6 IMPACT ASSESSMENT METHODOLOGY

6.1 INTRODUCTION

An EIA methodology should minimise subjectivity as far as possible and accurately assess the project impacts. In order to achieve this, ERM has followed the methodology defined below for planned activities. The methodology for assessing the risk significance of accidental/unplanned activities is described in *Chapter 8* of this report.

6.2 IMPACT IDENTIFICATION AND CHARACTERISATION

An 'impact' is any change to a resource or receptor caused by the presence of a project component or by a project-related activity. Impacts can be negative or positive. Impacts are described in terms of their characteristics, including the impact type and the impact spatial and temporal features (namely extent, duration, scale and frequency). Terms used in this report are described in *Table 6.1*.

Table 6.1 Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the project (in terms of cause and effect).	**Direct** - Impacts that result from a direct interaction between the project and a resource/receptor (eg between occupation of the seabed and the habitats which are affected). **Indirect** - Impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment (eg viability of a species population resulting from loss of part of a habitat as a result of the project occupying the seabed). **Induced** - Impacts that result from other activities (which are not part of the project) that happen as a consequence of the project. **Cumulative** - Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect.
Duration	The time period over which a resource / receptor is affected.	**Temporary** - impacts are predicted to be of short duration and intermittent/occasional. **Short term** - impacts that are predicted to last only for the duration of the drilling and well testing phase, i.e. 6 months or less. **Medium term** - impacts that are predicted to extend beyond the drilling phase but not longer than three years. **Long term** - impacts that will continue beyond three years but within 10 years.

		Permanent - impacts that cause a permanent change in the affected receptor or resource or ecological process, and which endures beyond 10 years.
Extent	The reach of the impact (ie physical distance an impact will extend to)	**On-site** - impacts that are limited to the site area only, ie within 500m of drilling well (exclusion zone). **Local** - impacts that are limited to the project site and within the block. **Regional** - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems, ie extend to areas outside the block. **National** - impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. **Trans-boundary/International** - impacts that affect internationally important resources such as areas protected by international conventions or impact areas outside of South Africa.
Scale	Quantitative measure of the impact (eg the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.

6.3 *DETERMINING IMPACT MAGNITUDE*

Once impacts are characteristed they are assigned a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale; and
- Frequency.

The scale of the Magnitude (from Negligible to Large) is evaluated by the EIA team using professional judgment and experience.

Each impact is evaluated on a case-by-case basis and the rationale for each determination is noted. Magnitude designations for negative effects are: Negligible, Small, Medium and Large. The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the project is expected to result in a positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a Negligible magnitude.

6.3.1 Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

Large Magnitude Impact affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measureable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A Large magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

Medium Magnitude Impact affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A Medium magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.

Small Magnitude Impact affects a specific area, system, aspect (physical), group of localised individuals within a population (biological) and at sufficient magnitude to result in a small increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) over a short time period (one plant/animal generation or less, but does not affect other trophic levels or the population itself), and localised area.

Negligible Magnitude Impact is one where the area of the impact to the resource/receptor (including people) is immeasurable, undetectable or within the range of normal from natural background variations.

6.3.2 *Determining Magnitude for Socio-Economic Impacts*

For socio-economic impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The quantitative elements are included into the assessment through the designation and consideration of scale and extent of the impact.

6.4 *DETERMINING RECEPTOR SENSITIVITY*

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact, is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered. Where the receptor is biological or cultural (ie the marine environment or a coral reef), its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of receptor is Low, Medium and High.

For ecological impacts, sensitivity is assigned as Low, Medium or High based on the conservation importance of habitats and species. For the sensitivity of individual species, *Table 6.2* presents the criteria for deciding on the value or sensitivity of individual species.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as the level of resilience (or capacity to cope) with sudden social and economic changes. *Table 6.2* and *Table 6.3* present the criteria for deciding on the value or sensitivity of biological and socio-economic receptors.

Table 6.2 ***Biological and Species Value / Sensitivity Criteria***

Value / Sensitivity	Low	Medium	High
Criteria	Not protected or listed as common / abundant; or not critical to other ecosystem functions (e.g. key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions eg CITES Listed as rare, threatened or endangered e.g. IUCN

Note: The above criteria should be applied with a degree of caution. Seasonal variations and species lifecycle stage should be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods. This table uses listing of species (eg IUCN) or protection as an indication of the level of threat that this species experiences within the broader ecosystem (global, regional, local). This is used to provide a judgement of the importance of affecting this species in the context of project-level changes.

Table 6.3 ***Socio-Economic Sensitivity Criteria***

Sensitivity	Low	Medium	High
Criteria	Those affected are able to adapt with relative ease and maintain pre-impact status.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Those affected will not be able to adapt to changes and continue to maintain-pre impact status.

6.5 ASSESSING SIGNIFICANCE

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in *Figure 6.1*.

Figure 6.1 ***Impact Significance***

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix. *Box 6.1* provides a context for what the various impact significance ratings signify.

Box 6.1 ***Context of Impact Significances***

An impact of **Negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
An impact of **Minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
An impact of **Moderate** significance has an impact magnitude that is within applicable standards. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
An impact of **Major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the project.

6.6 *MITIGATION POTENTIAL AND RESIDUAL IMPACTS*

A key objective of an EIA process is to identify and define socially, environmentally, technically acceptable and cost effective measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in *Figure 6.2.* The priority is to first apply mitigation measures to the source of the impact (i.e. to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures. The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in *Figure 6.2*.

Figure 6.2 *Mitigation Hierarchy*

Avoid at Source; Reduce at Source:
Avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
Abate/Minimize on Site:
Add something to the design to abate the impact (eg pollution control equipment).
Abate/Minimize at Receptor:
If an impact cannot be abated on-site then control measures can be implemented off-site (eg traffic measures).
Repair or Remedy*:*
Some impacts involve unavoidable damage to a resource (eg material storage areas) and these impacts require repair, restoration and reinstatement measures.
Compensate in Kind; Compensate through Other Means:
Where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg financial compensation for degrading agricultural land and impacting crop yields).

As required by the South African EIA Regulations (as amended in 2017) the following additional items will be considered in the assessment of impacts and risks identified:

- The degree to which the impact and risk can be reversed (this will be rated on a scale of High, Medium, or Low);

- The degree to which the impact and risk may cause irreplaceable loss of resources (this will be rated on a scale of High, Medium, or Low).

This will inform the residual impact significance.

6.7 Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

6.8 *CUMULATIVE IMPACTS*

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact.

How the impacts and effects are assessed is strongly influenced by the status of the other activities (e.g. already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet operating; and
- Projects that are a realistic proposition but are not yet built.

7 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF PLANNED ACTIVITIES

7.1 INTRODUCTION

The identification of potential environmental and social impacts of the project's planned activities during the Environmental Impact Assessment (EIA) process are described in this *Chapter*, together with the mitigation measures for impact prevention, mitigation and control. The criteria used to evaluate impacts and assign significance are included in *Chapter 6*. Impacts have been assessed essentially through an objective exercise to determine what could happen to environmental, social and health receptors as a consequence of the project activities.

7.2 IDENTIFICATION AND SCREENING OF KEY IMPACTS

During the Screening and Scoping Phase of the EIA process, the EIA team identified the key environmental and social impacts, between the planned and unplanned project activities and environmental or social resources and receptors, which require further evaluation.

During the Scoping Phase stakeholder engagement, these key impacts were discussed and new impacts were raised by stakeholders. These issues were then used to update the summary of the potentially significant impacts from the Scoping Phase and are provided in *Table 7.1.* The key impacts associated with unplanned/ accidental events are assessed in *Chapter 8.*

The impacts considered potentially significant by the project Team and stakeholders are evaluated further in this report. The impacts considered non-significant are discussed briefly and scoped out of the detailed assessment. Non-significant issues are presented in *Table 7.2.*

In addition to addressing the potential impacts from the project activities, this section also provides an early indication of key considerations for the project activities together with the mitigation measures for impact prevention, mitigation and control. The criteria used to evaluate impacts and assign significance are included in *Chapter 6*.

Table 7.1 Potential Impacts from Planned Activities

No.	Issue	Activities	Scoping Results
1	**Planned Activities**		
1.1	Climate change	Burning of fossil fuels	There are climate change implications from the burning of fossil fuels by the project vessels. The significance of this impact is assessed in *Section 7.3.1* below.
1.2	Seawater and sediment quality degradation /contamination and impacts on marine fauna	Wastewater discharges from the drillship, supply and support vessels	Operational discharges from the drillship and all the other project vessels could have an impact on the water quality of the area and therefore potentially impact fish, marine mammals and turtles present in the Project Area. Due to stakeholder concern, the significance of this impact is assessed in *Section 7.3.2* below.
		Disposal of excess cement	Already mixed excess cement will be disposed of overboard. The cementing of the casing (steel pipe) into the well is required to ensure the safety of the well and avoid a blowout and oil spill. The presence of excess cement slurry that has already been mixed is unavoidable during operation and it will be disposed of overboard to avoid damages to lines, cement unit and tanks. The amount of excess slurry will be minimised as far as possible. Contaminant concentrations in seawater would be expected to return to background levels rapidly, with the assistance of currents and the mixing capacity of the water body (the assimilative capacity of water would be expected to minimise any impacts) and therefore have limited impacts on marine fauna. The significance of this impact is assessed in *Section 7.3.3* below.
		Drilling	The impact of drilling on the seabed will be very localised and short-term, limited physical impact to the seabed due to tophole (first sections) drilling, cuttings discharge, residual WBM and excess cement. The significance of this impact of drilling on the seabed is assessed in *Section 7.3.3* below.
		Disposal of cuttings to the seafloor and overboard during drilling	Cuttings discharged both at the seabed (prior to the installation of the riser) and overboard (after the installation of the riser) will generate a plume of sediment which would disturb the marine habitats, benthic communities and marine fauna present in the Project Area. The significance of this impact is assessed in *Section 7.3.4* below.
1.3	Disturbance of marine organisms	• Drillship and vessels noise due to dynamic positioning and moving • Noise from drilling activities (including well logging) • Light pollution from drillship and vessels	Scoping determined that the underwater noise generated during the drilling works, including well logging and the presence of vessels and drillship could lead to disturbances to marine habitats and fauna. The significance of this impact is assessed in *Section 7.3.5* to *7.3.7* below.

No.	Issue	Activities	Scoping Results
1.4	Disturbance to fishing (commercial and subsistence)	• Drillship, supply, survey and support vessels transit to and from the Richards Bay/Durban Port • Presence of drillship at drilling location (including 500 m exclusion zone) • Wellhead abandonment	Both the Port of Richards Bay and the Port of Durban are large, commercial, high traffic ports and, as such, the additional vessel traffic for this project will be non-significant and will not be a major change from the current status quo in terms of impact to fishing, supply and goods shipping activities. Large pelagic long-line activities overlap with both areas of interest and may therefore be impacted by the presence of the drillship at the drilling location and the enforcement of the 500 m exclusion zone. The extent to which fishing activities could be interrupted or placed at risk as a result of the drilling, vessel activities and wellhead abandonment is assessed in *Section 7.4.2* and *Section 7.4.4* below.
Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping			
2	**Planned Activities**		
2.1	Maritime Heritage	Exploration drilling	The South African Heritage Resources Agency raised a concern that the exploration drilling activities could disturb cultural heritage material present on the seabed, particularly historical shipwrecks. Due to the known presence of shipwrecks in the Project Area, the significance of this impact is assessed in *Section 7.4.4* below.
2.2	Local employment / income generation	Employment of labour and allocation of jobs Training / capacity building of local people	Eni has estimated that in the order of 10 direct jobs will be created for locals by this project. The project will use local labour as far as possible based on their existing skills and provide new employees with appropriate training. Based on feedback from stakeholders during the scoping phase, the impact of employment creation is assessed further in *Section 7.4.1* below.
2.3	Abandonment of the wellhead on the seabed	Disturbance to demersal fishing activities	PASA raised questions over the impact of the wellhead being decommissioned (plugged and abandoned) and left on the seabed to demersal fishing. Therefore an assessment was conducted in *Section 7.4.3* below

Table 7.2 Non-Significant Impacts

No.	Impact	Activities	Scoping Results
1	**Planned Activities**		
1.1	Community Health, Safety & Security	Interactions of foreign/ migrant workers with local residents	Although Scoping determined that the project will employ workers during all the phases of the project, due to the nature of the work, the majority of the employees onboard the drillship will be expatriate staff who may transit through Durban or Richards Bay for a short period of time. Shore base employees are likely to be mainly current employees of existing logistics companies based in these areas. Given the short-term nature of the project and the limited workers to be employed this impact was considered not significant and will not be assessed further.
1.2	Local economy	Trade with local suppliers for food, fuel, water, hotel, waste treatment and other supplies	Scoping determined that the project will result in trade with local suppliers for food, fuel, water, hotel, waste treatment and other supplies. This may result in a positive impact, however given the short-term nature of the benefit and the large-scale suppliers who likely be utilised this impact was considered not significant and will not be assessed further.
1.3	Degradation of air quality	Vessels and helicopter atmospheric emissions Power generation on the drillship during drilling Bunkering	A reduction in air quality from the vessel and helicopter activities, power generation and bunkering are not expected to be significant in a regional context, or to cause human health impacts due to the temporary nature of the project, the well mixed air shed of the offshore environment and the distance of the project site to shore. Therefore this impact was considered not significant and will not be assessed further.
1.4	Community Health, Safety & Security	Noise from helicopters	The noise generated by helicopters for crew transfers will be over the Port of Richards Bay or Durban; helicopters will not fly over residential areas and therefore this impact was considered not significant and will not be assessed further.
1.5	Increase in non-hazardous and hazardous wastes disposal	Disposal of non-hazardous and hazardous wastes generated by the project activities at onshore disposal sites	The project will result in an increase in both non- hazardous (eg: kitchen waste and scrap metals) and hazardous (eg engine lubricants and filters) waste generated in the area. Wastes will be transported by vessels to the onshore supply base in Richards Bay or Durban for temporary storage prior to off-site disposal. Solid non-hazardous waste will be disposed of at a suitably licensed waste facility. Hazardous wastes will be treated/ disposed of at a licensed waste treatment/ disposal facility. Therefore, this impact was considered not significant and will not be assessed further.
1.6	Fresh water supply	Provision of drinking water for the crew on all vessels Storage of water at onshore base	Water will be provided via a reverse osmosis plant onboard the project vessels and where required, bottled water may be provided. Therefore, this impact was considered not significant and will not be assessed further. Water stored at the onshore base for water supplies for the onshore staff will be sourced from the local municipality and will not have a significant impact.

No.	Impact	Activities	Scoping Results
1.7	Marine pollution and impacts on marine fauna (e.g. invertebrates, fish, larvae, marine mammals and turtles)	Discharge of well clean-up and well testing water	Following cessation of drilling activities, contaminant concentrations in seawater would be expected to return to background levels rapidly, with the assistance of currents and the mixing capacity of the water body (natural dispersion, dilution and assimilative capacity of water would be expected to minimise any impacts) and therefore have limited impacts on marine fauna. Control measures will be included in the EMPr. Impacts of well clean-up and testing water on water quality and marine fauna are therefore not expected to be significant and will not be assessed further.
		Well logging: Logging while Drilling (LWD) and wireline logging (radioactive sources).	There will be no discharges to the environment from well logging and therefore there will be no interaction with the environment. Therefore, this impact was considered not significant and will not be assessed further.
		Vertical Seismic Profiling (VSP log) -	The VSP log will consist of one to three shots and will be of a very short duration per well (instants for shot and a few hours for acquisition). Prior to the execution of the VSP log, JNCC guidelines (2017) will be followed including performing a pre-shooting search for marine mammals by a marine mammal observer on board. The short-duration of the activity combined with the implementation of the JNCC guidelines means that the impact will not be significant and will not be assessed further.
1.8	Toxicity and bioaccumulation effects of seawater sweeps and high viscous pills on the seabed and impacts on marine fauna	Disposal of seawater sweeps and high viscous pills to the seafloor during riserless drilling	The sweeps and high viscous pills are a solution prepared with fresh or seawater and bentonite viscosifer, a non-toxic, insoluble and inert natural phyllosilicate clay with limited presence of caustic soda as pH and alkalinity control. The sweeps and high viscous pills to be used for hole cleaning during drilling the initial sections of the well will not contain spotting fluids or lubricating hydrocarbons, and the impacts of discharges of these drilling fluids in terms of toxicity and bioaccumulation are therefore not expected to be significant and will not be assessed further.
1.9	Disturbance of seabed geology	Drilling	The impact of drilling of the geology will be very localised to the drilling location and where the drill bit will penetrate the seabed geology. Therefore, the impact was not considered significant and will not be assessed further.
1.10	Increased hard substrata on the seabed	• Placement of wellhead on the seabed • Discharge of residual cement during riserless stage • Abandonment of wellhead on seabed	The impact of increased hard infrastructure on the seabed is highly localised and has a neutral impact on benthic biodiversity. Therefore, the impact was not considered significant and will not be assessed further.
1.11	Visual	Drillship	The drillship will be located more than 60 km offshore and it will not be seen from the shore. Therefore, this impact was considered not significant and will not be assessed further.
2	**Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping**		
2.1	Impact of drilling on MPAs	Exploration drilling	Stakeholders raised concerns over the impact of exploration drilling on the MPAs. The proposed areas of interest do not overlap with existing <u>and recently approved</u> MPAs and therefore this impact has been assessed as not significant.

7.3 PLANNED OPERATIONS: KEY ENVIRONMENTAL IMPACTS

The following sections present the evaluation of the impacts from the planned activities that were identified during scoping and stakeholder engagement as potentially significant.

Potentially significant impacts to the environmental receptors are assessed below and include:

Table 7.3 Summary of Environmental Impacts Assessed

Impact	Section
Impact of Project Greenhouse Gas Emissions on Climate Change	7.3.1
Impact of Operational Discharges from Project Vessels on Marine Fauna	7.3.2
Impact on the Physical Disturbance of the Seabed Sediments and Benthic Fauna from Pre- Drilling and Drilling Operations	7.3.3
Impact on Marine Fauna from Disposal of Drilling Muds and Cuttings from the Drillship	7.3.4
Disturbance of Marine Fauna by Underwater Noise Associated with Drilling Operations	7.3.5
Disturbance of Marine and Avian Fauna by Helicopter Noise Associated with Drilling	7.3.6
Disturbance of Marine Fauna and Avian Fauna by Light Associated with Drilling	7.3.7

7.3.1 *Impact of Project Greenhouse Gas Emissions on Climate Change*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, climate change is likely to have a significant impact on South Africa's economy (Madzwamuse, 2010). In particular, health, agriculture (particularly maize production), plant and animal biodiversity, water resources and rangelands are the most vulnerable sectors to climate change.

Climate change constitutes a key concern in South Africa. Mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65°C over the past five decades and extreme rainfall events have increased in frequency (WIREs Clim Change, 2014).

South Africa's current per capita CO_2 emissions are high (8.3 tonnes/person) as compared with other countries on the African continent and, to some extent globally (average 4.8 tonnes/person) and as a result, climate change mitigation has been a focus for a number of years. The current total annual CO_2 emissions in South Africa are 468 Mega tonnes of CO_2 (Global Carbon Atlas, 2018, WIREs Clim Change, 2014).

Proposed Project Activities and Inbuilt Control and Compliance Measures

Table 7.4 below summarises the project activities that will result in greenhouse gas emissions.

Table 7.4 Summary of Project Activities that will result in Greenhouse Gas Emissions

Activity phase	Activity
Mobilisation	Atmospheric emissions will be released from the exhaust of the drillship and vessels while in transit. However, the impact of these emissions are temporary as the drillship will be constantly moving. Therefore, these emissions are of Negligible significance and have not been assessed further.
Operations	The main sources of air emissions (continuous or non-continuous) resulting from offshore drilling activities include: • Exhaust gas emissions produced by the combustion of gas or liquid fuels in pumps, boilers, turbines, compressors and other engines for power and heat generation on the offshore vessels including the drillship, supply and standby vessels and helicopters. This can be the most significant source of air emissions from offshore facilities. • Fugitive emissions associated with leaking valves, tubing, connections etc. and hydrocarbon loading and unloading operations. • If well testing is conducted, it may be necessary to flare or vent off some of the oil and gas brought to the surface. Flaring and venting is also an important safety measure used to ensure gas and other hydrocarbons are safety disposed of in the event of an emergency, power or equipment failure or other plant upset conditions. The flow periods and rates will be limited to the minimum necessary to obtain the required reservoir information during the well test. It is anticipated that a maximum well test time for this project, if required, will be approximately 20 days.
Demobilisation	Atmospheric emissions will be released from the exhaust of the drillship and vessels while in transit. However, the impact of these emissions are temporary as the drillship will be constantly moving. Therefore, these emissions are of Negligible significance and have not been assessed further.

The main sources of atmospheric emissions will be from the drillship and other vessels (i.e. supply and standby vessels) involved in the drilling operation. The principal expected atmospheric emissions from the drilling activities include carbon dioxide (CO_2), methane (CH_4), oxides of nitrogen (NOx), sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOC). Many of these compounds are known to have the potential to contribute to a number of environmental processes and impacts including acidification (acid rain), the formation of low level ozone, and local air pollution.

Table 7.5 indicates predicted total greenhouse gas (GHG) emissions from vessels and helicopters during drilling operations. The emissions from flaring, during well testing have not been quantified in *Table 7.5* as the characteristics of the well in terms of pressure, flow rate and pressure are unknown and will only be determined while the well is being drilled.

As can been seen in *Table 7.5*, it is estimated that approximately 3,599 tonnes of fuel will be burnt by the Project vessels and helicopters resulting in approximately 13.1 Kt of GHG (CO_2, CH_4, N_2O) emissions, of which CO_2, is the largest component, being emitted to the atmosphere during the drilling operations (up to 71 days).

Table 7.5 Predicted Total Atmospheric Emissions from Vessels during Drilling Operations

	Gaseous emission	Drillship	Supply Vessel	Helicopter	Total	CO_2 equivalent
Consumption (tonnes)		2,580	994	25	3,599	
Emissions (tonnes)	CO_2	9,355.08	3,604.33	76.20	13,035.61	13,035.61
	N_2O	0.07	0.03	6.62E-4	0.10	30.85
	CH_4	0.36	0.14	3.31E-3	0.50	10.47
Total CO_2 equivalent			**13,076.92**			

Source: Calculated using SANGEA software http://www.api-sangea.org/

Eni has committed to the following inbuilt compliance and control measures:

- Compliance to MARPOL 73/78 Annex VI regulations regarding the reduction of NOx, SOx and GHG emissions from vessel engines;
- All diesel motors and generators will undergo routine inspections and receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere;
- Leak detection and repair programmes will be implemented for valves, flanges, fittings, seals, etc.; and
- If well testing is conducted for the disposal of test fluids, only the minimum volume of hydrocarbons required for the test will be flowed and well-test durations will be reduced to the extent practical.

Significance of Impact

The **magnitude** of the impact on climate change due to GHG emissions from the project activities during the drilling phase is assessed to be **Negligible** as CO_2 emissions generated by the project equate to only 0.0003 percent of the total CO_2 emissions for South Africa. The **sensitivity** is assessed as **High** due to South Africa's vulnerability to climate change.

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact from the project's contribution to climate change will be **Negligible** (*Table 7.6*).

Mitigation and Management Measures

The following mitigation and management measures will be implemented for the project to minimise the air emissions:

- If well testing is conducted for the disposal of test fluids, an efficient test flare burner head equipped with an appropriate combustion enhancement system will be selected to minimize incomplete combustion, black smoke, and hydrocarbon fallout to the sea. Volumes of hydrocarbons flared should be recorded [1]:
- Use of a low sulphur fuel, if available; and
- Implementation of a maintenance plan to achieve efficient performance.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact from the project's contribution to climate change will remain as **Negligible** (*Table 7.6*).

Table 7.6 Significance of Impacts Related to Climate Change

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Medium (partially reversible)	
Loss of resource	Low	
Magnitude	Negligible	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High	High
Significance of Impact	**Negligible**	**Negligible**

[1] Based on IFC Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development, June 2015.

7.3.2 *Impact of Operational Discharges from Project Vessels on Marine Fauna*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 3*, the operational waste discharges from the vessels would primarily take place at the well locations and along the route taken by the support vessels between the drillship and either Durban or Richards Bay. The drilling activities would be located in the offshore marine environment, approximately 62 to 65 km offshore, far removed from any sensitive coastal receptors (e.g. bird colonies or turtle nesting sites), but could still directly affect migratory pelagic species transiting through both areas of interest for drilling.

The taxa most vulnerable to waste discharges in the Project Area are turtles, pelagic seabirds, large migratory pelagic fish, and both migratory and resident cetaceans. Many of which are considered globally 'Critically Endangered' (eg Southern Bluefin tuna, Blue whale, hawksbill turtle), 'Endangered' (e.g. whale shark, Fin and Sei whales, 'Vulnerable' (e.g. Leatherback turtle, short-fin mako, whitetip sharks, sperm whale) or 'Near threatened' (e.g. blue shark).

However, all of the operational discharges from the project vessels described above are low in volume, do not contain toxic or persistent chemicals and are rapidly dispersed. Therefore, wastewater discharges from the project vessels are considered to pose limited threat to the environment or the identified biological receptors described above.

Proposed Project Activities and Inbuilt Control and Compliance Measures

The table below summarises the vessel activities that will result in operational discharges to sea.

Table 7.7 Summary of Vessel Activities that Discharge Operational Wastes to Sea

Activity phase	Activity
Mobilisation	Transit of drillship and support vessels to the drill site
Operations	Drillship and support vessels operations
Demobilisation	Drillship / support vessels leave drill site and transit to Port or next destination

These project activities, including inbuilt compliance and control measures, are described further below:

- **Deck drainage**: all deck drainage from work spaces is collected and piped into a sump tank on board the drillship to ensure MARPOL 73/78 Annex I compliance (15 ppm oil in water). The fluid will be analysed and any hydrocarbons skimmed off the top prior to discharge. The oily substances will be added to the waste (oil) lubricants and recycled or disposed of on land at an appropriate waste disposal facility.

- **Sewage**: sewage discharges will be comminuted and disinfected. In accordance with MARPOL 73/78 Annex IV, the effluent must not produce visible floating solids in, nor cause discolouration of, the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination before the treated effluent can be discharged into the sea. The discharge depth is variable, depending upon the draught of the drillship / support vessel at the time, but would not be less than 5 m below the surface.

- **Vessel machinery spaces, mud pit wash residue and ballast water**: the concentration of oil in discharge water from vessel machinery space or ballast tanks may not exceed 15 ppm oil-in-water (MARPOL Annex I). If the vessel intends to discharge bilge or ballast water at sea, this is achieved through use of an oily-water separation system. Oily waste substances must be shipped to land for treatment and disposal.

- **Food (galley) wastes**: food wastes may be discharged after they have been passed through a comminuter or grinder, and when the drillship is located more than 3 nautical miles (± 5.5 km) from land. Discharge of food wastes not comminuted is permitted beyond 12 nautical miles. (± 22 km). The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a typical drillship is expected to be <0.5 m^3.

- **Detergents**: detergents used for washing exposed marine deck spaces are discharged overboard. The toxicity of detergents varies greatly depending on their composition, but low-toxicity, biodegradable detergents are preferentially used. Those used on work deck spaces will be collected with the deck drainage and treated as described above.

- **Cooling Water:** electrical generation on drillships is typically provided by large diesel-fired engines and generators, which are cooled by pumping water through a set of heat exchangers. The cooling water is then discharged overboard. Other equipment is cooled through a closed loop system, which may use chlorine as a disinfectant. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines.

- **Opening and closing of Blowout Protector (BOP):** A further operational discharge is associated with routine well opening and closing operations. As part of these operations, based on the BOP manufacturer technical specification and recommendations for test, the subsea BOP stack elements will vent between 500 to 1,000 litres per month of water-based hydraulic fluid into the ocean at the seafloor.

It is the intention of Eni to ensure that the proposed drilling activities are undertaken in a manner consistent with good international industry practice, including ISO and API standards. All the vessels used for supporting drilling operations (standby, supply vessels and drilling ship) will comply with the applicable requirements in MARPOL 73/78 Annex I, Annex IV, Annex V.

Significance of Impact

The potential impact of such operational discharges from the drillship would include reduced physiological functioning of marine organisms due to the biochemical effects on the water column, increased food source for marine fauna due to discharge of galley wastes potentially leading to fish aggregation around the drillship and increased predator-prey interactions.

Given the offshore location of both the areas of interest for drilling, waste discharges are expected to disperse rapidly and there is no potential for accumulation of wastes leading to any detectable long-term impact. The majority of the discharged wastes are not unique to the project vessels, but rather common to the numerous vessels that operate in or pass through South African coastal waters daily.

As volumes discharged would be low, any associated impacts would be of low intensity and limited to the drilling location over the short-term.
For support vessels travelling from Durban or Richards Bay, operational discharges would likewise be restricted to the immediate vicinity of the vessel over the short-term.

The potential impact on the marine environment of such operational discharges from the project vessels will be limited to the well site over the short-term. Combined with their non-toxicity, high biodegradability and low persistence means the **magnitud**e of the impact will be **Small**.

Based on the environmental baseline conditions as discussed above, the **sensitivity** of the receptors in the region is **Low**.

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of operational discharges from the project vessels on marine fauna will be **Negligible** (*Table 7.8*).

Mitigation and Management Measures

In addition to compliance with MARPOL 73/78 regulations regarding the various operational discharges from vessels mentioned above, the following management measures are recommended to reduce wastes at the source:

- Implement a waste management system in accordance with Eni's Waste Management Guidelines that addresses all wastes generated at the various sites, shore-based and marine. This should include:

  - Separation of wastes at source;
  - Recycling and re-use of wastes where possible;
  - Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation); and
  - Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.

Residual Impact

Based on the implementation of the proposed management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the residual impact from wastewater discharges from the project vessels on marine fauna will remain as **Negligible** (*Table 7.8*).

Table 7.8 Significance of the Impact of Wastewater Discharges from Project Vessels on Marine Fauna

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	High (Fully reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

7.3.3 *Impact on the Physical Disturbance of the Seabed Sediments and Benthic Fauna from Pre- Drilling and Drilling Operations*

Description of the Baseline Environment and Sensitive Receptors

The outer shelf is dominated by gravels of shell-fragment and algal-nodule origin (Heydorn *et al*., 1978). Outer shelf sediments are influenced solely by the strong Agulhas Current, forming large-scale subaqueous dunes with a southwesterly transport direction. The benthic fauna inhabiting unconsolidated sediments of the outer shelf and beyond into the abyss are poorly known. With little sea floor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy.

<u>Video footage from the submarine canyons and feeder valleys on the shelf edge in the Maputaland and St Lucia Marine Reserves has identified vulnerable communities including sponges, black corals, gorgonians, alcyonarian soft corals and stylasterine lace corals (Sink *et al.* 2006). Although the occurrence of such potentially vulnerable marine ecosystems in Block ER236 and the areas of interest for well drilling is unknown, the potential presence of such sensitive deep-water ecosystems in the Project Area cannot be excluded.</u>

Eni has implemented a commitment to avoid the canyons (i.e. no drilling will take place in the canyons) as a conservative measure to avoid any direct impact to possible sensitive receptors inside canyons. .

The benthos[1] of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. As deep-water corals tend to occur in areas with low sedimentation rates (Mortensen *et al.* 2001), these benthic suspension-feeders and their associated faunal communities are likely to show particular sensitivity to increased turbidity and sediment deposition associated with drilling. Exposure of deep water corals to drilling solids can result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification (Rogers, 1999).

[1] Benthos, the assemblage of organisms inhabiting the seafloor. Benthic epifauna live upon the seafloor or upon bottom objects; the infauna live within the sediments of the seafloor. The macrobenthos are, those forms larger than 1 mm.

The table below summarises the project activities that may physically disturb the seabed sediments.

Table 7.9 Summary of Project Activities that Physically Disturb the Seabed Sediment and Benthic Fauna

Activity phase	Activity
Mobilisation	N/A
Operations	Pre-drilling Remotely Operated Vehicle (ROV) seabed survey
	Drilling activities (including localised removal of sediments and smothering)
	Discharge of cuttings and residual cement at the seabed
	Removal of BOP
Demobilisation	N/A

These activities are described further below:

- During pre-drilling surveys, a ROV is deployed to obtain video footage of the seabed at the proposed well location. The ROV is also used to support drilling operations, monitoring the wellhead and BOP. At the end of the drilling activities, the ROV is used to conduct a final survey of the wellhead and wellsite prior to demobilization of operations. Although the standard operating procedure is not to land or rest the ROV on the seabed, the ROVs thrusters can stir up the soft or silty sediments when operating close to the seabed.

- The current well-design parameter is to have at seabed a hole diameter of approximately 42 inches (107 cm) during spudding. The penetration of the seabed by the drill bit during the riserless phase would physically disturb a surface area of 0.91 m^2, and displace deeper sediments (~400 m^3 of rock cuttings) into a conical cuttings pile around the wellhead.

- During the drilling of the well(s), the primary discharge from the drillship would be the drill cuttings. For the current project, these are expected to comprise muds and sands ranging in size from 0.02 mm to 60 mm. The chemistry and mineralogy of the rock particles reflects the types of sedimentary rocks penetrated by the bit.

- Cuttings from lower-hole sections (drilled with WBM /NADFs) are lifted up the marine riser to the drillship and separated from the drilling fluid by the onboard solid control systems. The solids waste stream is fluidised with seawater and discharged overboard through the caisson, which is typically located a few metres below the sea surface. In the order of 220 m^3 (583 MT) of cuttings will be discharged from the drillship, which has been modelled to predict the impact. (Refer to *Annex D*).

- Should there be spent WBM remaining at the end of the drilling operation, this will either be stored onboard and shipped to shore for reuse/ recycling / disposal or will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- The NADF muds will be recovered and stored onboard and shipped to shore for disposal. The NADF drill cuttings will be routed through a vertical cuttings dryer (centrifuge type equipment) to remove residual liquids for reuse. The NADF retained on drill cuttings will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- During riserless operations, after a casing string is set in a well, specially designed cement slurries are pumped into the annular space between the outside of the casing and the borehole wall. To ensure effective cementing, an excess of cement is usually used.

- During the riser phase at the end of cement job activities, residual cement slurry from lines and tanks will be discharged overboard.

- Before demobilisation, the well(s) will be plugged (cement plug), tested for integrity and abandoned, irrespective of whether hydrocarbons have been discovered in the reservoir sections. The plug will create a permanent barrier to avoid future fluid release from the well bore and across any reserve sections. Residual cement slurry in cement lines will be discarded overboard.

- All the proposed drilling operations will be undertaken by Eni in a manner consistent with good international industry practice.

Significance of Impact

Disturbance of seabed sediments and benthic fauna due to ROV surveys (including site survey prior to start operations)

Disturbance of seabed sediments during pre-drilling and drilling ROV surveys/operations (survey inspection and monitoring of seabed conditions to identify possible environmental sensitivities, e.g. deep water corals, present in the well location area prior to start any drilling operations, and ROV wellhead/BOP routinely inspection) could potentially increase turbidity of the near-bottom water layers. This may place transient stress on sessile and mobile benthic organisms, by negatively affecting filter-feeding efficiency of suspension feeders or through disorientation of mobile species due to reduced visibility (Clarke and Wilber 2000). However, in most cases sub-lethal or lethal responses occur only at concentrations well in excess of those anticipated due to resuspension of sediments by ROV thrusters.

The impact of increased turbidity and suspended sediment concentrations would be extremely localised (a few metres around the ROV and/or ROV flight track) and would persist only over the very short term (hours or minutes, based on sediment consistency). Impacts to benthic organisms are temporary and the **magnitude** of any potential adverse effects on sessile benthos would be **Negligible**.

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, the disturbance of and reduction in benthic biodiversity due to increased turbidity can be considered negligible, and no cumulative effects on higher order consumers is expected and therfore the **sensitivity** is evaluated to be **Low**.

During normal operations, ROV operators want to avoid the contact with seabed to avoid any damage to the equipment. For this reason, the contact of ROV with seabed is a rare unwanted event. Based on the analysis provided above and the assumption that the compliance and control measures described above and below are implemented, the significance of the impact of increased turbidity from ROV operations on the seabed sediments and benthic fauna will be **Negligible** (*Table 7.10*). The **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low** and as no further mitigation measures are required, the significance remains as **Negligible** (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna due to drilling

Drilling of exploration wells within the two areas of interest in the Project Area would result in the direct physical disturbance and removal of sediments during tophole drilling activities, potential changes in sediment characteristics and condition.

The immediate effect of the physical disturbance and removal of seabed sediments on the benthos depends on their degree of mobility, with sedentary and relatively immobile species likely to be physically damaged or destroyed during the disturbances associated with well drilling.

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, this disturbance of and reduction in benthic biodiversity can be considered Negligible, and no cumulative effects on higher order consumers are expected and therefore the **sensitivity** is evaluated to be **Low**.

The physical disturbance and/or removal of unconsolidated sediments and their associated benthic communities during drilling and spudding is unavoidable, but the impact would be extremely localised and persist only over the short term and would be of **Small magnitude**.

Based on the analysis provided above and the assumption that the compliance and control measures described above and below are implemented; the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low** and the significance of the impact of drilling on the seabed, sediments and benthic fauna will be **Negligible** (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna from the disposal of drill cuttings and solids

The discharge of cuttings at the seabed would have both direct and indirect effects on benthic communities in the vicinity of the wellhead and within the fall-out footprint of the cuttings plume discharged from the drillship.

Disturbance of seabed sediments would result in direct damage to, and disturbance of, the invertebrate benthic communities living on the seabed or within the sediments.

The cuttings discharged at the seabed during the spudding of a well and riserless operations will form a highly localised spoil mound around the wellbore, thinning outwards. The main impacts associated with the disposal of drilling solids would be smothering of sessile benthic fauna (such as corals), physical alteration of the benthic habitat (changes in sediment properties) in the immediate vicinity (<200 m) of the well, as supported by the literature and the cuttings model (*Annex D 5*) that predicts that areas of deposition of <5 mm thickness is mainly isolated to within a 100 m radius of the wellhead.

Studies (Neff *et al.* 1992; Ranger 1993; Montagna & Harper 1996; Schaanning *et al.* 2008), have found that changes in diversity and abundance of macrofaunal communities in response to deposited cuttings are typically detected within a few hundred metres of the discharge, with recovery of the benthos observed to take from several months to several years after drilling operations had stopped.

Mobile benthic infaunal species are able to burrow or move through the sediment and some infaunal species are able to move vertically through overlying deposited sediment thereby significantly affecting the recolonisation and subsequent recovery of impacted areas. Due to the high natural variability of benthic communities in the region, the structure of the recovering communities would likely be highly spatially and temporally variable.

The results of the cuttings dispersion modelling studies undertaken as part of this project (ERM, 2018a) largely confirm the reports of international studies that predicted that the effects of discharged cuttings are localised (Perry 2005). The cuttings discharged at the seabed were predicted to create a cone in the order of 1,000 mm thickness close to the wellbore, thinning outwards to a thickness of 5 mm at a radius of < 50 m (total area of 0.008 km^2), regardless of the well position (N1, N2 and S) or whether minimum or maximum average monthly current conditions were considered.

Areas of deposition of < 5 mm thickness were mainly isolated to within a 100 m radius of the wellhead, although isolated deposition extended to distances well beyond 1 km, primarily down-current of the well. The maximum area of deposition > 50 m (the threshold thickness adopted by the modelling study) remains restricted to an area of less than 0.003 km² at each location.

Although the variations in current direction between the well locations and between the minimum and maximum average monthly current condition scenarios modelled result in different directional spread of the particles, the overall footprint deposition > 1 mm covers a maximum total predicted area that extends approximately 7 km² around the well site. The differences apply primarily for the settlement patterns of the finer fractions (< 0.2 mm), which would remain in the water column for longer.

The large depths at the well sites in combination with the strong current speeds therefore result in a high dispersion of the discharged drill cuttings. This is, however, offset by the relatively low deposition thicknesses (<5 mm) predicted for distances beyond approximately 50 m from the well location.

Relatively rapid recolonisation of benthic fauna can thus be expected in shallower waters (see for example Kingston 1987, 1992; Trefry *et al.* 2013), with subsequent bioturbation playing an important role in the physical recovery of the seabed (Munro *et al.* 1997). However Jones *et al* (2012) found that recovery of deepwater faunal assemblages took up to 10 years to recover from drilling disturbance conducted in the deepwater Faroe- Shetland Channel.

Exposure of deep water corals to drilling solids can result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification. If deep water corals are identified by ROV within 500 m of the wellsite, then Eni will relocate the drill site to more than 500 m from any identified vulnerable habitats.

The smothering effects resulting from the discharge of drilling solids at the wellsite is assessed to have an impact of **Medium magnitude** on the benthic infauna of unconsolidated sediments in the cuttings footprint as recovery of deep water benthic communities may take up to 10 years. In both cases, the impact is localised.

Due to the benthic infauna's ability to recover and recolonise the area, their **sensitivity** is evaluated to be **Medium.** As discussed above, if deep water corals are found to be present in the Project Area their **sensitivity** to smothering from drilling solids is **High.**

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of drill cuttings and solids due to smothering on benthic infauna and sessile benthos (such as deep water corals) will be **Moderate** (*Table 7.10*).

Based on the implementation of the proposed mitigation and management measures below, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of drilling cuttings and muds on benthic infauna and sessile benthos (such as deep water corals) due to smothering will be **Minor** (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna from cement disposal at the seabed

The discharge of residual cement during cementing would result in the physical disturbance of the seabed sediments and accumulation of cement on the seabed, where it will dissolve into the water column.

During riserless operations, the excess cement (100 m^3 in the worst case) emerges out of the top of the well onto the cuttings pile, where (depending on its mix) it either does not set and dissolves slowly into the surrounding seawater or, if it remains in a pile, may act as a habitat (reef) for colonisation by epifauna and may attract fish and other mobile predators (Buchanan *et al*., 2003).

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, the disturbance of and reduction in benthic biodiversity due to cementing can be considered Negligible, and no cumulative effects on higher order consumers is expected and therefore the sensitivity is evaluated to be **Low.**

Disturbance and smothering of benthic fauna due to the release of excess cement around the wellbore is of **Small magnitude** as the cement would be discharged in an area already affected by drill cuttings. Any potential impacts would be extremely localised (i.e. confined to the wellbore footprint) and temporary. Based on the analysis provided above, the significance of the impact of cement on the seabed, sediments and benthic fauna will be **Negligible** (*Table 7.10*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to benthic communities:

- Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site;

- Ensure drill site is located more than 500 m from any identified vulnerable habitats;

- Use high efficiency solids control equipment to minimize liquid content on cuttings, maximize reuse and recycle of drilling mud, reduce the need for fluid change out and minimise the final amount of residual spent mud;

- Maximize re-use and re-cycle of used WBM and NADF for different drilled section and for drilling other wells;

- Minimize spent WBM discharge to sea; avoid NADF mud discharge;

- Regularly maintain the onboard solids control system.
- Reduce excess of cement slurry during riserless drilling;

- Monitor cement returns and will terminate pumping if returns are observed on the seafloor; and

- Implement procedures for ROVs that stipulate that the ROV does not land or rest on the seabed as part of normal operations.

Table 7.10 Significance of the Impacts of the Physical Disturbance of the Seabed sediments and Benthic Fauna due to Pre- Drilling (ROV survey) and Drilling Activities

Characteristic	Impact of ROV Operations on Benthic Fauna	Residual Impact of ROV operations on Benthic Fauna	Impact of Drilling on Benthic Fauna	Residual Impact of Drilling on Benthic Fauna	Impact of Disposal of Muds and Cuttings at the Seabed on Benthic Infauna	Residual Impact of Disposal of Muds and Cuttings at the Seabed on Benthic Infauna	Impact of Disposal of Muds and Cuttings at the Seabed on sessile Benthic Fauna	Residual Impact of Disposal of Muds and Cuttings at the Seabed on sessile Benthic Fauna	Cement disposal Impact on Benthic Fauna	Cement disposal Residual Impact on Benthic Fauna
Extent	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term	Long-term	Long-term	Long-term	Long-term	Short term	Short term
Scale	Negligible	Negligible	Small	Small	Small	Small	Small	Small	Small	Small
Reversibility	High (fully reversible)		High (fully reversible)		Medium (partially reversible)		Medium (partially reversible)		Medium (partially reversible)	
Loss of resource	Low		Low		Low		Low		Low	Low
Magnitude	Negligible	Negligible	Small	Small	Medium	Small	Small	Small	Small	Small
Sensitivity/ Vulnerability/Importance of the Resource/Receptor	Low	Low	Low	Low	Medium	Medium	High	Medium	Low	Low
Significance of Impact	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Moderate**	**Minor**	**Moderate**	**Minor**	**Negligible**	**Negligible**

7.3.4 *Impact on Marine Fauna from Disposal of Drilling Muds and Cuttings from the Drillship*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, due to the offshore location of the areas of interest, the abundance of phytoplankton and pelagic fish and invertebrate fauna is likely to be very low. Being dependent on nutrient supply, plankton abundance is typically spatially and temporally highly variable and is thus considered to have a low sensitivity. Higher productivity with associated development of detritivore-based food-webs that support demersal fish species can, however, be expected in the vicinity of the submarine canyons.

It is currently unknown whether sensitive receptors (such as corals and coelacanths) occur in the submarine canyons within the Block, which are located to the immediate south of the northern area of interest and some 30 km northeast of the southern area of interest. No drilling operation will be performed in these canyons.

Proposed Project Activities and Inbuilt Control and Compliance Measures

- During the drilling of the well(s), the primary discharge from the drillship would be the drill cuttings. Cuttings from deeper (lower-hole) sections, drilled with WBM /NADFs, are lifted up the marine riser to the drillship and separated from the drilling fluid by the onboard solid control systems. The solids waste stream is fluidised with seawater and discharged overboard through the caisson, which is typically located a few metres below the sea surface. In the order of 220 m^3 (583 MT) of cuttings will be discharged from the drillship.

- Should there be spent WBM remaining at the end of the drilling operation, this will either be stored onboard and shipped to shore for disposal/recycling or will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- The NADF muds will be recovered and stored onboard and shipped to shore for disposal. The NADF drill cuttings will be routed through a vertical cuttings dryer (centrifuge type equipment) to remove residual liquids for reuse. The NADF retained on drill cuttings will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

Significance of Impact

The disposal of cuttings from the drillship would have various direct and indirect biochemical effects on the receiving environment. The direct effects are associated with the contaminants contained in the drilling muds, sweeps and cements used during drilling operations. The indirect effects result from changes to water and sediment quality.

The cuttings themselves are generally considered to be relatively inert, but may contribute small amounts of trace metals and/or hydrocarbons to receiving waters (Neff *et al*. 1987). However, most of the metals associated with cuttings are in immobile forms in minerals from the geologic strata, and their composition will thus resemble that of natural marine sediments. The drilling muds on the other hand, are a specially formulated mixture of natural clays, polymers, weighting agents and/or other materials suspended in a fluid medium. The constituents and additives of the discharged muds may potentially have ecotoxicological effects on the water column and sediments. These are discussed further below.

<u>Toxicity and Bioaccumulation Effects of Excess WBM and Residual NADFs on Drill Cuttings and spent WBM discharge</u>

For the current project, the deeper sections of the well would be drilled using WBM and/or NADF muds to guarantee hole stability and hole cleaning.

WBM (treated wet cuttings and spent mud discharged overboard)
For the current project, it is estimated that some 220 m^3 of WBM cuttings will be discharged overboard through a caisson. The spent WBM will rapidly dissolve and disperse into the surrounding seawater and the cuttings will be deposited to a maximum area of approximately 7 km^2, over the short-term and therefore the impacts are considered of **Small magnitude**.

The primary issues related to the discharge of WBMs include bioaccumulation. Typically, the major ingredients that make up over 90 percent of the total mass of the WBMs are fresh or seawater, barium sulphate (barite), bentonite clay, lignite, lignosulphonate, and caustic soda. Others substances are added to gain the desired density and drilling properties. The sensitivity of receptors is **Negligible**. Therefore, the significance of biochemical impacts of WBM on marine fauna will be **Negligible** (*Table 7.11*).

Based on the implementation of the proposed management and mitigation and management measures below, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of WBMs on marine fauna will remain **Negligible** (*Table 7.11*).

NADF (treated wet cuttings, no spent mud discharged overboard)
In case drilling will necessitate the use of NADF mud, drilling cuttings will be treated as per standard solid control system used for WBM with in addition the use of a dryer to minimize the liquid content. Although most of the drilling fluids would be mechanically separated from the drilling cuttings, some NADF would remain adhered to the cuttings and would therefore reach the ocean. It is estimated that the NADF discharged cuttings may contain up to 5 percent by weight of drilling fluid (ERM 2018a), after treatment. During drilling of the deeper sections of the well, in the order of 38.36 m^3 (29.2 MT) of NADF would be discharged overboard through a caisson, from where they will be redistributed by currents before settling back onto the seabed.

The primary issues related to the discharge of NADFs include bioaccumulation and toxicity. The disposal of mud into the marine environment and its subsequent fate has been extensively investigated through field and laboratory studies (reviewed by Neff, 2005). In general, it has been found that the impacts are not significant in the open marine environment (Thomson *et al*. 2000; Hurley & Ellis 2004). Biological effects associated with the use of NADFs are not typically found beyond 250 to 500 m from the drillship (Husky 2000, 2001a; Buchanan *et al*. 2003; IOGP 2016).

The potential for significant bioaccumulation of NADFs in aquatic species is unlikely due to their extremely low water solubility and consequent low bioavailability (OGP, 2003). However, certain hydrocarbons are known to have tainting effects on fish and shellfish.

The potential for significant bioaccumulation of NADFs in aquatic species is unlikely due to their extremely low water solubility and consequent low bioavailability (IOGP, 2016). Therefore, the **sensitivity** of the receptors is assessed as **Low**. Rather than direct chemical toxicity, impacts to sessile marine organisms arise primarily through smothering effects (*Section 7.3.3*) and oxygen depletion due to rapid biodegradation of the base fluid in the sediment.

For the current project, deposition following surface discharges of NADF cuttings were anticipated to be present in a maximum area of approximately 7 km^2, over the short-term (ERM, 2018b). The larger footprint of the surface-discharged cuttings was, however, offset by the relatively low deposition thicknesses (< 5 mm) predicted for distances beyond approximately 50 m from the well location and therefore the impacts are considered of **Medium magnitude**.

Based on the analysis provided above and the assumption that the control measures described above are implemented, the significance of biochemical impacts of NADF on marine fauna will be **Minor** (*Table 7.11*).

Based on the implementation of the proposed mitigation and management below, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of NADF on marine fauna will remain **Minor** (*Table 7.11*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to benthic communities:

- Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site;

- Ensure drill site is located more than 500 m from any identified vulnerable habitats;
- Careful selection of fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential;
- Ensure only low-toxicity and partially biodegradable additives are used;
- Use high efficiency solids control equipment to minimize liquid content on cuttings, maximize reuse and recycle of drilling mud, reduce the need for fluid change out and minimise the final amount of residual spent mud; to maximize reduction of NADF wet content on cuttings, utilize drier system after standard solids control equipment;
- Maximize re-use and re-cycle of used WBM and NADF for different drilled section and for drilling other wells;
- Ensure regular lab test (for toxicity, barite contamination and oil content etc) on board to confirm that drilling cuttings and WBM properties are compliant with limitation prior of discharge overboard;
- Minimize spent WBM discharge to sea; avoid NADF mud discharge; and
- Regularly maintain the onboard solids control system.

Table 7.11 Significance of Biochemical Impacts Related to Drill Cuttings and Muds on Marine Fauna Present in the Water Column

Characteristic	WBM and WBM content on wet cuttings Bioaccumulation Impact	WBM and WBM content on wet cuttings Bioaccumulation Residual Impact	NADF content on wet cuttings (no NADF discharge) Bioaccumulation Impact	Residual NADF content on wet cuttings (no NADF discharge) Bioaccumulation Residual Impact
Extent	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term
Scale	Small	Small	Small	Small
Reversibility	High (fully reversible)		Medium (partially reversible)	
Loss of resource	Low		Low	
Magnitude	Small	Small	Medium	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low	Low	Low
Significance of Impact	**Negligible**	**Negligible**	**Minor**	**Negligible**

7.3.5 *Disturbance of Marine Fauna by Underwater Noise Associated with Drilling Operations*

Description of the Baseline Environment and Sensitive Receptors

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (McCauley, 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Thus, anthropogenic sound sources in the ocean can be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC, 2003). Natural ambient noise will vary considerably with weather and sea state, ranging from about 80 to 120 dB re 1 µPa (Croft & Li, 2017).

Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC, 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate hundreds of kilometres thereby affecting very large geographic areas (Coley, 1994, 1995; NRC, 2003; Pidcock *et al*. 2003). The sound level generated by vessels fall within the 160 to 170dB re 1 µPa range close to the vessel, with main frequencies from 1 to 500 Hz (McCauley, 1994; NRC, 2003).

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön, 2012).

The sound level generated by drilling operations fall within the 120 to 190 dB re 1 µPa range at the drillship, with main frequencies less than 0.2 kHz, depending on the drill unit and support vessels used (Croft & Li, 2017).

Dynamically positioned vessels are noisier as they produce more noise than the fixed platforms. This is due to additional noise from thrusters and propellers as well as the larger surface area in contact with the water, which produces greater vibration into the water column (Hurley and Ellis, 2004).

The underwater noise generated by well-drilling operations in general and by the current project, thus falls within the hearing range of most fish and marine mammals, and would be audible for considerable ranges (in the order of tens of kilometres) before attenuating to below threshold levels (*Table 7.12*).

Table 7.12 Known Hearing Frequency and Sound Production Ranges of Various Marine Taxa

Taxa	Order	Hearing frequency (kHz)	Sound production (kHz)
Shellfish	Crustaceans	0.1 – 3	
Snapping shrimp	*Alpheus/ Synalpheus* spp.		0.1 - >200
Ghost crabs	Ocypode spp.		0.15 – 0.8
Fish	Teleosts		0.4 – 4
Hearing specialists		0.03 - >3	
Hearing generalists		0.03 – 1	
Sea turtles	*Chelonia*	0.1 – 1	Unknown
Sharks and skates	Elasmobranchs	0.1 – 1.5	Unknown
Seals	Pinnipeds	0.25 – 10	1 – 4
Northern elephant seal	*Mirounga agurostris*	0.075 – 10	
Manatees and dugongs	Sirenians	0.4 – 46	4 – 25
Toothed whales	Odontocetes	0.1 – 180	0.05 – 200
Baleen whales	Mysticetes	0.005 – 30	0.01 – 28

Source: Koper & Plön 2012

Underwater noise generated during the project could affect a wide range of fauna; from benthic invertebrates and demersal species residing on the seabed in the vicinity of the wellhead, to those invertebrates and vertebrates occurring throughout the water column and in the pelagic habitat near the surface.

The taxa most vulnerable to noise disturbance in the Project Area are turtles, pelagic seabirds, large migratory pelagic fish, and both migratory and resident cetaceans many of which are considered globally 'Critically Endangered' (e.g. Southern Bluefin tuna, Blue whale, hawksbill turtle), 'Endangered' (e.g. whale shark, Fin and Sei whales,) 'Vulnerable' (e.g. Leatherback turtle short-fin mako, whitetip sharks, sperm whale) 'Near threatened' (e.g. blue shark) and 'Least concern' (e.g. Humpback and Southern Right Whales.

Proposed Project Activities and Inbuilt Control Measures

The table below summarises the project activities that will result in underwater noise.

Table 7.13 Summary of Underwater Noise Activities that may Disturb Marine Fauna

Activity phase	Activity
Mobilisation	Transit of drillship and support vessels to the drill site
Operations	Operation of drillship (including VSP log[1]) and support vessels
Demobilisation	Drillship / support vessels leaving drill site and transit to port or next destination

The significant activities are described further below:

- The operation of the drillship and support vessels during transit to the drill site, during the proposed drilling activities and during demobilisation will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area

Significance of Impact

Underwater noise generated during the project could affect a wide range of fauna. However, the emission of underwater noise from drilling operations and associated drill unit and tender vessel activity is not considered to be of sufficient amplitude to cause direct physical injury or mortality to marine life, even at close range. The underwater noise from well drilling operations may, however, induce localised behavioural changes or masking of biologically relevant sounds in some marine fauna, but there is no evidence of significant behavioural changes that may impact the wider ecosystem (Perry 2005).

Behavioural changes may generally include such trends as retreat from noise source, but also in some circumstances attraction to the source itself. In general, mammals have a highly developed and highly specialised hearing system, and there is evidence that noise levels in excess of 90 dB re 1 μPa can cause a behavioural response including escape from the immediate area or high stress. However, available data are not conclusive (Moulton & Richardson, 2000) and often misinterpreted. There is a lack of definitive evidence regarding the effects of drilling operations on marine mammals; however, the most likely outcome is modified behaviour, which may generally include retreat from the noise source.

[1] The VSP log noise emission has been considered not significant due to very short term duration but an additional precautionary measure has been introduced by the Company and indicated in this section

Southall *et al* (2007) found that low frequency cetaceans (i.e. large baleen whales) generally start to show avoidance behaviour and other behaviour effects to this type of non-pulsed sound in the 120 and 160dB re 1 μPa between 10 m and 3.5 km from the drillship. The reaction of mid-frequency cetaceans (i.e. dolphin species and toothed whales) to non-pulsed sound were varied and there was no clear conclusion about behavioural changes (Southall *et al*, 2007).

For another deep well-drilling project off the southern Namibian coast (SLR, 2017), it was estimated that noise from project activities would decrease to below the estimated median ambient background level (100 dB re 1μPa) within a distance of 14 to 32 km from the drill site, depending on the specific vessels used, the number of support vessels operating and the scenario. Maintenance activities represented the worst-case scenario for noise, although this would be expected to occur only for relatively short periods of time (Croft & Li, 2017). The extent of the noise impacts would, however, also depend on the variation in the background noise level with weather and with the proximity of other vessel traffic (not associated with the project).

The effects of underwater noise generated during well-drilling and by the drillship and support vessels on marine fauna is considered to be of **Small magnitude** in the drilling area and for the duration of the drilling campaign. Ultimately there will be no change to the natural ecosystem due to this disturbance as it is only temporary.

Based on the environmental baseline conditions discussed in *Chapter 4*, the **sensitivity** of the receptors in the region in terms of masking impacts from underwater noise is **High** due the presence of species of conservation concern in the Project Area. The **sensitivity** of the receptors in the region is in terms of avoidance impacts from underwater noise is **Low** due to the distance of the drilling from the shore.

Based on the analysis provided above, the impact of underwater noise potentially masking biologically significant sounds is considered of **Minor** significance without mitigation, whereas the impact of underwater noise resulting in avoidance of feeding and/or breeding area is considered **Negligible** without mitigation due to the extreme offshore location of the areas of interest (*Table 7.14*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the underwater impacts to marine fauna:

As far as reasonably practicable, vessels used in the project should incorporate measures to reduce the amount of underwater noise generated as follows:

- Vessels should also undergo regular maintenance regime to reduce noise which include the cleaning of propeller and underwater hull; and

- Prior to VSP log acquisition, as an additional precautionary measure, a qualified marine mammal observer will be available on board of drilling ship and monitor operations

Residual Impact

Based on the implementation of the proposed management measure, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**. The significance of the residual impact of underwater noise generated by drilling on masking biologically significant sounds remains **Minor**, whereas the impact of underwater noise resulting in avoidance of feeding and/or breeding area remains **Negligible** (*Table 7.14*).

Table 7.14 Significance of Impacts of Underwater Noise Generated by Drilling Operations on Marine Fauna

Characteristic	Masking Impact	Masking Residual Impact	Avoidance Impact	Avoidance Residual Impact
Extent	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term
Scale	Small	Small	Small	Small
Reversibility	High (fully reversible)		High (fully reversible)	
Loss of resource	Low		Low	
Magnitude	Small	Small	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium	Low	Low
Significance of Impact	**Minor**	**Minor**	**Negligible**	**Negligible**

7.3.6 *Disturbance of Marine and Avian Fauna by Helicopter Noise Associated with Drilling*

Description of the Baseline Environment and Sensitive Receptors

Noise generated by helicopters undertaking crew transfers between Durban or Richards Bay and the drillship could affect seabirds in breeding colonies and roosts on the mainland coast. Low altitude flights over the ocean could also affect marine mammals and turtles in surface waters in the Project Area.

The dominant low-frequency components of aircraft engine noise (10 to 550 Hz) penetrate the water only in a narrow (26° for a smooth water surface) sound cone directly beneath the aircraft, with the angle of the cone increasing in Beaufort wind force >2 (Richardson *et al.*, 1995). The peak sound level received underwater is inversely related to the altitude of the aircraft.

Available data indicate that the expected frequency range and dominant tones of sound produced by fixed-wing aircraft and helicopters overlap with the hearing capabilities of most odontocetes and mysticetes (Richardson *et al.* 1995; Ketten, 1998). Determining the reactions of cetaceans to overflights is difficult, however, since most observations are made from either the disturbing aircraft itself (Richardson & Würsig, 1997), or from a small nearby vessel.

Studies have shown, reactions to aircraft flyovers vary both within and between species, and range from no or an observable behavioural response. Most studies established that the response resulted from the animals presumably receiving both acoustic and visual cues (the aircraft and/or its shadow).

As would be expected, sensitivity of whales to disturbance by an aircraft generally lessened with increasing distance, or if the flight path was off to the side and downwind, and if its shadow did not pass directly over the animals (Watkins 1981, 1986; Smultea *et al*. 2008). Smultea *et al*. (2008) concluded that the observed reactions of whales to brief overflights were short-term and isolated occurrences were probably of no long-term biological significance and Stewart *et al*. (1982) suggested that disturbance could be largely eliminated or minimised by avoiding flying directly over whales and by maintaining a flight altitude of at least 300 m.

However, repeated or prolonged exposures to aircraft overflights have the potential to result in significant disturbance of biological functions, especially in important nursery, breeding or feeding areas (Richardson *et al*. 1995). Humpback whales were almost completely displaced from East Coast waters during historical whaling activities and have only recently returned on their migrations to calving sites off Mozambique. This species can be observed off the East Coast between May and February, with peak sightings in June and November/December (Banks, 2013).

The level of disturbance would also depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions.

The hazards of aircraft activity to birds include direct strikes as well as disturbance, the degree of which varies greatly. The negative effects of disturbance of birds by aircraft were reviewed by Drewitt (1999) and include loss of usable habitat, increased energy expenditure, reduced food intake and resting time and consequently impaired body condition, decreased breeding success and physiological changes. Nesting birds may also take flight and leave eggs and chicks unattended, thus affecting hatching success and recruitment success (Zonfrillo, 1992).

Differences in response to different types of aircraft have also been identified, with the disturbance effect of helicopters typically being higher than for fixed-wing aeroplanes. Results from a study of small aircraft flying over wader roosts in the German Wadden Sea showed that helicopters disturbed most often (in 100 percent of all potentially disturbing situations), followed by jets (84 percent), small civil aircraft (56 percent) and motor-gliders (50 percent) (Drewitt, 1999).

Sensitivity of birds to aircraft disturbance are not only species specific, but generally lessened with increasing distance, or if the flight path was off to the side and downwind. However, the vertical and lateral distances that invoke a disturbance response vary widely, with habituation to the frequent loud noises of landing and departing aircraft without ill effects being reported for species such as gulls, lapwings, ospreys and starlings, amongst others (reviewed in Drewitt, 1999).

Further work is needed to examine the combined effects of visual and acoustic stimuli, as evidence suggests that in situations where background noise from natural sources (e.g. wind and surf) is continually high, the visual stimulus may have the greater effect. There is an Important Bird Area (IBA) at Richards Bay, potentially within the flight path of aircraft commuting between Richards Bay airport and the northern area of interest for well drilling.

Proposed Project Activities and Inbuilt Control and Compliance Measures

Crew transfers by helicopter from Richards Bay / Durban to the drillship, during the operational phase, will generate noise in the atmosphere that may disturb coastal species such as seabirds and seals.

The helicopter operator will comply with the following SA regulations:

- The National Environmental Management: Protected Areas Act (2003) stipulate that the minimum over-flight height over nature reserves, national parks and world heritage sites is 762 m (2,500 ft).

- The Marine Living Resources Act (1998) prohibits aircraft to approach within 300 m of a whale. Therefore, except for when the aircraft lands on or takes off from the drillship and logistics base, the flight altitude would be >300 m.

- The operation of helicopters and fixed-wing aircraft is governed by the Civil Aviation Act (No. 13 of 2009) and associated regulations.

Significance of Impact

Indiscriminate low altitude flights over whales, seabird colonies and turtles by helicopters used to support the drillship could have an impact on behaviour and breeding success. The level of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions and could range from **Small** to **Large magnitude**.

Although such impacts would be localised and short term, impacts would be likely for low altitude flights and may thus have wider ramifications over the range of the affected species. Based on the environmental baseline conditions discussed in *Chapter 4*, the **sensitivity** of the receptors in the region is **High.**

Based on the analysis provided above, the significance of the impact of helicopter noise on marine fauna will be **Moderate** (*Table 7.15*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to disturbance to marine fauna from helicopter noise:

- Pre-plan flight paths to ensure that no flying occurs over IBAs;
- Avoid extensive low-altitude coastal flights (<914 m and within 2 km of the shore);
- The flight path between the onshore logistics base and drillship should be perpendicular to the coast;
- A flight altitude >305 m be maintained at all times, except for when the aircraft lands on or takes off from the drillship and logistics base;
- Maintain an altitude of at least 914 m within Marine Protected Areas;
- Contractors should comply fully with aviation and authority guidelines and rules; and
- Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of helicopter noise generated by drilling on marine fauna will be reduced to **Minor** (*Table 7.15*).

Table 7.15 Significance of Impacts of Helicopter Noise Associated with Drilling on Marine and Avian Fauna

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Medium (partially reversible)	
Loss of resource	Low	
Magnitude	Small to Large	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Moderate**	**Minor**

7.3.7 *Disturbance of Marine Fauna and Avian Fauna by Light Associated with Drilling*

Description of the Baseline Environment and Sensitive Receptors

The drilling activities would be located in the offshore marine environment, 62 km offshore, far removed from any sensitive coastal receptors (e.g. bird colonies), but could still directly affect migratory pelagic species transiting through both the areas of interest for drilling.

The taxa most vulnerable to ambient lighting in the Project Area are pelagic seabirds, although turtles, large migratory pelagic fish, and both migratory and resident cetaceans may also be attracted by the lights.

Proposed Project Activities and Inbuilt Control and Compliance Measures

Table 7.16 below summarises the project activities that will result in an increase in ambient light:

Table 7.16 Summary of Project Activities that will Result in Increased Ambient Light

Activity phase	Activity
Mobilisation	Transit of drillship and support vessels to the drill site
Operations	Operation of drillship and support vessels
	Flaring during production tests
Demobilisation	Drillship / support vessels leave drill site and transit to port or next destination

These activities are described further below:

- Transit and operation of the drillship and support vessels. The operational lighting of drillship and support vessels can be a significant source of artificial light in the offshore environment; and

- During well testing it may be necessary to vent or flare off some of the oil and gas brought to the surface. Flaring and venting is also an important safety measure used to ensure gas and other hydrocarbons are safety disposed of in the event of an emergency, power or equipment failure or other plant upset conditions. Flaring and venting produces a flame of intense light at the drill unit.

The light impacts from the activities described above would primarily take place at the well location and along the route taken by the support vessels between the drillship and either Durban or Richards Bay.

Significance of Impact

Although little can be done at the offshore installation to prevent seabird collisions, reports of collisions or death of seabirds on drillships are rare. It is expected that seabirds and marine mammals in the area become accustomed to the presence of the installations within a few days, thereby making the significance of the overall impact on these populations **Negligible**. The significance to the populations of fish and squid of increased predation as result of being attracted to an installation's lights is deemed to be not significant.

The increase in ambient lighting in the offshore environment would be of **Negligible magnitude** and limited to the drilling location over the short-term. Due to the far offshore location of both the areas of interest away from most sensitive receptors the **sensitivity** is **Low**.

For support vessels travelling from Durban or Richards Bay increase in ambient lighting would likewise be restricted to the immediate vicinity of the vessel over the short-term and would be of **Negligible magnitude.** Due to the movement of the vessel from the coast to the offshore location the **sensitivity** of the receptors are **Medium**.

Based on the analysis provided above, the significance of the impact of light from the project vessels on marine fauna will be **Negligible** (*Table 7.17*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to disturbance to marine fauna from increased ambient light:

- The lighting on the drillship and support vessels should be reduced to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimized; and

- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Injured birds should be returned to shore, where feasible, to allow for treatment.

- Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of light on marine fauna remains **Negligible** (*Table 7.17*).

Table 7.17 Significance of the Impact of Light from Project Vessels on Marine Fauna and Avian Fauna

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	High (fully reversible)	
Loss of resource	Low	
Magnitude	Negligible	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Low
Significance of Impact	**Negligible**	**Negligible**

7.4 PLANNED OPERATIONS: KEY SOCIAL IMPACTS

Potentially significant impacts to the social receptors are assessed below in *Table 7.18*.

Table 7.18 Summary of Social Impacts Assessed

Impact	Section
Creation of Employment Opportunities	7.4.1
Impact of the Presence of the Exclusion Zone on Commercial Fishing Activities	7.4.2
Abandonment: Presence of Wellhead on Marine Activities	7.4.3
Disturbance of Marine Cultural Heritage from Drilling Operations	7.4.4
The No-Go Alternative	7.4.5

7.4.1 *Creation of Employment Opportunities*

Description of the Baseline Environment and Sensitive Receptors

The unemployment rate within the ADI, (eThekwini Metropolitan Municipality and the uMhlathuze Local Municipality) varies, with a high unemployment rate in the uMhlathuze LM (40 percent) and a significantly lower rate in the eThekwini MM (16 percent).

There is an increasing demand for skilled labour in the ADI, however, the skills base remains low. Approximately a quarter of the population have finished secondary school and around eight percent of the population in the ADI have received tertiary education (StatsSA).

Proposed Project Activities and Inbuilt Enhancement Measures

The project is not expected to create employment for people living within the ADI. The drillship will require up to 200 personnel and due to the short-term nature of the work and the necessary expertise and required technical skills, the majority of staff employed will be expatriates.

The preferred option is to utilise existing local vessels and staff for the supply vessels. The number of personnel on the supply vessels will vary based on vessel size and the types of activities they support. It is anticipated that existing vessels and crews will be contracted and no new employment opportunities will be created.

Between five and ten people will be employed temporarily at the onshore logistics base. Some will be existing Eni personnel.

A summary of project activities and employment opportunities is presented in *Table 7.19.*

Table 7.19 Summary of Project Activities Linked to Employment Creation

Activity phase	Activity
Mobilisation	Transit of drillship and support vessels to the drill site with existing crew.
Operation	Operation of drillship and support vessels using existing drillship crews and local support vessels.
	Short term operation of the onshore logistics base in the Port of Durban or Richards Bay.
Demobilisation	Drillship leaves drill site and transit to Port or next destination with existing crew. Contracts with local support vessels terminated.

Significance of Impact

The impact of employment creation can be classified as positive and direct. The extent will be local depending on skills capacity and availability. The impact will be short-term for the duration of exploration drilling. For those who are able to secure employment on the project, and for local vessel contractors able to secure a contract with the project, the scale of the impact will be medium and the frequency will be constant for the duration of project.

The **magnitude** of the impact is **Positive**, and the **sensitivity** is **Low** considering that the project will create limited employment opportunities (five to ten at most) within local community and most of the project will be staffed with expatriates. The significance of this impact is assessed as **Negligible** (*Table 7.20*).

Mitigation and Management Measures

The objective of mitigation and management is to optimise opportunities for employment of local people, wherever possible.

- The Project will establish a recruitment policy which prioritises the employment of South African and local residents (originating from the Local Municipality) at the onshore logistics base over foreigners, where they meet the skill base and experience required. Criteria will be set for prioritising local residents and then other South Africans as part of the recruitment process.

- Priority will be given to South African vessel contractors to provide the project with supply vessels and vendor supplies that meet international quality standards for oil and gas operations.

Residual Impact

Based on the implementation of the proposed enhancement measures the **reversibility** of the impact is **High**. There is no loss of resource and, the significance of the impact remains **Negligible** (*Table 7.20*).

Table 7.20 Significance of Impacts Related to Employment Creation

Characteristic	Impact	Residual Impact
Extent	Local	Local to International
Duration	Short-term	Short-term
Scale	Medium	Medium
Reversibility	High (fully reversible)	
Loss of resource	N/A	N/A
Magnitude	Positive	Positive
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

7.4.2 *Impact of the Presence of the Exclusion Zone on Commercial Fishing Activities*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, the only commercial fishery that overlaps with the drilling areas of interest is the pelagic longline fishery. From 2000 to 2014, the sector directed 1.95 percent and 2.32 percent of their total recorded effort in the vicinity of the northern and southern areas of interest, respectively[1]. Catch recorded within the areas amounted to 2.34 percent (46.5 t) and 1.98 percent, (39.2 t) of the total catch, respectively.

The KwaZulu-Natal linefish and prawn trawl fishery overlaps with Block ER236. However, there is no evidence of overlap with the proposed areas of interest for drilling with the areas fished by the linefish and the prawn trawl fishery.

The KwaZulu-Natal linefish fishing effort lies at least 10 km and 35 km inshore of the northern and southern areas of interest, respectively, and therefore there is no impact expected on the fishery.

The KwaZulu-Natal prawn trawl fishery is situated at least 35 km and 30 km inshore of the northern and southern areas of interest, respectively, and therefore there is no impact expected on the crustacean trawl fishery.

Proposed Project Activities and Inbuilt Enhancement Measures

Table 7.21 below summarises the project activities that will result in an impact to the commercial fishing industry.

[1] Fishing positions are reported where the deployment of a line commences. Lines with start positions outside the areas of interest for well drilling may extend into these areas. In an attempt to include all affected fishing areas, we have tallied catch and effort reported within and beyond the boundaries of the areas of interest to a distance of 40 km.

Table 7.21 Summary of Project Activities that will Impact the Commercial Fishing Industry due to the Presence of an Exclusion Zone

Activity phase	Activity
Mobilisation	N/A
Operation	Presence of 500 m exclusion zone around the drillship
Demobilisation	Abandonment of wellhead(s)[1] on seafloor after plug and abandonment operations

These activities are described further below:

- Operation of the drillship: the exclusion of vessels from entering the 500 m safety zone (approximately 0.8 km^2) around a drillship poses a direct impact to fishing operations in the form of loss of access to fishing grounds only if the fishing areas for each fishing sector identified overlap. The safety zones aim to ensure the safety both of navigation and of the drillship, avoiding or reducing the probability of accidents caused by the interaction of fishing boats and gears and the drillship.

- Abandonment of wellhead(s) on the seafloor: exploration and appraisal well(s), prior to the demobilization phase, will be sealed with cement plugs, tested for integrity and abandoned (plug and abandon operations can be indicated as "decommissioning"). The wellhead, with a height of approximately 3 m and a diameter of 1 m, will remain on the seafloor.

- Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a drillship that is engaged in underwater operations is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), an "exploration platform" or "exploration vessel" used in prospecting for or mining of any substance falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone.

- A Notice to Mariners and a navigational warning will be issued to mariners, to communicate the location of the drillship and exclusion zone, via the South African Navy Hydrographic Office (HydroSAN). Support vessels with appropriate radar and communications will be used during the drilling operation to warn vessels that are in danger of breaching the exclusion zone.

[1] Impact for wellhead presence assessed separately in the next chapter

Significance of Impact

As discussed above the only fishery that is expected to be impacted by the drilling activity is the pelagic longline fishery. The exclusion zone around the drillship will be temporary as when the drillship is finished drilling it will move off station.

The impact of exclusion from the pelagic longline fishing ground during the operational phase of well drilling is considered to be local in extent (limited to the area of interest) and of short-term duration (71 days).

The scale of the impact is determined to be small, since the catch recorded within the impacted area falls in the 1 – 5 percent category (*Chapter 4*). The frequency with which the sector operates in the proposed Project Area is high, as the fishery operates almost continuously all-year-round. Therefore, the **sensitivity** of the pelagic longline fishers is **Small** and the **magnitude** of the impact is **Medium.**

Based on the analysis provided above, the significance of the presence of the exclusion zone on the commercial pelagic longline fisheries is assessed as **Minor**.

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to the commercial pelagic longline fisheries:

- Prior to the commencement of drilling activities the following key stakeholders should be consulted and informed of the proposed drilling programme (including navigational co-ordinates of well location, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m exclusion zone and the movements of support vessels):

    - Fishing industry / associations: SA Tuna Association; and
    - Other key stakeholders: HydroSAN, Ports Authority and SAMSA.

- These stakeholders should again be notified at the completion of drilling when the drillship and support vessels are off location.

- Request, in writing, the HydroSAN to broadcast a navigational warning via Navigational Telex (Navtext).

- Distribute a Notice to Mariners prior to the commencement of the drilling operations. The Notice to Mariners should give notice of (1) the co-ordinates of the well location, (2) an indication of the proposed drilling timeframes, (3) an indication of the 500 m safety zone around the drillship, and (4) provide details on the movements of support vessels servicing the drilling operation. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.

- The lighting on the drillship and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.

- Notify any fishing vessels at a radar range of 45 km (24 nm) from the drillship via radio regarding the safety requirements around the drillship; and

- Abandoned well location, including wellhead location, must be surveyed and accurately charted with the HydroSAN office.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the impact to restricted access to fishing grounds will remain **Minor** (*Table 7.22*).

Table 7.22 Significance of Impacts Related to Restricted Access to Fishing Grounds and Damage to Fishing Nets

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	High (fully reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Minor**	**Minor**

7.4.3 *Abandonment: Presence of Wellhead on Marine Activities*

Description of the Baseline Environment and Sensitive Receptors

After the plug and abandon ("decommissioning") of the well and demobilisation of the drillship, the vessel won't impact the areas of interest anymore.

On the contrary the presence of an abandoned wellhead could impact only those fisheries that direct fishing effort at the seabed (demersal fisheries). Snagging of fishing gear or anchors on a wellhead could pose a risk of damage to fishermen's equipment where fishing grounds overlap with the abandon wellhead. In the case of this project, the abandoned wellhead would be located at a depth of between 1,500 m and 2,100 m in the northern area of interest, and between 2,600 m and 3,000 m in the southern area of interest. Considering there are no demersal fishing activities overlapping with Block ER236 and that the water depths of both areas of interest are deeper than 1,500 m, there is unlikely to be any interaction with demersal fishing activities if the wellhead is left at seabed

The pelagic longline sector does overlap with the area of interest, and vessels operate within much of the area covered by both the northern and southern areas of interest for well-drilling. Due to the nature of the gear used by the fishery and the depth of the wellhead, interaction between the wellhead and gears is not likely to occur.

Proposed Project Activities

Upon demobilisation, exploration well(s) would be sealed with cement plugs, tested for integrity and abandoned. The wellhead, with a height of approximately 3 m and a diameter of 1 m, would remain on the seafloor (*Table 7.23*).

The abandoned wellhead would be located at a depth of between 1,500 m and 2,100 m in the northern area of interest, and between 2,600 m and 3,000 m in the southern area of interest.

Table 7.23 Summary of Presence of the Wellhead on Marine Activities

Activity phase	Activity
Mobilisation	N/A
Operation	N/A
Demobilisation	Abandonment of wellhead(s) on seafloor

Significance of Impact

The impact of the presence of the wellhead after abandonment is considered to be local in extent (limited to the area of interest) and of long-term duration. The scale of the impact is determined to be small, since the interaction between any sea user i.e. deep water trawling and the abandoned wellhead is unlikely.
The frequency with which the sector operates in the drilling areas of interest is low, as there is no deepwater trawling activity currently at the well site. The **sensitivity** of the receptor is **Low** and the **magnitude** of the impact is **Small.**

Based on the analysis provided above, the significance of the presence of the wellhead on marine activities is assessed as **Negligible**.

Mitigation and Management Measures

The abandoned wellhead location must be surveyed and accurately charted with the HydroSAN office.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the impact on marine activities will remain **Negligible** (*Table 7.24*).

Table 7.24 Significance of Impacts of the Presence of the Wellhead during Abandonment

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Long-term	Long-term
Scale	Small	Small
Reversibility	Medium (Partially reversible)	
Loss of resource	Low	
Magnitude	Small	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Negligible**	**Negligible**

7.4.4 Disturbance of Marine Cultural Heritage from Drilling Operations

Description of the Baseline Environment and Sensitive Receptors

Global sea levels have fluctuated substantially on at least three occasions during the last 500,000 years. The lower sea levels would have caused large parts of the continental shelf to be exposed as dry land along the narrow continental shelf of west and east coasts of South Africa. Although the most westerly edges of Block ER236 lie in relatively shallow water, the entire block and particularly the two Areas of Interest that will be the focus of the exploration drilling are in water that is too deep for the seabed to have been exposed in the past by glacially driven fluctuations in world sea levels and thus accessible to our human ancestors.

There have been numerous shipping casualties along the adjacent coast, the earliest recorded on the KZN coast being the Sao Joao, a Portuguese nau (ship) wrecked at Port Edward in 1552, south of Block ER236 (Axelson 1973; Burger 2003).

In the broader study area defined for this assessment, there are records of seven maritime losses. Based on their given positions none of these wrecks are located within either of the two Areas of Interest for exploration drilling, although the level of confidence in the available positions is generally low.

With regard to the potential for encountering a shipwreck – either one of the known wrecks described above or a currently unknown wreck - during the marine-based activities associated with the exploration drilling programme in the two Areas of Interest, this is assessed to be extremely unlikely.

Proposed Project Activities

The drilling operations proposed could potentially disturb the marine cultural heritage including submerged prehistory and shipwrecks. However, the two Areas of Interest are located in water in excess of 1,500m and there is thus no likelihood of any submerged prehistoric archaeological sites or material being encountered in the course of exploration drilling in either of these two areas.

Further to this, there are no known or recorded shipwreck within the two Areas of Interest identified for exploration drilling as part of this project. However, the co-ordinates of the known wrecks within the wider study area are approximate (none having been ground-truthed to remains on the seabed) and these sites may thus not be at the given positions on the seabed. There is thus the potential for some of these wrecks to be within particularly the northern area of interest, or outside of the study area entirely.

Table 7.25 below summarises the project activities that may physically disturb the seabed and sediment, thereby disturbing submerged prehistory or shipwrecks.

Table 7.25 Summary of Project Activities that Physically Disturb the Marine Cultural Heritage

Activity phase	Activity
Mobilisation	N/A
Operation	Drilling activities (including localised removal of sediments and smothering)
	Discharge of residual cement during riserless stage
	Removal of BOP
Demobilisation	N/A

Significance of Impact

The impact on marine cultural heritage resources can be classified as direct and negative. The extent will be localised and the duration will be short-term, for the duration of exploration drilling. The scale of the impact would potentially be large if marine cultural heritage resources were disturbed or damaged by project activities, however, with the lack of heritage resources identified in both areas of interest, scale is determined to be small.
Given that there is no known presence of heritage resources in both areas of interest, the frequency is considered remote.

The **magnitude** of the impact is **Small**, and the **sensitivity** is **Low** considering the lack of known cultural heritage resources in in both areas of interest. The significance of this impact is assessed as **Negligible** (*Table 7.20*).

Mitigation and Management Measures

No mitigation measures have been recommended with respect to submerged prehistoric archaeology as it is extremely unlikely that sites or material are present in the study area.

No mitigation is required or proposed in respect of the known wrecks identified as being in the study area as their reported positions suggest that they all lie outside the two exploration drilling Areas of Interest.

Within the areas of interest it is recommended that any pre-drill remote sensing data collected to ground-truth seabed conditions is reviewed to establish whether any shipwrecks are present on the seabed.

Any video footage collected in the vicinity of proposed well locations should be reviewed for evidence of shipwreck material on the seabed.

Should these reviews of data identify wreck material at or near the location of a proposed drill site, micro-siting of the well location and the possible implementation of a drilling activity exclusion zone around the archaeological feature should be sufficient to mitigate the risks to the site.

A chance find procedure must be developed for the project and should any shipwreck material that was not identified by the measures set out above be encountered during the exploration drilling process.

Residual Impact

Based on the implementation of the proposed management measures, the **reversibility** of the impact **Medium** and the degree of the **loss of resource** is **High.** The significance of the impact of marine cultural heritage will remain **Negligible** (*Table 7.26*).

Table 7.26 Significance of Impacts of Drilling on the Marine Cultural Heritage

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Low (not reversible)	
Loss of resource	High	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

7.4.5 *The No-Go Alternative*

Description of the Baseline Environment and Sensitive Receptors

The option not to proceed with exploration or appraisal drilling will leave the areas of the potential drilling sites in their current environmental state, with the oil/gas potential remaining unknown i.e. unless explored by competitors or by using alternate technologies not currently available).

Proposed Project Activities and Inbuilt Control and Compliance Measures

The No-Go alternative entails no change to the status quo, in other words; the proposed exploration drilling activities will not be conducted in Block ER236. The commercial viability of the hydrocarbon reservoir in the area, will therefore not be assessed and future development may not be possible.

Significance of Impact

The No-Go alternative is in contravention of the Draft Integrated Energy Plan (IEP) (2016[1]); which highlights the need to address current and future energy needs by securing a reliable and viable supply, minimising the cost of energy and simultaneously minimising emissions.

Economic growth will be altered by a lack of foreign investment associated with the exploration drilling and this has a direct impact on South African investments in a development project (including job creation), increased government revenues and dependence on the importation of hydrocarbons.

Based on South Africa's current 600 000 barrels / day crude oil demand, the country is not and will not be in a position to influence the price of crude oil (which is largely influenced by global dynamics due to South Africa being a net importer of crude oil). This may imply that even if the demand in South Africa increases, the price to the consumer will remain high or increase further.
Another implication is that without exploration, there is a knowledge gap in terms of what is available for future developments and to potentially address the countries requirements. Once the price of crude oil becomes uneconomical (i.e. unaffordable in the broad sense), many industries and business may experience the knock on effects of this, leading to shut downs, job losses and a potential decline in the local and regional economy.

The No- Go alternative is also in contravention of Operation Phakisa's aim to implement South Africa's policies and programmes better, faster and more effectively, and to unlock the economic potential of South Africa's oceans. Exploration is the only means to investigate potential resources and assess their viability for extraction and future development.

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[1] Still under public review and comment

The No- Go alternative may also result in the following negative impacts:

- No local economic impact in term of procurement (direct and indirect), taxes (royalties and other taxes) and salary paid to direct employees and suppliers employees that would have been realised if the project proceeded and potentially went on to exploitation phase.

- No diversification of the South Africa energy mix that may be realised if the project proceeded (and a viable hydrocarbon source was discovered).

- Sustained (or even increased) reliability on importation from other countries depending on the growing demand.

Therefore, the **sensitivity** of the receptor is **Medium** and the **magnitude** of the impact is **Medium.**

The potential impact related to the lost opportunity to explore oil and gas reserves within the area and identify opportunities to maximise the use of South Africa's own reserves should these exist, is considered to be of direct, negative, **Moderate** significance (*Table 7.27*).

Mitigation and Management Measures

The only way to mitigate the negative impacts associated with the No-Go alternative, from an economic opportunity perspective, is to proceed with the exploration project and implement appropriate mitigation and management measure to minimise any potential impacts associated with carrying out the exploration drilling.

Residual Impact

By implementing the recommended mitigation measure (and inadvertently proceeding with the exploration activities), the residual impact is likely to be of **Moderate positive significance** (*Table 7.27*)- this is due to the benefits associated with obtaining knowledge regarding the viability and extent of available reserves that may be exploited. Such an understanding is likely to have a national reach and attract investment opportunities leading to further economic development

Table 7.27 Significance of Impacts of the No-Go Alternative

Characteristic	Impact	Residual Impact
Extent	Local	National
Duration	Short-term	Long-term
Scale	Small	Small
Reversibility	High (fully reversible)	
Loss of resource	Low	
Magnitude	Medium	Medium
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Moderate (-ve)**	**Moderate (+ve)**

7.5 CUMULATIVE IMPACTS FROM PLANNED OPERATIONS

A cumulative impact is one that arises from a result of an impact from the project interacting with an impact from another activity to create an additional impact. How the impacts and effects are assessed is strongly influenced by the status of the other activities (eg already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet operating; and
- Projects that are a realistic proposition but are not yet built.

7.5.1 *Planned Projects and Activities in the Project Area*

The earliest that drilling is expected to take place is in 2019. The drilling of one well is estimated to take approximately 71 days to complete. There are no known planned future projects planned in the Project Area.

The known socio-economic activities (detailed in *Chapter 4*) that may occur in the Project Area are:

- There is a possibility that the offshore recreational boat-based fishing activities travel offshore and into Block ER236;

- The only commercial fishery that overlaps with the areas of interest is the KwaZulu-Natal pelagic longline fishery;

- The KwaZulu-Natal traditional linefish and prawn trawl fishery overlaps with Block ER236 but does not overlap with the areas of interest;

- The Project Area may overlap with tankers and bulk carriers navigating offshore of the East Coast on their way around the southern African subcontinent;

- Block ER236 may overlap with the routes taken by tankers and bulk carriers. The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Richards Bay or the Port of Durban;

- Both the EASSy and Seacom cables may pass through Block ER236; and

- Exploration activities are being undertaken in neighbouring oil and gas blocks, including Tugela South operated by EMEPSAL to the north-west; Deep Water Durban operated by EMEPSAL to the south and Silverwave deepwater block to the east.

7.6 IDENTIFICATION AND SCREENING OF POTENTIAL CUMULATIVE IMPACTS

The potential for cumulative environmental and social interactions caused by the project in combination with other planned activities were identified as:

- GHG emissions from the project vessels <u>and from flaring during appraisal well testing</u> and their contribution towards climate change in combination with other vessels in the region;

- Underwater noise generation from the project vessels and their contribution to underwater noise in combination with other vessels in the region and the combined impacts on marine mammals; and

- Disturbance to benthos due to oil and gas activities.

7.7 EVALUATION OF POTENTIAL CUMULATIVE IMPACTS

A description of the nature of potential cumulative impacts likely to arise from the project in combination with other reasonably foreseeable activities is provided below:

7.7.1 *GHG Emissions*

The GHG emissions from project activities have been calculated and these will contribute to the total GHG emissions by offshore oil and gas facilities/ development activities offshore South Africa, which may have an impact on climate change. The addition of the project activities' GHG emissions to the cumulative levels of GHG in the Project Area will be of **Minor significance**.

7.7.2 *Disturbance to Marine Mammals and Turtles*

Drilling and generator noise aboard the drillship, support vessel and helicopter noise may cause disturbance and/or nuisance to on/off site marine mammals and turtles. Noise will be cumulative in nature due to existing noise caused by marine traffic in the region. Vessel activity will contribute to ambient levels of underwater noise, but even sensitive species (cetaceans and possibly marine turtles and certain fish species) are unlikely to be significantly affected. The addition of the project activities' to the cumulative levels of noise in the Project Area will be of **Minor significance**.

7.7.3 *Disturbance to Benthos*

The primary impacts to benthos associated with the drilling of exploration wells in the West Indian Offshore Bioregion off the coast of KZN, relate to physical disturbance of the seabed, discharges of drilling solids to the benthic environment, the presence of infrastructure remaining on the seabed and associated vessel or drillship presence.

The development of the proposed exploration well(s) in this assessment would impact a maximum cumulative area of ~0.003 km^2 (per well) in the West Indian Bioregion, which can be considered an insignificant percentage of the bioregion as a whole. Cumulative impacts from other hydrocarbon ventures in the area may increase in future.

The cumulative impacts of the proposed drilling of exploration wells off the KZN coast can be considered of **Low significance.**

7.7.4 *Mitigation Options for Cumulative Impacts*

Proposed mitigation measures for the drilling activities as identified in the impact assessment above are adequate to mitigate any potential cumulative impacts from adjacent activities. No additional mitigation measures are required.

8 *UNPLANNED/ACCIDENTAL EVENTS*

8.1 *INTRODUCTION*

An unplanned/ accidental event is defined as 'a reasonably foreseeable incident that is not anticipated to occur as part of the proposed project, but which may conceivably occur as a result of project activities (e.g. vessel accidents and loss of well containment/blowout), but with a low probability'. Accidental events may occur during any phase of the project. This *Chapter* describes the potential accidental events associated with the project and provides an assessment of the risk significance of the impact on the receiving environment based on an assessment of likelihood vs consequence.

The following accidental events, summarized in *Table 8.1*, were considered non-significant and have not been assessed further in this EIA Report.

Table 8.1 Non-Significant Risks

Activities	Scoping Results
Small oil/chemical spills	The Project vessels shall be required to have the Shipboard Oil Pollution Emergency Plan (SOPEP) in place for all vessels. Small chemical and oil spills onboard the Project vessels will be cleaned up immediately and adhere to the SOPEP and EMPr and therefore the impact of small oil or chemical spills is unlikely to be significant and will not be assessed further.
Ballast from support and supply vessels (potentially international)	All ships that carry ballast water must de- and re-ballast in adherence with the International Maritime Organization (IMO) guidelines and standards governing discharge of ballast waters at sea. The IMO states that vessels using ballast water exchange should, whenever possible, conduct such exchange at least 200 nm from the nearest land and in water of at least 200 m depth. Where this is not feasible, the exchange should be as far from the nearest land as possible, and in all cases a minimum of 50 nm from the nearest land and preferably in water at least 200 m in depth. Based on the implementation of these measures the impact will not be significant and will not be assessed further.
Dropped objects	Dropped objects from the project vessels could lead to significant health and safety risks. This risk however, is managed through industry standards around health and safety, in-built control measures and compliance with Eni's H&S Standards. Mitigation and prevention of these incidents is included in the EMPr for this project to minimise the risk. The significance of this impact is not assessed further is this EIA Report.
Helicopter incidents	Helicopter collisions could have significant health and safety risks. This risk is however, managed through industry standards around health and safety, in-built control measures and compliance with Eni's H&S Standards. Mitigation and prevention of these incidents is included in the EMPr for this project to minimise the risk. The significance of this impact is not assessed further is this EIA Report

The following accidental events were considered to be potentially significant during scoping and are assessed in *Section 8.3*:

- Accidental oil spill due to a blowout;

- Accidental oil (diesel) spill due to a vessel collision; and

- Accidental release of Non Aqueous Drilling Fluid (NADF) due to the emergency disconnection of the riser occurring during drilling.

A range of design features and control measures have been developed as part of the design planning phase to reduce the likelihood of accidental events. In addition, existing management measures applied by Eni on its other exploration projects to minimise the risk of accidental events will be adopted on this project. These measures are presented in *Section 8.3.5*. All recommended mitigation measures presented in this Section have been incorporated into the Environmental Management Programme (EMPr) for this project (*Chapter 9)*.

8.2 METHODOLOGY

8.2.1 Assessing Significance of Risks

The methodology used to assess the significance of the risks associated with accidental events differs from the impact assessment methodology set out in *Chapter 6* of this report. Risk significance for accidental events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing compliance and control measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects, and informed by the results of the various modelling studies undertaken to confirm the extent and duration of an oil spill. In order to determine the potential extent and duration of accidental oil spills (in the unlikely event that they occur) an oil spill modelling study was conducted for this project (*Annex D*).

Definitions used in the assessment for likelihood and consequence are set out in *Box 8.1*.

Box 8.1 *Risk Significance Criteria for Accidental events*

Likelihood
Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:

- **Low**: the event or incident is reported in the oil and gas industry, but rarely occurs;
- **Medium**: the event or incident does occur but is not common; and/or
- **High**: the event or incident is likely to occur several times during the project's lifetime.

Consequence
The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in accidental events is similar to significance (magnitude x sensitivity) of planned events (*Section 7*) and is classified as either a:

- **Minor consequence**: impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required;

- **Moderate consequence**: impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or

- **Major consequence**: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in *Table 8.2* is used to determine the risk significance for accidental events. The prediction of the risk takes into account the compliance or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 8.2 *Accidental Events Risk Significance*

Risk Significance Rating				
	Likelihood	Low	Medium	High
Consequence	**Minor**	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of accidental events occurring. However, the mitigation strategy to minimise the risk of the occurrence of accidental events is outlined in *Box 8.2*.

Box 8.2 *Mitigation Strategy for Accidental events*

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through:

- Reducing the likelihood of the event (e.g. well design, control measures, preventative maintenance measures, emergency response procedures and training);
- Reducing the consequence (e.g. well capping and containment solutions); and
- A combination of the above.

Recovery/remediation: includes contingency plans and response, e.g.:

- Emergency Response Plan; and
- Oil Spill Contingency Plan.

8.3 ASSESSMENT OF ACCIDENTAL OIL SPILL AND BLOWOUT

8.3.1 Overview

The risk of an oil spill (including crude oil and diesel) into the marine environment is inherent in all offshore oil exploration and appraisal projects. The likelihood (probability) of significant oil spills (i.e. those that can reach the coastline or other sensitive areas) is **very low** with most oil spills being very small and having only limited environmental effects.

An oil spill is an unplanned and unwanted event determined by an accidental or emergency situation. The extent, fate and behaviour of the unplanned oil spill could impact the environment if not properly managed. For instance an oil spill generated by a hydrocarbon release during a blowout (an unwanted situation in which an uncontrolled mass of gas and/or oil is released from the well to the surface or to the seabed), is considered an emergency situation and must be immediately managed to reduce the size and scale of spill.

The probability of a blowout is **very low** where the frequency of occurrence is 2.5×10^{-4} (1 in 4,000 wells) for wells drilled (OGP Report, 2010[1]). The industry approach to dealing with potential oil spills is to develop technology and operational procedures to reduce the likelihood of spills (i.e. an unwanted accidental or emergency situation). Catastrophic events such as the blowout of the Macondo well (2010 in GoM - USA) have significantly contributed to the revision and upgrade of international standards (API/ISO) and best practice and the development and the implementation of new technologies in the field. This has resulted in significant reduction of the risk of catastrophic events occurring in the future.

[1] OGP Risk Assessment Data Directory, Report No. 434-2, March 2010.

The industry focus, commitment and effort, in particular for major oil companies like Eni, is to conduct operations with the highest safety standards, in order to perform drilling operations with no risk and harm to the people, the environment and the asset. In order to minimize the residual risk of incidents, strict rules are defined by international standards (API/ISO) and best practice and must be followed by the company, the drilling contractors and all parties involved in drilling operations, including maritime and logistic operations.

To prevent an unwanted oil spill, the industry has defined number of mandatory response, control and management measures and resources that must be implemented during drilling operations. These includes advanced planning of tools that can be used and training of personnel to reduce the severity of impacts in the event of a spill. These tools include the use of subsea BOP (Blowout Preventer), to immediately shut in the well in case of emergency. In addition, the availability of a capping system can provide a backup tool to be used in case of failure of BOP. The new capping system has been developed after the Macondo incident, in which a similar tool has been used to successfully shut-in the well and contain any further spill. The capping system is now an effective option in case of emergency.

All the response procedures form part of an Oil Spill Contingency Plan (OSCP) that must be developed prior to the beginning of the proposed drilling activities. The OSCP shall be reviewed and approved by the South African Maritime Safety Authority (SAMSA) prior to start of drilling. On approval, SAMSA will issue a Pollution Safety Certificate.

8.3.2 Oil Spill Modelling

The purpose of the oil spill modelling is to identify the worst case consequences for a range of spill scenarios and identify the probability of oil impacting the sea surface and seawater column, coastline or nearshore receptors. The oil spill modelling will also support the preparation of the OSCP.

It is important not only to understand the main risks of oil spills associated with exploration drilling including those related to supporting vessels such as vessel collision resulting in a spill , but also the consequences if any spills were to occur. A key element of identifying the consequence of a spill is to understand what is likely to happen to the oil in the marine environment. Oil spill trajectory modelling plays an important role in predicting the spatial extent of an oil spill for a worst case scenario and subsequently quantifying environmental risks from such oil spills.

For this draft EIA Report, oil spill modelling has been undertaken in order to predict the consequences of three spill scenarios. These three scenarios are:

- **Scenario 1** - vessel collision releasing diesel;

- **Scenario 2a** – blowout at the wellhead leading to hole collapse[1];

- **Scenario 2b** – blowout at the wellhead followed by the installation of a capping system (back-up system for failed BOP); and

- **Scenario 3** - riser disconnect releasing oil associated with the Non-Aqueous Drilling Fluids (NADF) due to the emergency disconnection of the riser occurring during drilling.

Each spill scenario is run 120 times (iterations) with the spill's start date evenly spaced across a five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories across the different seasons. In each case the worst case scenario has been adopted in the assessment for unplanned events, in line with international requirements.

In addition, modelling of Dissolved Aromatic Hydrocarbons (DAH) was conducted for Scenario 2a and the results are presented in *Annex D*.

A number of assumptions has been made in order to determine the scenarios to be modelled. These include the following:

- The event is completely uncontrolled, with no intervention (unrealistic situation) for avoidance/reduction;

- Primary BOP (Blowout Preventer) closure fails with no response from automatic, primary and secondary response activation systems (rigfloor and toolpusher office panels), and no activation from secondary/tertiary ROV and beacon activation systems (unrealistic situation);

- The use of a capping system, a back-up tool to be used in case of BOP failure, has been considered in only one scenario (2b) without considering its capability to recover oil and reduce flow rate prior of final installation on top of BOP/wellhead stack and well killing;

- The use of spill/blowout containment or reduction systems (boom, skimmer, tanks etc.) has not been included in the simulation;

- No depletion/reduction in flowrate has been taken into account for the full release period.

The above assumptions depict an improbable situation, however the modelling of the worst case scenario is in line with best practice and is required for the development of the Emergency Response Plan and OSCP.

[1] This is a self-killing event in which the reservoir hole naturally collapses upon itself, thereby terminating the release.

In particular, in the case of an accidental event, an emergency response team (this team will be available at all times during the drilling activities) will be immediately activated, in accordance with the OSCP, to react to the event in order to reduce and contain the scale of the spill and, in case of blowout, shut-in the well.

8.3.3 *Oil Spill Modelling Results*

This section summarizes the main outcomes of the oil spill study. The model input, assessment scenarios and results are described in detail in *Annex D*.

Scenarios 1 and 3 were evaluated at two representative locations in the northern area: N1 (Lat. -29.171510347, Lon. 32.773259341), N2 (Lat. -29.361772647, Lon. 32.901946107) and one representative location in the southern area S (Lat. -30.539622500, Lon. 31.779959861) of Block ER236.

Scenarios 2a and 2b were evaluated at N1 and S, because N1 was considered the worst case as it has a higher risk of shoreline oiling being closest to the coast.

These spill scenarios were modelled in order to simulate the:

- Spill trajectories;
- Potential locations of the surface slicks and their potential to impact wildlife;
- Potential shoreline locations at risk of oiling; and
- Minimum travel time for the slick to arrive at the shoreline.

The three oil spill scenarios modelled are summarized in *Table 8.3*.

Table 8.3 shows the volume released for each scenario, the release depth, the spill and the total simulation duration.

Table 8.3 Release Descriptions

<table>
<tr><th>Scenario</th><th>Description</th><th>Volume Released</th><th>Spill / Simulation Durations</th><th>Release Depth</th></tr>
<tr><td>1</td><td>Diesel Spill – Vessel Accident</td><td>5,000 bbl
(794.9 m³)</td><td>1 hour /
7 days</td><td>N1: 0.5 m
N2: 0.5 m
S: 0.5 m</td></tr>
<tr><td>2 a</td><td>Crude Blowout – Hole Collapse</td><td rowspan="2">Constant Release Rate
N1: 4,717 bpd (750 m³/d)
S: 6,604 bpd (1,050 m³/d)</td><td>7 days/
21 days</td><td rowspan="2">N1: 1,623 m
S: 2,883 m</td></tr>
<tr><td>2b</td><td>Crude Blowout – Cap Install</td><td>20 days/
34 days</td></tr>
<tr><td>3</td><td>NADF release - Riser Disconnect</td><td>N1: 1,867 bbl (296.9 m³)
N2: 2,094 bbl (332.9 m³)
N2: 3,318 bbl (527.5 m³)</td><td>1 hour /
7 days</td><td>N1: 0.5 m
N2: 0.5 m
S: 0.5 m</td></tr>
</table>

From the stochastic (or probabilistic) scenarios performed, worst case iterations were selected describing the largest amount of the water surface area oiled, the most amount of shoreline oiling mass, and the fastest time for shoreline oiling to occur. In line with the 'worst case 'approach, no mitigation measures and clean-up measures were considered in the simulations. This is an unrealistic situation because in reality, where an oil spill to occur, Eni would initiate appropriate response measures to limit the extent and impact of a spill.

Three critical threshold assumptions were used in the design of the models and interpretation of results. These assumptions address critical thresholds for oil slick thickness (as described in *Annex D*), shoreline flux and DAH (Dissolved Aromatic Hydrocarbons) concentration and relate directly to the ecological effects. *Table 8.4* summarizes these assumptions.

Table 8.4 Threshold Assumptions

Assumption	Value	Importance	Source
Significant slick thickness	1.0 µm	Minimum thickness for smothering of aquatic organisms and wildlife. Range of 1-10 µm minimum smothering thicknesses cited in the literature. In this EIA Report the minimum threshold thickness value was defined as 1 µm.	Peakall *et al*. (1985); French- McCay (2009)
Significant shoreline mass flux	100 g oil/m² of shoreline	Provides a lower-limit to delineate significance for impacting wildlife making contact with shoreline deposits.	French-McCay (2009)
Dissolved Aromatic Hydrocarbons (DAH)	5 ppb	Narcosis has typically been attributed to the aromatic hydrocarbons within an oil. Dissolved aromatic 96-hour LC50 values range between 100 ppb and 1,000 ppb. Low Reliability Triggers, concentrations below which no toxic effects would be expected (effectively a No Observable Effects Concentration or NOEC), are assumed to be 10 to 100 times less than the 96-hour LC50. To enable a significant margin of safety, a highly conservative value of 5 ppb was chosen	ANZECC and ARMCANZ (2000) French (2000), French- McCay (2009)

"Significant surface oiling" is defined as any oil having a thickness above the minimum thickness threshold, a value that delineates where oil becomes visible and below which aquatic biota are at near zero risk of smothering from a crude oil (Lewis, 2007).

Research has been undertaken, in order to estimate exposure thresholds for birds and mammals contacting an oil slick. Peakall *et al*. (1985) and French-McCay (2009) found that oil slicks less than 1 µm were not harmful to seabirds; therefore visible oil between 0.1 µm and 1 µm was chosen as the low risk exposure thickness range. Additional studies found that aquatic birds and marine mammals may be affected at slick thicknesses in the range of 10 µm and 25 µm [Engelhardt (1983), Clark (1984), Geraci and St. Aubin (1988), Jenssen (1994), and Scholten *et al* (1996)]. Thus, a moderate exposure threshold is defined as oil with a thickness between 1 µm and 10 µm, while a high exposure threshold is defined as any oil with a thickness above 10 µm. Model output of the surface oiling and arrival time is filtered to remove oil thinner than 1 µm.

For evaluating the potential for oil impacts to birds and wildlife on the shorelines for use in environmental risk assessment studies, French-McCay (2009) published an evaluation of various animals' sensitivity to oil. French-McCay recommended a threshold of 100 g/m^2 as a reasonable value to indicate when a sufficient amount of oil mass per unit area may cause an impact to shorebirds and wildlife on or along the shore.

Summary of Results per Scenario

Scenario 1 - vessel collision releasing diesel;
A spill of 794.9 m^3 (5,000 bbl) of diesel fuel oil is likely to travel predominantly in the southwest direction with the strong influence of Agulhas Currents parallel to the coastline. It is unlikely that such a spill at any of the three spill locations would carry an oil slick with thickness greater than the minimum smothering thickness (1.0 µm) with potential to impact wildlife to an area within 20 km off South African coastline.

During the modelling of the diesel spill, each spill scenario was run 120 times (iterations) with the spill's start date evenly spaced across the five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories. The worst case for each season was selected and assessed.

In these iterations, the total area on the water surface that was contacted by the minimum smothering thickness for wildlife or higher (1-10 µm), at some point, in the 7-day simulation were 1,896 km^2, 1,684 km^2 and 2,848 km^2 for the releases at N1, N2 and S respectively. These iterations also showed that the total area of the slick on the water surface that was contacted by the high exposure threshold (10.0 µm or higher), at some point, in the 7-day simulation were 210 km^2, 147 km^2 and 243 km^2 for the releases at N1, N2 and S respectively.

In the absence of response efforts, the diesel fuel slick of above the minimum smothering thickness for wildlife (1.0 µm) is able to travel up to a distance of 230 km, 215 km and 320 km from the discharge locations N1, N2 and S respectively. The diesel would be present at these locations in the water column with an oil thickness above the minimum smothering thickness (1.0 µm) for wildlife for up to 3 days, before weathering away into a thinner sheen (*Table 8.5*).

Regions above the minimum smothering thickness for wildlife (1.0 µm) extend as narrow and long streaks parallel to the South African coastline. The locations of shoreline impact from the 7-day diesel spill simulations (simulations undertaken at equally spaced time intervals throughout a historical five year period, which represents a range of hydrodynamic and meteorological conditions), range from the Durban to East London coastlines.

Although no significant shoreline oiling occurs (>100 g/m²), under the worst case scenario oil, below the significant threshold for wildlife injury, would reach 200 to 370 km stretch of shoreline between Durban and East London. However, the probability of shoreline impact due to a spill at any of the three spill locations is less than 15 %. In the case of a spill event from the two northern well locations, diesel reached a shoreline area near Richards Bay area in the shortest time.
Shoreline stretches south of the Durban area were the earliest to contact diesel in the case of a spill originating from the southern well location.

Regardless of the shoreline oiling threshold, out of the 120 iterations over a five year period, the probability of any shoreline oiling occurring at any shore is 7.5, 3.3 and 15 % in that timefor locations N1, N2 and S respectively.
In either case, in the absence of response efforts the diesel has the potential to reach shoreline within 3 days. Note that, unlike crude oil, diesel fuel is unlikely to form sticky emulsions or tarballs. Shoreline cleanup is often not needed as diesel typically degrades naturally and quickly (Annex D 4 Oil Spill Modelling Report).

Table 8.5 Summary of Results - Scenario 1 (Diesel spill)

Drilling Location	Criterion 1: Largest Amount of the Water Surface Area Oiled Above 1 µm Threshold (km²)	Criterion 1: Largest Amount of the Water Surface Area Oiled Above 10 µm Threshold (km²)	Criterion 2: Most Amount of Shoreline Oiling Mass - Shoreline Length (km)	Criterion 3: Fastest time for shoreline oiling to occur (days)	Probability of Shoreline Contact
N1	1,896	210	205	2.6	7.5%
N2	1,684	147	366	3.3	3.3%
S	2,848	243	336	2.8	15.0%

Source: ERM, 2018b
Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

Scenario 2 Blowout

Scenario 2a - Blowout leading to hole collapse:- In the blowout scenario, the release of crude oil was assumed to be constant at 4,717 bpd (750 m^3/day) from a wellhead at N1 and 6,604 bpd (1,050 m^3/d) from a wellhead at S, for 7 days before the hole collapses and stops the release.

Scenario 2b - Blowout followed by the installation of a capping system:- In the blowout scenario, the release of crude oil was assumed to be constant at 4,717 bpd (750 m^3/day) from a wellhead at N1 and 6,604 bpd (1,050 m^3/d) from a wellhead at S, for 20 days before the installation of the capping system stops the release.

As previously discussed, this is an overestimation of both the rate and quantity of oil that would be released in the unlikely event of a blowout. The oil rises through the water column affected by different currents at the various vertical strata, where the oil either; dissolves, volatilizes, degrades, or remains in the liquid state as a droplet until reaching the surface. On the water surface, a slick is formed.

During the modelling of the blowout event, each spill scenario was run 120 times (iterations) with the spill's start date evenly spaced across the five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories. The worst case scenario <u>for the probability of oil impacting the sea surface and seawater column, coastline or nearshore receptors</u> for each season was selected and assessed.

In the case of a blowout event, the spill migration will be simulated with real time Metocean data, in order to predict the movement and emergency response team will implement the OSCP to contain/reduce/shut in the spill and so limit possible residual risk for shoreline impact.

The modelling results (refer to *Annex D*) are interpreted in *Table 8.6* below*:*

Table 8.6 Interpretation of Scenario 2a and Scenario 2b Modelling Results

Scenario	Result
Scenario 2a - Blowout leading to hole collapse	• Once the oil surfaces, it generally moves in a south-westerly direction as a widening plume due to the Agulhas current, prevailing near-surface currents and winds. • A slick of minimum smothering thickness for wildlife (1.0 µm) is unlikely (less than 1 % probability) to come ashore before weathering away into a thin sheen. • The maximum total area on the water surface contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during Summer and Autumn, was 401 km^2 (N1 well site) and 3,049 km^2 (S well site). • No regions exceeded the 10 µm high exposure threshold for risks to birds and wildlife.

Scenario	Result
	• Significant shoreline oiling (>100 g/m²) is unlikely (less than 1 % probability) to reach the shoreline. • Should oil reach the shore it would do so within 4 to 6 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring. • Maximum area of DAH above the conservative 5 ppb threshold for worst case oiling ranged from 2,033 km² (southern well location during summer/autumn) to 324 km² (northern well location during winter/spring).
Scenario 2b - Blowout followed by the installation of a capping system (back up equipment in case of failure of BOP)	• Once the oil surfaces it generally moves in a south-westerly direction as a widening plume due to the prevailing near-surface currents and winds. • A slick of minimum smothering thickness for wildlife (1.0 µm) is unlikely (less than 1 % probability) to come ashore before weathering away into a thin sheen. • At the N1 well site, the maximum total area contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during winter and spring, was 695 km². • At the S well site, the maximum total area contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during summer and autumn, was 4,386 km². • No regions exceeded the 10 µm high exposure threshold for risks to birds and wildlife. • Significant shoreline oiling (>100 g/m²) is unlikely (less than 1 % probability) to reach the shoreline. • Should oil reach the shore it would do so within 5 to 7 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring.

Source: Interpreted from ERM, 2018b by Pulfrich, 2018
Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

Scenario 3 - riser disconnection and NADF mud release
In the riser disconnect scenario, released base oil travels similarly to the diesel spill scenario, predominantly in the south and southwest directions, and potentially reaching shorelines within 3 days.

The modelling results (refer to *Annex D*) shows that the surface area above the minimum smothering thickness for wildlife (1.0 µm) would be carried to an area within 25 km off South African coastline. In the absence of response efforts, the smothering slick of oil is able to travel over 215 km, 160 km, and 305 km from the release points N1, N2 and S respectively before weathering away into a thinner sheen. The maximum total area on the water surface contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm was 1,232 km² (N1 well site), 870 km² (N2 well site) and 2,050 km² (S well site).

No significant shoreline oiling (>100 g/m²) occurred although, under the worst case scenario, oil would reach the shore within 2 to 3 days potentially affecting a shoreline length of 119 km (N1 well site), 249 km (N2 well site) and 186 km (S well site), between Durban and East London.

The probability of shoreline impact due to a spill at any of the three spill locations is 8.3 %, 5.8 % and 15 % for N1, N2 and S.
The modelling results (refer to *Annex D*) also showed the surface plumes of elevated Total Suspended Solids would extend up to 6 km down-current of the point of release under maximum average current conditions, but concentrations remain below the ecological threshold of 35 mg/l.

Table 8.7 Summary of Results – Scenario 3 (NADF Release due to Riser Disconnect)

Drilling Location	Criterion 1: Largest Amount of the Water Surface Area Oiled above 1 µm Threshold (km²)	Criterion 1: Largest Amount of the Water Surface Area Oiled above 10 µm Threshold (km²)	Criterion 2: Most Amount of Shoreline Oiling Mass - Shoreline Length (km)	Criterion 3: Fastest Time for Shoreline Oiling to Occur (days)	Probability of Any Shoreline Contact with Oil
N1	1,232	0	119	2.5	8.3%
N2	873	0	249	3.2	5.8%
S	2,046	0	186	2.7	15.0%

Source: ERM, 2018b
Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

Overall Summary of Results

It is important to repeat here that, in line with international best practice, all the modelling scenarios have been run on the assumption that no oil spill response measures would be implemented and that no mitigating actions would be taken at the point of spillage. Therefore, as this will not be the case, the results of the modelling present the 'worst case' that could result from any particular oil spill. A summary of the modelling results that were used for the assessment are provided in *Table 8.8*.

Table 8.8 Summary of the Oil Spill Modelling Results for all Scenarios

Drilling location	Most Shoreline Oiling Above 100 g/m² Significant Threshold (km)	Shortest Time to Contact Shoreline (days)	Probability of Shoreline Contact Above 100 g/m² Significant Threshold (%)	Max. Area Above 1 µm Significant Threshold (km²)	Max. Area Above 10 µm Significant Threshold (km²)
Diesel spill modelling results summary – Scenario 1					
N1	205	2.6	7.5%	1.896	210
N2	366	3.3	3.3%	1,684	147
S	336	2.8	15%	2.848	243
Crude oil blowout modelling results summary – Scenario 2a					
N1	0	4.25	<1	401	0
S	0	5.00	<1 %	3049	0
Crude oil blowout modelling results summary – Scenario 2b					
N1	0	5.75	<1 %	695	0
S	0	5.25	<1 %	4386	0
Riser disconnect modelling results summary – Scenario 3					
N1	119	2.5	8.3%	1,232	0

Drilling location	Most Shoreline Oiling Above 100 g/m² Significant Threshold (km)	Shortest Time to Contact Shoreline (days)	Probability of Shoreline Contact Above 100 g/m² Significant Threshold (%)	Max. Area Above 1 µm Significant Threshold (km²)	Max. Area Above 10 µm Significant Threshold (km²)
N2	249	3.2	5.8%	873	0
S	186	2.7	15%	2,046	0

8.3.4 *Likelihood/Probability of a Spill*

The frequency of a release of crude oil from a well blowout from a normal deep-water well is considered rare, with a frequency of incident worldwide estimated at 1 in 4,000 wells (2.5×10^{-4}) for exploratory wells drilled where international best practice methods are applied (according to OGP Report 434-02, 2010).

Eni assesses the risk of a well blowout, from the geological factors, tools reliability and human errors, during the well design phase and considers the use of new technology to minimize the risk. By using such an approach, Eni has modelled the impact based on a specific design of its proprietary technologies. This results in a reduction of the blowout probability by up to two orders of magnitude: from 10^{-4} down to 10^{-6}, i.e. 1 in 400,000 wells drilled.

8.3.5 *Risk Reduction and Response Measures*

As per OGP (2016), an oil spill assessment should seek to identify measures that:

- Avoid/ reduce the possibility of accidental events occurring, i.e. preventive measures (e.g. BOP, additional barriers);
- Reduce the potential size of spills from actual events, i.e. response/source control measures (e.g. installation capping system and containment solutions); and
- Reduce the consequences if accidental events should occur, i.e. mitigating measures (e.g. oil spill preparedness, plan for high-risk activities during seasons or yearly quarters with lower consequence potential).

Table 8.9 details the avoidance/prevention actions, which will be implemented by Eni during the drilling process as well as the mitigation measures that will be implemented in the unlikely event of a spill.

Table 8.9 Avoidance/Prevention Actions and Mitigation Measures

Barriers and Controls (Avoidance/Prevention Actions)	
Design and Engineering	Prior to the start of any drilling operation, the Company (Eni) adopts several avoidance and mitigation actions, starting from the design and engineering phases. For instance Eni defines the design (well profile, analysis of expected lithology, temperature and pore pressure analysis, casing and tubing stress analysis, wellhead, BOP and marine riser stress and stability simulations, shallow hazard study etc.) and subsequently the drilling program to be followed during well construction. The drilling program is certified by Eni Headquarters (HQ) to ensure the compliance to Company best practice rules and according to highest international standard and industry best practices. It also details assurance and competency requirements for well engineering and well intervention personnel. The phase of the well design also includes procurement of materials, rig selection and the contractor qualifying process. During drilling operations, the drillship and HQ implement a real time monitoring of drilling parameters in order to reduce the risk of unexpected hydrocarbon influx (kicks) inside the well and so maximize the safety during the construction of the well at different drilled sections.
Multiple Barriers	Eni will adopt, all over the well's construction, the dual barrier principle. In order to minimize the risk of negative and unwanted events (such as a blowout), the well design and the operation procedures, device and equipment, will guarantee the presence of a second barrier in case of failure of the primary barrier. For instance the subsurface pressures above and within the hydrocarbon-bearing strata will be controlled by the use of weighted drilling mud. Mud is the primary barrier during drilling but in case of failure and hydrocarbon influx, the BOP could safely seal around the drillpipe allowing the killing of the well and the weight increase of the mud in order to restore the primary barrier. Another example of double barrier is casing with cemented annulus. Casing, that is designed to withstand a variety of forces, such as collapse, burst or tensile failure, and chemical corrosion, is the primary mechanical barrier to isolate the well from external lithology. In case of failure, the presence of cement in the annulus will provide a secondary containment barrier.
BOP stack	BOP stacks are used to control the pressure of a well through mechanical devices designed to rapidly seal the well (or "shut in") in an emergency. BOP is a piece of equipment with blind rams, which allows you to close the well without drillpipes or casing inside the BOP ("empty"BOP). The BOP can also be configured with redundancy rams, so in case of the failure of the first set, a secondary set of rams are used. These shear rams allow you to close the ram and cut the pipe present inside BOP, in order to allow, if necessary, the safe evacuation of the drilling ship. After the riserless phases, the BOP installation is mandatory. Eni will adopt a BOP with redundancy activation point both at surface (panels located in different position of the rig) and from remote (acoustic activation system, ROV).
Competent Staff	Eni has experienced competent and certified staff who will design the well and conduct operations. Also for well control, all relevant positions (well operations engineers, superintendent, supervisors, driller, toolpusher, drilling safety leader) are certified and periodically trained/tested by IWCF[1] the only independent organisation to develop and administer well control training, assessment and certification programmes on behalf of the exploration and production sector of the oil and gas industry.

[1] IWCF: International Well Control Forum http://www.iwcf.org/

Barriers and Controls (Avoidance/Prevention Actions)	
Testing and Certification	Safety critical equipment will be subject to testing and certification to ensure that it meets design specifications. The well design, drilling and completion plans will go through several stages of review involving experts from Eni and the drilling contractor prior to the commencement of drilling operations.
Response and Recovery (Mitigation Actions)	
Oil Spill Contingency Plan (OSCP)	Despite the prevention measures and management procedures built into the design of the project there is always a risk that a spill can occur. Thus, as standard practice, an OSCP is prepared and put in place at all times during the drilling operation. There are three principal components underpinning an OSCP: • Crisis management (Emergency Command and Control Management); • Spill response, containment and clean-up; and • Well control. Further details are provided in *Chapter 9*.
Emergency Management	The On-scene Commander, normally the OIM off-shore installation manager, will manage emergency on site and ensure the correct application of OSCP, including the guarantee of the correct communication channel to the Company Representative on board and Emergency Response Room (ERR) as per OSCP
Well Control	Whilst the OSCP defines the approach and strategy required to manage the containment, removal and clean up following a major spill, the well control process is focussed on stopping the source of the leak (e.g. killing the well). A Well Control Contingency Plan (WCCP) will be put in place for each well.
Cap and Containment Equipment (capping system installation as back up of BOP failure)	If the BOP does not successfully shut off the flow from the well, the drillship will disconnect and move away from the well site while crews mobilise a capping system. The capping system will be lowered into place from its support barge and connected to the top of the BOP to contain and control the flow from the well. This will significantly reduce the spill period. All of Eni's wells are designed to allow for capping. In case of a blowout event, Oil Spill Response Limited[1] (OSRL) (for oil spill response equipment) and Wild Well Control[2] (for source control and well killing) will be immediately mobilised. Both Companies provide a support 24/7. In the unlikely case of larger spills, Eni has a contract with a global provider, Oil Spill Response Limited (OSRL), which will intervene within 24 hours providing part of the oil spill response equipment and oil spill dispersants. Saldanha Bay is the logistics base in country for OSRL. In case of the loss of control of the well, Eni has a service agreement in place with Wild Well Control to mobilise the capping stack within 48 hours. Further equipment will be available in the logistics base close to operations.
Containment and clean-up equipment	Project vessels will be equipped with appropriate spill containment and clean-up equipment, eg booms, dispersants and absorbent materials. All relevant vessel crews will be trained in spill clean-up equipment use and routine spill clean-up exercises. Logistical arrangements for the integration of additional support would be in place (eg from OSRL/SWIS). Eni will specifically develop its own Oiled Wildlife Response Plan as part of it's OSCP.

[1] Oil Spill Response Limited (OSRL) is a Global Tier 3 Oil Spill Response Organization, owned by its oil industry member shareholders, for the benefit of its members. OSRL provides immediate response to a Tier 3 Event

[2] Wild Well Control is the world's leading provider of onshore and offshore well control emergency response, pressure control, relief well planning, engineering, environmental, and training services.

8.3.6 *Risk Significance of Oil Spills on Marine and Coastal Habitats and Species*

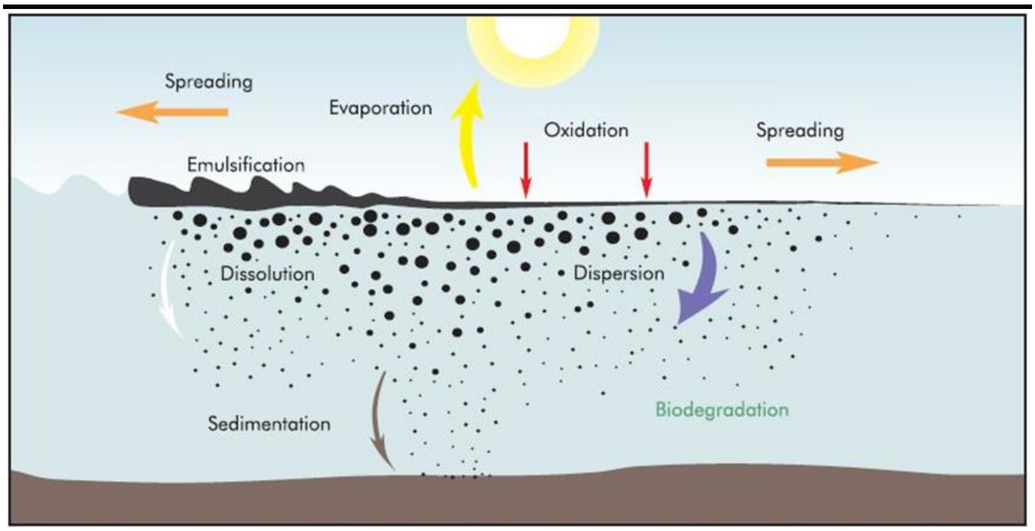
General Description of Effects to the Marine Environment from a Hydrocarbon Spill

Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment. 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 1998; Perry, 2005).

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. The physical properties that affect the behaviour and persistence of an oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the oils chemical composition (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 will be exposed to the toxic constituents of the released product.

As soon as oil is spilled, various weathering processes (*Figure 8.1*) come into play. Although the individual processes may act simultaneously, their relative importance varies with time (*Figure 8.2*). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer term processes of oxidation, sedimentation and biodegradation.

Figure 8.1 ***The Weathering Processes Acting on Oil***



Source: ITOPF, 2002

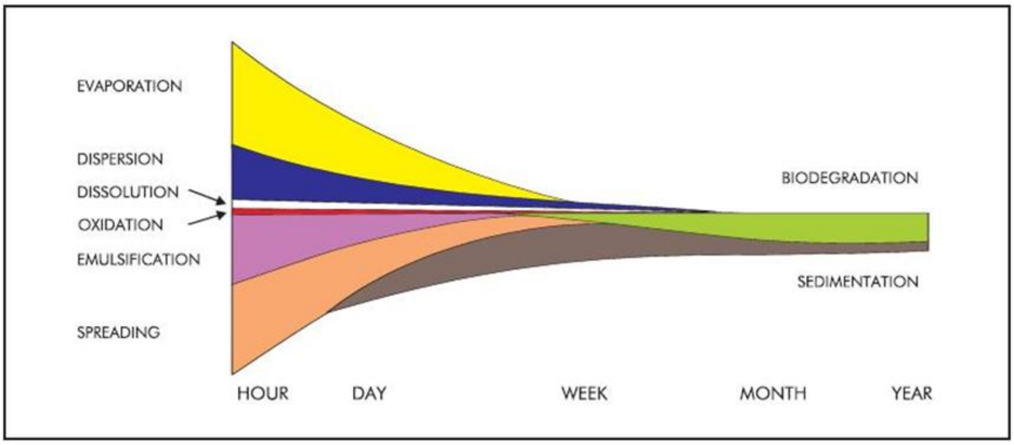
As a general rule, oils with a volatile nature, low specific gravity and low viscosity are less persistent and tend to disappear rapidly from the sea surface (e.g. diesel and light oils). In contrast, high viscosity oils containing bituminous, waxy or asphaltenic residues, dissipate more slowly and are more persistent, usually requiring a clean-up response (e.g. heavy crude oil). Eni is anticipating the oil viscosity to be light for this project.

Oil spilled in the marine environment will have an immediate detrimental effect on water quality. Most of the toxic effects are associated with the monoaromatic compounds and low molecular weight polycyclic hydrocarbons (also referred to as Dissolved-phase Aromatic Hydrocarbons (DAHs)), as these are the most water-soluble components of the oil.

Oil is most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify. The time of year during which a large spill takes place will significantly influence the magnitude of the impact on plankton and pelagic fish eggs and larvae. Should the spill coincide with a major spawning peak, it could result in severe mortalities and consequently a reduction in recruitment (Baker *et al*. 1990). However, spawning and recruitment success is temporally variable and environmental conditions are likely to have a far greater impact than a single large spill (Neff 1991).

Sensitivity of fish eggs and larvae are primarily associated with exposure to fresh (unweathered) oils (Teal & Howarth 1984), with little mortality attributable to exposure to weathered product (Neff 1991). Because of their mobility and ability to avoid floating oil masses and the associated hydrocarbon contamination, adult pelagic fish are considered less at risk from exposure to oil spills than benthic or inshore species.

Figure 8.2 The Fate of a Typical Medium Crude Oil under Moderate Sea Conditions



Source: ITOPF, 2002

Note: Figure showing changes in the relative importance of weathering processes with time - the width of each band indicates the importance of the process.

Surface spills in the offshore environment are unlikely to have an immediate effect on the seabed. However, oil in sediments, as a result of accidental spillage near the coast, or the loss of NADFs and oil-contaminated drill cuttings following emergency disconnection of the riser, can result in physical smothering of the benthos and chronic pollution of the sediments. A wide range of effects of oil on benthic invertebrates has been recorded, with much of the research focussing on the various life stages of polychaetes, molluscs and crustaceans (Volkman *et al*. 1994). However, as tolerances and sensitivities vary greatly, generalisations cannot be confidently made.

Some burrowing infauna (e.g. polychaetes and copepods) show high tolerances to oils, as the weathered product serves as a source of organic material that is suitable as a food source.

Polychaetes in particular can take advantage of bioturbation and degradation of oiled sediments (Scholtz *et al*. 1992). This results in highly modified benthic communities with (potentially lethal) 'knock-on' effects for higher order consumers. Bioaccumulation of petroleum hydrocarbons by fish through oil-contaminated prey and sediments is a well-described phenomenon (CSIR & CIME, 2011).

Volkman *et al*. (1994) suggest that some epifauna produce complex responses to oiling and that bioaccumulation of petroleum hydrocarbons can readily occur in some cases. Sessile and motile molluscs (e.g. mussels and crustaceans) are frequent victims of direct oiling or coating.

Filter-feeders in particular are susceptible to ingestion of oil in solution, in dispersion or adsorbed on fine particles. Chronic oiling is known to cause a multitude of sub-lethal responses in taxa at different life stages, variously affecting their survival and potential to re-colonise oiled areas. Tolerances to oil vary between life stages, with larvae and juvenile stages generally being more sensitive to the water-soluble fractions of oil than adults (Volkman *et al*. 1994; CSIR & CIME 2011).

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). However, being mobile, fish are likely to be able to avoid a large spill.

Chronic and acute oil pollution is a significant threat to both pelagic and inshore seabirds. Diving sea birds that spend most of their time on the surface of the water are particularly likely to encounter floating oil and will die as a result of even moderate oiling which damages plumage and eyes. The majority of associated deaths are from the properties of the oil and damage to the water repellent properties of the birds' plumage.

This allows water to penetrate the plumage, decreasing buoyancy and leading to sinking and drowning. In addition, thermal insulation capacity is reduced requiring greater use of energy to combat cold. Oil is also ingested as the birds preen in an attempt to clear oil from plumage and may furthermore be ingested over the medium to long term as it enters the food chain (Munro 2004).

The effects of ingested oil include anaemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs (Scholz *et al*. 1992). Furthermore, even small concentrations of oil transferred from adult birds to the eggs can cause embryo mortalities and significantly reduce hatching rate. Oil spills can thus have an effect on birds that may be some distance from the spill site, which can be attributed to the parent's feeding habits. Impacts of oil spills on turtles is thought to primarily affect hatchling survival (CSIR & CIME 2011). It is anticipated that juvenile turtles will be present in the area potentially impacted by an oil spill (Agulhas Current), particularly during January to March. Similarly, 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 (or starvation, if they had taken refuge on land).

The effects of oil pollution on marine mammals is poorly understood (White *et al*. 2001), with the most likely immediate impact of an oil spill on cetaceans being the risk of inhalation of volatile, toxic benzene fractions when the oil slick is fresh and unweathered (Geraci & St Aubin 1990, cited in Scholz *et al*. 1992). Common effects attributable to the inhalation of such compounds include absorption into the circulatory system and mild irritation to permanent damage to sensitive tissues such as membranes of eyes, mouth and respiratory tract.

Direct oiling of cetaceans is not considered a serious risk to the thermoregulatory capabilities, as cetacean skin is thought to contain a resistant dermal shield that acts as a barrier to the toxic substances in oil. 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. Field observations record few, if any, adverse effects among cetaceans from direct contact with oil, and some species have been recorded swimming, feeding and surfacing amongst heavy concentrations of oil (Scholz *et al*. 1992) with no apparent effects.

Although there is a very low probability (less than 1 %) of shoreline oiling during a crude blowout, if the oil reaches the coastline it could impact the coastline in the following ways:

- Subtidal zone:

    - Change in community structure with a decrease in species that have a high sensitivity to hydrocarbon spills (e.g: burrowing bivalves and small crustaceans; IOGP, 2015) and altered composition of opportunistic species, eg polychaetes, oligochaetes, and sometimes increased algal biomass due to increased nutrient availability in the photic zone. (Houghton, *et al*, (1991); Cabioch *et al* (1978); Corredor *et al* (1990); Dauvin (1987); Lee & Page (1997),).

- Rocky shores:

    - Toxic exposure of rocky shore fauna and flora (molluscs on rocks, algae, echinoderms etc.) leading to direct mortality from smothering by oil or toxic effects through the respiratory or digestive system of organisms. Toxic effects are worsened through the use of dispersants although recovery period is increased.
    - Exposed shores recover more quickly than sheltered shores as strong wave action removes contamination and biota of exposed shores are able to more quickly colonise an impacted shore. (Hawkins *et al* (2002); Edgar *et al* (2003); Smith (1968); Brien & Dixon (1976); Chasse (1978); Teal & Howarth (1984); Edgar & Barrett (2000); Kingston (2002); Laffon *et al* (2006); Mariogomez *et al* (2006).

- Sandy beaches:

    - Toxic exposure and smothering of flora and fauna causing direct mortality of species, particularly species that have a high sensitivity to hydrocarbon spill, such as crustaceans (filter feeders) and amphipods, which can rapidly disappear after an oil spill.
    - Species on high shore beaches often do not have a larval dispersion phase and therefore are not quickly recolonised.
    - Exposed shores recover more quickly than sheltered shores as strong wave action removes oil contamination, and biota of exposed shores are able to more quickly colonise an impacted shore.
    - Decreased species richness is observed in beaches after oil spills with lower diversity of crustaceans, polychaetes, molluscs and insects, but recovery occurs in the short to medium term. (Sanders *et al* (1980); Elmgren *et al* (1983); Dauvin (1987); Gomez Gesteira *et al* (2000); De la Huz *et al* (2005)).

- Estuaries:

    - Natural intrusion of sea water into estuaries can result in ingress of oil entrained in seawater entering these habitats which are critical nursery areas for fish and prawn recruitment as well as foraging areas for birds and habitat for unique estuarine crustaceans such as mud crabs.

- Oil entering an estuary will increase the concentration of aromatic hydrocarbons and therefore the toxicity of the water column with greater effects on aquatic organisms (eg fish and prawns) than in the open sea.

Sensitivity

Being highly toxic, oil from a 'blow-out', a release of oil associated with the NADF riser disconnection or marine diesel released during an operational spill would negatively affect any marine fauna that come into contact with the slick.

The drilling activities will be located in the offshore marine environment, approximately 62 to 65 km offshore, and removed from most sensitive coastal receptors (e.g. bird colonies), canyons or MPAs. However, due to the proposed well(s) being situated within the influence of the strong Agulhas Current, spilled hydrocarbons would be rapidly transported considerable distances parallel to the South African coastline potentially reaching the shore well to the southwest of the proposed well locations.

Depending on the nature and type of the spill, sensitive coastal receptors would thus likely be affected to a greater or lesser degree offshore of East London, as well as the estuaries along that section of coastline.

The benthic fauna inhabiting unconsolidated sediments of the outer shelf and continental slope are very poorly known, but at the depths of the proposed well are expected to be relatively similar, varying only with sediment grain size, organic carbon content of the sediments and/or near-bottom oxygen concentrations. These benthic communities usually comprise fast-growing opportunistic species able to rapidly recruit into areas that have suffered natural environmental disturbance. Epifauna living on the sediment typically comprise taxa which are longer lived and therefore more sensitive to disturbance. No rare or endangered species are known.

In contrast, the benthos of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. As video footage has identified sensitive communities including sponges, black corals, gorgonians, alcyonarian soft corals and stylasterine lace corals (Sink *et al* 2006) in submarine canyons off the KZN coastline, the potential occurrence of such sensitive deep-water ecosystems in the Block ER236 area, and specifically the areas of interest for well drilling, cannot be excluded.

In the offshore environment, the taxa most vulnerable to spills are pelagic seabirds, although turtles, large migratory pelagic fish and both migratory and resident cetaceans may also be affected. Many of these are considered globally 'Critically Endangered' (e.g. Southern Bluefin tuna, Blue whale, hawksbill turtle), 'Endangered' (e.g. whale shark, Fin and Sei whales,) 'Vulnerable' (e.g. Leatherback turtle short-fin mako, whitetip sharks, sperm whale) 'Near threatened' (e.g. blue shark) and 'Least concern' (e.g.: Humpback and Southern Right Whales).

Although it is currently unknown whether coelacanths occur in the deep water submarine canyons near Block ER236, coelacanths are known to occur in the Wright and Jesser canyons in the Sodwana Canyon complex (Hissman *et al.,* 2006) off the Greater St Lucia Wetland Park (GSLWP) World Heritage Site, within caves in the 90 to 140 m depth range. Internationally, coelacanth discovery depths range from 120 m to 300 m. The Tugela canyon head starts at approximately 600 m depth with the thalweg ending in the Natal Valley at approximately 2,800 m (Wiles *et al.,* 2013). The Tugela Canyon differs significantly in morphology from the Wright and Jesser Canyon, where coelacanths have been reported. Although terraces are present which may provide shelter in the form of caves and overhangs, they occur at depths (>1,500 m) well beyond those at which coelacanths have been recorded to date.

Potential habitats have been with further potential habitats being located off Lake St Lucia (Hissman *et al*. 2006) and on the continental shelf off the stretch of coastline between Port Shepstone and Port St Johns (Green *et al*. 2006).

Although the areas of interest for well drilling do not overlap with any existing or recently approved[1] Marine Protected Areas (MPAs) and Ecologically or Biologically Significant marine Areas (EBSAs), there are numerous MPAs, EBSAs and Hope Spots in the Area of Indirect Influence. These include the Amathole MPA in the vicinity of East London, and the Dwesa-Cwebe, Hluleka and Pondoland MPAs located on the Wild Coast. Biota protected within these areas could be impacted by both surface and sub-surface oil slicks following a major blowout.

8.3.7 *Risk Significance of an Oil (diesel) Spill on Marine and Coastal Habitats and Species due to Vessel Collision*

At any phase of the project (mobilisation, drilling and decommissioning), there is the unlikely possibility that a moderate diesel spill could occur through a vessel collision resulting in a release of diesel into the marine environment. Diesel is a light hydrocarbon and is likely to dissipate rapidly to the atmosphere.

[1] 24 October 2018, Department of Environmental Affairs, www.sanbi.org

From the results of modelling ***Scenario 1***, a slick resulting from a vessel collision would spread in a south-westerly direction (due to the strong influence of Agulhas Currents) and would be unlikely to reach the shore (probability of shoreline impact due to a spill at any of the three spill locations is less than 15 %).

Dissolved aromatic concentrations may, however, persist in the top few meters of the water column beneath the slick for a number of days, potentially resulting in acute toxicological effects in marine fauna coming in contact with the slick for extended periods.

The magnitude of the potential impact varies depending on the faunal group affected ranging from low for benthic macrofauna, marine mammals and turtles, to high for seabirds and sensitive coastal/estuarine environments, likely persisting over the medium- to long-term.

The likelihood of such an occurrence taking place would be **Low.** The consequence was assessed as **Moderate** for other marine fauna and **Major** for seabirds. This was based on the low probability of the spill reaching over 200 km of the coastline above the significant shoreline oiling threshold (100 g/m²).

Therefore, the ***risk significance*** (*Table 8.10)* is assessed as **Minor** (for other marine fauna) to **Moderate** (for seabirds). Taking into consideration the extensive well planning and built-in barriers, capping and containment measures, (*Table 8.9)* supplemented with an OSCP, the magnitude of the spill will be reduced, therefore the ***residual risk*** is considered **As Low As Reasonably Practicable (ALARP).**

Table 8.10 Risk Significance of an Oil (Diesel) Spill on Marine and Coastal Habitats and Species from a Vessel Collision

Characteristic	Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Seabirds
Type of Impact	Direct	Direct
Likelihood	Low	Low
Consequence	Moderate	Major
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**

8.3.8 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species due to Blowout

Although unlikely, there is the possibility of a well blowout (uncontrolled release of oil- ***Scenario 2a and 2b***) during exploration.

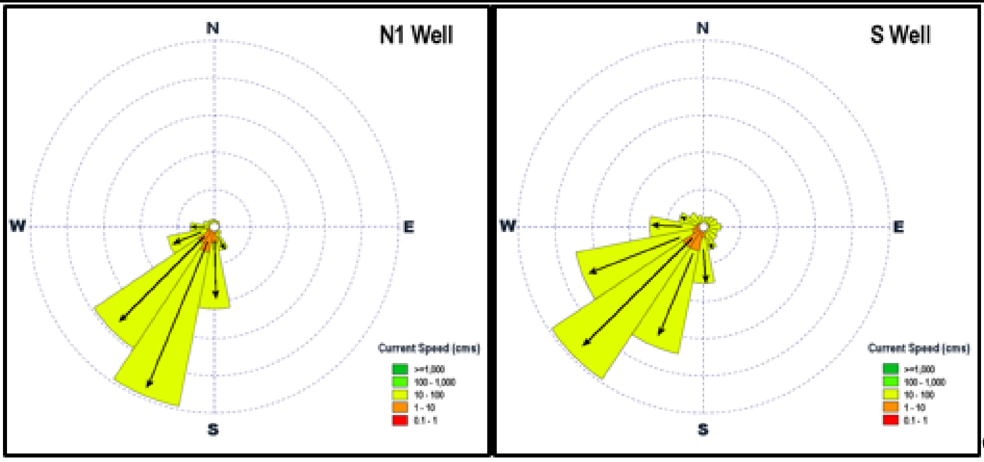
As depicted in *Section 8.3.3*, the results of the oil spill modelling study indicate that the spill would spread in a south-westerly direction, with a very low probability (less than 1 % chance) of significant oiling reaching the shoreline, thus being of regional extent for all but benthic macrofaunal communities. Significant oiling (>100 g/m^2) is unlikely (less than 1 % probability) to reach the shoreline. Should oil reach the shore it would do so within 5 to 6 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and within 4 to 5 days at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring. Dissolved aromatic hydrocarbon concentrations may also persist, for a few days, throughout the water column due as the plume rises from the blowout to the top few meters of the water column beneath the slick. Where threshold concentrations for dissolved aromatics are exceeded close to the blowout, these could trigger acute toxicological effects in both demersal and pelagic marine fauna.

The DAH trigger threshold has been calculated based on conducting tests, over 96 hours, on marine organisms to identify at what concentration an acute toxicological response is triggered. The DAH 96-hour LC_{50} values range between 100 and 1,000 ppb at which an acute toxicological response may result). These are conservative value as studies have been carried out that indicate that no toxic effects occur at 10 to 100 ppb (ANZECC & ARMCANZ 2000, French 2000). In the modelling study undertaken for this project, an even more conservative value of 5 ppb, a value that there will be no acute toxicological response effect and the results show that the majority of the DAH concentrations are still below the 100 ppb trigger threshold (ERM 2018b).

Distributions of current speed and direction indicate that at the northern well site, currents flow towards the west, southwest and south for 89% of the time, with north, north-northwest and northwest flows occurring only 2% of the time. At the southern well site, currents flow towards the west, southwest and south for 83% of the time, with north and north-northwest flows occurring only 3% of the time. Concentrations of DAHs above the threshold would thus affect a larger volume of water and result in longer durations of exposure of aquatic organisms to the dissolved components than the DAH footprints for surface slicks (*Figure 8.3,* ERM, 2018b).

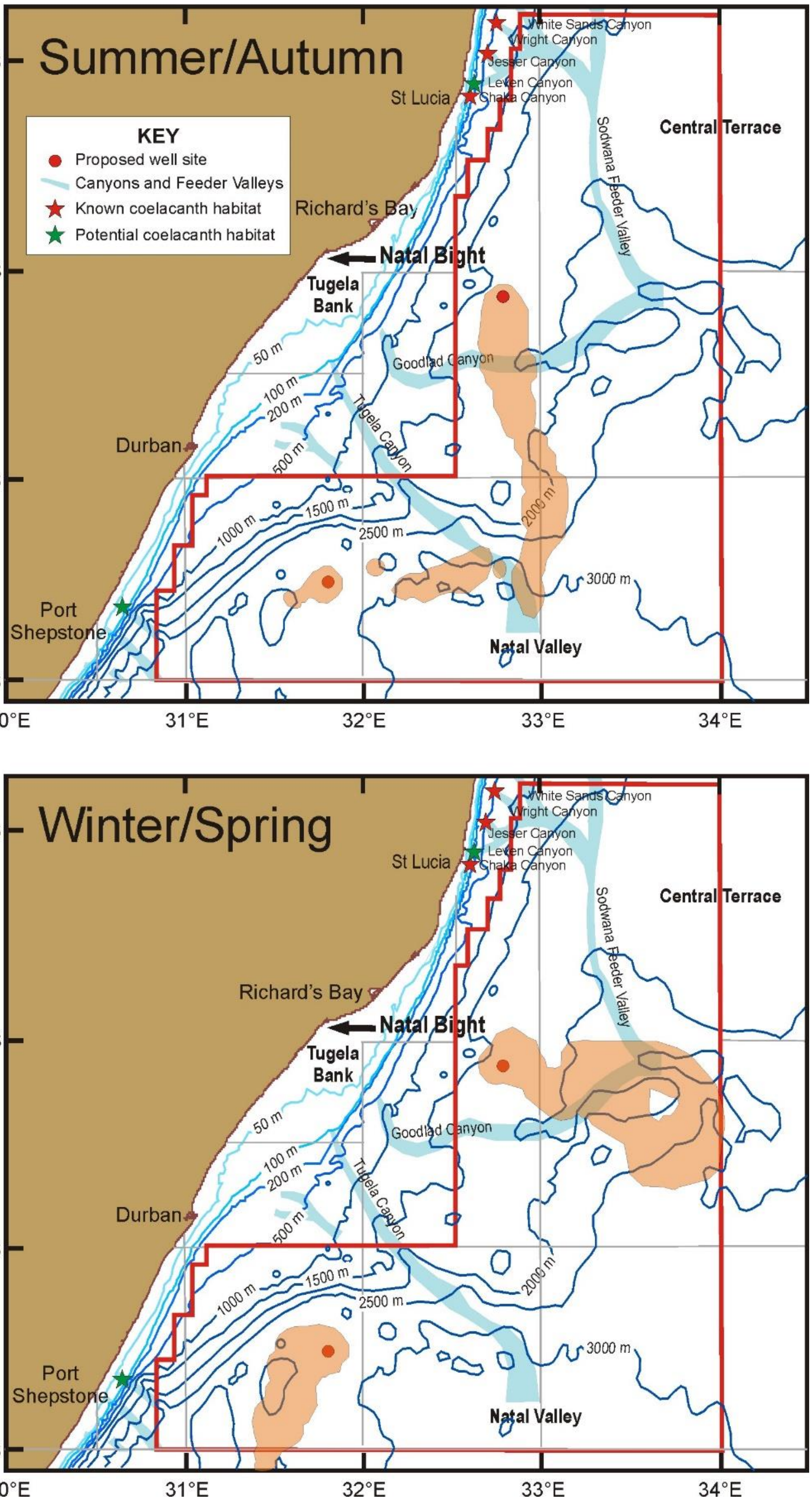
Modelling results indicate that for a blowout at the northern well site in summer/autumn, the DAH plume above the 5 pbb threshold would tend to travel in a southerly direction for approximately 200 km before turning west. The plume travels independently and further than the surface slick and, regardless of depth, was estimated to affect an area of 4,403 km². The plume would cross the Goodlad Canyon at approximately 2,000 m water depth and the Tugela Canyon at between 2,500 m and 3,000 m water depth. The likelihood of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low (2 to 3%). In contrast, the DAH plume from a blowout at the southern well site remains confined to within approximately 30 km west of the well location, only affecting an area of 324 km² *Figure 8.4*, top). The canyons off Port Shepstone would not be affected.

Figure 8.3 Current Roses (Distributions of Speed and Directions) across All Depths, 2013-2017 at N1 and S. Arrows depict direction of currents.



Source: HYCOM (Annex D4)

Figure 8.4 *<u>Illustrative</u> Extent of the Modelled DAH Plume*



Source: Pulfrich, 2018

Note: footprints >5 ppb (orange shading) from the northern and southern well sites (red dots) during summer/autumn (top) and winter/spring (bottom) in relation to submarine canyons off the KwaZulu-Natal coast. The map shows that the plume does not extend into the areas known or potential coelacanth presence. <u>This figure is not geo-referenced.</u>

DAH plume footprints for a blowout at the northern well location during winter/spring would tend to travel mostly eastwards for approximately 100 km before turning southwards, affecting an area of some 5,874 km^2.

The plume would cross the deeper portions (>2,500 m) of the Goodlad Canyon and its confluence with the base of the Sodwana Feeder Valley at approximately 2,500 m depth. The probability of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low (2 to 3 %). The DAH plume from a blowout at the southern well site would tend to travel mostly southwest for approximately 100 km, affecting an area of 2,033 km^2 before diluting and degrading away (*Figure 8.4*, bottom). The canyons off Port Shepstone would not be affected. The probability of northward transport of the plume towards the Tugela Canyon was very low. The plumes would again travel independently and further than surface slicks.

The magnitude of the potential impact from the surface slick varies depending on the faunal group affected ranging from low for benthic macrofauna, fish, marine mammals and turtles, too high for seabirds and sensitive coastal/estuarine environments (including MPAs), likely persisting over the medium to long-term.

Impacts of the spill may cause a substantial change in the population of sensitive species over multiple generations, particularly if the spill occurs during the turtle hatching season (juvenile turtles in the Agulhas current during the January - March) or during seabird moulting season.

When considering the risks of subsurface oiling to coelacanths and coelacanth habitat in particular, the subsurface plume from a potential blowout in both the northern and southern areas of interest for well drilling occur far to the south of the known and potential coelacanth habitat of the GSLWP. Additionally the subsurface plume does not reach potential coelacanth habitat identified inshore of Port Shepstone.

When considering the risks of subsurface oiling to coelacanths and coelacanth habitat in particular, the subsurface plume from a potential blow out in both the northern and southern areas of interest for well drilling are more likely (89 % and 83 %, respectively) to occur far to the south of the known and potential coelacanth habitat off the GSLWP and St Lucia. Although the paths of the plumes cross the Goodland and Tugela Canyons, the overlap occurs where the canyons are in excess of 2,000 m deep and thus far beyond the depths at which coelacanths are known to occur. Based on the distribution of current speeds and direction across all depths, the modelling results predicted that the probability of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low, as currents travelling towards the north, north-northwest, and northwest comprise 2% of currents from N1 and 3% of currents from S.

Similarly, the potential coelacanth habitats on the continental shelf off the stretch of coastline between Port Shepstone and Port St Johns are located far inshore of the anticipated path of the DAH plume (*Figure 8.4*).

It must also be kept in mind that the light oil or gas expected in the well(s) (°API gravity >31.1) is less persistent and droplets would thus dissolve more rapidly and not deposit as readily as heavy oil particles. Should any sedimentation of oil droplets occur in submarine canyons off the KZN coast, concentrations are thus likely to be well below threshold levels.

The likelihood of a blow-out taking place would be **Low**. Given the extent of a spill on the surface and the sensitivity of the species and habitats potentially impacted, the potential consequence of the spill on the surface could be **Moderate** (for other marine fauna) and **Major** (for seabirds). Therefore, the ***risk significance*** for a surface spill is assessed as **Minor** (for other marine fauna) to **Moderate** (for seabirds) (*Table 8.11)*. These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9)* to be implemented in the unlikely event of a spill.

Given the extent of a spill on the sub-surface (i.e. DAH concentrations) and the sensitivity of the species and habitats potentially impacted, the potential consequence of the spill on the sub-surface could be **Minor** (for seabirds and other marine fauna, including coelacanths). Therefore, the **risk significance** for a surface spill is assessed as **Minor** (for seabirds and other marine fauna, including coelacanths).) (*Table 8.11)*. These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9)* to be implemented in the unlikely event of a spill.

Taking into consideration the extensive well planning and built-in barriers, capping and containment measures (*Table 8.9*), supplemented with an OSCP, the magnitude of the spill will be reduced and therefore the ***residual risk*** is considered ***As Low As Reasonably Practicable (ALARP).***

Table 8.11 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species due to Blowout

Characteristic	Surface Risk to Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Surface Risk to Seabirds	Sub-Surface Risk to Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Sub-Surface Risk to Seabirds
Type of Impact	Direct	Direct	Direct	Direct
Likelihood	Low	Low	Low	Low
Consequence	Moderate	Major	Minor	Minor
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**	**Minor (ALARP)**	**Minor (ALARP)**

8.3.9 *Risk Significance of Loss of Drilling Fluids and Cuttings on Marine and Coastal Habitats and Species due to Emergency Riser Disconnect*

At any phase of the project (mobilisation, drilling and decommissioning), there is the possibility that a NADF spill could occur through the emergency disconnect of the riser during drilling activities. During the modelling, the volume of oil within the riser pipe released was estimated to be 1,120 bbls, 1,256 bbls, and 1,991 bbls of base oil at locations N1, N2 and S respectively.

From the results of ***Scenario 3***, a slick resulting from a riser disconnect at the seabed would rise to the water surface and spread in a south-westerly direction (due to the strong influence of Agulhas Currents) and would be unlikely to reach the shore (probability of shoreline impact due to a spill at any of the three spill locations is very low (less than 15 %).

Dissolved aromatic concentrations may, however, persist in the top few meters of the water column beneath the slick for a number of days, potentially resulting in acute toxicological effects in marine fauna coming into contact with the slick for extended periods. Should they occur, impacts would be partially (seabirds) or fully reversible (benthic macrofauna, fish and larvae and marine mammals and turtles

The likelihood of such an occurrence taking place would be *Low*, as it is reported in the oil and gas industry, but rarely occurs. Based on the extent of the spill and sensitivity of the species and habitats potentially impacted, the potential consequence could be **Moderate** and therefore the ***risk significance*** is assessed as **Minor** (other marine fauna, including coelacanths) to **Moderate** (for seabirds) and therefore is considered ***ALARP*** (*Table 8.10)*. These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9*) to be implemented in the unlikely event of a spill.

Table 8.12 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species from an Emergency Riser Disconnect

Characteristic	Invertebrates, fish, larvae, marine mammals and turtles	Seabirds
Type of Impact	Direct	Direct
Likelihood	Low	Low
Consequence	Moderate	Major
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**

8.3.10 *Risk Significance of Oil Spills on Marine and Coastal Based Livelihoods (Tourism, Fisheries)*

General Description of Effects to Coastal and Marine-Based Livelihoods from a Hydrocarbon Spill

In the event of an accidental crude oil blowout, (the continuous loss of crude oil from the reservoir), oil will be carried south by the Agulhas Current and possible scenarios have been modelled to determine what areas of coastline would potentially be impacted (*Annex D)*. Based on the modelling results, in the unlikely event of an uncontrolled blowout, while there is an unlikely possibility of shoreline oiling from Richards Bay through to East London (in the worst case).

The potential risk significance of a spill on coastal and marine based livelihoods is discussed below in terms of tourism and fisheries.

General Description of Effects on Tourism

The extent of loss of livelihood would depend of the severity of the spill and how long clean-up operations take to complete. A spill could lead to the closure of beaches and limit activities in the coastal and marine environment, resulting in visitors cancelling or deferring their trip, leading to a decrease in tourist numbers.

This in turn would lead to a loss of income for those employed in the tourism industry as well as the service industry, which supports tourism. The effect of a spill may be felt temporarily even after clean-up operations are complete as members of the tourism industry may not have been able to market themselves post-spill and will need to rebuild their client base or their brand.

Sensitivity of Tourism Receptors

The tourism industry relies on the pristine natural environment of the KZN Coast and the Eastern Cape Coast, which attracts visitors to the area. Tourism is a key contributor to local economic development and is recognised as a sector that can drive local economic growth. Tourism along the KZN coast is well established and tourism infrastructure such as accommodation and restaurants are in place and easily accessible.

Tourism activities include surfing, scuba diving, recreational fishing, boating and sailing, beach-going, nature walks and more.

In contrast, tourism along the Wild Coast in the Eastern Cape is underdeveloped, and challenges to the tourism sector include poor road quality (especially the access roads from the N2 to the various Wild Coast destinations) and a lack of accommodation (Fuller Frost & Associates, 2010).

However, most of the coastal local municipalities in the Eastern Cape highlight tourism as a key area of growth in their respective Integrated Development Plans (IDPs).

It is recognised across the Area of Direct Influence (ADI) and Area of Indirect Influence (AII) that the protection of natural assets is important in promoting tourism. There are numerous activity outfitters in the coastal towns along the Kwa-Zulu Natal and along the Wild Coast who depend on local and international tourists visiting the area for selling their products/ tours. In addition, accommodation and restaurants have been established in response to the increasing demand for such services. The tourism sector creates employment opportunities across a wide range of skills sets, from highly skilled to unskilled labour.

In the event of a spill that results in shoreline oiling, people relying on the coastal and marine tourism sector for their livelihood would be highly sensitive as they rely on pristine conditions of these natural tourism assets. Further, for those employed either directly or indirectly in the tourism sector, it is unlikely that they have alternative livelihood strategies, or means of income generation.

General Description of Effects on Fisheries

The coastal bays and estuarine environments are critical nursery areas for the commercial stocks most, if not all commercial, small-scale and recreational fisheries.

In the event that a crude oil blowout were to occur, the resulting oil slick would not reach the spawning areas for hake, sardine, anchovy and horse mackerel situated on the southern Agulhas Bank nor the additional hake spawning areas thought to exist further eastward off the continental shelf (refer to *Annex D*). Spawn products of linefish species would be affected within the important nursery ground offered by the Natal Bight.

The affected area would not be expected to coincide with squid spawning grounds situated along the inshore areas of the south coast. The impact of the marine diesel and NADF release scenarios would likely only affect spawn product of linefish species advected by the Agulhas Current through the affected area en route to the Agulhas Bank and inshore nursery areas.

Detrimental effects on marine life (and fishing operations) would be likely where oil thickness is above the minimum smothering thickness for wildlife of 1.0 µm (as explained in *Section 8.3.6*). Spawning areas are mostly located inshore (that is on the shelf from the coastline to approximately the 200 m depth contour).

The results of the modelling of different unplanned discharge scenarios described in *Section 8.3.3* indicate the possibility that nearshore, inshore and offshore areas marine environment eastward of East London could be affected by the release of hydrocarbons.

The offshore well drilling areas coincide with the grounds of only one main commercial fishery (large pelagic longline); however the area impacted by a well blowout (Scenario 2a – blowout at the wellhead leading to hole collapse[1] and Scenario 2b – blowout at the wellhead followed by the installation of a capping system) would coincide with fishing grounds of the other fisheries such as large pelagic longline, traditional linefish, south coast rock lobster and crustacean trawl, (based on the affected area described in *Section 8.3.3*).

The result of the modelling indicates that no significant shoreline oiling would occur, and it is therefore, unlikely that the unplanned release of hydrocarbons would affect the operations of the nearshore fisheries (which included commercial, small-scale and recreational net fisheries, the small-scale (subsistence)and recreational line fisheries, and beach/rocky shore invertebrate fisheries).

Regardless of any potentially toxic effect on fish species, operators of fishing vessels would want to avoid polluted areas that contaminate fishing gear and affect cooling water intake systems.

Sensitivity of Fisheries Receptors

In the event of an oil spill reaching fishing grounds, fisheries may be temporarily banned by the regulatory authorities to prevent the introduction of tainted fish into markets. The offshore commercial fishers might, for a period, be forced to suspend fishing operations or temporarily move to other fishing grounds free of oil slicks. While commercial fisheries have the ability to move to other fishing grounds, small-scale and subsistence fishers are typically shore based and exploit resources close to where they live. As such, shore based fishers would not easily be able to find alternative fishing grounds that are not affected by a spill, as they may not have access transport and distances may be too far to cover on foot. Small-scale and subsistence fishers typically lack access to reliable vessels, so they would not be able to seek waters unaffected by a spill.

In terms of the annual amount of food harvested, it is estimated that the subsistence shore fishery harvests approximately 23 t of linefish in the marine and estuarine environments per annum (Mkhize 2010, Kyle 2013c, WIOFish 2013). Based on the estimates made by Dunlop (2011), the total subsistence linefish catch for the seashore was in the region of 16 t per annum.

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[1] This is a self-killing event in which the reservoir hole naturally collapses upon itself, thereby terminating the release.

In the event of shoreline oiling, these fishers would have no choice other than to suspend fishing activities.

Communities relying on the small-scale or subsistence fisheries for their livelihood would be highly sensitive as it is often a vital part of their livelihood strategy and the income or food source lost would not easily be replaced.
Recreational fishers make up the largest numbers of fishers in KZN and it was estimated that between 8,463 and 13,958 shore anglers visit KZN annually from other provinces or countries (Dunlop & Mann 2012). The suspension of recreational fishing activity due to a spill would have implications for the tourism industry as described above, it is likely that recreational fishers would divert a planned fishing trip to an area not affected by a spill. Some local recreational fishers will be in a position to access alternative fishing areas via boat or by driving to alternative areas, and the impact from a spill would amount to one of inconvenience rather than an impact of livelihood.

Commercial fisheries are less sensitive to this impact as they have the ability to fish alternative grounds until such time that clean-up operations have been completed.

Mitigation Measures

In additional to the built-in control measures described in *Table 8.9*, Eni will develop a Fisheries Management Plan (FMP), which will be implemented in the event of an accidental spill. The plan will describe suitable livelihood restoration measures Eni will implement for any temporary or permanent loss of livelihood of the local fisheries and related stakeholders.

Risk Significance of Oil Spill Due to Blowout on Coastal and Marine Livelihoods

Results of the oil spill modelling study indicated that the spill would spread in a south-westerly direction, with a low probability of reaching the shoreline (*Table 8.7)* and the oil reaching the shoreline would be below the significant (>100 g/m^2) impact threshold of for wildlife injury Shoreline oiling occurs in 6 days or more.

The likelihood of such an incident taking place would be **Low**, however, the potential consequence would be **Major** for the tourism sector and for small-scale and subsistence fisheries. It would result in a loss of access to income generating activities, livelihoods and food source for an unknown period of time. The ***risk significance*** as it relates to tourism, small-scale and subsistence fisheries is, therefore, assessed as **Moderate** (*Table 8.11)*.

Recreational fishers will be inconvenienced by a spill as they may have to seek alternative fishing grounds or suspend fishing activities. The consequence would be **Moderate** as it would not result in a loss of livelihood. The ***risk significance*** as it relates to recreational fisheries is, therefore, assessed as **Minor** (*Table 8.11)*.

For commercial fisheries, the consequence would be **Moderate**, as these fisheries are able to fish in alternative fishing grounds and would not suffer an economic loss to the same extent as small-scale fishers. The ***risk significance*** as it relates to commercial fisheries is, therefore, assessed as **Minor** (*Table 8.11)*.

Within the in-built controls described in *Table 8.9* and effective implementation of the Emergency Response Plan and OSCP, the ***risk significance*** is considered **ALARP.**

Table 8.13 ***Risk Significance of Oil Spill on Coastal and Marine Based Livelihoods due to Blowout or Diesel Spill***

Risk Significance of Oil Spill on Marine and Coastal Based Livelihoods (Tourism, Fisheries) **due to Blowout or Diesel Spill**	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**
Risk Significance of Oil Spill on Small-scale and Subsistence Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**
Risk Significance of Oil Spill on Recreational Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**
Risk Significance of Oil Spill on Commercial Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**

8.3.12 Accidental Vessel on Vessel Collision on Community and Workforce Health and Safety

Description of the Baseline Environment and Sensitive Receptors

A large number of vessels navigate along the East Coast on their way around the southern African subcontinent. The majority of this boat traffic remains relatively close inshore on the East Coast. The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Richards Bay or the Port of Durban. Both Durban and Richards Bay are well established and busy ports, those using the ports are accustomed to high volumes of marine traffic. In the event of a collision, there is a risk of injury or fatalities to crew or passengers on other vessels.

The crew on the drillship and supply vessels will undergo vigorous HSE training and vessels are equipped with navigation and warning systems that enable them to avoid such collisions. All operations during drilling will follow Eni's standards.

It is expected the other vessels operating offshore will also be equipped with navigation and warning systems that enable them to avoid collisions. Some smaller vessels, operating near shore may not have navigation systems.
The planned activities include the use of vessels that will use the same navigation routes to the Port of Richards Bay and Durban. The drillship will be supplied and/or serviced by supply vessels operating out either Port. The movement of supply vessels will take place on a daily basis.

Mitigation Measures

The following mitigation measures will be implemented to manage the risk of vessel on vessel collision.

Project vessels will:

- Distribute a Notice to Mariners prior to the commencement of the drilling operations to inform them of drilling activities, including timing and location thereof;

- Use navigational aids and markings as built-in control measures;

- Project vessels to inform other ships and boats by radio announcements regarding drilling activity location;

- Use of signals, lights and markings on the project vessel(s);

- Enforce a safety/exclusion zone with a 500 m radius around the project vessels; and

- Use of chase vessel to watch for and ward off vessels in the vicinity of the drillship.

Further management measures to manage interaction with non-project related vessels include the following:

- Eni will inform relevant local authorities, fisheries associations and commercial fishermen regarding proposed activities associated with the drillship, including details on timing, location, timing and area of temporary exclusion zone, fishing vessels clearance.

- Eni will develop a compensation plan, which will describe suitable compensation for any temporary or permanent loss due to a vessel collision with non-project vessels.

Risk Significance of Vessel Collision on Community and Workforce Health and Safety

The likelihood of a vessel on vessel collision is *Low*, as it is reported in the oil and gas industry, and rarely occurs. A vessel collision incident could result in serious injury, loss of work time and in a worst case scenario, loss of life. Further, small vessel operators may rely on their vessels as a source of income (small-scale fisheries or boat tours), and damage to or the loss of a vessel would result in the loss of access to income generating activities. However, taking in-built control measures, compliance with Eni's Health and Safety Standards and the development of a compensation plan into consideration, the consequence of an incident for the Eni workforce is considered **Moderate.**

The project is does not have any control over implementation of health and safety practices on-board non-project related vessels. The consequences of an incident involving non-project related vessels could therefore be **Major.**

The ***risk significance*** for workforce health and safety is assessed as **Minor,** and the ***risk significance*** for community health and safety is considered **Moderate** and both are considered **ALARP.**

Table 8.14 Risk Significance of Vessel Collision on Community and Workforce Health and Safety

Risk Significance of Vessel Collision on Workforce Health and Safety	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**
Risk Significance of Vessel Collision on Community Health and Safety	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**

9 *ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)*

9.1 *INTRODUCTION*

The aim of the Environmental Management Programme (EMPr) is to provide a set of guidelines and actions aimed at addressing potential environmental risks and impacts associated with the mobilisation, drilling and demobilisation of the project, and will be included in contract documentation between the Company and its contractors. The EMPr also provides assurance to regulators and stakeholders that their requirements with respect to environmental and socio-economic performance will be met, and provides a framework for compliance auditing and inspection programs. It becomes a legally binding document on the Environmental Authorisation of the project.

9.2 *OBJECTIVES*

The objectives of the EMPr are to:

- Fulfil the requirements of South African EIA legislation and international Conventions;
- Be consistent with oil and gas industry good practices and Eni South Africa's technical guidelines/standards;
- Outline the appropriate avoidance and/or mitigation options to potential impacts, to minimise impacts, after first establishing whether impacts cannot be avoided;
- Provide an implementation mechanism for mitigation measures and commitments identified in the EIA Report;
- Establish a monitoring programme and record-keeping protocol against which Eni South Africa and its contractor's/sub-contractor's performance can be measured and to allow for corrective actions or improvements to be implemented when needed; and
- Provide protocols for dealing with unforeseen circumstances such as unplanned events or ineffective mitigation measures.

9.3 *CONTENTS OF AN EMPR*

An EMPr needs to fulfil the requirements listed in section 24N of the Act of Environmental Impact Assessment (EIA) Regulations of 2014 (as amended).

Table 9.1 Contents of an EMPr

Legislated Content	Section in this Report
In detail, an EMPr needs to provide the following information:	
• The Environmental Assessment Practitioner (EAP) who prepared the EMPr; and	*Section 9.4*
• The expertise of that EAP to prepare an EMPr, including a curriculum vitae;	*Annex A*
• A detailed description of the aspects of the activity that are covered by the EMPr as identified by the Project Description;	*Section 9.5*
• A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	*Section 9.5*
• A description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including:	*Section 9.6*
o Planning and design;	
o Pre-construction activities;	
o Construction activities;	
o Rehabilitation of the environment after construction and where applicable post closure; and	
o Where relevant, operation activities;	
• A description of proposed impact management actions, identifying the manner in which the impact management outcomes will be achieved, and must, where applicable, include actions to:	*Table 9.8*
o Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;	
o Comply with any prescribed environmental management standards or practices;	
o Comply with any applicable provisions of the Act regarding closure, where applicable; and	
o Comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	
o The method of monitoring the implementation of the impact management actions identified;	
o The frequency of monitoring the implementation of the impact management actions identified;	
o An indication of the persons who will be responsible for the implementation of the impact management actions;	
o The time periods within which the impact management actions must be implemented;	
o The mechanism for monitoring compliance with the impact management actions identified;	
o A programme for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	
• An environmental awareness plan describing the manner in which—	*Section 9.7.1*
o The applicant intends to inform his or her employees of any environmental risk which may result from their work; and	
o Risks must be dealt with in order to avoid pollution or the degradation of the environment; and	
• Any specific information that may be required by the competent authority.	*Section 9.7, to 9.12*

9.4 DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

ERM was appointed by Eni as the Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment process and application for environmental authorisation for the proposed offshore drilling project.

ERM and the specialists appointed by ERM have no financial ties to nor are they a subsidiary, legally or financially, of Eni. Remuneration for the services by Eni in relation to the EIA Report (including the EMPr) is not linked to approval by any decision-making authority and ERM has no secondary or downstream interest in the development.

ERM is a global environmental consulting organisation employing over 5,000 specialists in over 150 offices in more than 40 countries. In South Africa, ERM Southern Africa employs over 150 environmental consultants out of offices in Johannesburg, Durban and Cape Town.

The contact details of the EAP for the application are presented in *Box 9.1* below.

Box 9.1 Contact Details of the EAP

Environmental Resources Management Southern Africa (Pty) Ltd.
Postnet Suite 90
Private Bag X12
Tokai
7966

Vicky Stevens
1st Floor | Great Westerford | 240 Main Road | Rondebosch | 7700
Cape Town | South Africa
T +27 21 681 5400 | F +27 21 686 0736
E eni.exploration.eia@erm.com

The CV and details of the Independent Environmental Practitioner are presented in *Annex A*.

The core EIA team members and specialists involved in this EIA process are listed in *Table 9.2* below.

Table 9.2 The EIA Team

Name	Organisation	Role	Qualifications, Experience
Ingeborg McNicoll	ERM	Project Director	BSc (Hons) Marine Biology. 35 years' experience
Vicky Stevens	ERM	Project Manager and EAP	MSc (oceanography), 12 years' experience
Lindsey Bungartz	ERM	Social and Stakeholder Engagement Specialist	BSocSc (Hons), 10 years' experience
Dr Andrea Pulfrich	Pisces Environmental Services (Pty) Ltd	Marine Ecology Specialist	PhD (Fisheries Biology), 20 years' experience
Dr David Japp	Capricorn Marine Environmental (Pty) Ltd (CapMarine)	Fisheries Specialists	MSc (Ichthyology and Fisheries Science), 30 years' experience
Ms Sarah Wilkinson			BSc (Hons) Oceanography and Botany, University of Cape Town, 14 years' experience
Dr John Gribble	ACO Associates CC	Maritime Heritage Specialist	BA (Hons), MA Archaeology, 20 years' experience
Michael J. Fichera	ERM	Oil Spill and Drill cuttings modelling Specialist	B.S. in Civil Engineering and an M.E. in Environmental Engineering, 25 years' experience
Mr Stephen Luger	PRDW	Modelling Peer Reviewer	MSc Engineering, 24 years' experience

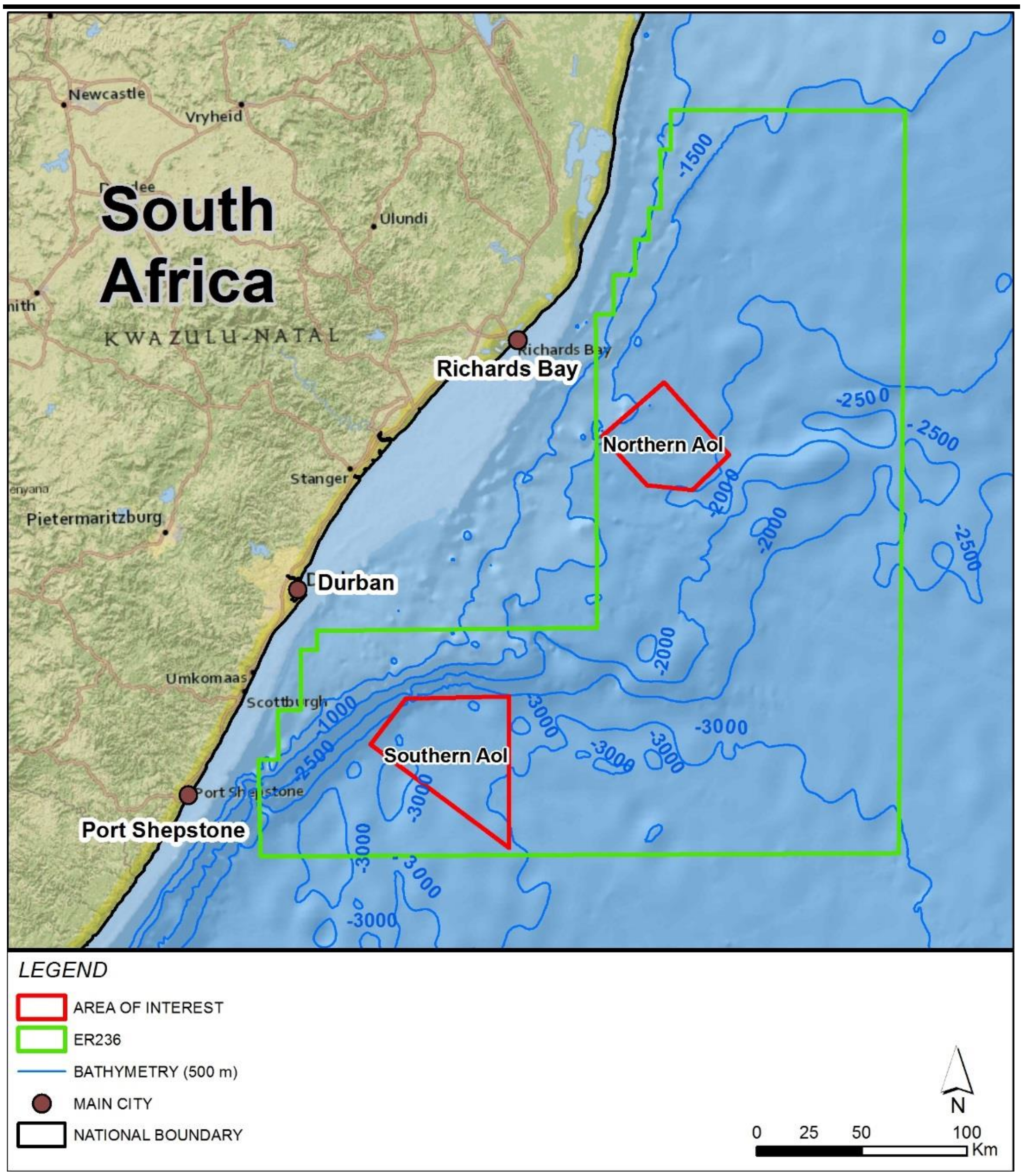
9.5 SITE AND PROJECT DESCRIPTION

Eni South Africa BV (Eni), and Sasol Africa Limited (Sasol) hold an Exploration Right off the East Coast of South Africa. Eni South Africa and Sasol are considering the possibility of conducting an exploration drilling programme in Block ER236 (12/3/236) to assess the commercial viability of the hydrocarbon reservoir for future development.

Eni South Africa proposes to drill up to six wells inside Block ER236 (*Figure 9.1*), within two areas of interest, to establish the quantity and potential flow rate of any hydrocarbon present.

The drilling of the first exploration well is planned for some time between November 2019 and March 2020, dependent on drillship availability, amongst a number of other planning requirements. The drilling of one well is expected to take in the order of 71 days to complete. The time sequence and the number of additional exploration and appraisal wells will be dependent on the results of the first exploration well.

Figure 9.1 Project Location – Offshore South Africa



Source: ERM, 2018

The drilling of the northern and the southern areas of interest will be undertaken as two separate campaigns, which consist of:

- Up to four wells (two exploration and two appraisal wells) in the northern area of interest, which is located, at its closest point, approximately 62 km from shore, in water depths ranging between 1,500 m and 2,100 m;
- Up to two wells (one exploration and one appraisal well) in the southern area of interest, which is located, at its closest point, approximately 65 km from shore, in water depths ranging between 2,600 m and 3,000 m.
- The expected drilling depth will be between approximately 3,800 m and 4,100 m from the sea surface, through the seabed, to the target depth in the northern area, while around 5,100 m for the southern area.

- Well testing may be conducted on the appraisal wells if they present potential commercial quantities of hydrocarbon.

The co-ordinates of the Block ER236 and the drilling areas of interest are provided in tables below.

Table 9.3 Coordinates of the Block ER236 (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	27°48'30"S	32°52'0"E
B	27°48'30"S	34°0'0"E
C	31°0'0"S	34°0'0"E
D	31°0'0"S	30°49'0"E
E	30°35'0"S	30°49'0"E
F	30°35'0"S	30°55'0"E
G	30°22'24,6"S	30°55'0"E
H	30°22'24,72"S	31°2'0"E
I	30°7'0"S	31°2'0"E
L	30°2'0"S	32°30'0"E
M	28°41'18"S	32°30'0"E
N	28°41'18"S	32°35'20"E
O	28°31'4"S	32°35'20"E
P	28°31'4"S	32°41'30"E
Q	28°21'59"S	32°41'30"E
R	28°21'59"S	32°45'40"E
S	28°13'51"S	32°45'40"E
T	28°13'51"S	32°49'0"E
U	27°58'47"S	32°49'0"E
V	27°58'47"S	32°52'0"E

Table 9.4 Co-ordinates of the Northern Drilling Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	29° 12' 33,341"S	32° 31' 46.013"E
B	28° 58' 47.34"S	32° 49' 32.73"E
C	29°17'28.529"S	33°8'58.59"E
D	29°26'34.962"S	32°58'11.965"E
E	29°25'22.117"S	32°44'46.372"E

Table 9.5 Co-ordinates of the Southern Drilling Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	30°19' 39.588"E	32° 3' 48.518"E
B	30°58' 35.904"E	32° 3' 25.921"E
C	30°31' 35.022"E	31° 22' 26.396"E
D	30°19' 49.794"E	31° 33' 7.656"E

9.5.1 Project Components and Activities

Main project components include the following:

- Deep Water Drillship: due to water depth in each area of interest, it is anticipated that exploratory drilling will be conducted using a deep water drillship. The deep water drillship will be kept in position using a dynamic positioning system (DPS) which allows for minimal subsea disturbance due to its ability to operate without moorings. A significant benefit to using a drillship is the ease of mobility as it is a self-propelled vessel with the flexibility to move from location to location without the need of transport vessels;

- Exclusion Zone: During the drilling operations, there will be a temporary 500 m safety zone around the drillship, which will be enforced by a standby vessel. The safety zone will be described in a Notice to Mariners as a navigational warning. The purpose of the safety zone is to prevent a vessel collision with the drillship during operations. Under the Marine Traffic Act, 1981 (No. 2 of 1981), an "exploration platform" or "exploration vessel" used in prospecting for or mining of any substance falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone.

- Shore base: an onshore logistics base will be located in either the Richards Bay or Durban, on an existing brownfield site (previously developed land) within the Port or the Industrial Development Zone (IDZ). A final decision will be undertaken after a logistic survey is conducted in the identified areas.

- Supply and standby vessels: for the duration of the drilling operation, the drillship will be supported by Platform Supply Vessels (PSVs), which are general purpose vessels designed to carry a variety of equipment and cargo. These vessels will supply the drillship three to four times a week with drilling muds, cement and equipment such as casing, drill pipe and tubing. They will also remove waste that must be appropriately disposed of on land. The number of PSVs has not yet been defined (it is anticipated that there will be two or three).

- Personnel: all shore based personnel will reside locally. The majority of onshore staff employed will be local if an existing locally based logistics company is evaluated as suitable for operational logistics support and follow up. The drillship will accommodate around 150-200 personnel. The number of personnel on the supply vessels will vary based on vessel size and the types of activities they support. All workers will be provided with health and safety training and Personal Protective Equipment (PPE) suitable for the types of activities.

- Crew transfer: transportation of personnel to and from the drillship will most likely be provided by helicopter operations from Richards Bay or Durban. The drillship will accommodate around 200 personnel. Crews will generally work in 12 hour shifts in 2 to 4 weeks cycles. Crew changes will be staggered, and in combination with ad hoc personnel requirements. Thus helicopter operations to and from the drillship will occur on an almost daily basis. The helicopter crew will generally work in 10 hour shifts in 2 to 4 week cycles and in accordance with Eni's Aviation Manual.

- Infrastructure and services:

  - *Freshwater*: the project will require seawater and some limited industrial water for making the water based drilling muds for the tophole sections of the well and for rig cleaning. This industrial water will be transported from shore. The drinking (potable) water for the drillship will be provided either by reverse osmosis system or by bottled water;
  - *Fuel:* the drillship and supply vessels will use marine diesel during transit, standby and drilling operations; and
  - *Food Supplies and Local Services:* a catering company will provide food and beverages to the offshore vessels. Food selection, quantities, and sourcing will be undertaken with support from the shore base.

Project activities associated with drilling include the following phases:

- Mobilisation of the supply vessels to Richards Bay or Durban, ;

- Operation of the shore-based facilities for handling support services needed by the drillship;

- Drilling of a well (and subsequent 5 additional wells depending on the results of this initial well);

- Well execution (side track, logging, completion) options;

- Well testing for appraisal option;

- Well abandonment (Plug and Abandonment "decommissioning"); and

- Demobilisation of the drillship, vessel and local logistics base.

All activities will be conducted by Eni in conformity with recognised industry international best practice.

9.6 POTENTIAL IMPACTS ASSESSED

Table 9.6 Potential Impacts from Planned Activities

No.	Issue	Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
1	**Key Impacts Identified from Planned Activities**			
1.1	Climate change	Burning of hydrocarbons from vessels and during well testing (if confirmed) for appraisal wells.	**Negligible**	**Negligible**
1.2	Seawater and sediment quality degradation /contamination and impacts on marine fauna	Wastewater discharges from the drillship, supply and support vessels	**Negligible**	**Negligible**
		Physical disturbance to the seabed, sediments and benthic fauna from pre-drilling Remote Operated Vehicle (ROV) surveys	**Negligible**	**Negligible**
		Physical disturbance to the seabed, sediments and benthic fauna from drilling operations	**Negligible**	**Negligible**
		Impact of disposal of muds and cuttings at the seabed on benthic fauna	**Moderate**	**Minor**
		Impact of disposal of muds and cuttings at the seabed on deep water corals (sessile fauna)	**Moderate**	**Minor**
		Physical disturbance to the seabed, sediments and benthic fauna from cement disposal	**Negligible**	**Negligible**
		WBM biochemical impacts related to drill cuttings, adhered residual WBM and WBM muds on marine fauna present in the water column	**Negligible**	**Negligible**
		NADF biochemical impacts related to drill cuttings and adhered residual NADF muds on marine fauna present in the water column	**Minor**	**Negligible**
		Disturbance of marine fauna by the masking of biologically relevant sounds by underwater noise associated with drilling operations	**Minor**	**Minor**
		Avoidance behaviour of marine fauna due to disturbance by underwater noise associated with drilling operations	**Negligible**	**Negligible**
		Impacts of helicopter noise associated with drilling on marine fauna	**Moderate**	**Minor**
		Impact of light from project vessels on marine fauna	**Negligible**	**Negligible**
1.4	Disturbance to fishing (commercial and subsistence)	Impacts related to restricted access to fishing grounds	**Minor**	**Minor**
1.5	Abandonment of wellhead(s) on seafloor	Impacts of the presence of the wellhead after abandonment on other marine activities	**Negligible**	**Negligible**
1.6	No-Go alternative	Impact of the No-Go alternative	**Moderate (-ve)**	**Moderate (+ve)**

No.	Issue	Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
2	**Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping**			
2.1	Maritime Heritage	Exploration drilling	**Negligible**	**Negligible**
2.2	Local employment / income generation	Employment of labour and allocation of jobs Training / capacity building of local people	**Negligible**	**Negligible**

Table 9.7 Potential Risks of Unplanned Activities and their Risk Significance ratings

No.	Issue	Impact	Post -Mitigation Significance Rating
1	**Unplanned Activities**		
1.1	Risk significance of oil spills on marine and coastal habitats and species	Hydrocarbon spill from a vessel collision (ie loss of diesel) on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
1.2		Hydrocarbon spill from a vessel collision on marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
1.3		Oil spill due to blowout surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.4		Oil spill due to blowout surface risk to marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
1.5		Oil spill due to blowout - sub-surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.6		Oil spill due to blowout -sub-surface risk to seabirds	**Minor (ALARP)**
1.7		Loss of drilling fluids and cuttings due to riser disconnect on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
1.8		Loss of drilling fluids and cuttings due to emergency riser disconnect on seabirds	**Moderate (ALARP)**
1.9		Loss of drilling fluids and cuttings due to emergency riser disconnect on invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.10	Risk significance of oil spills on marine and coastal based livelihoods	Oil spill due to blowout or diesel spill on tourism	**Moderate (ALARP)**
1.11		Oil spill due to blowout or diesel spill on small-scale and subsistence fisheries	**Moderate (ALARP)**
1.12		Oil spill due to blowout or diesel spill on recreational fisheries	**Minor (ALARP)**
1.13		Oil spill due to blowout or diesel spill on commercial fisheries	**Minor (ALARP)**
1.14		Vessel collision on workforce health and safety	**Minor (ALARP)**

No.	Issue	Impact	Post -Mitigation Significance Rating
1.15	Accidental vessel on vessel collision on community and workforce health and safety	Vessel collision on community health and safety	**Moderate (ALARP)**

9.7 IMPLEMENTATION OF EMPR

The EMPr details the mitigation measures, which must be implemented during the development of the proposed project and assigns responsibilities for specific tasks. Eni shall ensure that a copy of the approved EMPr and associated approvals are supplied to the Drilling Contractor and a copy is kept on board the drillship and support vessels during the operations.

The EMPr is applicable to all work activities during the planning, operations and decommissioning phases of the proposed activities. As per section 102 of the Mineral and Petroleum Resources Development Amendment Act, 2008 (No. 49 of 2008) (MPRDAA) may not be amended or varied without the written consent of the Minister.

The EMPr should be fully integrated into Eni's Health, Safety and Environment (HSE) procedures to promote:

- Ownership of the plan at the highest level;
- Appropriate resource allocation for implementation of the EMPr; and
- Effective execution of the EMPr.

The ultimate responsibility for the project's environmental performance lies with Eni, specifically the Managing Director, project Managers and HSE Managers. This will involve ensuring that the HSE requirements are applied and that all requirements are met by contractors and subcontractors engaged in work; including monitoring the performance of its contractors as well as the overall project. Environmental commitments will be incorporated into operational procedures, working practices and overall management procedures. Eni South Africa will be required to track and steward implementation of the EMPr.

9.7.1 *Environmental Awareness Training*

Eni will identify, plan, monitor and record training needs for personnel whose work may have a significant adverse impact upon the environment. Eni recognises that it is important that employees at all levels are aware of Eni's HSE policy, potential impacts of their activities, and roles and responsibilities in achieving conformance with the policy and procedures. The personnel with responsibilities in specific environmental practices will be adequately trained to ensure effective implementation of the work instructions and procedures for which they have responsibilities. This training will include awareness and competency with respect to:

- General awareness relating to exploration well drilling activities, including environmental and social impacts that could potentially arise from project activities;

- Legal requirements in relation to environmental performance;

- Necessity of conforming to the requirements of the EMPr, including reporting requirements (ie such as incident reporting);

- Activity-specific training (ie waste management practices); and

- Roles and responsibilities to achieve compliance, including change management and emergency response.

Training would take cognisance of the level of education, designation and language preferences of the personnel. Eni would also require that each of the appointed contractors institute training programmes for its personnel. Each contractor will be responsible for site Health Safety & Environment (HSE) awareness training for personnel working on the project and for identification of any additional training requirements to maintain required competency levels. The contractor training programme will be subject to approval by Eni and it will be audited to ensure that:

- Training programs are adequate;
- All personnel requiring training have been trained; and
- Competency is being verified.

9.8 SPECIFIC MANAGEMENT PLANS

9.8.1 Emergency Response Plan

An Emergency Response Plan (ERP) is a requirement of the International Finance Corporation (IFC) Performance Standards and EHS Guidelines. This plan will include each stage of the project lifecycle (mobilisation, drilling and demobilisation) and commensurate with the potential risks and impacts identified in the EIA Report.

The objective of the ERP is to be prepared to respond to accidental and emergency situations in a manner appropriate to the operational risks, and to prevent their potential negative consequences.

9.8.2 Oil Spill Contingency Plan

A project specific Oil Spill Contingency Plan (OSCP) will be developed by Eni. This plan will be developed in terms of the nationally adopted Incident Management System for spills and the National OSCP. This plan would instruct employees as to the correct response procedures for any unlikely oil spill that may occur during the exploration drilling operation. This plan of intervention, providing contacts lists and mobilization procedures will be drafted prior to the commencement of drilling activities.

Eni will specifically develop its own Oiled Wildlife Response Plan (OWRP) according to the National Oiled Wildlife Preparedness & Response Plan (NOWCP) as part of it's OSCP.

All employees who are affected by the plan would be trained before commencement of drilling and at least one exercise would be held during drilling to confirm preparedness of people and equipment.

The oil spill contingency plan should include or address, but not be limited to, the following:

- Alert procedure;
- Initial / immediate actions;
- Oil Spill Response Options / Strategies;
- Oiled Wildlife Response Plan;
- Roles and responsibilities (including Emergency Directory);
- Response Actions;
- Response termination procedure;
- Oil Spill Modelling Report;
- Oil Spill Risk Assessment (environmental sensitivities and priorities for protection);
- Oil Spill Response Equipment Inventory;
- Response technical guidelines and limitations;
- Response equipment and maintenance / Inspection plan;
- Facilities (including specification) and products (including MSDS manual); and
- Drills and training.

The OSCP shall be reviewed and approved by the South African Maritime Safety Authority (SAMSA) prior to start of drilling. On approval SAMSA will issue a Pollution Safety Certificate. Eni shall provide copies of the plan and the approved Pollution Safety Certificate from SAMSA to the Petroleum Agency of South Africa, and the Department of Environmental Affairs.

9.8.3 Waste Management Plan

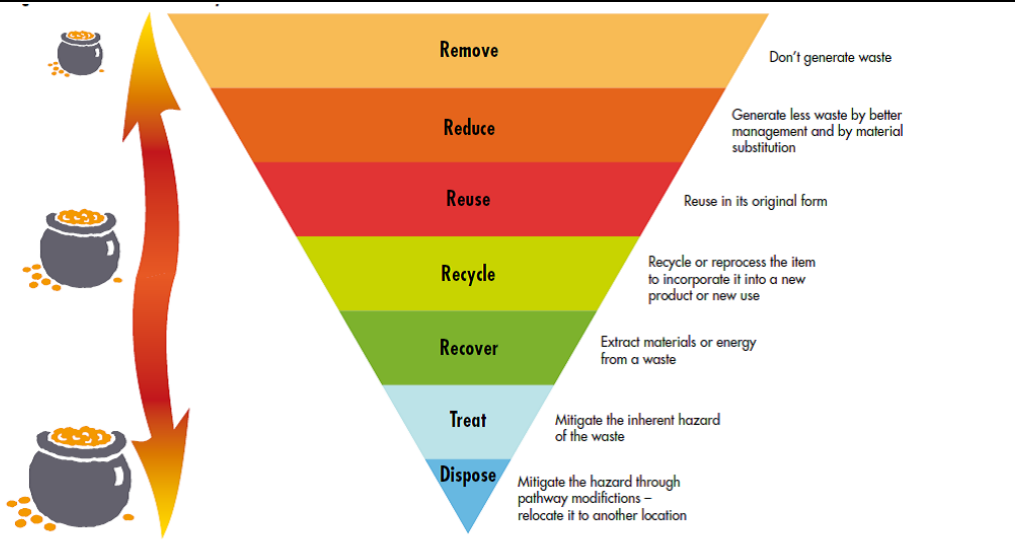
A Waste Management Plan (WMP) will be developed before the start of the drilling activities start for implementation during the project activities. The WMP establishes the procedures adopted for the management of waste to be generated during the course of conducting offshore and onshore operations (drilling, vessels trips, and onshore support facilities). It covers collection, storage, treatment, transport, disposal, discharge, reporting and data management. The WMP will comply with applicable International Conventions for the Prevention of Pollution at Sea from Ships (MARPOL 73/78).[1]

[1] It is the understanding of ERM that a Waste Management Licence is not required.

The following are key recommended measures for the Waste Management Plan Development:

- Waste will be dealt by Eni South Africa in accordance with the waste hierarchy presented in *Figure 9.2* below;
- Suitably approved and fully licensed companies providing waste treatment and disposal services will be selected by review and evaluation in line with international good practice;
- Waste tracking procedures will be defined in the WMP to provide traceability from source of generation to end point; and
- Non-hazardous waste will be segregated and recycled where possible.

Figure 9.2 Waste Hierarchy



Source: Eni Technical Guideline, AMTE-TG-010, 2015

9.9 INSURANCE

There will be adequate protection and indemnity insurance cover for oil pollution incidents. Eni retains worldwide third-party liability insurance coverage, which is designed to hedge part of the liabilities associated with damage to third parties, loss of value to the Group's assets related to unfavourable events and in connection with environmental clean-up and remediation. Tier 1 Oil spill equipment is already available on the drillship drilling site (off-shore) to respond immediately to unlikely spill events. Furthermore, Eni has service agreements in place for equipment and personnel to be mobilized from onshore to the spill event in short time within 48 hours. For instance part of Equipment and dispersants are held already available in Saldanha Bay.

Further equipment will be available on board of stand-by vessels and in the logistic base close to operations with short lead times to access and execute response strategies.

9.10 *ENVIRONMENTAL MANAGEMENT PROGRAMME COMMITMENTS REGISTER*

This section details the specific management commitments to be implemented to prevent, minimise or manage significant negative impacts and optimise and maximise any potential benefits of the project. These commitments are presented for the three project phases; planning, operations and decommissioning phases.

This EMPr Commitments Register (*Table 9.8)* is structured in the following manner so that the mitigation measures have a clear and logical context within which they are designed, implemented, monitored and evaluated:

- Activities;
- Objective;
- Mitigation /Management and Enhancement Commitments;
- Responsibility;
- Timing / Frequency; and
- Requirement for the Close Out Report.

Table 9.8 EMPr Commitments Register

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
A)Planning Phase						
1.	Drilling timing/ scheduling	Drill in a favourable fair weather period to reduce impacts in the unlikely event of a blow-out	Since the probability of shoreline oiling in the unlikely event of a blow-out is significantly influenced by the season in which drilling is undertaken, it is recommended that drilling be undertaken during the summer months.	Eni	Prior to commencement of operation	Confirm drilling period and justify timing
2.	Preparation of subsidiary plans	Preparation for any emergency that could result in an environmental impact	The following plans should be prepared and in place: • A project-specific OSCP approved by SAMSA. • Eni to provide copies of the approved plan and the Pollution Safety Certificate from SAMSA to PASA and the Department of Environmental Affairs (DEA). • Shipboard Oil Pollution Emergency Plan (SOPEP) for drillship and support vessels as required by MARPOL 73/78. • Emergency Response Plan (ERP) • South African Search and Rescue (SASAR) Manual. • Waste Management Plan (*WMP*). • Ballast Water Management Plan. In addition to the above, ensure that: • Drillship has Pollution Safety Certificate(s) issued by the South African Maritime Safety Authority (SAMSA). • There is adequate protection and indemnity insurance cover for oil pollution incidents. • There is a record of the drillships and support vessels' seaworthiness certificate and/or classification stamp. • The wellheads and BOP are designed to allow for capping system installation. • Eni should have a contract in place with contractors specialized in Well Emergency (capping system, killing and relief well during Blow Out) response and oil spill response (e.g. Oil Spill Company Limited (OSRL) and	Eni and Drilling Contractor	Prior to commencement of operation	Confirm compliance and justify any omissions

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			Wild Well Control) for the duration of the exploration drilling programme.			
3.	Stakeholder consultation and notification	PASA and DEA notification	Compile the specific details of each drilling operation into a Drilling Notification document and submit to PASA and DEA. The notification should provide, inter alia, the details on the following: • Drilling programme (timing, co-ordinates and duration). • Contractor details. • Drillship and support vessel specifications (including relevant certification and insurance). • Oil Spill Contingency Plan (OSCP). • Emergency Response Plan (ERP).	Eni	30 days prior to commencement of operations or as required by PASA and / or DEA	Confirm that notification was sent to PASA and DEA

		Stakeholder notification	Develop a stakeholder management plan for drilling operations. This plan should include:
			
			• Notification of relevant government departments and other key stakeholders of the proposed drilling programme (including navigational co-ordinates of well location, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m exclusion zone and the movement of support vessels). Stakeholders include:
			  • Fishing industry / associations:
			  • South African Tuna Association.
			  • SAMSA.
			  • South African Navy (SAN) Hydrographic office.
			  • Department of Agriculture, Forestry and Fisheries (DAFF),
			  • Transnet National Ports Authority (ports of Richards Bay and / or Durban).
			  • Adjacent prospecting / exploration and mining / production right holders.
			• Distribution of a Notice to Mariners prior to the commencement of the drilling operations to inform them of drilling activities, including timing and
				Eni	30 days prior to commencement of operations	Provide copies of all correspondence

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			location thereof. • Any dispute arising with adjacent prospecting / exploration right holders should be referred to the Department of Mineral Resources and / or PASA for resolution.			
4.	Financial provision		Ensure that financial provision is in place to execute the requirements of the EMPr. Financial provision is to be approved by PASA.	Eni	Prior to commencement of operations	Confirm that financial provision for EMPr has been put in place
5.	Permits / exemptions	Compliance with legislative requirements	• If necessary, apply to the South African Heritage Resource Agency (SAHRA) for permission to disturb any cultural heritage material (e.g. shipwrecks) older than 60 years. • Comply with any requirements specified by SAHRA.	Eni	Prior to commencement of operations or when identified	Provide copy of permit / exemption
6.	Pre-Drilling Survey	Ensure that well positions will not affect obstacles / installations and sensitive habitats on the seabed	• Use a Remotely Operated Vehicle (ROV) to survey the seafloor prior to drilling in order to confirm the presence or absence of any significant topographic features, vulnerable habitats and / or species (e.g. cold-water corals, sponges) and cultural heritage material (e.g. wrecks) in the area. • Implementation of procedures for ROVs that stipulate that the ROV does not land or rest on the seabed as part of normal ROV operations. • Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site. • Relocate drill site more than 500 m from any identified vulnerable habitats.	Eni/ Drilling/ support vessel contractors	Prior to commencement of operations or when identified	• Copy of permit from SAHRA (if required) • Provide photographic evidence of the seabed condition from ROV coverage

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
7.	Pre-Drilling Survey	Protect Shipwrecks	• Review any pre-drill remote sensing data collected to ground-truth seabed conditions to establish whether any shipwrecks are present on the seabed. • Should these reviews of the ROV data identify wreck material at or near the location of a proposed drill site, micro-siting of the well location and the possible implementation of a drilling activity exclusion zone around the archaeological feature should be sufficient to mitigate the risks to the site. • A chance find procedure must be developed for the project and should any shipwreck material that was not identified by the measures set out above be encountered during the exploration drilling process.	Eni/ Drilling/ support vessel contractors	Prior to commencement of operations or when identified	• Copy of permit from SAHRA (if required) • Provide photographic evidence of the seabed condition from ROV coverage
B) Operational Phase						
General Vessel Operations						
8.	Use of drilling and supply vessels during all phases	Minimise impact to air quality by complying with MARPOL 73/78 Annex VI, Regulations for the Prevention of Air Pollution from ships	• Compliance to MARPOL 73/78 Annex VI regulations regarding the reduction of SOx, NOx, ODS, VOC and emissions from shipboard incineration. • Compliance to MARPOL 73/78, IMO certification and classification of the hazardous area according to EN 60047-10 for incineration of non hazardous domestic solid waste (paper, carton, wood etc.) on the drillship • All diesel motors and generators will undergo routine inspections and receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere. • Leak detection and repair programmes will be implemented for valves, flanges, fittings, seals, etc. • Use of a low sulphur fuel for project vessels, if available.	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel log book records

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
9.		Minimise impact to marine water quality by complying with MARPOL 73/78 requirements (Annex I - Regulation for the Prevention of Pollution by Oil; Annex IV - Regulation for Prevention of Sewage from ships; Annex V - Prevention of Pollution by Garbage from Ship).	• Storage of chemical, fuels and oil in bunded areas on board the vessels to contain leaks and spills. • Oil spill response equipment present on board of drillship and vessels. • Compliance with MARPOL 73/78 standards for all facilities and vessels and equipment with wastewater treatment unit for the treatment of domestic wastewater. • Compliance with national and international requirements of wastewater treatment and disposal. • Discharge of all the wastewater effluents from drillship and vessels only after treatment. Equipment of vessels with oil/water separators to treat drainage and bilge water in compliance with MARPOL 73/78 Annex I requirements, that is to a level lower than 15 ppm oil content in water.	Drilling/ support vessel contractors	Throughout vessel operations	• Confirm compliance and justify any omissions • Provide summary of waste record book / schedule and receipts • Report occurrence of minor oil spills and destination of wastes
			Implement a waste management system in accordance with Eni's Waste Management Guidelines that addresses all wastes generated at the various sites, shore-based and marine.	Drilling/ support vessel contractors/ Eni	Prior to mobilisation	
			Route all deck and machinery drainage to: • Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks, e.g. oil separating/filtering equipment and oil content meter. • Oil residue holding tanks. • Oil discharge monitoring and control system	Drilling/ support vessel contractors	Prior to mobilisation	
10.	Use of drilling and supply vessels during all phases	Minimise impact to marine water quality by complying with MARPOL 73/78 requirements (Annex I - Regulation for the Prevention of Pollution by Oil; Annex IV - Regulation for Prevention of Sewage	The following certificates shall be in place: • A valid International Sewage Pollution Prevention Certificate, as required by vessel class. • International Oil Pollution Prevention (IOPP) Certificate, as required by vessel class.	Drilling/ support vessel contractors	Throughout vessel operations	Confirm compliance and justify any omissions
			Discharge food wastes after they have been passed through a comminuter or grinder, and when the drillship is located more than 3 nautical miles (± 5.5 km) from land.	Drilling/ support vessel contractors	Throughout vessel operations	Provide summary of Garbage Record Book

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
		from ships; Annex V - Prevention of Pollution by Garbage from Ship).				
		Control the spread of non-native invasive species to vulnerable ecosystems	All ships that carry ballast water must de- and re-ballast in adherence with the International Maritime Organization (IMO) guidelines and standards governing discharge of ballast waters at sea.	Drilling/ support vessel contractors	During ballast water discharge, throughout vessel operations	Provide Ballast Water Record Book logs.
11.	Use of drilling and supply vessels during all phases	Protect marine fauna, migratory birds and seabirds by managing noise from the drillship and supply vessels transit	Vessels shall undergo a regular maintenance regime to reduce noise.	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel maintenance records
12.	Use of drilling and supply vessels during all phases	Protect marine fauna, migratory birds and seabirds by managing illumination of the drillship and supply vessels	• Adopt use of lights compatible with safe operations whenever and, wherever possible, reduction of the intensity and emissions to the surrounding environment. • Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Injured birds should be returned to shore where feasible to allow for treatment. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring)	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel log book records
13.	Use of drilling and supply vessels during all phases	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• Implement refuelling procedures for bunkering. • Use dry break couplings. • Regularly inspect refuelling hoses. • Conduct oil spill response exercises. • Ensure all workers are trained to recognise and report incidents and emergencies. • Select chemicals to ensure low impact to aquatic organism in case of accidental overboard disposal.	Eni and Drilling/ support vessel contractors	Throughout vessel operations	• Record of all spills (Spill Record Book), including spill reports, emergency exercise

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Bund and drain hydrocarbon and chemical storage areas to a closed loop system. • Ensure all drainage water passes through an oily water analyser maintained and calibrated (<15 mg/L oil in water) prior to overboard discharge. • Inspect and maintain all chemical / fuel containers including the vessels fuel tanks and mud tanks. • In the case of a small spill implement the SOPEP. • In case of a large spill activate the OSCP and onshore emergency team			reports, audit reports • Incident log • Records of staff training
14.	Use of drilling and supply vessels during all phases	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• Categorise the likely different quantities of oil spills in the OSCP and agree with the relevant authorities how each categories of spills need to be reported and responded to. • <u>Develop an Oiled Wildlife Response Plan (OWRP) according to National Oiled Wildlife Preparedness & Response Plan (NOWCP). as an Annex to the OSCP</u> Information that should be supplied when reporting a spill includes: • The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company. • Geographic location of the incident, distance offshore and extent of spill. • Prevailing weather conditions, sea state in affected area (wind direction and speed, weather and swell). • Persons and authorities already informed of the spill.	Eni and Drilling/ support vessel contractors	In event of spill	• Record of all spills (Spill Record Book), including spill reports, emergency exercise reports, audit reports • Incident log

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Control and contain the spill at sea (e.g. booms installation), as far as possible and whenever the sea state permits, using suitable recovery techniques to reduce the spatial and temporal impact of the spill. • Use low toxicity dispersants except within 5 nautical miles offshore or in depths < 30 m to reduce concentrations below most acute toxicity thresholds. • Provide adequate resources to collect, transport and treat oiled animals (e.g. birds or sea turtles) to a cleaning station in compliance with National Oiled Wildlife Preparedness & Response Plan (NOWCP)	Drilling/ support vessel contractors	In event of spill	• Record of all spills (Spill Record Book), including spill reports. emergency exercise reports. audit reports • Incident log
15.		Protect marine fauna from accidental collision	• Use anti-collision monitoring equipment and procedures on the drillship and supply vessels. • Report any cases of collision or observation of any strandings to the South African Stranding Network	Eni and Drilling/ support vessel contractors	Throughout vessel operations	• Incident log
C) Drilling Phase						
16.	Operation of drillship at drill site	Ensure navigational safety	• Implementation of the stakeholder management plan for drilling operations	Eni	30 days prior to commencement of operations	Provide copies of all correspondence with stakeholders
17.	Operation of drillship at drill site	Ensure navigational safety	• Prevent collisions by ensuring that the drillship and support vessels display correct signals by day and lights by night (including twilight), by visual radar watch and standby vessel(s). • Manage the lighting on the drillship and support vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations. • Maintain standard vessel watch procedures. • Enforce the 500 m safety/exclusion zone around the drillship. • A support vessel, equipped with appropriate radar and communications, is kept on 24-hour standby. • Use flares or fog horn where necessary.	Drilling/ support vessel contractors	Throughout operation	Provide records of any incidents and interaction with other vessels

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Co-operate with other legitimate users of the sea to minimise disruption to other marine activities.			
18.	Operation of drillship at drill site and transit of supply vessels to and from port	Minimise impact to water quality by complying with the requirements of MARPOL 73/78 standards (Annex I - Regulation for the Prevention of Pollution by Oil; Annex IV - Regulation for Prevention of Sewage from ships; Annex V - Prevention of Pollution by Garbage from Ship).	• Separation of wastes at source. • Recycling and re-use of wastes where possible. • Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation). • Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.	Drilling/ support vessel contractors	Throughout operation	• Confirm compliance and justify any omissions • Provide summary of waste record book / schedule and receipts • Report occurrence of minor oil spills and destination of wastes
19.	Operation of drillship at drill site and transit of supply vessels to and from port	Appropriate waste management	• Segregate, classify and store all hazardous waste in suitable receptacles on board in order to ensure the safe containment and transportation of waste. • Provide a specific waste management storage and segregation area at the onshore logistics base. • Dispose of hazardous waste at a facility that is appropriately licensed and accredited • Incineration of non-hazardous waste (paper, wood, carton) using a certified burner.	Drilling/ support vessel contractors/Eni	Throughout operation	

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
20.	Operation of helicopters	Conserve and ensure the protection of marine and coastal fauna	• The National Environmental Management: Protected Areas Act (2003) stipulate that the minimum over-flight height over nature reserves, national parks and world heritage sites is 762 m (2,500 ft). • The Marine Living Resources Act (1998) prohibits aircraft to approach within 300 m of a whale. Therefore, except for when the aircraft lands on or takes off from the drillship and logistics base, the flight altitude would be >300 m. • The operation of helicopters and fixed-wing aircraft is governed by the Civil Aviation Act (No. 13 of 2009) and associated regulations.	Eni Logistics Manager and Helicopter contractor	All flights to/from drillship	• Submit copy of set flight path (including altitude) • Report deviations from set flight paths
		Conserve and ensure the protection of marine and coastal fauna	• Pre-plan flight paths to ensure that no flying occurs over IBAs; • Avoid extensive low-altitude coastal flights (<914 m and within 2 km of the shore). • Maintain an altitude of at least 914 m within Marine Protected Areas; • Comply fully with aviation and authority guidelines and rules; and • Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.			
		Community/ Occupational Health and Safety	• Compliance with Eni's H&S Standards. • Flights to be prohibited in bad weather.			
21.	Spudding	Protect sensitive seabed habitats	Adjust the well location to avoid spudding on or in close proximity to potential vulnerable habitats (identified in pre-drilling ROV surveys).	Eni / Drilling contractor	Prior to spudding	• Provide photographic evidence of the seabed condition from ROV coverage

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
22.	Well drilling	Protect sensitive seabed habitats	• Careful selection of fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential. Use only low-toxicity and partially biodegradable additives. • Use high efficiency solids control equipment to reduce the need for fluid change out and minimise the amount of residual fluid on drilled cuttings. • Regular maintenance of the onboard solids control package. • Use high efficiency solids control equipment to reduce the need for fluid change out and minimise the amount of residual fluid on drilled cuttings. • Minimize residual NADF adhered to cuttings using dedicated efficient equipment (e.g. drier) • Drilling fluids to be discharged to sea (including residual material on drilled cuttings) must be subject to tests for meet discharge standards. • If drilled cuttings or mud tests demonstrate concentrations/contaminations higher than discharge limits, collect cuttings in skips and mud on board of drilling ship for delivery to shorebase and land waste treatment facilities • At the end of operations shore to base any residual volume of NADF mud for recycle/reuse or to land waste treatment facilities	Eni/ Drilling contractor	Prior to drilling, throughout drilling, after drilling	• Provide material safety data sheet (MSDS) sheets for chemicals used • Provide volumes of muds, cuttings and cement disposed • Provide photographic evidence of the seabed condition from ROV coverage
			• Minimise excess cement during the initial riserless drilling stage by monitoring (by ROV) for discharges during cementing. • Use only low-toxicity and partially biodegradable cement additives.		Prior to cementing	

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
23.	Well drilling	Minimise impact to marine water quality and sensitive species	• Eni's specifications for discharge of WBM includes: o Discharge of cuttings via a caisson in >15 m depth. o Discharge of cuttings only in water >30 m depth. o Hg: max 1 mg/kg dry weight in stock barite. o Cd: max 3 mg/kg dry weight in stock barite. o Maximum chloride contraction must be less the four time the ambient concentration of fresh or brackish receiving water. o Ship-to-shore otherwise. • Eni's specifications for discharge of NADF retained on drill cuttings includes: o Discharge of cuttings via a caisson in >15 m depth. o Discharge of cuttings only in water >30 m depth. o Organic Phase Drilling Fluid concentration: maximum residual non aqueous phase drilling fluid (NAF) 5% (C16-C18 internal olefins) or 9.4% (C12-C14 ester or C8 esters) on wet cuttings. o Hg: max 1 mg/kg dry weight in stock barite. o Cd: max 3 mg/kg dry weight in stock barite. o Ship-to-shore otherwise.	Drilling contractor	Throughout drilling, after drilling	Provide volumes of muds, cuttings and cement disposed

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
24.	Vertical Seismic Profiling (VSP)	Protect offshore marine fauna	Apply JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys • Undertake a 30-minute pre-start scan (prior to soft-starts) within the 3 km radius observation zone in order to confirm there is no cetacean activity within 500 m of the source. • Implement a "soft-start" procedure of a minimum of 20 minutes' duration when initiating the VSP acoustic source. • The "soft-start" procedure may only commence if no cetaceans have been sighted within the shut- down zone (ie a 500 m horizontal radius from the VSP acoustic source) during the pre- start-up visual scan. • Maintain visual observations within the 500 m shut-down zone continuously to identify if there are any cetaceans present. • Shut down the acoustic source if a cetacean is sighted within 500 m shut-down zone until such time as the animal has moved to a point more than 500 m from the source.	Eni/Drilling contractor	During VSP	Provide records of number of species observed (including abnormal behaviours)
25.	Placement of wellhead on seafloor	Minimise risk of the introduction of non-indigenous invasive marine species	• Ensure all infrastructure (e.g. wellheads, BOPs and guide bases) that has been used in other regions is thoroughly cleaned before use in South Africa. • Avoid presence and spread out of invasive species by the implementation of the ballast water management plan	Contractor	Prior to mobilisation	Confirm compliance and justify any omissions
26.	Well Drilling	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• Fully inspect the BOPs on the drillship in accordance with the American Petroleum Industries recommended practices (or equivalent) prior to drilling. • Utilize biodegradable hydraulic control fluid for BOP test • All responsible personnel must be adequately trained in both accident prevention and immediate response. • Implement monitoring and management measures in accordance with normal well control practise to assist in the detection and control of uncontrolled releases.	Eni/Drilling contractor	Prior to and during drilling	Provide relevant certification and / or evidence of BOP inspection and application of risk control system

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Inspect and maintain all chemical / fuel containers including the vessels fuel tanks and mud tanks • Develop a Well Control Contingency Plan (WCCP) for each well.			

27.	Well Drilling	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• In the event of a spill, apply the OSCP and ERP
			• In the event of an oil spill that poses a risk of major harm to the environment immediately notify relevant authorities and emergency team. Information that should be supplied when reporting a spill includes:
			  o The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company.
			  o Geographic location of the incident, distance offshore and extent of spill.
			  o Prevailing weather conditions, sea state in affected area (wind direction and speed, weather and swell).
			• Persons and authorities already informed of the spill.
			• Immediately activate and mobilize the OSCP ; containment and recovery tools, equipment and personnel (e.g skimmers, booms, dispersants sprays, capping system)
			• Monitor oil spill movements at sea surface (using metocean and oil spill modelling data) to predict possible coastline area to be impacted and organize emergency response team nearshore and along coastline
				Eni and contractors (including support stand-by vessels)	In event of medium to large spill	• Record of all spills (Spill Record Book), including spill reports; emergency exercise reports; audit reports
						• Incident log

28.	Use and handling of hazardous materials	Minimise damage to the environment by implementing response procedures efficiently	• Provide MSDS to all personnel involved in management of materials prior of any mobilization or usage • Implement OSCP and ERP. • Induction and training (proper use, transfer procedures). • Implement ERP to deal with all chemical spills.	Eni Drilling/ support vessel contractor	In event of medium to large spill	
29.	Transport, Storage And Handling Of	Avoid human and environmental exposure to radio- active material	Comply with necessary regulations and licence requirements for the transport, storage and handling of radioactive devices.	Eni Drilling/ support vessel contractor	Throughout drilling operations	Provide copy of licence(s) and results from routine tests on

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
	Radioactive Devices					radioactive sources to determine leak levels
30.	Well testing	Minimise impact to air quality	• Selection of an efficient test flare burner head equipped with an appropriate combustion enhancement system to minimise incomplete combustion, black smoke, and hydrocarbon fallout to the sea. • Record volumes of hydrocarbons flared	Eni/Drilling contractor	During well testing operations	Provide records of hydrocarbons flared
31.	Dropped objects	Community/ Occupational Health and Safety	• Compliance with Eni's H&S Standards • Recover (wherever practicable) objects which are accidentally dropped into the sea.	Eni/Drilling contractor	Throughout drilling, after drilling	• Incident log
D) Demobilisation/Decommissioning Phase						
32.	Abandonment of wells	Isolate permeable and hydrocarbon bearing formations and avoid leakages	• Seal well by inserting cement plugs in the well bore at various levels according to good oilfield practice. • Test well integrity. • Final wellhead and seabed ROV survey after well(s) plug and abandonment ("decommissioning"). • The abandoned wellhead location must be surveyed and accurately charted with the HydroSAN office.	Eni/contractor	On completion of well drilling, after plug and abandonment ("decommission ing") operations	• Provide copies of correspondenc e with SAN Hydrographer
33.	Transit of drillship and supply vessels from drilling location	Ensure navigational safety	Inform all key stakeholders that the drillship and support vessels are off location.	Eni	Within four weeks after completion of drilling	Copies of notification documentation required
34.	Transit of drillship and supply vessels from drilling location		Dispose all waste retained onboard at a licensed waste site using a licensed waste disposal contractor.	Drilling/ support vessel contractors	When drillship / support vessels are in port	Waste receipt required from contractor

9.11 MONITORING

Monitoring will be conducted to ensure compliance with regulatory requirements and the performance objectives specified in the EMPr, as well as to evaluate the effectiveness of operational controls and mitigation measures.

The main objectives of the monitoring programme will be to:

- Gather, record and analyse data required for regulatory and EMPr purposes;
- Verify the predictions and conclusions made in the EIA;
- Identify changes in the environment and receptors;
- Produce information to evaluate environmental performance specified in the EMPr;
- Produce information about emergencies that require an immediate response;
- Obtain information on the actual and potential environmental impacts of exploration activities;
- Use monitoring results as a source of information and as grounds for decision making regarding the design of new mitigation measures; and
- Describe whether and to what extent discharges from exploration activities have had impacts on the marine environment.

Monitoring will include, but not limited to the following:

Table 9.9 Monitoring Activities

No.	Aspect	Criteria to be monitored	Timing / Frequency
1	Sensitive seabed structures and sediments quality	• Hard substrate and rocky outcrops • Type and quantity of benthic fauna • Granulometry, hydrocarbons, metals and heavy metals	Prior to drilling and once during campaign
2	Ballast water prior to arrival on location	• Volume discharged, treatment and location (compliance with International Convention for the Control and Management of Ships' Ballast Water and Sediments	Before/during first de-ballasting in country
3	Drilling fluids	• Volume on board • Volume used • Volume discharged • Toxicity, barite contamination, Organic Phase Drilling Fluid concentration (NADF), chloride concentration (WBM-brine)	Daily during drilling operations

No.	Aspect	Criteria to be monitored	Timing / Frequency
		• Update MSDS of chemicals and products on board of vessels	
4	Cement	• Volume used and excess of cement discharged overboard/at sea bottom during riserless operations • Monitor cement returns and terminate pumping if returns are observed on the seafloor	During cementing operations
5	Chemicals and hazardous materials	• Cement chemicals and additives • Volume stored • Volume consumed	Daily during drilling operations
6	Drill cuttings	• Volume discharged • Oil content in drill cuttings	Daily during drilling operations
7	Deck drainage /machinery space /bilge water	• Correct operation of oil separating/filtering equipment and oil content meter (compliance with MARPOL 73/78 standards, Annex I Regulation for the Prevention of Pollution by Oil)	Prior to drilling and once during campaign
8	Sewage discharge	• Correct operation of sewage treatment system (compliance with MARPOL 73/78 standards, Annex IV (Regulation for Prevention of Sewage from ships)	At start and once during campaign
9	Galley waste	• Type and volume discharged • Correct operation for discharge (compliance with MARPOL 73/78 standards, Annex V Regulation for Prevention of Pollution by Garbage from ships))	Daily during drilling operations
10	General waste	• Type and volume of waste generated • Type and volume transferred for onshore waste disposal facility • Compliance with waste Management Plan	Daily during drilling operations
11	Hazardous waste	• Volume of waste generated • Volume transferred for onshore disposal • Compliance with Waste Management Plan	Daily during drilling operations
12	Fuel usage	• Type and volume on board • Volume consumed	Daily during drilling operations
13	Accidental oil and chemical spills	• Type • Volume • Compliance with Shipboard Oil Spill Emergency Plan	Daily during drilling operations
14	Radioactive sources	• Correct containment and storage on board and during transportation	At start and once during campaign
15	Vertical Seismic Profiling	• Marine mammals observations and final report • Application of JNCC best practice	During pre-watch period and continuous during VSP
16	Well (flow) testing (if required)	• Volumes of hydrocarbon fluids	Daily during well testing operations

17	Dropped objects	• Establish a hazards database listing:
		  o the type of gear left on the seabed
		  o date of abandonment/loss
		  o location; and
		  o where applicable, the dates of retrieval
			Daily during drilling operations

18	Disruption/ interference to	• Interactions with other vessels (via radio)	Daily during drilling operations

No.	Aspect	Criteria to be monitored	Timing / Frequency
	fishing/shipping	• Number of grievances/incidents logged	
19	Fauna interaction	• Bird and sea fauna incidents of injury/death • Stray land birds resting on drillship	Daily during drilling operations

9.12 *AUDITING*

Section 34 of the Environmental Impact Assessment Regulations (GNR R982/2014) stipulate that a holder of an environmental authorisation must, for the period during which the environmental authorisation and EMPr, and the closure plan, remain valid:

- Audit the compliance with the conditions of the environmental authorisation, the EMPr, and the closure plan; and

- Submit an environmental audit report to the relevant competent authority, i.e. Petroleum Agency of South Africa (PASA).

Section 34 of the regulations also stipulates that the environmental audit report must be prepared by an independent person with the relevant environmental auditing expertise and must be conducted and submitted to the relevant competent authority at intervals as indicated in the environmental authorisation. These intervals may not exceed 5 years.

An environmental audit report must contain all information set out in Appendix 7 of the Environmental Impact Assessment Regulations.

10 SUMMARY AND CONCLUSION

10.1 INTRODUCTION

The aim of the EIA process and associated EIA Report for the proposed exploration drilling programme in Block ER236 (12/3/236) is multi-faceted. The objectives includes the following:

- Conducting a comprehensive and inclusive public participation process, as defined in the NEMA;
- Providing a detailed project description, including assessment of alternatives;
- Undertaking a review of legislation, guidelines and strategies;
- Incorporating the outcomes of public participation activities into reporting;
- Reviewing the baseline of the site;
- Assessing potential impacts;
- Proposing appropriate mitigation/ management measures that aim to avoid /minimise/manage the severity of identified impacts; and
- Assessing the cumulative impacts associated with other planned, existing or project-related developments AOI.

The above- mentioned information is critical to informed decision-making and assessment of sustainable development.

The purpose of this report is to provide an appropriate level of information and an independent assessment of potential impacts for the Competent Authority (i.e. the Department of Mineral Resources (DMR)) to make an accountable and informed decision regarding whether or not to grant an environmental authorisation for the proposed development in terms of National Environmental Management Act (NEMA) (Act No. 107 of 1998) as amended and associated Regulations, 2014 (as amended in 2017).

This report will also assist the DMR to define under what conditions the development should proceed if authorisation is granted. In considering the nature of the proposed development, it is inevitable that there will be certain negative environmental impacts. However, mitigation measures have been developed for these and can be found in the Environmental Management Programme (EMPr, *Chapter 9* and *Annex F*).

The purpose of the exploration drilling activities proposed is to determine whether there are sufficient hydrocarbons under the seabed to warrant further development. Exploration success would result in long-term benefits for South Africa, including access to new energy sources, improved security of supply, in-country investments in a development project (including job creation), increased government revenues, contribution to economic growth and reduced dependence on the importation of hydrocarbons.

Through the EIA process, which included stakeholder and specialist input, ERM has identified and assessed the potential impacts relating to the proposed project activities. A brief overview of the findings of the EIA process, specifically those with a significance rating greater than Negligible and key mitigation measures, are presented below.

With regards to the various alternatives considered for the proposed project, the No-Go alternative entails no change to the status quo. This means that the proposed drilling exploration activities would not occur in Block ER236. The commercial viability of the hydrocarbon reservoir in the Project Area will therefore not be assessed and future development may not be possible (based on a lack of knowledge of the extent and viability of the resource). The option not to proceed with exploration or appraisal drilling will leave the potential drilling sites in their current environmental state, with the oil/gas potential remaining unknown temporarily (i.e. unless explored by competitors or by using alternate technologies not available currently).

Despite many advances in seismic data acquisition and analysis, currently no alternatives exist to understand the presence of hydrocarbon reserves with certainty, other than through exploration and appraisal drilling. No activity alternatives have therefore been assessed.

Although the well locations are still to be finalised based on a number of factors, including further analysis of the seismic data, the geological target, and seafloor obstacles, the impact assessment (*Chapter 7*) considers that the wells could be drilled anywhere within the northern and southern areas of interest. Impacts are assessed and reported on with a logistic base potentially being placed in either Richards Bay or Durban.

Eni's preferred drilling vessel is a drillship due to the distance of the activity offshore, water depth constraints and its availability, flexibility and ease of mobility. Eni also prefers to treat and discharge cuttings offshore in accordance with international best practice requirements. Lastly, this report assesses the impact of drilling of one well within each area of interest at any time of the year and therefore seasonality has been considered.

10.2 SUMMARY OF IMPACTS IDENTIFIED AND ASSESSED

The impacts assessed as part of this EIA Report were only those considered as potentially significant. All non-significant impacts were scoped out during screening (refer to the Scoping Report for further details).

10.2.1 *Planned Activities*

The impacts from planned activities with the highest significance rating, namely those associated the smothering of the seabed habitat from the discharge of drilling muds and cuttings, noise generated by a helicopters, and the No-Go alternative are summarised below. The complete evaluation of planned activities impacts are reported within *Chapter 7*.

The main impacts associated with the disposal of drilling solids will be smothering of sessile benthic fauna (such as corals, if present), and the physical alteration of the benthic habitat in the immediate vicinity (< 200 m) of the well. The results of the cuttings dispersion modelling studies undertaken as part of this project (ERM, 2018a) have indicated that the effects of discharged cuttings are localised. The smothering effects from discharged drillings have been assessed to have an impact of Medium magnitude on the benthic fauna of unconsolidated sediments in the cuttings footprint.
This is because, although the impact is localised, the recovery of benthic communities is expected to take up to 10 years. If deep water corals are found to be present in the Project Area their sensitivity to smothering from drilling solids is High. Their presence is unknown at these depths and would be evaluated in the ROV planning phase of operations.

Undertaking crew transfers between Durban or Richards Bay and the drillship will generate helicopter noise, which affects seabirds in breeding colonies and roosts on the mainland coast. Low altitude flights over the ocean could also affect marine mammals and turtles in surface waters in the Project Area. During the transfers, the helicopter operator will be required to comply with the necessary SA regulations. In addition to this, mitigation measures associated with the flight altitude and path taken have been proposed to minimise the impact as much as possible.

The No-Go alternative is in contravention of Operation Phakisa's aim to implement South Africa's policies and programmes better, faster and more effectively, and to unlock the economic potential of South Africa's oceans. The government, through Operation Phakisa, is seeking to grow the country's ocean economy through several industrial sectors, including the promotion of the oil and gas sector.

Table 10.1 *Summary of Moderate to Minor Impacts Identified Associated with Planned Activities*

Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
Impact of Disposal of Muds and Cuttings at the Seabed on Benthic Fauna	**Moderate**	**Minor**
Impact of disposal of muds and cuttings at the seabed on deep water corals (sessile fauna)	**Moderate**	**Minor**
NADF biochemical impacts related to drill cuttings and muds on marine fauna present in the water column	**Minor**	**Negligible**
Disturbance of marine fauna by the masking of biologically relevant sounds by underwater noise associated with drilling operations	**Minor**	**Minor**
Impacts of helicopter noise associated with drilling on marine fauna	**Moderate**	**Minor**
Impacts related to restricted access to fishing grounds and damage to equipment due to the presence of the wellhead on the seabed	**Minor**	**Minor**
Impact of the No-Go alternative	**Moderate (-ve)**	**Moderate (+ve)**

The potential cumulative impacts likely to arise from the project in combination with other reasonably foreseeable activities include the following:

- GHG emissions contribution to climate change- Minor significance.
- Noise disturbance to marine life- Minor significance.
- Disturbance to Benthos- Low significance.

10.2.2 *Unplanned Activities*

Summarised in this section are the impacts from unplanned activities identified to have a risk significance of Minor and above (*Chapter 8).*

Table 10.2 *Summary of Potential Risks or Unplanned Activities and their Significance Ratings*

Issue	Impact	Residual Impact Significance (Post-mitigation)
Risk significance of oil spills on marine and coastal habitats and species	Hydrocarbon spill from a vessel collision (i.e. loss of diesel) on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
	Hydrocarbon spill from a vessel collision on marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
	Oil spill due to blowout surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
	Oil spill due to blowout surface risk to marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
	Oil spill due to blowout - sub-surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**

Issue	Impact	Residual Impact Significance (Post-mitigation)
	Oil spill due to blowout -sub-surface risk to seabirds	**Minor (ALARP)**
	Loss of drilling fluids and cuttings due to riser disconnect on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
	Loss of drilling fluids and cuttings due to emergency riser disconnect on seabirds	**Moderate (ALARP)**
	Loss of drilling fluids and cuttings due to emergency riser disconnect on invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
Risk significance of oil spills on marine and coastal based livelihoods	Oil spill due to blowout or diesel spill on tourism	**Moderate (ALARP)**
	Oil spill due to blowout or diesel spill on small-scale and subsistence fisheries	**Moderate (ALARP)**
	Oil spill due to blowout or diesel spill on recreational fisheries	**Minor (ALARP)**
	Oil spill due to blowout or diesel spill on commercial fisheries	**Minor (ALARP)**
Accidental vessel on vessel collision on community and workforce health and safety	Vessel collision on workforce health and safety	**Minor (ALARP)**
	Vessel collision on community health and safety	**Moderate (ALARP)**

The risk of an oil spill (including crude oil and diesel) into the marine environment is inherent in all offshore oil exploration and appraisal projects. The likelihood (probability) of significant oil spills (ie those that can reach the coastline or other sensitive areas) is **very low** with most oil spills being very small and having only limited environmental effects.

The industry approach to dealing with potential oil spills is to develop technology and operational procedures to reduce the likelihood of spills occurring, while at the same time planning appropriate responses to oil spills to reduce the severity of impacts in the event of a spill. The response procedures form part of an Oil Spill Contingency Plan (OSCP).

A range of design features and control measures have been developed as part of the design planning phase of this project to reduce the likelihood of accidental events. In addition, existing management measures applied by Eni on its other exploration projects to minimise the risk of accidental events will be adopted on this project. All recommended mitigation measures presented in this Section have been incorporated into the Environmental Management Programme for this project (*Chapter 9* and *Annex F)*.

10.3 RECOMMENDATIONS

During this EIA process, certain control measures have been recommended as part of the project to manage the anticipated impacts. These control measures have been recommended, to an extent that is practically possible for Eni without compromising the economic viability of the project. These control measures also ensure that the project is fully compliant with South African Regulations as well as international policies, frameworks and industry best practise during its operations.

Over and above the recommended controls, mitigation and management measures have been drafted and form part of the EMPr developed with this EIA Report.

All mitigation measures listed in the EMPr (*Chapter 9* and *Annex F)* are recommended to be implemented during the course of the project to ensure compliance and that the potential negative impacts associated with the establishment of the project are respectively mitigated to a level, which is deemed adequate for the project to proceed.

10.4 CONCLUDING STATEMENT

The most significant negative impacts associated with the proposed project include the following (as summarised in *Table 10.1*):

1. Impact of disposal of muds and cuttings at the seabed on benthic fauna.
2. Impact of disposal of muds and cuttings at the seabed on deep water corals (sessile fauna).
3. Impacts of helicopter noise associated with drilling on marine fauna
4. Impact of the No-Go alternative.

All of the pre-mitigation significances of the aforementioned impacts are related as Moderate and are reduced primarily to Minor, by the implementation of the recommended mitigation and/ or management measures.

The EIA process, findings of the specialist studies and the mitigation measures identified by the EAP team as consolidated in a standalone EMPr (*Chapter 9* and *Annex F*); provide the basis for approval of the project.

Overall, the findings of this EIA indicate that many of the potential impacts of the project can be successfully mitigated to an acceptable level through adherence to the provisions of the EMPr, and the project can be developed to achieve an overall acceptable outcome. Adherence to these mitigation and/ or management measures, as well as the EMPr, by Eni and their appointed contractors is essential in achieving the level of impact defined in *Chapter 7*.

The risks associated with oil spills and vessel collisions can be minimised through early identification and implementation of the strict controls described in the EMPr. These risks will require vigilance on the part of Eni (and any contractors) in terms of adherence to specified best practice and monitoring protocols.

The project should be allowed to proceed on the basis of the implementation of the mitigation measures in order to ensure the long term sustainability of the project.

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