TotalEnergies EP South Africa B.V.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE OFFSHORE PRODUCTION RIGHT AND ENVIRONMENTAL AUTHORISATION APPLICATIONS FOR BLOCK 11B/12B – REF NO: 12/4/13 PR

Draft Environmental and Social Impact Assessment Report

CHAPTER 10

REPORT NO: 41105306-358669-10
SEPTEMBER 2023

PUBLIC

TotalEnergies EP South Africa B.V.

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DATE: SEPTEMBER 2023

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QUALITY CONTROL

Issue/revision	Final issue
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Project number	41105306
Report number	41105306-358669-10

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10.1 INTRODUCTION

Unplanned events or accidents linked to the proposed Project that could have the greatest environmental impact is a major spill of hydrocarbons from a subsea well blowout, or rupture of the production pipeline. The cause of a well blowout is due to failure of pressure control systems which causes the uncontrolled release of hydrocarbons from a well. The IOGP (International Association of Oil & Gas Producers) report 434-02 (2019) contains the following definitions related to blowouts:

- Blowout: an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers or the activation of the same have failed.
- Surface blowout: Uncontrolled incidents with surface flow and includes subsea releases, e.g., from topside or subsea wellhead, drill floor or Christmas tree.
- Underground blowout: Underground flow only or with limited surface flow where minor flow occurred and typically the BOP has been activated.
- Kick: During drilling, the drilling mud compensates the reservoir pressure. If the mud density is too low compared to the actual reservoir pressure, or if the well integrity cannot ensure this counterpressure, then hydrocarbons can flow through the wellbore – this phenomenon is known as a “kick” – and this can quickly escalate into a blowout if not promptly identified and addressed.

The term “blowout”, therefore, does not necessarily infer that this will lead to a major uncontrolled flow of hydrocarbons from the well. This relates to the failure of a technical barrier when a “kick” is happening in the well.

Industry standards require that a minimum of two barriers is maintained at all time during drilling. If one of the barriers has technical integrity issues then operations will stop and the issue will be addressed. If a “kick” is detected, the drill entry point will be isolated by closing in the well, thus reducing the probability of a blowout. A heavier fluid will then be introduced into the well to raise the hydrostatic pressure and achieve a balance. Meanwhile, the fluid or gas that infiltrated the wellbore will slowly be evacuated in a controlled and safe manner.

The probability of a well blowout occurring is considered to be extremely low. Offshore South Africa, 358 wells have been drilled to date (based on shapefile data provided by PASA in 2021) and no well blowouts have been recorded to date. Worldwide offshore, a well blowout database from 1980 until 2019 maintained by Lloyds Register (and IOGP Blowout frequencies Sept 2019) indicates that the frequency of a blowout for exploration wells is in the order of 1.43 x 10-4 (0.000143) per well drilled.

TotalEnergies is a recognised operator in the offshore and deep offshore drilling industry and has developed a set of methodologies to prevent and mitigate blowouts. TotalEnergies has drilled more than 400 offshore exploration wells since 1980. In South Africa, TotalEnergies has successfully drilled two wells in Block 11B/12B (Brulpadda, 2019 and Luiperd, 2020) with no incident.

Failure from subsea pipelines could result from mechanical damage (hooking with anchors and trawls, falling heavy objects, etc.), corrosion and ageing, construction and pipe metal defects, and/or natural conditions such as underwater currents.

Other unplanned events from the proposed Project that will have negative environmental impacts, should they occur, are from:

- Accidental minor spills of hydrocarbons or other chemicals (e.g., from pipeline leak, vessel accident or bunkering);
- Accidental release of solid objects (or equipment) dropped at sea;
- Accidental subsea production system and (trawling) vessel accident; and
- Vessel collision.

Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on marine fauna (and associated habitats) and the fishing industry in the offshore, nearshore and coastal environment. Spilled hydrocarbons move according to the prevailing weather conditions with the greatest possible impact realised if it makes landfall. Spilled fuel can have toxic and/or smothering effects on organisms in the path of a spill, with coastlines being particularly vulnerable. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton (particularly copepods), pelagic eggs and fish larvae, and habitat loss or contamination (CSIR 1998b, Perry 2005, in Anchor Environmental, 2023).

Furthermore, large spills that reach the offshore and nearshore environment can have socio-economic impact on fisheries, coastal tourism and recreational activities (among others). The intangible cultural heritage of the coastline will also be negatively impacted should a large spill reach the shoreline. The quantification of the risk related to a well blowout and pipeline rupture was assessed through modelling studies, conducted for both the western Project Development Area and the eastern Exploratory Priority Area. The results of these studies are summarised below (refer to Appendix 6 of Volume 2 of the ESIA report for the detailed reports).

10.2 IMPACT ASSESSMENT

10.2.1 WELL BLOWOUT AND PRODUCTION PIPELINE RUPTURE

10.2.1.1 Oil Spill Modelling Results

This section was extracted from:

- The Marine Impact Assessment Report (Anchor Environmental, 2023), attached to this ESIA report as Appendix 11;
- Oil Spill Modelling Report conducted, for the western Project Development Area (DHI, 2023), (DHI, 2023) attached in Appendix 6a ; and
- Oil Spill Modelling Reports conducted for two discharge points in the eastern Exploratory Priority Area (HES, 2021a) and (HES, 2021b), both attached in Appendix 6b .

10.2.1.1.1 Approach and Methodology

For wells in the western Project Development Area, SATOCEAN input and the MIKE Oil Spill (OS) module from the MIKE suite were used to assess predetermined loss of containment (LOC) scenarios associated with operations related to oil and gas wells and subsea production systems. MIKE OS is a particle tracking software that simulates the movements of discrete particles in a fluid flow field. The spilled oil is simulated as a collection of particles, each representing a specified oil mass with associated physical and bio-chemical properties (DHI 2023). The mass and properties of each particle vary as the simulation proceeds to include the effects of weathering. The probability of condensate stranding and water re-entry is described as a function of the shoreline characteristics (i.e., rocky, shingle, sandy or muddy beach, seawall or revetment, marshy, etc.). The study assumes that once the condensate strands on a coast/beach, it stays on the coast/beach and does not return to the sea (DHI 2023).

For wells in the eastern Exploratory Priority Area, H-Expertise Services S.A.S (HES, 2021a, b) used the Oil Spill Contingency and Response (OSCAR) module from MEMW software (v11.0.1), to assess the possible fates and trajectories of a crude oil spill (from a subsea blowout discharge). The OSCAR module has capabilities to determine how the slick will drift and how oil components will interact with the marine environment to support decision making. OSCAR computes the fate and weathering of oil, and uses surface spreading, advection, entrainment, emulsification, and volatilization algorithms to determine the transport and fate of the oil on the surface and/or the shoreline (HES 2021a, b). The near-field blowout model applied in OSCAR is Deepblow. The model is based on a Lagrangian model concept, and the oil droplet size distribution is given by a modified Weber number model (HES 2021a, b).

> In the Brulpadda and Luiperd exploration wells, mainly gas with condensate with a thin oil rim were discovered. Due to the analogy with Brulpadda environment, it is expected to find similar types of fluids at wells in the eastern Exploratory Priority Area. However, for the oil spill modelling conducted for the eastern area, only the worst case was considered, namely a spill of crude oil. Crude oil is heavier than condensate and the crude hydrocarbons float and form a thick layer on the sea surface.

The fate and behaviour of oil spills in the marine environment requires an accurate characterisation of the ambient meteorological and oceanographic (metocean) conditions and environmental data, including wind, waves, currents, salinity, and water temperature (DHI, 2023). For the western Project Development Area, hydrodynamic conditions were simulated through the combination of surface elevation data from a Hybrid Coordinate Ocean Model (HYCOM[47]) dataset (HYCOM GLBv0.08_expt_56.3 from the Naval Research Laboratory 2014-2021) in combination with the current speed and direction from the SAT-OCEAN[48] dataset (DHI, 2023). Wave data was derived from DHI's Global Wave Model[49] and water temperature, and salinity was also sourced from HYCOM (DHI, 2023). For the eastern Exploratory Priority Area, metocean data were purchased from SAT-OCEAN, and covered five years of data (2012-2016) (see more detail in HES 2021a, b).

For the western Project Development Area, data on the oil characteristics (True Boiling Point, density, viscosity at 10, 20 and 40°, content of asphaltenes and wax) were provided by TotalEnergies (DHI, 2023). For the eastern Exploratory Priority Area, modelled oil properties were chosen to simulate the oil rim encountered at Brulpadda-1AX (HES 2021a, b).

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[47] HYCOM is an open-source ocean general circulation modelling system that provides simultaneous analyses of temperature, salinity, geopotential, and vector velocity (DHI 2023).

[48] SAT-OCEAN is a source of meteorological and oceanographic (metocean) data for several industries. It provides information on current direction, current speed, wind speed, and wind direction, which are input variables for oil spill modelling. The SAT-OCEAN dataset was provided by TotalEnergies (DHI 2023).

[49] DHI Global Wave Model (GWM) serves as an important source of data for many oceanographic and meteorological studies, as it provides valuable information on wave and ice coverage data. This model is validated against both wave and satellite altimetry observations, proving its reliability and effectiveness when applied as boundary conditions for several models around the world (DHI 2023).

10.2.1.1.2 Scenarios Modelled

For the western Project Development Area, two spill scenarios were considered: condensate blowout at Discharge Point 5 location (Scenario 1), and a condensate pipe leak at approximately 40 km south of the F-A Platform within the production pipeline base case corridor, in the first year of operation (Scenario 2) (see Table 10-1).

The pipeline rupture will result in 1 610 bbl of condensate being released in the first two hours assumed to be the time required to shut down the well. This will result in a two-hour release of condensate at a rate equivalent to 19 320 bbl/day. It is assumed that the entire volume of 9 755 bbl of condensate remaining in the pipeline then will be released in the 22 hours following the shut-down of the well. This will result in a 22-hour release at a rate equivalent to 10 728 bbl/day.

To investigate the effect of varying ambient conditions throughout the year and from year to year, several seasonal simulations were conducted for each spill scenario. For each spill scenario, 400 simulations were selected and distributed across the modelling period (2012-2016) and four seasons. The four representative seasons used were: Season 1 (December – February), Season 2 (March – May), Season 3 (June – August) and Season 4 (September – November). These relate to summer, autumn, winter and spring, respectively.

Table 10-1 - General characteristics of modelled spill scenarios for the western Project Development Area wells

Spill Scenario Characteristics	Well Blowout at Discharge Point 5 (Scenario 1)	Pipeline Rupture (Scenario 2)
Event Characteristics	Deepsea blow out at wellhead.	Full rupture of the pipe in first year of production (i.e., highest condensate yield).
	Release assumed to last 20 days until containment is re-established via a capping stack.	Two hours to shut-down the wells (worst-case) i.e., as there is no valve between the Production Manifold in western Project Development Area and FA platform riser in B9.
		Assumption entire volume inside the pipe will be released within one day.
Release Point (WGS84)	S 35° 35’ 17.3071’’ E 23° 08’ 27.6914’’	S 35° 6’ 58.41’’ E 22° 23’ 1.66’’
Water depth (below MSL)	~1 780 m	~ 146 m
Currents - primary direction (to)	Southwest to West Southwest	Southwest to West Southwest
Winds - primary direction (from)	West Southwest to West Northwest	West Southwest to West, East
Duration (days)	20	1

Simulation period (days)	30	30
Discharge rate (bbl/day)	18 350	1-2 hour 19 320 2-24 hour 10 728

DHI, 2023

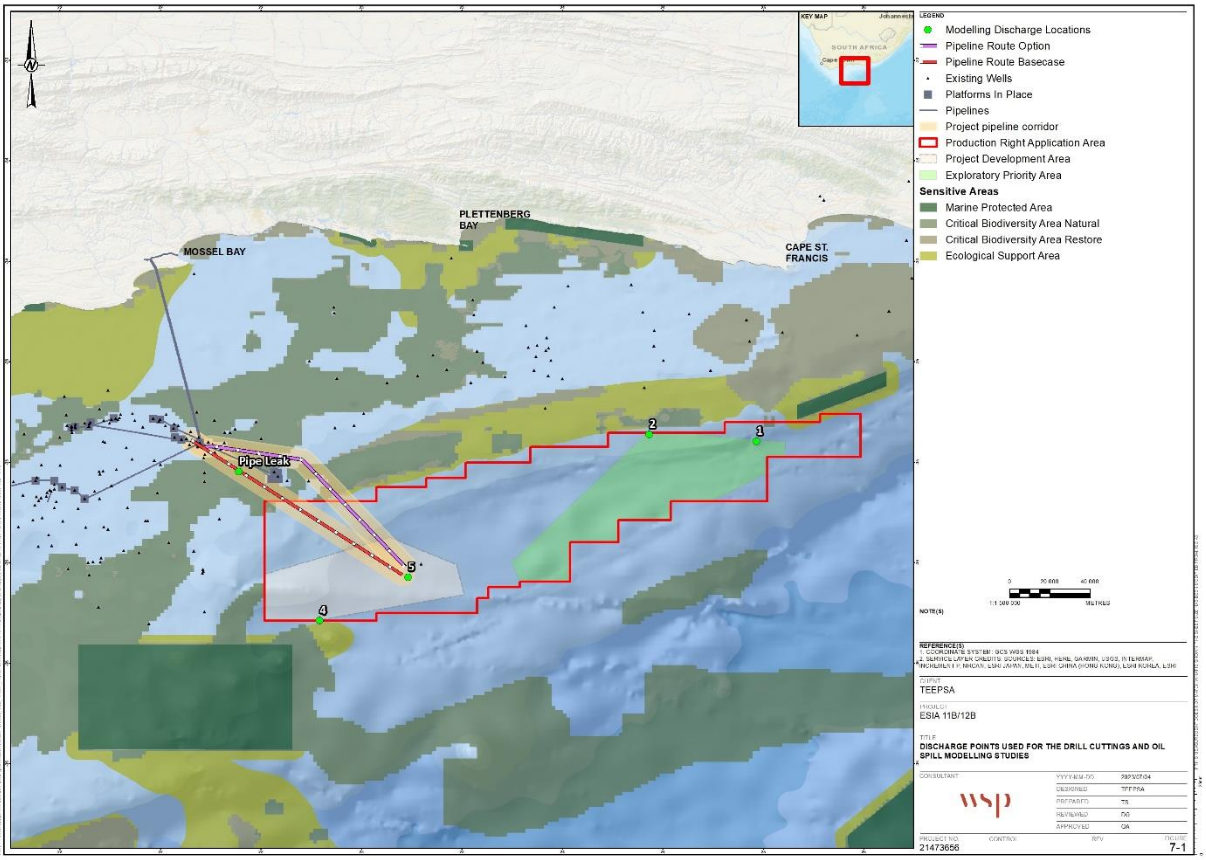

Figure 10-1 - Modelling Discharge Point Locations

For the eastern Exploratory Priority Area wells, a crude oil spill of 69 000 barrels/day was considered at two sites that represent worst-case scenarios, considering depth (Discharge Points 1 and 2 are located at 1 254 m and 690 m, respectively), distance from the coast (89 km and 98km from the nearest shore, respectively) and proximity to areas of sensitivity and significance (HES, 2021a, b) (Table 10-2). To investigate the effect of varying ambient conditions throughout the year and from year to year, several seasonal simulations were conducted for each spill scenario. For each spill scenario, 90 simulations were selected and distributed across the modelling period (2012-2016) and four seasons. The four representative seasons used were: Season 1 (January – March), Season 2 (April – June), Season 3 (July – September) and Season 4 (October – December). Please note that the months for the representative seasons used for Discharge Points 5 and pipe leak, and for discharge Points 1 and 2, differ.

Table 10-2 - General characteristics of modelled spill scenarios for the eastern Priority Exploratory Area wells

Spill Scenario Characteristics	Well Blowout at Discharge Point 1	Well Blowout at Discharge Point 2
Event Characteristics	Deepsea blow out at wellhead.	Deepsea blow out at wellhead
Release Point (WGS84)	S 34° 58' 49,765" E 24° 42' 3,649"	S 34° 56' 56,043" E 24° 13' 18,074
Water depth (below MSL)	1 254 M	690 M
Currents - main directions	Southeast	Southeast
Winds - main directions	West – East	West – East
Duration (days)	20	20
Simulation period (days)	60	60
Discharge rate (bbl/day)	69 000	69 000

HES, 2021a,b

Thresholds used for this study for surface oil thickness, the No Observed Effect Concentration (NOEC) for acute exposure to dispersed oil in the water-column, and shoreline oiling are summarised in Table 10-3.

Table 10-3 - Thresholds applied to results of the modelled spill scenarios

Threshold	Threshold value	Rationale
Surface Oil	5 µm	While 10 µm corresponds to the thickness that would impart a lethal dose to an intersecting wildlife individual (French McCay, 2009), a more conservative threshold of 5 µm was chosen because it is minimum thickness at which response equipment can skim/remove oil from the surface, surface dispersants are effectively applied, or oil can be boomed/collected. Fresh oil at this thickness corresponds to a slick being a dark brown or metallic sheen (as per the Bonn Agreement Oil Appearance Code).
Water-Column	58 ppb	A NOEC value for acute exposure to dispersed oil of 58 ppb has been proposed, based on the toxicity of chemically dispersed oil to various aquatic species, which showed the 5% effect level is 58 ppb (see details in DHI 2023, HES 2021a, b).
Shoreline Oiling	10 g/m^2	Shoreline oiling was calculated for deterministic scenarios assuming that a certain surface is affected by kilometre of shoreline, depending on the shoreline type. For various shoreline types, a set of maximum oil “holding capacities” is estimated along with a set of removal rates. The holding capacities are intended to reflect both shoreline slope and permeability. The threshold of 10 g/m^2 provides a more conservative screening threshold used for potential ecological effects on shoreline fauna. Assumed as a sublethal effects threshold for birds on the shoreline (see details in DHI 2023, HES 2021a, b).

Adapted from DHI, 2023 and HES, 2021a,b

To obtain a better understanding of worst-case results, a number of simulations were identified for both western and eastern wells, which included the worst case from each season in each spill scenario. The worst case was defined as the simulation that produced the largest impact on the shoreline. The worst-case simulation from stochastic simulations was re-simulated and further analysed to illustrate mass balance as well as evolution of drift. The worst-case simulations were selected from those that produced the longest impacted shoreline. These deterministic simulations provide detailed pictures of the oil trajectory during the simulation periods.

10.2.1.1.3 Modelling Results - Western Project Development Area

Stochastic and deterministic results are provided for both spill scenarios (well blowout and pipeline rupture). Stochastic simulations are statistical calculations / analyses based on the results from ensemble modelling of the LOC scenario under a wide range of weather and/or seasonal conditions, while deterministic simulations provide detailed pictures of the oil trajectory during the simulation periods (DHI, 2023).

Based on the thresholds presented in Table 10-3, the results of the statistical analysis for the oil spill scenarios are presented as:

- Surface probability of exposure to an oil slick (> 5 μm) [%].
- Probability of shoreline oiling larger than 10 g/m^2 [%].
- The minimum time (from the start of a spill) to exposure to an oil slick [days] 95% percentile.

10.2.1.1.3.1 Fate of the Spilled Oil

Model results show that, over approximately four months (i.e., one season), evaporation is the most important weathering process for condensate, as evaporation starts immediately after loss of containment (DHI, 2023). Indeed, most of the total oil released evaporates over the modelled time frame while biodegradation, sedimentation and photooxidation contribute less than 10% of the total mass balance of the oil spill (Figure 10-2) (DHI, 2023).

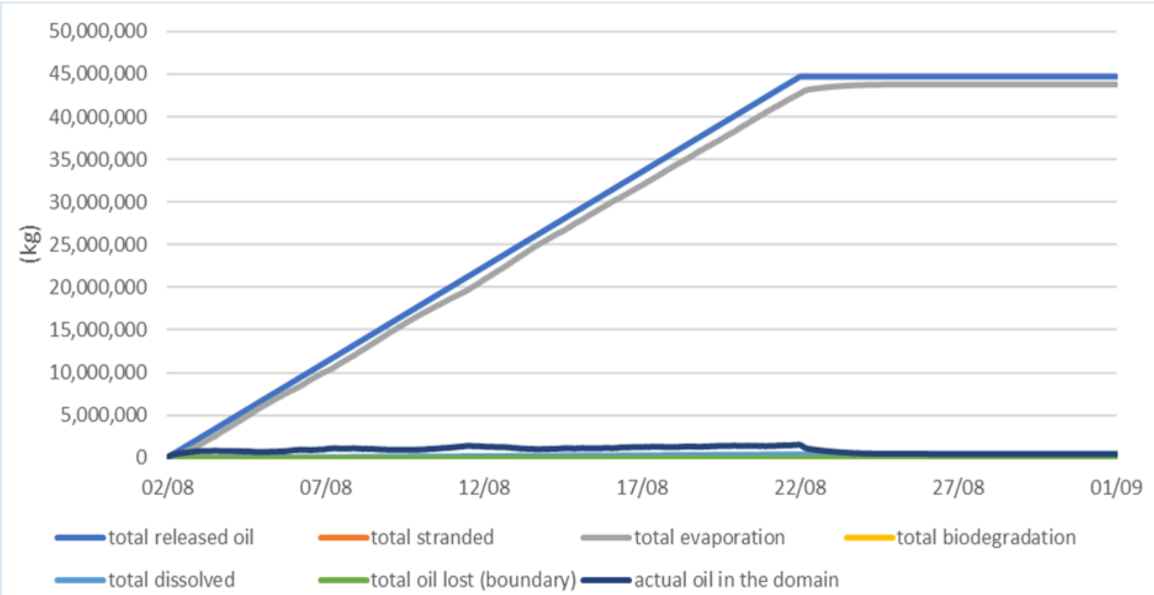

Figure 10-2 - Worst-case, all seasons, Scenario 1 model mass balance (i.e., all the processes that influence the fate of the total oil spilled, and the relative proportion thereof assuming conservation of mass). Note how most of the total oil released (medium blue line) evaporates over time (grey line) (DHI 2023)

10.2.1.1.3.2 Scenario 1: Well Blowout (Discharge Point 5)

In a well blowout scenario, worst-case model results indicate that there is a 90% probability that a spill would extend 250 to 290 km from the rupture point to the southwest, depending on season (Figure 10-2). Model results indicate that there is a 1% chance that a spill would extend 490 km west for all seasons, and 750 to 950 km to the southwest, dependent on season. Indeed, these results show that for all seasons, a well blow out would result in oil reaching waters beyond the South African EEZ (i.e., international waters).

Offshore, surface oil (> 5 µm thick) is projected to intersect (>75% probability) with a number of EBSAs and MPAs, including almost the entirety of the Southwest Indian Seamounts MPA and large portions of the Shackleton Seamount Complex EBSA and the Mallory Escarpment and Trough EBSA to the southwest Figure 10-3. In autumn and winter, the northwestern portion of the Southwest Indian Seamounts MPA is also modelled to overlap with the >75% probability plume.

In winter (Jun-Aug), there is also a large overlap with the Kingklip Corals EBSA to the northeast of the blowout site . In winter (Jun-Aug) and spring (Sep-Nov) (the worst-case models), the results indicate that the surface oil is projected to overlap several MPAs, with a 1% probability of overlapping 18.1% of the Browns Bank Corals MPA and 5% of the Port Elizabeth Corals MPA, 1 to 5% probability of overlapping 91% of the Agulhas Front MPA and 94% of the Southeast Atlantic Seamounts MPA and 1 to 10% probability of overlapping 49% of the Agulhas Bank Complex.

The model results show that oil (>10 g/m^2) is expected to reach shore in 2 to 4 days in every season except summer (Dec-Feb, when no oil is expected to come ashore) (Table 10-4). The highest probability of oil-shoreline impact after a well blowout occurs in winter (Jun-Aug), with >10 g/m^2 oil predicted to potentially impact some 64 km of shoreline. The maximum oil amount found on shore based on the worst-case scenario (deterministic simulation) is 1.2 to 2.8 tons, with a probability of 1.1 to 4.8. The probability of oil reaching shore in concentrations that result in sublethal effects threshold for birds on the shoreline (> 10 g/m^2) is, however, very low (4.8% for the worst-case, and 1.3% across all seasons). The impacted shoreline is predicted to comprise Cape St Francis, Oyster Bay, Huisklip Nature Reserve, Thyspunt, Rebelsrus Private Nature Reserve, Wasserna's Beach.

While DHI (2023) reports that the probably of oiling > 10 g/m^2 is 0% at sensitive sites (specifically, Bird Island, the De Hoop MPA, Knysna Lagoon, the Klein Brak Estuary, Stilbaai Estuary, Tsitsikamma MPA and Walker Bay) for all modelled seasons, this is likely the result of the site of measurement (i.e., an observation point was included in the model, and oiling was measured at that specific point). Taking the full area into account, worst-case model results indicate that, in winter (Jun-Aug), there is a 1 to 5% probability that surface oil > 5 µm thick would overlap with the south eastern corner of the Tsitsikamma MPA (an area of 109.1 km^2, or 36.6% of the MPA) and a 1% probability that the surface oil would overlap with the southern half of the Robberg MPA (an area of 10.4 km^2, or 39.7% of the MPA).

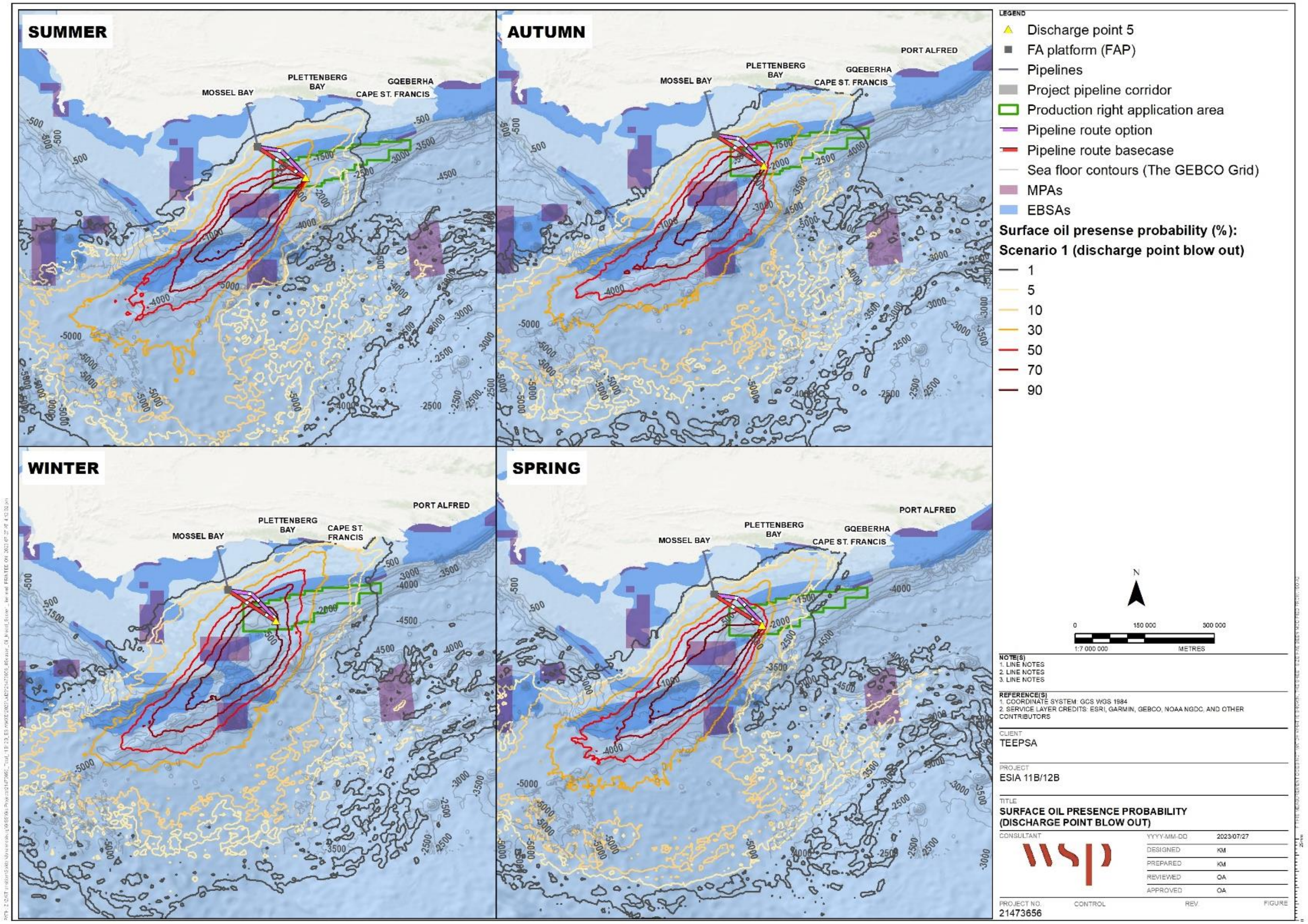

Figure 10-3 - Surface oil presence probability: Scenario 1 (well blow out) model results statistics for all simulations that start in summer, autumn, winter and spring. Note: these maps are an amalgamation of 400 spill simulations under different metocean conditions, not representative of a single spill event (DHI, 2023)

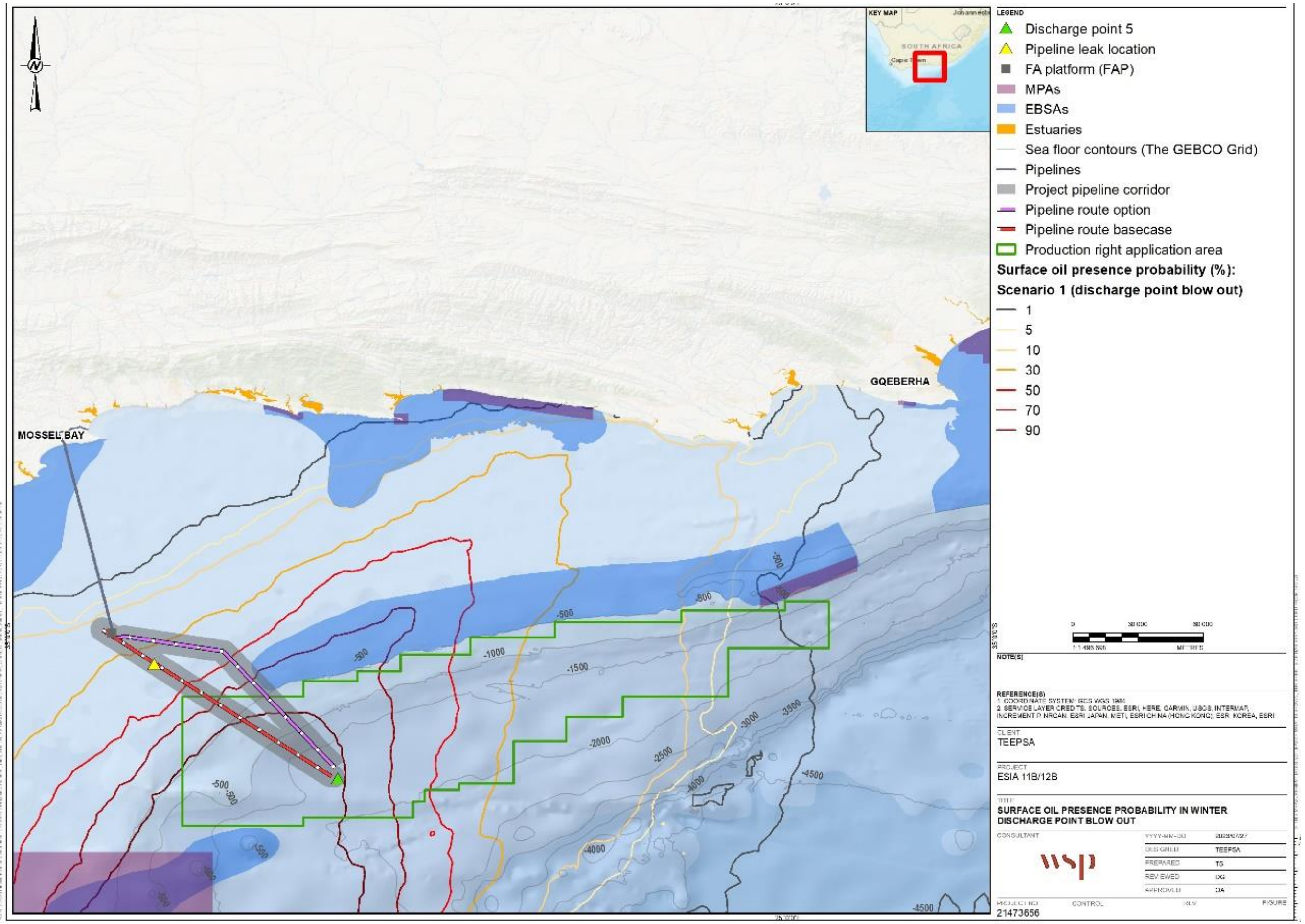

Figure 10-4 - Worst-case coastal surface oil presence probability: Scenario 1 (well blow out) model results statistics for all simulations that start in winter. This map is an amalgamation of 400 spill simulations under different metocean conditions, not representative of a single spill event (DHI, 2023)

Table 10-4 – Scenario 1: Well blowout model (Discharge Point 5) results summary across all seasons. RP = Release Point

Scenario 1: Blowout	All Simulations	Season 1 (Summer Dec-Feb)	Season 2 (Autumn, March-May)	Season 3 (Winter, June-Aug)	Season 4 (Spring, Sep-Nov)
Flow Rate / Amount: Oil: 18 350 bbl/d, Gas: 6 170 000 Sm^3/d					
Main direction of the Spill Drift	Toward SW	Toward SW	Toward SW	Toward SW	Toward SW
MAX. Distance of the 90%-oil-surface-probability contour	250 km SW from RP	275 km SW from RP	230 km SW from RP	240 km SW from RP	290 km SW from RP
MAX. distance of the 1%-oil-surface-probability contour	490 km W & 850 km SW from RP	490 km W and 970 km SW from RP	490 km W and 870 km SW from RP	490 km W and 750 km SW from RP	490 km W and 970 km SW from RP
Offshore surface waters possibly reached by a spill	South African, International Waters	South African, International Waters	South African, International Waters	South African, International Waters	South African, International Waters
Shoreline length that could receive oil >10 g/m^2 (considering all the simulations)	68 km	0 km	4 km	64.3 km	2.5 km
Shoreline Possibly Impacted (by oil >10 g/m^2)	Cape St Francis, Oyster Bay, Huisklip Nature Reserve, Thyspunt, Rebelsrus Private Nature Reserve, Wasserna's Beach	-	Huisklip Nature Reserve, Wasserna's Beach	Huisklip Nature Reserve, Thyspunt, Rebelsrus Private Nature Reserve, Wasserna's Beach	Huisklip Nature Reserve, Wasserna's Beach
Deterministic Worst-case Shoreline Length Impacted	20 km	0 km	4 km	20 km	0.8 km
MAX. % Shoreline Impact Probability	1.3%	0%	1.9%	4.8%	1.1%
MAX. oil amount onshore (tons)*	2.5	0.9	2.8	2.5	1.5
Probability of Shoreline Oiling (>10 g/m^2)					
Bird Island	0%	0%	0%	0%	0%
De Hoop MPA	0%	0%	0%	0%	0%
Knysna Lagoon	0%	0%	0%	0%	0%

Scenario 1: Blowout	All Simulations	Season 1 (Summer Dec-Feb)	Season 2 (Autumn, March-May)	Season 3 (Winter, June-Aug)	Season 4 (Spring, Sep-Nov)
Klein Brak Estuary	0%	0%	0%	0%	0%
Stilbaai Estuary	0%	0%	0%	0%	0%
Tsitsikamma MPA	0%	0%	0%	0%	0%
Walker Bay	0%	0%	0%	0%	0%
Minimum Shoreline Arrival Time	2-3 days	-	3-4 days	2-3 days	4 days

DHI, 2023

10.2.1.1.3.3 Scenario 2: Full Pipeline Rupture

In a pipeline rupture scenario, worst-case model results indicate that there is a 90% probability that a spill would extend 10 km from the rupture point for all seasons (Figure 10-5). Under a Scenario 2 pipeline rupture, there is a 1% chance that a spill would extend 490 km west for all seasons, and 145 to 230 km to the northeast, and 155 to 485 km to the southwest, dependent on season. Unlike Scenario 1, model results show that for all seasons, oil from a pipeline rupture spill remains within the South African EEZ.

Offshore, surface oil (> 5 µm thick) is projected to intersect (30 to 40% probability) with the Kingklip Corals EBSA to the northeast of Block 11B/12B (Figure 10-5). In winter (Jun-Aug) and spring (Sep-Nov) (the worst-case models), the results indicate that the surface oil is projected to overlap two MPAs, with a 1% probability of overlapping 12.1% of the Agulhas Bank Complex MPA and a 1 to 5% probability of overlapping 17% of the Southwest Indian Seamounts MPA.

The model results show that oil (>10 g/m^2) is expected to reach shore in 1 to 1.5 days in winter (Jun-Aug) and spring (Sep-Nov). The highest probability of oil-shoreline impact after a pipeline rupture also occurs in winter (Jun-Aug), with oil >10 g/m^2 predicted to potentially impact some 20.5 km of shoreline in this season, and 35 km across all seasons (Table 10-5). The probability of oil reaching shore in concentrations that result in sublethal effects threshold for birds on the shoreline (> 10 g/m^2) is also very low for a pipe rupture (1.9% for the worst-case, and 0.75% across all seasons).

The maximum oil amount found on shore based on the worst-case scenario (deterministic simulation) is 0.5 to 1.3 tons. The impacted shoreline is predicted to comprise Huisklip Nature Reserve, Robberg Nature Reserve, Kranshoek, Knoetzie Beach and the Knysna Lagoon offshore MPA, with a 1% probability that the oil reaches the Knysna Lagoon should a rupture occur in winter (Jun-Aug) and spring (Sep-Nov) (Table **10-10**, Figure 10-6). In winter (Jun-Aug) and spring (Sep-Nov), worst-case model results indicate that there is a 1% probability that surface oil > 5 µm thick would overlap with the Tsitsikamma MPA (a maximum area of 162.9 km^2, or 54.7% of the MPA), and Robberg MPA (an area of 13.9 km^2, or 52.7% of the MPA).

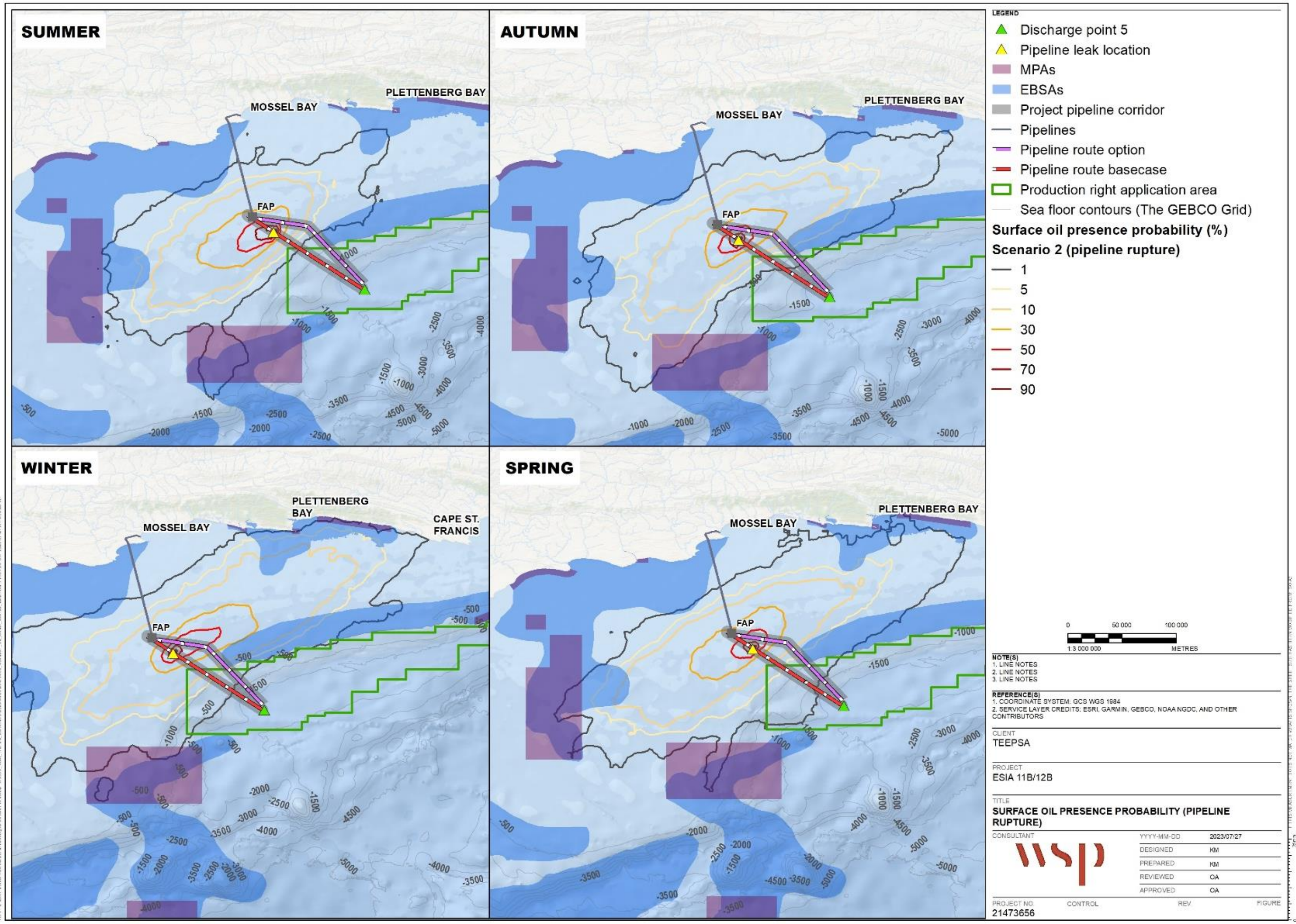

Figure 10-5 - Surface oil presence probability: Scenario 2 (pipeline rupture) model results statistics for all simulations that start in summer, autumn, winter and spring. Note that these maps are an amalgamation of 400 spill simulations under different metocean conditions, not representative of a single spill event (DHI, 2023)

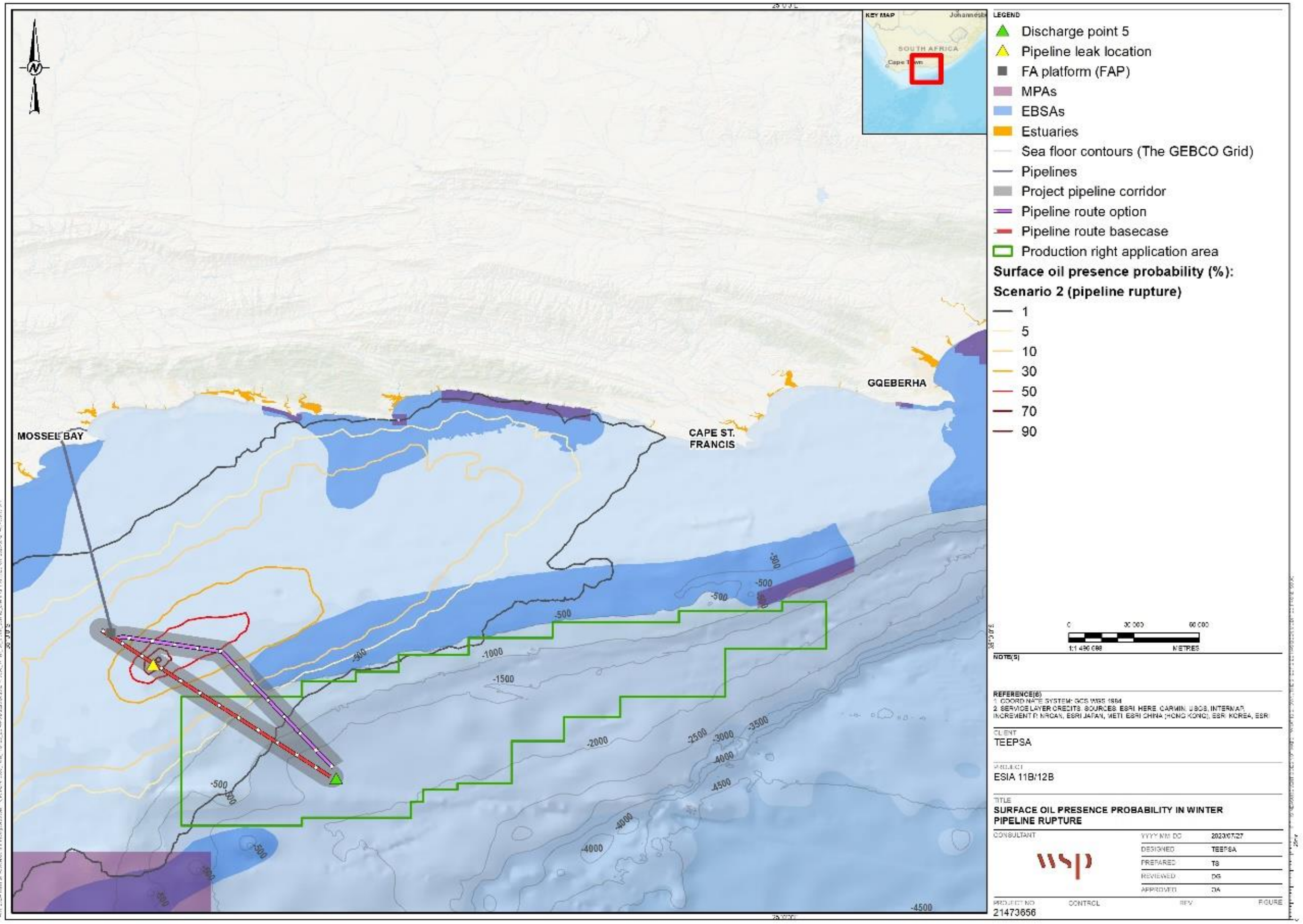

Figure 10-6 - Worst-case coastal surface oil presence probability: Scenario 2 (pipeline rupture) model results statistics for all simulations that start in winter. Note that these maps are an amalgamation of 400 spill simulations under different metocean conditions, not representative of a single spill event (DHI, 2023

Table 10-5 – Scenario 2: Pipeline rupture model results summary across all seasons. RP = Release Point

Scenario 2: Pipe Rupture	All Simulations	Season 1 (Summer Dec-Feb)	Season 2 (Autumn, March-May)	Season 3 (Winter, June-Aug)	Season 4 (Spring, Sep-Nov)
Flow Rate / Amount	Qoil: 19 320 bbl/d (0-2h), 10 728 bbl/d (2-24h), Qgas: 6170000 Sm^3/d (0-2h), 1 415 000 Sm^3/d (2-24h),				
Main direction of the Spill Drift	Toward SW or NE	Toward SW or NE	Toward SW or NE	Toward SW or NE	Toward SW or NE
MAX. Distance of the 90%-oil-surface-probability contour	10 km from RP	10 km from RP	10 km from RP	10 km from RP	10 km from RP
MAX. distance of the 1%-oil-surface-probability contour	195 km NE and 165 km SW from RP	145 km NE and 485 km SW from RP	210 km NE and 155 km SW from RP	230 km NE and 140 km SW from RP	205 km NE and 165 km SW from RP
Offshore surface waters possibly reached by a spill	South African	South African	South African	South African	South African
Shoreline length that could receive oil >10 g/m^2 (considering all the simulations)	35 km	0 km	0 km	20.5 km	18.4 km
Shoreline Possibly Impacted (by oil >10 g/m^2)	Huisklip Nature Reserve, Nature Valley Beach, Robberg Nature Reserve, Kranshoek, Knoetzie Beach, Knysna Lagoon	-	-	Huisklip Nature Reserve, Robberg Nature Reserve, Kranshoek, Knoetzie Beach, Knysna Lagoon	Nature Valley Beach, Robberg Nature Reserve, Kranshoek, Knoetzie Beach, Knysna Lagoon
Deterministic Worst-case Shoreline Length Impacted	19 km	0 km	0 km	19 km	18 km
MAX. % Shoreline Impact Probability	0.75%	0%	0%	1.9%	1%

Scenario 2: Pipe Rupture	All Simulations	Season 1 (Summer Dec-Feb)	Season 2 (Autumn, March-May)	Season 3 (Winter, June-Aug)	Season 4 (Spring, Sep-Nov)
MAX. oil amount onshore (tons)*	0.5	0.2	0.5	0.5	1.3
Probability of Shoreline Oiling (>10 g/m^2)					
Bird Island	0%	0%	0%	0%	0%
De Hoop MPA	0%	0%	0%	0%	0%
Knysna Lagoon	0.25-0.5%	0%	0%	1%	1%
Klein Brak Estuary	0%	0%	0%	0%	0%
Stilbaai Estuary	0%	0%	0%	0%	0%
Tsitsikamma MPA	0%	0%	0%	0%	0%
Walker Bay	0%	0%	0%	0%	0%
Minimum Shoreline Arrival Time	1-1.5 days	-	-	1-1.5 days	1-1.5 days

DHI, 2023

10.2.1.1.4 Modelling Results - Eastern Priority Exploratory Area wells

Stochastic and deterministic results are provided for all oil spill scenarios. Stochastic simulations are statistical calculations / analyses based on the results from ensemble modelling of the LOC scenario under a wide range of weather and/or seasonal conditions, while deterministic simulations provide detailed pictures of the oil trajectory during the simulation periods (HES 2021a, b). The oil spill modelling studies (HES 2021a, b) present data for various spill response strategies, as per the response strategy outlined in the TEEPSA BOCP (Blowout Contingency Plan) and OSCP (Oil Spill Contingency Plan).

The modelling for Discharge Point 1 and Discharge point 2 in the Exploratory Priority Area uses a slightly different seasonal description from that used in the modelling of the discharge points in the Project Development Area. The four seasons used are: Season 1 (January – March), Season 2 (April – June), Season 3 (July – September) and Season 4 (October – December), representing summer, autumn, winter and spring respectively.

10.2.1.1.4.1 Scenario 1: Discharge Point 1

In a well blowout scenario, worst-case model results indicate that there is a 40 to 50% probability that a spill would extend up to 460 km from the rupture point to the southwest, entering international waters, depending on season (Figure 10-6). There is a 90-100% probably that the surface slick would spread up to 340 km to the southwest across all seasons. Summer (Jan-Mar) represents the worst-case season. Offshore, surface oil (> 5 µm thick) is projected to intersect with a number of EBSAs and MPAs, including almost the entirety of the Southwest Indian Seamounts MPA and large portions of the Shackleton Seamount Complex EBSA and the Mallory Escarpment and Trough

EBSA to the southwest. In summer (Jan-Mar), there is a >70% probability that the plume overlaps with 53% of the Southwest Indian Seamounts MPA, with an overlap of 44% in spring (Oct-Dec).

In autumn (Apr-Jun), there is a 50 to 70% chance of the modelled plume overlapping with Port Elizabeth Corals, with this spill projected to cover 90% of the EBSA (Figure 10-7). There are slightly lower probability of overlap (5 to 10%) with over sensitive areas, including the Agulhas Bank Complex MPA (90.6% of area covered in summer) and the Browns Bank Corals MPA (23% of area covered in summer).

The model results show that oil (>10 g/m^2) is expected to reach shore in 1 to 3 days (minimum) and 10 to 15 days average (winter: Jul-Sep is the worst case, with oil expected to come ashore in the Gqeberha after approximately 1 day) (Table 10-6). The highest probability of oil-shoreline impact after a well blowout occurs in autumn (Apr-Jun) and winter (Jul-Sept), with a maximum shoreline impact probability of 87% in the Oyster Bay and Saint Francis Bay areas, from Plettenberg Bay to Gqeberha (Table 10-6). In spring (Oct-Dec), there is a 42% probability of the oil reaching shore from Knysna to Saint Francis Bay area.

In winter (Jul-Sep, the worst-case model), the Discharge Point 1 results indicate that the surface oil > 5 µm thick is projected to overlap three major coastal MPAs. There is a probability of 30 to 50% that the spill would overlap with the Addo Elephant National Park MPA (maximum area of 439.3 km^2, representing 39.6% of the MPA), 58.6% of the Tsitsikamma MPA (maximum area of 170.8 km^2) and a 10 to 30% probability of overlapping 95% of the Goukamma MPA (maximum area of 30.5 km^2) (Figure 10-9).

Table 10-6 – Discharge Point 1 blowout model results summary across all seasons. RP = Release Point

Scenario 1: Discharge Point 1 blowout	**Season 1 (Summer, Jan-Mar)**	**Season 2 (Autumn, Apr-Jun)**	**Season 3 (Winter, Jul-Sep)**	**Season 4 (Spring, Oct-Dec)**
Flow Rate / Amount	Oil: 69 000 bbl/d			
Main direction of the Spill Drift	Toward SW	Toward SW	Toward SW	Toward SW
MAX. Distance of the 90%-oil-surface-probability contour	400 km from RP	170 km from RP	175 km from RP	340 km from RP
Secondary draft		60% to the SW	75% to the N	
Offshore surface waters possibly reached by a spill	International			
MAX. % shoreline impact probability	22% observed from George to Saint Francis Bay area	87% observed in the Oyster Bay and Saint Francis Bay areas, from	87% observed in the Oyster Bay and Saint Francis Bay areas, from	42% observed from Knysna to Saint Francis Bay area

Scenario 1: Discharge Point 1 blowout	Season 1 (Summer, Jan-Mar)	Season 2 (Autumn, Apr-Jun)	Season 3 (Winter, Jul-Sep)	Season 4 (Spring, Oct-Dec)
		Plettenberg Bay to Gqeberha	Plettenberg Bay to Gqeberha	
Minimum Shoreline Arrival Time	Saint Francis Bay, approximately 3 days after start of the release	East of the Saint Francis Bay area, West to Gqeberha, 2 days after start of the release	Gqeberha area, approximately 1 day after start of the release	West of Oyster Bay area, approximately 2 days after start of the release
Average Shoreline Arrival Time	14 days	11 days	10 days	15 days
Deterministic Worst-Case Oil Onshore with capping only	12 000 g/m^2 is observed along approximately 270 km between Woodlands (west to Saint Francis Bay) and Cannon Rocks (East of Algoa Bay)	12 000 g/m^2 is observed along approximately 470 km between George and Port Alfred towns	12 000 g/m^2 are observed along approximately 190 km between George and Oyster Bay	12 000 g/m^2 is observed along approximately 235 km between Woodslands George coastline and Saint Francis Bay

HES, 2021a

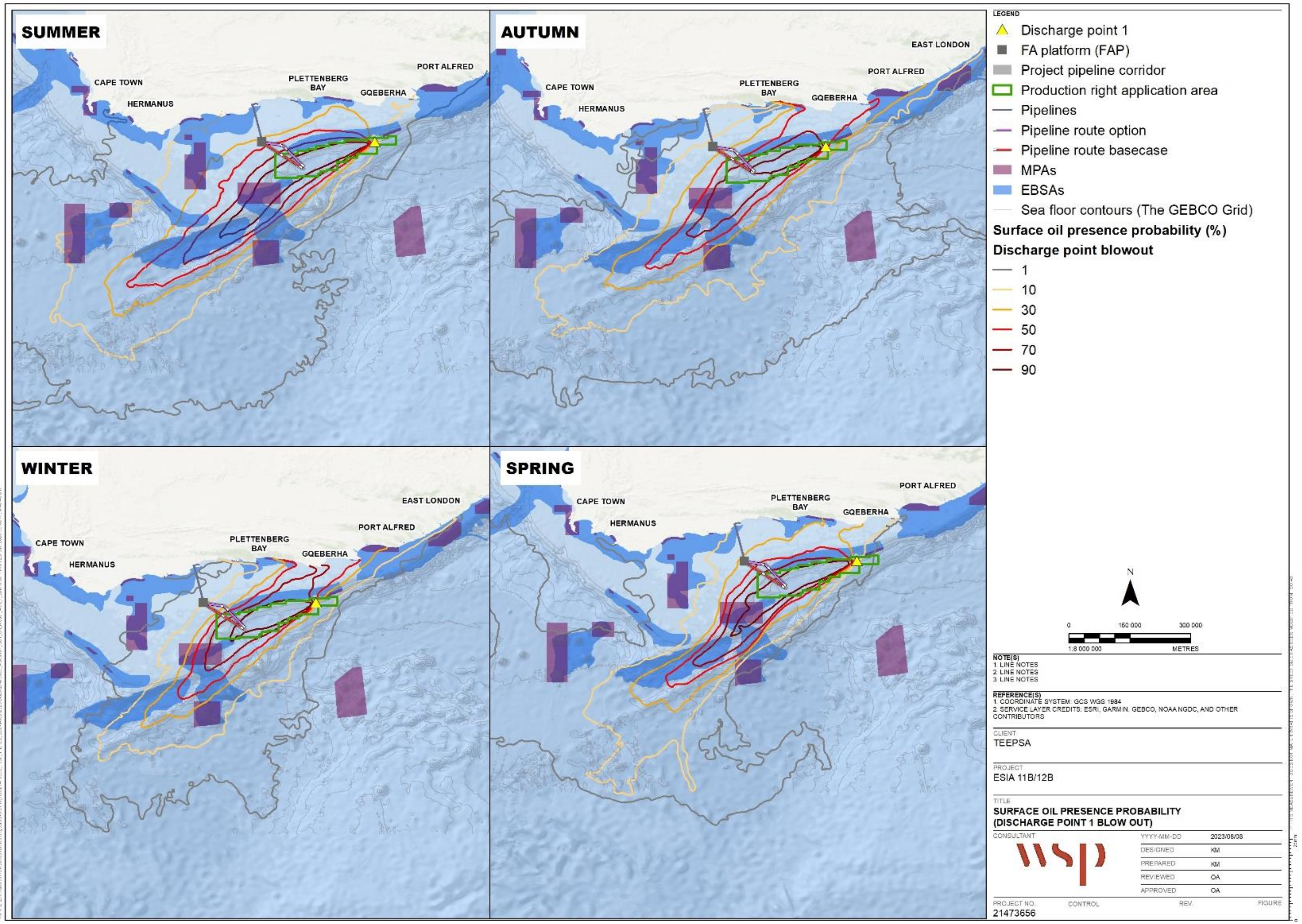

Figure 10-7 - Surface oil presence probability: Discharge Point 1 blowout model results statistics for all simulations in summer, autumn, winter and spring. Note: these maps are an amalgamation of 90 spill simulations under different metocean conditions, not representative of a single spill event (HES, 2021a)

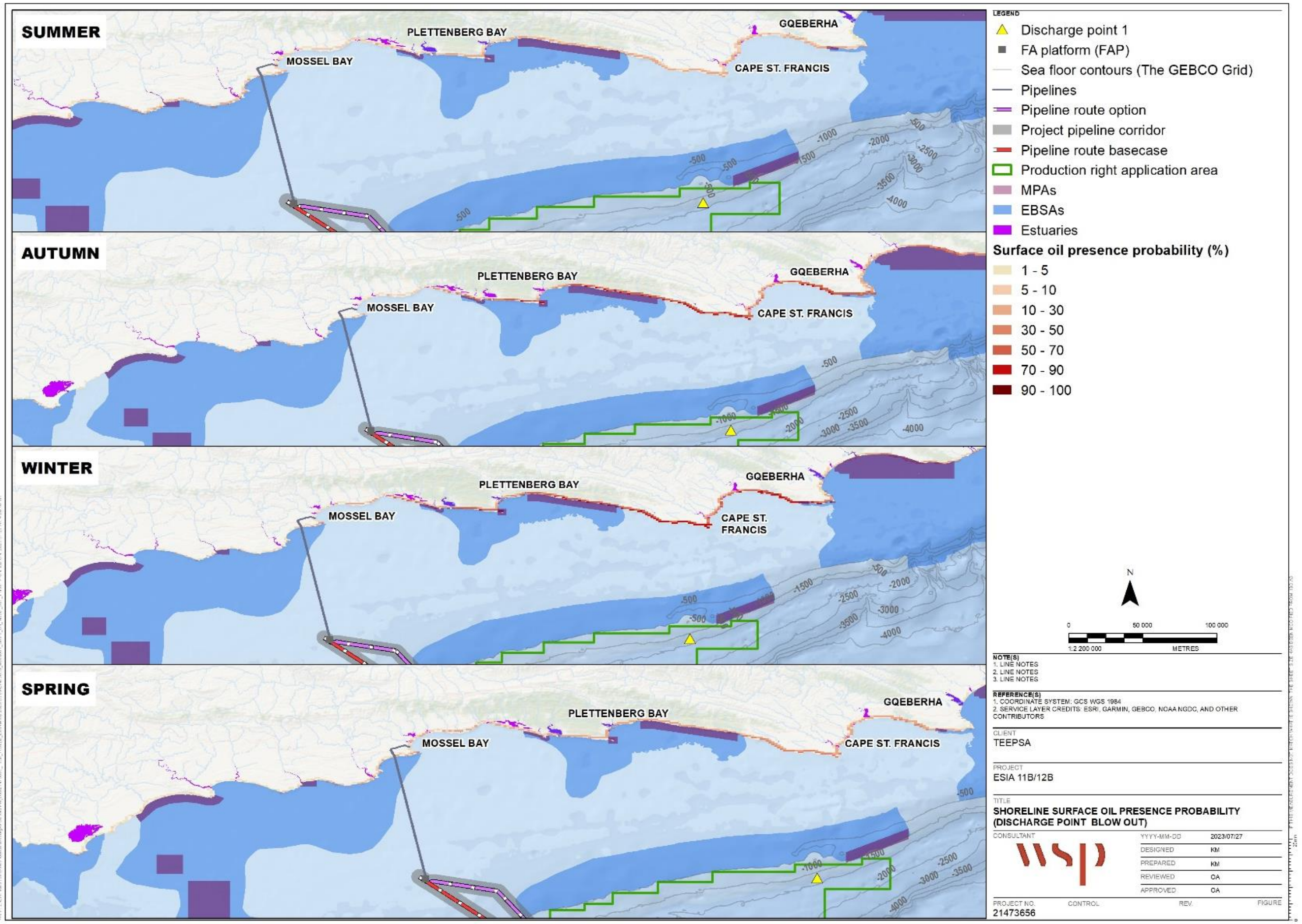

Figure 10-8 - Worst-case shoreline oiling probability above threshold (>10 g/m2): Discharge Point 1 blowout model results statistics for all simulations in summer, autumn, winter and spring. Note: these results do not represent a single spill but the combination of statistical results of the 90 individual trajectories composing the various Stochastic scenarios (seasons) (HES, 2021a)

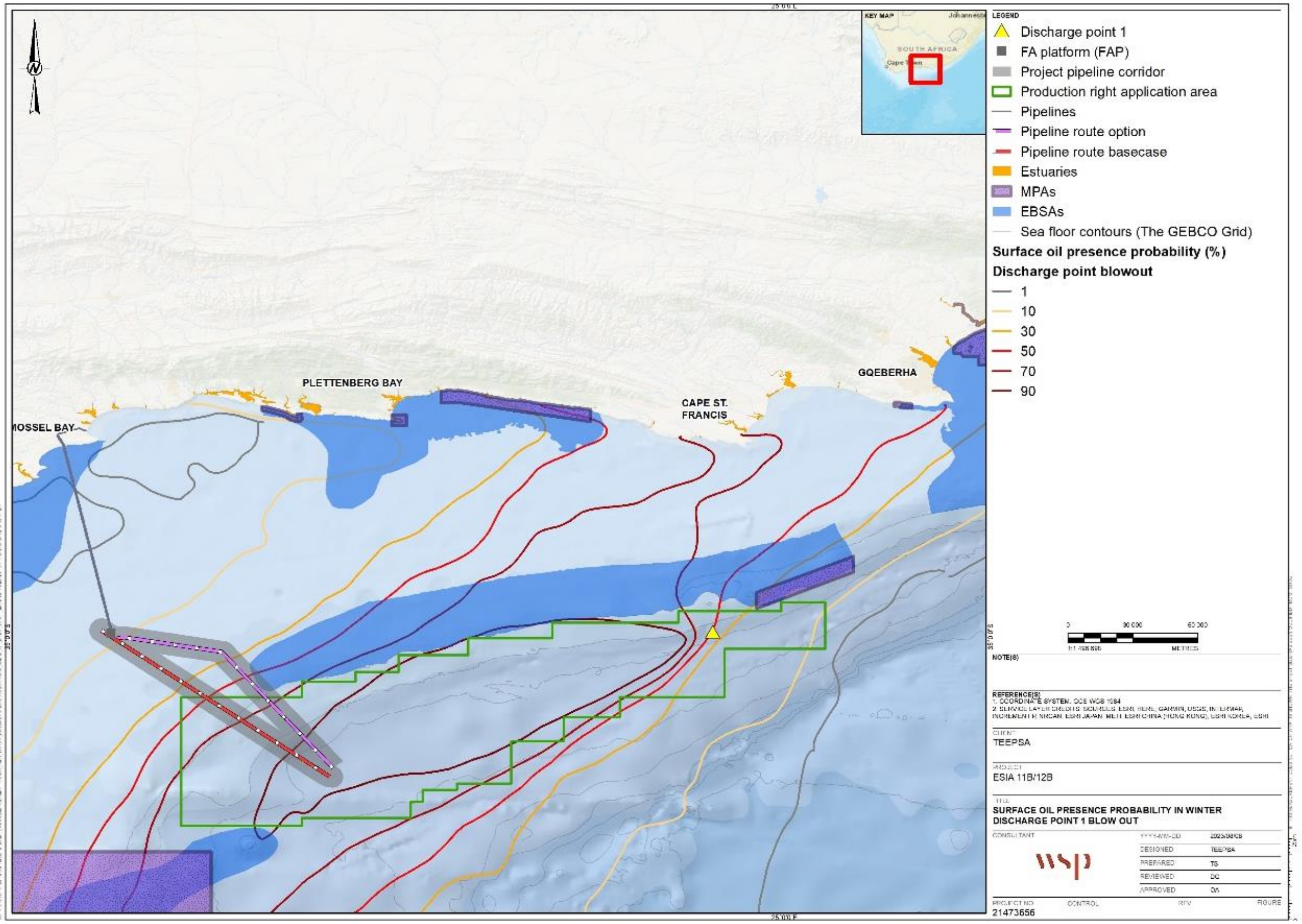

Figure 10-9 - Worst- case surface oil presence probability: Discharge Point 1 blowout model results statistics for all winter, focussing on coastal MPAs. Note: these maps are an amalgamation of 90 spill simulations under different metocean conditions, not representative of a single spill event. Marine Protected Areas are overlaid (HES, 2021a)

10.2.1.1.4.2 Scenario 2: Discharge Point 2

In a well blow out scenario, worst-case model results indicate that there is a 37% probability that a spill would extend up to 500 km from the rupture point to the southwest, entering international waters during the summer (Jan-Mar), whilst in winter (Jul-Sep), there is a 17% probability of the spill extending 435 km south west (Figure 10-10). There is a 90 to 100% probably that the surface slick would spread 135 to 310 km from the rupture point to the southwest across all seasons (Figure 10-10, Table 10-7). There is also a 90 to 100% probably that the surface slick would spread 138 km to the north/north east in winter (Jul-Sep), a 70% probability of the spill moving north east towards Gqeberha in summer (Jan-Mar), and a 80% probability of a autumn spill moving north/north east towards the east coast of South Africa. Summer (Jan-Mar) represents the worst-case season for surface oil spread.

Surface oil (> 5 µm thick) is again projected to intersect with a number of EBSAs and MPAs, including almost the entirety of the Southwest Indian Seamounts MPA and large portions of the Shackleton Seamount Complex EBSA and the Mallory Escarpment and Trough EBSA to the southwest (Figure 10-10). In summer (Jan-Mar), there is a >70% probability that the plume overlaps with 47% of the Southwest Indian Seamounts MPA, with an overlap of 40% in spring. In autumn (Apr-Jun), there is a 10 to 30% chance of the modelled plume overlapping with Port Elizabeth Corals, with this spill projected to cover ~90% of the EBSA. There is a 10 to 30% probability of the spill covering ~96% of the Agulhas Bank Complex MPA in spring (Oct-Dec), and a 1 to 5% probability that 77% of the Browns Bank Corals MPA would be covered in winter (Jul-Sep).

The model results show that oil (>10 g/m^2) is expected to reach shore in 1 to 2 days (minimum) and 11 to 14 days on average (winter: Jul-Sep is again the worst case, with oil expected to come ashore in Gqeberha after approximately 1 day) (Table 10-7). Model results indicate that shoreline oiling annual probability is 83%, with the highest probability of oil-shoreline impact after a well blowout occurring in autumn (Jul-Sept) with a maximum shoreline impact probability of 100% from George to Gqeberha (Table 10-7, Figure 10-11). In spring (Oct-Dec), 63% of shoreline impacts are observed on the Tsitsikamma National Park coastline area, while in autumn (Apr-Jun), 98% of impacts are modelled to occur between Knysna and Gqeberha. The period of the year identified as the worst in the event of a blowout (i.e., with maximum oil amount onshore coupled with the maximum probability) is again in season 3, Jul-Sep (spill starting in August).

In winter (Jul-Sep, the worst-case model), the Discharge Point 2 results indicate that the surface oil > 5 µm thick is projected to overlap three major coastal MPAs. The overlap is projected to occur with a 50 to 70% probability of overlapping 28.8% of the Addo Elephant National Park MPA (maximum of 319km^2). There is also a 70 to 90% probability of overlap with the Tsitsikamma MPA (representing 84.61% of the MPA, with a maximum area of 246 km^2) and 40.47% of the Goukamma MPA (13.75 km^2) (Figure 10-12).

Table 10-7 – Discharge Point 2 blowout model results summary across all seasons. RP = Release Point

Scenario 2: Discharge Point 2 blowout	Season 1 (Summer, Jan-Mar)	Season 2 (Autumn, Apr-Jun)	Season 3 (Winter, Jul-Sep)	Season 4 (Spring, Oct-Dec)
Flow Rate / Amount	Oil: 69 000 bbl/d			
Main direction of the Spill Drift	Toward SW	Toward SW	Toward SW; N/NE	Toward SW
MAX. Distance of the 90%-oil-surface-probability contour	310 km from RP	135 km from RP	160 km SW from RP 138 km N/NE from RP	290 km from RP
Secondary draft	70% NE towards Gqeberha	80% on N/NE		
Offshore surface waters possibly reached by a spill	International			
MAX. % shoreline impact probability	72% observed on Plettenberg Bay area	98% observed between Knysna and Gqeberha	100% observed from George to Gqeberha	63% observed on the Tsitsikamma National Park coastline area
Minimum Shoreline Arrival Time	Saint Francis Bay after ~2 days	Saint Francis Bay area, West to Gqeberha after 2 days	West of Saint Francis Bay area after ~1 day	Cape Saint Francis Bay area after ~2 days
Average Shoreline Arrival Time	14 days	11 days	11 days	12 days
Deterministic Worst-Case Oil Onshore with capping only	12 000 g/m^2 along ~230 km between Knysna and Gqeberha	12 500 g/m^2 along ~480 km between George and East of Gqeberha	12 000 g/m^2 from George to Gqeberha	12 000 g/m^2 along ~460 km between Uiterstepunt coastline and Saint Francis Bay

HES, 2021b

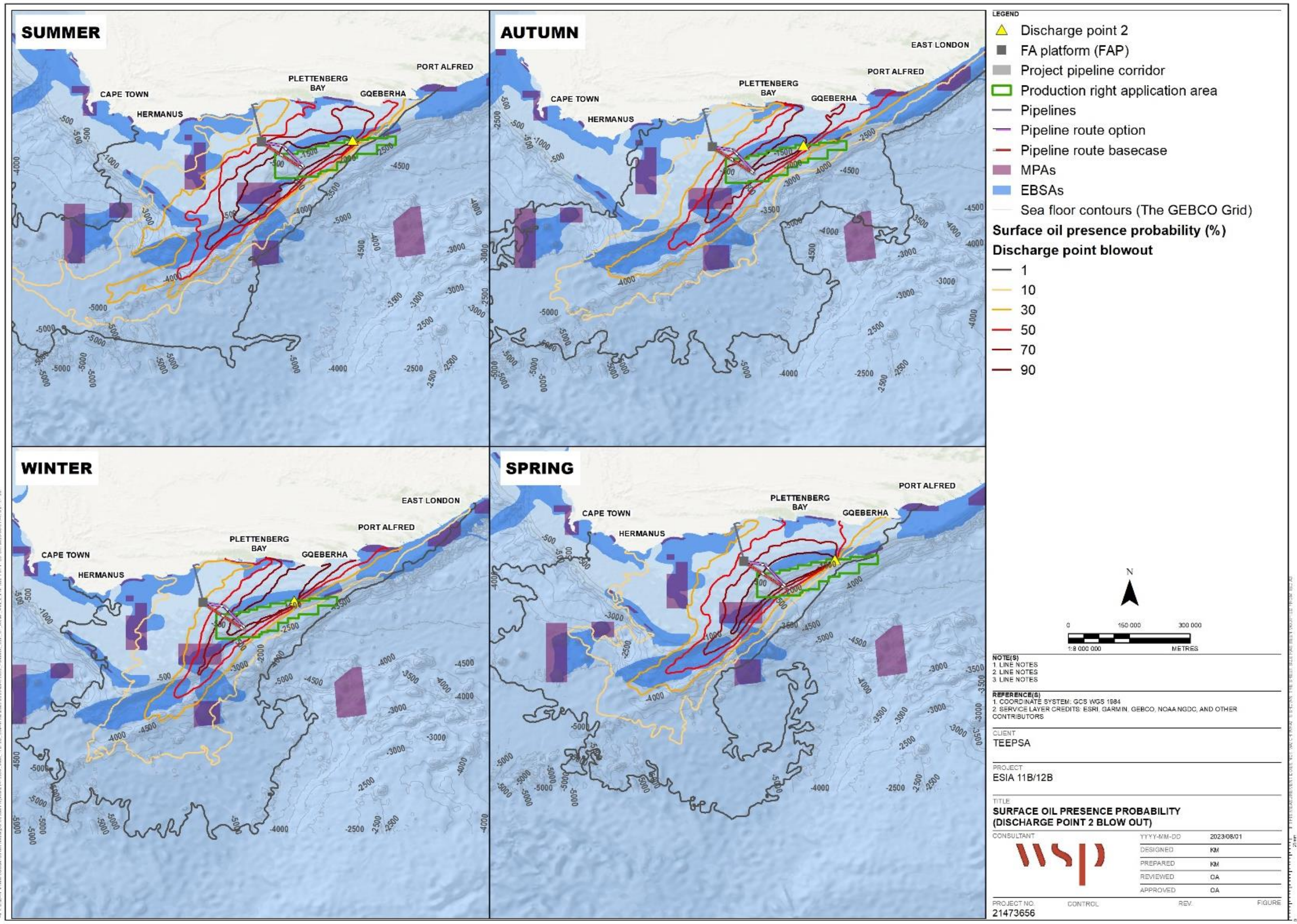

Figure 10-10 - Surface oil presence probability: Discharge Point 2 blowout model results statistics for all simulations in summer, autumn, winter and spring. Note that these maps are an amalgamation of 90 spill simulations under different metocean conditions, not representative of a single spill event (HES, 2021b)

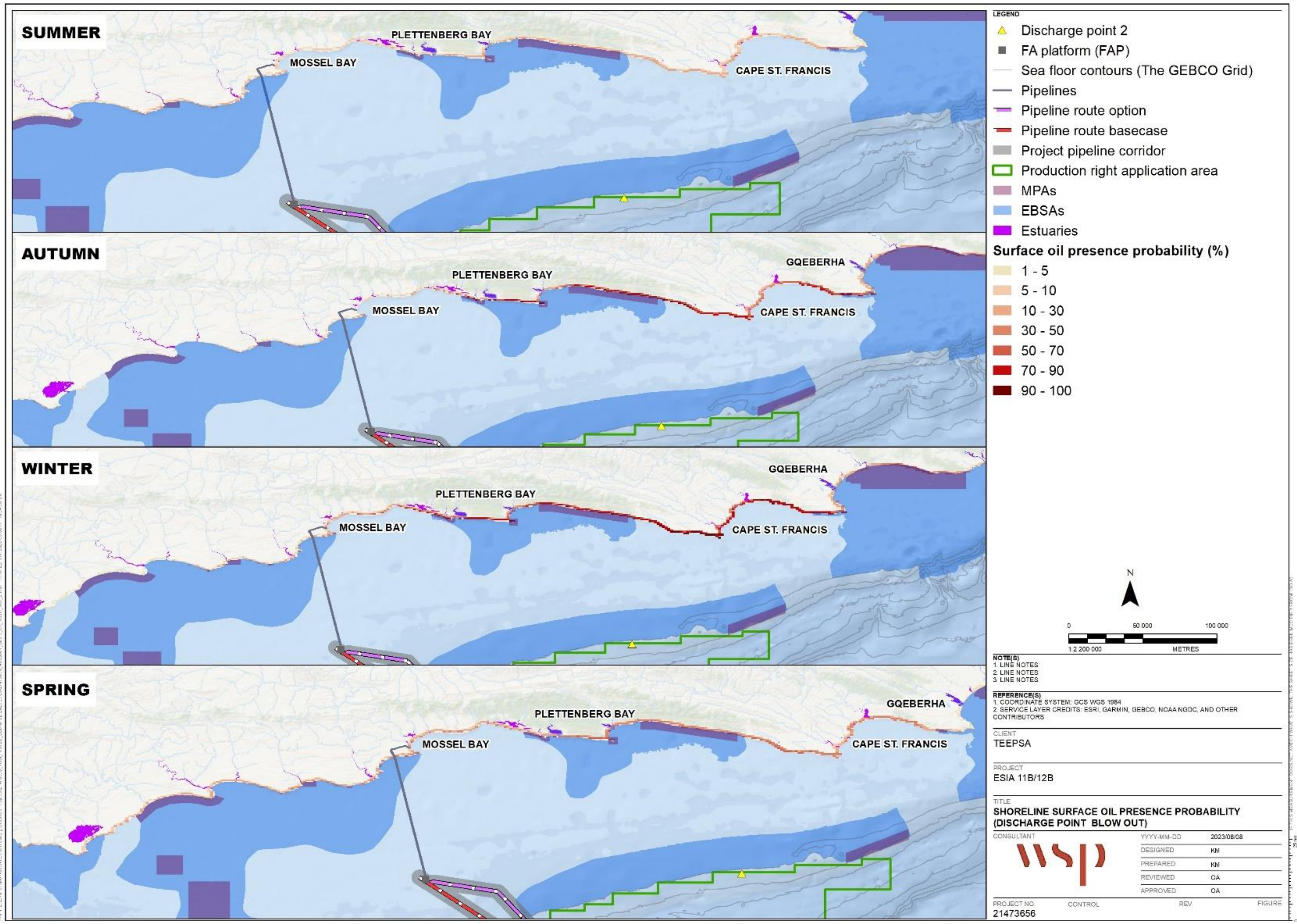

Figure 10-11 - Worst-case shoreline oiling probability above threshold (>10 g/m^2): Discharge Point 2 blowout model results statistics for all simulations in summer, autumn, winter and spring. Note that these results do not represent a single spill but the combination of statistical results of the 90 individual trajectories composing the various Stochastic scenarios (seasons) (HES, 2021b)

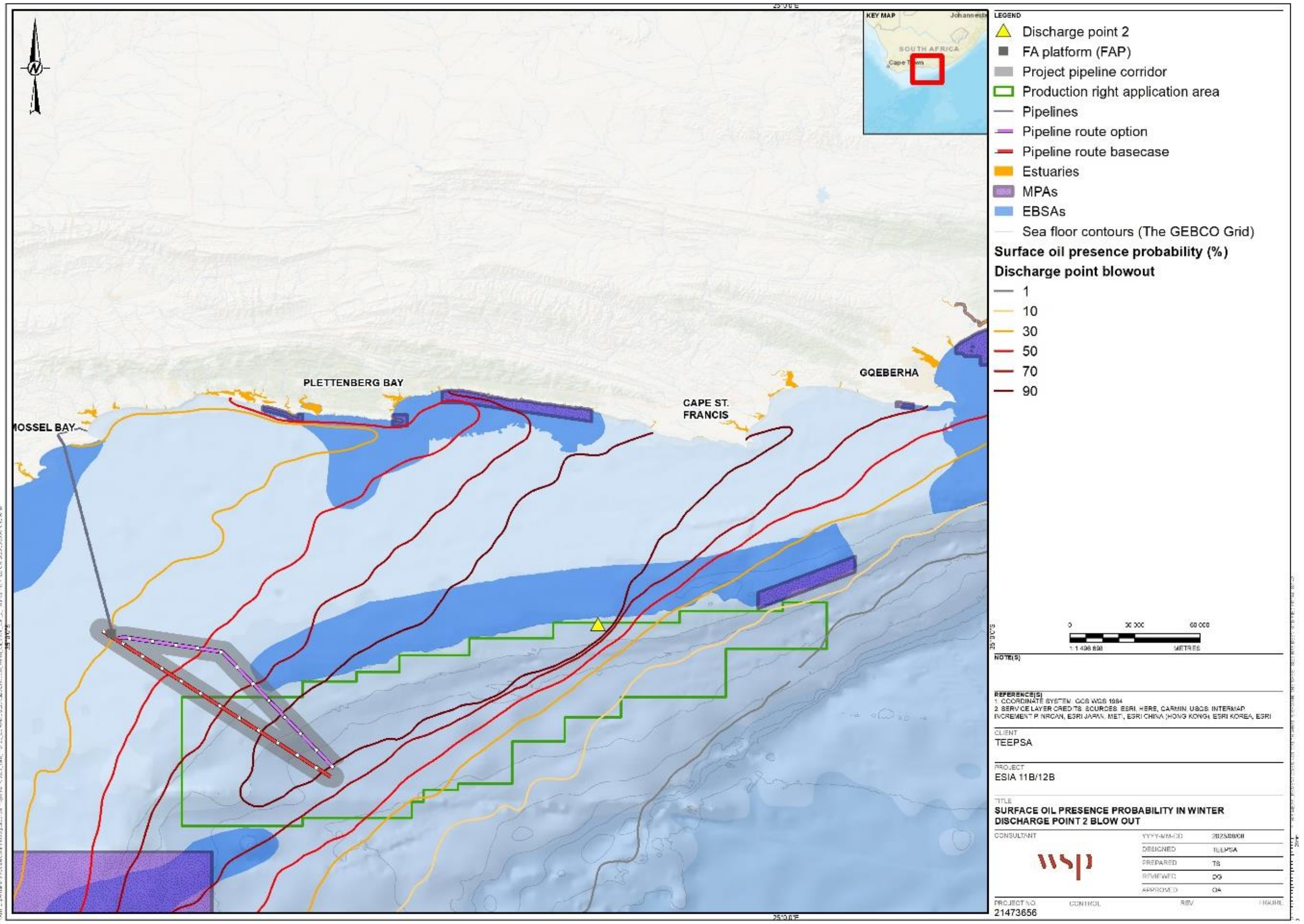

Figure 10-12 - Worst- case surface oil presence probability: Discharge Point 2 blowout model results statistics for all winter, focussing on coastal MPAs. Note: these maps are an amalgamation of 90 spill simulations under different metocean conditions, not representative of a single spill event (HES, 2020d). Marine Protected Areas are overlaid

10.2.1.2 Project Controls

This section provides a description of the operational Project Controls TEEPSA has in place related to a well blowout.

A "multi-barrier" approach will be implemented to deal with the risk of oil spills. This approach involves defining multiple barriers (Avoidance / Technical Barriers / Mitigation Measures) to manage environmental risk. These are described in Sections 10.2.1.2.1 to 10.2.1.2.8. The first step and most important priority in applying the mitigation hierarchy to manage the risk of an oil spill is Avoidance (or prevention). If these preventative technical and control barriers fail or are not effective under certain conditions, then control and response capabilities (Mitigation Measure) will be in place.

In the unlikely event of a spill incident resulting from a blowout, an emergency response system will be implemented by TEEPSA to mitigate the consequences of the spill. The size and location of a spill incident will determine the tiered response scenario and actions to be implemented.

TEEPSA will ensure all the required measures are in place to deal with a spill event, including the preparation and implementation of a Project and well-specific Oil Spill Contingency Plan (OSCP) and Blowout Contingency Plan (BOCP), based on international best practices (IOGP and IPIECA), and which will be co-ordinated with the South African National Oil Spill Contingency Plan and approved by SAMSA, PASA and DFFE.

10.2.1.2.1 Avoidance (or prevention) of blowouts

- The drill site will be assessed and selected after a shallow hazard survey has been performed 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.
- Wells will be designed as per TotalEnergies' rules and industry standards to ensure that casing, sections and design are optimised to withstand the most stringent pressure profiles prognosed. Well design parameters will be peer reviewed by specialists to ensure that a robust well architecture is selected for the drilling operations. Technical integrity detailed engineering and risk assessment studies will then be performed to finalise the well architecture and the contingency plans mentioned above.

10.2.1.2.2 Technical Barriers

- Casings (steel pipes cemented in the borehole to ensure integrity) will be designed to withstand a variety of forces, such as collapse, burst or tensile failure. They will be used to prevent caving or fracturation of the rock formations drilled and to provide strong foundations for continued drilling operations.
- Wellbore pressure and drilling mud weight: Subsurface pressures above and within the hydrocarbon-bearing well formations will be controlled using 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 (i.e. 'kick'). Pressure monitoring will be undertaken during drilling to ensure that kicks are avoided or managed to prevent escalation into a blowout.
- TotalEnergies 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' will be performed to brainstorm and anticipate the future well drilling operations.

- 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 environment. All key personnel are certified under the highest international standards (International Well Control Forum- IWCF certification level 4).
- 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 TotalEnergies and the drilling contractor prior to the commencement of drilling operations.
- Drilling barriers and controls during operations include using a conservative mud weight based on the expected pressure profile (Pore pressure, leak off pressure and fracturation pressure) of the well formations. Logging while drilling will also contribute to reduce geological depth uncertainties. Further continuous monitoring systems are used to follow rate of penetration, mud volumes (in versus out), and cuttings. Early kick detection systems and sensors to detect any anomalies with alarms is also used during the well drilling operations. Since 2021 a Real Time Centre monitoring all this data supports the operation team 24/7 in identifying a well control risk.

10.2.1.2.3 Blowout Control and Oil Spill Response Methodology

- Usual International good Practices
  - In the unlikely event, despite all these preventive barriers, should a kick be detected, the first thing that will be done is to control the source of the flow by closing in the well, thus reducing the probability of a blowout. A heavier fluid would then be introduced to try and raise the hydrostatic pressure and achieve a balance. Meanwhile, the fluid or gas that infiltrated the wellbore would slowly be evacuated in a controlled and safe manner.
  - If the well control cannot be achieved by increasing the mud weight, the (BOP) stack will be used to control the pressure through mechanical devices designed to rapidly seal the well (or “shut in”) in an emergency. The BOP consists of the following minimum configuration: 2 annular preventers; capability to safely disconnect with Lower Marine Riser Package ; blind shear rams and casing shear rams (capable to shear pipes in well in order to shut well in) and 3 pipe rams to seal around drill pipes.
  - The BOP is inspected and certified by the original equipment manufacturer (OEM) prior to contract start-up and this certification is maintained current by the rig contractor. The BOP must be regularly tested as per American Petroleum Institute and TotalEnergies rules.
  - Well control procedures and specific well operating guidelines are developed in advance to respond to unplanned events such as well control events. The well control in this case relies on trained personnel and early detection means (with additional remote monitoring) to react and close the well as quickly as possible.
  - The BOP is function and pressure tested on a regular basis and always prior to entering reservoirs to ensure it activates and closes in the well in case of a well control event. Enough redundancies are available in the rig BOP control system to ensure TEEPSA can shut-in a well at any time (and in case the redundant function is lost then repairs are conducted prior to resumption of operations). The rig contractor BOP is designed to control and prevent the occurrence of blowouts.

- Specific additional tool used for the proposed drilling programme:
  - In addition to the barriers already detailed above, new technological advancements have been developed which could be applied to the proposed drilling campaign. The new technology involves pre-installation of a supplementary well control shut in device, called a Mudline Closure Device, designed as an additional blowout stopper for the proposed drilling operations. In the unlikely event that the BOP fails to close and shut in the well, this device can be activated independently from the rig or from a support vessel to shut in the well. This device drastically reduces the possibility of a surface blowout.
  - TEEPSA is still in the process of completing its testing process in real operations. Once the testing is successfully completed, the equipment will be incorporated and taken into account in the BOCP and OSCP.
- Despite this increased level of confidence, TotalEnergies' and Industry's standards still provide for the mobilisation and deployment of:
  - A SSDI – TEEPSA has access to these kits through contracts with OSRL; and
  - A capping stack(s) to cap the well – TotalEnergies has access to various capping stacks including the capping stack stationed in Saldanha Bay.
- All preparations and planning to drill a relief / kill well in the case of a blowout is made in advance and forms part of the BOCP which is developed and approved before drilling commences.

10.2.1.2.4 Oil Spill / Slick Monitoring

- If despite all the above-mentioned measures, an oil spill or release occurs, aerial surveillance means would be deployed in order to track and predict the movements of the oil slick.
- Oil slick tracking buoys would be deployed offshore in order to improve tracking and modelling of slick movement through satellite imagery. Modelling forecasts of potential impacts on shorelines / sensitive areas would be used to feed and update the response strategy.
- The oil slick would be sampled and analysed to determine the behaviour and toxicity of the spill. This information would be used to monitor response efforts and advise on additional response measures to be deployed / corrected.

10.2.1.2.5 Offshore Oil Spill Response (as per specific OSCP)

- Depending on the volume of oil spill or release, various offshore response resources can be mobilised which includes sea and air response means (vessels, airplanes, dispersant deployment kits, containment and recovery kits).
- TotalEnergies has got access to various sources of dispersant stockpiles around the globe which will be mobilised and deployed by vessel and aircraft. This includes access to the global stockpile dispersants from OSRL of which 800 m^3 is stored in Cape Town.

10.2.1.2.6 Shoreline Response Strategy (as per specific OSCP)

- As part of the OSCP:
  - TEEPSA conducts a coastal sensitivity assessment and mapping study in order to identify coastal sensitivity in order to priorities coastal response strategies together with coastal oil spill response plans. Protection of sensitive areas is prioritised for onshore response strategies and resource deployment during oil spill responses.
  - Identification and agreement on waste management which includes, collection of waste (oil, tar balls and oiled response equipment), temporary storage of waste, and transportation of waste

for final disposal and treatment. Facilities for long-term storage, treatment and disposal are identified and included in the OSCP.

- Impacted wildlife management: the Operator has contracts with specialised national and international Wildlife response organisations (i.e. SANCCOB and Global Oiled Wildlife Response Services. Such contracts allow for the setting up of temporary collection, treatment, rehabilitation, care and release back of the impacted wildlife.

10.2.1.2.7 Compensation and Insurance

- In the unlikely event of oil spill occurring, a process of determining the economic effects and related compensation would be initiated including engagement and consultation with affected parties in terms of the IPIECA-IOGP guideline document for the economic assessment and compensation for marine oil releases.
- This process typically involves government, insurers, the organisation responsible for the incident, industry organisations and the applicable legal system (including Sections 28 and 30 of the NEMA which outline the requirements for Duty of Care, Remediation of Environmental Damage, and Control of Emergency Incidents).
- All claims will be submitted to DFFE, who will take the necessary steps to establish that the claim is adequately substantiated and reasonable. These claims could include loss or damage to property, grazing lands, livestock, fishing nets, loss of livelihood etc., in South Africa, resulting from the discharge of oil from an offshore installation and also damage or loss caused by methods used to clean up polluted areas during a spill.
- Once the details of each claim have been verified, it will be forwarded to the SAMSA Administration Officer for processing.
- The claims are paid from insurance cover to financially manage the consequences of any unplanned event.
- Proof of this financial insurance and assurances must be provided to PASA. Refer to Section 6.15 for a description of TEEPSA's financial provision and insurances.

10.2.1.2.8 Oil Spill Contingency Plan

TEEPSA will develop well-specific response strategy and plans (including OSCP and BOCP), which will need to be approved by SAMSA, PASA and DFFE. The primary objective of the OSCP is to identify all possible spill scenarios, level of response requirements and set in motion the necessary actions to stop any discharge of oil and to minimise its effects. The OSCP thus provides for a comprehensive response to all oil and chemical pollution emergencies in the marine environment.

An overview of the TEEPSA oil spill planning process is described in the sections below. TEEPSA will however develop a well-specific OSCP 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 will take cognisance to the local oceanographic and meteorological seasonal conditions, local environmental receptors, and local spill response resources.

10.2.1.2.8.1 Tiered Preparedness and Response

Oil spill response planning is based on the principle of a tiered response. Tiered Preparedness and Response gives a structured approach to both establishing oil spill preparedness and undertaking a response. It allows potential oil spill incidents to be categorised in terms of their potential severity and the capabilities that need to be in place to respond (IPIECA, 2007). Conventionally the concept has been considered as a function of size and location of a potential oil spill, with three tiers typically defined (see table below). Tier 1 being the lowest category of response and Tier 3 being the highest category requiring response from Government and international assistance (South Africa's NOSCP).

- Tier 1 – Minor spills that are quickly controlled, contained and cleaned up using local (onsite or immediately available) company/contractor owned equipment and personnel resources. For offshore facilities, local resources could include those at the facility, or nearby support vessels or at a designated shore support base or staging area.
- Tier 2 – Tier 2 events are more diverse in their scale and by their nature involve potentially a broad range of impacts and stakeholders. Moderate spills, controlled or uncontrolled, requiring activation of significant regional oil spill response resources and all or most of the Spill Management Team. Tier 2 response resources are varied in their provision and application. Management responsibilities are usually shared in a collaborative approach and a critical feature is the integration of all resources and stakeholders in the response efforts.
- Tier 3 – Major spills, controlled or uncontrolled, requiring activation of large quantities and multiple types of response resources including those from out of the region, and possibly international sources. Tier 3 events are rare but have the potential to cause widespread damage and affect many people. Tier 3 response resources are concentrated in a relatively few locations, held in readiness to be brought to the country when needed. Such significant events usually call for the mobilisation of very substantial resources and a critical feature is their rapid movement across international borders and the integration of all resources into a well-organised and coordinated response. The entire Spill Management Team will be required and will likely be supplemented by outside organisations.

10.2.1.2.8.2 Spill Contingency Planning Process Overview

To achieve the objective of developing an effective response through an appropriate preparedness, oil spill contingency planning is based on a structured process (see Figure 10-13), resulting into an OSCP.

The main steps are listed below:

- **Step one**: Once the operations are defined, the international and national regulatory framework and environmental/societal context are analysed to carefully define the requirements and expectations to be met, during the preparation and in case of a spill.
- **Step two**: All oil spill scenarios are identified and analysed, together with their consequences and classified following the international tiered approach (refer to Box 10-1).
- **Step three/four/five**: For each representative scenario, a response strategy is developed, appropriate tiered response resources are determined for an effective, proportionate and sustainable response and a functional incident management organization is set up to implement the response, to operate effectively at all tier levels, with clear roles and responsibilities for each party involved.
- **Step six**: An OSCP is developed.
- **Step seven**: Personnel are trained, and the OSCP is tested through drills/exercises to verify the adequacy and effectiveness of the preparation.
- **Step eight**: As operations evolve and/or exercises show a need for, the OSCP is updated.

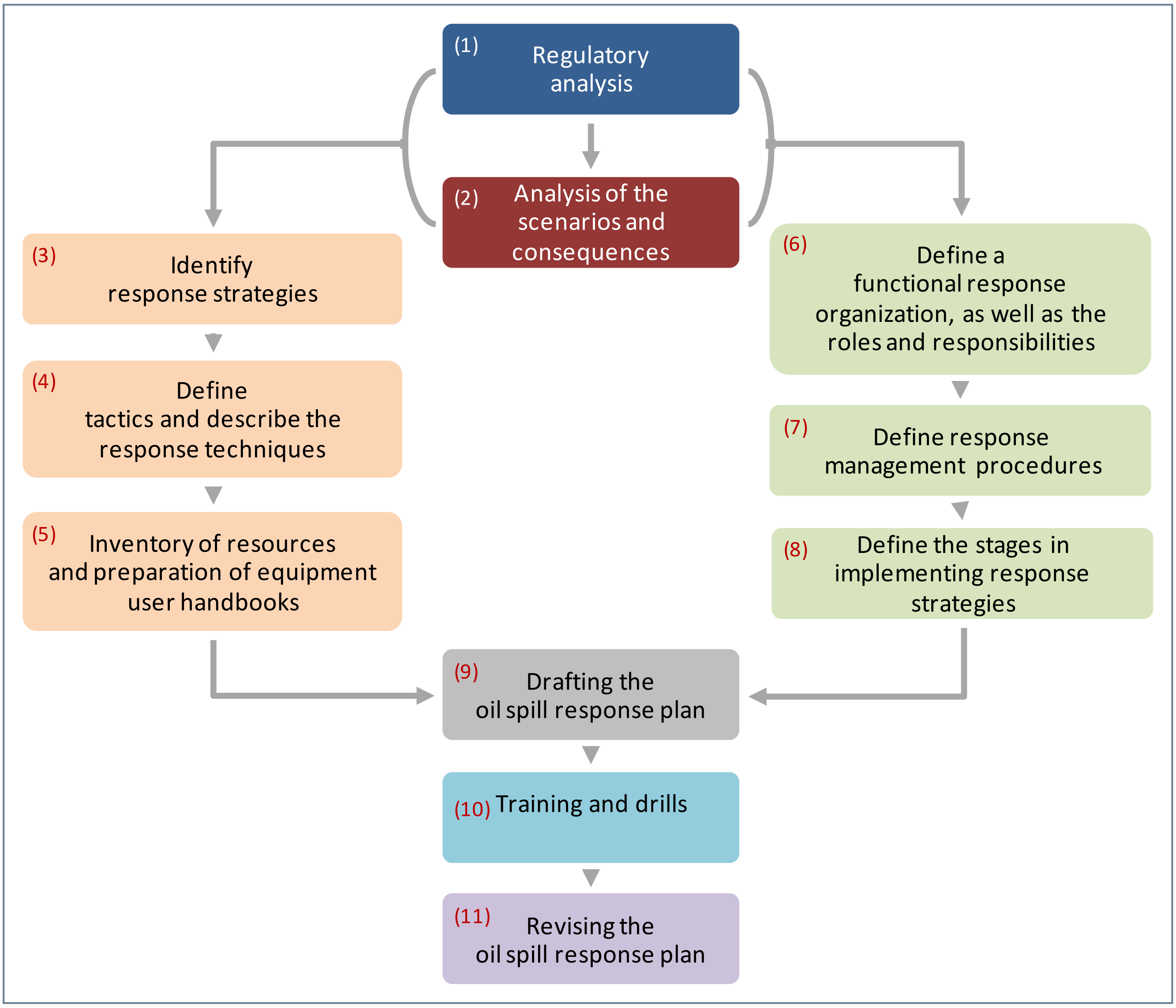

Figure 10-13 – Spill contingency planning process overview (source: TEEPSA)

10.2.1.2.8.3 Structure of a standard TotalEnergies OSCP

The structure of a standard TotalEnergies OSCP is outlined in Box 10-1 below.

BOX 10-1: STRUCTURE OF A STANDARD TEEPSA OIL SPILL CONTINGENCY PLAN

Introduction

The introduction provides the overview and structure of the OSCP, including:

- the generic elements of any emergency document, confirming that the plan is approved and up to date, as well as a circulation list;
- the scope of application and list of previous versions of the oil spill response plan;
- the reference documents related to the oil spill response plan;
- information situating the plan in the more general context of the response, emphasising the priorities concerning the safety and security of the personnel; and
- the instructions for use to ensure that the plan is easy to use, specifying the scope of each volume and the operational supports, as well as the personnel concerned.

Volume 1: Action Plan (Operational Document)

Volume 1 is an overview of the operational and organisational support structure for oil spill response. It is used by the various Emergency Response teams and it defines:

- "What to do": through the Action Plans,
- "How to do it" through the Operational Supports.

This volume consists of two Action Plans and Operational Supports. These action plans are the guideline for the various emergency response teams to initiate, sustain and manage the response operations. They provide:

- A description of the overall TEEPSA oil spill response organisation, and its interfaces with the national authorities of South Africa.
- Guidelines on initial response actions.
- A summary of the oil spill response strategy of TEEPSA, according to the various levels of seriousness of the incident (Tier 1, 2 and 3).
- A series of job tickets for the various positions in the emergency teams, to allow personnel to act promptly in case of an incident.

Volume 1.1: Action Plan for personnel at the Incident Command Post (ICP) at TEEPSA headquarters, Cape Town

- The objective of Volume 1.1 is to set up the initial actions and management of the incident. It helps the ICP staff to:
- Understand the responsibilities of the different actors in the response (headquarter internal teams, national organisms, external support, etc.).
- Rank the event according to the tiered level of severity (Tiers 1 - 3).
- Set up a functional organisation according to the extent of the spill.
- Understand their roles and responsibilities and complete their tasks throughout all the response phases.
- Define and manage operationally the different stages of one or more oil spill response strategies according to the extent and type of spill, on the basis of representative scenarios and/or strategic decision trees and predefined actions.
- Manage the response stages via procedures associated with standard forms and documents (immediate actions, alert, internal and external mobilisation, preparing a response action plan, internal and external communication, managing the end of response operations, etc.).

BOX 10-1 cont.

Volume 1.2: Action Plan intended for personnel in the Advanced Command Post (ACP) on the drilling unit

Volume 1.2 has the same objectives as Volume 1.1, but scaled for the ACP on the drilling unit.

Operational supports

They consist of a series of documents designed to assist the tasks of personnel involved in ICP and in the ACP. The list of Operational Supports for a standard TEEPSA OSCP is presented below.

Operational Support N°1: Description of the Project and Facilities

Description of the drilling operations: characteristics of installations, location maps, logistics support and distance between main facilities.

Operational Support N°2: Characteristics of Oil and Hydrocarbon Products

Characteristics of hydrocarbon products which could be involved in an oil spill.

Operational Support N°3: Fate & Behaviour of Oil at Sea

Assessment of the likely behaviour of hydrocarbon products if spilled at sea. Principles of movements of oil.

MetOcean Data – Results of modelling studies.

Operational Support N°4: Material Safety Data Sheets (MSDS)

Material Safety Data Sheets of hydrocarbon products which could be spilled.

Operational Support N°5: IMT Coordination for Offshore Monitoring and Response Strategies

Offshore response options: monitoring, containment and recovery, mechanical dispersion, chemical dispersion

Operational Support N°6: Onsite Coordination of Offshore Spill Response Tactics

Offshore response operations: safety procedures, setup, management and termination.

Operational Support N°7: IMT Coordination for Shoreline Survey and Response Strategies

Port response options: Containment and recovery at the quayside, protection and clean-up.

Shoreline response options: shoreline surveys, containment and recovery in the coastal area, shoreline clean-up operations, management of oily wastes collected.

Operational Support N°8: Onsite Coordination of Shoreline Response Tactics

- Shoreline response operations: safety procedures, setup, management and termination.
- Shoreline protection
- Oiled shoreline survey (SCAT)
- Shoreline clean-up.

- Waste management: technical recommendations.

Operational Support N°9: Use of Offshore Monitoring, Response Tools and Equipment

Practical guidelines for monitoring and deployment of oil spill resources offshore. Use of tools to assist in the management of the response, including guidelines for the use of GPS, digital camera and dedicated software for documenting and reporting on aerial surveillance, the launching of drifter buoys, the use of dedicated oil spill response software for calculating the trajectories of oil slicks and quantifying oil on the water.

Operational Support N°10: Emergency Directory

Lists of emergency contacts for oil spills.

Operational Support N°11: Inventory of Oil Spill Response Resources

- Resources available on site.
- Resources existing in South Africa (additional TEEPSA equipment, other operators, national resources, oil spill contractors).
- Resources which TEEPSA could mobilise from outside South Africa.

Operational Support N°12: Forms

Forms which might be needed during an incident, e.g., Notification, mobilisation of resources, etc.

Operational Support N°13: Oiled Wildlife Response

Reference to the arrangements in place in South Africa.

Operational Support N°14: Sensitivity Mapping

Sensitivity maps showing sensitivities on the shoreline and in coastal area.

BOX 10-1 cont.

Volume 2: General context and OSCP management (non-operational document)

This volume presents the justification for the oil spill response strategies selected for the operation. TEEPSA oil spill response strategies are identified by following a methodology advocated by TotalEnergies Group worldwide and compliant with internal standards and best practices for oil spill response. The methodology takes into account:

- The legal context (international, regional and national).
- An analysis of the environmental context and potential impacts, which is used to identify sensitive areas on the coastline of South Africa, translated into coastal sensitivity maps.
- The methodology is also based on a risk analysis which leads to:
- The identification of possible oil spill scenarios.
- The analysis of the behaviour of hydrocarbon products which could be spilled.
- The hierarchy of incidents based on their seriousness and potential impacts (Tier 1, 2 and 3), and the appropriate response strategies to minimise the impacts.

10.2.1.3 Impacts on Marine Ecology

This section was extracted from the Marine Impact Assessment Report (Anchor Environmental, 2023), attached to this ESIA report as Appendix 11 in Volume 2.

10.2.1.3.1 Potential Impact Description

Hydrocarbons spilled in the marine environment would have an immediate detrimental effect on water quality. Most of the toxic effects are associated with the mono-aromatic compounds and low molecular weight polycyclic hydrocarbons, as these are the most water-soluble components of the spill. Hydrocarbon spills are most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify. For the purposes of the marine ecology assessment, impacts were assessed for operational spills of condensate and crude oil occurring both offshore and nearshore, in line with the results of the oil spill modelling conducted for the Project (Section 10.2.1.1).

Various factors influence the scale of impacts of hydrocarbons, such as condensate or oil, on the marine environment. The physical properties and chemical composition of the condensate/oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product (Pulfrich, 2015). The magnitude of coastal impacts related to such spill events are also dependent on the location (inshore/offshore) and volume of hydrocarbons spilled i.e., large volumes spilled in close proximity to the coast would have a greater impact than smaller amounts spilled offshore. The physical properties that affect the behaviour and persistence of oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the composition of the condensate/oil (e.g., the amount of asphaltenes, resins and waxes).

Spilled oil undergoes physical and chemical changes (collectively termed 'weathering'), which in combination with its physical transport determine the spatial extent of oil contamination and the degree to which the environment would be exposed to the toxic constituents of the released product (Pulfrich, 2015). As soon as oil is spilled, various weathering processes begin breaking down the oil. Although the individual processes may act simultaneously, their relative importance varies with time (Figure 10-14). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer-term processes of oxidation, sedimentation and biodegradation (Pulfrich, 2015).

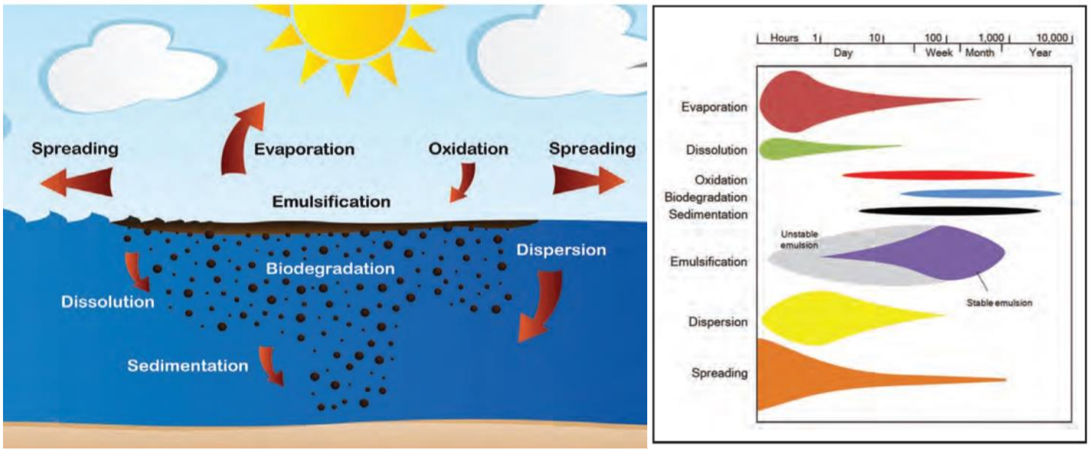

Figure 10-14 - (Left) Weathering processes acting on oil at sea. (Right) Relative importance of weathering processes on a crude oil spill with time; the width of each band indicates the importance of each process. Source: ITOPF, from Biccard et al. (2018)

The impact of a blowout on the marine environment is largely dependent on the quantity and physical state of the hydrocarbons released (Biccard et al. 2018, SLR 2021). A blowout would result in a jet release rising through the water column of two-phase material (gas and liquids). Gaseous components would be released to the atmosphere, while liquid components would form a slick on the sea surface. Some oil would, however, be dispersed and dissolved into the water column. A seabed blowout would form a crater as a result of the escape of high-pressure gas.

Escaping hydrocarbons would form a plume of bubbles, liquids and re-suspended sediments as the gas and liquids are ejected through the water column. The potential hazards to the marine ecosystem are associated with the toxicity of the hydrocarbons, damage to the benthic community, the effects of increased turbidity generated by the rising gas/sediment loaded plume and impacts associated with hydrocarbons in the water column and a slick on the sea surface (Biccard et al. 2018).

10.2.1.3.1.1 Phytoplankton, Zooplankton and Microbes

The reduction in light penetration through the water column as a result of the shading by the buoyant oil reduces phytoplankton photosynthesis and growth and exposure to both the hydrocarbons and dispersant materials can impact both the physiological functioning of these organisms themselves (Quigg et al. 2021). These impacts can have cascading indirect effects on trophic functioning by changing/disrupting between phytoplankton and zooplankton, and among phytoplankton and heterotrophic microbes (Quigg et al. 2021).

These physiological effects as a result of direct exposure to petroleum-based hydrocarbon pollutants through a spill are difficult to predict at a community level (different studies have shown both negative and positive effects on growth) and are likely influenced by site specific conditions and species composition (Teal & Howarth 1984, Ozhan et al. 2014, Bretherton et al. 2018, cited in Quigg et al. 2021). Additionally, the use of chemical dispersants have been shown to modify the uptake and accumulation of crude oil residues in both laboratory and *in situ* studies (Quigg et al. 2021).

As with phytoplankton, the impacts of oil spills on marine zooplankton depends on species composition and life history stage, exposure time, oil type and concentration, as well as site conditions (temperature, salinity, nutrients) (Moore & Dwyer 1974, Daly et al. 2021). Zooplankton species found in the surface waters are particularly vulnerable to hydrocarbon pollution (National Research Council, 2003, Daly et al. 2021). In addition, some zooplankton (including dinoflagellates, gelatinous doliolids and copepods) have been shown to ingest oil and egest oil in faecal pellets, which may be reingested by other particle feeding zooplankton, creating a transferral of oil pollution to deeper waters though the sinking of marine snow and faecal pellets (Lee et al. 2012, Almeda et al. 2014, Almeda et al. 2016 in Daly et al. 2021).

Because the South Coast of South Africa does not have confirmed oil seep anomalies, the area is unlikely to have established oil-degrading microbial communities (especially considering the harsh offshore oceanographic conditions), and the impacts of deposited oil on the seabed are therefore likely to persist over the long term.

10.2.1.3.1.2 Benthic Fauna

The impacts of hydrocarbon spills, particularly large blowouts, on infaunal macrofauna communities (of size 300 µm-30 mm) have been shown to be moderate to severe, with decreases in abundances and diversity indices (Schwing et al. 2020). Literature details how, after catastrophic blowouts in the past, abundance and diversity of macrofauna were depressed relative to background values across. These impacts are likely related to chronic pollution of the benthos as well as smothering, with recovery times in excess of four years (Reuscher et al. 2017).

Tolerances and sensitivities between species vary greatly. While sessile and mobile molluscs (e.g., mussels and crustaceans) are highly susceptible to direct oiling or coating and are highly sensitive to oil residue exposure, opportunistic polychaetes are known to persist and aid with the bioturbation and degradation of oiled sediments (Gordon et al. 2011, Washburn et al., 2016, Biccard et al. 2018). Based on estimates of sedimentation rates, oil residue degradation rates, and metabolic rates, Montagna et al. (2017) estimated that, “it may take between 50 and 100 years to fully bury and/or degrade (the)-contaminated sediment below macrofaunal bioturbation depths, thus allowing a full recovery of benthic species diversity and abundance” (Schwing et al. 2020). Chronic oiling from a large blowout may also cause additional sub-lethal responses in various taxa at different life stages, affecting their survival and ability to re-colonise oiled areas (Biccard et al. 2018).

Filter-feeders in particular are vulnerable from the ingestion of oil in solution, in dispersion or adhered to fine particles. The impacts of large-scale blowout events on epifauna including deep water corals are particularly severe and include colony injury and tissue/branch loss (Silva et al. 2015). *In situ* studies have found slow recovery in deepwater coral communities affected by elevated hydrocarbon concentrations, with some work documenting a continued decline in health years after a pollution event (Etnoyer et al. 2016).

The impacts of sedimentation processes (i.e., the buoyant oil moving down through the water column to the benthos) in the fate of both condensate and crude oil in the marine environment as a result of oil spills was not included in either the western Project Development Area or the eastern Exploratory Priority Area (DHI 2023, HES, 2020a, b). It is presumed therefore that the studies deem these processes to be an insignificant mechanism. However, the literature pertaining to biological processes involved in the movement of oil to the benthos (see Lee et al. 2012, Almeda et al. 2014, Almeda et al. 2016 in Daly et al. 2021) suggests that it cannot be assumed that little to no oil would reach the benthos. Therefore, the assessment of the impacts, and in particular, the impacts of crude oil on the benthic environment, was conducted with medium confidence.

10.2.1.3.1.3 Fish

Many species of larval and juvenile fish spend their earliest life history stages as zooplankton, and fish eggs are another important component of plankton (Cushing 1995). Various studies on the effects of hydrocarbon exposure have identified polycyclic aromatic hydrocarbons (PAHs) as the most damaging and cardiotoxic (damaging to the heart) to the sensitive early-life stages, due to their high lipophilicity and enduring persistence in the marine environment (Carls et al. 1999; Incardona et al. 2004; Hicken et al. 2011; Incardona et al. 2013). Thus, fish larvae are considered to be highly vulnerable to lethal and sub-lethal exposure even at very low levels of hydrocarbon exposure (Pasparakis et al. 2019).

Impacts of oil on juvenile and adult fish can be lethal, as gills may become coated with oil. 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 (Thomson et al. 2000). While highly mobile, fish are likely to be able to avoid a large spill; a large-scale pollution event within an important nursery area would have a significant impact on recruitment of juveniles. Juvenile fish are unlikely to be able to move out of an affected area and, depending on the size of the spill, mortality is to be expected.

It is likely that commercially important species would also be affected, thus having a negative impact on fisheries. The time of year during which a large spill takes place would significantly influence the magnitude of the impact on plankton, pelagic fish eggs and larvae and consequently a reduction in recruitment (Baker et al. 1990). However, spawning and recruitment success varies with each season and environmental conditions are likely to have a far greater impact than a single large spill (Neff, 1991). As such, significant loss of pelagic eggs and fish larvae can be expected if they are present in the area of an oil spill. Should it coincide with a major spawning peak, it could result in severe mortalities and hence a in recruitment. It follows that the time of year would greatly affect the degree of this impact.

Studies have also documented sublethal impacts of oil spills and hydrocarbon pollution on fish that may persist through development, and result in decreased fitness and survival at later life stages (Pasparakis et al. 2019). These effects include delayed growth and latent mortality following embryo/larval exposure (i.e., delayed mortality after survival of the initial pollution event) (Duffy et al. 2016, Johansen et al. 2017). Deceased growth following the Deepwater Horizon oil spill has been demonstrated in a number of fish species, including the bay anchovy (*Anchoa mitchilli*) (Duffy et al. 2016).

A crude oil spill that covers the coastal MPAs could have negative impacts on the fish protected with these areas — for example, worst-case model results show that there is a 70-90% probability that a blowout at Discharge Point 2 (crude oil) would result in a surface oil slick (> 5 µm thick) that covers 84.61% of the Tsitsikamma MPA. This MPA, along with the others along the South Coast that are also likely to be affected (such as the Addo Elephant National Park MPA and Goukamma MPA) are especially important for the protection of over exploited, endemic seabream fish species.

10.2.1.3.1.4 Seabirds

Seabirds are particularly vulnerable to being coated by spilled oil, and chronic and acute oil pollution is a significant threat to both pelagic and inshore species (Vanstreels et al. 2023). Oiled seabirds may be more vulnerable to hypothermia, as oil reduces their insulation. Oil can also cause them to experience skin irritation and develop ulcers. Seabirds often try to preen the oil off their plumage and subsequently ingest the toxic fuel oil, which can have endocrine-disrupting effects. Flightless birds, such as penguins, are especially prone to oiling, as they cannot fly over polluted areas and there have been cases of substantial penguin mortality as a result of oil spills (Wolfaardt et al. 2008, 2009). In addition, certain seabirds travel great distances to feed, and it should be noted that an oil spill may impact birds roosting some distance from the spill site (Biccard et al. 2018).

Seabirds likely to be encountered in Block 11B/12B include the Endangered Cape cormorant Phalacrocorax capensis (reported up to 80 km from their colonies) and Cape gannet Morus capensis (regularly feed as far offshore as 100 km), Indian yellow-nosed albatross *Thalassarche carteri* and Atlantic yellow-nosed albatross *T. chlororhynchos*, as well as the Vulnerable White chinned petrel *Procellaria aequinoctialis* Leach's storm petrel and Wilson's storm petrel *Oceanodroma leucorhoa*. An oil spill that remains offshore is likely to affect these species.

However, should an oil spill reach the shore, a more diverse range of species would be affected, including breeding colonies of the Endangered African penguin Spheniscus demersus (Vanstreels et al. 2023). This of particular concern in the case of model results presented for a blowout of wells in the eastern Exploratory Priority Area — worst-case (winter) model results indicate a 30 to 50% probability of an oil spill reaching Addo Elephant National Park MPA (Algoa Bay) if there is a blowout at Discharge Point 1, and 50 to 70% probability of an oil spill reaching the Addo MPA if there is a blowout at Discharge Point 2. An oiling of the Addo MPA and Algoa Bay would be of catastrophic consequences for seabirds, as the Bay is host to the most important breeding islands for the endangered Cape gannet and African penguin on the south coast, and arguably in South Africa.

Some species, including penguins and gannets, have a history of being successfully rehabilitated via cleaning of the birds or temporary removal of breeding pairs to prevent oiling (DEA, 2013, Helm et al. 2015, Tseng & Ziccardi, 2019, Chilvers et al. 2021). However, not all oiled birds would be found, particularly pelagic seabirds. Moreover, even if they are found and cleaned, there can be long term impacts on their ability to breed (Wolfaart et al. 2008).

Furthermore, there can be substantial costs associated with rehabilitating oiled seabirds, particularly if chicks or eggs need to be rescued due to their "parents" being oiled, which significantly extends the timeframe of the response. Due to their Endangered status, the Cape gannet, Cape cormorant and African penguin may be even more sensitive to impacts such as oil spills.

10.2.1.3.1.5 Turtles and Marine Mammals

Impacts of hydrocarbon spills and blowouts on turtles are thought to primarily affect hatchling survival (CSIR and CIME 2011). Turtles encountered offshore would mainly be migrating adults and vagrants. While direct coating of nesting females, contamination of nests and absorption of oil by eggs and hatchlings would occur with heavy shoreline oiling, with far-reaching effects on recruitment success and population status (Putman et al. 2015). However, since the nesting sites in South Africa are all located some 1 000 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 would occur to hatchlings and adults leading to respiratory stress, while coating of eyes, nostrils and mouths with oil would cause vision loss, inhalation and ingestion.

The effects of hydrocarbon pollution on marine mammals are poorly understood (White et al. 2001). Little work has been done on the effect of an oil spill on fur seals, but they are expected to be particularly vulnerable as oil would clog their fur and they would die of hypothermia (Pulfrich, 2015). The most likely immediate impact of an oil spill on cetaceans is the risk of inhalation of volatile, toxic benzene fractions when the oil slick is fresh and unweathered (Scholz et al. 1992). Direct oiling of cetaceans is not considered a serious risk to thermoregulatory capabilities, as cetacean skin is thought to contain a resistant dermal shield that acts as a barrier to the toxic substances in oil (Pulfrich, 2015). Baleen whales may experience fouling of the baleen plates, resulting in temporary obstruction of the flow of water between the plates and, consequently, reduce feeding efficiency. The impact of oil pollution on local and migrating cetacean populations would depend on the timing and extent of the spill. In particular, oil pollution in areas of critical importance to cetaceans, such as near-shore calving grounds of the Southern Right whale or summer feeding grounds off the Cape, would most likely impact populations.

Field observations record few, if any, adverse effects among cetaceans from direct contact with oil, and some species have been recorded swimming, feeding and surfacing amongst heavy concentrations of oil (Scholz et al. 1992). It is assumed that the majority of cetaceans would be able to avoid oil pollution, except where the area of avoidance is critical to population survival. Although adult whales have been noted to swim, and even feed through heavy concentrations of oil, Southern Right whale calves have a far higher surfacing rate than adults and could possibly be affected by inhalation of volatile hydrocarbons (Blood, 2015).

10.2.1.3.1.6 Coastal Environments

A diverse community of fauna and flora are found in the narrow coastal strip between the high-water mark down to the shallow subtidal. These species found here have evolved to cope with the dynamic nature of this habitat and live nowhere else. It is this very strip of habitat which is most heavily affected by oil should a slick come ashore. Indeed, the most sensitive coastal areas are coastal lagoons and estuaries.

While model results indicate a very small probability (0.5 to 1%) that a pipeline rupture would result in oil shore in concentrations that result in sublethal effects threshold for birds on the shoreline (> 10 g/m^2) entering the Knysna Estuary, the impacts of oil entering this system would be of high intensity. Modelling results for Discharge Points 1 and 2 (crude oil) indicate a far higher probability of oil reaching the Knysna Estuary — there is a modelled worst-case, maximum, shoreline impact probability of 100% from George to Gqeberha in winter (July to September), while in autumn (April to June), 98% of shore-line impacts are modelled to occur between Knysna and Gqeberha (Discharge Point 2). The highest probability of oil-shoreline impact after a well blowout occurring in from July to September for both Discharge Points 1 and 2.

Discharge Point 1 has a 42% probability of the oil reaching shore from Knysna to Saint Francis Bay area in spring (Oct-Dec). The Knysna Estuary is one of only three large, permanently-open estuarine bays along the South African coastline. The estuary is considered to be the most ecologically significant estuary in South Africa, representing 42.8 % of all estuarine biodiversity

(Turpie et al. 2002) Knysna is home to a number of critically endangered species, the most famous of which being the Knysna seahorse *Hippocampus capensis*, which is endemic to the Knysna Estuary and wilderness lakes and relies on the survival of the local eelgrass species *Zostera capensis*.

Oil spilled on beaches would results in significant declines in abundance, biomass and diversity of meiofaunal and macrofaunal communities, with recovery of macrofaunal communities typically occurring between 2 and 5 years, but with recovery of burrowing and long-lived species potentially taking up to 10 years on heavily oiled beaches (Bejarano & Michel 2016). Recovery of meiobenthos is typically more rapid. In some cases, recovery of the invertebrate communities is hampered by both re-oiling frequency and the type and degree of beach clean-up following a spill, while in other cases clean-up attempts has promoted recovery.

In the case of oiling of rocky shores, natural recolonisation typically begins after the processes of physical and chemical degradation have started, with recovery of exposed rocky shore communities typically occurring over 3 to 4 years but may take longer on sheltered shores (Sell et al. 1995, Finlayson et al. 2015). Indeed, wave exposed rocky shores are among the least vulnerable environments to oil spills, because wave action enhances processes that act to degrade the oil, and hence facilitate its removal (Gundlach & Hayes 1978, Finlayson et al. 2015).

It is important to note however that “recovery” should not simply mean a reduction of oil residue and potential exposure to toxins (Hayworth et al. 2011) but needs to account for recovery of community structure and function. This may take several years and is strongly dependent on the size of the spill, the sensitivity of the receptors impacted, and the type and extent of clean-up (Newey & Seed 1995, Kingston 2002, Bustamante et al. 2010, Finlayson et al. 2015).

10.2.1.3.2 Sensitivity of Receptors

The sensitivity of receptors, given the presence of a number of critically endangered, endangered and vulnerable species (such as turtle species, various pelagic fish and shark species, sperm whales, Sei whales and the Knysna seahorse), is **high**.

10.2.1.3.3 Impact Magnitude (or Consequence)

The impacts of a worst-case unplanned event (well blowout, pipeline rupture) for operations within Block 11B/12B and Exploratory Priority Area on marine and coastal communities is highly dependent on prevailing metocean conditions at the time of the spill as well as the time of year, duration of the spill and extent and the plume.

For Discharge Point 5 and the pipe leak discharge point (in the western Project Development Area), the intensity of the impact of a condensate spill on pelagic and coastal systems is rated as **high** prior to the implementation of mitigation. Impact intensity on seabirds is also rated as **high**. As spilled condensate is unlikely to impact the benthos (most of it evaporates rapidly, see Section 10.2.1) benthic impacts are assessed as of **low** intensity, with medium confidence because the modelling study for Discharge Point 5 and the pipe leak discharge point did not report on the dissolved component in the water column as it constitutes a very small fraction of the total amount of oil and condensate released, and sub-surface effects are minimal due to the characteristics of the condensate discharged.

For the modelled discharge points in the western Project Development Area, the probability of oil reaching the coast in a form that has been defined to cause ecological harm is exceedingly small (less than 5% for the worst-case, and a 1% probability it reaches the Knysna Estuary). The probability is significantly higher for a blowout at the modelled Exploratory Priority Area wells to the east, especially Discharge Point 2; worst-case results indicate a modelled worst-case, maximum, shoreline impact probability to the Knysna area of 98-100%, depending on season. As such, the intensity of the impact of a crude oil spill on pelagic and coastal systems is rated as **very high** prior to the implementation of mitigation, at Discharge Points 1 and 2 (in the eastern Exploratory Priority Area).

Worst-case model results indicate that for a blowout (depending on season), there is a 90% probability that oil would extend 250 to 290 km from the rupture point to the southwest (for Discharge Point 5 and the pipe leak discharge point), and a 90% probability that oil would extend 135 to 340 km from the rupture point to the southwest (for Discharge Points 1 and 2 to the west). Model results show that surface oil (with >75% probability) would cover a number of EBSAs and MPAs to the south and southwest, and that a crude oil blowout from Discharge Point 1 and Discharge Point 2 would also result in surface over coverage of a number of inshore MPAs.

The worst-case scenario for Discharge Point 1 (in winter) shows that there is a probability of 30 to 50% that the spill would overlap with the Addo Elephant National Park MPA (representing 39.6% of the MPA), 58.6% of the Tsitsikamma MPA, and a 10 to 30% probability of overlapping 95% of the Goukamma MPA. For Discharge Point 2 (also in winter), the worst-case results show that there is a 50 to 70% probability of a surface spill overlapping 28.8% of the Addo Elephant National Park MPA, and a 70 to 90% probability of overlap with the Tsitsikamma MPA (representing 84.61% of the MPA) and 40.47% of the Goukamma MPA.

The spatial extent of a pipeline rupture is smaller than a well blowout, with worst-case model results predicting with 90% probability that oil would extend 10 km from the rupture point in all seasons, depending on season. Because there is a possibility that oil from a well blowout would reach international waters under the worst-case scenario, the extent of the impact is rated as **international**, with a **long-term** duration.

10.2.1.3.4 Impact Significance

Impacts on the ecological systems and communities as a result of a well blowout or a pipe rupture in the western Project Development Area are assessed as **high** (plankton, benthic fauna and fish) to **very high** (sea birds, turtles, marine mammals and coastal environment) and as **very high** **(**plankton, benthic fauna, fish, sea birds, turtles, marine mammals and coastal environment) in the eastern Exploratory Priority Area.

10.2.1.3.5 Identification of Mitigation Measures

Over and above the Project Controls already described in Section 10.2.1.1, the following additional mitigation measures are recommended:

- Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants).
- Ensure that at least 5 m^3 of dispersant is readily available on standby vessels for initial response.
- Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.

- Include in TEEPSA induction programme training on how to handle, capture and transport exhausted or injured birds.
- Schedule joint oil spill exercises including TEEPSA and local departments/organisations to test the oil spill response readiness.
- 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.

10.2.1.3.6 Residual Impact Assessment

The successful implementation of the Project controls (Section 10.2.1.1) and mitigation measures (Section 10.2.1.3.5 reduces the significance of high impacts to **medium**, and very high impacts to **high** (for Discharge Point 5 and pipe leak discharge point in the west). The impacts of a crude oil blowout resulting from exploratory drilling in the east are all rated as **high** with the implementation of mitigations and Project controls. While the probability of occurrence of a blowout at these exploratory wells is low, the implications of a crude oil spill of the magnitude modelled are significant.

10.2.1.3.7 Additional Assessment Criteria

The impact is considered to be **unlikely** for Discharge Point 5 and pipe rupture discharge point in the west, and **possible** for Discharge Points 1 and 2 in the east. The impacts for both are considered to be partially reversible. The mitigation potential is **high** for Discharge Point 5 and pipe leak discharge point in the west, and **medium** for Discharge Points 1 and 2 in the east. The loss of resource is **high**, and the cumulative potential is **possible** for all the sites (Discharge Points 1, 2 5 and pipe rupture).

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.1.4 Impacts on Fisheries and Mariculture

This section was extracted from the Marine Impact Assessment Report (Anchor Environmental, 2023), attached to this ESIA report as Appendix 11.

10.2.1.4.1 Potential Impact Description

There are several possible impacts of large oil/condensate spills on fisheries and mariculture. These include the displacement of species from normal feeding areas, physical contamination of animals (including eggs and larvae) resulting in mortality and/or physiological effects such as clogging of gills, the exclusion of fisheries from polluted areas and gear damage due to oil contamination. These impacts can range from relatively short term to much longer term, if mitigation measures and clean-up efforts are not effective. Various factors influence the scale of impacts of hydrocarbons such as condensate or oil, on the marine environment. The physical properties and chemical composition of the condensate/oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product (Pulfrich 2015), and therefore its impact.

Potential impact descriptions for an unplanned well blowout and pipeline rupture in the Project Development Area, and for an unplanned well blowout in the Exploratory Priority Area, based on the results of the oil spill modelling that was done for these areas, are provided in 10.2.1.4.1.1 and 10.2.1.4.1.2, respectively.

10.2.1.4.1.1 Production Development Area

The potential impacts on fisheries and mariculture as a result of a blowout or pipeline rupture are dependent on the extent and behaviour of a spill i.e., the area affected. The Project Development Area and pipeline locations (both routing options) are in areas where commercial fisheries currently operate. In a pipeline rupture scenario, worst-case model results indicate that there is a 90% probability that a spill would extend 10 km from the rupture point all seasons. In a well blowout scenario, worst-case model results indicate that there is a 90% probability that a spill would extend 250 to 290 km from the rupture point to the southwest, depending on season. Model results indicate that there is a 1% chance that a spill would extend 490 km west for all seasons. Based on these model outputs the uncontrolled spillage would overlap with the operations of a number of commercial and recreational fisheries (Table 10-8, Figure 10-15 to Figure 10-20).

The overlap of the modelled oil spill with each fishery has been calculated for both above and below 50% surface oil probabilities. The overlapping area (% of total fishing area) for both scenarios is presented in Table 10-8 below.

In offshore areas, the impacts of a spill on commercial fisheries would be operational. In the event of a blowout, surface condensate (> 5 µm thick) is expected. Offshore, the greatest impacts are therefore expected for commercial fisheries that regularly deploy and haul gear, which, in the event of a spill, would spatially restrict fishing operations as any fishery that would continue to operate in the area of a spill would damage both gear and catch, directly impacting the fishery. In the event of a spill, fishing may have to be temporarily suspended in oiled waters.

The model results show that during a well blowout scenario, surface condensate presence probability >70% overlaps with the activities of the large pelagic fishery to a large degree, and some offshore demersal trawling to a much smaller degree. The modelling shows a west, south west, directionality for surface condensate and if, as is 90% probable in the modelling scenario, this surface condensate travels 200 km from the discharge point in this direction then substantial overlap with the large pelagic fishery is expected. This fishery would be impacted the most considering both Scenario 1 (well blowout at Discharge Point 5) and Scenario 2 (pipeline rupture).

The behaviour and persistence of the modelled oil spill results suggest the impacts on benthic habitats should be considered minimal in offshore areas. In the nearshore and intertidally, important benthic species of low mobility such as rock lobster, sessile filter feeders (mussels) and grazers are vulnerable to the effects of an uncontrolled oil spill. Particularly vulnerable are mussel and oyster mariculture areas and the highly valuable abalone, *Haliotis midae* (Biccard et al. 2018).

The model results show the highest probability of oil-shoreline impact after a well blowout occurs in winter (Season 3, June-August), with >10 g/m^2 oil predicted to potentially impact some 64 km of shoreline. The maximum oil amount found on shore based on the worst-case scenario (deterministic simulation) is 1.2 to 2.8 tons, with a probability of 1.1 to 4.8%. The probability of oil reaching shore in these concentrations is, however, very low (1 to 5% across all seasons). The impacted shoreline is predicted to comprise Cape St Francis, Oyster Bay, Huisklip Nature Reserve, Thyspunt, Rebelsrus Private Nature Reserve, and Wasserna's Beach.

Small-scale and recreational fisheries operate in the intertidal and typically from the shoreline. The direct effects and vulnerability of many shoreline species, harvested by small-scale recreational and subsistence fishers means impacts associated with an uncontrolled spill are higher for this sector. These sectors also have reduced flexibility in terms of redistribution of effort, considering the extent of coastline potentially impacts by a spill.

There may be a handful of individuals that are considered small-scale but operate further from shore, accessing offshore fishing grounds. These fishers are relatively few in number, but they do exist, particularly on the west coast. Spatial data on the activities of these fishers is lacking, but these fishers are known to be accessing mostly linefishing resources and in some instances resources such as squid (DFFE personal communication, January 2023). Considering this, interactions with Block 11B 12B and its impacts on small-scale fishers, if not coastal, would be captured in the commercial linefishing and squid assessments.

The overlap of the modelled condensate spill with each fishery sector has been calculated for both above and below 50% surface oil probabilities. The overlapping area (% of total fishing area) for both scenarios is presented in Table 10-8 below.

Table 10-8 – Area* of overlap between the fishing grounds of relevant South African commercial fisheries, recreational, and mariculture fisheries and modelled uncontrolled condensate spill results for western Project Development Area

Fishery Sector	Percentage of fishing grounds (>50% probability)	Percentage of fishing grounds (<50% probability)
Scenario 1: Blowout at Discharge Point 5		
Inshore demersal trawl	2.84	36.53
Deepsea trawl	5.82	32.43
Hake longline	4.95	70.43
Mid-water trawl	17.47	53.00
Line fishery	0.00	10.92
Large pelagics	19.99	31.37
Small pelagics	0.00	11.61
Rock lobster	2.66	68.37
Squid jig	0.08	36.33
Recreational	0.00	0.93
Mariculture	0.00	0.00
Scenario 2: Production Pipeline Rupture		
Inshore demersal trawl	0.00	28.25
Deepsea trawl	0.00	16.10
Hake longline	0.06	42.63
Mid-water trawl	0.16	28.85
Line fishery	0.00	3.80
Large pelagics	0.00	5.87
Small pelagics	0.00	16.73

Rock lobster	0.53	25.26
Squid jig	0.00	22.56
Recreational fisheries	0.00	0.00
Mariculture	0.00	0.00
Small-scale fisheries (blowout)	0.04**	23.62**
Small-scale fisheries (pipe rupture)	0.00**	13.18**

*Area is calculated as % of total (national) fishing grounds of each fishery, based on catch and effort data from DFFE and using 'footprint' layers produced for the National Biodiversity Assessment 2018. Area of overlap is calculated for both above and below 50% probabilities of condensate presence (areas of 0% (i.e., no overlap) are not included in the calculations).

**As no small-scale specific area data is available, the overlap with this sector is calculated as % of TAC impacted (% of the TAC for all fisheries combined to which TAC has been allocated to the small-scale sector) rather than total fishing area.

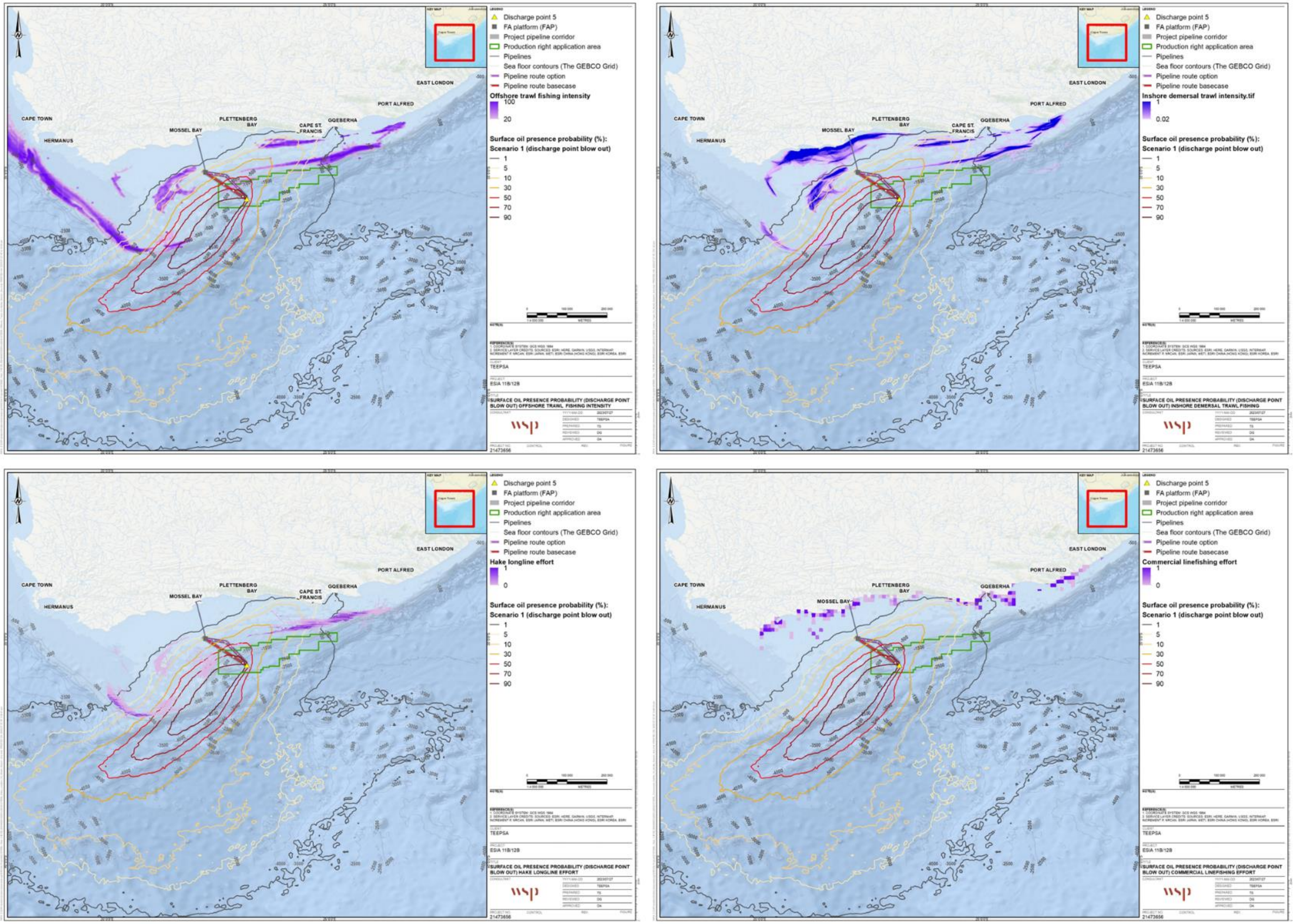

Figure 10-15 - Surface condensate presence probability well blow out model results for all simulations across the full simulation period with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore hake trawl (top left), offshore demersal trawl (top right), hake longline (bottom left) and linefishing (bottom right)

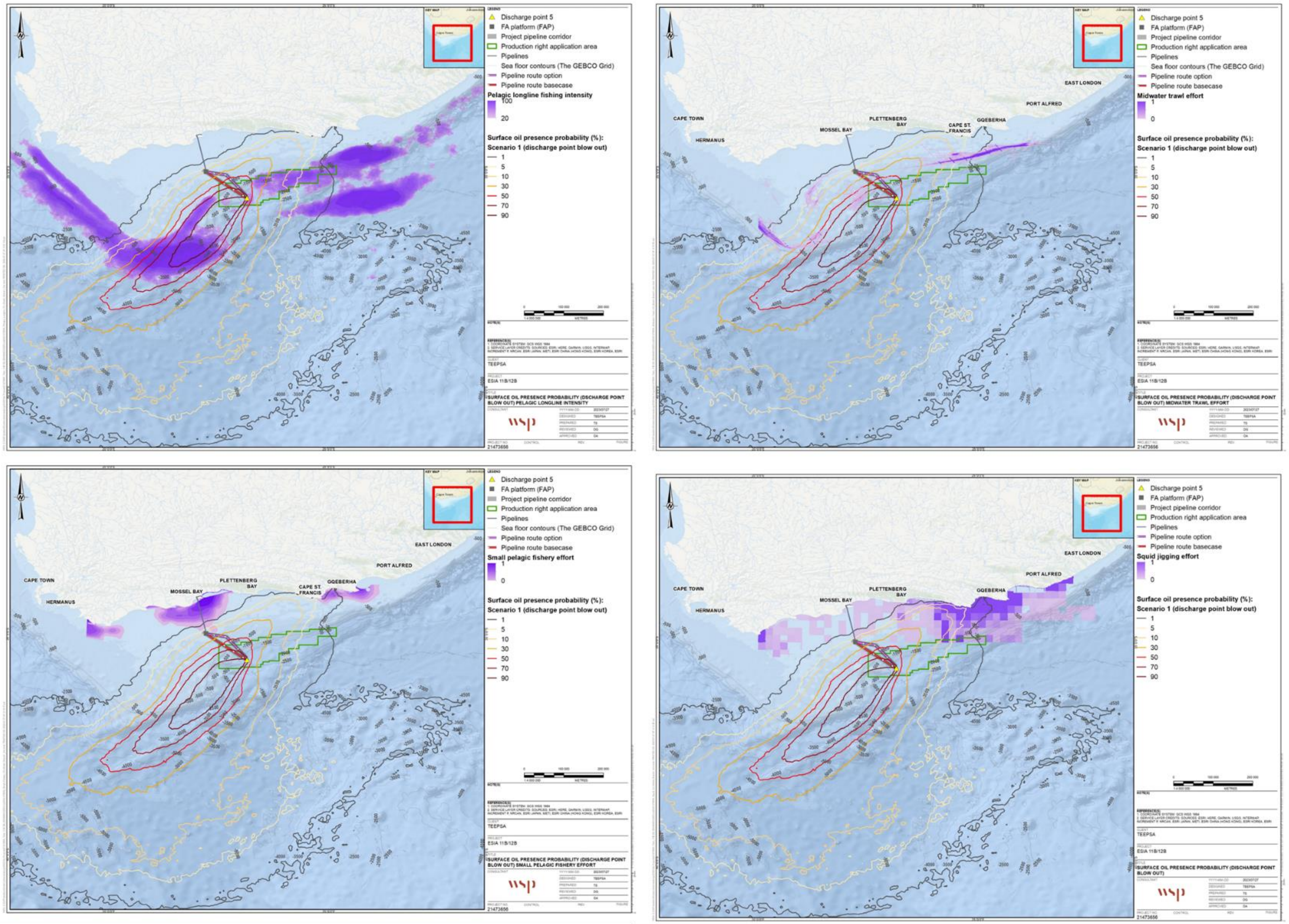

Figure 10-16 - Surface condensate presence probability well blow out model results for all simulations across the full simulation period with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are pelagic longline (top left), midwater trawl (top right), small pelagic purse seine (bottom left) and squid jig (bottom right)

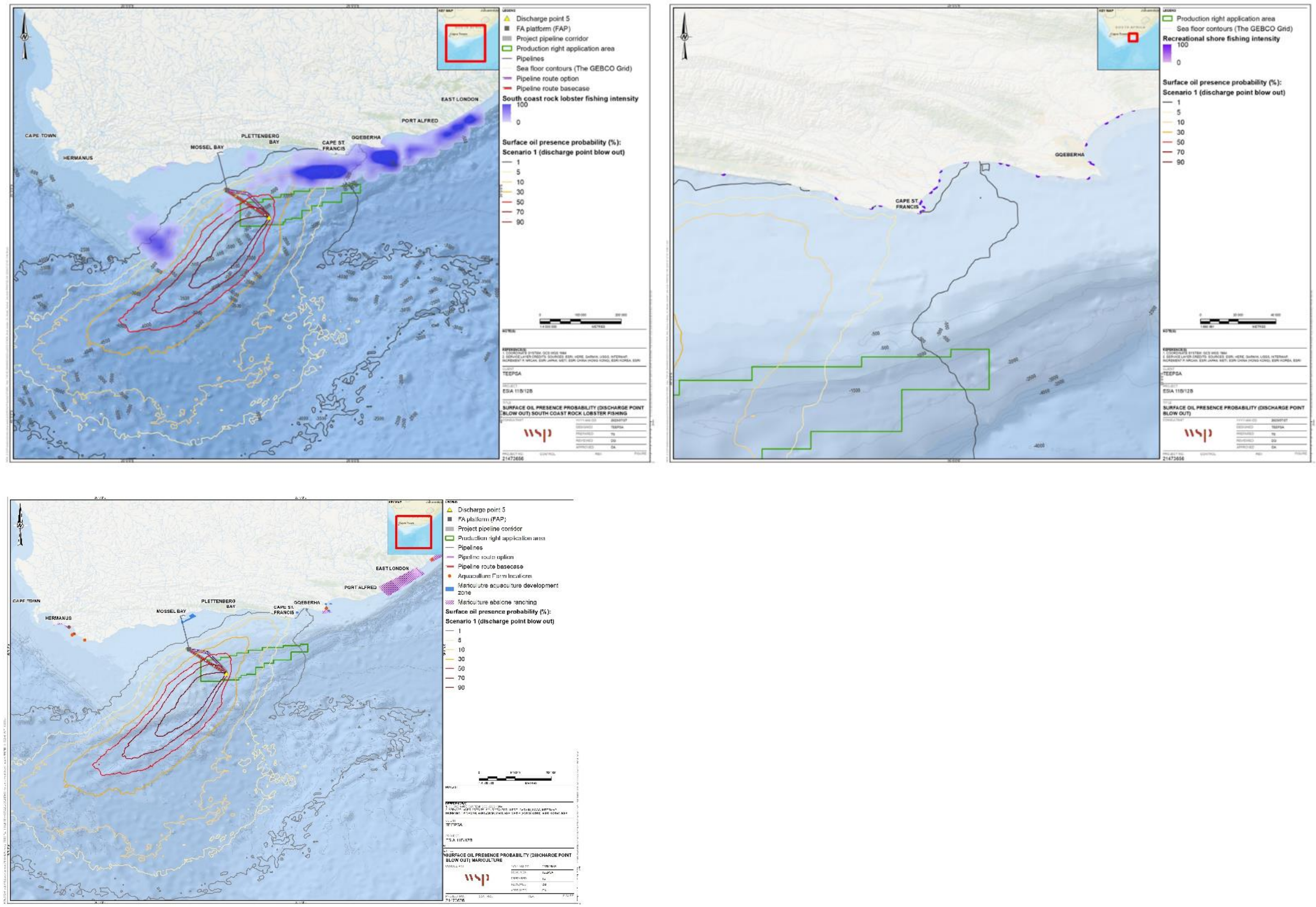

Figure 10-17 - Surface condensate presence probability well blow out model results (red gradients) for all simulations across the full simulation period with fishing activity for each affected fishery overlaid (blue gradients). Fisheries shown are south coast rock lobster (left), recreational shore angling (right), and mariculture (bottom)

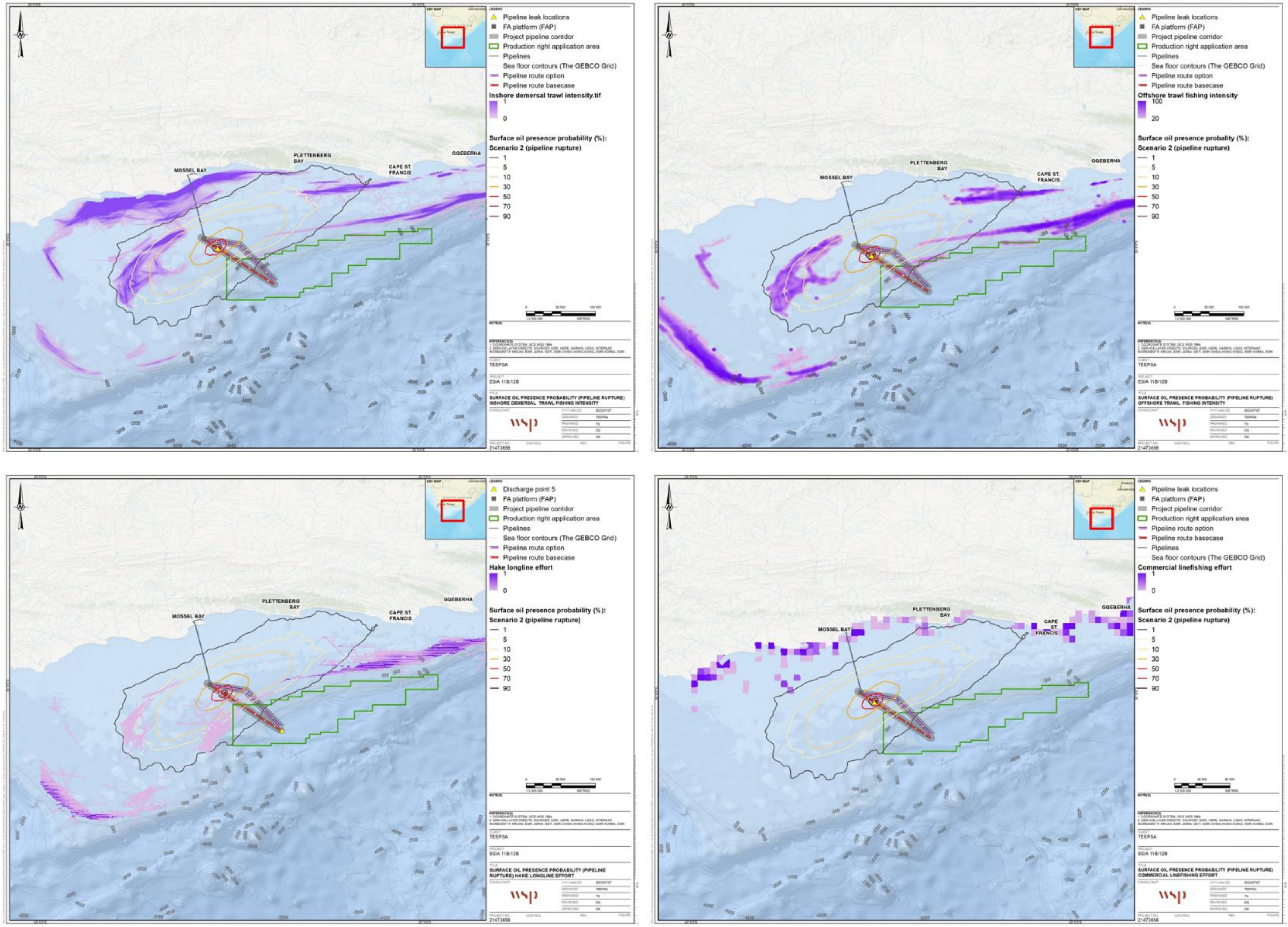

Figure 10-18 - Surface condensate presence probability pipeline rupture model results for all simulations across the full simulation period with fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore hake trawl (top left), offshore demersal trawl (top right), hake longline (bottom left) and linefishing (bottom right)

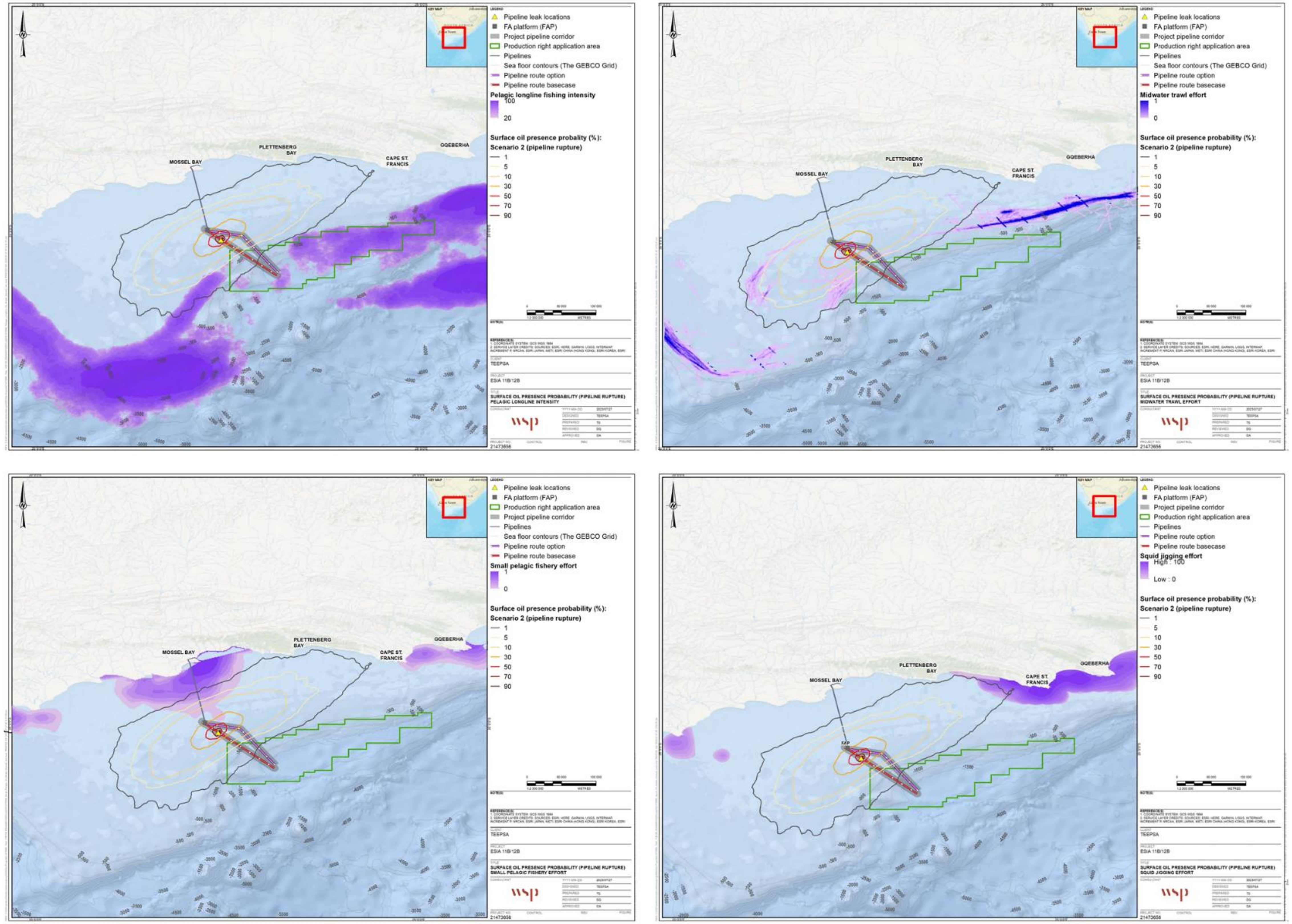

Figure 10-19 - Surface condensate presence probability pipeline rupture model results (red gradients) for all simulations across the full simulation period with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are pelagic longline (top left), midwater trawl (top right), small pelagic purse seine (bottom left) and squid jig (bottom right)

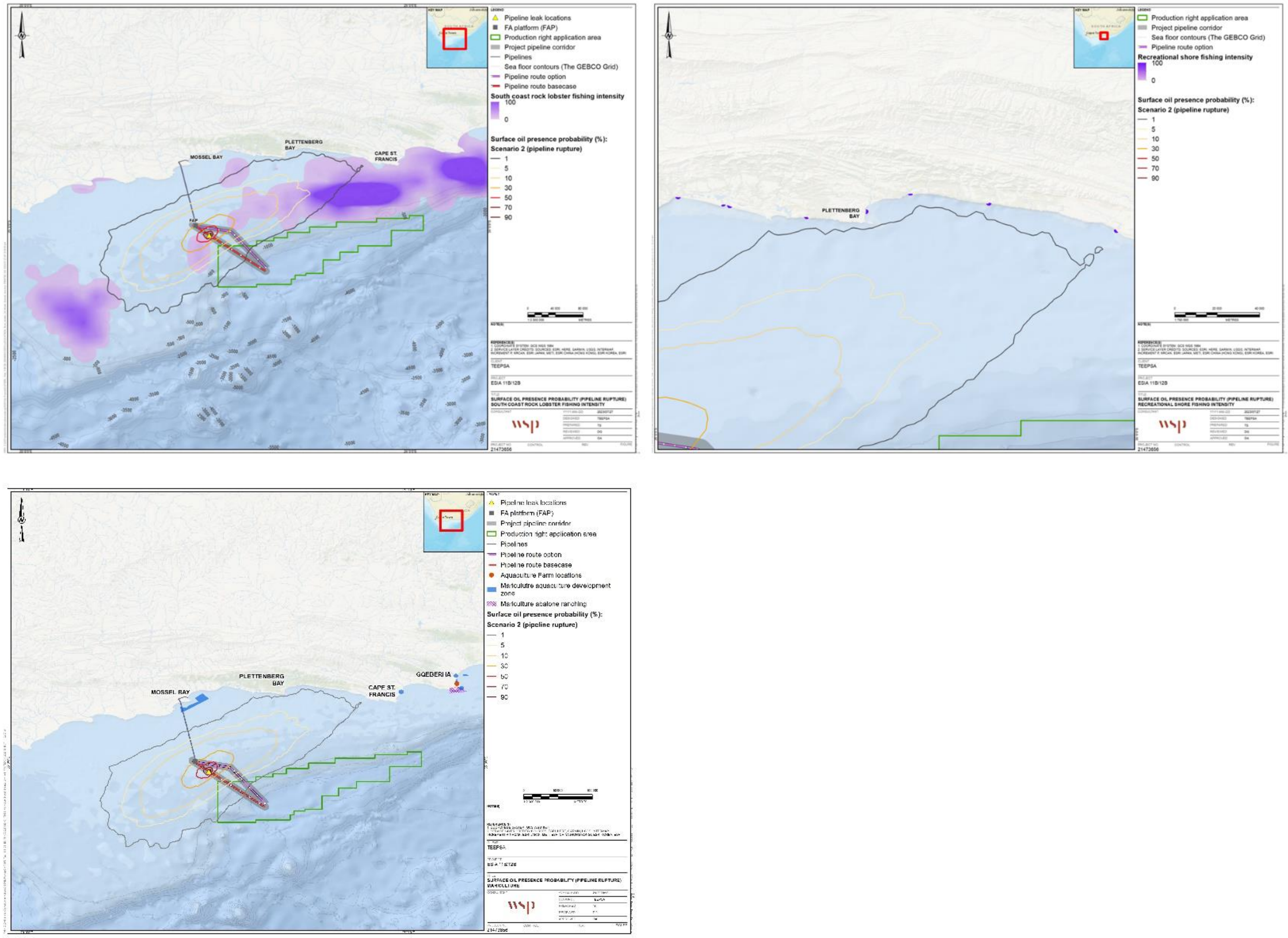

Figure 10-20 - Surface condensate presence probability pipeline rupture model results for all simulations across the full simulation period with fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are south coast rock lobster (left), recreational shore angling (right) and mariculture (bottom)

10.2.1.4.1.2 Exploratory Priority Area

Crude oil spills can have a significant impact on fisheries resources. These impacts can include physical contamination, toxic effects on stock, and direct disruption of fishing activities (Andrews et al. 2021). Oil spills can cause serious damage to the environment, including marine habitats and fish, and can also have negative effects on small-scale fisheries and coastal communities that rely on shore-based harvesting of marine resources and economic income through fishing (Andrews et al. 2021).

Some of the spilled oil may evaporate, while some may mix with water and form an emulsion. Emulsification, if it occurs, has a great effect on the behaviour of oil spills at sea. Over time, some of the oil may sink to the bottom of the ocean and settle on the seabed. The fate of crude oil in the water column is complex and depends on many factors.

Crude oil spills can have a significant impact on benthic habitats and the marine life that inhabit them. Oil can harm marine life in two ways: from the oil itself and from the response or clean-up operations (Andrews et al. 2021). Oil spills are harmful to marine birds, mammals, fish, and shellfish (Andrews et al. 2021). Fish and shellfish may not be exposed immediately but can come into contact with oil if it is mixed into the water column. When exposed to oil, adult fish may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion, and reproduction impairment. Fish eggs and larvae can be especially sensitive to lethal and sublethal impacts (Andrews et al. 2021). Even when lethal impacts are not observed, oil can make fish and shellfish unsafe for humans to eat.

A serious threat of oil spills to fisheries is the economic loss arising from business interruption. Oil on and in the water, and on the seabed, would temporarily disrupt fishing and impact normal production (and therefore income). It could also lead to a loss of market confidence may occur leading to price reductions or outright rejection of seafood products by commercial buyers and consumers.

Based on the modelling results for the two wells in the eastern part of Block 11B/12B, the impact of an unplanned oil spillage has been assessed (see Section 9.1.6.1.4). The worst-case scenario (i.e., summer) of the surface probability modelling results has been used for this impact assessment.

The impacts of crude oil in the marine system on the direct fishing activities and on the key fishery resources and benthic environment have all been considered. In general, the impact of a crude oil spillage is significant, overlapping with the fishing grounds of most major fisheries of South Africa (demersal trawl, midwater trawl, commercial linefishing, large pelagic longline, small pelagic purse seine, squid jig, south coast rock lobster) small-scale and recreational fisheries (Table 10-9, Figure 10-21 to Figure 10-26).

In terms of the most affected fisheries, hake longline, midwater trawl and south coast rock lobster fisheries would have significant direct impacts with over 20% of their fishing grounds >50% likely to be covered by crude oil in the event of a spillage (**Table 10-9**) from Discharge Point 1, while spillage from Discharge Point 2 would cover over 20% of grounds of these three fisheries, plus the squid fishery. This would result in significant disruption to fishery operations in those areas in the short term but impacts of crude oil persisting in the marine system would impact the resource for much longer than this.

The length of time that crude oil remains in the marine environment after a spill can vary greatly depending on a number of factors, including the type of oil spilled, the location of the spill, weather conditions, and the effectiveness of clean-up efforts. In some cases, toxic chemicals from oil spills can remain in the ocean for years, sinking down to the seafloor and poisoning the sediment (Zhang et al. 2019). The damage caused by oil spills can be long-term and in some cases possibly irreparable (World Economic Forum, 2021). It is important to note that the effects of an oil spill can continue to impact marine life and the environment for years after the initial spill event. This would be of particularly concern for demersal fish species such as hake, monk and others. Demersal trawl fisheries would therefore be greatly negatively impacts by crude oil spillage.

The model results for both Discharge Points 1 and 2 predict that a large degree of the South African southern coastline would experience oil spill surface coverage (over 500 km of coastline have a 30% chance of being exposed to crude oil in the event of a spillage).

Small-scale and recreational fishers that operate on the south coast (coastline and offshore e.g., those targeting squid) would be significantly impacted by the modelled crude oil spill though significant interruption to normal fishing activities and would be detrimental to the populations of species they target (allocated within the small-scale 'basket' of species).

On the coastline, 23.64 % of small-scale fishing grounds are >50% likely to be covered by crude oil in the event of a spillage from Discharge-1, while spillage from Discharge-2 would cover over 15.97 % of small-scale fishing grounds (Table 10-9). Offshore, the intersection between the modelled oil spill with small-scale fisheries have been assessed slightly differently using % of TAC impacted rather than total fishing area as this is not assumed (Table 10-9). As TAC for squid and hake are defined, with the remainder of species in the small-scale 'basket' currently without TAC allocations, this is likely an underestimate.

The model results for both Discharge Points 1 and 2 predict that particularly in Spring and Summer, the oil spill surface coverage extends into the Western Cape to Cape Town (1-5% probability). The stretch of coast between Hermanus to Quoin Point Nature Reserve would be impacted and this is where a number of abalone mariculture farms operate (**Figure 10-23**).

Table 10-9 – Area* of overlap between the fishing grounds of relevant South African commercial fisheries (and small-scale and recreational fisheries and mariculture activities) and modelled uncontrolled oil spill results (worst case scenario), for Discharge Point 1 and 2 in the Exploratory Priority Area in the east

Fishing Sector	Percentage of fishing grounds (>50% probability)	Percentage of fishing grounds (<50% probability)
Discharge Point 1		
Inshore demersal trawl	7.08	89.10
Deepsea trawl	7.50	50.06
Hake longline	21.96	79.89
Mid-water trawl	28.07	67.45
Line fishery	0.00	80.17
Large pelagics	12.22	21.26
Small pelagics	0.00	99.39
Rock lobster	42.38	55.46
Squid jig	5.26	78.53
Recreational fisheries	0.00	23.64
Mariculture	0.00	72.2
Discharge Point 2		
Inshore demersal trawl	21.19	62.49
Deepsea trawl	16.68	32.32
Hake longline	50.84	43.02
Mid-water trawl	43.52	43.07
Line fishery	10.68	60.34
Large pelagics	8.31	19.03
Small pelagics	5.91	85.69
Rock lobster	20.98	19.11
Squid jig	26.61	43.44
Recreational	3.19	15.97
Mariculture	0.00	30.00
Small-scale fisheries (Discharge Point 1)	2.63**	79.1**
Small-scale fisheries (Discharge Point 2)	35.91**	51.89**

*Area is calculated as % of total (national) fishing grounds of each fishery, based on catch and effort data from DFFE and using 'footprint' layers produced for the National Biodiversity Assessment 2018. Area of overlap is calculated for both above and below 50% probabilities of oil presence (areas of 0% (i.e., no overlap) are not included in the calculations). **As no small-scale specific area data is available, the overlap with this sector is calculated as % of TAC impacted (% of the TAC for all fisheries combined to which TAC has been allocated to the small-scale sector) rather than total fishing area.

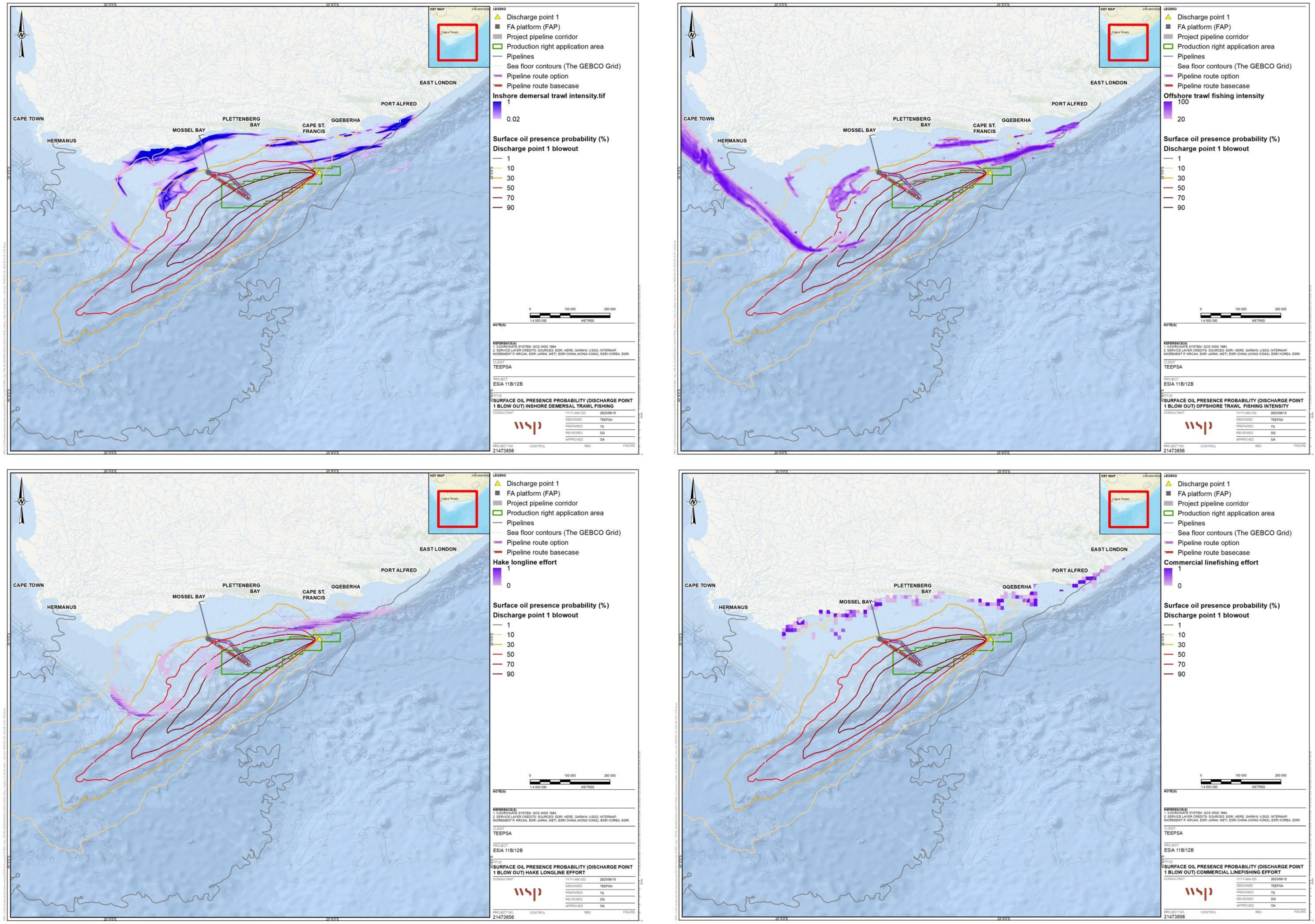

Figure 10-21 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 1, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore hake trawl (top left), offshore demersal trawl (top right), hake longline (bottom left) and linefishing (bottom right)

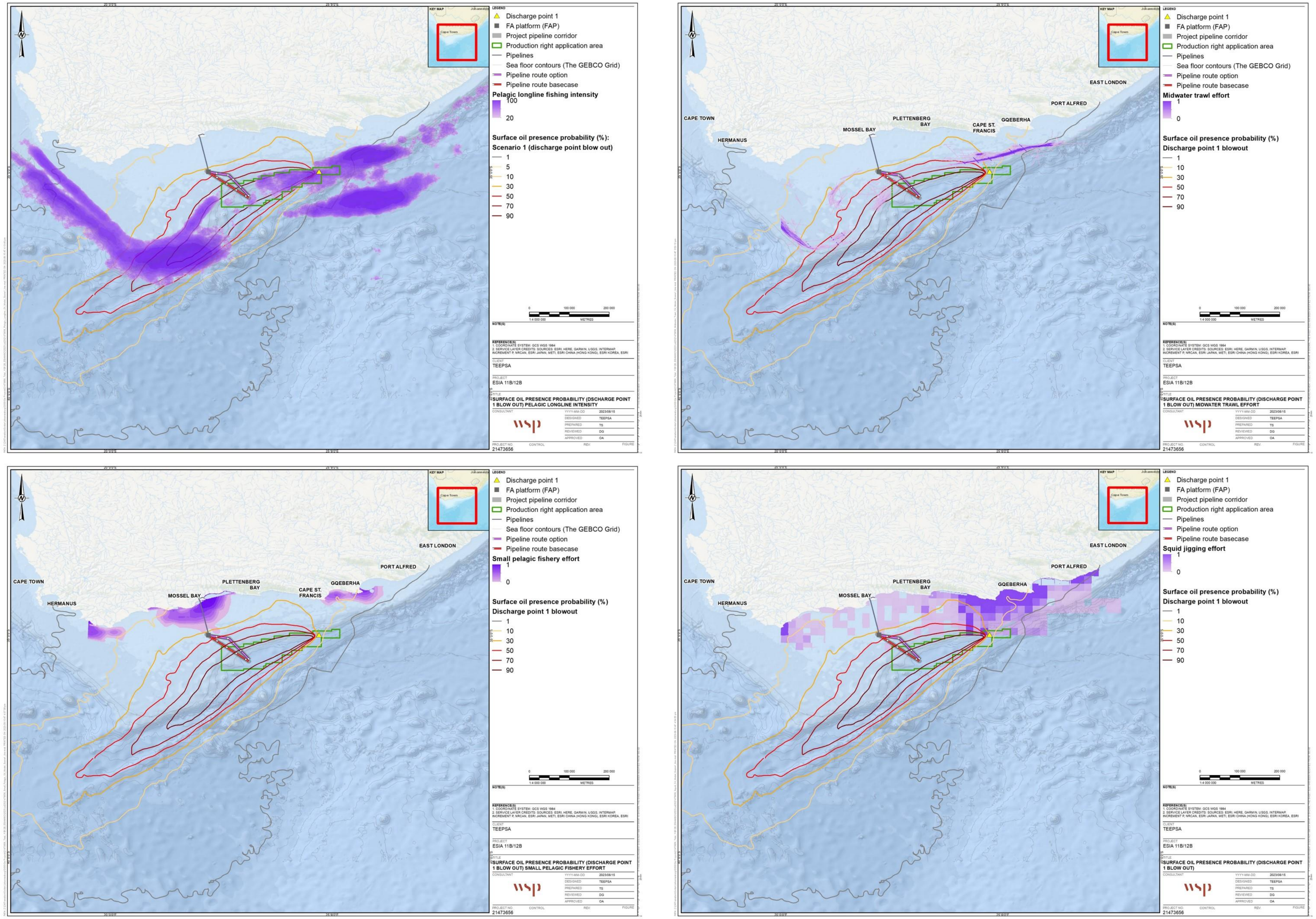

Figure 10-22 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 1, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore pelagic longline (top left), midwater trawl (top right), small pelagic purse seine (bottom left) and squid jigging (bottom right)

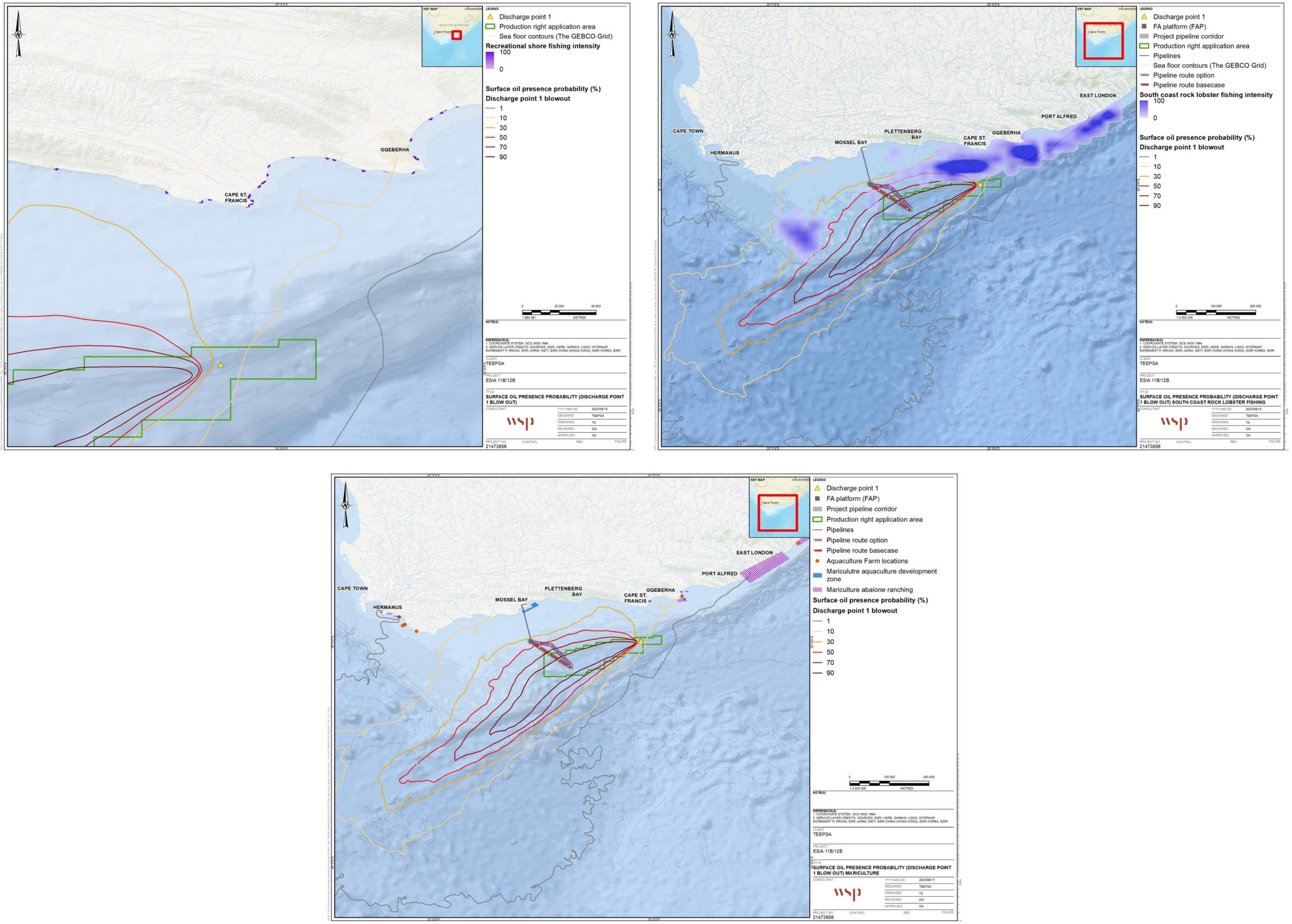

Figure 10-23 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 1, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are south coast rock lobster (left), recreational fisheries (right) and mariculture (bottom)

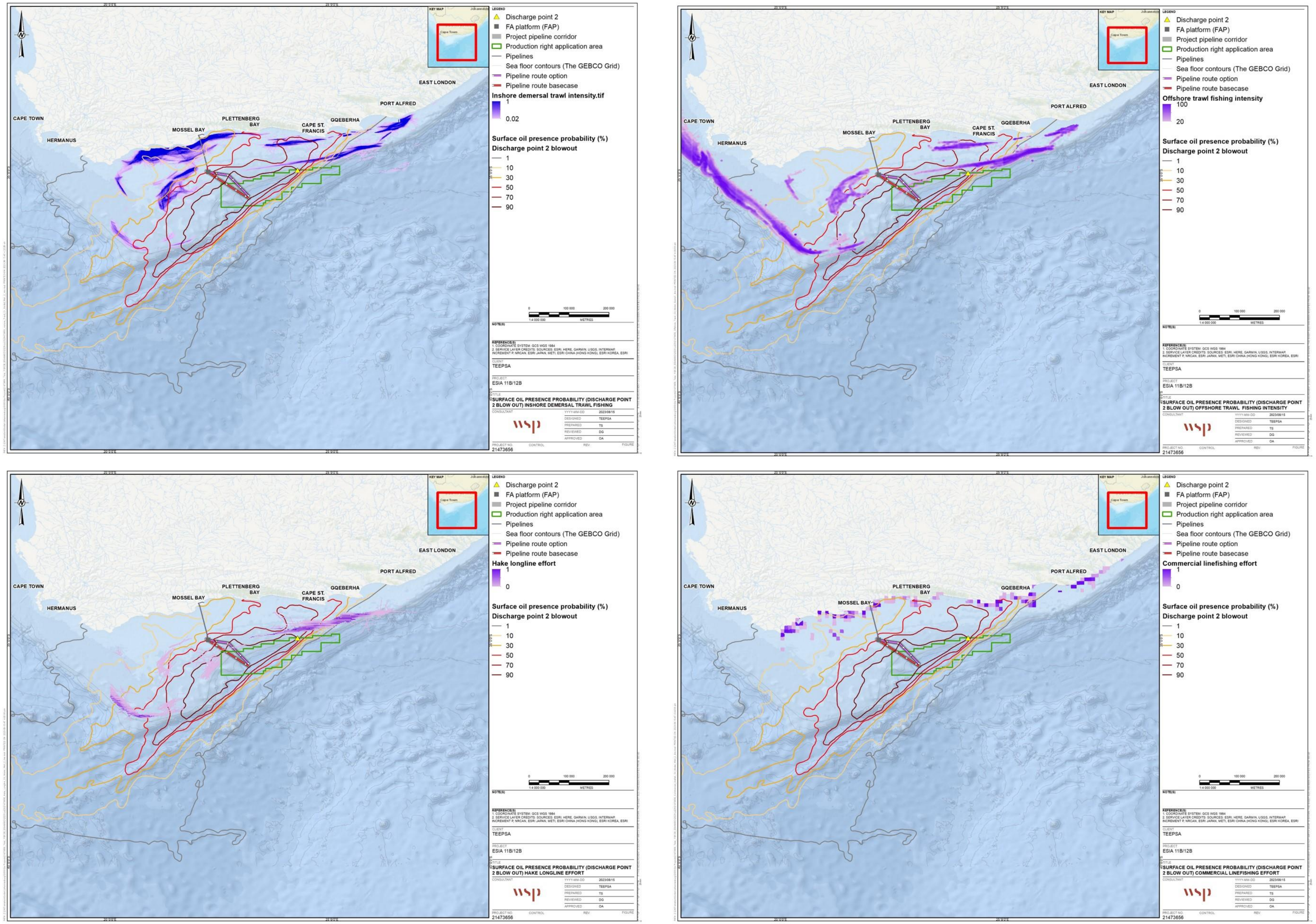

Figure 10-24 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 2, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore hake trawl (top left), offshore trawling (top right), hake longline (bottom left), commercial longline (bottom right)

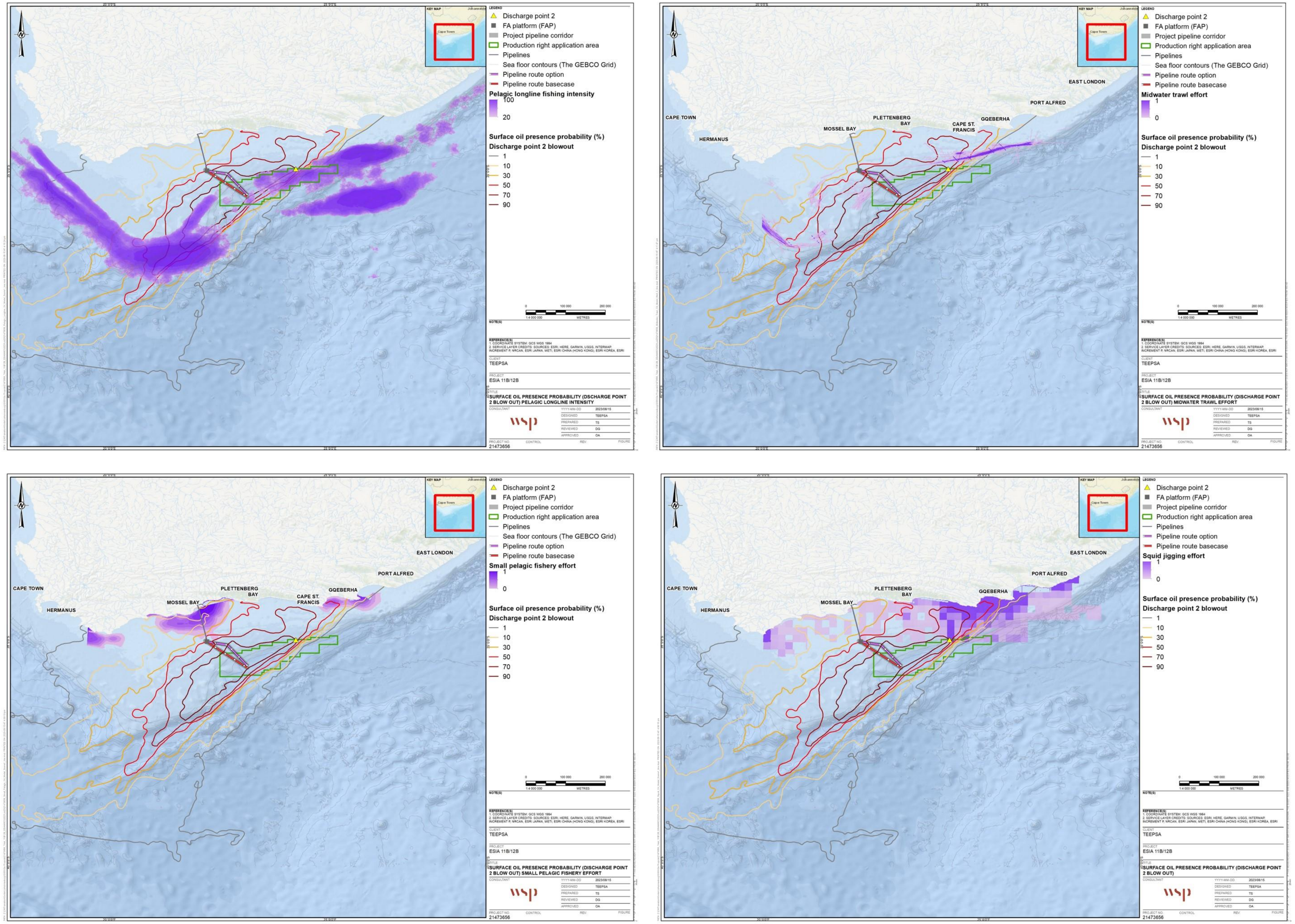

Figure 10-25 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 2, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are inshore pelagic longline (top left), midwater trawl (top right), small pelagic purse seine (bottom left) and squid jigging (bottom right)

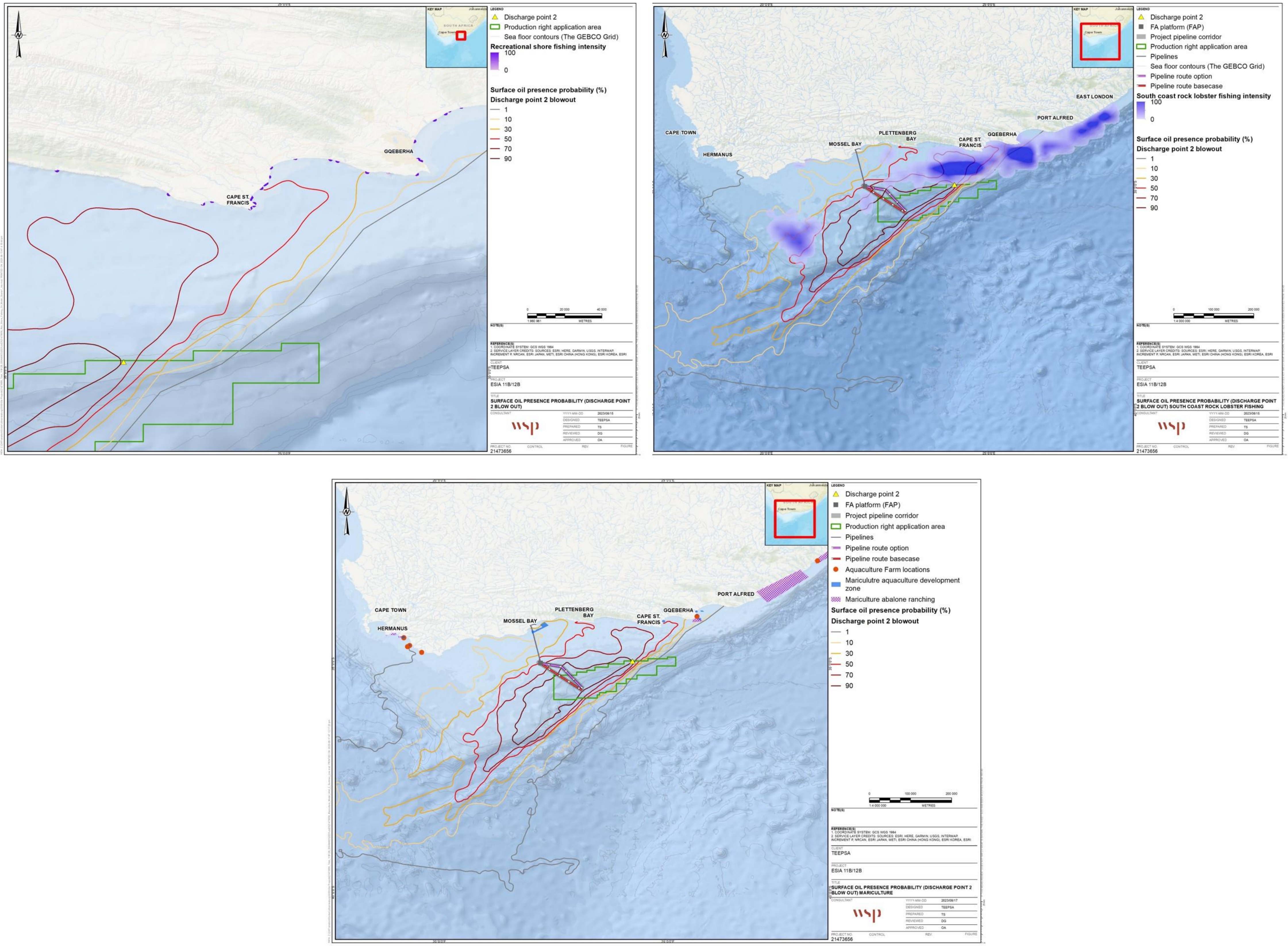

Figure 10-26 - Crude oil surface presence probability model results for worst case scenario (Summer) for Discharge Point 2, with commercial fishing activity for each affected fishery overlaid (purple gradients). Fisheries shown are south coast rock lobster (left), recreational fishing (right) and mariculture (bottom)

10.2.1.4.2 Sensitivity of Receptors

The sensitivity of the receptors is rated as **high**.

10.2.1.4.3 Impact Magnitude (or Consequence)

For Discharge Point 5 and the pipe leak discharge point (in the western Project Development Area), the intensity of impacts on receptors was rated as **high**, without mitigation,. Impacts of condensate on the surface from a spill on commercial fisheries persist over the **medium-term** but due to the potential extent of the spread of the spill and the potential suspension of fishing practices extent is considered to be on the **regional scale**.

For Discharge Points 1 and 2 (in the eastern Exploratory Priority Area), prior to mitigation, impacts would be of **high** intensity, covering an area beyond South Africa EEZ (international) and persist in the **long term** (2 to 25 years). With mitigation, impact intensity remains **high**, but the extent is reduced to **regional** and duration to **medium term**.

10.2.1.4.4 Impact Significance

For Discharge Point 5 and the pipe leak discharge point (in the western Project Development Area), impact significance on all fishing sectors was considered as **high**, without mitigation, despite probability being low. Impact significance for all fishing sectors however was reduced to **medium** with mitigation in place.

For Discharge Points 1 and 2 (in the eastern Exploratory Priority Area), given the likelihood (probability) based on the modelling results, the significance of crude oil spillage from Discharge Points 1 and 2 (worst-case scenario) on all fishing sectors is rated **very high** without mitigation and is **high**, with mitigation.

10.2.1.4.5 Identification of Mitigation Measures

Over and above the Project Controls already described in Section 10.2.1.1, the following additional mitigation measures are recommended:

- Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants).
- Ensure that at least 5 m^3 of dispersant is readily available on standby vessels for initial response.
- Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.
- Include in TEEPSA induction programme training on how to handle, capture and transport exhausted or injured birds.
- Schedule joint oil spill exercises including TEEPSA and local departments/organisations to test the oil spill response readiness.
- 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.
- Ensure that the location of the subsea infrastructure and production pipeline, once installed, is surveyed and marked on bathymetric and navigation charts as a hazard. Maritime shipping, commercial and small-scale fishing sectors must be notified of the presence of the infrastructure, to avoid damages to the infrastructure.

10.2.1.4.6 Residual Impact Assessment

For Discharge Point 5 and the pipe leak discharge point (in the western Project Development Area), the significance of an uncontrolled condensate spill on all fishing sectors is reduced to **medium**, after the implementation of the mitigation measures.

For Discharge Points 1 and 2 (in the eastern Exploratory Priority Area), the significance of crude oil spillage on all fishing sectors is **high**, with mitigation.

10.2.1.4.7 Additional Assessment Criteria

The impact is considered to be **unlikely** for the Discharge Point 5 and pipe rupture discharge points in the west, and **possible** for Discharge Points 1 and 2 in the east. The impacts for both are considered to be partially reversible. The mitigation potential is **high** for Discharge Point 5 and pipe leak discharge point in the west, and **medium** for Discharge Points 1 and 2 in the east. The loss of resource is **high**, and the cumulative potential is **possible** for all the discharge points (1, 2, 5 and pipe rupture).

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.1.5 Economic Impacts on Fishing Industry

10.2.1.5.1 Potential Impact Description

Commercial, recreational and small-scale fisheries could be negatively affected from an economic perspective as a result of impacts on fish populations resulting from a well blowout or a pipeline rupture in Block 11B/12B. Furthermore, surface oil can damage fisherman gear and catch. In such an event, fishing would have to be suspended until a clean-up is completed and the impact of oil subsides. It cannot be assumed that all lost catch as a result of an unplanned event would be replaceable by avoiding the areas to be impacted. It is also likely that by avoiding affected areas, additional costs would have to be incurred, particularly fuel costs. Furthermore, increasing travel times between catching and offloading affects the quality of the fish.

The tables below provide an estimate of the areas of fishing grounds that may be affected by a well blowout and pipeline rupture in the western Project Development Area (Table 10-10) and well blowout in the eastern Exploratory Priority Area (Table 10-11) of Block 11B/12B.

The western Project Development Area (Table 10-10) estimates the largest economic impact for a well blowout on the respective fishing industries is on the deepsea trawl industry. Considering the employment numbers of the various industries, the deepsea trawl, squid jig and hake longline industries would be the most affected by a well blowout. For a pipeline rupture, the deepsea trawl and small pelagic industries would be highly affected in economic value and employment numbers.

Table 10-10 - Estimated overlap of modelled well blowout and pipeline rupture oil spill in the western Project Development Area, with commercial industry areas and the economic impact thereof (Urban Econ, 2023)

Commercial industry areas	*Percentage of fishing grounds (>50% probability)	*Percentage of fishing grounds (<50% of probability)	Direct estimated economic impact given the size of the industry	Direct estimated employment
Scenario 1: Blowout (Discharge Point 5)				
Inshore demersal trawl	2.84	36.53	R9.9 million – R127.9 million	43 – 548 jobs
Deepsea trawl	5.82	32.43	R261.9 million – R1 459.4 million	425 – 2 367 jobs
Hake longline	4.95	70.43	R18.0 million – R255.7 million	87 – 1 233 jobs
Mid-water trawl	17.47	53.00	R69.0 million – R212.0 million	44 – 133 jobs
Line fishery	0.00	10.92	R0 – R71.0 million	0 – 826 jobs
Large pelagics	19.99	31.37	*No information available on industry size*	
Small pelagics	0.00	11.61	R0 – R371.5 million	0 – 673 jobs
Rock lobster	2.66	68.37	R8.0 million – R205.1 million	11 – 273 jobs
Squid jig	0.08	36.33	R0.9 million – R309.5 million	2 – 1 069 jobs
Recreational fisheries	0.00	0.93	*No information available on industry size*	
Small-scale fisheries	0.04**	23.62**	*No information available on industry size*	
Scenario 2: Pipeline Rupture				
Inshore demersal trawl	0.00	28.25	R0 – R98.9 million	0 – 424 jobs
Deepsea trawl	0.00	16.10	R0 – R727.5 million	0 – 1 175 jobs
Hake longline	0.06	42.63	R0.2 million – R154.7 million	1 – 746 jobs
Mid-water trawl	0.16	28.85	R0.6 million – R115.4 million	0 – 72 jobs
Line fishery	0.00	3.80	R0 – R24.7 million	0 – 287 jobs
Large pelagics	0.00	5.87	*No information available on industry size*	
Small pelagics	0.00	16.73	R0 – R535.4 million	0 – 970 jobs
Rock lobster	0.53	25.26	R1.6 million – 75.8 million	2 – 101 jobs
Squid jig	0.00	22.56	R0 – R242.5 million	0 – 664 jobs
Recreational fisheries	0.00	0.00	*No information available on industry size*	
Small-scale fisheries	0.00**	13.18**	*No information available on industry size*	

*Area is calculated as % of total (national) fishing grounds of each fishery, based on catch and effort data from DFFE and using 'footprint' layers produced for the National Biodiversity Assessment 2018. Area of overlap is calculated for both above and below 50% probabilities of oil presence (areas of 0% (i.e., no overlap) are not included in the calculations). **As no small-scale specific area data is available, the overlap with this sector is calculated as % of TAC impacted (% of the TAC for all fisheries combined to which TAC has been allocated to the small-scale sector) rather than total fishing area.

Given the size of the respective fishing industries in terms of their commercial value, the largest economic impact, as a result of an uncontrolled oil spill in the eastern Exploratory Priority Development Area, is estimated to be on the deepsea trawl and pelagic fish industries (Table 10-11). Taking into consideration the employment numbers of the various industries, the deepsea trawl, line fishing and small pelagic industries may be the most affected.

Table 10-11 - Estimated overlap of modelled well blowout oil spill in the eastern Exploratory Priority Area, with commercial industry areas and the economic impact thereof (Urban Econ, 2023)

Commercial industry areas	Percentage* of fishing grounds (>50% probability)	Percentage* of fishing grounds (<50% of probability)	Direct estimated economic impact given the size of the industry	Direct estimated employment
Scenario 1: Blowout (Discharge Point 1)				
Inshore demersal trawl	7.08	89.10	R24.8 million – R311.9 million	106 – 1 337 jobs
Deepsea trawl	7.50	50.06	R337.5 million – R2 252.7 million	548 – 3 654 jobs
Hake longline	21.96	79.89	R79.7 million – R290.0 million	384 – 1 398 jobs
Mid-water trawl	28.07	67.45	R112.3 million – R269.8 million	70 – 169 jobs
Line fishery	0.00	80.17	R0 – R384.8 million	0 – 5 844 jobs
Large pelagics	12.22	21.26	*No information available on industry size*	
Small pelagics	0.00	99.39	R0 – R3 180.5 million	0 – 5 765 jobs
Rock lobster	42.38	55.46	R127.1 million – R166.4 million	170 – 222 jobs
Squid jig	5.26	78.53	R56.5 million – R844.2 million	155 – 2 311 jobs
Recreational fisheries	0.00	23.64	*No information available on industry size*	
Mariculture	0.00	72.2	*No information available on industry size*	
Small-scale fisheries	2.63**	79.1**	*No information available on industry size*	
Scenario 2: Well Blowout (Discharge Point 2)				
Inshore demersal trawl	21.19	62.49	R72.4 million – R218.7 million	318 – 937 jobs
Deepsea trawl	16.68	32.32	R750.6 million – R1 454.4 million	1 218 – 2 359 jobs
Hake longline	50.84	43.02	R184.5 million – R156.2 million	890 – 753 jobs

Commercial industry areas	Percentage* of fishing grounds (>50% probability)	Percentage* of fishing grounds (<50% of probability)	Direct estimated economic impact given the size of the industry	Direct estimated employment
Mid-water trawl	43.52	43.07	R172.3 million – R174.1 million	753 – 890 jobs
Line fishery	10.68	60.34	R51.3 million – R289.6 million	779 – 3 527 jobs
Large pelagics	0.00	5.87	*No information available on industry size*	
Small pelagics	5.91	85.69	R189.1 million – R2 742.1 million	343 jobs – 4 970 jobs
Rock lobster	20.98	19.11	R57.3 million – R62.9 million	76 – 84 jobs
Squid jig	26.61	43.44	R286.1 million – R467.0 million	783 – 1 278 jobs
Recreational fisheries	3.19	15.97	*No information available on industry size*	
Mariculture	0.00	30.00	*No information available on industry size*	
Small-scale fisheries	35.91**	51.89**	*No information available on industry size*	

*Area is calculated as % of total (national) fishing grounds of each fishery, based on catch and effort data from DFFE and using 'footprint' layers produced for the National Biodiversity Assessment 2018. Area of overlap is calculated for both above and below 50% probabilities of oil presence (areas of 0% (i.e., no overlap) are not included in the calculations). **As no small-scale specific area data is available, the overlap with this sector is calculated as % of TAC impacted (% of the TAC for all fisheries combined to which TAC has been allocated to the small-scale sector) rather than total fishing area.

10.2.1.5.2 Sensitivity of Receptors

The commercial, recreational and small-scale fishing industries have a **high** sensitivity to any negative impact on fish due to an uncontrolled oil spill stemming from a well blowout or pipe rupture.

10.2.1.5.3 Impact Magnitude

For the western Project Development Area, despite the low probability of occurrence, the intensity of the impact on commercial fishing activities is considered **high,** given the modelling results of potential overlap with fishing grounds and the estimated value of the commercial fishing industries. Given the potential spread of condensate on the water surface, the impact on fisheries is considered to be **regional**. However, the impacts are considered to be only over a **medium-term** period. As such, the impact magnitude on the fishing industry is classified as **high**.

For the eastern Exploratory Priority Area, the intensity of the impact on the fishing industry is considered **high,** given the modelling results of potential overlap with fishing grounds and the estimated value of the fishing industries. Given the potential spread of oil on the water surface, the impact on fisheries is considered to be **regional** and over a **long-term** period. As such, the impact magnitude on the fishing industry is rated as **very high**.

10.2.1.5.4 Impact Significance

For the western Project Development Area, based on the high impact magnitude on the commercial fishing industry and the high sensitivity of any negative impact on the fishing industry, the negative impact is considered to be of **high** significance.

For the eastern Exploratory Priority Area, given the very high impact magnitude on the fishing industry and the high sensitivity of any negative impact on the fishing industry, the impact significance is considered to be **very high**.

10.2.1.5.5 Identification of Mitigation Measures

Over and above the Project controls listed in 10.2.1.1, the following mitigation measure is proposed:

- Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises.
- TEEPSA will seek to work with the relevant local authorities and civil society organisations with regard to the development and implementation of the emergency response plan in the unlikely event of a large oil spill.

10.2.1.5.6 Residual Impact Assessment

For the western Project Development Area, by implementing the Project controls and mitigation measures, the impact intensity will range from low to medium depending on the fishing industry. The magnitude of the potential negative impact on the fishing industry will therefore be low post mitigation. While the sensitivity will remain high, the economic impact post-mitigation is considered to be of **medium** significance.

For the eastern Exploratory Priority Area, by implementing the Project controls and mitigation measures, the impact intensity will remain high due to the long-term nature of the potential negative impact on fisheries. The significance of the potential negative impact on the fishing industry will therefore be **high** post-mitigation.

10.2.1.5.7 Additional Assessment Criteria

The negative impact on the fishing industry in monetary terms as a result of an uncontrolled oil spill is considered to be **unlikely** and **partially reversible**. Depending on the industry, there will be a variable loss of resources in terms of access to fishing grounds or the quality and quantity of fish available. The loss of resources are therefore considered to be **medium** to **high**, depending on the area, and the cumulative potential is **unlikely**.

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.1.6 Economic Impacts on Tourism

10.2.1.6.1 Potential Impact Description

Based on the modelling results, should a well blowout or pipeline rupture occur in Block 11B/12B, there is a possibility for the shoreline to be affected which would have a negative impact on tourism and the local economy in the affected area. If access to the shoreline is restricted for tourists or if there is a perception that their experience would be affected, fewer tourists may choose to visit the affected areas. The tourism industry is an important component of the local economy in the immediate zone of influence.

In the event of a well blowout in the western Project Development Area, there is less than 5% probability of oil (>10g/m^2) reaching the shoreline (see Figure 10-4). During peak tourism months (season 1 and 2), this ranges from 0% to 1.9%. The length of the shoreline that could be affected is 0 km for season 1 and 4 km for season 2. For a pipeline rupture, there is a less than 2% probability of oil (>10g/m^2) reaching the shoreline (Figure 10-6). During the peak tourism months, the probability of this occurring is 0%. It is therefore anticipated that in the event of an oil spill or pipeline rupture in the western Project Development Area, the impact on tourism would be low.

In the event of a well blowout in the eastern Exploratory Priority Area, the probability of shoreline contamination ranges from 22% (Discharge Point 1) to 100% (Discharge Point 2), with an extensive stretch of shoreline being contaminated.

10.2.1.6.2 Sensitive Receptors

For the western Project Development Area, given the low probability of a well blowout or pipeline rupture affecting the shoreline during peak tourist seasons, the negative impact on tourism is deemed to be of **low** sensitivity.

For the eastern Exploratory Priority Area, in the event of a well blowout, there is a high probability of shoreline contamination, and the large stretch of coastline to be affected covers key tourism areas along the Western- and Eastern Cape Coast. The negative impact on tourism is deemed to be of **very high** sensitivity.

10.2.1.6.3 Impact Magnitude

For the western Project Development Area, during peak tourism seasons (December to February), modelling results indicate that no oil comes ashore and only a small portion of the shoreline is likely to be affected should a well blowout occur. The extent of the negative impact is therefore considered to be **local** and of a **very low intensity**. The impact is expected to be **short-term**. Given these considerations, the impact magnitude is therefore deemed **very low**.

For the eastern Exploratory Priority Area, the shoreline between Gqeberha and George is likely to be affected. The area is of importance as a tourist destination for both domestic and international tourists. The extent of the negative impact is therefore considered to be **national** and of **high intensity**. The impact is expected to be **long-term**. Given these considerations, the impact magnitude is therefore deemed **very high**.

10.2.1.6.4 Impact Significance

For the western Project Development Area, based on the low sensitivity and the very low impact magnitude, the anticipated negative impact on tourism is expected to be of **negligible** significance.

For the eastern Exploratory Priority Area, the anticipated negative impact on tourism is expected to be **very high**, given the high sensitivity and the very high impact magnitude.

10.2.1.6.5 Identification of Mitigation Measures

Over and above the Project controls listed in 10.2.1.1, the following mitigation measure is proposed:

- Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises.
- TEEPSA will seek to work with the relevant local authorities and civil society organisations with regard to the development and implementation of the emergency response plan in the unlikely event of a large oil spill.

10.2.1.6.6 Residual Impact Assessment

For the western Project Development Area, by implementing the mitigation measures, the sensitivity of receptors would be very low. The impact magnitude would remain very low. The negative impact on tourism would therefore remain of **negligible** significance post implementation of the proposed mitigation measures.

For the eastern Exploratory Priority Area, post mitigation, the sensitivity of receptors would be high. The implementation of the mitigation measures can reduce the intensity as well as the duration to a medium, if it reduces the likelihood of the spill reaching the shore or reduces the stretch of shoreline contamination. The extent remains national, as any level of oil spill can affect international perspectives of the attractiveness of South Africa, and particularly the Western Cape, as a tourist destination. The post-mitigation impact of an uncontrolled oil spill from a well blowout in the eastern Exploratory Priority Area is therefore of **high** significance.

10.2.1.6.7 Additional Assessment Criteria

The negative impact on tourism due to a well blowout is considered to be **unlikely** and **partially reversable.** The mitigation potential is **high** and cumulative potential is **likely**.

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.1.7 Impacts on Household Livelihood

10.2.1.7.1 Potential Impact Description

Large oil spills can have a significant impact on fisheries resources. These impacts can include physical contamination, toxic effects on stock, and direct disruption of fishing activities (Andrews et al. 2021, in Wright et al, 2023). Oil spills can cause serious damage to the environment, including marine habitats, fish, mussel and oyster mariculture areas and the highly valuable abalone, which can also have indirect negative effects on small-scale fisheries and coastal communities that rely on shore-based harvesting of marine resources and economic income through fishing (Andrews et al. 2021, in Wright et al, 2023).

Oil spills could lead to loss of access to fishing grounds with consequent loss of revenue to the fisheries. Oil on and in the water, and on the seabed, would temporarily disrupt fishing and impact normal production (and therefore income). It could also lead to a loss of market confidence may occur leading to price reductions or outright rejection of seafood products by commercial buyers and consumers.

For small-scale and recreational fishers, and mariculture activities, a disruption to fishing resulting from a spill could compromise the food security for coastal communities.

Furthermore, should an oil spill come to shore, this could have a negative impact on tourism in the IZoI. If tourists' access to the shoreline is restricted or if there is a perception that their experience would be affected, fewer tourists may choose to visit the area. Cruise tourism to the Port of Mossel Bay may be halted. The tourism industry is an important component of the local economy in the IZoI and many people rely on the tourism industry for income.

10.2.1.7.2 Sensitivity of Receptors

The impact on household livelihood as a result of a well blowout or a pipeline rupture is of **high** sensitivity due to the vulnerability and resilience of receptors involved. Many people in the IZoI rely on the fishing and tourism industries as a source of income.

10.2.1.7.3 Impact Magnitude

Based on oil spill modelling results, potential negative impacts on household livelihood as a result of a well blowout or pipe rupture in the western Project Development Area are expected to have a **regional impact** over the **medium-term**. The intensity of the negative impacts on household livelihood is **high**. Therefore, the magnitude of the potential negative impact on livelihood is **high**.

Given that oil spill modelling results indicate that a large crude oil spill in the eastern Exploratory Priority Area would result in more extensive area of impact, potential negative impacts on household livelihood are expected to have a **regional impact** occurring over the **long-term.** Impact intensity is also regarded as **high**. Therefore, the magnitude of the potential negative impact on household livelihood is **very high**.

10.2.1.7.4 Impact Significance

Based on the high sensitivity and high/very high impact magnitude, the anticipated negative impact is expected to be of **high** significance (western Project Development Area) and **very high** significance on household livelihood (eastern Exploratory Priority Area).

10.2.1.7.5 Identification of Mitigation Measures

Over and above the Project controls, the following additional mitigation measures have been identified, to the reduce the negative impacts on household livelihoods:

- Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises.
- TEEPSA will seek to work with the relevant local authorities and civil society organisations with regard to the development and implementation of the emergency response plan in the unlikely event of a large oil spill.

10.2.1.7.6 Residual Impact Assessment

By implementing the mitigation measures, residual impact significance is expected to be **medium** (western Project Development Area) and **high** (eastern Exploratory Priority Area).

10.2.1.7.7 Additional Assessment Criteria

The impact is considered to be **unlikely** should the relevant Project controls be implemented. The impact is considered to be **partially reversible**. The mitigation potential is **medium**. The loss of resource is **medium** (western Project Development Area) and **high** (eastern Exploratory Priority Area), and the cumulative potential is possible.

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.4 for the impact summary.

10.2.1.8 Impacts on Community Health, Safety and Security

10.2.1.8.1 Potential Impact Description

Even when lethal impacts are not observed, oil can make fish and shellfish unsafe for humans to eat (Anchor Environmental, 2023). It could also become unsafe to swim or undertake any other recreational activities in the affected coastal waters. Should a large oil spill occur, it is likely that the local authority's emergency response plan would include restricting access to affected beaches and banning fishing and collection of shellfish in certain areas.

Should a large oil spill occur, this could potentially result in emissions through evaporation and from fire on vessels, drill unit or ignition of the highly combustible gas and condensate (from loss of well control). These emissions could impact on human health.

Conflict could arise between fishers and authorities if fishers are asked to leave restricted fishing areas. The same would apply to community members accessing beaches for recreational activities.

10.2.1.8.2 Sensitivity of Receptors

Receptors onshore are expected to have **medium** sensitivity, assuming that any risks to community members would be addressed by the local authority's emergency response plan.

10.2.1.8.3 Impact Magnitude

Based on modelling results, only a small area of shoreline is anticipated to be affected by a large spill in the western Project Development Area. Therefore, impact intensity is expected to be **low** and impact extent **local**. Impact duration is anticipated to be **short-term**. Impact magnitude is therefore expected to be **very low**.

Based on modelling results, an extensive area of shoreline is anticipated to be affected by a large crude oil spill in the eastern Exploratory Priority Area. Therefore, impact intensity is expected to be **high** and impact extent **regional**. Impact duration is anticipated to be **long-term**. Impact magnitude is therefore expected to be **high**.

10.2.1.8.4 Impact Significance

Taking into account the magnitude of the potential negative impact on community health, safety and security very low (western Project Development Area) and high (eastern Exploratory Priority Area) and the medium sensitivity of receptors, the impact significance is **very low** (western Project Development Area) and **high** (Exploratory Priority Area).

10.2.1.8.5 Identification of Mitigation Measures

Over and above the Project controls, the following additional mitigation measure has been identified, to the reduce the negative impacts on community health, safety and security:

- Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises. TEEPSA will seek to work with the relevant local authorities with regard to the development and implementation of the emergency response plan in the unlikely event of a large oil spill.

10.2.1.8.6 Residual Impact Assessment

The residual impact significance after the Project controls and mitigation measure have been applied is expected to remain **very low** for the western Project Development Area and reduce to **low** for the eastern Exploratory Priority Area.

10.2.1.8.7 Additional Assessment Criteria

The impact is considered to be **unlikely** should the relevant Project controls be implemented. The impact is considered to be **partially reversible**. The mitigation potential is **medium**. The loss of resource is **low (**western Project Development Area) and medium (eastern Exploratory Priority Area), and the cumulative potential is **likely**.

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.4 for the impact summary.

10.2.1.9 Impacts on Cultural Heritage

10.2.1.9.1 Potential Impact Description

Any impact on the integrity of the coastal and marine ecosystem through a well blowout or pipeline rupture spill could negatively impact various aspects which make up people's intangible cultural heritage (**indirect negative** impact).

10.2.1.9.2 Sensitivity of Receptors

The following cultural heritage sensitivity receptors for a well blowout are noted:

- Ancestry / spirituality: As the shoreline would be impacted, and spiritual practice and spiritual engagement with the sea requires a healthy ocean, or at the very least, a not visibly polluted ocean, the sensitivity of this receptor would increase from high (under normal operations) to very high. People drink seawater as an emetic in ritual purposes and swim in it for leisure and spiritual or health renewal. Should an oil spill occur, people would not be able to use the sea at all.
- Archaeology/Tangible Heritage: The sensitivity of this receptor would increase to high if an uncontrolled oil spill occurs from Block 11B/12B activities. This is because coastal tangible heritage sites are often vulnerable sites, containing vulnerable material culture (i.e., in shell middens there are potential human artifacts that can be destroyed by oil residues). There would however not be a very high impact because these receptors are mainly onshore, and the drill site appears to be far from the shore. The national government has yet to define rivers to be tangible, cultural heritage and it cannot be presumed that national government would do so. However, if rivers in the Eastern Cape were considered part of tangible cultural heritage, then, it could be argued that the sensitivity of these receptors is very high indeed, since there more than 25 rivers in the Eastern Cape, as well as extremely sensitive ecologically rich estuaries.
- Sense of Place: The sensitivity of this receptor would increase to very high if an uncontrolled oil spill vent occurs because valuable heritage towns and locations depend on the sense of place to attract visitors, researchers, and investors. If the coastline is negatively impacted by an oil spill, these patrons and researchers would not come to the place, thereby destroying the ‘sense’ of place.
- Livelihoods: The sensitivity of this receptor is rated as very high. The livelihoods of small-scale fishers (SSF) would be negatively affected as they depend directly on fish species they catch at sea. Going out to sea for SSF and recreational fishing is also a ritual and gendered (male)

cultural heritage in the areas of indirect influence. For example, SSF boys learn from older SSF men how to collect bait, catch smaller/less vulnerable fish species, how to manage a boat and to navigate at sea. The experience creates masculine solidarity, camaraderie and opportunity for both livelihood and leisure. This keeps young boys and men away from the influences of drug abuse and crime. Furthermore, anglers and deepsea fishers organize fishing trips from which they may earn an income and promote recreational fishing and masculine leisure. These fishers go to the 'deep' sea and their fishing would be affected if there is a well blow out or pipeline rupture. Regarding other livelihoods, the sensitivity of this receptor, would increase to high in an unplanned event. The towns in which these small-scale fishing activities occur also accumulate heritage value.

- Natural heritage: The sensitivity of this receptor is assessed to be very high since natural and cultural heritage are interdependent. Therefore, any impact on the sea is going to negatively impact natural heritage (i.e., fynbos) that are used in cultural heritage practices. First Peoples and Nguni descendants are likely to be most affected, given the wide range of life cycle and healing rituals that involves the use of nature (i.e., medicines from the sea and fynbos) for cultural practices.
- Health: The sensitivity of this receptor would increase to very high as people use the sea in cultural ways to improve, sustain and restore physical and mental health. Access to a healthy ocean is therefore critical in this regard. An impact on the ocean may affect the health of the coastline and coastal communities who regularly access the sea to sustain physical and psychological health. For example, people at the coast walk by the sea, admire marine life in the sea (i.e., whale season in Plettenberg Bay, the Knysna seahorse, dolphins in Algoa Bay and penguins in Gqeberha) and people take their children to the sea and beach. In a well blowout or pipeline rupture, the sea would, in the short-term (and possibly medium term depending on the extent of the spillage), be unusable for the health and cultural health practices noted above.

The overall cultural heritage sensitivity of receptors would be very high should an uncontrolled oil spill occur from Block 11B/12B activities. The sensitivity of the receptors can be reduced if immediate action is taken to reduce the spread of the oil spill, thereby reducing its extent and duration.

10.2.1.9.3 Impact Magnitude

An uncontrolled oil spill will be of **very high** intensity on the intangible cultural heritage, of **medium** duration as clean-up operation will commence swiftly to limit ocean pollution, and on **national extent** as the oil spill could affect large portions inshore of Block 11B/12B along the South Cape Coasts. The magnitude of an uncontrolled oil spill on intangible coastal cultural heritage is therefore assessed to be **very high**.

10.2.1.9.4 Impact Significance

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

10.2.1.9.5 Identification of Mitigation Measures

Over and above the Project Controls provided in 10.2.1.1, the following mitigation measures are recommended for implementation:

- Ensure that operating procedures maintain the safety standards required to prevent an unplanned event.
- Support relevant authorities in conducting a transparent and independent process for evaluation of loss experienced by communities affected by an unplanned event, including an estimate of the impact on intangible cultural heritage, to provide the basis for appropriate compensation.

10.2.1.9.6 Residual Impact Assessment

The proposed mitigation measures would reduce the intensity from high to medium, and the overall magnitude of the impact from very high to high. This in turn would reduce the residual impact to **high** significance.

10.2.1.9.7 Additional Assessment Criteria

The impact is considered to be **unlikely** should the relevant Project controls be implemented. The impact is considered to be **partially reversible**. The mitigation potential is **medium**. The cumulative potential is **possible**.

Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.4 for the impact summary.

10.2.1.10 Impacts on Air Quality

10.2.1.10.1 Potential Impact Description

Should a large oil spill occur, this could potentially result in emissions through evaporation and from fire on vessels, drill unit or ignition of the highly combustible gas and condensate (from loss of well control).

10.2.1.10.2 Sensitivity of Receptors

Receptors offshore are anticipated to have **low** sensitivity, whereas receptors onshore are expected to have **medium** sensitivity.

10.2.1.10.3 Impact Magnitude

The impact would likely be regional (possibly even transboundary dependant on the volume of emissions and meteorological conditions), considered medium intensity (reversible over the medium term, and may affect a moderate proportion of receptors), and of medium-term duration (occurring when an unplanned event happens). Thus, the impact magnitude (or consequence) is considered to be **medium**.

10.2.1.10.4 Impact Significance

Considering sensitivities for offshore and onshore receptors, the potential impact of emissions to the atmosphere is considered to be of **low** significance for offshore receptors and of **medium** significance for onshore receptors in the vicinity of the port.

10.2.1.10.5 Identification of Mitigation Measures

See Section 10.2.1.2.

10.2.1.10.6 Residual Impact Assessment

With the implementation of the Project controls (Section 10.2.1.2), impact significance if anticipated to reduce to **very low** (offshore) to **low** (onshore).

10.2.1.10.7 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**. Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.4 for the impact summary.

10.2.2 ACCIDENTAL HYDROCARBON SPILLS DURING REFUELLING OR DUE TO VESSEL COLLISIONS

10.2.2.1 Source of Impact

Although a contingency plan would be prepared and be in place at all times during operations, accidental, or non-routine discharges of hydrocarbons may occur from accidental loss of fuel during refuelling or from a vessel accident or collision. Diesel or hydraulic fluid spills are another risk of ship-to-ship bunkering[50].

10.2.2.2 Project Controls

This following operational Project Controls are applicable to vessel collisions and accidental operational spills and will be applied to the Project:

- Compliance with COLREGS (the Convention dealing with safety at sea, particularly to reduce the risk of collisions at sea) and Safety of Life at Sea (SOLAS) (the Convention ensuring that vessels comply with minimum safety standards).
- A 500 m safety zones will be enforced around the drilling unit and construction areas within which fishing and other vessels will be excluded.
- An emergency response system will be implemented to be prepared in the event of a spill incident. 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.

[50] Bunkering refers to the supplying of fuel for use by ships including the logistics of loading and distributing the fuel among available shipboard tanks.

10.2.2.3 Marine Ecology

This section was extracted from the Marine Impact Assessment Report (Anchor Environmental, 2023), attached to this ESIA report as Appendix 11 in Volume 2.

10.2.2.3.1 Potential Impact Description

Hydrocarbon spills of oil, diesel or hydraulic fluid in the marine environment will have an immediate harmful and negative effect on water quality. Due to its highly toxic properties, an accidental hydrocarbon spill will negatively affect any marine fauna in which it comes into contact. In the offshore environment, coastal and pelagic seabirds are most vulnerable to hydrocarbon spills. Furthermore, hydrocarbon spills are toxic to aquatic organisms. Refer to Section 10.2.1.3 and 10.2.1.4 for more details related to the impacts of oil and condensate on marine ecology and fisheries and mariculture, respectively.

10.2.2.3.2 Sensitivity of Receptors

The sensitivity of marine life receptors such as the coastal and pelagic seabirds, and aquatic organisms was rated as **medium**.

10.2.2.3.3 Impact Magnitude (or Consequence)

Given that the negative impact intensity is medium, the extent is regional, and the duration is medium term, the magnitude of the impact of a minor hydrocarbon spill is considered **medium**, without mitigation.

10.2.2.3.4 Impact Significance

Impact significance of a minor hydrocarbon spill on marine ecology is considered **medium** without mitigation.

10.2.2.3.5 Identification of Mitigation Measures

Over and above the Project Controls (10.2.2.2), the following mitigation measures have been identified for minor hydrocarbon spills:

- Spray the spill with dispersants (if sea conditions permit and permission has been obtained from the relative authority).
- Ensure adequate resources are available to collect and transport oiled birds to a cleaning station.
- Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants).

10.2.2.3.6 Residual Impact Assessment

The implementation of suitable mitigation measures reduces the intensity from medium to low, and the magnitude from medium to low. The significance rating of the hydrocarbon spill impact is therefore reduced to **low**.

10.2.2.3.7 Additional Assessment Criteria

The impact is considered to be **definite** and partially reversible. The mitigation potential is **medium**. The loss of resource is **low**, and the cumulative potential is **unlikely**. Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.3 ACCIDENTAL VESSEL COLLISION OR SUBSEA PRODUCTION SYSTEM AND TRAWLING GEAR ACCIDENT

10.2.3.1 Source of Impact

There is an expected increase in vessel traffic during the construction and decommissioning phases of the Project. Block 11B/12B is located within the main vessel traffic routes that pass around southern Africa. The overlap of some fishing areas with the SPS, including the production wells, may result in accidents related to trawling gear.

10.2.3.2 Project Controls

- Ensure vessel transit speed between the survey/drill area 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).
- During the Construction Phase, a 500 m safety zone will be established around the vessels where the subsea infrastructure and pipeline installation is conducted.
- Radar, facility lighting and designated navigation channels will be used to manage support vessel traffic, tugboats, and supply vessels. The designated safety zones will be enforced with Project patrol boats during well drilling, construction, and decommissioning phases.
- Deployment of metocean buoys will require a temporary safety zone of between a 500 m and 2 km radius on the sea surface. All vessels would be excluded from entering this safety zone.
- During the Construction Phase, a 500 m safety zone will be established around the vessels where the subsea infrastructure and pipeline installation is conducted. After installation the location of the production wells, subsea infrastructure and pipeline will be surveyed and marked on bathymetric and navigation charts as a hazard. Maritime shipping, commercial and small-scale fishing sectors will be notified of the presence of the infrastructure.
- For abandoned exploration wells, well heads will be left on the seafloor with an over trawl cap designed to allow for trawling activity without damaging trawling gear.
- Once the closure certificate for the plugged wells is issued by the Competent Authority, the requirement for a safety zone will be decided by SAMSA based on an assessment of the risk of the infrastructure as a navigational hazard. Any infrastructure deemed a navigational hazard will remain marked on the navigational charts.
- 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).

10.2.3.3 Potential Impact Description

Although unlikely, incidents between fishing and recreational vessels, and Project vessels could occur. Fishing trawl nets could also be caught on subsea infrastructure and well heads. Increasing coastal traffic, and the increased likelihood of vessel collisions, could also lead to displacement of fishers from fishing grounds.

10.2.3.4 Sensitivity of Receptors

The sensitivity of receptors is considered to be **medium**, given that safety zones will be communicated via notices to mariners and/or marked on navigation charts.

10.2.3.5 Impact Magnitude

Negative impacts on the health and safety of fishers are expected to have a **local** impact over the **long-term**. The intensity of the impact is however considered to be **high**, given that the impact could lead to loss of life. Therefore, the magnitude of the impact is considered to be **high**.

10.2.3.6 Impact Significance

Taking into account the high magnitude of the impact and the medium sensitivity of receptors, the impact significance is considered to be **high** before mitigation.

10.2.3.7 Identification of Mitigation Measures

Over and above the Project controls listed in Section 10.2.3.2, the following mitigation measures are recommended:

- Ensure all Project support vessels are aware of navigation management systems outside Mossel Bay Port.
- Support sea rescue services to ensure that the organisation has sufficient resources and training to deal with vessel-on-vessel collision.

10.2.3.8 Residual Impact Assessment

With the implementation of the Project controls and mitigation measures, impact significance will remain **high**.

10.2.3.9 Additional Assessment Criteria

The impact is considered to be **possible** before mitigation, but with mitigation is unlikely. The mitigation potential is **medium**. The loss of resource is **high**, and the cumulative potential is **possible**. Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.4 FAUNAL STRIKES

10.2.4.1 Potential Impact Description

The increase in vessel traffic as a result of the Project could increase the risk of vessel collisions with cetaceans. Also, vessel traffic between Block 11B/12B and the coast can have a significant disturbance impact on cetaceans during their breeding and mating season (Pisces, 2020 in Anchor Environmental, 2023).

Of particular concern are the potential overlaps in vessel movement with migrating Humpback whales and Southern Right whales inshore of Block 11B/12B (the former April to December, with calving season from July to October, peaking in early August, and the latter June and November) (Best, 2007, in Anchor Environmental, 2023). Southern Right whales use the sheltered bays of the South Coast to breed and calve, with winter concentrations recorded all along the southern and eastern coasts of South Africa, with the most significant concentration currently on the South Coast between Cape Town and Gqeberha.

It is highly likely that several hundred right whales can be expected to pass directly through Block 11B/12B between May and June and then again November to January. Smaller cetaceans in the area include the Indo-Pacific Humpback dolphin, which occurs as a localised population concentrated around shallow reefs in the Plettenberg Bay- Algoa Bay region. Other species of concern that are likely to be encountered frequently in Block 11B/12B include the Vulnerable Bryde's whales (throughout the year, with peak encounter rates occurring in late summer and autumn), the Endangered Sei whale (peaking in abundance on the East Coast in June and September), and the Vulnerable Sperm whale (high probability throughout the year, increasing in winter).

10.2.4.2 Project Controls

- TEEPSA will ensure that the contractors undertake Project activities in a manner consistent with good international industry practice and best available technology (BAT).
- All whales and dolphins are given protection under South African Law. The Marine Living Resources Act, 1998 (Act 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.
- Ensure vessel transit speed between the survey / drill / construction area 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).

10.2.4.3 Sensitivity of Receptors

Since some of the species that may occur in the Block 11B/12B are listed as globally Endangered or Critically Endangered, the sensitivity of receptors to vessel collision is rated as **high**.

10.2.4.4 Impact Magnitude

The intensity of the increase in vessel traffic when considering current levels of vessel presence within the area is rated as **medium**. Since the impact will occur locally and have a short-term duration, impact magnitude is anticipated to be **very low**.

10.2.4.5 Impact Significance

With the receptor sensitivity being high, and impact magnitude being very low, the overall impact significance is expected to be **low** before mitigation.

10.2.4.6 Identification of Mitigation Measures

Over and above the Project controls (10.2.3.2), the following mitigation measures are proposed:

- Ensure that all vessel paths avoid breeding areas or migration routes during peak migration or breeding times of year, if possible.
- Placing a trained, dedicated observer onboard vessel to help increase the detection rate of cetaceans or turtles along a vessel's route during day-light hours.
- Include in induction and awareness training awareness about collision risks.

10.2.4.7 Residual Impact Assessment

With the implementation of the Project controls and recommended mitigation measures, the residual impact significance is reduced to **very low**.

10.2.4.8 Additional Assessment Criteria

The impact is considered to be **definite** and fully reversible. The mitigation potential is **medium**. The loss of resource is **low**, and the cumulative potential is **likely**. Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.2.5 LOSS OF EQUIPMENT AT SEA

10.2.5.1 Source of Impact

Accidental loss of equipment from the drilling unit and Project vessels may occur during transit, during transfers from one vessel to another (via e.g., crane), and/or during operations.

10.2.5.2 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.

10.2.5.3 Potential Impact Description

Loss of equipment will cause disturbance to the benthic substrate and potentially crushing of biota.

10.2.5.4 Sensitivity of Receptors

Sensitivity of receptors is rated as **high**.

10.2.5.5 Impact Magnitude

The intensity of the of the impact is rated as **low**. Since the impact will occur locally and have a short-term duration, impact magnitude is anticipated to be **very low**.

10.2.5.6 Impact Significance

With the receptor sensitivity being high, and impact magnitude being very low, the overall impact significance is expected to be **low** before mitigation.

10.2.5.7 Identification of Mitigation Measures

Over and above the Project control listed in Section 10.2.5.2, the following mitigation measures are recommended:

- Ensure containers are sealed / covered during transport and loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system.
- Minimise the lifting path between vessels.
- Maintain an inventory of all equipment and undertake frequent checks to ensure these items are stored and secured safely on board each vessel.
- Undertake a post drilling ROV survey to scan seafloor for any dropped equipment and other removable features around the well and construction sites. Retrieve these objects, where practicable, after assessing the safety and metocean conditions.

10.2.5.8 Residual Impact Assessment

With the implementation of the Project control and mitigation measures, impact significance will remain **low**.

10.2.5.9 Additional Assessment Criteria

The impact is considered to be **unlikely** and partially to fully reversible. The mitigation potential is **medium**. The loss of resource is **low**, and the cumulative potential is un**likely**. Refer to the impact assessment tables in Appendix 4 for details pertaining to the impact ratings, and Section 10.3 for the impact summary.

10.3 IMPACT ASSESSMENT SUMMARY

The impact summary table for unplanned events are provided in the table below.

Table 10-12 – Impact Summary Table: Unplanned events

No.	Phase	Aspect	Impact on Main Receptor	Pre-Mitigation Significance	Project Controls	Key Mitigation Measures	Residual Significance
1	Well drilling & production operations	Pollution generated from production well blowout and pipeline rupture	Negative impact on seabirds, turtles, marine mammals, and coastal environment	Very high	The following "multi-barrier" approach will be implemented to deal with the risk of oil spills (see Section 10.2.1.2 for details): ▪ Avoidance (or Prevention): Identify constraints that may impact the operational integrity of the drilling operation and optimise well design to ensure most stringent pressure profiles can be withstood. ▪ Technical Barriers: Design well casings to withstand a variety of forces. ▪ Blowout Control and Oil Spill Response: Implement the Blowout Contingency Plan, Emergency Response Plan and Oil Spill Contingency Plan, that has been prepared and approved in consultation with PASA, the DFFE and the South African Maritime Authority. ▪ Oil Spill/Slick Monitoring: Predict the movement of an oil spill/slick and sample and analyse spill to determine the behaviour and toxicity levels. ▪ Offshore Oil Response: Deploy adequately trained resources and dispersants. ▪ Shoreline Response: Conduct a coastal sensitivity assessment and mapping exercise to identify coastal sensitivities in order to prioritise coastal response strategies. ▪ Compensation and Insurance: Determine the economic effects of the oil spill/slick and financially manage the consequence through compensation to affected parties.	▪ Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants). ▪ Ensure that at least 5 m^3 of dispersant is readily available on standby vessels for initial response. ▪ Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station. ▪ Include in TEEPSA induction programme training on how to handle, capture and transport exhausted or injured birds. ▪ Schedule joint oil spill exercises including TEEPSA and local departments/organisations to test the oil spill response readiness. ▪ 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. ▪ Ensure that the location of the subsea infrastructure and production pipeline, once installed, is surveyed and marked on bathymetric and navigation charts as a hazard. Maritime shipping, commercial and small-scale fishing sectors must be notified of the presence of the infrastructure.	High
2	Production well drilling & production operations	Pollution generated from production well blowout and pipeline rupture	Negative impact on plankton, benthic infauna, benthic epifauna, fish	High	As for Point No. 1	As for Point No. 1	Medium
3	Exploration well drilling	Pollution generated from exploration well blowout	Negative impact on seabirds, turtles, and coastal environment	Very high	As for Point No. 1	As for Point No. 1	High
4	Exploration well drilling	Pollution generated from exploration well blowout	Negative impact on plankton, benthic fauna, marine mammals	Very high	As for Point No. 1	As for Point No. 1	High

No.	Phase	Aspect	Impact on Main Receptor	Pre-Mitigation Significance	Project Controls	Key Mitigation Measures	Residual Significance
5	Production well & production operations	Pollution generated from production well blowout and pipeline rupture	Negative impact on fisheries and mariculture	High	As for Point No. 1	▪ Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants). ▪ Ensure that at least 5 m^3 of dispersant is readily available on standby vessels for initial response. ▪ Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station. ▪ Include in TEEPSA induction programme training on how to handle, capture and transport exhausted or injured birds. ▪ Schedule joint oil spill exercises including TEEPSA and local departments/organisations to test the oil spill response readiness. ▪ 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. ▪ Ensure that the location of the subsea infrastructure and production pipeline, once installed, is surveyed and marked on bathymetric and navigation charts as a hazard. Maritime shipping, commercial and small-scale fishing sectors must be notified of the presence of the infrastructure, to avoid damages to the infrastructure.	Medium
6	Exploration well drilling	Pollution generated from exploration well blowout	Negative impact on fisheries and mariculture	Very high	As for Point No. 1	As for Point No. 5	High
7	All phases	Pollution generated through fuel leaks, refuelling (bunkering), or vessel collision	Negative impact on marine environment	Medium	▪ 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 and construction areas within which fishing and other vessels will be excluded. ▪ An emergency response system will be implemented to be prepared in the event of a spill incident. 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.	▪ Spray spills with dispersants (if sea conditions permit and permission has been obtained from the relative authority). ▪ Ensure adequate resources are available to collect and transport oiled birds to a cleaning station. ▪ Ensure use of low toxicity dispersants that conform with DFFE's requirements (refer to DFFE Oil Dispersant Policy and SAMSA Marine Notice on dispersants).	Low

No.	Phase	Aspect	Impact on Main Receptor	Pre-Mitigation Significance	Project Controls	Key Mitigation Measures	Residual Significance
8	Production well drilling & production operations	Well blowout or pipeline rupture	Negative economic impact on fishing industry	High	As for Point No. 1	▪ Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises.	Medium
9	Exploration well drilling	Well blowout	Negative economic impact on fishing industry	Very High	As for Point No. 1	As for Point No. 8	High
10	Production well drilling & production operations	Well blowout or pipeline rupture	Negative economic impact on coastal tourism	Negligible	As for Point No. 1	As for Point No. 8	Negligible
11	Exploration well drilling	Well blowout	Negative economic impact on coastal tourism	Very High	As for Point No. 1	As for Point No. 8	High
12	Production well drilling & production operations	Well blowout or pipeline rupture	Negative impact on household livelihood	High	As for Point No. 1	▪ Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises. TEEPSA will seek to work with the relevant local authorities with regard to the development and implementation of the emergency response plan in the unlikely event of a large oil spill. ▪ Implement, in coordination with local authorities, if requested, an emergency plan to ensure food security of affected vulnerable households and groups if needed. ▪ Ensure provision is made for compensation in the case of an unplanned event. ▪ Establish appropriate mechanisms for dealing with any claims of losses by affected parties in the case of an unplanned event.	Medium
13	Exploration well drilling	Well blowout	Negative impact on household livelihood	Very High	As for Point No. 1	As for Point No. 13	High
14	Production, appraisal and exploration well drilling Production operations	Well blowout or pipeline rupture	Negative impact on intangible cultural heritage	Very High	As for Point No. 1	▪ Ensure that operating procedures maintain the safety standards required to prevent an unplanned event. ▪ Support relevant authorities in conducting a transparent and independent process for evaluation of loss experienced by communities affected by an unplanned event, including an estimate of the impact on intangible cultural heritage, to provide the basis for appropriate compensation.	High
15	Exploration well drilling	Well blowout	Negative impact on community	High	As for Point No. 1	▪ Ensure resources to be mobilised in response to an unplanned event are effectively trained and equipped through periodic training and simulations exercises. TEEPSA will seek to work with the relevant local authorities with regard to the development	Low

No.	Phase	Aspect	Impact on Main Receptor	Pre-Mitigation Significance	Project Controls	Key Mitigation Measures	Residual Significance
			health, safety and security			and implementation of the emergency response plan in the unlikely event of a large oil spill.	
16	Production, appraisal and exploration well drilling Production operations	Well blowout or pipeline rupture	Negative impact on community health, safety and security	Very Low	As for Point No. 1	As for Point No. 16	Very Low
17	Production, appraisal and exploration well drilling Production operations	Well blowout or pipeline rupture	Negative impact on air quality	Low (offshore receptors) Medium (onshore receptors)	As for Point No. 1	As for Point No. 1	Very Low (offshore receptors) Low (onshore receptors)
18	All phases	Vessel collisions or SPS and trawling gear accident	Negative impact community health and safety	High	▪ Ensure vessel transit speed between the survey/drill area 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). ▪ 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). ▪ Ensure vessel transit speed between the survey/drill area 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). ▪ During the Construction Phase, a 500 m safety zone will be established around the vessels where the subsea infrastructure and pipeline installation is conducted. ▪ Radar, facility lighting and designated navigation channels will be used to manage support vessel traffic, tugboats, and supply vessels. The designated safety zones will be enforced with Project patrol boats during well drilling, construction, and decommissioning phases. ▪ Deployment of metocean buoys will require a temporary safety zone of between a 500 m and 2 km radius on the sea surface (depending on the water depth). All vessels would be excluded from entering this safety zone. ▪ During the Construction Phase, a 500 m safety zone will be established around the vessels where the subsea infrastructure and pipeline installation is conducted. After installation the location of the production wells, subsea infrastructure and pipeline will be surveyed and marked on bathymetric and navigation charts as a hazard. Maritime shipping, commercial and small-scale fishing sectors will be notified of the presence of the infrastructure. ▪ For abandoned exploration wells, well heads will be left on the seafloor with an over trawl cap designed to allow for trawling activity without damaging trawling gear. ▪ Once the closure certificate for the plugged wells is issued by the CA, the requirement for a safety zone will be decided by SAMSA based on an assessment of the risk of the infrastructure as a navigational hazard. Any infrastructure deemed a navigational hazard will remain marked on the navigational charts.	▪ Ensure all Project support vessels are aware of navigation management systems outside Mossel Bay Port. ▪ Support sea rescue services to ensure that the organisation has sufficient resources and training to deal with vessel-on-vessel collision.	Medium

No.	Phase	Aspect	Impact on Main Receptor	Pre-Mitigation Significance	Project Controls	Key Mitigation Measures	Residual Significance
19	All phases	Faunal strikes	Negative impact on cetaceans	Low	▪ TEEPSA will ensure that the contractors undertake Project activities in a manner consistent with good international industry practice and best available technology (BAT). ▪ All whales and dolphins are given protection under South African Law. The Marine Living Resources Act, 1998 (Act18 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. ▪ Ensure vessel transit speed between the survey / drill / construction area 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).	▪ Ensure that all vessel paths avoid breeding areas or migration routes during peak migration or breeding times of year, if possible. ▪ Placing a trained, dedicated observer onboard vessel to help increase the detection rate of cetaceans or turtles along a vessel's route during day-light hours. ▪ Include collision risks in induction and awareness training.	Very Low
20	All phases	Loss of equipment at sea	Negative impact on benthic substate and biota	Low	▪ TEEPSA will ensure that the contractors undertake Project activities in a manner consistent with good international industry practice and best available technology (BAT).	▪ Ensure containers are sealed / covered during transport and loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system. ▪ Minimise the lifting path between vessels. ▪ Maintain an inventory of all equipment and undertake frequent checks to ensure these items are stored and secured safely on board each vessel. ▪ Undertake a post drilling ROV survey to scan seafloor for any dropped equipment and other removable features around the well and construction sites. Retrieve these objects, where practicable, after assessing the safety and metocean conditions.	Low

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