology/Environment

Potential Impact Description

Diesel, hydraulic fluid and/or oil spilled in the marine environment will 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) (**direct negative** impact). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats. The impact assessment is summarised in Table 10-4.

Note: the impact associated with the release of unburnt hydrocarbons during well testing (‘drop-out’) is assessed under normal operations in Section 9.2.5.3.

Project Controls

Compliance with COLREGS (the Convention dealing with safety at sea, particularly to reduce the risk of collisions at sea) and SOLAS (the Convention ensuring that vessels comply with minimum safety standards).

A 500 m safety zones will be enforced around the drilling unit within which fishing and other vessels will be excluded.

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 Oil Spill Contingency Plan (OSCP) will be prepared and available at all times during the drilling operation.

Regulation 37 of MARPOL Annex I will be applied, which requires that all ships of 400 gross tonnage and above carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). The purpose of a SOPEP is to assist personnel in dealing with unexpected discharge of oil onboard, 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.

Sensitivity of Receptors

The area of interest is located in the marine environment, more than 60 km offshore at its closest point, far removed from coastal MPA and any sensitive coastal receptors (e.g., key faunal breeding/feeding areas, bird or seal colonies and nursery areas for commercial fish stocks); however, any accidental spills could still directly affect migratory pelagic species transiting through the drill area or be transported into the nearby Brown’s Bank and/or Southeast Atlantic Seamounts MPAs. Diesel spills or accidents *en route* to the onshore supply base in

Cape Town or Saldanha Bay could result in fuel loss closer to shore, thereby potentially having an environmental effect on the sensitive coastal environment, especially seabird colonies.

The taxa most vulnerable to hydrocarbon spills are coastal and pelagic seabirds. Some of the species potentially occurring in the area of interest, are considered regionally 'Endangered' (e.g., African Penguin, Cape Gannet, Cape Cormorant, Bank Cormorant, Roseate Tern) or 'vulnerable' (e.g., White Pelican, Caspian Tern, Damara Tern). Although species listed as 'Endangered' or 'vulnerable' may potentially occur in the drill area, due to their extensive distributions their numbers are expected to be low.

The overall sensitivity of receptors to a spill incident is considered to be **high**.

Impact Magnitude (or Consequence)

Oil, diesel or hydraulic fluid spilled in the marine environment will have an immediate detrimental effect on water quality. Being highly toxic, marine diesel released during an accidental spill will negatively affect any marine fauna in which it comes into contact.

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 2003). Satellite imagery analysis covering an area of 156 600 km^2 was used by TEEPSA (in 2020) in an oil slicks detection study of the southern offshore part of South Africa (see Section 7.3.9). Although no oil seep anomalies were detected, the study did demonstrate the presence of oil from other sources in the offshore area of Block 5/6/7 (including shipping).

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, volume spilled, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. As a general rule, oils with a volatile nature, low specific gravity and low viscosity (e.g., marine diesel) are less persistent and tend to disappear rapidly from the sea surface. In contrast, high viscosity oils containing bituminous, waxy or asphaltenic residues, dissipate more slowly and are more persistent, usually requiring a clean-up response.

The consequences and effects of small (2 000 – 20 000 litres) diesel fuel spills into the marine environment are summarised below (NOAA, 1998). Diesel is a light oil that, when spilled on water, spreads very quickly to a thin film and evaporates or naturally disperses within a few days or less, even in cold water. Diesel oil can be physically mixed into the water column by wave action, where it adheres to fine-grained suspended sediments, which can subsequently settle out on the seafloor. As it is not very sticky or viscous, diesel tends to penetrate porous sediments quickly, but also to be washed off quickly by waves and tidal flushing. In the case of a coastal spill, shoreline clean-up is thus usually not needed. Diesel oil is degraded by naturally occurring microbes within one to two months. Nonetheless, in terms of toxicity to marine organisms, diesel is considered to be one of the most acutely toxic oil types. Many of the compounds in petroleum products are known to smother organisms, lower fertility and cause disease. Intertidal invertebrates and seaweed that come in direct contact with a diesel spill may be killed. Fish kills, however, have never been reported for small spills in open water as the diesel dilutes rapidly. Due to differential uptake and elimination rates, filter-feeders (particularly mussels) can bio-accumulate hydrocarbon contaminants. Crabs and shellfish can be tainted from small diesel spills in shallow, nearshore areas.

In the unlikely event of an accidental spill, the intensity of the impact would depend on whether the spill occurred in offshore waters where encounters with pelagic seabirds, turtles and marine mammals would be low due to their extensive distribution ranges, or whether the spill occurred closer to the shore where encounters with sensitive receptors will be higher. Due to the dominant winds and currents in the area of interest, a diesel slick would more than likely be blown in a north-westerly direction and away from the coast. The diesel would remain at the surface for up to 5 days (short-term) with a negligible probability of reaching sensitive coastal habitats.

In offshore environments, impacts associated with a spill would be of **low intensity**, **regional** (depending on the nature of the spill) over the **short-term** (up to five days). The impact **magnitude** for a marine diesel spill in the area of interest (**offshore** environment) is, therefore, considered **very low**.

However, in the case of a spill *en route* to the drill site, the spill may extend into coastal MPAs and reach the shore affecting intertidal and shallow subtidal benthos and sensitive coastal bird species, in which case the **intensity** would be considered **high**, but of **local** extent over the **medium-term**. The **magnitude** for a **nearshore** spill is **medium**.

Impact Significance

Based on the **high sensitivity** of receptors and the **very low** (offshore) and **medium magnitude** (nearshore), the potential impact on the marine fauna is considered to range from **low significance** (offshore) to **medium significance** (nearshore) without mitigation.

Identification of Mitigation Measures

In addition to the best industry practices and project standards, the following measures will be implemented to manage the impacts associated with small accidental spills:

No.	Mitigation measure	Classification
Hydrocarbon spills		
1	Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel.	Avoid / reduce at source
2	Obtain permission from DFFE to use low toxicity dispersants. Use cautiously.	Abate on and off site
3	Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.	Restore
Bunkering at sea		
4	Ensure offshore bunkering is not undertake in the following circumstances: • Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale; • During any workboat or mobilisation boat operations; • During helicopter operations; • During the transfer of in-sea equipment; and • At night or times of low visibility.	Avoid / Reduce at source

Residual Impact Assessment

With the implementation of the mitigation measures, which would reduce the intensity of a nearshore impact to low, the residual impact will be of **very low magnitude** and of **LOW significance** for both offshore and nearshore spills.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **fully reversible**. The mitigation potential is **medium**, the loss of resource is **low** after mitigation, and the cumulative potential is **unlikely**.

TABLE 10-4: IMPACTS ON MARINE ECOLOGY/ENVIRONMENT FROM A SMALL ACCIDENTAL RELEASE OF OIL

Project Phase:	**Mobilisation, Operation and Decommissioning**	
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY LOW (offshore) to MEDIUM (nearshore)**	**VERY LOW**
Intensity	LOW (offshore) to HIGH (nearshore)	LOW
Extent	LOCAL (nearshore) to REGIONAL (offshore)	LOCAL (nearshore) to REGIONAL (offshore)
Duration	SHORT TERM (offshore) to MEDIUM TERM (nearshore)	SHORT TERM (offshore) to MEDIUM TERM (nearshore)
Significance	**MEDIUM (nearshore) – LOW (offshore)**	**LOW** (nearshore and offshore)
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**HIGH**	**HIGH**
Reversibility	**FULLY REVERSIBLE**	**FULLY REVERSIBLE**
Loss of Resources	**LOW (offshore) to MEDIUM (nearshore)**	**LOW**
Mitigation Potential	-	**MEDIUM**
Cumulative potential	**UNLIKELY**	**UNLIKELY**

10.3.2 Impact on Commercial Fishing

Potential Impact Description

Hydrocarbon spilled in the marine environment will 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). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

An oil spill can also result in several impacts on fishing (**indirect negative** impact). These include:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort;
- Mortality of animals (including eggs and larvae) leading to stock reduced recruitment and loss of stock; and
- Gear damage due to oil contamination.

The impact assessment is summarised in Table 10-5.

Project Controls

Refer to Section 10.3.1.

Sensitivity of Receptors

Refer to Section 10.3.1 for a description of marine faunal sensitivity to a spill incident.

Adult free-swimming fish in the open sea seldom suffer long-term damage from oil spills because oil concentrations in the water column decline rapidly following a spill, 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. Only in extreme cases of coastal spills when gills become coated with oil can effects be lethal, particularly for benthic or inshore species.

The embryonic and larval life stages of fish show acute toxicity to PAHs, even at low concentrations, although effects vary depending on the species and the extent of exposure. 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 a spill coincide with a major spawning peak in the kingklip, squid, hake, anchovy and pilchard spawning areas during spring and summer, it could result in severe mortalities and consequently a reduction in recruitment.

A variety of pelagic species, including anchovy, pilchard, and horse mackerel, are reported to spawn off the Western, Southern and Eastern Agulhas Bank. The eggs and larvae spawned in this area are thought to largely remain on the Agulhas Bank. The coastal bays and estuarine environments are critical nursery areas for many of the fish stocks on which the various commercial fisheries are based. In particular, the small pelagic species of anchovy, sardine, red-eye round herring and juvenile horse mackerel and numerous line fish and demersal species are found in these protected areas in their juvenile stages. Any contamination of these areas would result in mortality of icthyoplankton and impact in the short term on recruitment of species to the demersal trawl sectors, demersal longline, small pelagic purse-seine, midwater trawl, line fish and squid jig sectors.

The eggs and larvae are also carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is, therefore, some overlap of Block 5/6/7 with the northward egg and larval drift of commercially important species, and the return migration of recruits. Thus, ichthyoplankton abundance in the inshore portion of the area of interest is likely to be seasonally high, particularly in late winter and early spring.

In the context of the detrimental effect on icthyoplankton (spawn products) on recruitment to fisheries, all affected fishing sectors are considered to be vulnerable to spills and are rated as high sensitivity.

Mariculture activities are highly sensitive to water quality variability. The effects of oil 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 abalone, white mussels and any mariculture activities, any pollution associated with oil reaching the shoreline could be devastating for the industry resulting in complete loss of stock.

The overall sensitivity of receptors to a spill incident is considered to be **high**.

Impact Magnitude (or Consequence)

For small spills of hydrocarbon, the dominant weathering processes are evaporation and dispersion over the short-term. Diesel is a light oil that, when spilled on water, spreads very quickly to a thin film and evaporates or naturally disperses within a few days or less (NOAA, 1998).

In the unlikely event of an accidental spill, the **intensity** of the impact would depend on whether the spill occurred in offshore waters (e.g., during bunkering) where encounters with pelagic fish would be **low** due to their extensive distribution ranges, or whether the spill occurred closer to the shore (e.g., in the event of a vessel accident) where encounters with sensitive receptors (mariculture) could be higher. Due to the dominant winds and currents in the area of interest, a diesel slick would be blown in a north-westerly direction and away from the coast and spawning areas (**regional** in extent). The diesel would remain at the surface for up to 5 days (**short-term**) with a negligible probability of reaching sensitive coastal habitats. Thus, in offshore waters, the **magnitude** of a small spill on all fisheries is expected to be **very low**.

However, in the case of a spill *en route* to the drill site (during a vessel accident), the spill may reach the shore affecting mariculture operations, in which case the **intensity** would be considered **high**, but of **local** extent over the **medium-term**. in nearshore water, the **magnitude** of a small spill on all fisheries is expected to be **medium**.

Impact Significance

Based on the **high sensitivity** of receptors and the **very low (offshore)** and **medium magnitude (nearshore)**, the potential impact of a small accidental spill on commercial fisheries is considered to be of **low to medium significance** for an offshore and nearshore spill, respectively.

Identification of Mitigation Measures

In addition to the project control and mitigation described in Section 10.3.1, the following will be implemented.

No.	Mitigation measure	Classification
1	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

Residual Impact Assessment

With the implementation of the mitigation measures, which would reduce the intensity and magnitude of a nearshore impact to low and very low, respectively, the residual nearshore impact reduces to **LOW significance**, while the significance of an offshore spill remains of **LOW significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **fully reversible**. The mitigation potential is **low**, the loss of resource is **low**, and the cumulative potential is **unlikely**.

TABLE 10-5: IMPACTS ON FISHNG FROM A SMALL ACCIDENTAL RELEASE OF HYDROCARBON

Project Phase:	**Mobilisation, Operation and Decommissioning**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**MEDIUM (nearshore) to VERY LOW (offshore)**	**VERY LOW**
Intensity	HIGH (nearshore) to LOW (offshore)	LOW
Extent	LOCAL (nearshore) to REGIONAL (offshore)	LOCAL (nearshore) to REGIONAL (offshore)
Duration	SHORT TERM (offshore) to MEDIUM TERM (nearshore)	SHORT TERM
Significance	**LOW (offshore) to MEDIUM (nearshore)**	**LOW**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**MEDIUM**	**MEDIUM**
Reversibility	**FULLY REVERSIBLE**	**FULLY REVERSIBLE**
Loss of Resources	**LOW**	**LOW**
Mitigation Potential	**-**	**LOW**
Cumulative potential	**UNLIKELY**	**UNLIKELY**

10.4 WELL BLOW-OUT

10.4.1 Introduction

Offshore drilling operations carry an inherent risk of oil entering the marine environment as a consequence of an unplanned oil spill event. The greatest environmental threat from offshore drilling operations, although unlikely, is the risk of a major spill of crude oil/condensate occurring from a well blow-out. A blow-out is the uncontrolled release of crude oil and/or natural gas from a well after pressure control systems have failed. This section considers the potential impacts of an unlikely well blow-out, based on the findings of the Oil Spill Modelling reports (see Appendix 7 in Volume 2). The Oil Spill modelling considered two theoretical well sites, at locations closest to the coast and the sensitivity areas (making them worst case) at two different depths. The oil spill modelling was subject to peer review by PRDW (see Appendix 9 in Volume 2).

10.4.2 Oil Spill Modelling and Weathering

The Oil Spill Contingency and Response (OSCAR) modelling tool was used in the current study to estimate oil spills interaction with the marine environment. OSCAR computes the fate and weathering of oil, in order to simulate the oil's drift, concentration and extent, on the sea surface and/or the shoreline. This tool offers the means to quantify potential environmental impacts caused by hydrocarbons spills and to identify the appropriate spill response strategy (dispersants, containment and mechanical recovery). OSCAR uses surface spreading, advection, entrainment, emulsification, and volatilization algorithms to determine the transport and fate of the oil on the surface (see Figure 10-1).

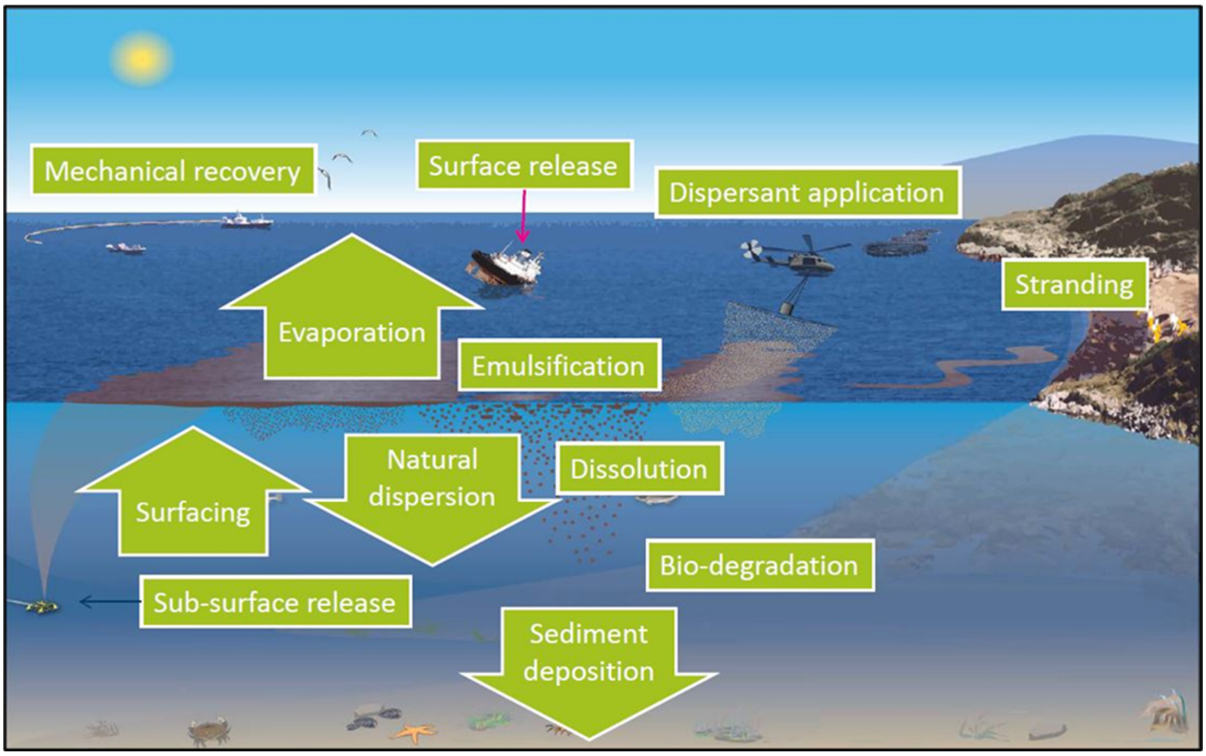


FIGURE 10-1: PHYSICAL AND CHEMICAL PROCESSES INCLUDED IN THE MODEL
Source: OSCAR

10.4.2.1 Modelled Parameters and Scenarios

Although the hydrocarbon profile is unknown at this stage (crude oil or condensate), crude oil was modelled as a worst-case scenario. This was determined based on a comparison of a "crude oil" scenario versus a "condensate" scenario. It should, therefore, be kept in mind that the potential impacts resulting from a blow-out releasing condensate will be significantly less than those described below.

Two discharge points were modelled in the area of interest, namely **Discharge 1 located 72 km from the coast in 719 m depth** and **Discharge 2 located 155 km from the coast at a depth of 1 357 m** (see Figure 9-2). These locations are representative of the area and conservative (worst-case), as they were selected considering proximity to the coast and sensitive areas (including MPAS, EBSAs and CBAs), water depth, and metocean dataset. The four seasons considered include **Season 1 (December – February), Season 2 (March – May), Season 3 (June – August), and Season (September – November)**. All scenarios simulated a continuous blow-out of 25 000 bbls/day[61] and 700 000 Sm^3 of gas/day for a period of 20 days.

The spill response strategies listed below were applied during the modelling. These assumptions were based on the OSCP prepared for Block 11B/12B in 2020 and adjusted for the Block 5/6/7 location.

A. Capping Stack deployed at the end of the 20th day

[61] For context, the Deepwater Horizon blowout in the Gulf of Mexico in 2010 averaged approximately 56 000 bbls/day for 87 days. The difference between the current modelling volumes and the Deepwater Horizon volumes are due to differences in geology and the availability of a capping stack. The discharge rate of 25 000 bbls/day considers the potential blow-out rate from the Venus exploration well in southern Namibia targeting similar burial and geology as for the Block 5/6/7 prospect, whilst the 20-day duration considers the time to deploy the capping stack from Saldanha Bay.

B. Subsea Dispersant Injection (SSDI) kit deployed after the 15th day.

C. Surface dispersion with the following resources:

- 2 aircrafts for chemical dispersion, deployed 24 h and 72 h after the start of the spill, respectively.
- 10 vessels for chemical dispersion operations with the following deployment times:
  - 2 vessels 24h after the start of the spill.
  - 1 vessels 48h after the start of the spill.
  - 2 vessels 96 h after the start of the spill.
  - 3 vessels 168 h after the start of the spill.
  - 2 vessels 216 h after the start of the spill.
- 5 vessels for containment and recovery operations with the following deployment times:
  - 1 pair 24h after the start of the spill.
  - 1 pair 48 h after the start of the spill.
  - 3 pairs 96 h after the start of the spill.

Refer to modelling study in Appendix 7 (Volume 2) for further details on the various modelling scenarios, oil profile, discharge rates, etc.

10.4.2.2 Model Outputs

OSCAR allows statistical modelling that provides insight into how typical oil spill scenarios unfold under a wide range of weather or seasonal conditions. Two different modelling simulations were considered, namely stochastic and deterministic simulations. It is important to differentiate between the different model outputs. An explanation of stochastic and deterministic modelling outputs is provided in Box 10-1.

- **Deterministic simulation** studies the trajectory and fate of an individual oil slick that starts at a defined moment in the past and uses the associated wind and current data (usually the worst-case trajectory identified in the stochastic simulation). The purpose of the deterministic simulation is to better understand how the oil spill progresses in the marine environment, estimate the amount of oil that could reach the coast depending on the weather conditions and oil weathering, as well as the minimum time to observe these impacts. For this study, the **worst-case** trajectory selected from the stochastic scenario, represents the trajectory with the **most quantity of oil reaching the shore**. **These plot shows the trajectory of a SINGLE SPILL EVENT over time modelled under specific conditions considering various spill responses.**
- The **stochastic simulation** is a statistical calculation based on results from many sets of similar deterministic simulations using the same weathering model. The results from each individual simulation making up the stochastic scenario are combined to produce statistics on oil slick distribution probabilities, in time and space, that are translated on statistical maps. The main result is a map showing the probability of contamination above defined threshold values, for sea surface and shoreline compartments. The probabilities are given as percentages of the total number of simulations (in the current study **72 simulations for Season 1 and 90 simulations for Seasons 2 to 4**). For example, a probability of 50% implies that an area was impacted during the studied period for half of the number of simulations in the stochastic scenario. **These probability plots DO NOT depict the extent of a single spill.**

BOX 10-1: EXPLANATION OF THE KEY MODEL OUTPUTS

Deterministic simulation: A plot of a **single spill event trajectory** over time modelled under specific conditions in Block 5/6/7 is shown in Figure (a).

Stocastic simulation: The probablity plot (Figure b) shows the entire area that will be swept by oil under all **72 simulations**. The probablity plot thus depicts a much larger composite area of possible oiling compared to what would actually occur under a single spill event. **The probability plot DOES NOT depict the extent of a single spill.**

Figure (a): Deterministic Single spill event

This example shows snapshots over time of a single spill event for a 20-day blow-out (with no surface response) showing the surface oiling at Day 3, 6, 16 and 22.

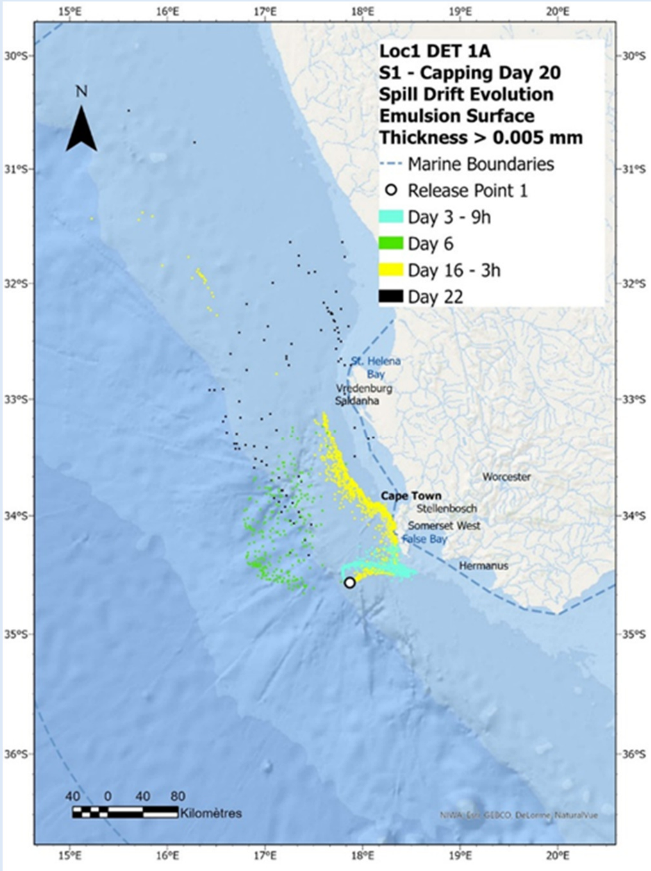
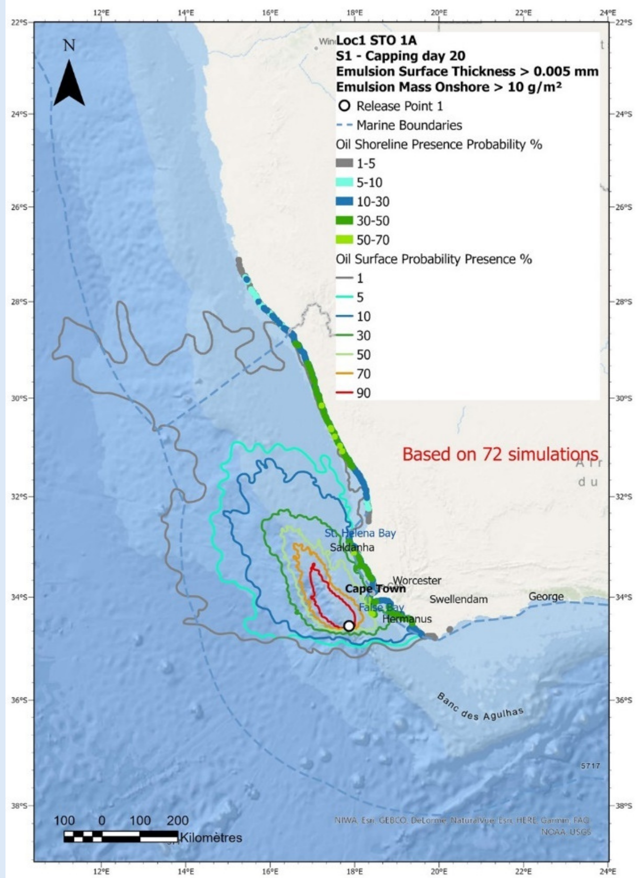


Figure (b): Stochastic Probability of all 72 simulations

This example is a probability plot showing the probability (%) of surface oiling under all 72 spill simulations for a 20-day blow-out (with no surface response).

Note: Colours show oiling probability percentage ranging from Red (90%) to Grey (1-5%).



10.4.2.3 Oil Spill Modelling Results

The discussion of modelling results and impact assessment below is focused on the worst-case scenario of assuming **capping only** in the event of a blow-out. However, it should be noted that the mitigated scenario, which includes a combination of surface response, capping and implementation of SSDI, results in much reduced oil spill footprints.

Stochastic Modelling Results

Water Column and Surface Layer Probability of Contamination

Depending on the season, stochastic simulation results of the oil spill modelling study indicated that at Release Point 1, the hydrocarbon mixture escaping from the well reaches the higher probability for contamination of the deep layers at 380 m to 420 m depth before forming a subsurface plume that is transported in a NW direction by the current. For this deep layer, 90% probability is reached at distances between approximately 9 km and 14 km from the well site, but spreading up to 70 km to the SE (Season 1) and in the direction of the sensitive Brown's Bank MPA and EBSA, and up to 97 km to the NW (Season 4) in the direction of the Cape Canyon. The probability of contamination of surface water (0-20 m depth) extends up to 165 km to the NW (90% probability), but spreading up to 1 420 km to the NW (Worst case: Season 1) (see Figure 10-2).

For Release Point 2 in deeper water, higher probability for contamination of the deep layers is reached at between 1 000 m and 1 020 m depth, with the oil in most cases being transported in a NW direction by the current reaching 90% probability between approximately 8 km and 16 km from the well site (depending the season), but spreading up to 77 km to the SE (Season 1) and in the direction of the sensitive Brown's Bank MPA and EBSA. The probability of contamination of surface water (0-20 m depth) extends up to 91 km to the NW (90% probability) but spreading up to 1 172 km to the WNW (Worst case: Season 1) (see Figure 10-3).

Considering the mitigated scenario, the implementation of SSDI results in an increase in the deep layer contamination area and the depth of contamination at both release points. For Release Point 1 there is a 90% probability of contamination up to 18 km and maximum distance 61 km SE to 114 km NW at maximum depths of 400 – 420 m, as the dispersant decreases the size of the droplets, reducing the speed of ascent to the surface, thereby increasing the presence of oil in the deep layers, especially close to the release point. At Release Point 2, the contamination area extends up to 18 km SE for the 90% probability for Season 1, but with a maximum distance of 62 km SE for Season 4, and maximum depths of 980 – 1 000 m.

Surface and Shoreline Oil Presence Probability

For both Release Points 1 and 2, the highest concentrations of rising oil are transported NW towards the 'vulnerable' and 'endangered' southeast Atlantic Canyons and Southern Benguela Canyons habitats, respectively, and SE towards the 'critically endangered' Southern Benguela Mosiac Shelves, which form part the Brown's Bank EBSA, and the key spawning areas. Some of the finely dispersed oil droplets in the subsurface plume would remain suspended in the water column and undergo microbial degradation or may be absorbed onto suspended sediments that are then deposited on the seabed. In areas where benthic turbidity events are common and termination depths are relatively close to the seabed, a fraction of the hydrocarbons may therefore be returned to the seabed via redepositing sediments. Once the oil reaches the surface it is distributed by prevailing winds and currents surface.

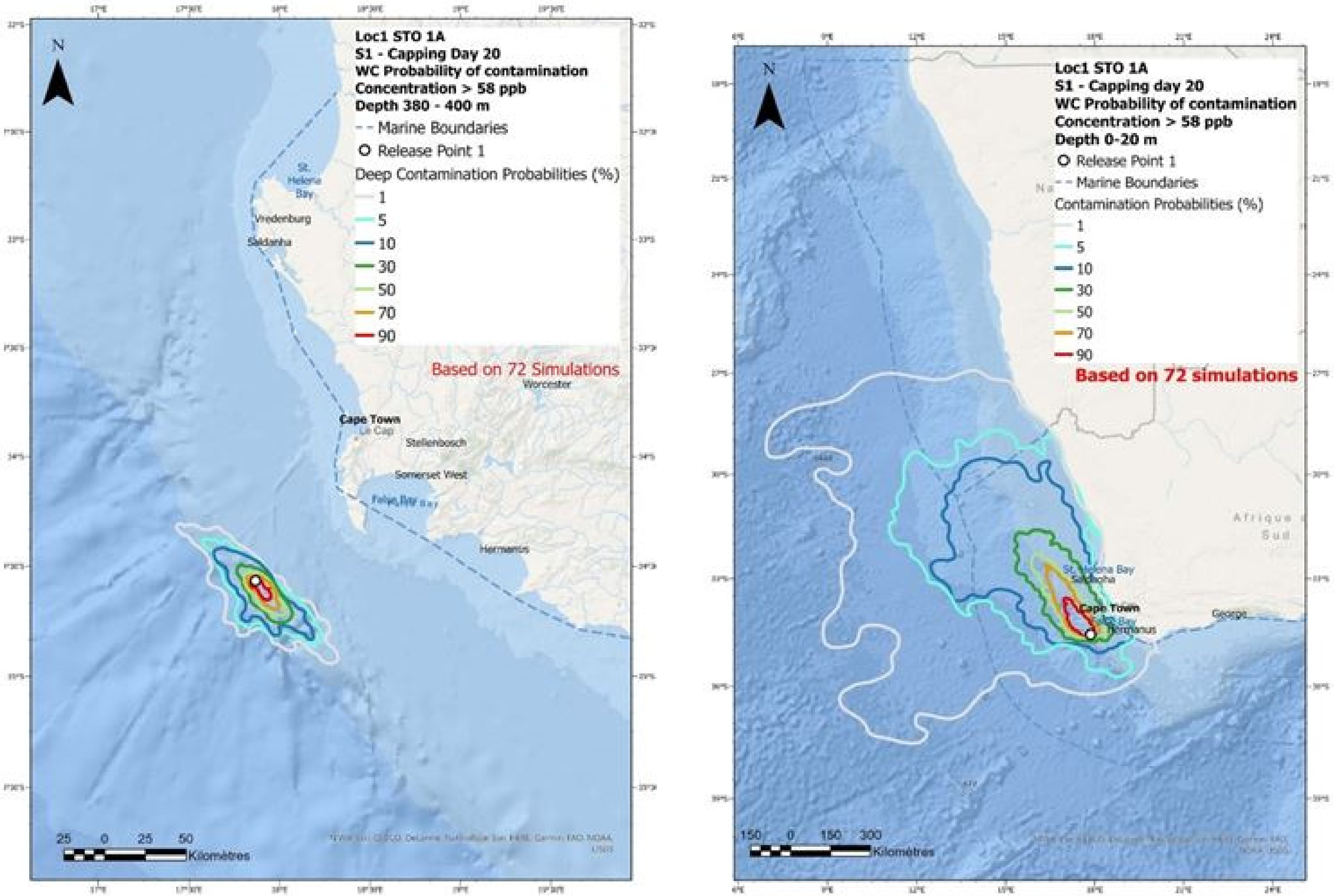


FIGURE 10-2: WATER COLUMN PROBABILITY OF CONTAMINATION >58 PPB FOR DEEP-WATER (LEFT) AND SURFACE LAYERS (RIGHT) FOR WORST CASE SEASON 1 AT RELEASE POINT 1 WITH CAPPING ONLY

Source: Livas 2022b

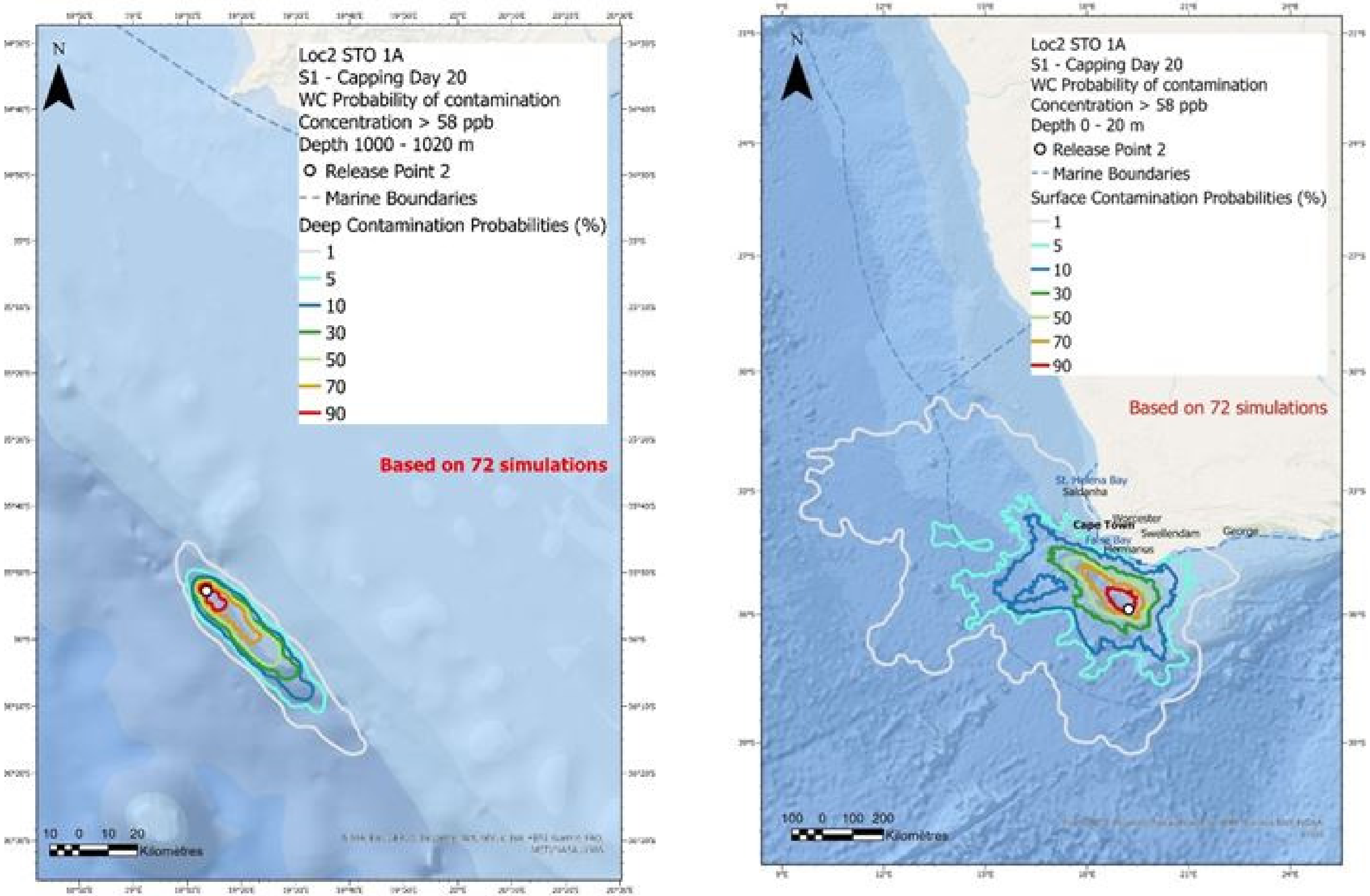


FIGURE 10-3: WATER COLUMN PROBABILITY OF CONTAMINATION >58 PPB FOR DEEP-WATER (LEFT) AND SURFACE LAYERS (RIGHT) FOR WORST CASE SEASON 1 AT RELEASE POINT 2 WITH CAPPING ONLY

Source: Livas 2022b

For the capping only response to a blowout, the stochastic modelling results indicate that the probability of shoreline oiling above the 10 g/m^2 threshold, extends along a maximum of some 2 640 km of coastline from Plettenberg Bay to north of the Namibian border for Release Point 1 (see Figure 10-4), with the maximum distance of the 1% oil surface probability contour extending 1 105 km NW of the release point (Worst case: Season 1). The probability of shoreline oiling is as high as 99%for the Cape Peninsula, 90% for False Bay and 88% along the West Coast north of Cape Town, with oil reaching the shore within 0.6 days (Worst case: Season 3). The model predicted that up to a maximum of 6 159 tons of oil could reach the shore.

For Release Point 2 for the capping only response, the stochastic modelling results indicate that the probability of shoreline oiling above the 10 g/m^2 threshold extends along a maximum of some 1 635 km of shoreline from George to Port Nolloth (Season 4) (see Figure 10-5), with the maximum distance of the 1% oil surface probability contour extending 755 km NW of the release point (Worst case: Season 1). The probability of shoreline oiling is as high as 98% at Hermanus bay to Agulhas Cape, with 70% probability of oiling on the Cape Peninsula and up to 30% probability of oiling along the West Coast north of Cape Town, with oil reaching the shore within 2.2 days (Worst case: Season 3). The model predicted that up to a maximum of 1 700 tons of oil could reach the shore.

In the event of a blow-out, the period June to August (Season 3) was identified as the worst in respect of the maximum amount of oil reaching the shore coupled with the maximum probability of shoreline oiling for both discharge locations. This is due to the dominant surface currents being directed towards the N and NW and winds from NW to SE, driving the spill more towards the coast than for during other seasons. Season 1 (December to February) was the period when a release would have the lowest probability of impacting the shore. This is due to the prevailing currents and wind driving the spill away from the coast toward the NW. However, the stronger currents and winds result the oil being distributed further, with oil from Release Point 1 entering Namibian waters and oil from Release Point 2 spreading westwards into international waters beyond South Africa's EEZ.

With implementation of both surface response and SSDI, the maximum distances from the release point and the maximum shoreline likely to be oiled are reduced. However, the maximum oil presence probability for oiling of the Cape Peninsula is still 95% for Release Point 1 (Season 3) and 33% for release Point 2 (Season 3), with highest values for shoreline oiling at Hermanus Bay to Cape Agulhas from Release Point 2 being as high as 87% (Season 3). The probability of surface oiling beyond the EEZ for both Release Points 1 and 2 remains at 1% although the area affected is much reduced. The probability of shoreline oiling extending into Namibia remains for Release Point 1 but is reduced to <5%.

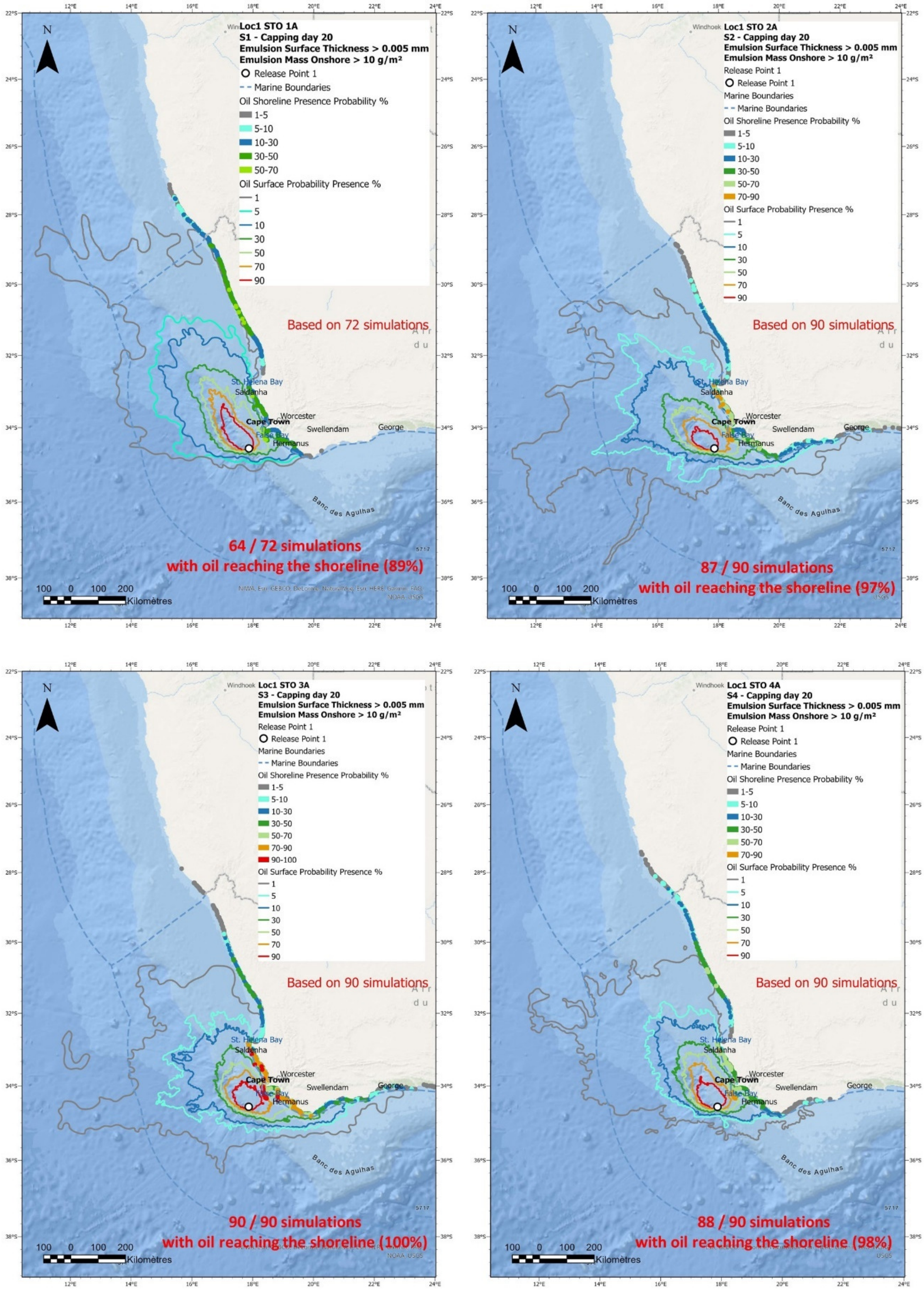


FIGURE 10-4: SUMMARY OF THE PROBABILITY OF SURFACE AND SHORELINE OILING FOR ALL FOUR SEASONS FOR RELEASE POINT 1 WITH CAPPING ONLY

Source: Livas 2022b

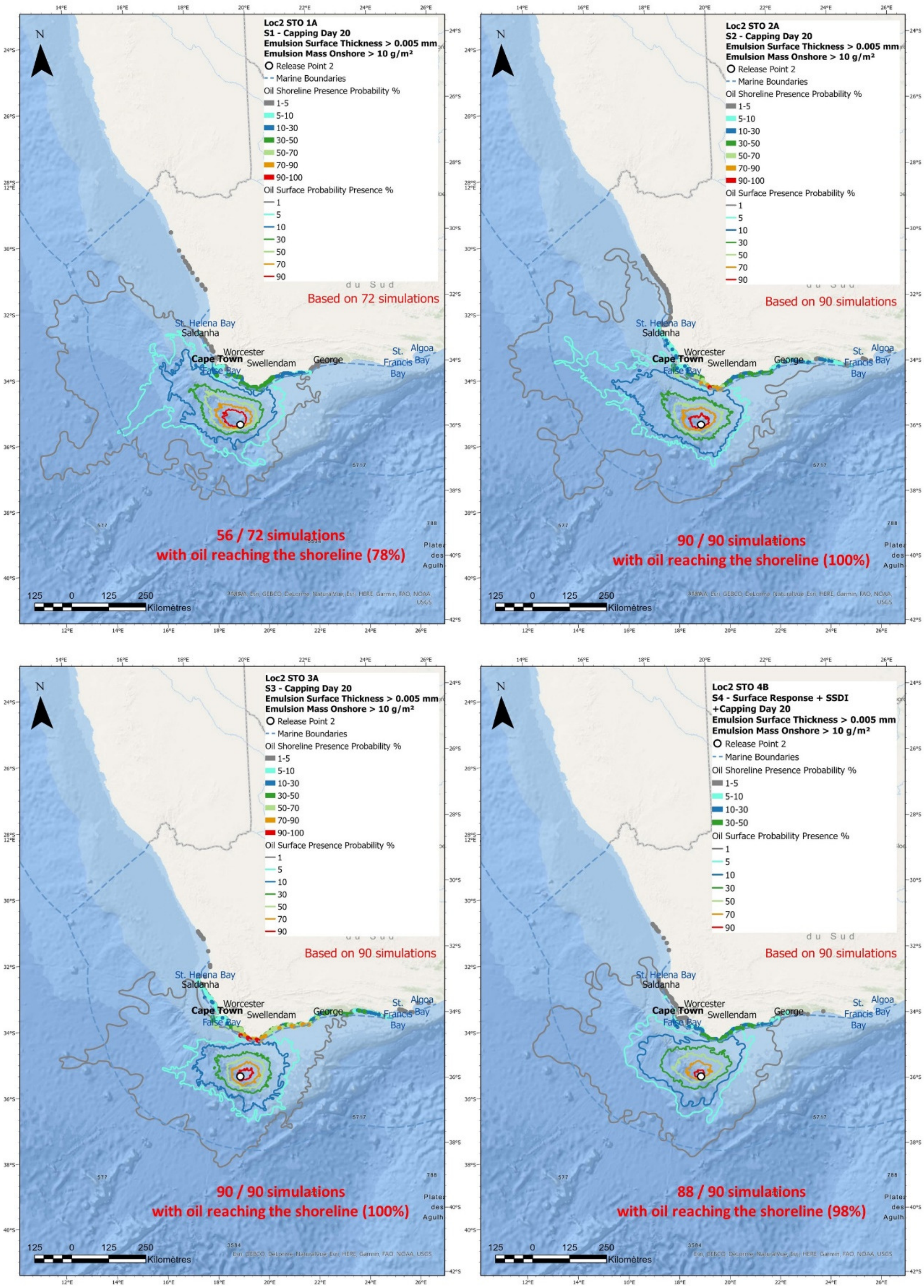


FIGURE 10-5: SUMMARY OF THE PROBABILITY OF SURFACE AND SHORELINE OILING FOR ALL FOUR SEASONS FOR RELEASE POINT 2 WITH CAPPING ONLY

Source: Livas 2022b

Deterministic Simulations

The deterministic predictions for the worst-case oil on the shoreline (with capping only) was between 9.9 and 14.6 kg/m^2 extending along 650 – 1 230 km of coastline for Release Point 1 and between 6.5 and 10.3 kg/m^2 extending along 520 - 800 km of coastline for Release Point 2. Capping, surface response and application of SSDI response reduces the oil concentration onshore to between 6.2 and 14.5 kg/m^2 (for Release Point 1) and 4.2 to 9.3 kg/m^2 (for Release Point 2) and reduces the length of coastline affected to a maximum of 1 031 km and 714 km for Release Points 1 and 2, respectively. The deterministic simulations indicate that the addition of surface response and SSDI response will result in the dispersion of oil, reduce the area of the slick and a reduction of the maximum shoreline oil concentration after 60 days. Refer to modelling results for surface response and SSDI (Release Point 1 Season 4) in Figure 10-6 (surface spill drift evolution) and Figure 10-7 (shoreline oiling concentration).

From the mass balance figures, it becomes evident that the majority of the oil released during a blow-out is evaporated and biodegraded, and that a substantial proportion of the spilled oil remains in the water column (submerged), with only a comparatively small proportion reaching the shoreline. The effect of the response procedures implemented in the control of the spill also becomes clear. Placing a capping stack only (after 20 days release) results in the highest amount of oil remaining at the surface and reaching the shore, with the degree of biodegradation and evaporation determined largely by metocean conditions. As would be expected, additional surface response deployment reduces both the amount of oil at the surface and that reaching the shore. Application of SSDI response has the effect of substantially reducing oil droplets size thereby promoting entrainment and dispersion in the water column and natural biodegradation processes. Consequently, the amount of oil reaching the surface and subsequently reaching the shore is usually reduced. However, the entrained plume could potentially extend over substantial distances and cover large areas before the hydrocarbons settle out thereby potentially impacting habitats far removed from the well site.

10.4.3 Potential Impacts of a Well Blow-Out

Source of Impact

Events that could result in a large oil and/or natural gas spill:

Project phase	Activity
Mobilisation	N/A
Operation	Loss of well control during drilling
Demobilisation	N/A

As indicated in the introduction to this section, the greatest environmental threat from offshore drilling operations is the risk of a major spill of crude oil and/or natural gas occurring either from a blow-out or loss of well control after pressure control systems have failed.

The probability of a well blow-out occurring is considered to be extremely unlikely. In a South Africa context, 358 wells have been drilled in the offshore environment to date (based on shapefile provided by PASA in 2021) and no well blow-outs have been recorded to date. Global data maintained by Lloyds Register indicates that frequency of a blow-out from normal exploration wells is in the order of 1.43×10^{-4} per well drilled.

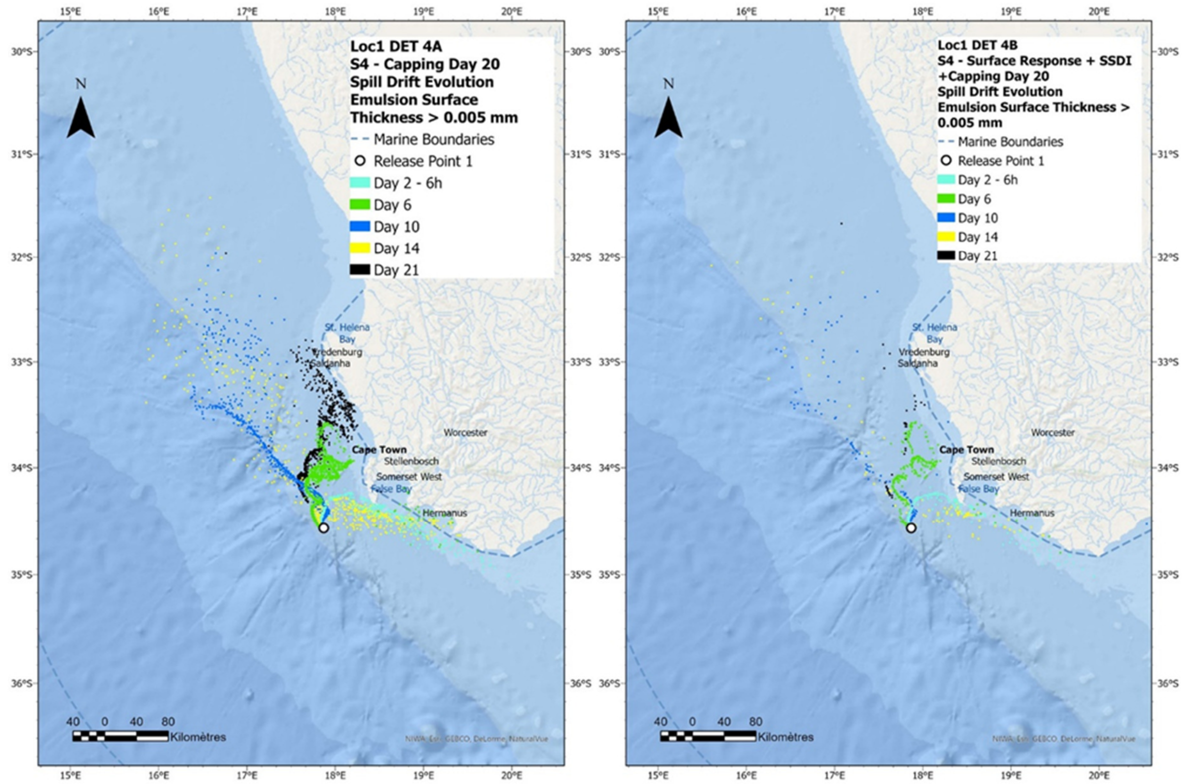


FIGURE 10-6: DETERMINISTIC SIMULATION SHOWING SURFACE SPILL DRIFT EVOLUTION - (LEFT) NO RESPONSE VS. (RIGHT) RESPONSE FOR RELEASE POINT 1 (SEASON 4)

Source: Livas 2022b

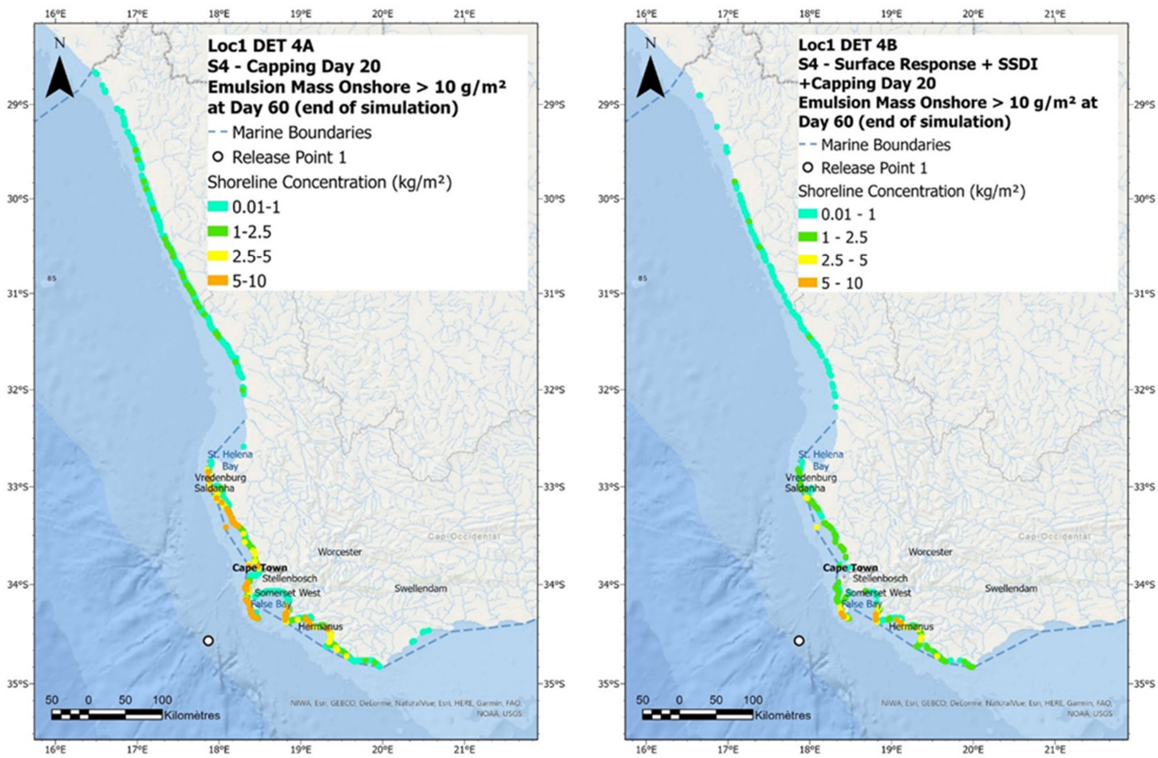


FIGURE 10-7: DETERMINISTIC SIMULATION SHOWING SHORE CONCENTRATION AFTER 60 DAYS - (LEFT) NO RESPONSE VS. (RIGHT) RESPONSE FOR RELEASE POINT 1 (SEASON 4)

Source: Livas 2022b

Project Controls

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 in place. Multiple response barriers are defined to deal with such an event after its occurrence (refer to Figure 10-8).

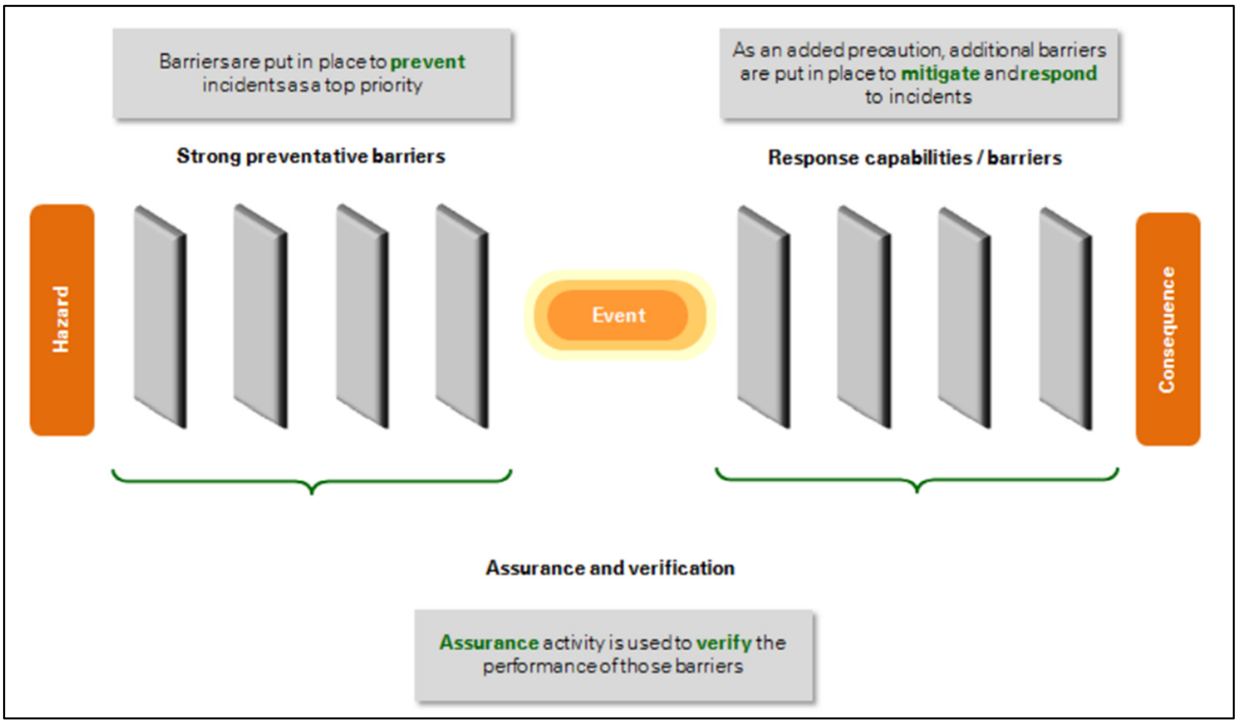


FIGURE 10-8: DEFINING MULTI-BARRIERS IN THE APPLICATION OF THE MITIGATION HIERARCHY
Adapted from CSBI 2015 and Abia *et al.* 2019

TEEPSA is committed to manage operational risks and develop tools, systems and safety culture to prevent the occurrence of major incidents, in particular accidental spills of liquid hydrocarbons in the environment. Nevertheless, whatever the residual probability of such an incident, TotalEnergies and its affiliates implement a systematic three-tier level of preparedness and response to incidents, through an HSE management system, which includes oil spill contingency planning. Oil spill preparedness and response aims at reducing to a minimum the impact of accidental spills to the environment and the time for polluted sites to recover. In that sense, an appropriate level of preparedness ensures that:

- Response capability is fit for purpose;
- Performance levels are set to promote effective preparedness;
- Response capability is built to be adaptable;
- Roles and responsibilities are clearly stated;
- Levels of response are scalable; and
- Response capability is sustainable.

In line with the standard industry practice, TEEPSA will be equipped and 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) - refer to Box 11-1 in Chapter 11.

TotalEnergies Group and its affiliates are committed to follow applicable international and national regulatory guidelines and standards, as well as internal policies and procedures, relevant for oil spill preparedness and response.

As part of TEEPSA's Emergency Response Plan, a detailed Oil Spill Contingency Plan and Blow-Out Contingency Plan (BOCP) will be prepared specifically for each of the drilling operations which considers the project specific conditions, well location, metocean conditions, equipment and resources used in line with applicable requirements (including national/local regulations) and guidelines related to oil spill preparedness and response. TEEPSA applies Good International Industry Practice in the planning, management, and response to oil spill risk. In this regard, TotalEnergies is a member of the International Petroleum Industry Environmental Conservation Association (IPIECA). IPIECA and the International Association of Oil and Gas Producers (IOGP) have a series of good practice guides that are relevant for dealing with oil spill preparedness and response. All barriers will be in accordance to TotalEnergies rules and will be tested before operations.

TEEPSA's standard project controls for oil spill preparedness and response are provided in Table 10-6.

TABLE 10-6: OVERVIEW OF THE MULTIPLE PREVENTIVE AND RESPONSE BARRIERS / MITIGATIONS TO DEAL WITH OIL SPILLS

Avoidance/Prevention	
Space (site selection)	• Site selection in avoiding sensitive areas such as sensitive and potentially vulnerable habitats (ROV survey). • A shallow hazard survey is undertaken to identify all possible constraints from man-made and geological features that may impact the operational or environmental integrity of the drilling and to ensure that appropriate mitigation practices are identified and adopted.
Design and Technical Integrity	• Detailed engineering risk analysis undertaken. • Well designed as per TotalEnergies' company rules for casing design. • Peer reviews organized with HQ specialists. • Optimisation of drilling phase durations / lengths to fit with weather forecasts window. • Robust well architecture. o Optimise drilling sections and casing design according to expected formation pressure profile. Well is designed to withstand the most stringent pressure profile. o Designed with the maximum possible safety factor for possible "kicks"[62]. o Casings able to withstand the max possible load case.
Multiple Technical Barriers	**Casing:** Casings will be designed to withstand a variety of forces, such as collapse, burst or tensile failure. They will be used to prevent caving-in of formations, prevent fracture of formations and to provide strong foundations for continued drilling operations.

[62] A "kick" is a well control problem in which the pressure found within the drilled rock is higher than the mud hydrostatic pressure acting on the borehole or rock face. When this occurs, the greater formation pressure has a tendency to force formation fluids into the wellbore. This forced fluid flow is called a "kick".

	Wellbore pressure and drilling mud weight: Subsurface pressures above and within the hydrocarbon-bearing strata will be controlled by the use of drilling mud. Mud Hydrostatic pressure will be higher than formation pressure and lower than fracturation pressure. The hydrostatic pressure (or weight) of the drilling mud in the well will be adjusted to ensure that it is greater than the formation pressure to prevent the undesired influx of fluids into the wellbore (known as a 'kick'). Pressure monitoring will be undertaken during drilling to ensure that kicks are avoided or managed to prevent escalation into a blow-out.
	Blow-out Preventer (BOP) stack: BOP stacks are used to control the pressure of a well through mechanical devices designed to rapidly seal the well (or "shut in") in an emergency. Minimum configuration (online and in working order at all times): • 2 annular preventers; • Capable to safely disconnect with Lower Marine Riser Package (LMRP); • Blind shear rams and casing shear rams; capable to shear any pipe in well • 3 pipe rams to seal around drill pipes • Redundancy of key equipment (rams, BOP acoustic system, ROV, etc.) The BOP is regularly tested as per American Petroleum Institute (API) and TotalEnergies rules, and will inspected by a BOP specialists prior to operations.
Competent Staff	The operator has trained, competent and certified staff who will design the well and conduct independent sign-off of its design.
	Before rigs and crews are moved into place to start drilling, a 'Drill Well On Paper' (DWOP) will be performed to brainstorm and anticipate the future well drilling and completion.
	Every unit will have a plan, training and expertise to effectively respond to emergency situations, in order to minimise their potential impact on people, facilities and the surrounding community. All key personnel are International well Control Forum (IWCF) certified level 2 to 4. Maersk simulator training undertaken focusing on well control procedure in harsh environment.
Testing and Certification	Safety critical equipment will be subject to testing and certification to ensure that it meets design specifications. The well design, drilling and completion plans will go through several stages of review involving experts from the operator and the drilling contractor prior to the commencement of drilling operations.
Drilling Operations barriers and controls	• Mud weight based on the Pressure profile (Pore pressure, leak off pressure and fracturation pressure) commitment case (conservative). • Utilisation of Group III NADF (low to negligible aromatic content). • Riser margin available (in case of BOP disconnection). • Logging while drilling (reduction of geological depth uncertainties). • Continuous monitoring systems to follow all well indications (Rate of penetration, Mud volumes (in versus out, cuttings). • Early kick detection systems and sensors to detect any anomalies with alarms.
Specific Procedures	• Specific well control procedures in harsh environment jointly implemented. • Specific WSOG (Well Specific Operating Guidelines) developed. • Upgrade of metocean forecasts (additional HF radars to be installed). • Well Sentinel initiative in place. • Operations follow-up 24/7 by TotalEnergies real-time services centre.

Response and Recovery/ Minimize	
Oil Spill Contingency Plan	As standard practice, a specific Oil Spill Contingency Plan (OSCP) will be prepared and approved internally by TotalEnergies HQ and submitted to the South African authorities (SAMSA, PASA and DFFE) for review and approval. The OSCP specifies how best to control an unlikely spill, how to prevent certain sensitive habitats / environments from exposure to oil, and what can be done to minimise the damage done by the spill (containment and recovery) and is based on the specific project conditions for that well. The OSCP is the operational document prepared and aligned with local and national regulations, including the South Africa's National Oil Spill Contingency Plan, applicable international conventions and internal rules. The primary objective of the OSCP is to set in motion the necessary actions to minimise the effects of an oil spill. It also: • Provides an emergency notification system, including a standardised format for oil spill notification; • Describes the escalation monitoring process from Tier 1 to Tier 2 and Tier 3 incidents; • Outlines the system for command and control of the oil spill response operations and organisation; • Provides checklists of actions for key personnel during an oil spill; and • Provides strategy and tactics to respond to the different types and levels of oil spills (Tier 1 to 3), including resources to be involved. Refer to Section 11.3.7.4 for further details on the OSCP. The OSCP will be communicated to staff and periodically tested in order to ensure an effective and co-ordinated response to situations. The OSCP will be available at all times during the drilling operation.
Emergency Response Plan	As standard practice, an Emergency Response Plan (ERP) / Evacuation Plan will be prepared and put in place. A Medical Evacuation Plan (Medevac Plan) will form part of the ERP.
Well Control / BOCP	Whilst the OSCP defines the approach and strategy required to manage the containment, removal and clean up following a major spill, the well control process is focussed on stopping the source of the leak. A BOCP will set out the detailed response plan and intervention strategy to be implemented in the event of a blow-out to stop any discharge of oil.
Capping Equipment	If the BOP does not successfully shut off the flow from the well, the drilling rig will disconnect and move away from the well site while crews mobilise a capping system. The capping system will be lowered into place from its support barge and connected to the top of the BOP to stop the flow of oil or gas. TEEPSA has contract agreements with global response companies to use globally advanced capping stacks in the event of a well blow-out. One contract is held with Oil Spill Response Limited (OSRL) based in Saldanha Bay and another with Wild Well Contain (WWC), based in Aberdeen. The capping stack provides for swift subsea incident response around the world. The equipment is maintained ready for immediate mobilisation and onward transportation by sea and/or air in the event of an incident.
Additional Equipment	• Implementation of Early Kick & Losses Detection system proven in harsh environment. • Emergency Drill Pipe Hang Off Tools available on site. These tools are used to reduce the disconnection time in case of an emergency by not having to pull the full drill string up before disconnecting. • Retrievable Test-Treat-Squeeze packer available on rig for testing, treating and squeeze cement operations. • Drop-In Check Valves adapted to drilling & landing string. • ROV available on site fully capable of operating BOP.
Containment and clean-up equipment	The primary tools used to respond to oil spills are mechanical containment, recovery, and clean-up equipment. In order to effectively combat spilled oil, equipment and materials most suited to the type of oil and the conditions at the spill site (sea state, currents and wind) will be selected and used. Coastal sensitivities are mapped as part of the OSCP and response strategies are selected to reduce the mobilisation / response timeframes as far as is practicable. Project vessels will be equipped with appropriate spill containment and clean-up equipment, e.g., booms, dispersants and absorbent materials. All relevant vessel crews will be trained in spill clean-up equipment use and routine spill clean-up exercises. Logistical arrangements for the integration of additional support will be in place before the drilling of the

	well, including all relevant contracts and call offs for emergency response assistance (e.g., from OSRL WWC, vessels brokers, etc.). TEEPSA also has its own internal emergency resources on standby in country and other neighbouring countries in the region, including equipment, dispersant and personnel. Emergency Response Services will be contracted, whenever needed.

10.4.3.1 Impact on Marine Ecology / Environment

Potential Impact Description

Crude oil spilled in the marine environment will 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) (**direct negative** impact). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats and oiling of marine fauna. The impact assessment is summarised in Table 10-7.

Sensitivity of Receptors

Although the area of interest is located in the marine environment, more than 60 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), a large spill could still directly affect these sensitive coastal receptors, as well as migratory pelagic species transiting through the drill area.

The benthic biota inhabiting unconsolidated sediments of the outer shelf and continental slope are very poorly known, but at the depths of the proposed well are 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 communities usually comprise fast-growing species able to rapidly recruit into areas that have suffered natural environmental disturbance. Epifauna living on the sediment typically comprise taxa which are longer lived and therefore more sensitive to disturbance. No rare or endangered species are known. In contrast, the benthos of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. The sensitivity of soft-sediment macrofauna is thus considered **low**, whereas the sensitivity of potential VME species from deep-water hard substrata is considered **high**. The area of interest for drilling, however, avoids potential VME species in the Brown's Bank Corals EBSA and MPA, but does overlap with CBAs.

Being highly toxic, oil released during a blow-out would negatively affect any marine fauna it comes into contact with. The taxa most vulnerable to hydrocarbon spills are coastal and pelagic seabirds. Some of the species potentially occurring in the drill area, are considered regionally 'Endangered' (e.g., African Penguin, Cape Gannet, Cape Cormorant, Bank Cormorant, Roseate Tern, Atlantic and Indian Yellow-nosed Albatross, Northern Royal Albatross, Sooty Albatross, Grey-headed Albatross) or 'Vulnerable' (e.g., White Pelican, Caspian Tern, Damara Tern, Wandering Albatross, Southern Royal Albatross, Leach's Storm Petrel, White-chinned Petrel, Spectacled Petrel). Numerous species of fish, turtles and cetaceans occurring in the project area are also considered regionally 'Critically Endangered' (e.g., Leatherback turtle, blue whale), 'Endangered' (e.g., loggerhead and green turtles, Fin and Sei whales, shortfin mako, whale shark, southern bluefin tuna) 'Vulnerable' (e.g., longfin mako, great white shark, whitetip sharks, sperm whale) or 'Near threatened' (e.g., blue shark). Although species listed as 'Endangered' or 'Vulnerable' may potentially occur in the drill area, due to their extensive distributions their numbers are expected to be low. Overall sensitivity of offshore receptors to a large oil spill is considered to be **high**.

As the oil is predicted to reach the shore, sensitive nearshore and coastal receptors must also be considered. Ecosystem types between Cape Agulhas and Cape Columbine considered 'Critically Endangered' (Southeast Atlantic Upper Slope), 'Endangered' (Cape Upper Canyon and Southern Benguela Muddy Shelf Edge) and 'Vulnerable' (Cape Lower Canyon, Southern Benguela Rocky Shelf Edge and Southern Benguela Sandy Shelf Edge) could potentially be affected by a spill. Coastal sensitivity along most of the southwestern Cape coast is considered 'Vulnerable' although portions of the coastline (particularly in Table Bay and Saldanha Bay) are considered 'Endangered' (see Figure 7-44 and Table 7-9). Similarly, there are a number of estuaries considered 'Critically Endangered' and 'Endangered' along the West Coast (see Figure 7-42 and Figure 7-43), with most others between Cape Agulhas and Mossel Bay considered 'Vulnerable'. Although not all of these habitats will be impacted concurrently, and the species inhabiting them have fairly extensive distributions, the sensitivity of the coastal habitats, especially coastal bird breeding colonies (e.g., Saldanha Bay Islands, Dassen Island, Robben Island, Dyer Island) is considered to be **very high**.

The overall sensitivity of marine ecology/environment to a large oil spill is considered **very high**.

Impact Magnitude (or Consequence)

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. (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 10-9, 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.

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 of the continental slope of the western Agulhas Bank. For example, sea surface temperatures off the South African West Coast are likely to be lower, and communities of oil degrading microbes less well established (if present at all). Furthermore, many of the ecological impacts reported for the DWH spill were the result of the application of dispersants, both at the leaking well head and at the sea surface. Dispersants applied to the DWH spill modified the spreading, dispersal, weathering, biodegradation, and toxicity of the spilled oil, and their use is now thought to have negatively influenced the total environmental impact of the DWH spill as some of the components proved to be considerably more persistent than originally thought (Kujawinski *et al*. 2011; White *et al.* 2014).

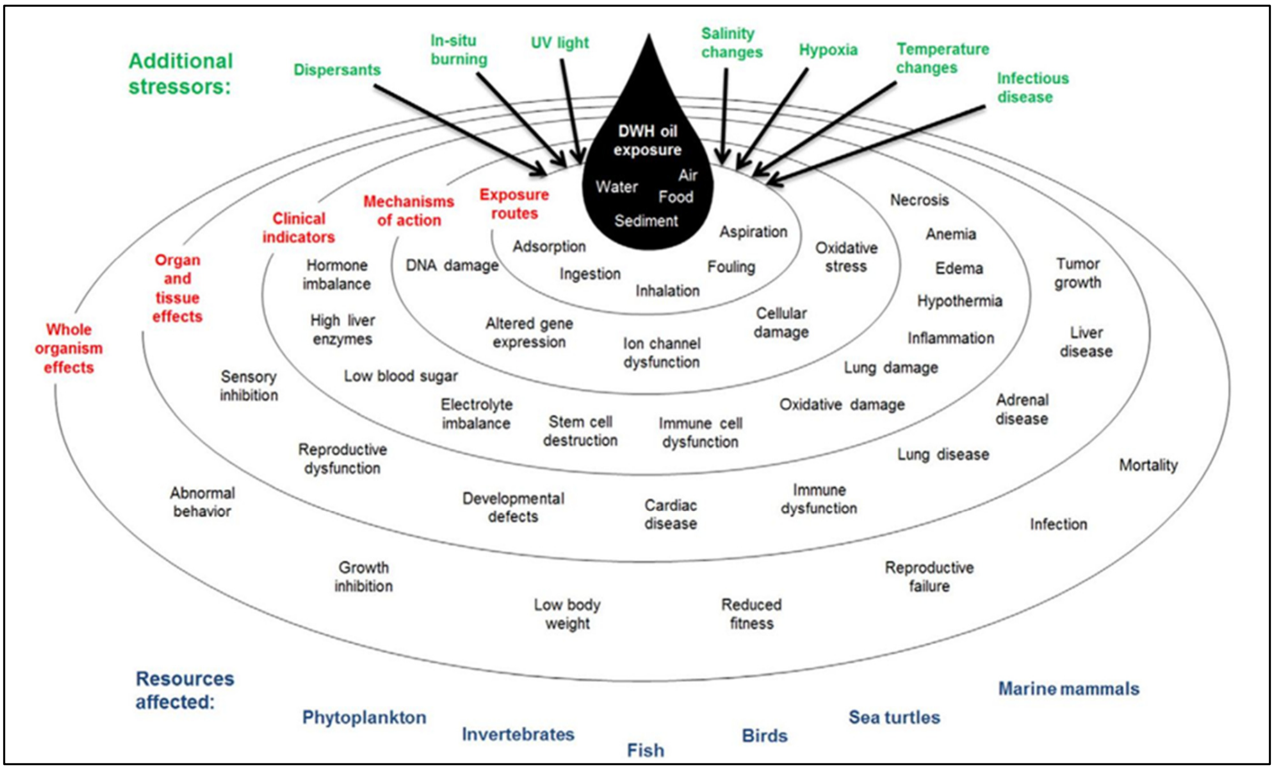


FIGURE 10-9: CONCEPTUAL FIGURE ILLUSTRATING THE BIOLOGICAL EFFECTS OF THE DEEPWATER HORIZON OIL SPILL

Source: Beyer *et al.* 2016

Oil spill modelling results are summarised in Section 10.4.2.3. Possible impacts on marine and coastal fauna related to a large oil spill are described below and summarised in Table 10-7.

- Plankton (comprising phytoplankton and zooplankton): The embryonic and larval life stages of fish 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 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 pilchard spawning areas (see Figure 7-23 to Figure 7-25) 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 1991), but recent studies have demonstrated that the weathered water accommodated fraction of the spill results in increased toxicity (Esbaugh *et al.* 2016).

- Benthic invertebrates: Oil in sediments as a result of accidental spillages can result in physical smothering of the benthos and chronic pollution of the sediments. Tolerances and sensitivities between species vary greatly and generalisations cannot be made confidently. Some burrowing infauna (e.g., polychaetes and copepods) show high tolerances to oils, as the weathered product serves as a source of organic material that is suitable as a food source. Polychaetes in particular can take advantage of bioturbation and degradation of oiled sediments. This results in highly modified benthic communities with (potentially lethal) 'knock-on' effects for higher order consumers. Sessile and motile molluscs (e.g., mussels and crustaceans) are frequent victims of direct oiling or coating. Filter-feeders in particular are susceptible to ingestion of oil in solution, in dispersion or adsorbed on fine particles. 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.

Fauna inhabiting unconsolidated sediments is expected to be relatively ubiquitous, usually comprising fast-growing species able to rapidly recruit into disturbed areas. Whereas benthic biota associated with hardgrounds (e.g., Brown's Bank and Cape Canyon) is typically more vulnerable to disturbance due to their long generation times.

- Fish: Adult free-swimming fish in the open sea seldom suffer long-term damage from oil spills because oil concentrations in the water column decline rapidly following a spill, 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). Only in extreme cases of coastal spills when gills become coated with oil can effects be lethal, particularly for benthic or inshore species. Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and opportunistic pathogens, and incorporation of PAH into the food chain (Thomson *et al.* 2000; Beyer *et al.* 2016).
- Seabirds: Chronic and acute oil pollution is a significant threat to both pelagic and inshore seabirds, many of which breed on the Saldanha Bay Islands, Dassen Island, Robben Island and Dyer Island, which could be impact 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 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. Ingestion of oil in an attempt to clear oil from plumage can also result in anaemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs. Habitat degradation of distant feeding or breeding areas may affect bird populations in ways that carry over to subsequent seasons.
- Turtles: The impact 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). As the nesting sites in South Africa are all located some 1 500 km away on the KwaZulu Natal coastline these would not be affected in the event of a spill, but hatchlings carried southwards in the Agulhas Current may become oiled. As turtles spend much of their time at the surface, inhalation of the volatile oil fractions will occur to hatchlings and adults leading to respiratory stress, while coating of eyes, nostrils and mouths with oil will cause vision loss, inhalation and ingestion.
- Seals: Little work has been undertaken on the effect of an oil spill on fur seals, but they are expected to be particularly vulnerable as oil will clog their fur and they will die of hypothermia (or starvation, if they had

taken refuge on land). Seal colonies within the broader project area that may be affected by a spill are at Bucchu Twins near Alexander Bay, at Cliff Point (~17 km north of Port Nolloth), at Kleinzee (incorporating Robeiland), Strandfontein Point (south of Hondeklipbaai), Paternoster Rocks and Jacobs Reef at Cape Columbine, Vondeling Island, Robbesteen near Koeberg, Seal Island in False Bay, Geyser Rock at Dyer Island, Quoin Point and Seal Island in Mossel Bay.

- <u>Cetaceans (dolphins and whales):</u> The impact of oil pollution on local and migrating cetacean populations will obviously 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 where the region of avoidance is critical to population survival. However, 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 of the Southern Right whale (e.g., in the vicinity of False Bay, Walker Bay and St Helena Bay, which serve as calving grounds for Southern Right whales), could be the most likely to impact populations.
- <u>Coastal environments:</u> Although only a minor portion of the total oil spilled from an offshore well typically reaches the shoreline, even small amounts can cause widespread contamination of coastal habitats and ecosystems, including estuaries. Landfall of oil is generally considered an unfavourable situation as stranding causes a multitude of new environmental impacts compared to those experienced at sea. 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 (Bejarano and Michel 2016). 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. Active clean-up operations of the shores can have a negative or marginal influence on the rate of recovery by sterilising the substratum by removing or killing those biota that survived the initial effects of oiling and would have formed the basis of the subsequent recovery process (Sell *et al.* 1995). 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).

While the probability of a major spill happening is extremely small, the impact nonetheless needs to be considered as it would have devastating effects on the marine environment. As noted previously, refer to Section 10.4.2.3 for a summary of the oil spill modelling results. Modelling results show that the coast between southern Namibia on the West Coast and Gqeberha the South-East Coast may be at risk depending on the metocean conditions at the time of drilling (season dependant). In the event of a blow-out, the period June to August (Season 3) was identified as the worst in respect of the maximum amount of oil reaching the shore coupled with the maximum probability of shoreline oiling for both discharge locations. The modelling results also found that the implementation of both surface response and SSDI reduced the amount of oil at the surface and that reaching the shore.

Assuming the worst-case scenario, the potential impact on the marine environment will be of **medium intensity** for offshore benthic macrofauna, marine mammals and turtles and deep-water reefs to **high intensity** for seabirds, shoreline benthic communities, spawning areas and cetacean and seal breeding areas. As the area does not have confirmed oil seep anomalies, and is therefore unlikely to have established oil-degrading microbial communities (especially considering the harsh offshore oceanographic conditions), the impacts of deposited oil on the seabed is likely to persist over the **medium- to long-term**. Similarly, oil reaching the shore would also likely persist over the **medium- to long-term**. Oil would spread regionally but could potentially extend beyond the EEZ and thus be of **international** extent. The impact **magnitude** would therefore range from **medium** to **very high** depending on the faunal group affected. However, collectively, the impact on marine fauna is assessed to be of **very high magnitude**.

Impact Significance

Based on the **high sensitivity** of receptors and the **very high magnitude**, the potential impact on the marine fauna is considered to be of **very high significance** without mitigation.

Identification of Mitigation Measures

As mentioned in the Project Controls, the priority first step is the prevention of any such spill from occurring through the implementation of the multiple preventative barriers. An emergency response system will be implemented before drilling starts to manage and minimise the consequences of any spills through containment and recovery barriers with a primary goal to keep oil off the coast and the sensitive habitats.

In addition to the project controls, the following measures are recommended to manage a well blow-out:

No.	Mitigation measure	Classification
1	All efforts to be made to avoid scheduling drilling operations during the periods when the likelihood of shoreline oiling for a blow-out is highest (namely the Austral Winter). In the case of exploration wells drilled in a sequence covering this period, response needs to be enhanced (see Section 2 below).	Avoid / Reduce
2	Develop a well-specific response strategy and plans (OSCP and BOCP), aligned with the National OSCP, TotalEnergies' requirements and International Industry best practice, for each well location that identifies the resources and response required to minimise the risk and impact of oiling (shoreline and offshore). This response strategy and associated plans 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
2.1	Assessment of onshore and offshore response resources (equipment and people) and capabilities at time of drilling, location of such resources (in-country or international), and associated mobilisation / response timeframes.	
2.2	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.	
2.3	Should there be any significant changes in the existing modelling input data closer to the spud date of the well, update the modelling report taking into consideration site- and temporal-specific information accordingly in order to guide the final response strategy and associated resources.	
2.4	Develop intervention plans for the most sensitive areas to minimise risks and impacts and integrate these into the well-specific response strategy and associated plans.	
2.5	If modelling and intervention planning indicates that the well-specific response strategy and plans cannot reduce the response times to less than the time it would take oil to reach the shore, TEEPSA must commit to undertake additional proactive measures must be committed to. For example: • Implement measures to reduce surface response times (e.g., pre-mobilise a portion of the dispersant stock on the support vessels, contract additional response vessels and aircrafts, minimise the time it takes to install the SSDI kit (have the kit on standby), improve dispersant spray capability, etc.). • Deploy and/or pre-mobilise shoreline response equipment (e.g., response trailers, shoreline flushing equipment, shoreline skimmers, storage tanks, shoreline booms, skirt booms, shore sealing booms, etc.) to key localities for the full duration of drilling operation phase to proactively protect sensitive coastal habitats and areas.	

No.	Mitigation measure	Classification
3	Schedule joint oil spill exercises including TEEPSA and local departments/organisations to test the Tier 1, 2 & 3 responses.	Abate on site / Restore
4	Ensure contract arrangements and service agreements are in place to implement the OSCP, e.g., capping stack in Saldanha Bay and other international locations, SSDI kit, surface response equipment (e.g., booms, dispersant spraying system, skimmers, etc.), dispersants, response vessels, etc.	Abate on site / Restore
5	Use low toxicity dispersants that rapidly dilute to concentrations below most acute toxicity thresholds (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants). Dispersants should be used cautiously and only with the authorisation of DFFE.	Abate on and off site
6	Ensure a standby vessel is within 30 minutes of the drilling unit and 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 10 m^3 of dispersant onboard for initial response.	Abate on site
7	Take all efforts, when the sea state permits, to 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 large spill, use drifter buoys and satellite-borne Synthetic Aperture Radar (SAR)-based oil pollution monitoring to track the behaviour and size of the spill and optimise available response resources	Abate off site
9	Submit all forms of financial insurance and assurances to PASA to manage all damages and compensation requirements in the event of an unplanned pollution event.	Restore

Residual Impact Assessment

With the implementation of the mitigation measures, although the extent and duration would decrease, thereby reducing the magnitude to high, the significance remains **VERY HIGH significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **partially reversible**. The mitigation potential is **medium**, the loss of resource is **high**, and the cumulative potential is **possible**.

TABLE 10-7: IMPACTS ON MARINE ECOLOGY/ENVIRONMENT FROM A WELL BLOW-OUT (WORST CASE)

Project Phase:	**Operation**	
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**Very High**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY HIGH**	**HIGH**
Intensity	HIGH	HIGH
Extent	INTERNATIONAL	REGIONAL
Duration	LONG TERM	MEDIUM TERM
Significance	**VERY HIGH**	**VERY HIGH**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**HIGH**	**HIGH**
Reversibility	**PARTIALLY REVERSIBLE**	**PARTIALLY REVERSIBLE**
Loss of Resources	**HIGH**	**HIGH**
Mitigation Potential	**-**	**LOW**
Cumulative potential	**POSSIBLE**	**POSSIBLE**

10.4.3.2 Impact on Commercial Fishing

Potential Impact Description

Crude oil spilled in the marine environment will 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). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

An oil spill can also result in several impacts on fishing (**indirect negative** impact). These include:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort;
- Mortality of animals (including eggs and larvae) leading to reduced recruitment and loss of stock (e.g., mariculture); and
- Gear damage due to oil contamination.

The impact assessment is summarised in Table 10-8.

Sensitivity of Receptors

Refer to Section 10.3.2. The overall sensitivity of commercial fishing receptors to a large spill incident is considered to be **high**.

Impact Magnitude (or Consequence)

The oil spill modelling results are summarised in Section 10.4.2.3.

As illustrated in Figure 10-4, the extent of the surface oiling could extend into international waters (southern Namibia). The probability of shoreline oiling is high with oil reaching the shore within 0.6 days. Thus, oil is likely to be transported into major fish spawning and nursery areas. Mortality of fish eggs, larvae and juveniles may lead to reduced recruitment, which may in turn impact fishing in the **medium-term**.

Large scale effects on fishing operations would also be likely to 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 of a large-scale blow-out and overlap with major fish spawning and nursery areas and key fishing areas, the operations of most commercial fisheries would be affected on a **regional to international scale;** viz, demersal trawl, midwater trawl, demersal longline, small pelagic purse-seine, large pelagic longline, tuna pole-line, traditional linefish, West coast rock lobster, south coast rock lobster and squid jig. In addition to offshore commercial fisheries, nearshore commercial and small-scale fishing (incl. beach seine, gillnet, seaweed harvesting, white mussels, oysters, abalone, etc.), as well as aquaculture facilities, could be affected by shoreline oil contamination.

Large scale effects on fishing operations would be likely to include area closures and exclusion of fisheries from areas closed to fishing due to contamination of surface waters by oil or the chemicals used for cleaning oil spills. Based on the possible extent of surface oiling (including major fish spawning and nursery areas), the **intensity** of the impact on most commercial fisheries would be **high**.

The impact is, therefore, considered to be of **very high magnitude**.

Impact Significance

Based on the **high sensitivity** of receptors and the **very high magnitude**, the potential impact on the commercial and small-scale fisheries is considered to be of **very high significance** without mitigation.

Identification of Mitigation Measures

In addition to the mitigation described in Section 10.4.3.1 the following will be implemented.

No.	Mitigation measure	Classification
1	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
2	Plan for and implement responses in terms of IPICEA-IOGP guideline document for the economic assessment and compensation for marine oil releases.	Restore

Residual Impact Assessment

With the implementation of the mitigation measures, although the intensity and duration would remain, the extent would decrease, thereby reducing the magnitude to high and significance to **HIGH significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **partially reversible**. The mitigation potential is **medium**, the loss of resource is **medium**, and the cumulative potential is **possible**.

TABLE 10-8: IMPACTS ON FISHING FROM A WELL BLOW-OUT

Project Phase:	**Operation**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**High**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY HIGH**	**HIGH**
Intensity	HIGH	HIGH
Extent	REGIONAL to INTERNATIONAL	REGIONAL
Duration	MEDIUM TERM	MEDIUM TERM
Significance	**VERY HIGH**	**HIGH**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**MEDIUM**	**MEDIUM**
Reversibility	**PARTIALLY REVERSIBLE**	**PARTIALLY REVERSIBLE**
Loss of Resources	**HIGH**	**MEDIUM**
Mitigation Potential	**-**	**MEDIUM**
Cumulative potential	**POSSIBLE**	**POSSIBLE**

10.4.3.3 Impact on Coastal and Nearshore Users

Potential Impact Description

An oil spill can also result in several socio-economic impacts (**indirect negative** impact). These include:

- Degradation of the coastline in terms of aesthetic and landscape appeal.
- Degradation of the coastline that supports a variety of commercial and private recreational and tourism activities.
- Reduction in both recreational, small-scale and commercial fishing in the region, including all forms of near-shore and offshore fishing (e.g., exclusion areas for fishing, non-consumption due to toxicity, decline in recruitment of fish stocks).
- Reduction in income for secondary and tertiary sectors that support tourism, recreational, fishing, and other coastal economies.
- Pressure on national, regional, and local public services and facilities as part of any shoreline responses.
- National, regional, and local collapse in public trust and increase in conflict related to environmental and social impacts from major spills.
- Impacts on national GDP and economic growth.

The impact assessment is summarised in Table 10-9.

Sensitivity of Receptors

All coastal communities and activities along the South-West coastline (key area affected) are considered to be of **very high sensitivity** to any major oil spills, given it is a high value coastline that services extensive regional tourism, recreation, residential development, and near-shore and offshore fishing. Although modelling undertaken for this study shows that a spill could affect areas between southern Namibia on the West Coast to Gqeberha on the South-East Coast, importantly, deterministic modelling suggests that even a worst-case scenario would only impact small portions of the coastline.

Impact Magnitude (or Consequence)

In worst-case scenario, the socio-economic impacts associated with an unlikely large oil spill will likely be focused along portions of the coastline between southern Namibia and Gqeberha depending on the well location and season. Specifically, if the blowout were to happen in mid-winter when there are westerly winds blowing, and the emergency response from Saldanha Bay does not cap it, oil could reach the shores in the densely populated areas between Saldanha Bay and Cape Agulhas. The likely range and nature of socio-economic impacts that could likely occur from such an event are discussed further below:

- Degradation of portions of the coastline in terms of aesthetic and landscape appeal. This would be seen as a major and significant impact immediately on coastal cities and communities, particularly those dependent on tourism and beach associated recreation, and would draw national attention. Wesgro reports that, in 2019, total visitor spend in Western Cape was R26.3 billion. In a survey, 61.5% of visitors to the Western Cape gave “holiday” as the reason for their visit, others were visiting relatives, etc. Assuming a spill that lasts a full month, and cuts tourism visits completely by an equivalent amount (i.e. by 1/12th of those visiting for holiday reason), visitor spend would drop by roughly R1.35 billion.
- Degradation of portions of the coastline that supports a variety of commercial and private recreational activities. In affected areas, such activities will probably need to be suspended during the clean-up along

the coastline. This will result in losses for commercial enterprises while disrupting the use of beaches by the public at large[63].

- The affected coastline supports domestic and international tourism, and the degradation of portions of the coastline will likely result in the temporary, but significant, reduction in tourism during and after the clean-up along the impacted coastline. This will result in losses for tourism operators and establishments, while potentially disrupting tourism trends in the region in the near future.
- Reduction in recreational, small-scale, and commercial fishing in the impacted area, including near-shore and offshore fishing. This may result in undermining fishing by the public at large. Large-scale effects on fishing operations would also be likely to 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 possible extent of surface oiling (including major fish spawning and nursery areas), the intensity of the impact on most commercial fisheries would be high. As an indicator, assuming a 10% drop in value of fisheries, sustained over a full three years, the revenue lost would be about R600 million a year. The percentage dop is however difficult to estimate.
- Reduction in income for secondary and tertiary sectors that support tourism, recreation, fishing, and other coastal economies. Reduction in income and livelihoods impacts on those dependent on small-scale fisheries.
- Pressure on national, regional, and local public services and facilities as part of any shoreline responses. Given the relatively undeveloped oil and gas sector nationally, there may be insufficient capacity, resourcing, and expertise to manage and respond to any major spills.
- National, regional, and local collapse in public trust and increase in conflict related to environmental and social impacts from major spills.
- Impacts on national GDP and economic growth which may see both a negative downturn as well as a positive upswing from clean-up costs.

The social impacts of a spill reaching the coast will be **international** in extent, **medium-term** in duration, and **high intensity** assuming that no comprehensive mitigation measures are in place. The impact is, therefore, considered to be of **very high magnitude**.

Impact Significance

Based on the **very high sensitivity** of receptors and the **very high magnitude**, the potential impact on the marine fauna is considered to be of **very high significance** without mitigation.

Identification of Mitigation Measures

In the event of an unplanned event (i.e. such as a well blow-out) occurring, a process of determining the economic effects and related compensation would be initiated. Such a process would typically involve government, insurers, the organisation responsible for the incident, industry organisations and the applicable legal system. TEEPSA will plan for and would implement responses in terms of the IPIECA-IOGP guideline

[63] In the event of an oil spill, the project proponent will have liability, as will their insurers. The costs of clean up, and liability for lost incomes etc fall on these parties. It is not clear that all losses will be made good, but typically unemployed people earn an income cleaning beaches, and those who suffer directly can put in a claim. This would be money coming into the country from abroad. This impact is, however, not considered in the assessment.

document for the economic assessment and compensation for marine oil releases. TEEPSA would also ensure that damages and compensation to Third-Parties are included in insurance cover to financially manage the consequences of any unplanned event.

No additional mitigation is proposed other than the implementation of the project controls and mitigation in Section 10.4.3.1 and 10.4.3.2.

Residual Impact Assessment

The residual impact remains of **VERY HIGH significance**.

Additional Assessment Criteria

The impact is considered to be **unlikely** and **partially reversible**. The mitigation potential is **low**, the loss of resource is **high**, and the cumulative potential is **possible**.

TABLE 10-9: SOCIO-ECONOMIC IMPACT FROM A WELL BLOW-OUT

Project Phase:	**Operation**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**VERY HIGH**	
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY HIGH**	**HIGH**
Intensity	HIGH	HIGH
Extent	INTERNATIONAL	INTERNATIONAL
Duration	MEDIUM TERM	MEDIUM TERM
Significance	**VERY HIGH**	**VERY HIGH**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**MEDIUM**	**MEDIUM**
Reversibility	**PARTIALLY REVERSIBLE**	**PARTIALLY REVERSIBLE**
Loss of Resources	**HIGH**	**HIGH**
Mitigation Potential	**-**	**LOW**
Cumulative potential	**POSSIBLE**	**POSSIBLE**

10.4.3.4 Impact on Intangible Cultural Heritage

Potential Impact Description

In addition to the impact of an oil spill on the marine environment, it would result in the degradation of the coastline in terms of aesthetic and landscape appeal. Any impact on the integrity of the coastal and marine ecosystem through a large oil spill could in turn impact various aspects that makes up people's intangible cultural heritage (**indirect negative** impact). The impact assessment is summarised in Table 10-10.

Sensitivity of Receptors

The sensitivity of the receptor for this assessment has been defined based on the following receptors:

- **Ancestry / spirituality receptor:** Sea is described as 'living' waters and is believed to play a critical role in spiritual and health management in indigenous groups specifically (First Peoples and Nguni). Any impact on these 'living' waters may, therefore, impact communication with the ancestors or its use as an emetic or in other ritual practices. The sensitivity of this receptor is high to very high, as ritual practice and spiritual engagement with the sea requires a healthy ocean, or at the very least, a not visibly polluted ocean.
- **Archaeology / Tangible heritage receptor:** The South African coastline has been shaped by human cultural relations and beliefs. The West Coast, South Coast and East coast have archaeologically and culturally significant coastal sites. The sensitivity of this receptor to an oil spill is high.
- **Sense of Place receptor:** The sea 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 intangible cultural heritage practices and beliefs. The sensitivity of this receptor is very high as an oil spill will result in the degradation of the coastline in terms of aesthetic and landscape appeal which towns depend on to attract visitors, researchers and investors.
- **Livelihoods receptor:** Certain stakeholder groups display a high regard of the sea due to their spiritual and cultural connection with the ocean and are directly reliant on the ocean and coast for their livelihood (e.g., fishing, shellfish harvesting, leisure, tourism, etc). The sensitivity of this receptor to an oil spill is very high because many coastal communities that rely on the ocean and coast for their livelihoods.
- **Natural heritage receptor:** People have a cultural relationship with the ocean and coast and this results in high cultural valuation of nature. Coastal sporting / leisure / tourism activities have become intangible cultural heritage 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 the coastal and marine ecosystem could in turn impact people's natural heritage. The sensitivity of this receptor to an oil spill is very high since natural and cultural heritages are interdependent.
- **Health receptor:** People use the sea in cultural ways to improve, sustain and restore physical and mental health. Access to a healthy ocean is critical in this regard. Any impact on the ocean may affect the health of coastal communities who regularly access the sea to sustain physical and psychological health. The sensitivity of this receptor to an oil spill is very high.

The overall sensitivity of receptors during a blow-out is assessed to be **very high**.

Impact Magnitude (or Consequence)

The intensity of the impact is considered to be **high**, of **medium-term** duration and of **national** extent. Thus, the magnitude (or consequence) is considered to be **very high**.

Impact Significance

Based on the **very high sensitivity** of receptors and the **very high magnitude**, the potential impact on intangible cultural heritage is considered to be of **very high significance**.

Identification of Mitigation Measures

Recommendations to mitigate the potential impact on intangible cultural heritage are similar to that recommended for normal operation (see Section 9.1.7) and that for marine ecology, fishing and social (see Sections 10.4.3.1 to 10.4.3.3).

Residual Impact Assessment

With the implementation of the mitigation measures, the sensitivity of the receptor would reduce to high and intensity of the impact will reduce to **medium**, leading to a residual impact of **HIGH** significance.

Additional Assessment Criteria

The mitigation potential is **medium** and **partially reversible** due to potential negative perceptions, loss of resource is **medium** and the cumulative potential is **possible**.

TABLE 10-10: IMPACT ON INTANGIBLE CULTURAL HERITAGE FROM A WELL BLOW OUT

Project Phase:	**Mobilisation, Operation and Decommissioning**	
Type of Impact	**Indirect**	
Nature of Impact	**Negative**	
Sensitivity of Receptor	**VERY HIGH**	**HIGH**
	Pre-Mitigation Impact	**Residual Impact**
Magnitude (Consequence)	**VERY HIGH**	**HIGH**
Intensity	HIGH	MEDIUM
Extent	NATIONAL	NATIONAL
Duration	MEDIUM TERM	MEDIUM TERM
Significance	**VERY HIGH**	**HIGH**
Probability	**UNLIKELY**	**UNLIKELY**
Confidence	**HIGH**	**HIGH**
Reversibility	**PARTIALLY REVERSIBLE**	**PARTIALLY REVERSIBLE**
Loss of Resources	**MEDIUM**	**MEDIUM**
Mitigation Potential	**-**	**MEDIUM**
Cumulative potential	**POSSIBLE**	**POSSIBLE**

10.5 IMPACT ASSESSMENT AND MITIGATION SUMMARY

A summary of the assessment of potential environmental and social impacts and proposed mitigation associated with unplanned events from the proposed well drilling activities is provided in Table 10-11.

TABLE 10-11: SUMMARY OF THE SIGNIFICANCE OF THE IMPACTS ASSOCIATED WITH UNPLANNED EVENTS

Note:
(1) Neg = Negligible; VL = Very Low; L = Low; M = Medium; H = High; VH = Very High
(2) * indicates that no mitigation is possible and/or considered necessary, thus significance rating remains.
(3) ** indicates that although the significance rating of the impact remains the same, the intensity, etxent or duraton of the impact decreases due to the proposed mitigation.

No.	Activities	Aspects	Impacts on Main Receptors	Pre-Mitigation Significance	Project Controls / Key Mitigation	Residual Significance
1	**FAUNAL STRIKES**					
1.1	Ship strikes and entanglement	Obstruction on sea surface, seafloor or in water column	Impacts on marine fauna	**LOW**	• Reduced transit speed	**LOW ****
2	**LOSS OF EQUIPMENT AT SEA**					
2.1	Accidental loss of equipment	Obstruction on seafloor or in water column	Impacts on marine ecology/environment	**NEGLIGIBLE**	• Storage, maintenance and lifting procedures • Undertake a post drilling ROV survey • Retrieve of lost objects / equipment, where practicable • Notify SAN Hydrographer • Grievance mechanism	**NEGLIGIBLE****
2.2			Impacts on commercial fishing and other marine traffic	**LOW**		**LOW ****
3	**ACCIDENTAL RELEASE OF OIL AT SEA DUE TO VESSEL COLLISIONS, BUNKERING ACCIDENT AND LINE / PIPE RUPTURE**					
3.1	Vessel or equipment failure and bunkering of fuel	Release of oil into the sea and localised reduction in water quality	Impacts on marine ecology/environment	**MEDIUM**	• Bunkering procedure • Shipboard Oil Pollution Emergency Plan – MARPOL Annex I • Compliance with COLREGS and SOLAS. • Emergency Response Plan and notification • Spill training and clean-up equipment • Grievance mechanism	**LOW**
3.2			Impacts on commercial and small-scale fishing	**MEDIUM**		**LOW**

No.	Activities	Aspects	Impacts on Main Receptors	Pre-Mitigation Significance	Project Controls / Key Mitigation	Residual Significance
4	**WELL BLOW-OUT**					
1.3.1	Loss of well control / well blow-out	Reduction of water quality and smothering of coastal resources	Impacts on marine ecology/environment	VERY HIGH	• Design and Technical Integrity • Detailed Technical Risk Analysis • Blow-out Preventer • Oil Spill Contingency Plan • Emergency Response Plan • Blow-Out Contingency Plan • Cap and Containment Equipment • Grievance mechanism	VERY HIGH **
1.3.2			Impacts on marine commercial fishing	VERY HIGH		HIGH
1.3.2			Impacts on coastal and nearshore users	VERY HIGH		VERY HIGH
			Impact on intangible cultural heritage	VERY HIGH		HIGH