PROPOSED EXPLORATION DRILLING IN THE ORANGE BASIN DEEP WATER LICENCE AREA OFF THE WEST COAST OF SOUTH AFRICA

FINAL ENVIRONMENTAL IMPACT REPORT

Prepared for:
Department of Environmental Affairs

On behalf of:
Shell South Africa Upstream B.V.

Prepared by:
CCA Environmental (Pty) Ltd

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Prepared for:
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On behalf of:
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PROJECT INFORMATION

TITLE	Final Environmental Impact Report for proposed exploration drilling in the Orange Basin Deep Water Licence Area off the West Coast of South Africa
APPLICANT	Shell South Africa Upstream B.V.
ENVIRONMENTAL CONSULTANT	CCA Environmental (Pty) Ltd
REPORT REFERENCE	SHE01WD/FEIR/Rev.0
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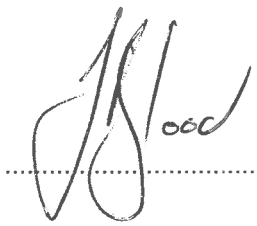
REPORT COMPILED BY: Jeremy Blood



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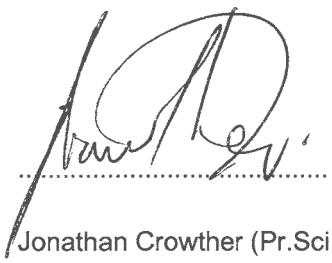

Jonathan Crowther (Pr.Sci.Nat.; CEAPSA)
Managing Director

EXPERTISE OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

NAME	Jonathan Crowther
RESPONSIBILITY ON PROJECT	Project leader and quality control
DEGREE	B.Sc. Hons (Geol.), M.Sc. (Env. Sci.)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat., CEAPSA
EXPERIENCE IN YEARS	27
EXPERIENCE	Jonathan Crowther has been involved in environmental consulting since 1988 and is currently the Managing Director of CCA Environmental (Pty) Ltd. He has expertise in a wide range of environmental disciplines, including Environmental Impact Assessments (EIA), Environmental Management Plans/Programmes, Environmental Planning & Review, Environmental Auditing & Monitoring, Environmental Control Officer services, and Public Consultation & Facilitation. He has project managed a number of offshore oil and gas EIAs for various exploration and production activities in South Africa and Namibia. He also has extensive experience in projects related to roads, property developments and landfill sites.

NAME	Jeremy Blood
RESPONSIBILITY ON PROJECT	Project management, report writing and specialist study review
DEGREE	B.Sc. Hons (Bot.), M.Sc. (Cons. Ecol.)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat., CEAPSA
EXPERIENCE IN YEARS	16
EXPERIENCE	Jeremy Blood has been working as an environmental assessment practitioner since 1999 and has project managed a number of large-scale projects covering a range of environmental disciplines, including Environmental Impact Assessments, Environmental Management Plans/Programmes, Environmental Auditing & Monitoring and Environmental Control Officer related work in South Africa, Namibia, Mozambique and Kenya. He has expertise in a wide range of projects relating to mining (oil/gas, heavy mineral mining and borrowpits), housing/industrial developments and infrastructure projects (e.g. roads, railway line, power lines and pipelines).

EXECUTIVE SUMMARY

1. INTRODUCTION

This Executive Summary provides a comprehensive synopsis of the Final Environmental Impact Report (EIR) prepared as part of the Scoping and Environmental Impact Assessment (hereafter referred to as "EIA") process being undertaken for Shell South Africa Upstream B.V.'s (hereafter referred to as "Shell") proposed exploration drilling in the Orange Basin Deep Water Licence Area off the West Coast of South Africa.

1.1 PURPOSE OF THIS REPORT AND OPPORTUNITY TO COMMENT

The Final EIR summarises the EIA process undertaken and provides a description of the proposed project and affected environment. It also presents the findings of the specialist studies and provides an assessment of the impacts of the proposed project. The compilation of the Final EIR has been informed by comments received on the Draft EIR. It should be noted that all significant changes to the original Draft EIR are underlined and in a different font (Times New Roman) to the rest of the text.

The Final EIR has been distributed for a 30-day comment period from **12 June to 13 July 2015** (which makes provision for the public holiday on 16 June) in order to provide Interested and Affected Parties (I&APs) with an opportunity to comment on any aspect of the proposed project and the findings of the EIA process. Copies of the full report have been made available on the CCA Environmental (Pty) Ltd (CCA) website (www.ccaenvironmental.co.za) and at the following locations:

Location	**Name of Facility**	**Physical Address**
Cape Town	Cape Town Central Library	Drill Hall, Darling Street, Cape Town
Vredenburg	Vredenburg Library	2 Akademie Street, Louwville, Vredenburg
Saldanha Bay	Saldanha Library	Berg Street, Saldanha
Lamberts Bay	Lamberts Bay Library	Church Street, Lamberts Bay
Kleinzee	Kleinzee Tourism Information Centre	1-3rd Street, Kleinzee
Springbok	Matjieskloof Library	Brisson Street, Matjieskloof, Springbok
Springbok	Moberg Library	Tempel Street, Bergsig, Springbok
Springbok	Springbok Library	Namakwa Street, Springbok
Port Nolloth	AJ Bekeur Library	Robson Street, Port Nolloth

Any comments on the Final EIR should be forwarded directly to the Department of Environmental Affairs (DEA) and copied to NMA Effective Social Strategists (Pty) Ltd (NMA) by **no later than 13 July 2015.** Contact details of both DEA and NMA are presented below.

Director: Integrated Environmental Authorisations Department of Environmental Affairs Private Bag X447 PRETORIA, 0001 Tel: (012) 399 9399 E-mail: vchauke@environment.gov.za Attention: Mr Vincent Chauke DEA Reference: 14/12/16/3/3/2/704	NMA Effective Social Strategists (Pty) Ltd PO BOX 32097 BRAAMFONTEIN, 2107 Tel: (011) 447 9737 Fax: 086 601 0381 E-mail: nomim@nma.org.za Attention: Nomi Muthialu

Comments on the Final EIR copied to NMA will be submitted to DEA, together with the Final EIR, for consideration and decision-making.

1.2 PROJECT BACKGROUND

In February 2012 Shell, a subsidiary of Royal Dutch Shell plc, obtained an exploration right for the Orange Basin Deep Water Licence Area in terms of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA). The licence area is approximately 37 290 km^2 in extent. The eastern border of the licence area is located between approximately 150 km and 300 km off the West Coast of South Africa roughly between Saldanha Bay (33ºS) and Kleinzee (30ºS), with water depths ranging from 500 m to 3 500 m (see Figure 1).

As part of the process of applying for the exploration right, an Environmental Management Programme (EMPr) was compiled and approved for the undertaking of seismic surveys and exploration drilling within the licence area. Shell subsequently undertook a 3D seismic survey in an 8 000 km^2 portion of the licence area, which was completed on 22 February 2013.

Based on analysis of the seismic data, Shell proposes to drill one or possibly two exploration wells in the northern portion of the licence area (see Figure 1) in order to determine whether identified geological structures or “prospects” contain oil or gas in potentially commercial extractable amounts.

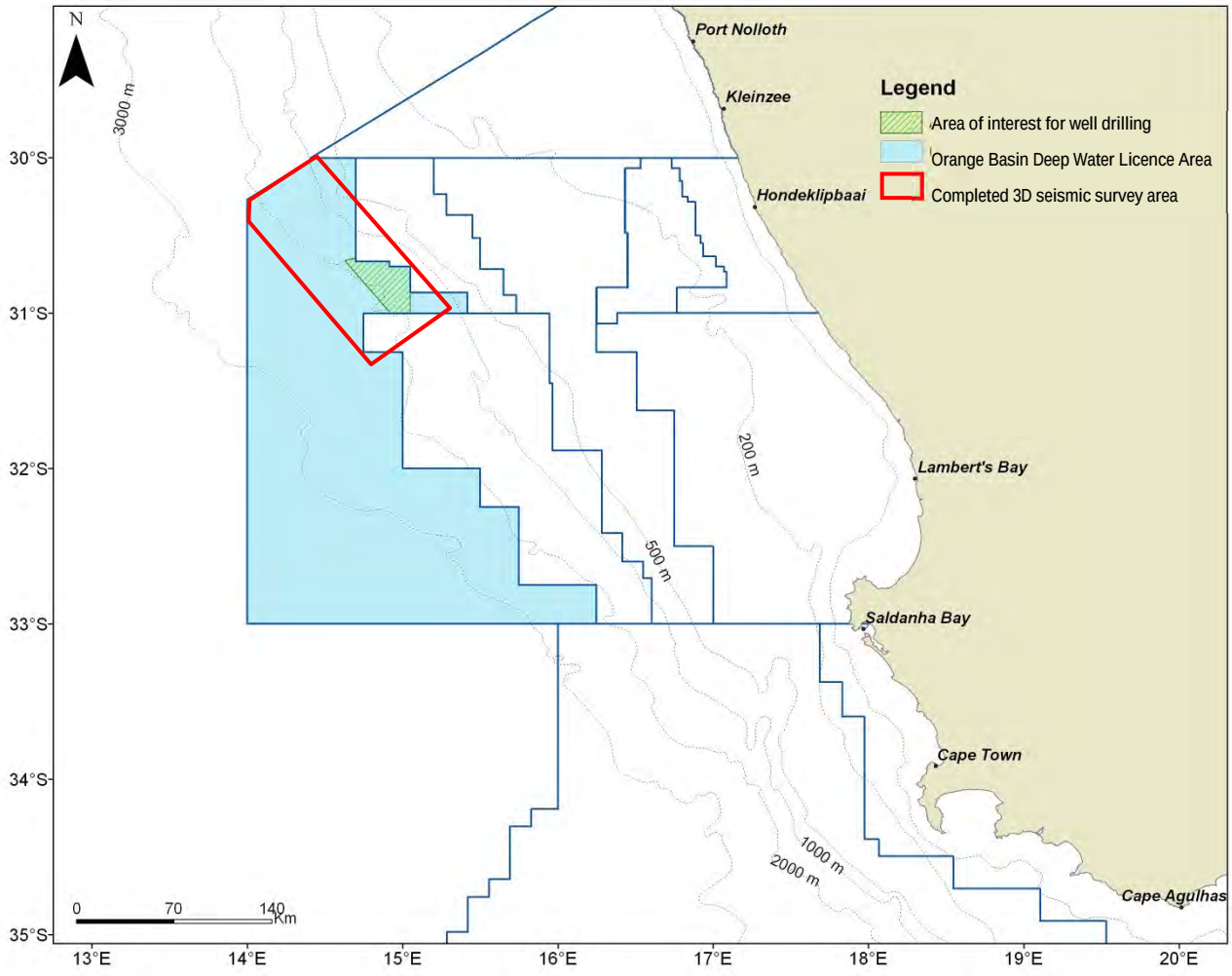

Figure 1: Locality of the Orange Basin Deep Water Licence Area off the West Coast of South Africa. The 2012/2013 seismic survey area and proposed area of interest for well drilling are also shown.

1.3 AUTHORISATION REQUIREMENTS

The proposed exploration drilling programme requires authorisation in terms of both the MPRDA and the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended.

In terms of Section 102 of the MPRDA, Shell is required to compile an EMPr Addendum to take account of any changes in the project scope on which the current approved exploration right work programme is based, and submit it to the Petroleum Agency of South Africa (PASA) for consideration and approval by the Minister of Mineral Resources (or the delegated authority).

The Environmental Impact Assessment (EIA) Regulations 2010[1], promulgated in terms of Chapter 5 of NEMA, require that environmental authorisation is obtained from the competent authority (namely DEA) to carry out the proposed exploration drilling programme. In order for DEA to consider the application for authorisation an EIA process must be undertaken.

CCA, in association with NMA, has been appointed by Shell to compile the EMPr Addendum and to undertake the EIA process. CCA is responsible for managing and undertaking the EMPr Addendum and EIA processes, while NMA is responsible for managing the associated public participation process.

2. EIA PROCESS

2.1 SCOPING PHASE

The Scoping Phase undertaken complied with the requirements of NEMA and the EIA Regulations 2010, as set out in GN No. R543. This involved a process of notifying I&APs of the proposed project and EIA process in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified. This information provided the basis on which the specialist studies and associated terms of references were determined.

All information gathered during the Scoping Phase was presented in a Final Scoping Report (FSR), which was prepared in compliance with Section 28(1) of the EIA Regulations 2010. The Scoping Phase culminated in the acceptance of the FSR by DEA on 23 January 2015. DEA's acceptance of the FSR stated that the next phase of the EIA may proceed in accordance with the tasks outlined in the Plan of Study for EIA.

2.2 EIA PHASE

2.2.1 Specialist studies

Three specialist studies were undertaken to address the key issues that required further investigation and detailed assessment, namely:

1. Cuttings and oil spill modelling;
2. The impact on fishing; and
3. The impact on marine fauna.

[1] Note: The EIA Regulations 2010 have subsequently been replaced by the EIA Regulations 2014. The EIA Regulations 2014, however, make provision for transitional arrangements in order to accommodate applications submitted in terms of the previous regulations and which are pending when the EIA Regulations 2014 took effect (i.e. 8 December 2014), despite the repeal of the previous regulations. Such applications must be dispended with in terms of the EIA Regulations 2010, as if these regulations had not been repealed.

Cuttings and oil spill modelling used the metocean data available for the area of interest in order to model the extent and concentration of various discharge scenarios (including drilling cuttings and hydrocarbon spills). The other two specialist studies involved the gathering of data relevant (including the results of the modelling study) to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales. Specialists also recommended appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively.

2.2.2 Compilation and review of Draft EIR

The specialist studies and other relevant information / assessments were integrated into a Draft EIR. The Draft EIR was distributed for a 40-day comment period from 2 March to 15 April 2015 (which made provision for the public holidays on 21 March, 3 April and 6 April) in order to provide I&APs with an opportunity to comment on any aspect of the proposed project and the findings of the EIA process.

A total of 18 written submissions were received during the Draft EIR review and comment period, nine of which were acknowledgment of receipts. Although there were no objections to the project, a number of issues were raised relating to employment opportunities, overlapping prospecting rights, onshore logistics base in Saldanha, oil spills and associated modelling, and heritage resources. All comments received on the Draft EIR have been collated, and responded to, in an updated Issues and Responses Trail (see Appendix 2.10 of the Final EIR).

2.2.3 Compilation and review of Final EIR

This Final EIR has been prepared in compliance with Section 31(2) of the EIA Regulations 2010 and has been informed by comments received on the Draft EIR. This report aims to present all information in a clear and understandable format, suitable for easy interpretation by I&APs and authorities, and to provide a further opportunity to comment on the proposed project and findings of the EIA process (see Section 1.1 for details of the comment period).

All comments received on the Final EIR will be submitted to DEA, together with the Final EIR, for consideration and decision-making.

2.2.4 Completion of the EIA Phase

The following steps are envisaged for the remainder of the EIA process:

- After DEA has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision; and
- A statutory appeal period in terms of the National Appeal Regulations will follow the issuing of the decision.

3. PROJECT DESCRIPTION

3.1 WELL LOCATION, PRE-DRILLING SITE SURVEY AND DRILLING PROGRAMME

As mentioned above, Shell is proposing to drill one or possibly two wells in the northern portion of the licence area. An area of interest has been defined for the well locations (see Figure 1), which is approximately 900 km^2 in extent with water depths ranging between 1 500 m and 2 100 m. The final well location will be based on a number of factors, including further analysis of the 3D seismic data, the geological target and seafloor location obstacles. The area of the proposed drill location would be analysed for hazards on a special high definition seismic dataset, which is a subset of the acquired 3D data. A Remotely Operated Vehicle (ROV) may be used to identify any seafloor obstacles.

The expected final depth of the well is between 2 700 m and 3 000 m below the seafloor and is expected to take in the order of three months to drill and complete. For safe operational reasons (i.e. optimal sea state and weather conditions), drilling is expected to take place in a future summer window period in the second (2017 - 2018) or third (2019 – 2020) exploration right renewal period.

Depending on the success of the first well, a second well may be drilled to establish the quantity and potential flow rate of the resource. The "appraisal" well would be drilled in a location and to a depth determined by the results of the first well. It is anticipated that the appraisal well would be drilled at least one year after completion of the first well in order to allow sufficient time for data analysis and planning.

3.2 DRILLING UNIT OPTIONS

Shell is currently considering two alternative vessel types for the proposed well drilling operation, these being either a semi-submersible drilling unit (see Figure 2a) or a drill-ship (see Figure 2b). In deeper water where anchoring is not practical such as in the area of interest, both the semi-submersible drilling unit and drill ship would be held in position by dynamic positioning thrusters (no anchoring).

While the drilling unit is operational at a well location, a temporary 500 m operational safety zone around the unit would be in force, i.e. no other vessels (except the support vessels) may enter this area. The safety zone would be described in a Notice to Mariners as a navigational warning.

Figure 2a: Photograph of a semi-submersible drilling unit (Source: Shell).

Figure 2b: Photograph of a drill ship (Source: Shell).

3.3 EXPLORATION DRILLING, TESTING AND COMPLETION

The well would be created by jetting or drilling a hole into the seafloor with a drill bit attached to a rotating drill string. After the hole is drilled, sections of steel pipe (or casings), slightly smaller in diameter, are placed in the hole and permanently cemented in place. The hole diameter decreases with increasing depth as progressively smaller diameter casings are inserted into the hole at various stages and cemented into place. The casing provides structural integrity to the newly drilled wellbore, in addition to isolating potentially dangerous high pressure zones from each other and from the surface.

Drilling is essentially undertaken in two stages, namely the riserless and risered drilling stages:

- During the riserless stage hole sections would be drilled using seawater (with viscous sweeps) and water-based mud (WBM). All cuttings and WBM from this initial drilling stage would be discharged directly onto the seafloor adjacent to the wellbore.
- During the risered drilling stage when WBMs cannot provide the necessary characteristics, a low toxicity synthetic-based mud (SBM) would be used to (a) obtain critical reservoir parameters, b) provide a greater level of lubrication, and (c) provide more tolerance to high temperatures. During this stage a riser connects the drilling unit to the well and allows the drilling fluid and rock cuttings to be circulated back to the drilling unit, thereby isolating the drilling fluid and cuttings from the marine

environment. The returned drilling fluid is treated to remove solids and drill cuttings from the re-circulating mud stream. During this stage a Blow-out Preventer (BOP) is also installed on the wellhead, which is designed to close in the well to prevent the uncontrolled flow of hydrocarbons from the reservoir.

The “appraisal” well may be flow-tested to determine the economic potential of the discovery before the well is either abandoned or suspended for later re-entry and completion. If flow testing is required, hydrocarbons would be burned at the well site using a high-efficiency flare to maximise combustion of the hydrocarbons.

Based on the results of the drilling, logging and possible testing of the well, a decision would be made as to whether to suspend the well on the seafloor or decommission it. If the well is decommissioned, the wellhead would either remain on or be removed from the seafloor. At the proposed drilling depths, the preferred option would be to leave the wellhead on the seafloor.

3.4 LOGISTICS

3.4.1 Onshore logistics base

An onshore logistics base would be located in either Cape Town or Saldanha Bay. The shore base would provide for the storage of materials (including wellbore materials, diesel, water and drilling fluids) and equipment that would be transported from/to the drilling unit by sea.

3.4.2 Support and supply vessels

The drilling unit will be supported by at least three vessels, including one standby and two supply vessels. The standby vessel would provide support for firefighting, oil containment / recovery, rescue and any equipment that may be required in case of an emergency. The standby vessel would also be used to patrol the area to ensure that other vessels adhere to the 500 m safety zone around the drilling unit. The supply vessels would provide equipment and material transport between the drilling unit and the port.

3.4.3 Crew transfers

It is anticipated that transportation of personnel to and from the drilling unit would most likely be provided by helicopter operations from the Kleinzee airport. Transportation to Kleinzee would be provided by fixed-wing flights from Cape Town. The drilling unit would accommodate in the order of 100 - 150 personnel. Crews would work in 12-hour shifts in 4-5 week cycles. Thus helicopter operations to and from the drilling unit and fixed wing operations between Kleinzee and Cape Town would occur on an almost daily basis.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

The Orange Basin Deep Water Licence Area lies within the southern zone of the Benguela Current region and is characterised by the cool Benguela upwelling system. The dominant southerly and south-easterly winds in summer drive the massive offshore movement of surface water, resulting in strong upwelling of nutrient-rich bottom waters. Nutrient-rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries.

The area of interest lies beyond the continental shelf. Two geological features of note within the vicinity of the proposed area of interest include Childs Bank, situated approximately 75 km east, and Tripp Seamount, situated in Namibia approximately 120 km north-northwest of the target area.

4.2 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions, one of which occurs in the proposed area of interest (namely the Atlantic Offshore Bioregion). Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales).

As the area of interest lies well offshore of the influence of coastal upwelling, waters are likely to be comparatively warm and clear with low abundances of phytoplankton, zooplankton and ichthyoplankton. The seabed sediments in the area of interest are likely to host a range of benthic macrofaunal species. The proposed area of interest area coincides with areas mapped as Least Threatened benthic habitats and Least Threatened and Vulnerable pelagic habitat, which generally occur along the shelf break.

The fish species likely to be encountered comprise primarily the large pelagic species (e.g. tunas, billfish and pelagic sharks), which migrate throughout the southern oceans, between surface and deep waters (>300 m).

Although most seabirds in the region reach highest densities offshore of the shelf break (200 to 500 m depth), well inshore of the proposed area of interest, a variety of pelagic seabirds are likely to be encountered during well drilling. Marine mammals likely to be encountered include sperm whales, migrating humpback whales and various baleen and toothed whales known to frequent offshore waters.

4.3 HUMAN UTILISATION

The only commercial fishing sector that could be affected by the proposed exploration drilling is the large pelagic long-line fishery. All other sectors occur inshore of the proposed area of interest. The large pelagic long-line fishery operates extensively from the continental shelf break into deeper waters, year-round and can be expected within the area of interest.

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels, especially between Kleinzee and Oranjemund. The majority of the shipping traffic *en route* to and from Cape Town would pass through the licence area and possibility through the area of interest.

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast. There is no current development or production from the South African West Coast offshore. More than half of the proposed area of interest overlaps with a recently approved large phosphate prospecting area. There are no diamond mining concessions within the licence area.

5. IMPACT ASSESSMENT CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration drilling programme and No-Go Alternative is provided in Table 1.

5.1 NORMAL OPERATIONS

The majority of the impacts associated with the normal operation of the drilling unit, support vessels and aircraft / helicopter would be highly localised, of short-term duration and of low intensity, and are considered to be of **VERY low** significance after mitigation. Key mitigation includes ensuring that the drilling unit and all support vessels comply with MARPOL 73/78 standards; flight paths avoid sensitive areas (e.g. coastal reserves, seal colonies, bird colonies or Important Bird Areas); prior notification is provided to key

stakeholders (including fishing industry and adjacent rights holders); and Radio Navigation Warnings and Notices to Mariners are released throughout the drilling period.

Table 1: Summary of the significance of the potential impacts associated with the proposed exploration drilling programme in the Orange Basin Deep Water Licence Area and No-Go Alternative (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating remains).

Potential impact		Probability	Significance	
			Without mitigation	With mitigation
Normal drilling unit, support vessel and aircraft / helicopter operation:				
Pollution of the atmosphere and marine environment	Emissions to the atmosphere	Definite	VL	**VL**
	Deck drainage into the sea	Highly Probable	VL	**VL**
	Machinery space drainage into the sea	Highly Probable	VL	**VL**
	Sewage effluent into the sea	Highly Probable	VL	**VL**
	Galley waste disposal into the sea	Highly Probable	VL	**VL**
	Solid waste disposal into the sea	Improbable	Insig	**INSIG**
Disturbance of marine biota	Noise from drilling unit and support vessel operation	Probable	VL	**VL***
	Noise from aircraft / helicopter operation	Probable	L	**VL**
Impact of well drilling on marine fauna:				
Removal or crushing of benthic macrofauna due to physical damage to the seabed and sediment disturbance	Unconsolidated sediments	Definite	VL	**VL**
	Hard grounds / reefs	Improbable	M	**VL**
Smothering of benthic macrofauna by cuttings and drilling fluid and plume turbidity	Unconsolidated sediments	Highly probable	VL - L	**VL - L**
	Hard grounds / reefs	Highly probable	M - H	**L**
Reduced physiological functioning of marine organisms due to biochemical effects	Water-based muds	Highly probable	VL	**VL**
	Synthetic-based muds	Highly probable	VL	**VL**
	Cement	Highly probable	VL	**VL**
	Increased turbidity	Probable	VL	**VL***
	Oxygen depletion	Probable	VL	**VL***
Disturbance of marine biota due to drilling noise		Probable	VL	**VL***
Faunal mortality due to attraction to drilling unit		Probable	VL	**VL**
Threat to marine biodiversity through the introduction of non-indigenous invasive marine species through vessels & equipment transfer and discharge of ballast water		Improbable	H-VH	**M**
Threat to marine biodiversity due to the physical presence of infrastructure	Removal of wellheads from the seafloor	Highly probable	VL-L (neutral)	**VL-L (neutral)***
	Abandon wellheads on the seafloor	Highly probable	L (neutral)	**L (neutral)***

Potential impact			Probability	Significance	
				Without mitigation	With mitigation
Impact on other users of the sea:					
Fishing industry: temporary loss-of-access to fishing grounds and associated loss of catch	Pelagic long-line		Highly probable	VL	**VL**
	Demersal trawl		Improbable	**No impact**	
	Pelagic purse-seine				
	Demersal long-line				
	Tuna pole				
	Tradition line-fish				
	West Coast rock lobster				
	Fisheries research				
Temporary disruption to marine mining and prospecting activities			Improbable	Insig	**INSIG**
Temporary disruption to exploration and production activities			Improbable	VL	**INSIG**
Temporary disruption to marine transport routes			Improbable	VL-L	**VL**
Impact on cultural heritage material:					
Impact on historical shipwrecks			Improbable	M	**INSIG.**
Impact on socio-economic environment:					
Job creation			Probable	*VL (+ve)*	***VL (+VE)****
Generation of direct revenues			Probable	*VL (+ve)*	***VL (+VE)****
Increased traffic volumes at onshore logistics base			Probable	VL	**VL**
Cumulative impact:					
Benthic environment			Probable	L	**-**
Fishing industry			Probable	L	**-**
Accidental release of oil:					
Toxic effects related to small instantaneous spills	Marine fauna		Improbable	M	**L**
	Fishing		Improbable	VL	**VL**
Toxic effects related to large blow-outs	Marine fauna		Improbable	VH	**H**
	Fishing	Pelagic purse-seine	Improbable	H	**H**
		Demersal trawl, demersal long-line, traditional line-fish and West Coast rock lobster	Improbable	M	**M**
		Pelagic long-line and tuna pole	Improbable	L	**L**
No-Go Alternative:					
Lost opportunity to further explore on the West Coast and to maximise the use of South Africa's potential own oil and gas reserves			Improbable	M	**-**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A = Not applicable

The only fishing sector which could potentially be impacted by the proposed exploration drilling programme is the large pelagic long-line fishery. Pelagic long-line vessels are primarily concentrated seawards of the 500 m depth contour where the continental slope is steepest, with only approximately 1.1% and 0.9% of the total national catch and effort (between 2008 and 2012) being recorded within the proposed area of interest, respectively. This, together with the short-term duration and highly localised nature of the drilling operation, would result in a potential impact on the large pelagic long-line fishery of **VERY LOW** significance with or without mitigation. There is no expected impact on other fishing sectors as there has been no catch or effort (recent or historic) recorded within the proposed area of interest.

One of the key issues associated with exploration drilling relates to the physical damage or smothering of vulnerable or sensitive benthic communities due to the location of the well and release of drill cuttings at the wellbore and drilling unit. Benthic communities in the area of interest are largely expected to be those associated with unconsolidated sediments, however, due to the high natural variability in the region, there could also potentially be vulnerable communities on rocky outcrops / reefs, which are sensitive to disturbance due to their long generation times. The total area impacted by the release of cuttings is approximately 0.09 km^2 per well (i.e. a radius of 150 m from the drill site where the thickness exceeds 1 mm), which is considered negligible in relation to the total area of the Atlantic Offshore Bioregion. The avoidance of any vulnerable or sensitive benthic communities identified during the pre-drilling ROV survey would reduce the significance of this potential impact to **LOW**.

The most significant, although unlikely, impact during normal drilling operations relates to the introduction of non-indigenous invasive marine species through vessel and equipment transfer and ballast water discharge. The improbable introduction of an invasive alien species due to vessels and equipment transfer and the discharge of ballast water could result in an impact of **high to very high** significance. However, the adherence to the IMO guidelines governing discharge of ballast waters at sea would reduce the significance of this impact to **MEDIUM**. It should be noted that this impact is not unique to the proposed project, but rather a threat common to the South African offshore environment from the numerous vessels that pass through South African coastal waters daily.

The proposed project would result in limited job opportunities for local companies in Cape Town / Saldanha and Kleinzee, e.g. vessel supplies, support vessels, helicopter operations, catering, cleaning, security, etc. In addition, it is anticipated that proposed drilling would have very little effect on the economy due to the very short duration (three months per well) and the relatively small amounts of additional revenue generated. Economic impacts relating to job creation and generation of direct revenues are thus considered to be of ***VERY LOW (positive)*** significance.

5.2 ACCIDENTAL OIL SPILL (UPSET CONDITION)

This is considered to be an abnormal operation and relates to the unlikely event of an uncontrolled release of oil during drilling operations. In order to assess the potential impact related to an oil spill, a modelling study was undertaken to establish the extent, trajectory and fate of oil due to a small accidental spill and a large well blow-out. The modelling study concluded that the significance of this impact depends on a number of factors including, but not limited to, the severity of the release / spill, weather conditions and time of year.

A minor accidental spill of hydrocarbons, chemicals or drilling mud would be relatively short-lived on the water surface (< 2 days) and there would be no probability of the oil reaching the shoreline. The impact of a small operational spill on marine fauna and fishing at the well site or near the coast is considered to be of **LOW** and **VERY LOW** significance after mitigation, respectively.

The most significant environmental threat from offshore drilling operations is the risk of a major spill of crude oil occurring either from a blow-out or loss of well control. Oil spilled in the marine environment would have an immediate detrimental effect on water quality. Based on the results of the oil spill modelling study, oil is predicted to reach the shore under the following scenarios, assuming no mitigation measures are put in place:

- 5-day blow-out scenario: During winter there is a <10% probability of shoreline oiling at various point between Oranjemund and Cape Town under the slow weathering scenario.
- 20-day blow-out scenario:
  - > During winter there is a <10% probability of shoreline oiling between Lüderitz to Oranjemund under the medium weathering scenario; and
  - > During winter and summer there is a <10% probability of shoreline oiling along the central and southern Benguela coastline off South Africa and Namibia under the slow weathering scenario.

In the unlikely event of a large oil spill, the impact on marine fauna is considered to be of **HIGH** significance with mitigation, while the impact on fishing is considered to range from **LOW** (for the pelagic long-line and tuna pole sectors) to **MEDIUM** (for the demersal trawl, demersal long-line (hake and shark), traditional line-fish and West Coast rock lobster sectors) to **HIGH** (for the small pelagic purse-seine sector) with and without mitigation. In order to mitigate this unlikely impact it is recommended that a project-specific oil spill response plan be prepared and be put in place for the duration of the drilling operation.

It should also be noted that Oil Spill Response Limited (OSRL) operates advanced well intervention and capping equipment from Saldanha Bay for deployment in the event of a subsea well control incident. This would further reduce the spill period and thus the likelihood of oil reaching the shore in the event of a blow-out. Shell is a member of OSRL, which gives them ready access to this equipment.

5.3 COMPARATIVE ASSESSMENT OF PROJECTS ALTERNATIVES

5.3.1 Drill site alternatives

Shell is proposing to drill the exploration wells in the northern portion of the licence area. This area of interest is based on an understanding of the geological information for the area from an analysis of the existing seismic data. Thus the drilling area is more or less fixed by the location of the area of geological interest. Although the final well location within the area of interest would be based on a number of factors, including further analysis of the seismic data, the geological target and seafloor obstacles, this EIA assesses the potential impacts associated with drilling anywhere within the area of interest.

The potential impact on the marine benthic environment and significance thereof is ultimately dependent on whether any vulnerable or sensitive benthic communities occur within the vicinity of the selected drill site. Similarly, the potential impact on cultural heritage material (e.g. historical shipwrecks) is dependent on whether any wrecks are located nearby. Thus in order to minimise the significance of these potential impacts, it is recommended that the final well position be adjusted to avoid any significant topographic features, vulnerable habitats / species or wrecks.

5.3.2 Drill schedule alternatives

The specific timing of drilling is highly dependent on physical factors such as sea state conditions and weather conditions. Thus for safe operational reasons, Shell is proposing to drill in a future summer window period from November to April.

It is evident from these results of the oil spill modelling that drilling during winter would significantly increase the probability of shoreline oiling in the event of an unlikely blow-out. Thus it is recommended that drilling is confined to summer, as proposed.

5.3.3 Drilling unit alternatives

All potential impacts associated with the normal operation of both drilling unit options (either a semi-submersible drilling vessel or drill ship) are assessed to be of similar significance. These include:

- Emissions to the atmosphere;
- Discharge of waste to sea;
- Fauna attraction to drilling unit;
- Introduction of non-indigenous invasive species through vessel transfer; and
- 500 m safety zone around the drilling unit.

There are no additional impacts or differences in impact significance relating to the choice of drilling unit used during the exploration drilling programme.

5.3.4 Drilling method and material alternatives

Two drilling methods may be employed on a drilling unit, namely rotary or downhole motor drilling. The potential impact associated with the noise related to both drilling methods is assessed to be of similar significance. Thus there are no additional impacts or differences in impact significance relating to the choice of drilling method used during the exploration well drilling programme.

Two types of drilling fluid would be used during drilling, namely WBM and SBM. During the initial riserless drilling stage WBM would be used. However, during the risered drilling stage, a low toxicity SBM would be used, when WBMs cannot provide the necessary characteristics. Although the potential impact related to biochemical effects from the discharge of drill cuttings and muds is assessed to be of similar significance for both WBF and SBM usage, the intensity of the impact is considered to be higher for SBM. It is thus recommended that the use of WBF is maximised at all times, using risered SBMs only when necessary.

5.3.5 Well completion alternatives

During well abandonment the wellheads would either remain on or be removed from the seafloor. At the proposed drilling depths, the preferred option would be to leave the wellhead on the seafloor.

The proposed abandonment of the wellhead on the seafloor would have no impact on the demersal trawl sector, which currently operates along the 1 000 m depth contour inshore of the area of interest. There is, however, a concern that the permanent abandonment of the wellhead on the seafloor could have a potential future impact on the fishery. In historically trawled areas, predominantly on the shelf in waters shallower than 500 m water depth, the trawling industry has objected to and requested the removal of abandoned wellheads and other structures associated with oil and gas development. Although the expansion of trawling into waters deeper than 1 000 m water depth is uncertain, it is unlikely that trawling effort would move into the proposed area of interest, which has water depths ranging between 1 500 m and 2 100 m (noting that the technology exists to trawl to these depths but that such activity would require approval from the national fisheries management authority).

It is anticipated that the proposed abandonment of the wellhead on the seafloor would have no long-term impact on the demersal trawl sector.

5.3.6 Onshore logistic base alternatives

An onshore logistics base would be located in either the Cape Town or Saldanha Bay harbour precincts. The location within the harbour precinct would ultimately be based on discussions with the relevant Ports Authority, availability of service providers and space availability to accommodate the proposed onshore logistics facilities. The overall positive impact related to the limited job opportunities and direct revenues would remain the same for both possible onshore logistic base alternatives.

Similarly, the potential traffic impact associated with operational activities at either the Cape Town or Saldanha Bay harbours is assessed to be of similar significance.

There are not considered to be any noticeable differences in impact significance associated with the location of the onshore logistic base in either Cape Town or Saldanha Bay.

5.3.7 No-go alternative

The no-go alternative is the option of not undertaking the proposed exploration drilling operation. If exploration drilling does not proceed, the residual impacts (i.e. impacts after implementation of mitigation measures) of the proposed activities would not occur. Without exploration drilling, information about the subsurface geology and potential for the presence of oil and gas would not be collected. Thus further exploration and production activities would less likely to be carried out. The halt of oil and gas exploration and production would result in a decrease in commercial interest in South Africa's oil and gas sector, and the loss of potential economic benefits including government revenues, taxes, and employment.

The implications of not going ahead with the proposed exploration in the Orange Basin Deep Water Licence Area relate to the lost opportunity to further explore for oil and gas reserves on the West Coast and maximise the use of South Africa's own hydrocarbon reserves should they exist. This potential impact of the No-Go Alternative is considered to be of **MEDIUM** significance.

5.4 RECOMMENDATION / OPINION OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved.

- Ecological integrity

  The disturbance of benthic communities is considered negligible in relation to the available area of similar habitat on and off the edge of the continental shelf in the Atlantic Offshore Bioregion, which is classified as Least Threatened. In addition, this localised impact is short-term with recovery expected within two to five years, assuming as recommended the avoidance of rock outcrops / reefs.

  The more significant impacts relating to large oil spills and the introduction of non-indigenous invasive marine species are both considered to be highly unlikely. These risks are no different to any other past or future exploration drilling operation undertaken of the coast of South Africa. As indicated above, the unlikely introduction of invasive marine species is not unique to the proposed project, but rather a threat common to the South African offshore environment from the numerous vessels that pass through South African coastal waters daily.

  In summary, the proposed project would result in the loss of some ecological integrity in the study area, but it is considered to be small, localised and short-term under normal operating conditions.

- Economic efficiency
  The 500 m safety zone around the drilling unit would essentially exclude other vessels from a very small area off the West Coast. The only economic activity operational in the area is that of the large pelagic long-line fishing sector, the impact on which is assessed to be highly localised of short-term duration (three months), after which the area would be opened up again to fishing.
  Although the economic benefits (job creation and generation of direct revenues) associated with this stage of exploration in the Orange Basin Licence Area are considered to be only of ***VERY LOW (positive)*** significance, an oil discovery could result in significant future benefits to South Africa.

  The proposed project is also considered to be economically efficient, as no other party/ies would be significantly impacted, while establishing the extent of indigenous oil / gas reserves.

- Equity and social justice
  Due to the offshore location of the licence area, the proposed project would not unfairly discriminate, directly or indirectly, against any one party nor result in an unequal distribution of negative impacts.

It is the opinion of CCA in terms of the sustainability criteria described above, the nature and extent of the proposed well drilling programme (under normal operating conditions) and the findings of the specialist studies, that the generally **VERY LOW** to **LOW** significance associated with normal operations should support a positive decision being made by DEA in this regard.

6. RECOMMENDATIONS

6.1 COMPLIANCE WITH ENVIRONMENTAL MANAGEMENT PROGRAMME AND MARPOL 73/78 STANDARDS

- All phases of the proposed project must comply with the Environmental Management Programme presented in Chapter 7.
- The drilling unit and all vessels must ensure compliance with MARPOL 73/78 standards.

6.2 NOTIFICATION AND COMMUNICATION WITH KEY STAKEHOLDERS

- 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: South African Tuna Long-line Association, South African Deep-sea Trawling Industry Association, South African Tuna Association and Fresh Tuna Exporters Association; and
  > Other key stakeholders: Department of Agriculture, Forestry and Fisheries (DAFF), DEA, PASA, Transnet National Ports Authority (ports of Cape Town and Saldanha Bay), South African Maritime Safety Authority (SAMSA), South African Navy Hydrographic office and adjacent prospecting / exploration right holders.

  These stakeholders should again be notified at the completion of drilling when the drilling unit and support vessels are off location.
- Shell must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the drilling period. 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 drilling unit, and (4) provide details on the

movements of support vessels servicing the drilling operation. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;

- Any fishing vessel targets at a radar range of 24 nm from the drilling unit should be called via radio and informed of the safety requirements around the drilling unit;
- The drilling unit vessel should be accompanied by a support vessel equipped with appropriate radar and communications be kept on 24-hour standby near the drilling unit in order to ensure that other vessels adhere to the safety zone;
- Any dispute arising with adjacent prospecting / exploration right holders should be referred to the Department of Mineral Resources or PASA for resolution; and
- Any wells suspended or abandoned on the seafloor must be surveyed and accurately charted with the South African Navy Hydrographic office.

6.3 FINAL WELL LOCATION AND EQUIPMENT

- Pre-drilling site surveys (using a ROV) should be undertaken in the vicinity of the proposed well locations to confirm the presence of any significant topographic features (e.g. rocky outcrops), vulnerable habitats (e.g. hard grounds) and / or species (e.g. cold-water corals and sponges), and cultural heritage material (e.g. shipwrecks) in the area. Final well location should be adjusted to avoid any identified vulnerable seabed communities bearing in mind the extent of smothering effects (as per the cuttings dispersal modelling) and cultural heritage material; and
- Unless thoroughly cleaned, no infrastructure (e.g. wellheads, BOPs and guide bases) should be deployed that has been used in other regions.

6.4 EMISSIONS AND DISCHARGES

6.4.1 General

- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for the drilling unit and all other vessels and be in place at all times during operation;
- All diesel motors and generators should receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere;
- Leak detection and repair programmes should be implemented for valves, flanges, fittings, seals, etc.;
- Spill management training and awareness should be provided to crew members regarding the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within a bunded area and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected;
- Initiate a waste minimisation system on board all vessels;
- On-board solid waste storage is to be secure; and
- The disposal of waste (solid and hazardous) onshore must be in accordance with the appropriate laws and ordinances.

6.4.2 Drilling fluids, cuttings and cement

- Maximise the use of WBM at all times, using risered SBMs only when necessary;
- Ensure only low-toxicity and partially biodegradable drilling fluid and cement additives are used;
- If the extent of cuttings dispersion overlaps with any vulnerable seabed communities identified in the vicinity of the proposed well location using the existing 3D seismic data and / or ROV (as recommended in Section 6.3 above), innovative technologies and operational procedures for drilling solids discharges should be considered (e.g. the use of weighted mud when drilling tophole sections to limit the extent of dispersion);
- Ensure regular maintenance of the onboard solids control package;
- The dispersion of the discharged cuttings should be aided by placing the cuttings chute at least 5 m below the sea surface;
- All recovered SBM should be stored on-board and taken to shore for treatment and reuse; and
- Avoid excess cement usage by using a ROV to monitor discharges to the seafloor around the drill casing.

6.4.3 Ballast water

- A ballast water management plan must be prepared for the drilling unit; and
- De- and re-ballasting of vessels must be undertaken only under strict adherence to International Maritime Organisation (IMO) guidelines governing discharge of ballast waters at sea. De- and re-ballasting at sea currently provides the best available measure to reduce the risk of transfer of harmful aquatic organisms, but is subject to ship-safety limits. 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; and
- Other precautionary guidelines recommended by the IMO include:
  - > During the loading of ballast, every effort should be made to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms, through adequate filtration procedures;
  - > Where practicable, routine cleaning of the ballast tank to remove sediments should be carried out in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's ballast water management plan; and
  - > Avoidance of unnecessary discharge of ballast water.

6.4.4 Flaring

- A high-efficiency burner should be used for flaring (as proposed) in order to minimise emissions and hydrocarbon ‘drop-out’ during well testing;
- Only the minimum volume of hydrocarbons required for the test should be flowed, without compromising safety, and well test durations should be reduced to the extent practical;
- Flare combustion efficiency should be maximised by controlling and optimising flare fuel/air/stream flow rates;
- The risk of pilot blow-out should be minimised by ensuring sufficient exit velocity and providing wind guards;
- Where appropriate, a high integrity instrument pressure protection system should be used to reduce over pressure events;

- Liquid carry over and entrainment in the flare stream should be minimised with a suitable liquid separation system;
- Flame lift off and / or flame lick should be minimised; and
- Odour and visible smoke emissions (no visible black smoke) should be monitored and controlled.

6.5 VESSEL SEAWORTHINESS AND SAFETY

- The drilling unit and support vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. American Bureau of Shipping, Det Norske Veritas, Lloyds Register, etc.). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include: the support vessels, the enforcement of the 500 m safety zone around the drilling unit, cautionary notices to mariners and access to current weather service information;
- The drilling unit and support vessels must be fully illuminated during twilight and night; and
- Report any emergencies to SAMSA.

6.6 VESSEL LIGHTING

- Non-essential lighting should be minimised on all platforms to reduce nocturnal attraction. However, such measure should not undermine work safety aspects or concerns; and
- A monitoring programme of faunal attraction should be implemented where any seabird injuries and mortalities are logged.

6.7 AIRCRAFT AND HELICOPTER OPERATIONS

- All flight paths must be pre-planned to ensure that no flying occurs over coastal reserves (MacDougall's Bay), seal colonies (Buchu Twins, Kleinzee and Strandfontein Point), bird colonies (Bird Island at Lambert's Bay) or Important Bird Areas (Orange River Mouth wetlands, Olifants River Estuary, Velorenvlei, Lower Berg River wetlands and the West Coast National Park and Saldanha Bay Islands);
- Extensive low altitude coastal flights (<2 500 ft and within 1 nm of the shore) should be avoided, particularly during the winter/spring (June to November inclusive) whale migration period and during the November to January seal breeding season. The flight path between the onshore logistics base in Kleinzee and drilling unit should be perpendicular to the coast. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended;
- Aircrafts may not, without a permit or an exemption, approach to within 300 m of whales in terms of the Marine Living Resources Act, 1998. As this may be both impractical and impossible, it is recommended that an application for an exemption permit is made to DEA;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level along the coast or above marine mammals.

6.8 CULTURAL HERITAGE MATERIAL

- If any cultural heritage material is found during activities the South African Heritage Resources Agency (SAHRA) should be notified immediately. If any material older than sixty years is to be disturbed a permit would be required from SAHRA.

6.9 JOB CREATION

- The use of local companies and vessels for support services should be promoted as far as possible. In addition, skills development should occur where possible.

6.10 ACCIDENTAL RELEASE OF OIL

6.10.1 Small instantaneous spills

- A SOPEP must be prepared for the drilling unit and all other vessels and be in place at all times during operation;
- Oil pollution emergency procedures for small spills must be integrated with the drilling units emergency procedures for all incidents covered in the Emergency Procedures Manual;
- A tiered response plan must be prepared;
- Arrangements must be put in place for rapid deployment of Tier 1 response at the spill site (e.g. from support vessel);
- Personnel must be trained in emergency procedures;
- Training and exercise programmes must be established to ensure that the response activity can be effectively executed; and
- Onboard spill equipment and spill containment materials must be in place, maintained and positioned in clearly identified locations.

6.10.2 Large blow-outs

Mitigation for large blow-outs falls into two categories, namely (1) prevention and (2) response:

1. Subsea Blow-out Prevention includes, *inter alia*:
    - Safety and technical training;
    - Subsea BOP stack;
    - Pipe rams;
    - Drilling fluids;
    - Casing and cement;
    - Leak detection systems; and
    - Integrity testing of well casing and cementing activities.
2. Oil Spill Response includes, *inter alia*:
    - Oil Spill Response Plan (OSRP) and Well Control Contingency Plan (WCCP);
    - Safety and technical training;
    - Mechanical recovery (e.g. booms, skimming devices and / or absorbent material);
    - Dispersants; and
    - Shoreline protection (including preventing the oil from reaching the shoreline), clean-up and rehabilitation of wildlife.

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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

BID	Background Information Document
AABW	Antarctic Bottom Water
AAIW	Antarctic Intermediate Water
BOD	Biological oxygen demand
BOP	blow-out preventer
BTEX	Benzene, ethyl benzene, toluene and xylenes
CCA	CCA Environmental (Pty) Ltd
CITES	Convention on International Trade in Endangered Species
cm	centimetres
cm/s	centimetres per second
CMS	Convention on Migratory Species
CO	Carbon monoxide
CO_2	Carbon dioxide
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DAFF	Department of Agriculture, Forestry and Fisheries
dB	Decibel
DEA	Department of Environmental Affairs
DEA: BOC	Department of Environmental Affairs: Branch Oceans and Coasts
DEA&DP	Western Cape Government: Department of Environmental Affairs and Development Planning
DEA&NC	Northern Cape Government: Department of Environment Affairs and Nature Conservation
DSR	Draft Scoping Report
DWA	Department of Water Affairs
E	East
EASSy	Eastern Africa Submarine Cable System
ECC	Emergency Control Centre
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
FSR	Final Scoping Report
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GN	Government Notice
GRT	Gross Registered Tonnage
H_2S	Hydrogen sulphide
HSSE	health, safety, security and environmental
IAEA	International Atomic Energy Agency
I&APs	Interested & Affected Parties
IBA	Important Bird Area
ICRC	International Commission on Radiological Protection
IFC	International Finance Corporation
IMO	International Maritime Organisation
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
m	Metres
m^2	Square metres
m^3	Cubic metre
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978
mg/l	Milligrams per litre
mm	Millimetres
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
m/s	Metres per second
mT	Metric tons
N	North
NADF	Non-aqueous drilling fluid
NADW	North Atlantic Deep Water
NBSA	National Biodiversity Spatial Assessment Report
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004
NEM:WA	National Environmental Management: Waste Act, 2008 (No. 59 of 2008)

nm	Nautical mile (1 nm = 1.852 km)
NMA	NMA Effective Social Strategists (Pty) Ltd
NNW	North-north-west
NO_X	Nitrogen oxides
NW	North-west
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSRL	Oil Spill Response Limited
OSRP	Oil Spill Response Plan
PAHs	Polycyclic aromatic hydrocarbons
PASA	Petroleum Agency of South Africa
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PRDW	Prestedge Retief Dresner Wijnberg Coastal Engineers
PTS	Permanent Threshold Shifts
psi	Per square inch
ROV	Remotely Operated Vehicle
S	South
SAFE	South Africa Far East
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SAN	South African Navy
SANBI	South African National Biodiversity Institute
SASAR	South African Search and Rescue
SAT3	South Atlantic Telecommunications cable no.3
SAWS	South African Weather Service
SBM	Synthetic-based mud
SO_X	Sulphur oxides
SOPEP	Shipboard Oil Pollution Emergency Plan
SSW	South-south-west
SW	South-west
t	Tons
TAC	Total Allowable Catch
TAE	Total Applied Effort
TSPM	Total Suspended Particulate Matter
TTS	Temporary Threshold Shifts
UNCLOS	United Nations Convention on Law of the Sea, 1982
VMEs	Vulnerable Marine Ecosystems
VOS	Voluntary Observing Ships
W	West
WACS	West Africa Cable System
WASC	West African Submarine Cable
WBM	Water-based mud
WCCP	Well Control Contingency Plan
WSW	West-south-west
µg	Micrograms
µm	Micrometre
µg/l	Micrograms per litre
µPa	Micro Pascal
°C	Degrees Centigrade
%	Percent
‰	Parts per thousand
<	Less than
>	Greater than
"	Inch

GLOSSARY

Abandoned well	A well which is officially plugged and abandoned.
Annulus	The space between the casing and the wall of the borehole.
Appraisal well	A well drilled to determine the physical extent, reserves and likely production rate of a field.
Bit	The cutting or boring element used in well drilling.
Blow-out	An uncontrolled flow of oil or gas occurring when formation pressure exceeds the pressure applied to it by the column of drilling fluid.
Blow-out preventers	High pressure wellhead valves designed to shut off the uncontrolled flow of hydrocarbons
Borehole	The hole as drilled by the drill bit.
Casing	Steel pipe cemented in the well to seal off formation fluids or keep the hole from caving in.
Cement casing	To fill the annulus between the casing and hole with cement to support the casing and prevent fluid migration between permeable zones.
Conductor pipe	A conductor pipe is a large diameter pipe that is set into the ground to provide the initial stable structural foundation for the well.
Cuttings	The fragments of rock dislodged by the bit and brought to the surface in the drilling mud.
Drill string	The column, or string, of drill pipe. Often loosely applied to both the drill pipe and drill collars.
Drilling unit	Drilling unit that is not permanently fixed to the seabed, e.g. a drill-ship or a semi-submersible drilling vessel.
Drilling fluid / mud	A mixture of clays, chemicals and water pumped down the drill pipe to lubricate and cool the drilling bit and to flush out the cuttings, as well as to strengthen the sides of the hole. Two main categories of drilling fluids are water-based muds (WBM) and synthetic-based muds (SBM).
Exploration well	A well drilled in an unproven area in order to verify the presence or absence of a hydrocarbon reservoir.
Riser	A pipe between a seabed blow-out preventer and a drilling unit.
Rotary drilling	A drilling method in which the hole is drilled by a rotating bit to which a downward force is applied.
Suspended well	A well that has been capped off temporarily.
Well log	A record of geological formation penetrated during drilling, including technical details of the operation.
Wellbore	A borehole – the hole drilled by the bit.
Wellhead	The equipment installed at the surface of the well bore.