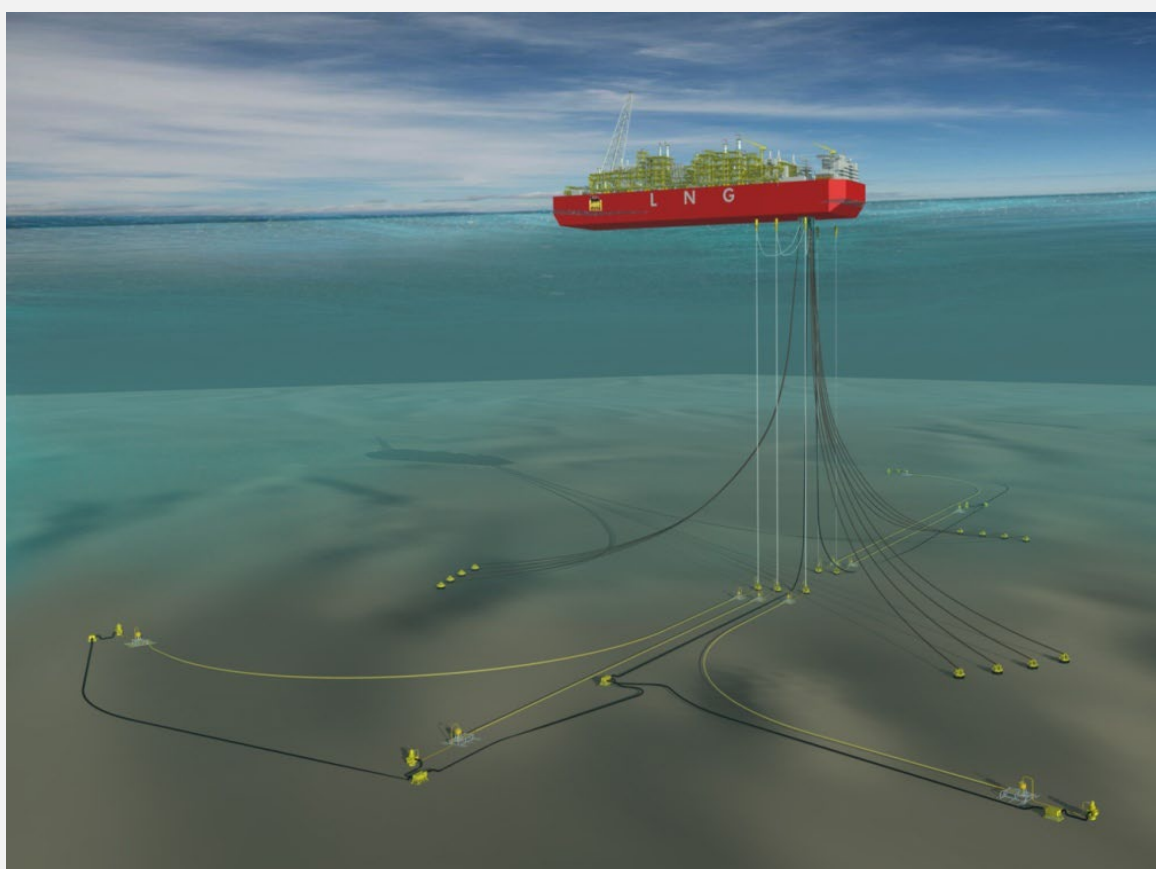


CORAL NORTH DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT STUDY

FINAL REPORT

VOLUME II – IMPACT ASSESSMENT AND MITIGATION MEASURES



JANUARY 2025

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LIST OF ACRONYMS AND ABBREVIATIONS

ADI	Area of Direct Influence
ADNAP	National Directorate of Fisheries (<i>Administração Nacional das Pescas</i>)
AHTS	Anchor Handling Tug Supply Vessel
All	Area of Indirect Influence
AIS	Alien Invasive Species
AoI	Area of Influence
AR6	IPCC's Sixth Assessment Report
BAOAC	Bonn Agreement Oil Appearance Code
BOD	Biological Oxygen Demand
BOG	Boil-off Gas
CadnaA	Computer Aided Noise Abatement
CIA	Cumulative Impact Assessment
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COC	Contaminants of Concern
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
CTA	Confederation of the Mozambican Economic Associations
CTNL	Change of Traffic Noise Level
DAH	Dissolved-phase Aromatic Hydrocarbons
dB	Decibel
DINAB	National Directorate of Environment (<i>Direcção Nacional do Ambiente</i>)
DPAPCD	Provincial Directorate of Agriculture and Fisheries of Cabo Delgado (<i>Direcção Provincial de Agricultura e Pesca de Cabo Delgado</i>)
DPDTA	Provincial Directorate of Land and Environment (<i>Direcção Provincial da Terra e Ambiente</i>)
DPTC	Provincial Directorate of Transports and Communication (<i>Direcção Provincial de Transportes e Comunicações</i>)
DVM	Diel Vertical Migration
EEZ	Economic Exclusive Zone
EIA	Environmental Impact Assessment Process
EIS	Environmental Impact Study
EMP	Environmental Management Plan
ENH	National Hydrocarbon Company

EP	Equator Principles
EPDA	Environmental Pre-Feasibility and Scope Definition Study
ERB	Eni Rovuma Basin
FHG	Functional Hearing Group
FLNG	Floating Liquefied Natural Gas
GBV	Gender Based Violence
GHG	Greenhouse Gas
GLC	Ground Level Concentration
GoM	Government of Mozambique
GTG	Gas Turbine Generator
HF	High Frequency
I&APs	Interested and Affected Parties
IDEPA	National Institute for the Development of Fisheries and Aquaculture (<i>Instituto de Desenvolvimento da Pesca e Aquacultura</i>)
IFC	International Finance Corporation
IMO	International Maritime Organization
INATUR	National Institute of Tourism (<i>Instituto Nacional do Turismo</i>)
INP	National Petroleum Institute
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Oil Industry Environmental Conservation Association
ISO	International Standard Organization
IUCN	International Union for the Conservation of Nature and Natural Resources
LC50	Lethal Concentration 50
LDAR	Leak, Detection, and Repair Program
LF	Low Frequency
LNG	Liquefied Natural Gas
LTOBM	Low Toxicity Oil Based Mud
MAAP	Ministry of Agriculture, Environment and Fisheries (<i>Ministério da Agricultura, Ambiente e Pescas</i>)
MARPOL	International Convention for the Prevention of Pollution from Ships
MMO	Marine Mammal Observation
MPV	Multi-Purpose Vessel
MRV	Mozambique Rovuma Venture
MTA	Ministry of Land and Environment (<i>Ministério da Terra e Ambiente</i>)

MTPA	Million Tons per Annum
nm	Nautical Mile
NMVOG	Non-Methane Volatile Organic Compounds
NO	Nitrogen Monoxide
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
NSR	Noise Sensitive Receptor
OBM	Oil Base Mud
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
Pa	Pascal
PM ₁₀	Particulate Matter (diameter < 10 mm)
PM _{2.5}	Particulate Matter (diameter < 2.5 mm)
PPP	Public Participation Process
PSV	Platform Supply Vessel
PTS	Permanent Threshold Shift
ROV	Remote Operated Vehicles
SEAH	Sexual Exploitation, Abuse and Harassment
SECP	Stakeholder Engagement and Communication Plan
SEJE	State Secretariat for Youth and Enterprise (<i>Secretaria de Estado da Juventude e Educação</i>)
SEL	Sound Exposure Level
Si	Sirenia
SO ₂	Sulfur Dioxide
SPA	Provincial Environmental Service (<i>Serviço Provincial do Ambiente</i>)
SPAS	Provincial Service of Social Action (<i>Serviço Provincial de Acção Social</i>)
SPL	Sound Pressure Level
SPS	Subsea Production System
SSP	Shared Socioeconomic Pathways
TAR	Turnaround
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
UEM	Eduardo Mondlane University

UNESCO	United Nations Educational, Scientific and Cultural Organization
UniLurio	Lúrio University
USEPA	United States Environmental Protection Agency
VECs	Valued Environmental and Social Components
VHF	Very High Frequency
VSR	Visual Sensitive Receptor
WB	World Bank
WBM	Water Based Mud
WHO	World Health Organization

7 Impact Assessment and Mitigation Measures

7.1 Introduction

7.1.1 General Considerations

This Chapter provides an assessment of the potential biophysical and socio-economic impacts, direct and indirect, positive and negative, that may result from the implementation of the Project.

Potential impacts of the Project are assessed for each component of the biophysical and socio-economic environment for which relevant impacts were identified. Impact identification was based on the preliminary impact scoping developed in the Environmental Pre-Feasibility and Scope Definition Study (EPDA) and was updated considering the findings of the specialist studies and other more detailed analysis undertaken for this Environmental Impact Study (EIS).

For each impact, an impact description is provided, and its significance is assessed according to a standardized impact assessment methodology, as described in the following section 7.1.2. Considering the significance rating, mitigation measures are then defined, with the goal to reduce the significance of the residual impact to acceptable levels. For positive impacts, and where relevant, enhancement measures are proposed.

The significance of each potential impact is also rated after the application of mitigation / enhancement measures, to assess the residual impact significance. The impact assessment for each impact is summarized in table format, including the pre-mitigation assessment, the key proposed mitigation measures and the residual impact assessment.

Mitigation, enhancement, and monitoring measures resulting from the impact assessment are then captured and systematized in the Environmental Management Plan (EMP) (see Volume III).

7.1.2 Impact Assessment Methodology

This section provides a detailed methodology to be used for the assessment of the significance of potential environmental and social impacts in the EIS. This methodology allows for impacts to be analysed in a systematic manner, with significance rating assigned to each potential impact (from *insignificant* to *very high*), thus helping to minimize the subjectivity inherent to impact assessment.

Impact identification and assessment was carried out for all project activities based on the Environmental Impact Assessment (EIA) team's professional judgement and experience, as well as through field work, public participation, and desktop analysis.

7.1.2.1 Types of Impacts

An impact is any change, or perceived change, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services (as defined in ISO 14001:2004). Any project can generate a wide range of potential impacts, of different types. The following table lists the different types of impacts that were identified and assessed.

Table 7.1: Types of Impacts

Type of Impact	Description
Direct	Impacts that result from the direct interaction between a project activity and the receiving environment (e.g., gaseous emissions which affects air quality).
Indirect	Impacts that result from other (non-project) activities but which are facilitated because of the project (e.g., the project may attract other investments and associated regional economic stimulation) or impacts that occur because of subsequent interaction of direct project impacts within the environment.
Cumulative	Impacts that act together with current or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors (e.g., combined effects of atmospheric emissions from the industry sector at regional level).

7.1.2.2 Impact Significance Assessment

The goal of impact assessment is to inform the mitigation and/or enhancement required to reduce the residual effect of a negative impact to acceptable levels or to maximize the benefits of a positive one. The consequence of an impact is defined as a combination of several impact criteria, which assess the temporal and spatial scale of the impact, the sensitivity, resilience or importance of the affected receptors / resources, and the intensity of the imposed changes on those receptors / resources. The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur.

The criteria that will be used to determine impact consequence are presented in the table below.

Table 7.2: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. Extent: the area over which the impact will be experienced		
Local	Confined to project or study area or part thereof (e.g., limits of the concession area)	1
Regional	The region, which may be defined in various ways, e.g., cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. Intensity: the magnitude of the impact in relation to the sensitivity of the receiving environment, considering the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue, albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration: the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a consequence rating, as follows:

Table 7.3: Method used to determine the consequence rating

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence is derived, the probability of the impact occurring is considered, using the probability classifications presented in the table below.

Table 7.4: Probability classification

Probability: the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall significance of the impact is then determined by considering consequence and probability using the rating system prescribed in the table below.

Table 7.5: Impact significance rating

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Finally, the impacts' nature is also considered (positive or negative impact) (Table 7.6).

Table 7.6: Impact status

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	(+) – positive – a 'benefit'
	(-) – negative – a 'cost'

There is no statutory definition of 'significance' and its determination is therefore necessarily partially subjective. Criteria for assessing the significance of impacts arise from the following key elements:

- Status of compliance with relevant local legislation, policies and plans, industry policies, environmental standards or guidelines and internationally accepted best practice;
- Consequence of the change to the biophysical or socioeconomic environment (e.g., loss of habitats, decrease in water quality) expressed, wherever practicable, in quantitative terms. For socioeconomic impacts, the consequence must be viewed from the perspective of those affected, by considering the likely perceived importance of the impact and the ability of people to manage and adapt to the change;
- Nature of the impact receptor (physical, biological, or human). Where the receptor is physical (e.g., a water resource) its quality, sensitivity to change, and importance must be considered. Where the receptor is biological, its importance (e.g., its local, regional, national, or international importance) and its sensitivity to the impact must be considered. For a human receptor, the sensitivity of the household, community, or wider societal group must be considered along with their ability to adapt to and manage the effects of the impact;

- Probability that the identified impact will occur. This is estimated based upon experience and / or evidence that such an outcome has previously occurred.

The impact significance rating also reflects the need for mitigation. While low significance impacts may not require specific mitigation measures, high significance negative impacts demand that adequate measures be put in place to reduce the residual significance (impact significance rating after mitigation), as described in the following table.

Table 7.7: Impact significance and mitigation requirements

Significance rating	Description
Insignificant to Low	No specific mitigations measures required, beyond normal environmental good practices and industry standard control measures.
Medium	Specific mitigation measures should be devised, to reduce the significance of the residual impact to an acceptable level.
High	Specific mitigation measures should be devised, to reduce the significance of the residual impact to an acceptable level. If avoidance or minimization is not possible, compensation measures should be considered.
Very High	Specific mitigation measures should be identified and implemented, to reduce the significance of the residual impact to an acceptable level. If such mitigation is not possible, very high significance residual negative impacts should be considered in the project's authorization process.

Impact significance was rated in the prescribed way both with and without the implementation of the recommended mitigation measures to ensure that the selected mitigation measures reduce the significance of the environmental impact to an acceptable level. If the significance of the impact remained high, further mitigation measures were developed to be implemented.

7.1.2.3 Mitigation

Mitigation and/or enhancement is a critical phase of the EIA process. When potential impacts have been identified, the aim is to avoid or reduce as much as reasonably practicable of the negative ones, while enhancing the positive impacts.

The basic principle of mitigation is to avoid any negative impact in the first place, rather than trying to remedy its negative effect later. Where impacts cannot be avoided, the aim then becomes to reduce them to an acceptable level, such that no major residual impacts are left. Table 7.8 provides the framework for mitigation options to be considered in the EIS; the mitigation hierarchy.

Table 7.8: Mitigation hierarchy

Level of mitigation	Description
Avoid	Re-design the project to remove the potential impact due to the project's feature.
Reduce	Design control systems and implement off-site measures to reduce impacts.
Remedy	Repair any residual damage to natural and human environment by restoration activities or appropriate interventions.
Offset	Compensate for significant residual impacts if other mitigation measures are not feasible or cost-effective, or are already fully implemented

7.2 Air Quality

7.2.1 Contaminants of Concern

Potential Project impacts on air quality are mostly associated with the start-up and operational phases, namely with the air pollutants that will be released from the combustion unit stacks and the Floating Liquefied Natural Gas (FLNG) flare. While some air pollution is also to be expected during the drilling, installation, and commissioning phases, mostly due to combustion emissions from vessel operation, these will be a small fraction of the emissions expected for start-up and operations. As such, the main air quality impacts are projected from the FLNG start-up and operational activities.

The following pollutants were identified as Contaminants of Concern (COC):

- Nitrogen dioxide (NO₂): NO₂ is a component of the oxides of nitrogen (NO_x) group composed of nitrogen monoxide (NO) and NO₂. Though NO is the main component at the stack exit, it rises into the atmosphere and reacts with oxygen to form NO₂; therefore, the relative composition of NO₂ increases the further it is from the emitting source. While NO is an innocuous component, exposure to NO₂ produces respiratory issues, such as asthma. Therefore, NO₂ is the component of greatest interest in air quality standards and is considered an indicator for levels of the NO_x group;
- Sulphur dioxide (SO₂): SO₂ is a pollutant generated in the combustion of sulphur-containing fuels. Short-term exposure to SO₂ can produce adverse respiratory effects, including bronchoconstriction and increased asthma symptoms;
- Particulate Matter (PM₁₀ and PM_{2.5}): Suspended particles are formed due to fuel combustion. Particles with the highest human health impact are PM₁₀ (with an aerodynamic diameter less than 10 µm) and PM_{2.5} (with an aerodynamic diameter less than 2.5 µm). Major concerns for human health from exposure to PM₁₀ and PM_{2.5} include several respiratory problems, increased asthma, and decreased lung function.

Although carbon monoxide (CO) is also emitted during fuel combustion, this pollutant was not assessed as a COC. The national ambient air quality standards established for CO are at least two orders of magnitude higher (i.e., more than 100 times) than for the other pollutants (NO₂, SO₂, or PM₁₀, and PM_{2.5} particulate matter), as provided in section 6.2.2 of Volume 1. For example, the national 1-hour ambient standard for NO₂ is 190 µg/m³, while for CO it is 30 000 µg/m³. Given that CO emissions from the facility will be of around the same order of magnitude as the other COC (please see Table AI.4, Volume IV, for the emission rates of all pollutants), they will not constitute a relevant impact on local air quality. The results from the modelling carried out for the EIA (Section 7.2.2.2) show that the project emissions do not cause exceedances to the much stricter NO₂ national ambient quality standard, therefore, the same is true for the much less strict CO standard.

According to air emissions information provided by the Proponent, traces of other pollutants such as benzene and non-methane volatile organic compounds (NMVOC) shall be expected from some emissions. Because of the very low emission rates of these pollutants (< 0.1 g/s), these pollutants are not considered as COC for the purposes of this study.

7.2.2 Air Quality Modelling

7.2.2.1 Modelling Approach

The assessment of potential operational Project impacts on air quality was based on air dispersion modelling, where the Project emissions were calculated and their dispersion in the atmosphere after emissions was simulated using dedicated software (air dispersion model), namely the CALLPUFF model.

Four different scenarios were modelled for this assessment:

- Scenario 1 – air quality impact from Coral North FLNG during the 1st start-up phase;
- Scenario 2 – air quality impact from Coral North FLNG during the operational phase;
- Scenario 3 – air quality impact from Coral North FLNG during an emergency flaring event;
- Scenario 4 – cumulative air quality impact during the operational phase of the project (Coral North + Coral South).

Additional details on the modelling approach used, including the CALLPUF model's characteristics, the modelling assumptions, limitations, and inputs are provided in Annex IV (see Volume IV).

7.2.2.2 Modelling Results

Maximum predicted ground level concentrations (GLCs) of COC, as modelled with CALPUFF for the 3-year period, are listed in Table 7.9. These represent the worst case operational impacts to air quality (the highest concentrations reached) identified throughout the full modelling period.

The overall maximum GLCs encountered in offshore areas near the FLNG are presented in the contour plots of maximum GLCs for each pollutant in Annex IV.A (Scenario 1 – start-up phase), Annex IV.B (Scenario 2 – operational phase), Annex IV.C (Scenario 3 – emergency/unplanned flaring), and Annex IV.D (Scenario 4 – cumulative impact) (please see Volume IV – Annexes), as well as the predicted maximum levels on the nearest onshore areas (coastal zones in Mozambique).

These modelling results represent the maximum predicted GLCs due to the worst-case meteorological conditions during the entire 3-year modelling period. These worst-case impacts will only happen under specific atmospheric conditions. For most of the time, operational impacts are expected to be lower than the GLC concentrations listed in the table.

Maximum predicted GLCs on onshore coastal zones derived from Coral North FLNG activities during the different phases and events of the project modelled are negligible, with maximum onshore predicted GLCs below 5% of applicable standards (10 $\mu\text{g}/\text{m}^3$ 1-hr NO_2 estimate under Scenario 1, compared to the 190 $\mu\text{g}/\text{m}^3$ Mozambican standard). This negligible impact is also predicted when considering the additional contribution from Coral South FLNG in Scenario 4 (cumulative assessment), with maximum predicted GLC at receptors below 3 $\mu\text{g}/\text{m}^3$.

Table 7.9: CALPUFF Modelling Results (GLC, $\mu\text{g}/\text{m}^3$) and comparison with applicable Air Quality Standards

COC	Averaging Period	Maximum Predicted GLC (µg/m³)								Air Quality Standards (µg/m³)	
		Scenario 1 Start-up		Scenario 2 Operation		Scenario 3 Emergency		Scenario 4 Cumulative			
		Overall	Onshore	Overall	Onshore	Overall	Onshore	Overall	Onshore	National	IFC
NO ₂	1-hr	217	< 10	34.5	< 2	3.25	< 2	34.5	< 3	190	200
	1-year	NA	NA	0.52	< 0.05	NA	NA	0.64	< 0.05	10	40
SO ₂	1-hr	4.5	< 0.2	3	< 0.1	NA	NA	8.9	< 0.3	800	--
	24-hr	0.89	< 0.1	0.56	< 0.1	NA	NA	0.59	< 0.1	100	20
	1-year	NA	NA	0.08	< 0.1	NA	NA	0.09	< 0.1	40	--
PM ₁₀	24-hr	2.9	< 0.2	2.3	< 0.2	NA	NA	3.1	< 0.3	150	50
	1-year	NA	NA	0.26	< 0.1	NA	NA	0.33	< 0.1	60	20

Notes: NA = non-applicable due to the short durations of emissions under Scenarios 1 and 3.

In general, the overall maximum predicted GLCs are very low and well below the air quality standards, with the exception of the 1-hr NO₂ GLC under Scenario 1 (Start-up phase), 217 $\mu\text{g}/\text{m}^3$. As seen in the GLC contour maps in Annex IV.A to IV.D, the overall maximum GLCs are encountered in offshore areas near the FLNG, where receptors to airborne pollutants (i.e., populated areas or terrestrial ecosystems) are not expected and deposition (dry or wet) of pollutants is not of concern. Therefore, no environmental impacts are expected in these locations. As an operation of limited duration, the start-up phase is unlikely to occur under the specific meteorological conditions that lead to the worst-case predictions. If the highest 1-hr NO₂ GLC at each modelling receptor is excluded under Scenario 1 (i.e., exclusion of the specific hour that leads to the maximum GLCs at all receptors), the maximum GLCs predicted by the model decrease from 217 $\mu\text{g}/\text{m}^3$ to 99.4 $\mu\text{g}/\text{m}^3$. Consequently, it is anticipated that NO₂ emissions during the Coral North FLNG start-up phase will not produce GLCs above the applicable air quality standards, even in offshore areas where these standards are not applicable.

7.2.3 Impact Assessment

The Project's potential impacts on ambient air quality are assessed below, for the initial phases of the project (drilling, installation, and commissioning), and for the operational phase. The operational impacts were assessed based on the four modelled Scenarios listed above and the modelling results provided in Table 7.9.

Impact AQ1: Air quality impacts during the drilling, installation, and commissioning phases

Impact Assessment

The vessels involved in the offshore drilling, installation, and commissioning activities will support the drilling of production wells, installation of subsea facilities, mooring chains and anchors, towing

and hook up of FLNG during the installation phase, and logistical support during the commissioning phase. Thus, different types of vessels will be involved in these activities (e.g. construction vessel, supply vessel, security vessel) which through the burning of fuel will release exhaust gases.

All vessels used to support the project phases will be in compliance with the emission standards required by MARPOL Convention 73/78, IMO, and use a low sulfur fuel. Nevertheless, fuel consumption by the vessels used will still emit several pollutants, including nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), and sulfur oxides (SO_x).

As provided in the project description (see section 4.3.3; Volume I), the vessels to be used during these project phases will include one drillship, three platform supply vessels (PSV), two installation vessels, one multi-purpose vessel, and five tugs.

Air emissions from these vessels are expected to be similar or lower than the emission from all the other vessels that compose the regional marine traffic. As discussed in the marine traffic baseline section (see section 6.11; Volume I), the estimated baseline regional traffic for 2027 (when installation is expected to occur) is 605 vessels/year.

The project related vessel traffic during these initial phases will thus be a small fraction of the projected regional traffic. As such, while there will be a minor addition of Project vessels and associated air emissions during this phase, the addition to potential air quality impacts in the open ocean environment is not expected to be relevant, compared with the overall regional marine traffic.

Taking into consideration above, the Project's air quality impact during the drilling, installation, and commissioning phases is assessed as negative, direct, of medium-term duration (i.e., the total duration of these phases is currently estimated in 2.5 years), low intensity (small increase in emissions from vessel traffic), and local extent (limited to the drilling site and navigation corridor), resulting in a very low significance.

Mitigation Measures

Given the low significance of the pre-mitigated impact, no mitigation is required or recommended, beyond standard maintenance procedures of the vessels' engines and generators.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AQ1: Air quality impacts during the during the drilling, installation, and commissioning phases								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Medium-term	Very Low	Definite	VERY LOW	-ive	High
	1	1	2	4				
- Implement standard maintenance procedures of the project vessels' engines and generators.								
With mitigation	Local	Low	Medium-term	Very Low	Definite	VERY LOW	-ive	High
	1	1	2	3				

Impact AQ2: Air quality impacts during the start-up phase

Impact Assessment

The start-up phase will be the phase with highest emissions of air pollutants, due to the specific conditions of that first start-up, with highest occurrence of flaring events, when compared to normal operations. However, even for these worst-scenario conditions, the air quality dispersion modelling results indicate that the concentrations of the modelled pollutants (NO₂, SO₂, PM₁₀) on onshore areas will be very low and well below national and international air quality standards (roughly 5% of the standard, for NO₂, and even lower than that for the other pollutants - see Table 7.9 above and the maps in Annex IV.A; Volume IV).

As discussed above, modelled concentrations for the offshore area are also well below applicable standards, with the exception of the 1-hr NO₂ GLC, which exceeds the standards. However, this only occurs in offshore areas, near the FLNG, where there are no relevant receptors to airborne pollutants (i.e., populated areas or terrestrial ecosystems), and therefore, no environmental impacts are expected in these locations.

Taking into consideration the data provided above, the Project's air quality impact during the start-up phase is assessed as negative, direct, of short-term duration (i.e., start-up phase duration only), low intensity (no noticeable increase of COC levels on onshore populated areas), and local extent (even though impact is expected to exceed the concession area, potential effects are negligible and will be limited to few onshore receptors), resulting in a very low significance.

Mitigation Measures

Given the low significance of the pre-mitigated impact, no mitigation is required or recommended, beyond standard maintenance procedures of the combustion equipment, to maintain design emissions.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AQ2: Air quality impacts during the start-up phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very Low	Definite	VERY LOW	-‘ve	High
	1	1	1	3				
- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions.								
With mitigation	Local	Low	Short-term	Very Low	Definite	VERY LOW	-‘ve	High
	1	1	1	3				

Impact AQ3: Air quality impacts during the operational phase

Impact Assessment

During operations, the air quality dispersion modelling results indicate that concentrations of COC from operation emissions will be negligible (under 1% of the applicable air quality standards - see Table 7.9 above and the maps in Annex IV.B; Volume IV), on onshore locations where air quality sensitive receptors are located. Offshore concentrations, while higher, are still well below applicable standards (under 18% of the standards).

No relevant air quality impacts are thus expected on any air quality sensitive receptors. As such, the Project's air quality impact during the operational phase is assessed as negative, direct, of low intensity (no noticeable increase of COC levels on onshore populated areas), local extent (even though impact is expected to exceed the concession area, potential effects are negligible and will be limited to few onshore receptors), but of long-term duration (25-year project life), resulting in a low significance.

Mitigation Measures

Given the low significance of the pre-mitigated impact, no mitigation is required or recommended, beyond standard maintenance procedures of the combustion equipment, to maintain design emissions.

A monitoring program will be implemented, with annual surveys of both emissions and ambient air quality, to ensure that real emissions are not higher than expected and to confirm the modelling findings.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AQ3: Air quality impacts during the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				
- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions; - Annual monitoring survey of project emissions and ambient air quality. If the monitoring surveys detect either higher emissions than expected or relevant impacts on ambient air quality, the causes for those impacts will be investigated and relevant mitigation implemented, to be defined on a case by case, as part of an adaptive management process.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				

Impact AQ4: Air quality impacts during emergency/unplanned flaring

Impact Assessment

The Coral North FLNG will have a zero flaring policy, meaning that no flaring is expected during normal operating conditions. However, under certain emergency circumstances (malfunctions of

equipment or similar) unplanned flaring could occur. These unplanned flaring events will be of short duration (several hours) by nature.

The air quality dispersion modelling results for this scenario, however, indicate that resulting concentrations of COC will be negligible (under 2% of the applicable air quality standards - see Table 7.9 above and the maps in Annex IV.C; Volume IV), both on onshore locations, where air quality sensitive receptors are located, and offshore areas.

No relevant air quality impacts are thus expected on any air quality sensitive receptors. The Project's air quality impact for unplanned flaring events is assessed as negative, direct, of low intensity (no noticeable increase of COC levels on onshore populated areas), local extent (even though impact is expected to exceed the concession area, potential effects are negligible and will be limited to few onshore receptors), and short-term duration (emergency situation, envisaged to only occur for several hours each time), resulting in a very low significance.

Mitigation Measures

Given the low significance of the pre-mitigated impact, no mitigation is required or recommended, beyond standard maintenance procedures of the combustion equipment, to maintain design emissions.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AQ4: Air quality impacts during emergency/unplanned flaring								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very Low	Definite	VERY LOW	-‘ve	High
	1	1	1	3				
- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions.								
With mitigation	Local	Low	Short-term	Very Low	Definite	VERY LOW	-‘ve	High
	1	1	1	3				

Impact AQ5: Air quality impacts from the cumulative emissions of Coral South and Coral North FLNGs

Impact Assessment

As the Coral Sul FLNG is in operation in the offshore waters of Area 4, and the proposed Coral North FLNG will be located relatively close by (roughly 12 km away), the cumulative impact of the emissions from the simultaneous operation of both FLNGs has been modelled (see Table 7.9 above and the maps in Annex IV.D; Volume IV).

Modelling results indicate that the cumulative effect of the operation of both FLNGs will still be very low, with modelled concentrations of COC on onshore areas under 2% of the applicable air quality

standards, and thus with negligible effects. Offshore concentrations are expected to be higher, but still well below the applicable standards.

No relevant air quality cumulative impacts are thus expected on any air quality sensitive receptors. The cumulative air quality impact from Coral South and Coral North operations is assessed as negative, direct, of low intensity (no noticeable increase of COC levels on onshore populated areas), local extent (even though impact is expected to exceed the concession area, potential effects are negligible and will be limited to few onshore receptors), but of long-term duration (cumulative operations will likely be longer than 20 years), resulting in a low significance.

Mitigation Measures

Given the low significance of the pre-mitigated impact, no mitigation is required or recommended, beyond standard maintenance procedures of the combustion equipment, to maintain design emissions.

A monitoring program will be implemented, with annual surveys of both emissions and ambient air quality, to ensure that real emissions are not higher than expected and to confirm the modelling findings.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AQ5: Air quality impacts from the cumulative emissions of Coral South and Coral North FLNGs								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				
- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions; - Annual monitoring survey of project emissions and ambient air quality. If the monitoring surveys detect either higher emissions than expected or relevant impacts on ambient air quality, the causes for those impacts will be investigated and relevant mitigation implemented, to be defined on a case by case, as part of an adaptive management process.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				

7.3 Greenhouse Gases and Climate Change Risk Assessment

7.3.1 Greenhouse Gases Emissions

7.3.1.1 Project GHG Emissions

The Coral North FLNG will generate greenhouse gases (GHG) emissions throughout its life-cycle, namely:

- Drilling and installation phases: emissions during the drilling and installation phases of the project will primarily arise from the fuel use in the marine vessels involved in the subsea and

installation works. Smaller amounts of emissions will be associated with the helicopter flights for the offshore work crew changes;

- Operation phase: the various operational emission sources on the Coral North facility include:
 - 4 x Gas Turbine Generators (GTG);
 - 4 x Gas Turbine Compressors (GTC);
 - 1 x Carbon Dioxide (CO₂) Thermal Incinerator;
 - Flaring;
 - Intermittent diesel usage (i.e., during start-up prior to fuel gas availability, emergency diesel generators during Turnarounds (TARs) and for other short use items such as the Fire Water Pumps);
 - Fugitive emissions;
 - Fuel usage in the marine support/supply vessels.
- Decommissioning phase: similar to the installation phase, the decommissioning phase will be associated with use of marine vessels for the removal of the FLNG and crew change flights over the decommissioning period.

In order to support the Project's GHG emissions impact assessment, a GHG inventory and estimate has been generated for the Coral North FLNG and is provided in Annex III (Volume IV). The main findings of that estimate are provided in the following paragraphs, to support the impact assessment. Please see Annex III (Volume IV) for additional details, and for a breakdown on GHG emissions for each project phase.

Total project GHG emissions across all phases are anticipated to be around 26.5 MMt of CO_{2e}, with the operational phase accounting for circa 99.6% of the total. The remaining 0.4% (0.11 MMt CO_{2e}) is associated with drilling, installation, and decommissioning.

Table 7.10 summarises the contribution of each phase of the project to the overall GHG estimation.

Table 7.10: Lifetime Project GHG emissions summary

Phase	ktCO _{2e}
Drilling & Installation ^(a)	91.9
Commissioning & Operation	26,374.3
Decommissioning	22.8
Total Emissions	26,489.0

Note: ^(a) includes emissions from towing FLNG from shipyard to Mozambique.

Annual operational emissions during normal operation are estimated to be 992 ktCO_{2e}/y which increases to 1,037 ktCO_{2e}/y on years with scheduled turnaround (TAR). The relative contribution from the emissions sources during operation are shown in the figures below for years without TAR (Figure 7.1) and years with TAR (Figure 7.2). Both are quite similar, with the main differences being an increased contribution from flaring and diesel use contribution during TAR.

The primary source of emissions is the GTGs and GTCs which account for greater than 90% of GHG emissions from the facility.

Operational GHG Emissions (no TAR)
Relative Contribution

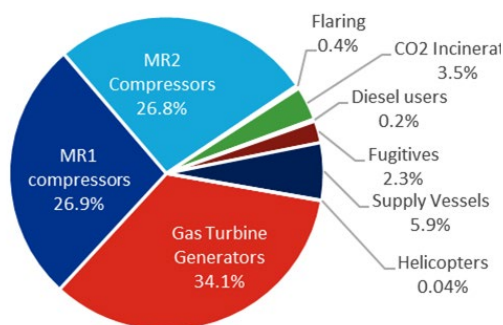


Figure 7.1: Source contribution – no TAR year

Operational GHG Emissions (with TAR)
Relative Contribution

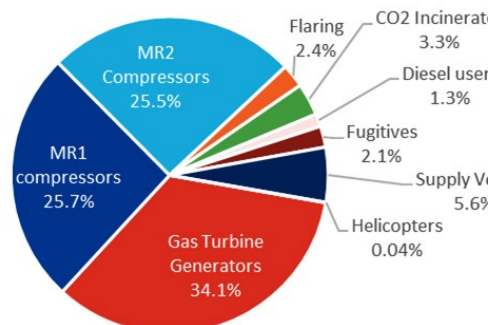


Figure 7.2: Source contribution – year with TAR

7.3.1.2 Comparison to National Emissions

The latest officially reported data from Mozambique is for 2020. The 2019 data has been used for comparison, over the 2020 data which is considered atypical of the region due to the downturn caused by the pandemic (see information on Mozambique's national emissions on the GHG baseline section – Volume I; section 6.3). Coral North's contribution has been given in the table below, compared first against the overall country GHG emissions for 2019 and then against the segregated energy sector emissions.

The highest emissions from the Coral North project are anticipated in the initial year, due to the one-off contribution from start-up activities. Emissions from this year were calculated to be approximately 2.2 MMtCO_{2e}, which corresponds to circa 2.1% of the national emission level. When comparing the energy sector specifically, the start-up of the project would result in an anticipated 21% increase on the sector's annual emissions.

During standard operational years, the annual emission level is significantly lower, ranging from 0.99 MMtCO_{2e} to 1.04 MMtCO_{2e} with the higher value corresponding to years with a TAR. In either case contribution to national emissions is just below 1% per year, or circa 10% relative to the energy sector's emissions.

Table 7.11: Contribution of Coral North GHG emissions to national emissions

Coral North Annual Emissions MMtCO _{2e}		Mozambique Emissions (2019) MMtCO _{2e}	Project Contribution to Mozambique	Energy Sector (2019) MMtCO _{2e}	Project Contribution to Sector
Year 1 (start-up)	2.2	106	2.1%	10.2	21%
Operation With TAR	1.04		1.0%		10%
Operation Without TAR	0.99		0.9%		9.6%

Project emissions are expected to remain relatively steady throughout project life. Given Mozambique's emissions are likely to continue to increase over time, the relative annual contribution from this project is anticipated to reduce year on year.

7.3.1.3 Impact Assessment

Impact GHG1: Project GHG emissions

Impact Assessment

As discussed in the previous sections, total project GHG emissions across all phases are anticipated to be around 26.5 MMt of CO_{2e}, with the operational phase accounting for circa 99.6% of the total. During standard operational years, annual emissions are estimated to range from 0.99 MMtCO_{2e} to 1.04 MMtCO_{2e}.

Based on the assessed phases of the project, the operational phase is considered the most impactful phase due to the higher level of emissions and prolonged duration compared to the drilling, installation, and decommissioning. Therefore, the operational phase is the focus of the impact assessment.

Annual Project emissions correspond to national emissions of just below 1% per year, or circa 10% relative to the energy sector's emissions, when compared with Mozambique's national emissions for 2019. Further, as project emissions are expected to remain relatively steady throughout project life, and Mozambique's emissions are likely to continue to increase over time, the relative annual contribution from this project is anticipated to reduce year on year.

Taking into consideration the data provided above, the Project's impact regarding GHG emissions is assessed as negative, direct, of long-term duration (i.e., during the expected operational life of the Coral North facility of 25 years), but of low intensity (as the GHG emissions from Coral North are not anticipated to directly result in any tangible impact on natural or social functions). In terms of the impact's extent, GHG emissions are less than 1% of Mozambique's yearly emissions, and thus the extent was classified as regional. Based on the above, the impact significance scoring has been evaluated as medium pre-mitigation.

Mitigation Measures

The reduction of the GHG emissions may be achieved through the implementation of best available technologies and processes able to improve the facilities' efficiency. As the Coral North FLNG is a replicate of the operating Coral South FLNG, the key mitigation measures have already been included in the design and operational features of the Coral North, as follows:

Energy Efficiency

- Design:
 - Aero-derivative type gas turbine for mechanical drive purpose (refrigerant compressors) and for power generation with higher thermal efficiency;
 - Main power generation is supplemented with power supplied from one process driven liquid turbine generator connected to the electrical distribution network at the

- 6.6 kV level. Total energy recovery is estimated at a maximum of 1.5 MWe during full production;
- Waste heat recovery - the installation of waste heat recovery units on the gas turbine exhaust stacks, to improve the waste heat utilisation;
 - Use of a combustor system technology to reduce NOx emission installed in all gas turbines;
 - Use of molecular sieves for gas dehydration which uses fuel gas for regeneration of molecular sieve beds and spent moist fuel gas is again sent back to the fuel gas system thus avoiding any flaring;
 - Use of boil-off gas in the facility as fuel rather than venting or flaring;
 - Transformer ratings selected to minimize losses by optimising ratings and thereby reducing the overall quantity of transformers; in addition to electrical requirements including switchgear fault levels and standardization considerations;
 - Low voltage motors are specified to meet the requirements of IEC IE2 high efficiency criteria.
- Maintenance - Implementation of frequent and/or preventative maintenance routines to avoid performance degradation due to fouling and component wear and tear; thereby reducing energy requirements. Performance based maintenance should also be considered where OEM assessment concludes this may be more beneficial than run-time scheduling.

Flare Reduction

- Zero flaring policy during normal operations;
- Development and implementation of plans for preventative maintenance and operational efficiencies to reduce need for flaring.

Minimise Fugitive Emissions through Design

- Fugitive loss prevention including boil-off gas (BOG) recovery, Leak, Detection and Repair Program (LDAR) system during operation, vapour emission control from condensate storage on the FLNG and during loading of condensate tankers;
- Low-leak seals on all equipment servicing pipelines carrying hydrocarbon components (i.e., LNG compressors and pump seals).

Monitoring and Continuous Improvement

- Implementation of a GHG monitoring and management plan to assess GHG emissions from the FLNG operation and link this data to technical workgroup tasked with identifying options to reduce emissions. GHG emissions monitoring will include the accounting of methane emissions. Project GHG emissions will be reported to the environmental authorities twice per year;
- Implementation of LDAR to reduce potential fugitive emissions from valves, flanges, seals, and connectors associated with LNG processing and storage emissions.

Impact Summary

The impact assessment summary is provided in the following table. Mitigations have been suggested which may result in GHG emission reduction benefits. However, the impact ranking is driven primarily by the duration (>15 years) and extent (regional); and as none of the key mitigations would significantly change either, the post-mitigation impact remains unchanged at medium.

Impact GHG1: Project GHG emissions								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	Low 1	Long term 3	Medium 6	Definite	MEDIUM	-ve	High
- Implementation of the best available technologies; - Implementation of preventative maintenance routines to avoid performance degradation; - Installation of waste heat recovery units; - Zero flaring policy during normal operations; - Preventative maintenance and operational efficiencies to reduce flaring; - Development and implementation of a GHG management plan to monitor and assess GHG emissions from the FLNG operation. GHG emissions monitoring will include the accounting of methane emissions. Project GHG emissions will be reported to the environmental authorities twice per year; - Project design to minimise fugitive emissions; - Plant design to guarantee energy efficient production; - LDAR program.								
With mitigation	Regional 2	Low 1	Long term 3	Medium 6	Definite	MEDIUM	-ve	High

7.3.2 Climate Change Risk Assessment

7.3.2.1 General Considerations

Climate change is placing increasing pressure on environmental and social assets; a trend that is projected to increase throughout this century. A Climate Change Risk Assessment (CCRA) was produced to understand the potential climate change threats to the Coral North FLNG Project. The aim was to determine to what extent the project's infrastructure and its surrounding natural environment is vulnerable to climate change, and to recommend adaptation actions to improve resilience, as applicable.

Projected climate changes which may impact the project include increases in air temperature, sea water temperature, rainfall, and storm frequency. These parameters have been assessed to determine the magnitude of risk they pose. Based on this, current and future physical risks to the project associated with climate change impacts are assessed.

7.3.2.2 Approach

Climate change physical risks

Physical risks are those risks resulting from climate change, which involve event driven (acute) or longer-term shifts (chronic) in climate patterns. Acute physical risks refer to those that are event-

driven, including increased severity of extreme weather events such as cyclones, hurricanes, or floods. Chronic physical risks refer to longer-term shifts in climate patterns such as sustained higher temperatures that may cause sea level rise or chronic heat waves (TCFD, 2017).

The following climate changes are considered to present the most significant physical risks to the FLNG (IPIECA; 2020):

- Increases in wind speeds;
- Increases in the magnitude and frequency of storms;
- Increases in ocean pH;
- Increases in ocean and air temperatures and humidity; and
- Increases in extreme rainfall events.

These potential increases may result in reduced output, damage to infrastructure, increased maintenance costs and reduced transport reliability.

Climate scenarios

As part of the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) (IPCC, 2023), five illustrative scenarios, within defined shared socioeconomic pathways (SSPs), were presented to cover a range of future emission scenarios. They are as follows:

- Very low GHG emission scenario (SSP1-1.9);
- Low GHG emission scenario (SSP1-2.6);
- Intermediate GHG emission scenario (SSP2-4.5);
- High GHG emission scenario (SSP3-7.0); and
- Very high GHG emission scenario (SSP5-8.5).

The emissions scenarios result in different 21st century outcomes for climate change parameters, e.g., for temperature. Projected temperature changes in the 2041-2060 time period are presented in Table 7.12.

Table 7.12: Increase in global mean surface temperature (from 1995 to 2014 reference point)

Emissions Scenario	2041-2060 increase in global mean surface temperature relative to 1995-2014 baseline, °C (likely range)
SSP1-1.9	0.8 (0.3 – 1.5)
SSP1-2.6	1.0 (0.6 – 1.6)
SSP2-4.5	1.3 (0.8 – 1.9)
SSP3-7.0	1.4 (0.9 – 2.3)
SSP5-8.5	1.7 (1.2 – 2.5)

To provide a balanced assessment, risks associated with the Intermediate (SSP2-4.5) and Very High (SSP5-8.5) emissions scenarios are addressed in this report.

Assessment periods

The project is anticipated to be operational between 2028 and 2053. Based on this the following risks have been assessed:

- Start of the operational life of the project in 2028, under climate conditions similar to the present day (baseline);
- End of the operational life of the project in 2053 under climate conditions resulting from the SSP2-4.5 emissions scenario (intermediate); and
- End of the operational life of the project in 2053 under climate conditions resulting from the SSP5-8.5 emissions scenario (very high).

Limitations

Climate projections are highly uncertain due to the complexity of global climate systems and the uncertainty of potential future GHG emission trends. The most likely outcomes for two emissions scenarios are presented to indicate some of the potential variability in projections. However, the inherent uncertainties associated with climate projections should be considered when interpreting results.

7.3.2.3 Future Climate Conditions

Introduction

As a result of rising GHG emissions, global temperatures are increasing and will continue to increase. Some of the likely impacts include:

- Rising sea levels;
- Changes in annual average precipitation, the seasonality of precipitation and the intensity of precipitation events;
- Increases in the frequency and intensity of droughts and heatwaves;
- Increases in the intensity and frequency of storms; and
- Changes to ocean circulation patterns.

Due to the complexity of the global climate system, climate change will have different impacts in different regions. This section focuses on site-specific climate changes which the project may be vulnerable to, as follows:

- Air temperature;
- Rainfall;
- Wind speed;
- Humidity;
- Sea temperature;
- Storms; and
- Ocean pH.

Site-specific climate observations are limited due to the site's offshore location in a relatively data scarce region. However, the IPCC's Interactive World Atlas (Gutierrez *et al.*, 2021), provides modelled current and future data for a range of climate variables globally at a high resolution. This dataset was generally used to illustrate future climate trends. Current climate and oceanographic characteristics at the Project site are provided in the baseline section (see sections 6.1 and 6.6 of Volume I) and are thus not repeated here.

Air temperature

Temperatures in Africa are projected to rise faster than the global average during the 21st Century (Niang *et al.*, 2014); however, due to the moderating influence of the sea, impacts at the project site will be less extreme than those observed on land (Gutierrez *et al.*, 2021). Under the SSP2-4.5 scenario, mean monthly temperatures are projected to increase by approximately 1°C by 2041-2060 and by up to 1.5°C under the SSP5 8.5 scenario. Projected increases in maximum temperature are similar to average temperature increases (Gutierrez *et al.*, 2021), with the maximum temperature under the SSP5-8.5 projected to be approximately 33°C.

Seawater temperature

Sea surface temperatures are projected to increase by approximately 1.0°C throughout the year under the SSP2-4.5 scenario (Gutierrez *et al.*, 2021). For the SSP5-8.5 emissions scenario, an increase of up to 1.4°C is projected.

Equipment has been designed to utilise sea water from 150 m below sea surface with a temperature between 19 °C – 27 °C. Future projected temperature changes 150 m below sea surface have not been determined; however, a similar decreasing trend with depth as observed currently is anticipated. Therefore, extracted sea water is expected to continue to comply with design temperature parameters at the end of the project life.

Humidity

Increases in future temperatures are likely to increase evaporation rates at the project site, increasing specific humidity. However, the impact on relative humidity is more uncertain, due to the greater capacity of hotter air to hold moisture. Site-specific data is not available; however, in general terms, ocean relative humidity is projected to remain relatively stable (Gutierrez *et al.*, 2021).

Rainfall

Globally, future precipitation changes are more uncertain than temperature changes. Across Mozambique in general, annual average rainfall is projected to remain fairly stable; however, the rain that falls during extreme events is projected to increase (McSweeney *et al.*, 2010).

At the project site under the SSP2 4.5 and SSP5-8.5 scenario, there is projected to be a minimal change to seasonal rainfall patterns and extreme rainfall events at the site; however, as observed globally, there is a high level of uncertainty (Gutierrez *et al.*, 2021). Potential increases in cyclone frequency and intensity may increase the risk of rare but extreme rainfall events.

Wind speed

Average wind speeds are projected to decrease globally. This is also projected at the site, with modelled wind speeds under a SSP5-8.5 scenario decreasing more than the SSP2-4.5. Changes are low (<5%) and highly uncertain.

Storms

Projections indicate that extreme storm events in general will become more frequent and intense, and their trajectories less predictable (Gutierrez *et al.*, 2021). It is uncertain if these changes will

impact the project area; however, cyclones which do impact the project area are likely to be more significant.

Ocean pH

As atmospheric CO₂ concentrations increase, more CO₂ will dissolve in water, causing acidification (lower pH) (Gutierrez *et al.*, 2021). Under the SSP2-4.5 and SSP5-8.5 emissions scenarios, pH values are set to decrease by 0.1 (Gutierrez *et al.*, 2021).

7.3.2.4 Risk Assessment

As defined by the TCFD¹, risks associated with air temperature, sea water temperature, rainfall, and storm frequency have been assessed based on the review of current and future climate conditions. Projections indicate that changes in humidity, wind speed and ocean pH will be minimal; therefore, these parameters have not been considered further.

Risk assessment method

The following steps set out the methodology used to assess the climate change risks associated with the project:

- Identification of potential physical climate-change-related vulnerabilities which may impact the project;
- Identification of key current and future climate conditions which may impact the project;
- Classification of present day (baseline) and future climate-related risks, based on the magnitude (consequence) and likeliness of an event occurring;
- Comparison of present-day and future risks to quantify climate-change related risks; and
- Discussion of adaptation measures.

Risk matrix and classification

Risks have been assessed and classified by considering both the consequence of an event occurring, and the likelihood the same event occurs.

Consequence is the outcome or degree of impact of an event. Likelihood describes the probability or frequency that a climate event will occur. In this study likelihoods were assigned based on consideration of historical occurrences and the level of confidence associated with the climate projections.

Table 7.13 provides the likelihood and consequence categories applied to Project site climate change risks. Table 7.14 provides the overall risk classification by applying these categories.

¹ <https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf>

Table 7.13: Likelihood and consequence categories applied to Project site climate change risks

			Consequence ²				
			1	2	3	4	5
Likelihood ³			Minor	Moderate	Major	Severe	Catastrophic
5 Almost Certain	More likely to occur than not, one or more a year	Greater than 90 % chance					
4 Likely	Significant chance of occurring, < once in 5 years	Between 60% and 90% chance					
3 Possible	Will probably occur < once in 10 years	Between 40% and 60% chance					
2 Unlikely	Unlikely to occur < once in 15 years	Between 10% and 40% chance					
1 Rare	May occur in exceptional circumstances < once in 20 years	Less than 10 % chance					

Table 7.14: Risk categories

R5	Extreme Risk	Immediate controls required
R4	High Risk	High priority control measures required
R3	Moderate Risk	Some controls required to reduce risks to lower levels
R2	Low Risk	Controls not likely required
R1	Negligible Risk	Scenarios do not require further consideration

Source: Black *et al.* (2010).

² Queensland Climate Change Centre of Excellence, 2011 <https://data.longpaddock.qld.gov.au/static/products/pdf/climateatrixworkbook.pdf>

³ Source ISO 31000, 2009: Risk management-principles and guidelines

Table 7.15: Definitions of the potential consequences

	Consequence				
	1	2	3	4	5
	Minor	Moderate	Major	Severe	Catastrophic
Profitability and Growth	The business is profitable, and growth is achieved but they both fail to meet expectations	The business would only be marginally profitable with growth stagnant	The business would be unprofitable and contract and require significant remedial action to remain viable	Business would be unprofitable and contract markedly and would likely become unviable even with significant remedial action	Business would be unprofitable and contract markedly making it unviable. Business would have to be wound up.
Safety	Minor injury / Near miss / Negligible	Lost time injury / HSE Letter of Concern	Major injury, reportable to regulators	Fatality / HSE Enforcement notice	Multiple fatality / HSE Enforcement notice
Supply chain and Market	Isolated difficulties would arise in the supply chain and market but would be resolved	Components of the supply chain and market would require more than normal levels of management attention to protect the business	Major disruption of a key source of supply or market having a significant effect on the business.	Severe disruption of a key source of supply or market having a serious effect on the business	Loss of a key source of supply or market threatening the business
Reputation	Negligible	Local press, low running order. Actions criticised in forums	Industry press. Negative reaction in national forums, supported by Regulator	Local TV / digital media or low running order in press. Reputation impacted, minor reduction in value of company	National/International media, TV / newspapers. Failure to address breach of license. Company reputation impacted, significant drop in value of company
Environment	Minor instances of environmental damage that could be reversed	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Major, semi- permanent loss of environmental amenity and danger of continuing environmental damage	Severe, semi-permanent and widespread loss of environmental amenity and likelihood of irrecoverable environmental damage	Extreme, permanent, and widespread loss of environmental amenity and progressive irrecoverable environmental damage

Physical risks

The following physical risks were identified by assessing the FLNG design with consideration for the climate variables relevant to the area:

- Heat-related failure of above water equipment and infrastructure (PR1);
- Heat-related deterioration of above water equipment and infrastructure (PR2);
- Power generation and availability for process cooling (PR3);
- Temperature effects on the health and productivity of workforce (PR4);
- Energy demand for air conditioning (PR5);
- Heat-related deterioration of below-water equipment and infrastructure (PR6);
- Heat-sensitive environmental receptors (PR7);
- Sea water for LNG cooling (PR8);
- Water-related failure of equipment and infrastructure (PR9);
- Water-related deterioration of above water equipment and infrastructure (PR10);
- Effect of extreme rainfall on health and productivity of workforce (PR11);
- Extreme winds-related failure of equipment and infrastructure (PR12);
- Extreme winds-related deterioration of infrastructure and equipment (PR13);
- Effects of extreme winds on supply operations supporting (PR14);
- Effects of extreme winds on the health and productivity of workforce (PR15);
- Extreme winds causing spills which impact the marine environment (PR16).

Full risk assessment tables for physical risks to Project site are provided in Annex VIII (see Volume IV), presenting consequence and likelihood. Risks have been quantified for the conditions representative of the present day (baseline) and for the 2041-2060 IPCC assessment period to cover the 2053 operational Project end date. The 2041-2060 period has been assessed for both low to intermediate (SSP2-4.5) and high (SSP5-8.5) emissions scenarios. A summary of results for current and projected physical risks is provided below.

Physical risks associated with the baseline period are provided for comparison with Project end risks to assess differences in climate-related risks.

Table 7.16: Physical risk ratings per climate variable (baseline)

Climate Variable	Risk Level				
	Negligible	Low	Moderate	High	Extreme
Air temperature	PR1, PR2, PR3, PR5	PR4			
Sea water temperature	PR6, PR7, PR8				
Rainfall		PR9, PR10, PR11			
Storm events		PR12, PR13, PR14, PR15, PR16			

Table 7.17: Physical risk ratings per climate variable. 2041-2060 low to intermediate emissions scenario (SSP2-4.5)

Climate Variable	Risk Level				
	Negligible	Low	Moderate	High	Extreme
Air temperature	PR1, PR2	PR3, PR4, PR5			
Sea water temperature	PR6, PR7	PR8			
Rainfall		PR9, PR10, PR11			
Storm events		PR12, PR13, PR14, PR15, PR16			

Table 7.18: Risk ratings per climate variable. 2041-2060 high emissions scenario (SSP5-8.5)

Climate Variable	Risk Level				
	Negligible	Low	Moderate	High	Extreme
Air temperature	PR1, PR2	PR3, PR4, PR5			
Sea water temperature	PR6, PR7	PR8			
Rainfall		PR9, PR10, PR11			
Storm events		PR12, PR13, PR14, PR15, PR16			

Discussion

This section discusses some of the key findings of the physical risk assessment.

Air temperature

Air temperature-related risks to operational performance (PR1 – PR5) are considered to be low or negligible under current conditions. Temperatures (and associated humidity) are consistently high although predictable, and the magnitude and frequency of extreme temperature events is low.

There is high confidence that average and extreme temperatures will increase throughout the project's operational life; however, due to the project site's offshore location temperatures will be moderated by the surrounding ocean. Equipment is typically designed and manufactured to international standards (IEC, -20 °C to +40 °C) and will operate safely in those anticipated under the high, SSP5-8.5 Scenario. The classification of risk items PR3 and PR5 change during the project life; however, they are still Low (previously Negligible). The increase in risks is associated with increased cooling requirements and subsequent increased power requirements for process cooling and air conditioning associated with consistently higher air temperatures.

Seawater temperature

Sea temperature-related risks to operational performance (PR6 – PR8) are considered to be low or negligible under current conditions. Temperatures are consistently high although predictable.

There is high confidence that sea water temperatures will increase throughout the project's operational life. However, equipment has been designed to operate with sea water from 150 m below sea level at 19° – 27°C and will operate safely in temperatures anticipated under the high, SSP5-8.5 Scenario.

Due to the high likelihood of sea temperatures increasing under the SSP2-4.5 and SSP5-8.5 scenarios, likelihood of climate-related impacts to marine environmental receptors increases, though the overall risk classification remains negligible.

Risks associated with PR6 remain negligible.

Rainfall

Rainfall-related risks to operational performance (PR9 – PR11) are considered to be low under current conditions, with rainfall unlikely to cause damage to equipment and infrastructure. Onshore, the high rainfall experienced may cause flooding; however, drainage infrastructure associated with the facility is considered to prevent any water accumulations.

Under the SSP2-4.5 and SSP5-8.5 scenarios, there are no significant changes to rainfall therefore risks remain the same.

Storm frequency and/or intensity

Storm-related risks to operational performance (PR12 – PR16) are low. Cyclones have not been experienced in recent years at the project site, with the nearest cyclone in recent years, Kenneth, tracking 100 km to the south of the project site. Coral North is designed to withstand winds associated with a 10,000 year return period cyclone event (Eni, 2023).

The impact of climate change on storm frequency and intensity at the project site is highly uncertain; however, globally, storm frequency is projected to increase. The risk score for PR16 (extreme winds causing spills which impact the marine environment) increases due to increased likelihood of a spill; however, the overall risk classification remains low. The risk classification for all other storm-related physical risks remains the same throughout the project life.

Summary

Current and future physical risks to the project associated with climate change impacts have all been assessed as low or negligible.

7.3.2.5 Climate Change Adaptation

Current and future physical risks to the project are considered negligible or low therefore mitigation against physical risks is not essential. However, increased temperatures will almost certainly increase the project site's cooling requirements. It is recommended that future cooling demands are fully quantified and efficiency is maximised for future profitability.

7.4 Atmospheric Noise

7.4.1 Construction Phase

7.4.1.1 Impact-Generating Activities

The only Project activities with relevant potential onshore atmospheric noise impacts are those related construction activities at the onshore logistics base. It was assumed that the onshore base used to support the offshore activities will be an upgrade to the current Eni Rovuma Basin (ERB) base.

The upgrade of the onshore logistics will likely include a set of civil works activities associated with the facility erection and associated infrastructures. Examples of construction activities include earthworks, foundations, erection of metallic structures, electric installation, equipment installation, paving, etc., as well as machinery operation and vehicle traffic. Civil works are expected to involve the use of common construction equipment such as excavators, front-end loaders, cranes, trucks, and other types of mobile and non-mobile equipment that will operate within the construction site.

All these construction activities and equipment operation both result in temporary noise emissions with potential adverse impacts on local noise sensitive receptors. These impacts are evaluated in the following section.

7.4.1.2 Impact Assessment – Construction Phase

Impact AN1: Noise impacts from general land-based construction activities

Impact Assessment

As stated in the previous section, construction activities and equipment operation during the required upgrade to the onshore logistics base will generate temporary noise emissions, with potential noise impacts at nearby noise sensitive receptors.

Noisy activities are expected to be performed only a fraction of the total construction time, which is estimated to take less than a year.

It is expected that the majority of Project activities will take place within the current onshore base area, in Pemba peri-urban zone, a location where commercial and industrial uses are predominant. Noise sensitive areas can be found in the onshore base area of influence; however, at more than 300 meters from the Project site (see baseline, section 6.3.5; Volume I). Additional Project activities and noise sources such as traffic associated with the transportation of materials and equipment will arise through the daily traffic to and from the construction site.

The assessment of noise impacts during the construction phase is carried out considering the land use of the construction site's surroundings and the typical noise levels associated with the planned construction equipment. Noise produced during the construction phase may sometimes reach high levels close to the primary noise-generating sources, namely machinery, vehicles, and other noise-emitting equipment. The noise emission levels produced during the construction activities will depend on several factors such as the typology and number of equipment involved in a specific activity and the working regimes.

The propagation of the sound energy coming from construction activities as a function of distance is performed in spherical geometry. Noisy equipment radiates spherical sound waves thus that the decay of sound energy is inversely proportional to the square of the distance, that is, it decreases by 6 dB when doubling the distance to the emitting source. The following formula is applicable for calculating noise propagation from point sources, such as the ones expected for the construction phase:

$$L_{p2} = L_{p1} - 20 \log \left(\frac{r_2}{r_1} \right)$$

In addition to the distance related attenuation, other mechanisms must be considered, such as the barrier effect produced by existing obstacles (walls, buildings), the type of terrain (morphology and vegetation cover), the effect of prevailing winds, temperature variations and atmospheric turbulence.

The combination of all these factors, both from the source and the propagation sides, contributes to the increase or to the attenuation of noise levels that may be perceived by a given sensitive receptor located at a certain distance from the construction site.

Due to all these contributing factors, the prediction of noise levels in the construction phase usually involves a significant degree of variability that makes a quantified and accurate prediction very difficult.

The following equipment is typically used in a warehouse construction:

- Site preparation: grader, dozer, tractor;
- Grading: grader, dozer, tractor;
- Building construction: crane, man lift, generator, tractor, welder;
- Architectural coatings: compressor.

Most of this equipment will be moved to site and remain on site for the entire duration of the construction phase.

Table 7.19 lists the average noise levels noticed at varying distances from typical construction equipment. The predominant sources of construction equipment noise are associated with internal combustion engines and impacting equipment. This table also provides a typical maximum A-weighted (dB(A)) Sound Pressure Level (SPL) for each type of noise source and their perception at different distances from source.

Table 7.19: Typical sound levels from commonly used construction equipment

Construction Equipment	Operating noise level at given distance considering potential maximum noise levels											
	Max SPL (dB(A))	5m	10m	20m	50m	100m	150m	200m	300m	500m	750m	1000m
Backhoe	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7
Compactor (ground)	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7
Compressor (air)	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7
Concrete Truck Mixer	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7

Construction Equipment	Operating noise level at given distance considering potential maximum noise levels											
	Max SPL (dB(A))	5m	10m	20m	50m	100m	150m	200m	300m	500m	750m	1000m
Mobile Crane	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7
Dozer	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7
Drum Mixer	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7
Dump Truck	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7
Excavator	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7
Flat Bed Truck	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7
Generator(>25KVA)	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7
Generator (<25KVA)	104.7	79.7	73.7	67.6	59.7	53.7	50.1	47.6	44.1	39.7	36.2	33.7
Grader	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7
Jackhammer	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7
Mounted Impact Hammer	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7
Slurry Trenching Machine	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7
Vibratory Concrete Mixer	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7
Welder/Torch	107.7	82.7	76.7	70.6	62.7	56.7	53.1	50.6	47.1	42.7	39.2	36.7

Source: FWHA (2006).

The table above shows that dozers and front-end loaders working simultaneous do generate sound levels of respectively 74.7 dB(A) and 69.7 dBA(A) at 50 m. These levels drop to 62.6 dB(A) and 57.6 dB(A) at 200 m and just below 55 dB(A) at approximately 500 m. It must be noted, however, that these noise levels refer to sound propagation in free space, i.e., without the consideration of obstacles to sound propagation, and to a continuous operation at full power for fixed equipment, or to the recorded level when the vehicle passes by at the indicated distance for mobile sources, hence the results may be regarded as an overestimation.

Noise levels are estimated and illustrated in Figure 7.3, representing the construction noise generation in a typical construction site, with a grid of equidistant receptors located at 100, 200, and 300 m from the noise source. This example considers the operation of several typical construction equipment including a dozer, a front-end excavator working simultaneous in the same area.

Considering a free surface (free of obstacle to noise propagation) and a medium absorbing terrain, the noise levels at 300 m are estimated to vary between a minimum of 54.2 dB(A) up to a maximum of 55.1 dB(A).

Therefore, it is to be expected that any sensitive receptors closer than 300 m from the construction site will experience an increase of the ambient noise levels (when compared to the baseline), with estimated ambient noise levels slightly above the 55 dB(A) guideline.

Both International Finance Corporation (IFC) and World Health Organization (WHO) guidelines associate an ambient noise level of 55 dB(A) as the threshold for annoyance effects on sensitive receptors (residential, institutional, and educational areas). As no sensitive receptors are closer than 300 m from the onshore base to be upgraded, no significant noise impacts are expected.

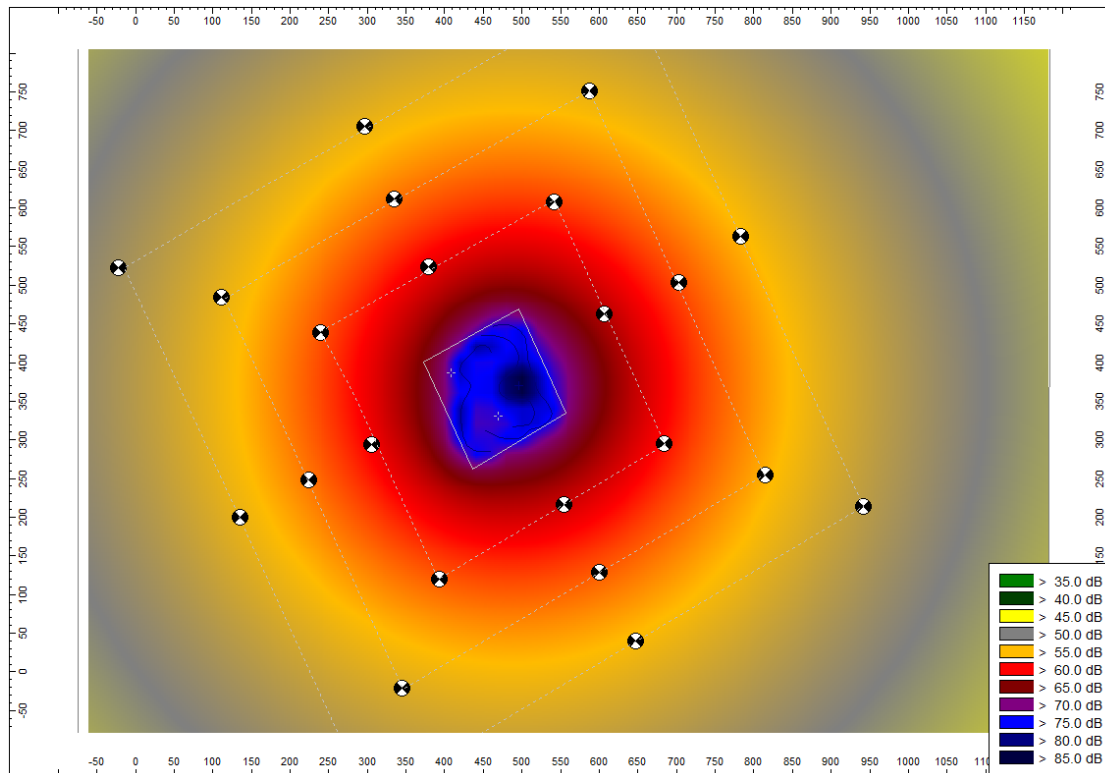


Figure 7.3: 2D view of the propagation of noise from a typical construction site

The potential noise impact from the onshore upgrade construction phase on nearby sensitive receptors without considering other attenuations effects is thus assessed as negative, local extent, medium intensity, and short-term duration, resulting in a very low significance.

Mitigation Measures

Despite the low significance of the expected noise impacts, standard good environmental practices during construction activities should be observed by the contractors to reduce the noise, as much as feasible possibly including the following:

- Operate earth moving equipment within specification and capacity (e.g., ensure machines are not overloaded). Use noise abatement accessories such as sound hood and mufflers where feasible;
- Use intake and exhaust silencers in all internal combustion powered equipment, ensuring that equipment has good quality mufflers installed;
- Specific access routes should be chosen for the transport of materials and equipment to avoid passing through inhabited areas, as much as feasibly possible;
- The noisiest construction operations (including earthworks and the transport of materials), should only take place on working days, during daytime hours;
- Maintain all mechanical equipment on a regular basis, replace worn parts, and lubricate as required;
- All equipment fitted with combustion engines should be regularly inspected to check their operating conditions (periodic maintenance), to minimize increased noise emissions resulting from poor operating conditions;

- Residents living near the area where the construction work is being carried out must be informed of the construction activities by the contractor and site supervisors. The information must include the start of the construction work, operating regime, duration, and must also include information about the Project and its objectives.

Impact Summary

The impact assessment summary is provided in the following table.

Impact AN1: Noise impacts from general land-based construction activities								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Short term	Very Low	Probable	VERY LOW	-‘ve	High
	1	2	1	4				
- Operate earth moving equipment within specification and capacity (e.g., ensure machines are not overloaded). Use noise abatement accessories such as sound hood and mufflers where feasible; - Use intake and exhaust silencers in all internal combustion powered equipment, ensuring that equipment have good quality mufflers installed; - Specific access routes should be chosen for the transport of materials and equipment to avoid passing through inhabited areas, as much as feasibly possible; - The noisiest construction operations (including earthworks and the transport of materials), should only take place on working days, during daytime hours; - Maintain all mechanical equipment on a regular basis, replace worn parts and lubricate as required; - All equipment fitted with combustion engines should be regularly inspected to check their operating conditions (periodic maintenance), to minimize increased noise emissions resulting from poor operating conditions. - Residents living near the area where the construction work is being carried out must be informed of the occurrence of construction activities by the contractor and site supervisors.								
With mitigation	Local	Low	Short term	Very Low	Probable	VERY LOW	-‘ve	High
	1	1	1	3				

7.4.2 Operational Phase

7.4.2.1 Impact-Generating Activities

Onshore project activities in Pemba are aimed to support the Coral North FLNG and include i) maintenance, fabrication, storage, logistics, administration, training, monitoring, etc., in the logistic base (warehouse); ii) vessel berthing, loading and unloading of materials and equipment at Pemba port marine quay; iii) helicopter services, at Pemba airport, that will be used to personnel transportation to and from the FLNG and for medical evacuation.

The expected port (ii) and airport (iii) activities are of the exact same type as the ones deriving from the Coral South FLNG and will be performed in the same facilities. The additional noise impacts from the Coral North Project specific activities in these areas are considered minimal, thus they will not be further developed.

The only operational Project activities that can generate atmospheric noise impacts are the ones associated with the operation of the logistic base in Pemba. The potential noise impacts associated with this base are evaluated in the following sections, based on:

- An inventory of the potential noise emissions generated by the base operation, including activities in the base itself and the noise from road traffic generated by the base;
- The implementation of a noise prediction model, to estimate the propagation of the noise generated by the base operation and its potential impact on nearby sensitive receptors.

7.4.2.2 Noise Emissions from the Operation of the Onshore Logistics Base

Warehouse noise sources

Noise generation during the operation of the warehouse is likely to fall in the category of intermittent noise emissions. The produced noise is anticipated to be low intensity (inside and outside of the warehouse) although sometimes it may be perceptible from the outside, depending on the activity being performed.

Truck traffic to and from the warehouse and the use of handling equipment such as mobile cranes and forklifts are anticipated to be the main although discontinuous noise sources. Loading and unloading of goods inside the warehouse and maintenance activities are other anticipated minor sources.

The warehouse is assumed to operate during the daytime period. Overall noise levels are expected to remain constant during the Project's lifetime. Barriers to noise propagation include the surrounding terrain, ground absorption, atmospheric absorption, and the main structural buildings such as the office building and the warehouse buildings.

Table 7.20 below lists the major noise sources associated with the warehouse operations.

Table 7.20: Major noise sources expected in the future warehouse

Noise Sources	Sound Power Level (LWA dB)	Source
Mobile Crane	95	BS 5228-1 :2009 +A1:2014
Forklift	100	BS 5228-1 :2009 +A1:2014
Heavy Duty Vehicles (5 +5 Vehicles/day)	81	BS 5228-1 :2009 +A1:2014
EN1 vicinity traffic Noise (light and heavy)	77.6	CadnaA / NMPB08 'Road Traffic Noise Prediction (NMPB-Routes-2008)

Traffic noise

N1 baseline traffic survey

To evaluate the noise impact of the vehicle movements into the warehouse, a baseline was established to compare against. The most applicable source of road traffic data was a seven-day traffic survey conducted on the N1 (CargoFrete, 2017). N1 is the major road leading into Pemba and through the city towards the Port. The proportion of traffic, by vehicle type, is shown in the table below.

Table 7.21: N1 road traffic composition by vehicle type

Vehicle Type	Proportion of traffic
Light vehicle	26%
Four Wheel Drive	28%
Mini-bus taxi	28%
Small Truck	17%
Heavy Truck	1%

Source: CargoFrete (2017).

The average weekday and maximum traffic by time of day are shown in Table 7.22. For the average weekday, the busiest (or peak) times are at midday and in the afternoon between 15h00 and 17h00. The maximum traffic recorded shows the same trend, with the busiest hour showing an estimated 226 vehicles per hour with an average of 1671 vehicles per day.

Table 7.22: Average weekday and maximum traffic per survey time slot

Time of Day	5-6	6-7	7-8	8-10	10-12	12-13	13-14	14-15	15-17	17-18	18-20	20-22
Average weekday traffic /hr	88	91	91	96	99	131	94	104	122	91	88	85
Maximum traffic/hr	128	106	116	122	140	226	124	134	210	124	116	132

Source: CargoFrete (2017).

Considering this is roughly four cars per minute, it can be concluded that the N1 in Pemba is not a very busy road and with the right controls in place, it should not become congested often.

Current N1 traffic estimates

With the operation of the Coral South Project an increase of an average of 31 to a maximum of 56 vehicles per day has been estimated (Consultec & PRDW, 2021). This represents a current total volume of 1727 vehicles per day (considering the maximum of 56 vehicles per day from Coral South Project) or an increase of 3% from the 2017 baseline traffic.

Future N1 traffic estimates

Extrapolating the above numbers to the future Coral North FLNG operation and considering that road traffic will experience a similar increase as from the Coral South Project (i.e., additional 56 vehicles per day), it can conservatively be assumed a maximum average daily traffic of 1783 vehicles per day, with 54% being of light and 4-wheel drives and 46% of small and heavy truck passing through the N1 Road (assuming the same distribution as stated in Table 7.21).

The amount of noise generated by the three percent traffic increase, and the way it may be perceived by the sensitive noise receptors around the future warehouse was modelled using CadnaA prediction software and compared with the baseline situation.

7.4.2.3 Assessment Criteria

The specific noise provisions established by WHO and IFC have been adopted as assessment criteria. As the onshore component of the proposed Project is located in an area with mixed industrial

and/or commercial uses and residential areas, the WB and IFC 70 dB(A) day-time one hour noise guideline applies.

In addition to the above-mentioned criteria, the South African Standard (SANS 10103:2008) provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise.

Table 7.23: Categories of community and/or group response

Excess of $L_{Req,T}^{(1)}$ (dBA)	Estimated response	
	Response category	Description
0	None	No observed reaction
$0 < \Delta L_r < 3$	None to Little	Change slightly noticeable
$0 < \Delta L_r < 10$	Little	Sporadic complaints
$5 < \Delta L_r < 15$	Medium	Widespread complaints
$10 < \Delta L_r < 20$	Strong	Threats of community/group action

Source: South African Standard (SANS 10103:2008; table 5). Note: ⁽¹⁾ Expected increase of ambient noise in an area due to a proposed development.

It must be noted that the overlapping ranges of community responses reflect that there is no clear-cut transition from one community response to another.

7.4.2.4 Noise Modelling

Modelling approach

CadnaA is a noise modelling software developed by the company DataKustic, GmbH and is widely used by acoustic modelling specialists for different types of projects and studies. CadnaA is a noise exposure calculation, presentation, assessment, and prediction software. The program runs mathematical algorithms that calculate the noise emitted by industrial plants, sports or recreational facilities, transportation infrastructure, such as roads, railways or any other facility that is likely to generate noise. The ambient (outdoor terrestrial) noise propagation model is based on the ISO 9613, Part 1: Calculation of the absorption of sound by the atmosphere and Part 2: General method of calculation (ISO 9613-2).

Major and potential noise source's locations have been determined, from both aerial photos, and through a site visit to the ERB warehouse and logistic base. For the noise modelling, the atmospheric conditions were assumed as 20°C and 70% relative humidity. The ground absorption coefficient was conservatively set to $G=0.50$, which corresponds to a moderately sound absorbing ground. Topographic information was imported into the noise model from data provided in electronic format (Digital Elevation Model) and converted in ground contour lines. The barrier effects of the buildings were also included. No other barriers, except those associated with the warehouse buildings, have been incorporated in the model. Noise emissions at the receptor's locations were considered at 2.0 m height. The inputs to the model included the project's baseline info and traffic data as represented in table and figure below.

The inputs to the model included also other project's baseline engineering data assumptions as listed in Table 7.24 below.

Table 7.24: Noise modelling calculation parameters and assumptions

Modelling Software	CadnaA (Computer Aided Noise Abatement) Version 2023
Calculation algorithm	ISO 9613 -2, Attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of source recommended by the European Union.
Orographic terrain modelling and input of buildings with sensitive uses	Based on the available engineering design layout, aerial photography, field surveys and DTM digital terrain data SRTM Worldwide Elevation data.
Terrain characteristics	Moderately sound absorbent G=0.50
Meteorological conditions	20° C and 70% Humidity conditions with prevailing winds directions included in the model
Calculation grid and sound reflection phenomena associated with obstacles to propagation	Calculation grid: 20m x 20 m; N.º of reflections: 1 Receptor Height ~2.0m
Modelling Scenario	Coral North Warehouse Operation in Pemba
Modelling Area	1,600 m X 2,600 m = 4,160,000 m ² encompassing the project's surrounding closest noise sensitive receptors. Noise contours prediction at 2.0 m height from soil-level.

Figure 7.4 illustrates the 2D conceptual model applied to predict the noise emissions of the Future Coral North warehouse facility using CadnaA.

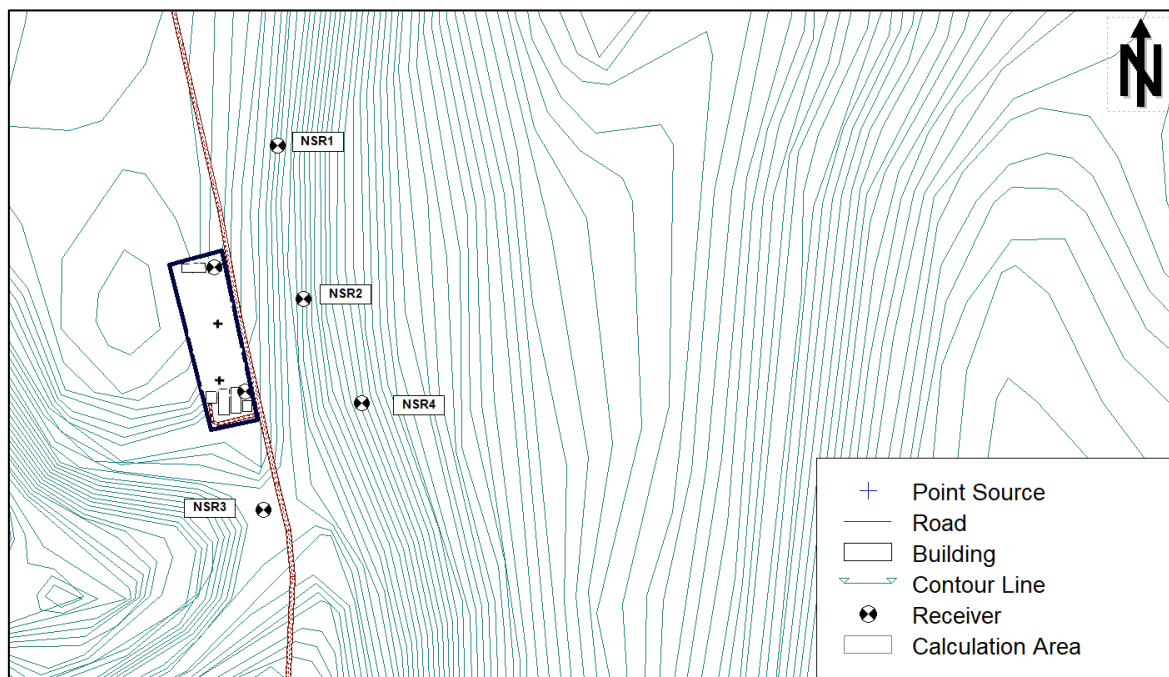


Figure 7.4: 2D conceptual model

Modelled scenarios

Two main residential areas were identified, both located along the N1 road, one located east of N1 and a second one located south of the ERB warehouse (see Volume I; section 6.4.5). These

residential areas may be marginally affected by the increase of noise levels from the induced traffic in the N1, and this was also included in the noise simulations and assessment. The increase in noise and its consequent impact at the closest noise sensitive receptors is determined by comparing the differential between the noise levels produced by the current traffic patterns (SC1 baseline scenario) and the expected future traffic increase with the Coral North Project (SC2 scenario).

Additionally, the expected impacts of the N1 traffic increase combined with the future warehouse operation (truck traffic, handling operations with the use of mobile crane and forklift) were also modelled (SC3 scenario).

As a result of the implementation of the proposed project, off-site traffic volumes on surrounding roadways will have the potential to increase. The Coral North Project will generate an additional net increase of 56 daily passenger car equivalent. Based on the estimated data, a total average daily traffic of 1783 vehicles is to be expected on N1 Road. The following algorithm was used to have a first approach the potential impacts of the project, expressed in Change of Traffic Noise Level (CTNL):

$$\text{CTNL} = 10X \text{ Log}_{10} [V_{e+p} / V_{\text{existing}}]$$

V_{existing} = existing daily volumes

V_{e+p} = existing daily volumes plus project

Change in CTNL = increase in noise level due to the project

Using a conservative assumption of an actual average daily traffic of 1731 vehicles (current traffic), the results of the calculations show an increase of approximately 0.14 dB(A). CTNL is expected along the roads adjacent to the warehouse site. A noise level increase of less than 1 dB(A) will not be perceptible to the human ear; therefore, the traffic noise increase in the vicinity of the warehouse resulting from the project operation would be insignificant. The specific route considered in this noise assessment is the one represented in red, along the N1 main roadway, in Figure 7.5.



Source: Aerial photo provided by Google Earth (2023)

Figure 7.5: Road traffic main route

Modelling results

SC1: Baseline scenario

N1 is a route where the daily circulation of both light and heavy-duty vehicles already contributes to some degree of traffic noise, which is mostly perceived along the immediate vicinity of this roadway. For the traffic baseline characterization, data from a traffic count consisting of a seven-day traffic survey conducted on the N1 (CargoFrete, 2017). This traffic count also included the count of both light and heavy-duty vehicles routing along the N1 road (Table 7.21 and Table 7.22).

With the current operation of the Coral South Project and associated FLNG onshore logistics operations in Pemba, an increase of a maximum of 56 vehicles/day along the N1 has been considered. This represents a total volume of 1727 vehicles/day or an increase of 3% from the 2017 baseline traffic survey, i.e., prior to Coral South operations (Consultec & PRDW, 2021).

Figure 7.6 illustrates the traffic noise contour lines induced by the current roadway traffic (baseline situation, including Coral South operations) considering the daily traffic volume as presented above. The noise levels perceived by the noise sensitive receptors located along the pathway of the N1 main roadway is presented and further evaluated below.

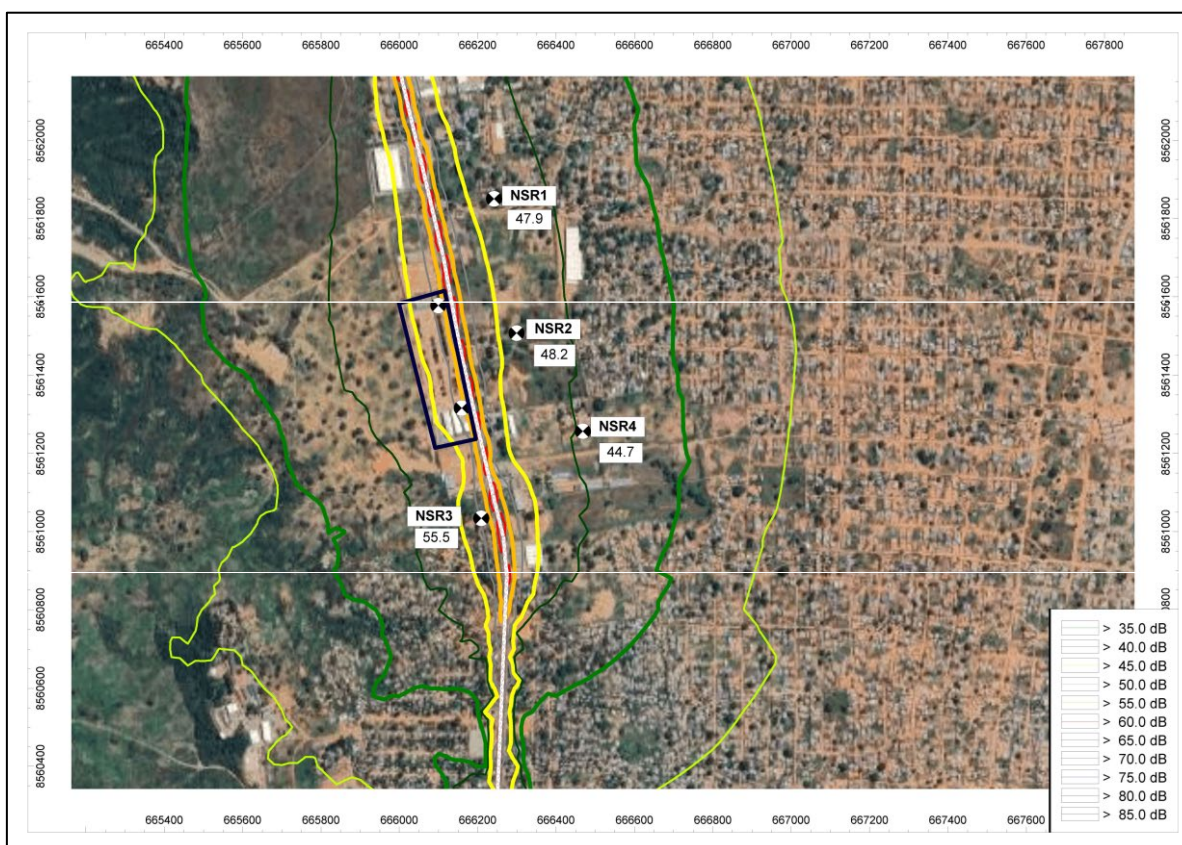


Figure 7.6: Predicted traffic noise levels along the local road network (SC1 baseline scenario; existing traffic)

Table 7.25 presents the estimated daytime noise levels induced by the actual vehicular activity at several noise sensitive receptors (NSR) for this baseline assessment scenario.

Table 7.25: Predicted noise levels at the NSR (SC1 baseline scenario; existing traffic)

Noise levels baseline (dB(A))		Current Noise Level (Lr)	Noise Type	Coordinates			
NSR Name	ID			Height	X	Y	Z
		(dBA)		(m)	(m)	(m)	(m)
NSR1	1	47.9	Total	2.00	666241.75	8561850.53	92.59
NSR2	2	48.2	Total	2.00	666299.45	8561506.92	87.57
NSR3	3	55.5	Total	2.00	666209.11	8561034.04	91.20
NSR4	4	44.7	Total	2.00	666468.08	8561257.09	78.52
Office Building	5	57.0	Total	2.00	666099.55	8561577.12	99.64
Warehouse building	6	57.7	Total	2.00	666159.22	8561316.08	95.91

As can be observed, only NSR3, located just South of the warehouse, and in the immediate vicinity of the N1 roadway, is expected to experience noise levels slightly above 55 dB(A) due to current traffic noise. All the other modelled locations were below the 55 dB(A) guideline limit as recommended by both the IFC and WHO guidelines for residential areas.

For the office and warehouse buildings, the model returned higher noise levels, ranging between 57.0 dB(A) up to 57.5 dB(A), both below the reference guideline for industrial areas use (70 dB(A)).

SC2: N1 traffic increase scenario

The SC2 modelling scenario considered the increase of traffic due to the projected future Coral North Project operations. Similar to Coral South, this scenario covers an increase of an additional 56 vehicles per day following the N1 main roadway as indicated in the noise prediction map below (Figure 7.7). This traffic volume was added to the traffic counts of the baseline situation for modelling purposes, assuming a conservative or worst-case- scenario. Figure 7.7 below illustrates the traffic noise contour lines generated by this increase of traffic volume on the N1.



Figure 7.7: Predicted traffic noise levels along the local road network and NSR (SC2 scenario; expected traffic increase)

Table 7.26 presents the estimated noise levels at the NSR for the future Coral North warehouse operation traffic (SC2).

Table 7.26: Predicted noise levels at the NSR (SC2 scenario; expected traffic increase)

Warehouse Operation dB(A)		Level Lr	Noise Type	Receptor Height	Coordinates		
NSR Name	ID				X	Y	Z
		(dBA)		(m)	(m)	(m)	(m)
NSR1	1	48.0	Total	2.00	666241.75	8561850.53	92.59
NSR2	2	48.3	Total	2.00	666299.45	8561506.92	87.57
NSR3	4	55.7	Total	2.00	666209.11	8561034.04	91.20
NSR4	3	44.8	Total	2.00	666468.08	8561257.09	78.52
Office Building	5	57.1	Total	2.00	666099.55	8561577.12	99.64
Warehouse building	6	57.8	Total	2.00	666159.22	8561316.08	95.91

From the difference between the traffic generated by the Coral North warehouse operations and the baseline, future vehicular activity within the N1 roadway will potentially generate an increase level of noise of 0.1 dB up to 0.2 dB. This noise increase is consistent with the CTNL calculations above and is considered as being barely imperceptible, and insignificant, as it will not promote any additional noise related changes in the communities located near the facility and the N1 roadway.

SC3: Coral North internal sources and traffic increase scenario

The modelling scenario, SC3, combines the increase in traffic due to the future Coral North warehouse operations plus the N1 road, and the expected warehouse specific sources, such as delivery trucks (an additional maximum 10 heavy vehicles/day) and handling equipment (mobile crane and a forklift operating simultaneously).

Figure 7.8 illustrates the noise contour lines generated by the CadnaA model and the estimated noise levels at each of the nearby noise sensitive receptors (please see Volume I; section 6.3.5).

Table 7.27 presents the estimated noise levels generated by the project in a worst-case scenario at the assessed NSR locations.

Table 7.27: Predicted noise levels at NSR (SC3 scenario; traffic and warehouse specific sources)

Warehouse Operation dB(A)		Level Lr	Noise Type	Receptor Height	Coordinates		
NSR Name	ID				X	Y	Z
		(dBA)		(m)	(m)	(m)	(m)
NSR1	1	48.1	Total	2.00	666241.75	8561850.53	92.59
NSR2	2	48.6	Total	2.00	666299.45	8561506.92	87.57
NSR3	4	55.7	Total	2.00	666209.11	8561034.04	91.20
NSR4	3	45.9	Total	2.00	666468.08	8561257.09	78.52
Office Building	5	57.3	Total	2.00	666099.55	8561577.12	99.64
Warehouse building	6	58.7	Total	2.00	666159.22	8561316.08	95.91

From the analysis of both Figure 7.8 and Table 7.27 the noise levels expected from the Coral North warehouse operations will be noticed in NSR1 to NSR 4, with levels ranging from 45.9 to 55.7 dB(A). Inside the perimeter of the future Coral North warehouse expansion workers will be exposed to a noise level ranging between 57.3 to 58.7 dB(A).

These estimated noise levels are fully compatible with residential use. Noise levels at the warehouse are also fully compatible with safety and occupational levels of a maximum level of 85 dB(A). Additionally, IFC guidelines for industrial areas (70 dB(A)) are also respected.



Figure 7.8: Predicted noise levels at NSR (SC3 scenario; traffic + warehouse specific sources)

7.4.2.5 Impact Assessment – Operational Phase

Impact AN2: Increase in noise levels from the logistics base operation

Impact Assessment

From the information and discussion provided in the preceding sections, during the operational phase, minor changes in the noise environment are expected as a direct result of the logistics base operation. The noise model runs returned results that represent a slight increase of baseline noise levels ranging between 0.2 dBA and 1.2 dBA. For a person with average hearing acuity, an increase of less than 3 dB in the general ambient noise level will not be noticeable.

At the warehouse, the noise generated by heavy traffic movements and by handling equipment will be acoustically noticed only in the immediate vicinity of the warehouse boundary, although still below the IFC commercial and /or industrial areas guideline (70 dB(A)).

As such, the overall noise impact expected to be generated by the future logistics base operation is assessed as negative, of local extent, low intensity, long-term duration, and low probability (possible), resulting in a very low significance.

Mitigation Measures

Despite the very low significance rating, the application of the following best practice measures is recommended:

- Ensure that predictive and regular maintenance is carried out on all noise emitting equipment operating in the warehouse. Maintain all mechanical equipment on a regular basis, replace worn parts and lubricate as required;
- Ear plugs should be provided to workers if near high noise generating equipment;
- Maintain a complaint register and proceed with a follow up to the noise events.

Impact Summary

The impact assessment summary is provided in the following table.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				
- Ensure that predictive and regular maintenance is carried out on all noise emitting equipment operating in the warehouse; - Ear plugs should be provided to workers if near high noise generating equipment; - Maintain a complaint register and proceed with a follow up to the noise events.								
With mitigation	Local	Low	Long term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				

7.5 Water Quality

7.5.1 Potential Impact-Generating Project Activities

This section presents the assessment of the potential impacts on the marine water masses resulting from the Project, which are mostly related to potential changes in the physical and chemical properties (water quality) of seawater.

During drilling and installation phases, the main project activity that may induce changes to marine water quality is the discharge of drill cuttings, associated with drilling of the production wells.

During the operational phase, changes to water quality may be caused by the effluent discharges of the FLNG facility, namely:

- Discharge of cooling water: during operation, seawater will be used as the main cooling medium for the LNG plant. The discharge of this water, at higher temperature than abstracted, may induce changes in the temperature profile of the receiving marine water mass;
- Discharge of produced water: gas reservoirs frequently include a percentage of water, which will be abstracted together with the natural gas. During the LNG process, this water is separated from the gas, treated, and discharged into the sea. The separated water is referred to as produced water. Produced water may contain traces of inorganic and organic compounds. Even though produced water will be treated before release, the discharge may impact on the receiving seawater quality;
- Discharge of other effluents, including stormwater (deck and machinery space drainage), bilge water, desalination brine, and sewage. These effluents will all be treated aboard prior

to discharge but may still contain some amount of dispersed and dissolved hydrocarbons and organic matter (in the case of sewage).

Finally, water quality impacts may also originate in unplanned events, such as accidental oil spills. Considering the planned activities, the potential unplanned events that may result in oil spills are the following three scenarios:

- Scenario 1 – diesel spill associated with vessel collision happening either during drilling of wells, installation, commissioning, operation phase or decommissioning;
- Scenario 2 – release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase;
- Scenario 3 – release of low toxicity oil based muds (LTOBM) due to an accidental riser disconnect on the seabed during the drilling phase.

Due to the different nature of the impacts in these phases, the impact assessment below is divided into drilling and installation, operation, and unplanned events (which may occur in any project phase).

This section only addresses the potential impacts on water quality (physical and chemical properties of the marine water mass where the FLNG vessel will be sited). The associated potential impacts on marine biodiversity are addressed in section 7.7. The potential socioeconomic impacts from the modelled unplanned events are addressed in section 7.8.3.

7.5.2 Drilling and Installation Phases

Impact WQ1: Potential seawater quality degradation due to the discharge of drill cuttings

Impact Assessment

As discussed in the Project Description (see section 4.4.1.2, Volume I), drilling wastes, including cuttings (rock fragments) and used muds, generated by drilling will be managed as follows:

- During the drilling of the upper sections of the wells, water based muds (WBM) will be used. All the fluids and cuttings will be dispersed at seabed, as at this stage the riser hasn't been installed yet. It is estimated that roughly 250 m³ of WBM cuttings and WBM will be dispersed at seabed, per well;
- Once the initial portions of a well have been drilled, a riser will be installed, which allows material (drilling muds and cuttings) to be returned to the drilling rig. As such, all the low toxicity oil based muds (LTOBM) and cuttings from the lower sections will be brought up to the drilling vessel and transferred by cutting skips and tanks to shore for treatment and disposal. It is estimated that roughly 250 m³ of LTOBM cuttings will be recovered to surface, for each well.

As such, under normal drilling conditions, no LTOBM drillings will be discharged to sea, and thus no impact on water quality is expected.

Notwithstanding, a modelling study was conducted to investigate potential impacts on water quality, in the event some drill cuttings using LTOBM were discharged at sea (under unplanned emergency

conditions). Detailed modelling methodology and results are provided in Annex VII (see Volume IV). A summary of the main modelling approach and results is provided here, to support the impact assessment discussion.

Modelling was performed to determine two key results:

- The amount of suspended sediment (Total Suspended Solids – TSS) concentration added to the water column background concentrations; and
- The seabed accumulation (thickness) of the drill cuttings over an area of the seafloor (the footprint). These modelling results will support the assessment of impacts on benthic organisms and are discussed in section 7.7.2.

Volumes of discharged drill cuttings were estimated, based on wells previously drilled in Area 4. The following volumes are expected to be discharged per well: 1 350 m³ of cuttings and 44.9 m³ of LTOBM (adhered to the cuttings).

Hydrodynamic modelling was then used to estimate the thickness of deposited materials at seabed level and calculate the concentration increase of TSS resulting from the discharge of these volumes, for each production well modelled. Only the TSS results are discussed in this section. Please refer to section 7.7.2 for a discussion on the thickness of deposited materials and their potential impact on benthic fauna. Detailed modelling results are provided in Annex VII (Volume IV).

Increases in concentration of TSS will occur due to discharges of drill cuttings. The highest concentration increases will naturally exist at the point of discharge and decrease over time and distance as the suspended solids plume dissipates. Larger particles will settle out more quickly than fine particles, such that the TSS plume of tiny particles may linger and travel further than plumes of larger grain-sizes. As such, elevated TSS may form in regions where tiny suspended particles linger in a cloud and mix with subsequent discharges.

Figure 7.9 shows a plot of the maximum TSS concentration for released cuttings and adhered residual LTOBM for one of the wells (well CO-15). A maximum TSS concentration of 0.23 mg/L was estimated, extending to 25 m from the discharge location.

The national regulation does not establish an ambient water quality standard for TSS on marine waters. In the absence of a national standard, best practice international standards were adopted, namely IFC's guidelines for effluent discharges of hydrotest water at LNG Facilities (IFC, 2007), which lists a guidance limit of 35 mg/l. This guidance limit was adopted in this assessment as an ambient water quality threshold value for TSS.

As stated above, the maximum modelled TSS concentration from the discharge of drill cuttings and muds was 0.23 mg/l, at 25 m from the discharge, which is well below the reference threshold value of 35 mg/L. This increase of suspended solids is therefore very unlikely to cause impacts related to light inhabitation, especially at depths below 1,800 m, well below the photic zone where photosynthesis occurs in the ocean.

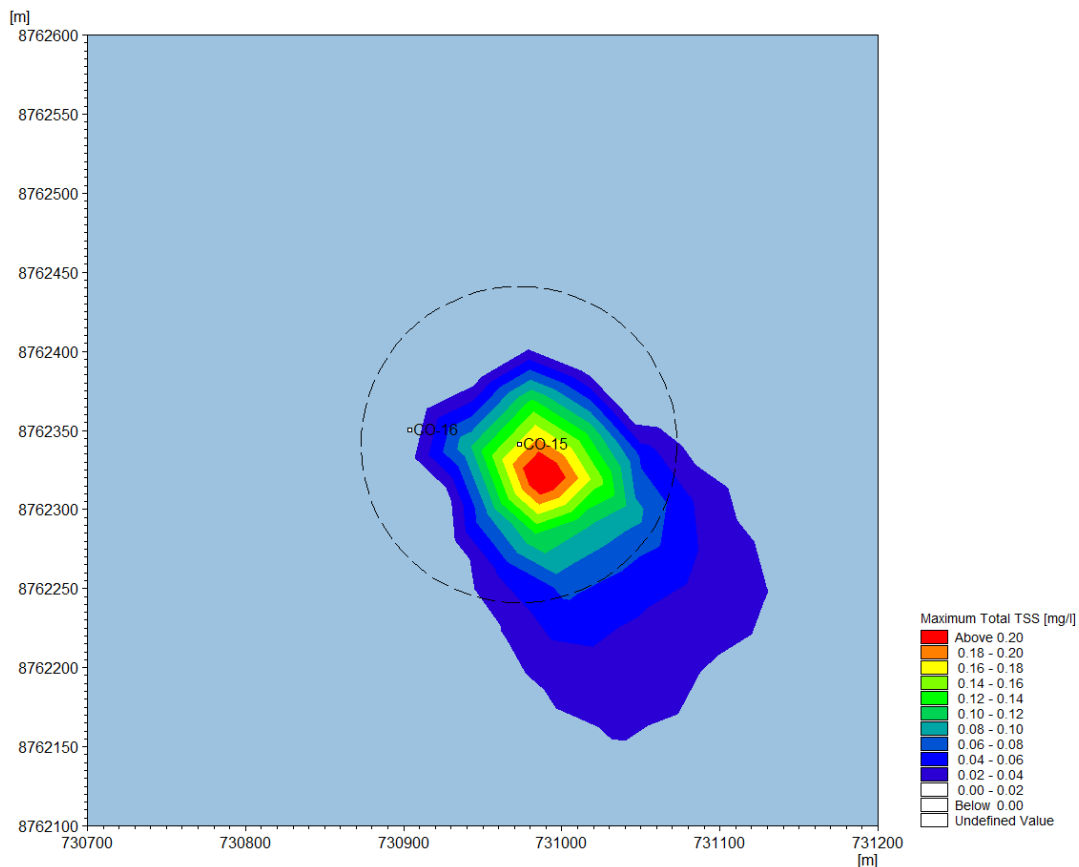


Figure 7.9: Maximum concentration TSS for well CO-15

These increases of suspended solids are therefore very unlikely to cause relevant impacts on seawater quality, and they affect a very localized area.

The impact is thus assessed as negative and direct, of short-term duration (restricted to the drilling activities), of local extent (only a small area around the drilling location will be affected) and low intensity (low concentrations of TSS, and therefore of other pollutants, are expected, below the recommended threshold), resulting in a very low significance.

Mitigation Measures

No relevant impact on water quality due to discharged TSS concentrations was identified, and as such no specific mitigation is required. The design option of retrieval of all LTOBM cuttings to vessel and transfer for onshore treatment and disposal will be carried out, and will negate this impact. If any unplanned event prevents transfer of drilling wastes to shore, the drilling operation will be temporarily suspended until transfer to shore can be resumed.

Impact Assessment Summary

The table below provides the impact assessment summary. In the event that drilling cuttings are discharged offshore, the significance of the impact will be very low (pre-mitigation scenario), as discussed above. Under normal conditions, with the design option implemented (i.e., transfer for onshore treatment and disposal), the impact will be insignificant (post-mitigation scenario).

Impact WQ1: Potential seawater quality degradation due to the discharge of drill cuttings								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very low	Probable	VERY LOW	-ive	High
	1	1	1	3				
- Collect LTOBM cuttings and muds to the vessel and transport them onshore by supply vessels for treatment and disposal at a recognized landfill; - If an unplanned event prevents transfer of drilling wastes to shore, the drilling operation will be temporarily suspended until transfer to shore can be resumed.								
With mitigation	Local	Low	Short-term	Very low	Improbable	INSIGNIFICANT	-ive	High
	1	1	1	3				

7.5.3 Operational Phase

Impact WQ2: Potential increase of marine water temperature due to the discharge of the FLNG's cooling water

Impact Assessment

The LNG production process will require a refrigeration system. Sea water has been selected as the main cooling medium: due to the thermal duties to be released from the topside process facilities, air cooling would be impractical for footprint and weight. Sea water is pumped by vertical sea water pumps at about 150 meters depth. Deep sea water intake hose system is equipped with a sea water filtration screen to avoid any debris carry-over. As result of this process, the seawater used to cool down the system will be heated and discharged in the ocean. It should be noted that the discharge cooling water has no relevant contaminants, the thermal component being the only concern.

The potential temperature impacts from cooling water discharge on the receiving marine water were assessed through modelling. Two models were used to assess the temperature impacts from cooling water discharge. One model (CORMIX) was used to predict the temperature rise from the point of discharge to the end of the mixing zone, while a second model (DHI MIKE) was used to predict the temperature rise on a larger scale extending beyond the initial mixing zone, based on the established hydrodynamic modelling.

The following recommendations have been tabled for the mixing zone in South Africa (Anchor Environmental Consultants, 2015): 300 m in an offshore environment, 100 m in a nearshore open coast environment, 30 m in sheltered coastal environments and special management areas, 0 m for outfalls in established or proposed MPAs, the surf zone and estuaries. These recommendations are applicable to Mozambican waters as well, and as such the recommended mixing zone is 300 m. However, impacts of the thermal discharge were assessed for a stricter 100 m mixing zone, as a conservative approach.

The detailed modelling methodology and results are provided in Annex VIII (Volume IV), with a brief summary of the main findings described below, to support the impact assessment.

The total flow rate of the thermal discharges, at average and peak operation, is estimated to be 24,964 MT/hr (Metric ton per hour) and 27,445 MT/hr, at a combined temperature of 30.64°C. The

discharge is made at superficial level (0.5 to 7.5 m below sea level). This data was sourced from the current thermal discharge of the Coral South FLNG. For the modelling, the top 5 m below sea level was used for the representative discharge.

The modelling was conducted for three oceanographic seasons: maximum, minimum, and typical current speeds. The worst-case modelling scenario, in terms of potential increases to marine water temperature caused by the thermal discharge, is the scenario of minimum current speed. This is the scenario where the natural cooling effect of marine currents (due to mixing) is lower.

Figure 7.10 below shows the modelling results for the minimum current scenario (please see Annex VII; Volume IV for more modelling results).

As can be seen in Figure 7.10, even in the worst-case scenario, temperature increases in the receiving marine waters are expected to be fairly low. At 100 m from the discharge point, the maximum expected temperature increase is of only 0.39 °C (SSW direction). At the edge of the recommended mixing zone of 300 m, the increase in temperature is below 0.1°C.

The marine water quality standards in Mozambique are established through Annex V of Decree 18/2004 (as amended by 67/2010). This regulation does not set a quality standard for marine waters in terms of temperature increases. In the absence of a national standard, best practice international standards were adopted, namely IFC's guidelines for thermal discharges, that defines that any thermal discharge should not result in a temperature increase greater than 3 °C at the edge of the mixing zone.

The modelling results discussed above show that the temperature increase at the end of the mixing zone caused by the FLNG thermal discharge will be much lower than the IFC standard. As such, the temperature increase impact from the FLNG thermal discharge is not expected to be relevant.

The results from the modelling are in line with the ongoing monitoring of the water quality around the operational Coral South FLNG, where no temperature increase in the receiving environment has been identified. The biannual water quality monitoring program for the operational Coral South FLNG includes 14 sampling stations, located in a radial pattern, at varying distances from the FLNG's discharges, including four stations located only 100 m from the FLNG (at the upstream, downstream, port, and starboard positions). Water quality monitoring at these stations includes water quality collection for laboratory analyses, and *in situ* monitoring of several parameters, including temperature. The most recent monitoring surveys in 2023 and 2024 (Consultec & CLS, 2023a, 2024), showed no temperature increase for all water quality stations including at the closest four stations, further substantiating the Coral North FLNG modelling results.

The impact is thus assessed as negative and direct, of long-term duration (operational lifetime), but of local extent, and low intensity, resulting in a low significance.

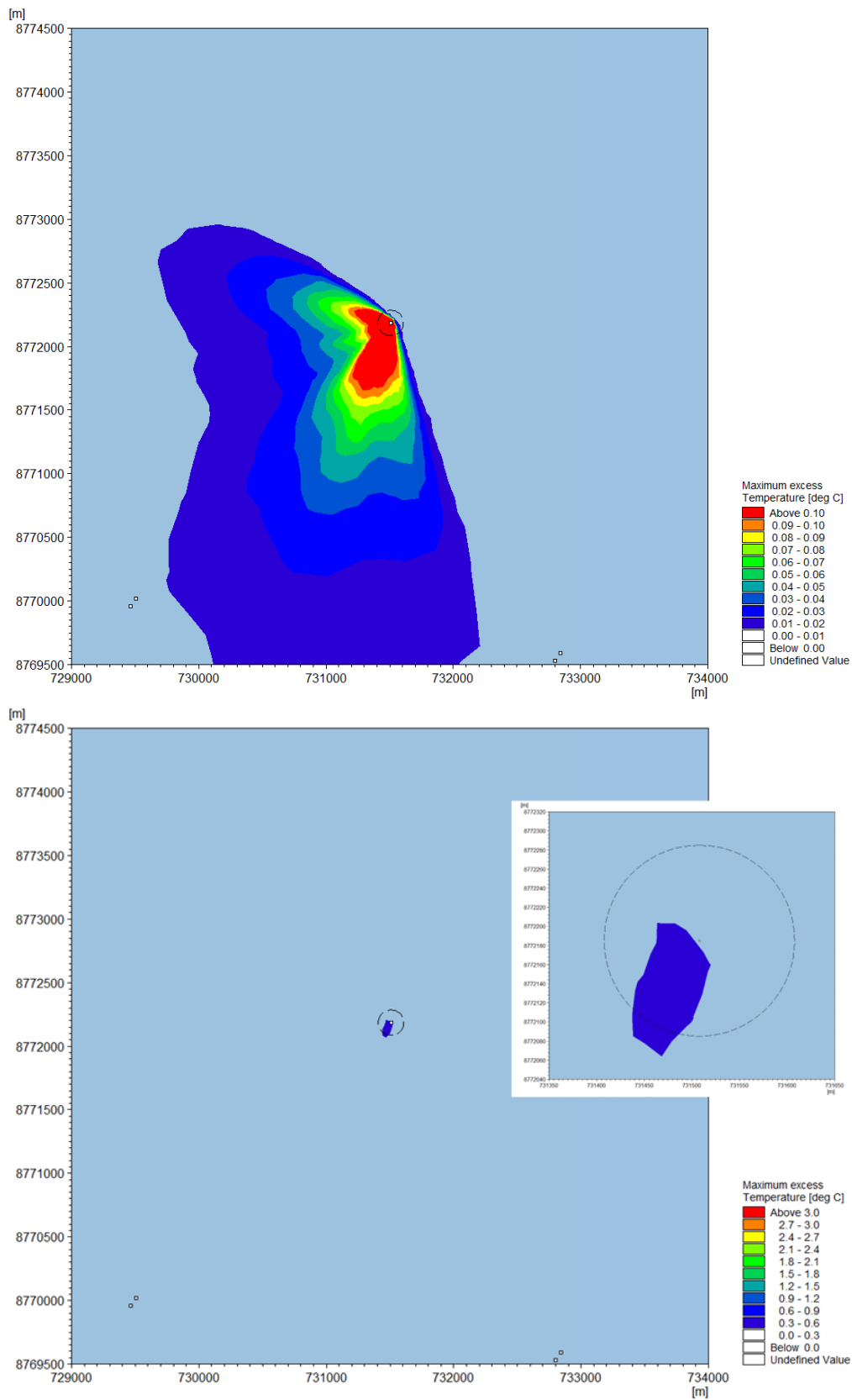


Figure 7.10: Maximum temperature rise in marine water during cooling water peak discharges and minimum current speeds. Thresholds of 0.1 °C (top) and 3 °C (bottom)

Mitigation Measures

No relevant impact was identified, and as such no specific mitigation is required. To ensure the impact remains of low significance, good management of the cooling system is recommended, including:

- Maintain the correct operation of the cooling system, to maintain designed discharge temperatures;
- Operate the cooling system as per best practices and international standards. This includes maintaining trained operating staff as well as enforcement of all operating policies and procedures;
- Shut down of cooling system when cooling is not required; and
- Online (continuous) monitoring of cooling water discharge temperature and biannual monitoring of the receiving seawater temperature, to ensure compliance with the end of mixing zone standard. This frequency is in line with the Coral South water quality monitoring and is deemed sufficient, given that no increase in seawater temperature has been noted from the Coral South discharge and no significant impact is expected. Should monitoring detect a degradation in the receiving water quality, the cause will be investigated with adaptive management implemented as appropriate which may include increasing the frequency of monitoring.

Impact Assessment Summary

No significant impact was identified. The proposed management actions will ensure that the residual impact remains of low significance.

Impact WQ2: Potential increase of marine water temperature due to the discharge of the FLNG's cooling water								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
- Maintain correct operation of the cooling system, to maintain designed discharge temperatures; - Ensure that the pumping of cooling water through the system is turned off when cooling is not required; - Continuous monitoring of the discharge temperature; - Biannual monitoring of the receiving seawater temperature, to ensure compliance with the end of mixing zone standard.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				

Impact WQ3: Potential seawater quality degradation due to the discharge of produced water in the operational phase

Impact Assessment

Gas reservoirs frequently include a percentage of water, which will be abstracted together with the natural gas. During the LNG process, this water is separated from the gas, treated, and discharged into the sea. This is referred to as produced water.

Produced water can contain a suite of potential contaminants (hydrocarbons, heavy metals, phenols). Most of these contaminants will be removed during the treatment process, prior to discharge, as discussed in the project description (see section 4.4.4.4; Volume I). This includes phenols, which will be removed from the produced water effluent through a specific unit within the produced water treatment package, designed to reduce phenol concentrations in the discharged effluent up to 0.5 mg/l. The discharge will thus be in compliance with the national ambient quality standard for phenols (see section 6.7.1; Volume I), and as such no water quality impact is expected for this constituent.

However, the discharge produced water will still present hydrocarbons (oil and greases), suspended solids, and Biological Oxygen Demand (BOD), and the potential impact of the discharge of these pollutants on seawater quality needs to be considered.

Table 7.28 below presents the expected pollutant concentrations of the discharged produced waters.

Table 7.28: Produced water discharge pollutant concentrations

Constituent	Discharge Concentration
Oil and grease (mg/l)	10
BOD ₅ (mg/l)	599
TSS (mg/l)	35
Temperature (°C)	38

The potential impacts of the produced water discharge on the receiving seawater ambient quality were assessed through dedicated modelling. The modelling methodology and detailed results are provided in Annex VII (see Volume IV). A summary of the main findings of this modelling study is provided below, to support the impact assessment.

The total flow rate of the produced water discharges, at average and peak operation, is estimated to be 32 m³/h and 62 m³/h respectively. The discharge is made at 10 m below sea level. It was further assumed that the discharge was continuous and that the contaminant levels were conservative (i.e., no decay was considered).

The modelling was conducted for three oceanographic seasons: maximum, minimum, and typical current speeds. For each of these scenarios, modelling was done for peak operation discharge (assuming the FLNG plant is operating at full capacity).

Figure 7.11 shows the modelling results for the peak discharge and typical current speed scenario, for the BOD₅ constituent (please see Annex VII, Volume IV for more modelling results). The maximum incremental concentrations of pollutants in seawater will occur at the discharge point and its proximity. Modelling shows that, in the worst-case scenario, the maximum increase of BOD₅ concentration at the discharge point (within 30 m of the discharge) is 0.67 mg/L, which is far below ambient quality standard of 5 mg/L. The BOD₅ concentration will continue to fall with distance, due to the dilution in the receiving waters.

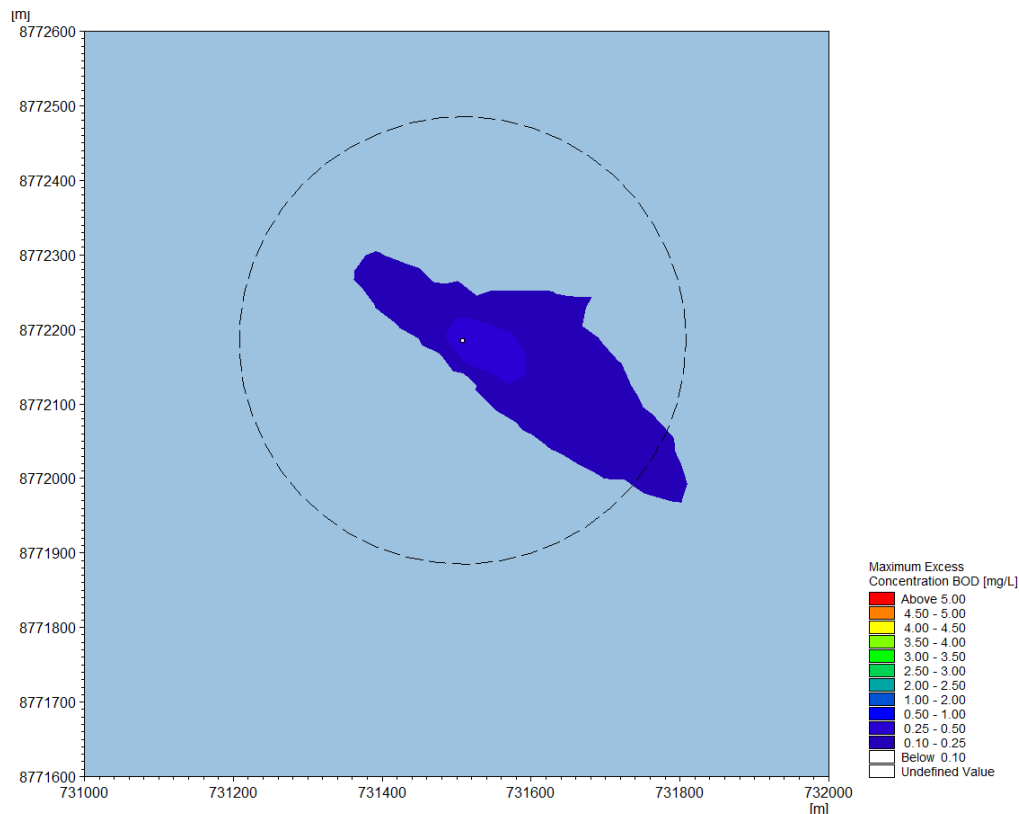


Figure 7.11: Maximum BOD5 concentration rise from produced water discharge simulation for peak discharge and typical current scenario (thresholds of 5 mg/l). Dotted circle is the 300 m mixing zone

Table 7.29 provides the estimated maximum incremental concentrations for all discharge pollutants at the discharge point (within 30m of the discharge), for the peak discharge and typical currents scenario.

Table 7.29: Maximum predicted incremental ambient pollutant concentrations resulting from produced water peak discharge with typical current speed

Pollutant	Discharge concentration (mg/l)	Maximum modelled concentration (mg/l)	Ambient Quality Standard (mg/l) ^a
Oil and greases	10	0.011	Virtually absent
BOD5	599	0.67	5
TSS	35	0.039	-

References: ^a I Annex V, Decree No. 18/2004 (as amended by Decree No. 67/2010).

As shown in Table 7.29, the resulting increases in the ambient concentration of oil and greases, BOD5, and TSS are all very low. The BOD5 maximum concentrations at the discharge location are well below the ambient seawater quality standard, as established in Decree 18/2004 (as amended by Decree 67/2010). The maximum predicted additional oil and grease concentration is 0.011 mg/l, which can be considered to be virtually absent (not detectable by visual observation). These concentrations will continue to rapidly decrease as the distance from the discharge point increases.

The results of this modelling study are consistent with the water quality monitoring data available for the operational Coral-SUL FLNG facility. Monitoring surveys conducted in 2022 and 2023 around the

Coral-SUL operational site showed no degradation of water quality (Consultec & CLS, 2022; 2023a; 2023b; please see additional information in the baseline section – section 6.7.2, Volume I).

The levels of constituents (BOD₅, oil and grease, and TSS) in the receiving marine waters, resulting from the treated produced water discharge, are predicted to be below all the applicable standards and regulations. As such, no relevant degradation of seawater quality resulting from the FLNG's produced water discharges is expected.

The impact is thus assessed as negative and direct, of long-term duration (operational lifetime), although of local extent (no relevant degradation of water quality is expected, even in close proximity to the discharge location), and low intensity (maximum additional concentrations of constituents are all very low, and well below applicable standards), resulting in a low significance.

Mitigation Measures

No relevant impact was identified, and as such no specific mitigation is required. To ensure the impact remains of low significance, good management of the produced water treatment system is recommended, including:

- Maintaining the proper operation of the treatment system, to maintain designed discharge concentrations;
- Operation of the treatment system following best practices and international standards. This includes maintaining trained operating staff as well as enforcement of all operating policies and procedures;
- Periodic monitoring of the produced water effluent, to verify compliance with emission limits;
- Biannual monitoring of the receiving seawater quality, to verify compliance with ambient quality standards.

Impact Assessment Summary

The impact assessment summary is provided in the following table. The proposed management actions will ensure that the residual impact remains of low significance.

Impact WQ3: Potential seawater quality degradation due to the discharge of produced water in the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
- Maintain proper operation of the treatment system, to maintain designed discharge concentrations; - Periodic monitoring of the produced water effluent, to verify compliance with the emission limits; - Biannual monitoring of the receiving seawater quality, to verify compliance with the ambient quality standards.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				

Impact WQ4: Potential seawater quality degradation due to the discharge of other FLNG effluents in the operational phase***Impact Assessment***

Other FLNG effluents discharged during the operational phase include stormwater, bilge water, desalination brine, and sewage.

Stormwater includes run-off water from both non-process areas (clean effluent) and process areas (potentially contaminated with hydrocarbons). Bilge water is oily water that is collected from the lowest space of the vessel (where it tends to concentrate). Both bilge water and drainage from process areas and machinery space will be treated aboard the FLNG, in an oily water treatment unit, to remove oily content before discharge to sea. The oil content of the discharged effluent is expected to be below 15 mg/L, in compliance with MARPOL and IFC requirements. Using the same modelling approach described in the previous impacts, the discharge concentration is expected to result in very low maximum additional oil concentrations in the receiving environment (0.017 mg/l), which can be considered to be virtually absent (not detectable by visual observation).

Freshwater will be generated aboard the FLNG using a freshwater generation package. The brines from this package (i.e., effluent with concentrated salinity) will be initially sent to an electro chlorination package, and then used in various process components such as seawater intake pumps. Very rarely, excess brine is discharged. Other than the concentrated salinity, the discharged brine is only expected to carry residual trace amounts of potential constituents (such as leached metals or residual chlorine) at negligible concentrations unlikely to cause relevant impacts to the well-mixed oceanic deepwater receiving environment.

The sewage effluent will include the wastewater from domestic areas (mainly the living quarters) and galley water (water used for cooking, cleaning, and washing in the kitchens), which can potentially have high organic matter content and biological contaminants. This wastewater will be treated aboard, using a biological water treatment unit, the goal of which is to remove excess organic matter and any biological contaminants prior to discharge.

The sewage discharge will comply with MARPOL emission limits requirements, as provided in section 4.4.4.4 (see Volume I), including TSS concentrations of 35 mg/L and BOD₅ concentrations of 25 mg/L. These are similar concentrations expected to be in the produced water discharge, and as shown in the previous impact, are not expected to have any relevant impact on the receiving marine waters quality (as shown in Impact WQ3 above).

Additionally, the sewage discharge is also expected to contain elevated nutrient concentrations, namely nitrogen. Ongoing monitoring of the Coral Sul FLNG's liquid discharges, which is equipped with a biological treatment unit similar to the one to be installed in the Coral North FLNG, have shown concentrations of Total Nitrogen in the treated sewage discharge up to 93 mg/l (Consultec, 2023). Similar concentrations are thus also expected in the Coral North sewage effluent.

In order to investigate the potential impact of this discharge, the results of a specific modelling dispersion study of the Coral Sul treated sewage discharge showed that maximum modelled

concentrations at the edge of the mixing zone (300 m) were estimated to be under 1 mg/L (Consultec & Anchor, 2023a).

This is consistent with ongoing water quality monitoring results for the Coral South Project. Recently, ERB performed 12 monitoring surveys, between May and September 2023, with samples collected at the edge of the mixing zone, at two sites on port and starboard of the Coral SUL FLNG. The average concentration of Total Nitrogen in the collected samples was 0.96 mg/L (range from below the detection limit - 0.5 mg/l - to 1.6 mg/L (Consultec & CLS, 2023b)).

While the national regulation does not establish an ambient quality standard for Total Nitrogen, it sets standards for some nitrogen species, including ammonium (5.0 mg/L), nitrates (10 mg/L), and nitrites (1.0 mg/L) (Decree no. 18/2004, dated June 2, as amended by Decree No. 67/2010). Based on the available laboratory data for the Coral Sul FLNG sewage discharge, most (99.8%) of the treated effluent total nitrogen is made up of nitrate (Consultec & Anchor, 2023a). As such, the nitrate ambient limit of 10 mg/L is considered to be a suitable target to evaluate the potential impacts of this effluent.

Maximum modelled total nitrogen concentrations are expected to be under 1 mg/l, well below this 10 mg/l standard. Such low additional total nitrogen concentrations are not expected to result in any significant change in both structure (biological communities) and function (ecological processes) of the receiving ecosystem.

The Coral North location is also not susceptible to nutrient over-enrichment. The most susceptible systems are those with limited tidal exchange and mixing, long retention time, vertically stratified water masses, and relatively low background concentrations of suspended sediments (National Research Council *et al.*, 2000; Boesch, 2002; Paerl, 2006; Chen *et al.*, 2021). This is not the case at the site of the Coral North FLNG, located in ~2 000 m of water, more than 50 km offshore, with significant south-flowing currents. As shown in the modelling results presented in Impact WQ3, the discharges of the Coral North FLNG are expected to disperse southwards, without any cumulative concentration effect at the site (see the figures in Impact WQ3 above).

Therefore, the impact of these effluents in the receiving marine water is assessed as negative and direct, of long-term duration (operational lifetime), although of local extent (no relevant degradation of water quality is expected beyond the mixing zone), and low intensity (maximum additional concentrations of constituents are all very low, and well below applicable standards), resulting in a low significance.

Mitigation Measures

Given the low significance of the impact, no mitigation measures are required. A monitoring program at both the end of pipe and mixing zone should be implemented, to verify that total nitrogen concentrations in the receiving environment are below the adopted 10 mg/L standard and that nitrate concentrations are below the chronic toxicity concentrations (DEA, 2018).

Impact Assessment Summary

The impact assessment summary is provided in the following table. The proposed management actions will ensure that the residual impact remains of low significance.

Impact WQ4: Potential seawater quality degradation due to the discharge of other FLNG effluents in the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				
- Monitor end of pipe concentrations and operations adjusted should adverse effects be detected by the monitoring program; - Monitor for total nitrogen at 300 m from the outfall to validate dispersion modelling results and ensure compliance with ambient quality standards.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-‘ve	High
	1	1	3	5				

7.5.4 Unplanned Events

Impact WQ5: Risk of seawater quality degradation resulting from accidental diesel spills due to vessel collision (unplanned event)

Impact Assessment

The FLNG Project will generate an increase in maritime traffic throughout its life cycle: during the drilling, installation and commissioning phases, this increase will come from the drilling and support vessels involved in such activities; during the operational phase, the increase will come from support vessels and from LNG carriers, used in the export process.

This increased traffic will generate an increased risk of vessel collisions. If such an accidental collision happens, it could result in the release of significant quantities of hydrocarbons to the marine environment, namely the release of diesel oil used as fuel by these vessels. This section assesses the effects such an accidental release may have on seawater quality, along the Cabo Delgado offshore and coastal waters.

Oils consist of a suite of hydrocarbons with varying degrees of toxicity. Any release of hydrocarbons, independently of its composition, will however result in degradation of seawater quality and on direct impacts on marine fauna. This section addresses the potential impacts on seawater quality, while the impacts on marine fauna are discussed in section 7.7.4, and potential socioeconomic impacts are discussed in section 7.8.3 (see Impact SE11).

The potential impacts of accidental oil spills due to vessel collision were assessed through oil spill modelling. Both stochastic and deterministic methodologies were implemented to assess the effects of a potential diesel spill. The modelling methodology and detailed results are provided in Annex VII (see Volume IV). A summary of the main modelling approach and results is provided below, to support the impact assessment rationale.

For the stochastic modelling 100 iterations of random periods during 2013 were executed and processed to offer a probabilistic outcome from the effects of an accidental oil spill. For deterministic

modelling the evolution of the accidental spill was tracked during periods representative of strong, weak, and typical current conditions. The median was also identified from the stochastic iterations and included with the deterministic results as representative for typical oil dispersion behaviour. The models were set up to simulate the instantaneous release of 2,000 bbl diesel at the well location of CO-15 and tracked for a period of 10 days to simulate the dispersion of oil.

The ambient seawater quality standards in Mozambique are established through Annex V of Decree 18/2004 (as amended by 67/2010). The standard for oil and grease is “virtually absent”, which means that upon a visual inspection no oil should be detected on seawater. The first clearly visible oil appears as a silvery sheen at thicknesses between 0.04 μm to 0.3 μm based on values catalogued in the 2006 Bonn Agreement Oil Appearance Code (BAOAC) (Lewis, 2007). A minimum threshold thickness value has been defined as 0.1 μm . Oil at this thickness may be visible and potentially wash upon the shore as a silver sheen although is not expected to cause physical injury (e.g., oiling, smothering) to wildlife.

Figure 7.12 below shows the modelling results for the extent of visible surface oil (average oil thickness $> 0.1 \mu\text{m}$) for a vessel collision diesel spill (please see Annex VI, Volume IV for more modelling results). Oil thickness of 1 μm is also shown as a yellow isoline on the plot.

The simulations show the potential of the diesel spill likely traveling in northern and southern directions along the coast of Mozambique and Tanzania. Dispersion of a spill in a southern direction is shown to have the highest probability of occurrence, but dependant on prevailing conditions there is significant likelihood of a spill traveling in the northern direction. Figure 7.13 shows the probability of oiling (exceeding average oil thickness $> 0.1 \mu\text{m}$) reaching a specific area.

There are also indications of a spill traveling in an eastern direction towards Madagascar and the Comoro islands. The simulations show a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania, although from results it is highly unlikely to ever reach the shorelines of Madagascar or the Comoro Islands (see Figure 7.13). The expected time for a spill to reach shoreline is between one (1) to three (3) days.

The average oil thickness derived from the probabilistic mapping shows a cumulative extent of approximately 170,000 km^2 for the potential of visible oil (thickness $> 0.1 \mu\text{m}$). The potential region where it can be considered to have a harmful effect on sea life (thickness $> 1 \mu\text{m}$), is however shown to be limited to a relatively close proximity of the discharge point with a cumulative extent of approximately 9,250 km^2 (see yellow isoline on Figure 7.12). From the 100 individual run results the extent of the median simulation was determined as 7,964 km^2 (ranging from 2,760 km^2 to 24,500 km^2) for the visible oil and approximately 789 km^2 (ranging from 237 km^2 to 1,971 km^2) for thickness considered to have a harmful effect on sea life.

The simultaneous discharge of an accidental spill event is of a short duration. The result from the modelling shows that when a spill event occurs, it is expected that weathering of the oil will reduce thickness to below levels harmful to sea life within 24 hours and further weathering to below levels of visible oil will occur within 10 days.

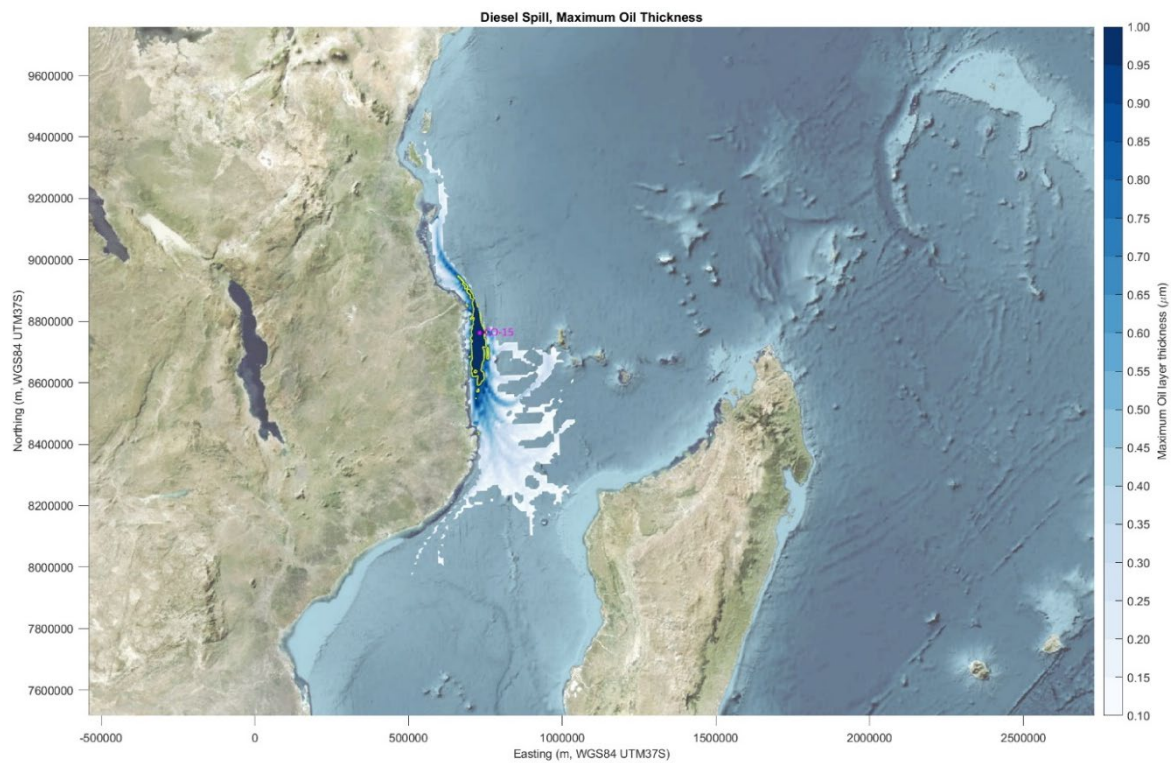


Figure 7.12: Maximum oil thickness for the diesel spill stochastic simulation

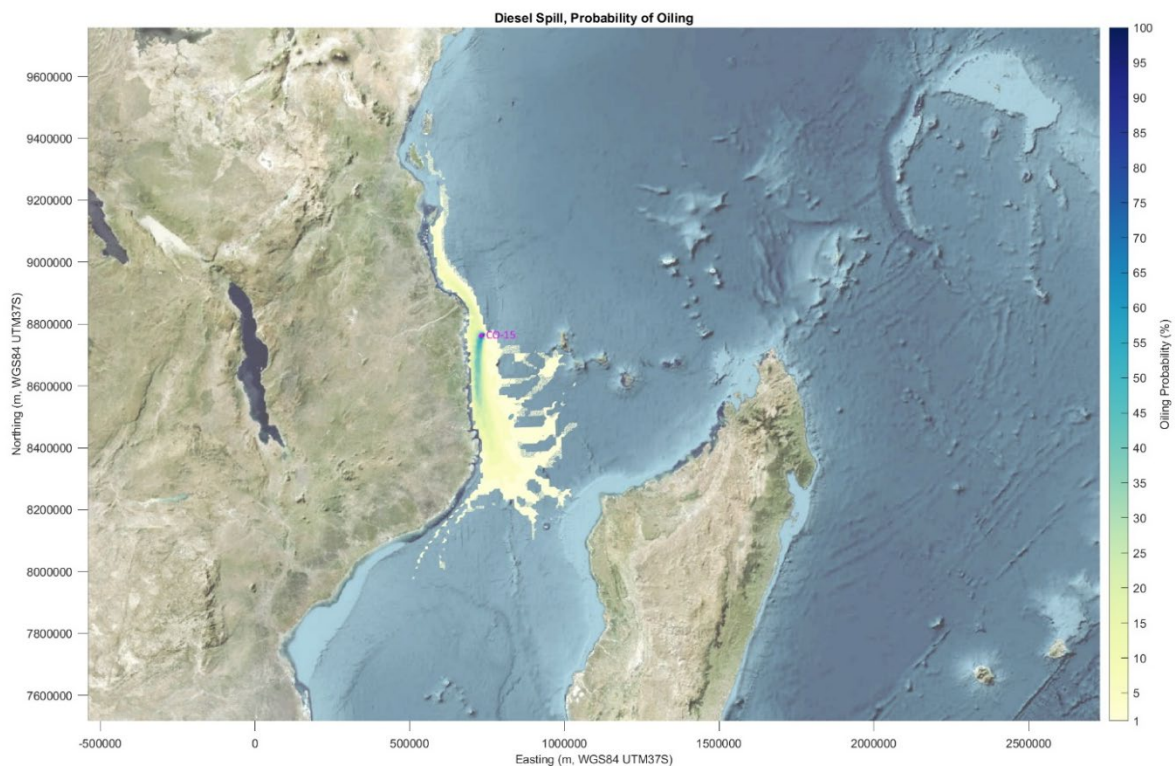


Figure 7.13: Probability of oiling for the diesel spill stochastic simulation

Considering the modelling results and seawater ambient quality standards, the risk of non-compliance with the “virtually absent” standard resulting from a vessel collision diesel spill is assessed as a negative and direct impact, of short term duration (weathering to below levels of visible

oil will occur within 10 days), of international scale (the oil spill may reach Tanzania, although with low probability) and high importance (given the non-compliance with the ambient water quality standard), resulting in a high consequence. As the probability of such a diesel spill is low (<40% - improbable), the resulting significance is assessed as medium.

Mitigation Measures

Mitigation is primarily operational controls to prevent unplanned events such as a vessel collision from occurring, and to be prepared to respond in the event an accident does occur. These mitigation controls include both preventative and response measures:

Preventative measures to ensure that the vessels comply with the following:

- International certification and approval by the Mozambican Authorities;
- Good operational conditions and serviced according to maintenance plan;
- Crews trained for emergency response in what concerns the cargo they transport and operations they perform;
- Maintain contact with the Port Authorities;
- Have updated information on the weather conditions in the area;
- Conduct transfer operations during calm weather conditions;
- Ensure that transfer hoses have the length and strength necessary to manoeuvre vessels as required by the sea conditions;
- Only conduct transfer operations during the day and hoist the “bravo” flag;
- When transfer under reduced visibility conditions (night or overcast), hoist a red light flag;
- Conduct transfer under favourable wind and tide conditions;
- Post warning signals before transfer operations begin.

Response measures:

- Oil Spill Contingency Plan: Develop and implement a comprehensive oil spill contingency plan (OSCP). As per Article 108 of Decree 34/2015, of December 31st (Petroleum Activities Regulation), the OSCP should be prepared by the Operator and submitted to INP for approval, prior to start of operations, as well as to the Ministry of Agriculture, Environment and Fisheries (MAAP) for opinion (as per Article 7 of Decree 45/2006). As such, the Proponent will develop the OSCP prior to the start of activities and submit it to the authorities for review and approval, in compliance with applicable regulations;
- Incident management and crisis management support teams: Develop these teams of highly trained leaders to respond quickly to emergencies;
- Training of personnel: Train personnel to effectively respond in the event of a hydrocarbon spill;
- Equipment: Tier 1 oil spill response equipment will be staged on support vessels and/or at shore;
- Agreements: Promote the use of Tier 2 equipment from peers, if necessary. Maintain membership of Oil Spill Response Limited (OSRL), a global spill response cooperative, that provides Tier 3 response equipment and personnel;

- Stakeholder Agreements: Communicate with stakeholders prior to spill response operations informing potentially affected communities of the OSCP procedures.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a vessel collision and response efforts will minimize the extent of the oil slick, if such a collision occurs. For the post mitigation assessment, it was assumed all spill response protocols were applied, all trained staff reacted appropriately, and all containment methods were deployed to minimize the spread of the spill. As a result, the spill would be prevented from reaching the shorelines and surface oiling maintained within a much closer vicinity to the ruptured vessel, and not travelling into Tanzania's waters. This will reduce the extent from international to regional and the intensity from high to medium. The overall residual significance score is reduced to very low after successful application of mitigation measures. The impact assessment summary is provided in the following table.

Impact WQ5: Risk of seawater quality degradation resulting from accidental diesel spills due to vessel collision (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	International 3	High 3	Short-term 1	High 7	Improbable	MEDIUM	-ve	High
- Vessel operations will adopt preventative measures in compliance with national regulation and international best practices; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Regional 2	Medium 2	Short-term 1	Low 5	Improbable	VERY LOW	-ve	High

Impact WQ6: Risk of seawater quality degradation resulting from an accidental gas condensate blowout (unplanned event)

Impact Assessment

As in Impact WQ5 above, this impact evaluates the possible degradation of water quality resulting from an unplanned event, in this case the release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase.

Condensate is a fossil fuel, a part of natural hydrocarbons which contains many toxicants and carries the ability to harm the environment and all life forms. The high pressure and volatile nature of condensate in combination with the difficulty at extreme depths (approximately 2 km below sea level) as planned for the FLNG project holds a high risk of potential release of condensate to the environment. Even with proper maintenance and protocols it is impossible to completely mitigate the possibility of a gas condensate blowout event. This section considers the effects that such an unplanned release may have on seawater quality.

The potential impacts of accidental oil spills due to condensate blowout were assessed through oil spill modelling. Both stochastic and deterministic methodologies were implemented to assess the effects of a potential condensate release. The modelling methodology and detailed results are provided in Annex VII (see Volume IV). A summary of the main modelling approach and results is provided below, to support the impact assessment rationale.

For the stochastic modelling 100 iterations of random events during 2013 were executed and processed to offer a probabilistic outcome from the effects of an accidental condensate spill. For deterministic modelling the evolution of the accidental spill was tracked during periods representative of strong, weak, and typical current conditions. The median was also identified from the stochastic iterations and included with the deterministic results as representative for typical oil dispersion behaviour. The models were set up to simulate the release of 60,300 bbl oil over a period of 45 days at the location of CO-15 and tracked for a period of 60 days to simulate the dispersion of oil.

Figure 7.14 shows the modelling results for the extent of visible surface oil (average oil thickness > 0.1 μm) for a gas condensate blowout (please see Annex VI, Volume IV for more modelling results). Oil thickness of 1 μm is also shown as a yellow isoline on the plot.

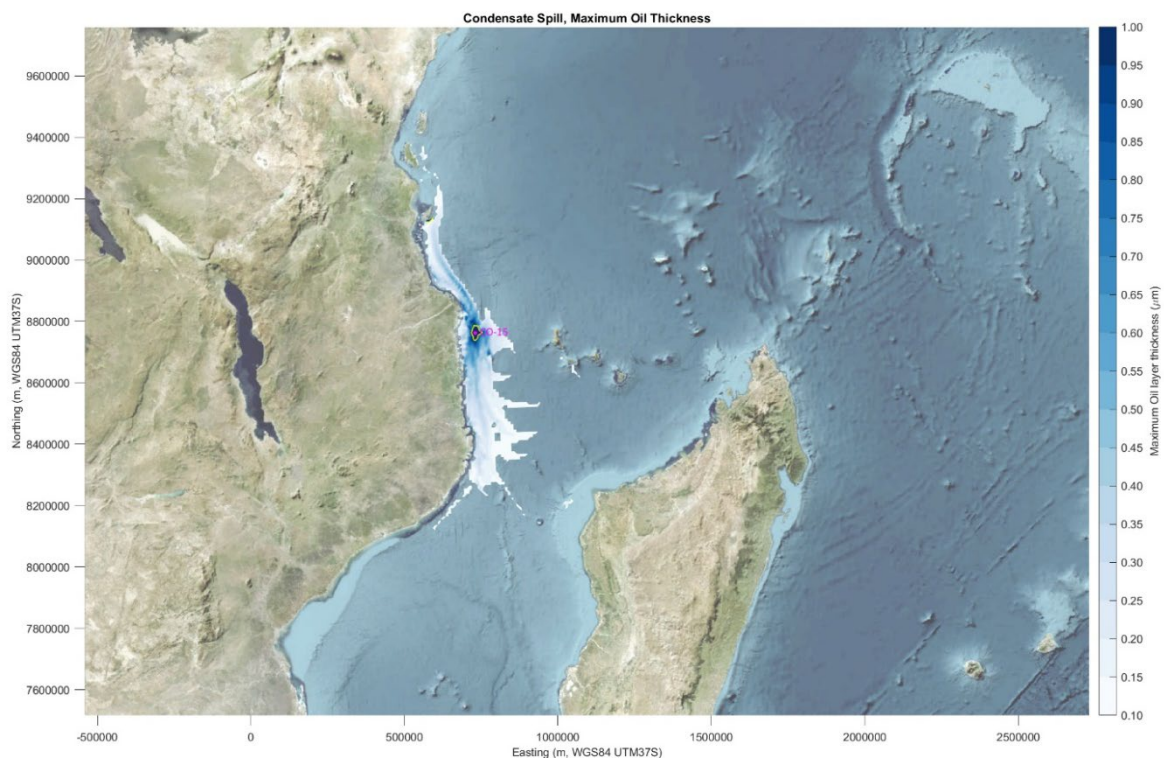


Figure 7.14: Maximum oil thickness for the condensate spill stochastic simulation

The simulations show a potential spill likely traveling in northern and southern directions along the coast of Mozambique and Tanzania. There are also indications of a spill possibly traveling in an eastern direction towards Madagascar and the Comoro islands. The simulations show a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania. While it also indicates a low probability of reaching the shoreline of the Comoro Island, none of the models indicate

that visible oil reaches the shoreline of Madagascar. The expected time for a spill to reach shoreline is between three (3) to 10 days. Figure 7.15 shows the probability of oiling (exceeding average oil thickness $> 0.1 \mu\text{m}$) reaching a specific area.

The average oil thickness derived from the probabilistic mapping shows a cumulative extent of approximately 100,000 km² for the potential of visible oil (thickness $> 0.1 \mu\text{m}$). The potential region where it can be considered to have a harmful effect on sea life (thickness $> 1 \mu\text{m}$), is however shown to be limited to a relatively close proximity of the discharge point with a cumulative extent of approximately 1,265 km² (see yellow isoline on Figure 7.14). From the 100 individual run results the extent of the median simulation was determined as 36,904 km² (ranging from 160 to 60,000) for the visible oil and approximately 552 km² (ranging from 80 to 880) for thickness considered to have a harmful effect on sea life.

The discharge of an accidental spill event occurring over 45 days is considered to be of a short duration. The result from the modelling shows that when a spill event occurs, it is expected that weathering of the oil will reduce thickness to below levels harmful to sea life within one (1) to two (2) days and further weathering to below levels of visible oil will occur within 11 to 15 days after a spill has been sealed.

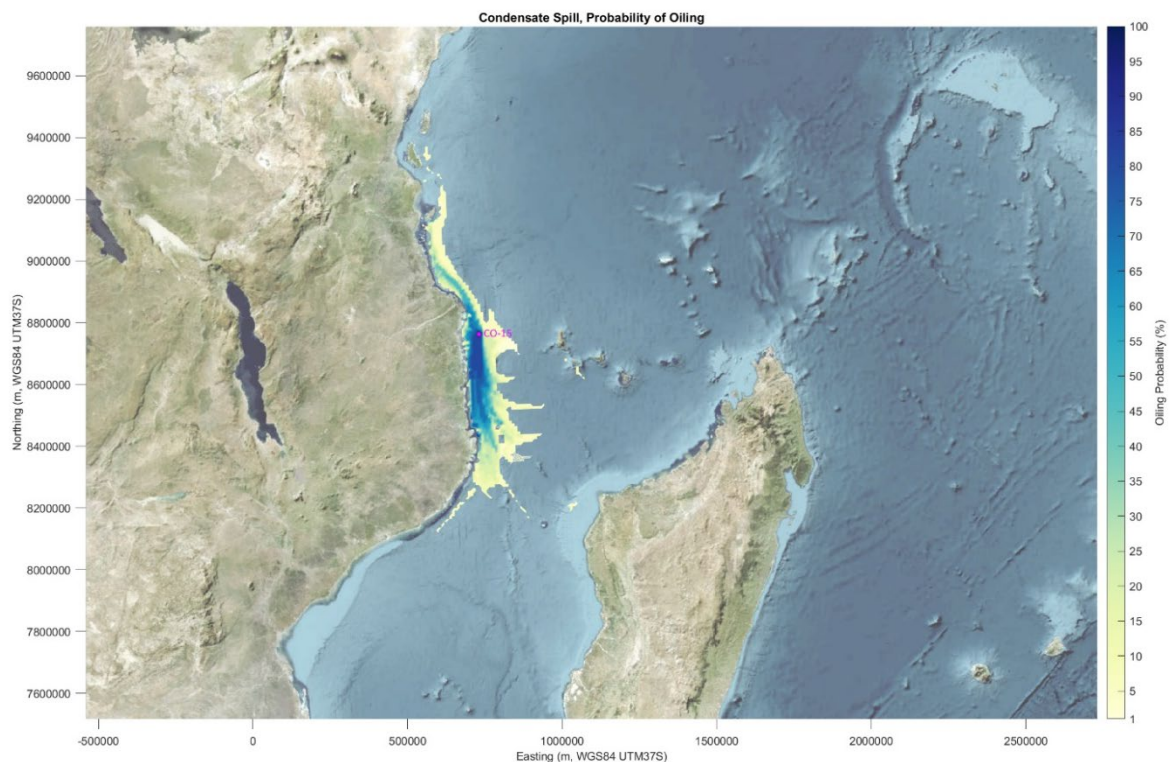


Figure 7.15: Probability of oiling for the condensate spill stochastic simulation

Considering the modelling results and seawater ambient quality standards, the risk of non-compliance with the “virtually absent” standard resulting from a condensate spill from a well blowout is assessed as a negative and direct impact, of short term duration (weathering to below levels of visible oil will occur within 15 days), of international scale (the oil spill may reach Tanzania, although with low probability) and high importance (given the non-compliance with the ambient water quality

standard), resulting in a high consequence. As the probability of such a condensate spill is relatively low (possible), the resulting significance is assessed as medium.

Mitigation Measures

Mitigation is primarily operational controls, including the use of blowout preventers (BOP), to prevent unplanned events such as a gas condensate blowout to occur, and to be prepared to respond in the event an accident does occur. The same mitigation controls proposed above for the diesel spill are applicable for a condensate spill scenario.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a well blowout and response efforts will minimize the extent of the oil slick, if such a blowout does occur. For the post mitigation assessment, it was assumed all spill response protocols were applied, all trained staff reacted appropriately, and all containment methods were deployed to minimize the spread of the spill. As a result, the spill would be prevented from reaching the shorelines and surface oiling maintained within a much closer vicinity to the well location, and not travelling into Tanzania's waters. This will reduce the extent from international to regional, the intensity from high to moderate, and further reduce the probability of impact occurring. The overall residual significance score is reduced to very low after successful application of mitigation measures. The impact assessment summary is provided in the following table.

Impact WQ6: Risk of seawater quality degradation resulting from an accidental gas condensate blowout (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	International	High	Short-term	High	Possible	MEDIUM	-ive	High
	3	3	1	7				
- Install blowout preventers (BOP) in the wellheads; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce of all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Regional	Medium	Short-term	Low	Improbable	VERY LOW	-ive	High
	2	2	1	5				

Impact WQ7: Risk of seawater quality degradation resulting from an LTOBM release due to an accidental riser disconnect (unplanned event)

Impact Assessment

As in Impacts WQ5 and WQ6 above, this impact evaluates the possible degradation of water quality resulting from the release of LTOBM due to an accidental disconnection of the riser during drilling.

LTOBM is a mixture of low toxicity base oil with solid particles (typically mainly barium sulphate with other minerals and crystals such as calcium chloride, calcium hydroxide, silica, etc.). Even though LTOBM is environmentally hazardous, the special features such as reliable shale inhibition and

excellent lubricity, makes oil base muds (OBM) an essential part of deep drilling in oil and gas exploration industries. For the FLNG project, the base oil used in the LTOBM was assumed to be Baroid Alkane™ (a low-toxicity base oil comprised primarily of alkanes). It is planned for LTOBM and cuttings to be returned to the surface via an installed riser, where it will be transported to shore, treated, and discharged within regulatory concentrations. In the event of an accidental riser disconnect, LTOBM can potentially be released into the environment. This section considers the effects that such an unplanned release may have on seawater quality.

The potential impacts of accidental oil spills due to riser disconnect and the release of LTOBM were assessed through oil spill modelling. Both stochastic and deterministic methodologies were implemented to assess the effects of a potential LTOBM spill. The modelling methodology and detailed results are provided in Annex VII (see Volume IV). A summary of the main modelling approach and results is provided below, to support the impact assessment rationale.

For the stochastic modelling 100 iterations of random periods during 2013 were executed and processed to offer a probabilistic outcome from the effects of an accidental oil spill. For deterministic modelling the evolution of the accidental spill was tracked during periods representative of strong, weak, and typical current conditions. The median was also identified from the stochastic iterations and included with the deterministic results as representative for typical oil dispersion behaviour. The models were set up to simulate the instantaneous release of 1,650 bbl of LTOBM at the location of CO-15 and tracked for a period of 10 days to simulate the dispersion of oil.

Figure 7.16 shows the modelling results for the extent of visible surface oil (average oil thickness > 0.1 μm) for a LTOBM release (please see Annex VI, Volume IV for more modelling results). Oil thickness of 1 μm is also shown as a yellow isoline on the plot.

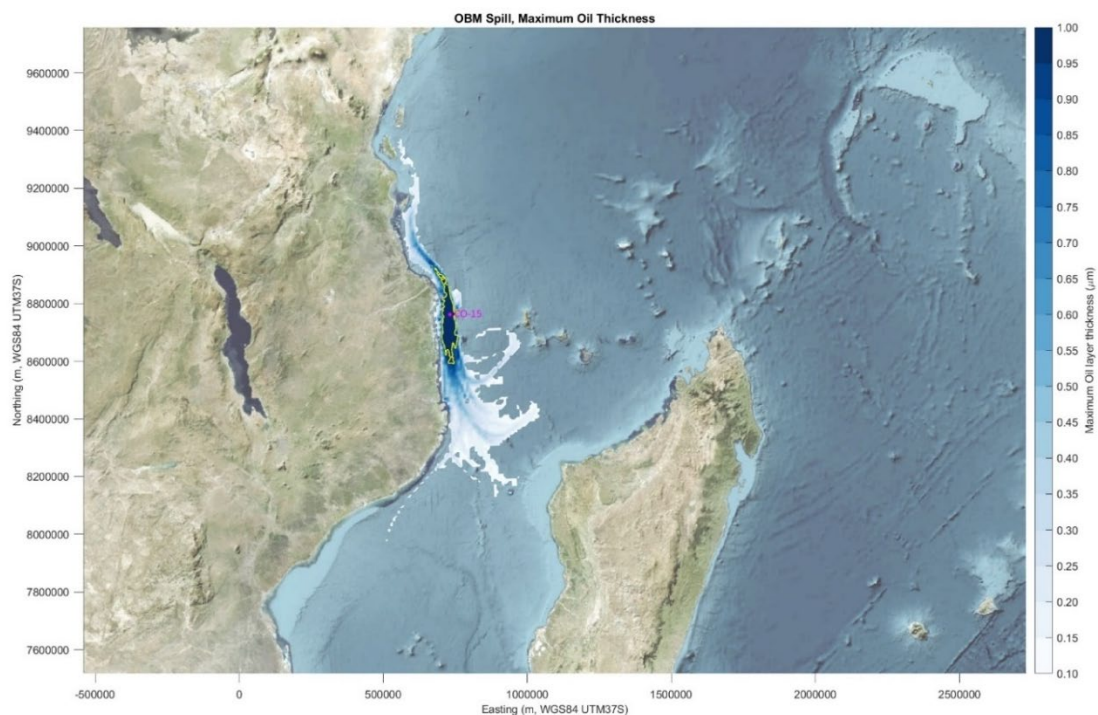


Figure 7.16: Maximum oil thickness for the LTOBM spill stochastic simulation

The simulations show the potential of the LTOBM spill likely traveling northwards and southwards along the coast of Mozambique and Tanzania. Dispersion of a spill southwards is shown to have the highest probability of occurrence, although depending on prevailing conditions there is significant likelihood of a spill traveling northwards. There are also indications of a spill traveling eastwards towards Madagascar and the Comoro islands. The simulations show a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania, although from results it is highly unlikely to ever reach the shorelines of Madagascar or the Comoro Islands. The expected time for a spill to reach shoreline is between one (1) to three (3) days. Figure 7.17 shows the probability of oiling (exceeding average oil thickness $> 0.1 \mu\text{m}$) reaching a specific area.

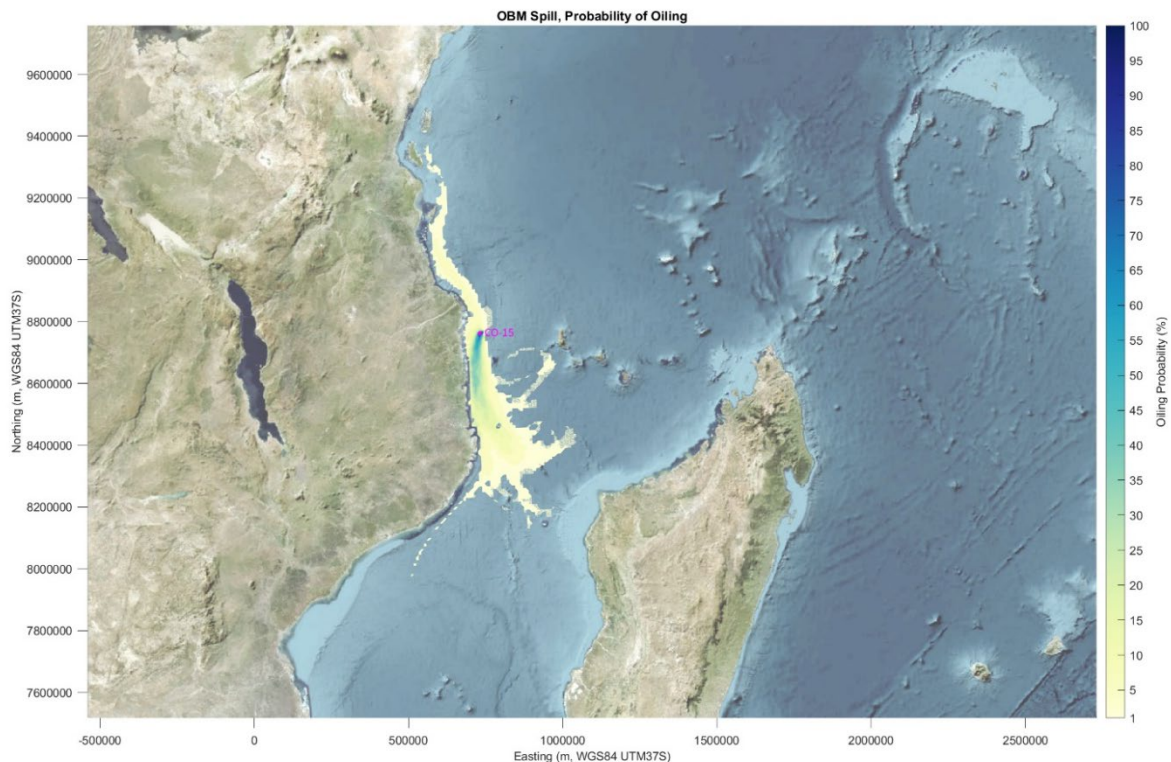


Figure 7.17: Probability of oiling for the LTOBM spill stochastic simulation

The average oil thickness derived from the probabilistic mapping shows a cumulative extent of approximately 145,000 km² for the potential of visible oil (thickness $> 0.1 \mu\text{m}$). The potential region where it can be considered to have a harmful effect on sea life (thickness $> 1 \mu\text{m}$), is however shown to be limited to a relatively close proximity of the discharge point with a cumulative extent of approximately 9,200 km² (see yellow isoline on Figure 7.16). From the 100 individual results, the extent of the median simulation was determined as 8,280 km² (ranging from 2,918 km² to 23,420 km²) for the visible oil and approximately 631 km² (ranging from 237 km² to 1,656 km²) for thickness considered to have a harmful effect on sea life.

The simultaneous discharge of an accidental spill event is of a short duration. The result from the modelling shows that when a spill event occurs, it is expected that weathering of the oil will reduce thickness to below levels harmful to sea life within 24 hours and further weathering to below levels of visible oil will occur within 10 days.

Considering the modelling results and seawater ambient quality standards, the risk of non-compliance with the “virtually absent” standard resulting from a condensate spill from an accidental LTOBM release is assessed as a negative and direct impact, of short term duration (weathering to below levels of visible oil will occur within 10 days), of international scale (the oil spill may reach Tanzania, although with low probability), and high intensity (given the non-compliance with the ambient water quality standard), resulting in a high consequence. As the probability of such a LTOBM spill is relatively low (possible), the resulting significance is assessed as medium.

Mitigation Measures

Mitigation controls are mostly preventive measures to eliminate a riser disconnection and any associated impacts from occurring. They also include response activities to minimize the impacts if a riser disconnection occurred.

To avoid an unplanned release from a riser disconnection, all drilling staff, drilling supervisors, and all third-party contactors must be competent and fully trained to undertake drilling operations with all the necessary certifications.

If an unplanned event occurs, all response activities must be conducted according to MRV's policies and procedures. Prior to commencement of operations, the drilling contractor must prepare plans following MRV's well control manual and procedures must be bridged to ensure alignment and consistency to the highest standard. Additionally, once drilling operations are initiated periodic safety drills shall be conducted by drilling supervisors to ensure readiness of drilling crews and third party service providers. Additional mitigation controls include:

- Well Plans: MRV should conduct reviews of the well drilling plans by subject matter experts to assure operational readiness;
- Oil Spill Contingency Plan (OSCP): develop and implement a comprehensive OSCP;
- Incident Management and Crisis Management Support Teams: develop teams of highly trained leaders to respond quickly to emergencies;
- Equipment: Tier 1 oil spill response equipment will be staged on support vessels and/or at shore.
- Stakeholder Agreements: Communicate with stakeholders prior to spill response operations informing potentially affected communities of the OSCP procedures.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a riser disconnection and response efforts will minimize the extent of the oil slick, if such an event does occur. For the post mitigation assessment, it was assumed all spill response protocols were applied, all trained staff reacted appropriately, and all containment methods were deployed to minimize the spread of the spill. As a result, the spill would be prevented from reaching the shorelines and surface oiling maintained within a much closer vicinity to the well location, and not travelling into Tanzania's waters. This will reduce the extent from international to regional, the intensity from high to moderate, and further reduce the probability of impact occurring. The overall residual significance score is reduced

to very low after successful application of mitigation measures. The impact assessment summary is provided in the following table.

Impact WQ7: Risk of seawater quality degradation resulting from an LTOBM release due to an accidental riser disconnect (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	International	High	Short-term	High	Possible	MEDIUM	-‘ve	High
	3	3	1	7				
- Well drilling plans should be reviewed by subject matter experts to assure operational readiness; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce of all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Regional	Medium	Short-term	Low	Improbable	VERY LOW	-‘ve	High
	2	2	1	5				

7.6 Landscape and Seascape

7.6.1 General Considerations

This section evaluates the possible impacts associated with the Project implementation and operation on landscape character and on visual amenity. These two different types of impacts can be described as:

- Impacts on landscape character – changes to a landscape and/or seascape unit's characteristics (character, value, sensitivity) due to the presence of project components or activities within that landscape unit;
- Impacts on visual amenity – visual impacts caused by the presence of the project activities or components on sensitive visual receptors within the zone of theoretical visibility (ZTV – see Volume I; section 6.8.1).

Impact significance for landscape and visual amenity is generally derived on the basis of the following main factors:

- Quality and/or importance of the landscape and/or visual amenity as a resource/function that is potentially affected;
- Sensitivity of the landscape and/or visual amenity towards Project activities; and
- Magnitude of change to the receiving landscape and visual amenity as a result of the Project.

The impact assessment on landscape character and visual amenity based on this approach is provided in the following sections.

7.6.2 Impacts on Landscape and/or Seascape Character

7.6.2.1 Impact Assessment Criteria

Landscape sensitivity can be assessed by the ability of a particular landscape character to absorb aesthetic alterations caused by Project activities and/or components. The following criteria are considered:

- Seascape character, value, and sensitivity;
- Magnitude of change.

The seascape units have been previously defined and described in the baseline (see Volume I; section 6.8) are as follows:

- Peninsulas of Cape Delgado and of Afungi Seascape Unit;
- Afungi Peninsula to Cabo Messangi Seascape Unit;
- Quirimbas Archipelago Seascape Unit.

The impact magnitude and receptor sensitivity criteria for landscape has been provided in Table 7.30 and Table 7.31 respectively.

Table 7.30: Landscape and/or seascape magnitude

Rating	Extent / Duration / Scale / Frequency
Large	A clearly evident and frequent /continuous change in landscape characteristics affecting an extensive area.
Medium	A moderate change in landscape characteristics, frequent or continuous, and over a wide area, or a clearly evident change either over a restricted area or infrequently perceived.
Small	A small change in landscape characteristics over a wide area or a moderate change either over a restricted area or infrequently perceived.
Negligible	An imperceptible, barely, or rarely perceptible change in landscape characteristics.

Table 7.31: Landscape and/or seascape sensitivity criteria

Rating	Designation / Importance / Vulnerability
High	A landscape protected by a regional (structure plan) or national designation and/ or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.
Medium	A landscape protected by a structure plan or national policy designation and/ or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.
Low	A moderately valued landscape, perhaps a locally important landscape, or where its character, land use, pattern and scale may have the capacity to accommodate a degree of the type of change envisaged.

7.6.2.2 Impact Assessment

Impact L1: Project impacts on landscape and / or seascape character

Impact Assessment

As stated in the previous section, landscape impacts occur when the characteristics (character, value, and sensitivity) are changed by the Project's presence. The project's activities will include:

- Drilling phase – operation of drilling and support vessels at the drilling sites;

- Installation phase, covering both the subsea infrastructure and positioning of the FLNG, with use of installation and support vessels;
- Commissioning and startup of the FLNG plant, including flaring;
- Operations - with the long-term presence of the FLNG, flare stacks and turret, and operation of support vessels;
- Decommissioning – with removal of the FLNG, with use of tugs and support vessels.

As such, Project activities will mostly take place at the Coral FLNG site, with the support of associated vessels. None of these Project activities changes the characteristics of any of the more inshore seascape units defined in this study: the Peninsulas of Cabo Delgado and of Afungi Seascape Unit and the Afungi Peninsula to Cabo Messangi Seascape Unit. Given this, no landscape impacts on these seascapes are identified.

The Quirimbas Archipelago Seascape Unit is the only one which can experience landscape impacts, caused by:

- Drilling activities for the subsea production wells and installation of the offshore Project infrastructure; and
- Presence of vessels associated with development, drilling, installation of subsea infrastructure.

The FLNG location falls outside this seascape and thus is not considered to cause any landscape impacts (i.e., changes to the nature of this seascape) on the Quirimbas Archipelago Seascape Unit. The presence of the FLNG, and its flare, may generate visual impacts, but this is assessed in the following section.

Taking into account the distance of this Seascape Unit to the FLNG site, it is very likely that most Project vessels and helicopters will transit outside this Seascape Unit. Even if some vessels and or helicopters pass closer to land, and therefore affect this seascape unit, they will be likely indistinguishable from other vessel traffic in the region. As such, it is considered that a low magnitude of change will arise to this seascape of low sensitivity, thereby resulting in an impact on the character of this landscape considered to be negligible.

Using the standardized impact assessment methodology considered for this EIS, this impact is assessed to be negative, direct, of local extent (changes to landscape are limited to the presence of vessels and are thus localized), low intensity (for the most part, project vessel traffic will be indistinguishable from other vessel traffic in the region), and short-term duration (changes are limited to the short periods where vessels are passing through), thus resulting in a very low significance.

Mitigation Measures

Given the very low significance, no mitigation measures are required.

Impact Summary

The impact assessment summary is provided in the following table.

Impact L1: Project impacts on landscape and / or seascape character								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very Low	Probable	VERY LOW	-ive	High
	1	1	1	3				
- No mitigation is required.								
With mitigation	Local	Low	Short-term	Very Low	Probable	VERY LOW	-ive	High
	1	1	1	3				

7.6.3 Impacts on Visual Amenity

7.6.3.1 Impact Assessment Criteria

Visual impacts refer mainly to the visual character changes of available views resulting from project development, such as:

- Obstruction of existing views;
- Removal of screening elements, thereby exposing viewers to unsightly views;
- Introduction of new elements into the views;
- Intrusion of foreign elements into the viewshed of landscape features.

The impact magnitude and receptor sensitivity criteria for visual amenity has been provided in Table 7.32 and Table 7.33, respectively.

Table 7.32: Visual magnitude of effect criteria

Rating	Extent / Duration / Scale / Frequency
Large	Major changes in view at close distances, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of the view.
Medium	Clearly perceptible changes in views at intermediate distances, resulting in either a distinct new element in a significant part of the view, or a more wide ranging, less concentrated change across a wider area.
Small	Minor changes in views, at long distances, or visible for a short duration, perhaps at an oblique angle, or which blends to an extent with the existing view.
Negligible	A change which is barely visible, at very long distances, or visible for a very short duration, perhaps at an oblique angle, or which blends with the existing view.

Table 7.33: Visual sensitivity criteria

Rating	Designation / Importance / Vulnerability
High	Larger numbers of viewers and/or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and well-used recreational facilities. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being high.
Medium	Small numbers of residents and moderate numbers of visitors with an interest in their environment. Larger numbers of recreational road users. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being medium.
Low	Small numbers of visitors with interest in their surroundings. Viewers with a passing interest not specifically focused on the landscape e.g., workers, commuters. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being low.

When determining the significance of visual effects, the following is considered:

- Large scale changes which introduce new discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view;
- Changes in views from recognized and important viewpoints or amenity routes are likely to be more significant than changes affecting less important paths and roads; and
- Changes affecting large numbers of people are generally more significant than those affecting a relatively small group of users. However, in wilderness landscapes the sensitivity of the people who use the areas may be very high and this will be reflected in the significance of effect.

The visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context, and the sensitivities of Visual Sensitive Receptors (VSRs).

The offshore activities are related to the production and export of liquefied natural gas (LNG) from the FLNG and supporting activities such as supply vessels coming transiting to and from the onshore port, operation of tug vessels and multi-purpose vessels in the FLNG proximity and docking and material movements to and from the FLNG and supply vessels.

The onshore Project components are related to onshore personnel and support logistic operations to the offshore FLNG and will be carried out from mainly the Pemba Port located in the south and outside of the Area of Influence (AoI). Most, if not all, onshore activities will be undertaken within the physical footprint of existing facilities (Maputo and Pemba offices, Pemba port and airport).

The ZTV (shown in Figure 6.16; Volume I, section 6.8.1), indicates that some components of the Project will theoretically be visible from the islands in the Quirimbas archipelago, and from the settlements of Maganja and Lalane.

However, the long distance of the Project from the islands and the coast and the presence of vegetation will restrict the visibility of the Project only to the littoral zone.

Receptors crossing the area of interest, either by land or sea, are assumed to have a low to medium level of sensitivity to change caused by project implementation due to the transitory nature of their exposure to change. However, sensitivity may be influenced by the purposes of transit through the area.

Tourists for recreational and leisure purposes include a variety of individual interests; however, generally the main purpose of the journey is to immerse themselves in nature and the typical landscape and/or seascape of the area. The sensitivity of visitors will differ according to their interests, however, the naturality of the landscape is an important factor; therefore, the sensitivity of these receptors will be considered high. These visitors will be potentially impacted as users of the island's beaches for recreational purposes or the ocean for water sports or boating.

Tourism is an important element of the local economy, especially for the coastal area and the Quirimbas Archipelago. Even though at this time, tourism is absent from the district (due to security issues), it was assumed that tourist activity would return to the district within the project timeframe. Tourism is influenced by the attractiveness of the natural environments and the abundant biodiversity that characterise these wilderness areas.

Workers, both at sea, such as fishermen, and on land, such as farmers, are generally focused on the work at hand; therefore, their sensitivity is considered low.

7.6.3.2 Impact Assessment

Impact L2: Project impacts on visual amenity

Impact Assessment

During the drilling and Subsea Production System installation phases, the parts of the coastline and seaward components will be affected by the visibility of the support vessels. The seascape units will not be traversed directly by ships and helicopters; however, their passage may be visible from land.

Considering the distance from the coast, the limited visibility of the project and the absence of direct transit of vessel and helicopter in this Unit, an impact of negligible significance is expected during the drilling and Subsea Production System (SPS) installation phases of the Project.

Specific considerations were made for each VSR during the operational phase, and the impact significance, receptor sensitivity, and impact magnitude are summarized in Table 7.34.

Table 7.34: Summary of visual impact

VSR	Site	Sensitivity of receptor	Magnitude of visual effect	Significance of visual effect
1	Cabo Messangi	Medium	Negligible	Negligible
2	Lalane Beach	Medium	Negligible	Negligible
3	Metundo Island (beach in the north of the area) is mainly a touristic island where a luxury lodge is present.	Medium	Negligible	Negligible
4	Vamizi Island (beach on north)	Medium	Negligible	Negligible
5	Vamizi Island (beach on north-eastern tip)	Medium	Negligible	Negligible
6	Rongui Island	Medium	Negligible	Negligible
7	Cape Delgado (on the eastern tip of the peninsula)	Medium	Negligible	Negligible
8	Settlement of Quiwía	Small	Negligible	Negligible

Impacts from the selected viewpoints are not expected due to the distance of the FLNG Vessel. Wireframe visualization shows that from the viewpoint 5 (the closest to the Project) the Flare of the FLNG was visible as a thin line on the horizon, assuming a flare height of 262 m (Figure 7.18), and the top of the deck will be barely perceptible on the horizon. In no scenario, will the entire FLNG be visible from any observation point in the islands or mainland.

Wireframe (Field of view 45°)



Construction lines



Zoom Detail



Figure 7.18: Wireframe view and construction lines from viewpoint 5

Using the standardized impact assessment methodology considered for this EIS, the Project's impact on visual amenity impact is assessed to be negative, direct, of local extent (project visibility will be very limited from land), low intensity (even if visible, the top of the FLNG will be seen as a thin line on the horizon), long-term duration (project lifetime), and low probability, resulting in a very low significance.

Mitigation Measures

Despite the very low significance, the following mitigation measures are defined, to further minimize the probability of occurrence of visual impacts:

- FLNG lighting will be restricted to the minimum required for safety and security;
- Whenever possible, directional lighting will be used to limit light spill (i.e., spread of light outwards from where it is needed into adjacent areas).

Impact Summary

The impact assessment summary is provided in the following table.

Impact L2: Project impacts on visual amenity								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-‘ve	High
	1	1	3	5				
- FLNG lighting will be restricted to the minimum required for safety and security; - Whenever possible, directional lighting will be used to limit light spill (i.e., spread of light outwards from where it is needed into adjacent areas).								
With mitigation	Local	Low	Long-term	Low	Improbable	VERY LOW	-‘ve	High
	1	1	3	5				

7.6.4 Cumulative Impacts with Coral South FLNG

Impact L3: Cumulative impacts on landscape character and visual amenity from Coral South and Coral North FLNGs

Impact Assessment

Cumulative impacts are the result of the combination, or even the synergetic effect, of various past, present, or future projects or human activities. Potential cumulative impacts with the Coral South project, which is currently in its operational phase, are considered.

The Coral North and Coral South are very similar, in terms of their potential impacts on landscape and visual amenity. The potential impacts of the Coral South are expected to be even smaller than Coral North, as it is further away from the considered VSR.

Given the location and the distance of the two Coral projects:

- During the drilling and SPS installation phases, the visibility impact of the Coral North is expected to be negligible considering the limited visibility of the project and the absence of direct transit of vessel and helicopter. Therefore, a cumulative effect in terms of visual impact of the area with the Coral South Project is not expected;
- During the operational phase, the visibility impact of the Coral North is expected to be negligible with no cumulative impact with the Coral South.

Using the standardized impact assessment methodology considered for this EIS, the cumulative impact of Coral South and Coral North on landscape and visual amenity is assessed to be negative, direct, of local extent (project visibility will be very limited from land), low intensity (even if visible, the FLNGs will be seen as a small dot on the horizon), long-term duration (project lifetime), and low probability, resulting in a very low significance.

Mitigation Measures

No additional mitigation is required for this cumulative impact, beyond the proposed above to minimize Coral North impacts.

Impact Summary

The impact assessment summary is provided in the following table.

Impact L3: Cumulative impacts on landscape character and visual amenity from Coral South and Coral North FLNGs								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Possible	VERY LOW	-ve	High
- FLNG lighting will be restricted to the minimum required for safety and security; - Whenever possible, directional lighting will be used to limit light spill (i.e., spread of light outwards from where it is needed into adjacent areas).								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Improbable	VERY LOW	-ve	High

7.7 Biodiversity

7.7.1 General Considerations

Potential impacts on biodiversity may arise from several project activities in the different phases of the Project. These can, however, be divided into effects of a more temporary nature, associated with the drilling, installation, commissioning, and decommissioning phases, and effects of a more continued nature, associated with the operational phase, including the short-term start-up activities. The impacts of the former phases are mostly related to the activities of vessels in the project site and with the installation and removal during decommissioning of the subsea infrastructure, while the impacts of the latter are associated with the operation of the FLNG facility (production of LNG and its export).

Several impacts associated with drilling, installation, commissioning, and decommissioning phases will be very similar (such as emission of noise, light, waste, etc.), as the sources of these impacts are also similar (the movement and activities of vessels). The impacts of the operational phase, however, are more specific, such as those associated with the FLNG discharges or noise emissions. As such, and for clarity purposes, the impact assessment has been divided into the following sections:

- Impacts of the drilling, installation, commissioning, and decommissioning phases;
- Impacts of the operational phase;
- Impacts associated with unplanned events.

These are presented and discussed in the following sections.

7.7.2 Drilling, Installation, Commissioning, and Decommissioning Phases

7.7.2.1 Potentially Impact Generating Project Activities

The main project activities with potential biodiversity impacts in these phases include:

- Drilling activities, including discharge of drill cuttings and drilling fluids – these could lead to impacts on benthic communities, due to smothering and burial of organisms, and to the degradation of water quality, which would then lead to indirect impacts on marine biota;
- Increase vessel movements and drilling operations – these will result in atmospheric and underwater noise and light emissions, which may result in the disturbance of marine fauna and avifauna, and will also increase the risk of collisions or entanglement with marine fauna;
- Wastewater discharges – discharge of liquid effluents normally associated with any marine vessel, including domestic effluents, bilge water, etc. These discharges may impact on water quality, and indirectly on marine biota;
- Waste generation and management – the management and disposal of solid waste generated aboard the vessels during these phases could lead to impacts on water quality, and indirectly on marine biota;

- Potential discharge of ballast waters – the drilling and installation phases will require sourcing international vessels. Any discharge of ballast waters taken in outside of Mozambican waters would result in the risk of introduction of marine alien species, and potential impacts on local biodiversity.

Potential impacts on marine habitats and fauna generated by these activities are discussed below.

7.7.2.2 Impact Assessment

Impact BIO1: Effects of vessel liquid effluents on marine ecology due to changes in water quality

Impact Assessment

The vessels used during drilling, installation, commissioning, and decommissioning will generate liquid effluents such as deck and machinery space drainage, bilge water, and sewage discharge. These discharges may have the potential to degrade the marine water quality, mainly through toxicity and oxygen depletion, with associated potential secondary effects on marine biota. Untreated sewage imposes an organic and bacterial load on the natural biodegradation processes of the sea which could increase BOD₅ and cause anaerobic conditions in the receiving seawater.

These impacts may arise from operating vessels that are not compliant with the provisions of MARPOL 73/78. The vessels used in these project activities will be equipped with sewage treatment plants, oily water and sludge holding tanks, as per Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. Sewage effluent discharged during the project's activities will thus be treated onboard and disposed of in accordance with the requirements of MARPOL Annex IV (Sewage). Treated sewage and organic waste will not increase the bacterial load, although may increase BOD₅. However, as discussed in Impacts WQ3 and WQ4 above, increased BOD₅ concentrations from sewage discharges from a vessel with a compliant MARPOL sewage treatment plant are expected to be very low, with no relevant impact on the receiving water quality and subsequent secondary effects to marine biota.

Contaminants such as fuel, oil, lubricants and detergents in drainage and bilge water discharge into the sea may have a range of toxicity effects on marine biota. However, deck drainage may contain very small volumes of oil and grease, while machinery space drainage and bilge water will pass through onboard oil-water separators to ensure compliance with MARPOL Annex I prior to discharge.

Monitoring as part of the environmental monitoring programme of the Coral South Project shows that the water quality parameters from all sampling points are as would be expected for this offshore location, a well-mixed region of the Western Indian Ocean (Consultec & CLS, 2023a; 2023b), with minimal influence from anthropogenic sources including contribution from the Coral South FLNG and associated vessels. Similarly, vessel discharges during the drilling, installation, commissioning and decommissioning of the Coral North Project will not result in elevated levels of contaminants.

As long as the vessels comply with standard maritime regulation, minor to negligible impacts on water quality are expected and consequently secondary minor to negligible impacts on marine fauna are also expected.

The impact is considered negative and direct. The duration of the impact is short-term (restricted to the drilling, installation, commissioning, and decommissioning phases), the extent is local (minor to negligible impacts on water quality), and the intensity is low. The impact is thus of very low significance.

Mitigation Measures

All discharge of liquid effluents from project vessels shall comply with relevant international maritime standards and regulations, namely those set out in MARPOL (73/78) regulations. The main requirements and limits include the following:

- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains). Bund all process areas to prevent contamination by storm waters, contain spills and leaks, and channel drainage water into the closed drains;
- Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system;
- Disposal of liquid waste in accordance with MARPOL 73/78:
 - Liquid effluents must be treated before discharged to the sea;
 - Sewage must be treated (on-board treatment plant) prior to discharge;
 - Sewage treated effluent shall comply with the following emission limits: pH 6.0-8.5, of total suspended solids < 35 mg/l, BOD₅ < 25 mg/l, COD < 125 mg/l, thermotolerant coliform count < 100 MPN / 100 ml;
 - Discharge depth is variable; however, it should not be less than 5 m below the surface;
 - Route water from machinery spaces to the closed drainage system, or contain and treat the bilge water before discharge;
 - Use efficient and IMO approved oil and water separators with concentration of oil in the water after treatment not exceeding 15 ppm;
 - Contain oil and chemical use areas and equipment (deck, mud tanks and pumps).
- Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.

Impact Assessment Summary

The impact assessment summary is provided in the following table. Post-mitigation impact is assessed as insignificant.

Impact BIO1: Effects of vessel liquid effluents on marine ecology due to changes in water quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very low	Probable	VERY LOW	-ve	High
	1	1	1	3				
- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains); - Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system; - Discharge of deck drainage, bilge water and sewage shall comply with MARPOL 73/78 requirements; - Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.								
With mitigation	Local	Low	Short-term	Very low	Possible	INSIGNIFICANT	-ve	High
	1	1	1	3				

Impact BIO2: Effects of solid waste disposal on marine ecology due to changes in water quality

Impact Assessment

Daily routines in the vessels will generate several types of solid wastes, including domestic waste (plastics, paper, etc.), sanitary waste (biomedical waste), and potentially some hazardous wastes (packages of hazardous substances or materials, light bulbs, batteries, etc.). Inadequate management or inadvertent discharge of these wastes to marine waters may result in impacts in water quality and/or marine fauna, in the areas where these vessels are operating or even further afield (Ng & Song, 2010). An example includes wastes such as plastic material which may travel considerable distances and have negative impacts on marine turtles, which may mistake them as food. Food waste would be readily consumed and biodegraded in the marine environment and, as such, is not deemed to pose a risk to water quality.

This is a negative and direct impact, of short-term duration (limited to these temporary phases), local extent, and low intensity, resulting in a very low consequence. However, this impact is unlikely given MRV's and Contractor's compliance with international and strict internal company waste management standards and adequate disposal. Considering the low probability of occurrence, the significance is reduced to insignificant.

Mitigation Measures

Despite the very low significance of the pre-mitigation impact, standard good waste management will be applied in all project activities, in compliance with national and international regulations and guidelines, namely:

- Apply adequate handling, treatment, and disposal of hazardous, non-hazardous, and biomedical solid waste in order to comply with applicable environmental national regulations (Decree No. 8/2003 – regulation on biomedical waste management, Decree 83/2014 – regulation on hazardous waste management, and Decree 94/2014 – regulation on urban solid waste management), technical norms and international standards and best practices;

- Ensure implementation of a robust Waste Management Plan in order to avoid pollution of marine waters. This should be based on the following guidelines:
 - Kitchen waste shall be treated in accordance with MARPOL (73/78) regulations: food waste macerated to <25mm and discharged to sea;
 - No garbage shall be discharged closer than 12 nautical miles from the nearest land;
 - All other solid waste must be segregated and temporarily stored and contained on the vessel, for appropriate treatment and/or disposal at port, in compliance with Annex V of MARPOL. No hazardous wastes will be discharged to the sea, under any circumstances.
- Ensure that all crew members directly involved in waste management activities receive appropriate training in waste management procedures.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO2: Effects of solid waste disposal on marine ecology due to changes in water quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very Low	Possible	INSIGNIFICANT	-'ve	High
	1	1	1	3				
- Apply adequate treatment and disposal of solid waste in order to avoid pollution of marine waters; - Apply all solid waste management measures according to national regulations and international standards and best practices; - Food solid waste will be treated in accordance with MARPOL (73/78) regulations; - All other solid waste must be segregated and temporarily stored and contained on the vessel, for appropriate treatment and/or disposal onshore in compliance with Annex V of MARPOL; - Train crew members on waste management procedures.								
With mitigation	Local	Low	Short-term	Very low	Improbable	INSIGNIFICANT	-'ve	High
	1	1	1	3				

Impact BIO3: Effects of the discharge of drill cuttings on marine ecology due to changes in water quality

Impact Assessment

As discussed above in Impact WQ1, drilling activities will generate drilling wastes, including cuttings (rock fragments) and used muds:

- During the drilling of the upper sections of the wells, WBM will be used. All the fluids and cuttings will be dispersed at seabed, as at this stage the riser has not been installed. It is estimated that roughly 250 m³ of WBM cuttings and WBM will be dispersed at seabed, per well;
- Once the initial portions of a well have been drilled, a riser will be installed, which allows material (drilling muds and cuttings) to be returned to the drilling rig. As such, all the LTOBM and cuttings from the lower sections will be brought up to the drilling vessel and transferred by cutting skips and tanks to shore for treatment and disposal, unless it is not possible due

to technical and operational constraints. It is estimated that roughly 250 m³ of LTOBM cuttings will be recovered to surface, for each well.

As such, with the exception of the WBM discharged during the drilling of the upper sections of the wells, drilling waste produced by the offshore drilling operations will be collected in containers certified for the specific waste typology and shipped to shore. Third-party contractor onshore facilities will treat and dispose drilling waste, in compliance with country regulations, MRV's waste management standards, and Good International Industry Practice for waste management.

This impact thus focuses on the potential impact of the discharge of both WBM during the drilling of the upper well sections and the release of treated LTOBM from the lower well sections on water quality, and indirectly on marine ecology. These discharges may lead to an increase in the concentration of contaminants in the marine environment (degradation of water quality), with any significant reduction in water quality leading to secondary effects on marine fauna in terms of morbidity or mortality, change in behaviour or simply displacement from preferred feeding areas.

WBMs for use in the offshore oil and gas industry comprise mainly seawater (approximately 75%) with the addition of barite and bentonite to control mud density. Other compounds are added as necessary to achieve the desired properties for a particular situation (OGP, 2003). WBMs are generally considered to be the least toxic of the drilling muds (Patin, 1999). However, WBMs do contain heavy metals in the barite component, which have the potential to pollute the marine environment; however, the selected WBMs will contain minimal amounts of barite.

Water quality may potentially be affected in two ways through the disposal of drill cuttings: increased turbidity, and contamination.

WBMs and cuttings from drilling the upper parts of the well will be discharged directly to the seafloor, where they are unlikely to affect the turbidity of the water column above (the density of the mixture will lead to particles settling to the sea floor). The discharge of WBMs may temporarily reduce water quality, but this is likely to be restricted to the duration of the discharge and localized to the well site (Impacto, 2008a).

According to Neff (2005 in Impacto, 2008), when WBMs and cuttings are discharged to the ocean, the larger particles and flocculated solids, representing about 90% of the mass of the mud solids, form a plume that settles quickly to the bottom. The remaining 10% of the mud solids mass, which consist of fine-grained unflocculated clay-sized particles and a portion of the soluble components of the mud, forms another plume in the upper water column that drifts with prevailing currents away from the rig and is diluted rapidly in the receiving waters.

Once the initial portions of a well have been drilled, a riser will be installed, and LTOBM muds and cuttings will be returned to the surface. The preferred option is for the LTOBM waste to be transported and managed onshore. However, this may not be always possible due to technical or operational constraints, in which case LTOBM muds and cuttings will be treated aboard the drillship (removal of LTOBM) and discharged at mean sea level. These drill cuttings will still be "wet" when discharged from the rig and will tend to clump together and settle quickly to the seabed. As a result of rapid settling, these drill cuttings do not disperse in the water column or significantly increase water column

turbidity (Neff *et al.*, 2000). Beyond the immediate vicinity of the drill site, the concentrations of suspended sediments introduced into the environment by drilling operations are typically less than the naturally occurring suspended sediments in the water column. Water turbidity only increases slightly at the discharge point and immediate vicinity.

This is substantiated by the modelling study developed for this EIA, where a possible discharge of LTOBM cuttings was modelled (see Annex VII for the detailed results and Impact WQ1 above for a summary). The modelling showed that increased turbidity (TSS concentration) was very low (maximum modelled concentration of TSS was 0.23 mg/l) and limited to a small area, 25 m, around the well. This increase of suspended solids is very unlikely to cause light impacts, especially at depths below 1,800 m, well below the photic zone (100-200m) where photosynthesis occurs in the ocean (Consultec & Advisian, 2023a).

Based on these results, the discharge of drill cuttings from the wells will thus produce localized turbidity within the water column, which will disperse and dilute rapidly at a rate dependent upon ambient oceanographic conditions. Once discharges cease, ambient water quality conditions will return within minutes to hours (Impacto, 2008).

Regarding the potential contamination of the water column, experimental and field studies have shown that acute toxic effects of WBM can be manifested only at high concentrations. Such concentrations can only be found within a few meters of the discharge point (Patin, 1999). Laboratory and field studies of 60 samples of WBMs showed that toxicity was lower than the limit set by the United States Environmental Protection Agency (USEPA) (96 h LC50⁴ must exceed 30 000 mg/L). Almost 80 % of the samples tested were considered practically non-toxic (Patin, 1999). Toxicity effects from LTOBM are expected to be higher; however, Ogeleka and Tudraro-Aherobo (2013) found a 96 h LC50 of 131 833 mg/l for a shrimp species exposed to synthetic drilling muds, thus above the USEPA limit.

The specific constituents of the drilling muds proposed in this project will be of low toxicity; therefore, it is unlikely that significant negative impacts in water quality and indirect impacts to marine biota will occur as a direct result of the drilling activities. Most cuttings from drilling will be discharged only after treatment (the exception being the top section WBM cuttings) and within the limit of oil content standards (oil content is less than 1%; Huang *et al.*, 2018), in order to minimize potential negative impacts.

Potential changes in water quality due to discharge of drill cuttings include increased turbidity and contaminant load. However, these changes are expected to be low, and restricted to the immediate proximity of the drilling sites as assessed through modelling (see Impact WQ1). Only negligible increases in the concentration of contaminants are expected further afield, and as such any indirect impact on marine biota will be restricted to a small portion of the pelagic environment surrounding the drilling sites. Given the distance (more than 50 km) from the Coral North drilling activities from the coast, no impacts are expected on the more sensitive coastal and nearshore habitats.

⁴ Lethal Concentration 50 - Concentration in which 50% of test organisms die after exposure to constant conditions over a 96-hour period

Free-swimming organisms (marine mammals, turtles, and fish) will be able to evade any areas where water quality is unfavourable and avoid any negative effects of toxicity. Given that the expected affected area would be close to the drilling rig, it is unlikely that these animals will be displaced from particular feeding grounds. Benthic communities at the proposed drilling sites are characterized by relatively low densities and no sensitive habitat or species of conservation concern was identified through the baseline characterization (as described in the biodiversity baseline section; Volume I).

Consequently, the potential impact on marine ecology due to changes in water quality associated with drilling activities is assessed as a negative and direct impact, of short term duration (any changes to water quality will be temporary, once discharges cease, normal water quality conditions will return within minutes to hours), local extent (restricted to a small area surrounding the drilling sites), and low intensity (low increases of pollutants are expected and no sensitive habitats or species are likely to be affected), resulting in a very low significance.

Mitigation Measures

Although the impact was assessed as of low significance, the adoption of industry best practices regarding the management of drilling fluids and discharge of cuttings is still recommended, namely:

- Use low toxicity WMB for the drilling of the initial well sections. The concentrations of mercury and cadmium in the barite used in the water-based drilling fluids should not exceed 1 mg/l and 3 mg/l, respectively, as per USEPA's recommendation;
- Use of mud recovery systems for LTOBM;
- Ensure that LTOBM drilling waste is collected in containers certified for the specific waste typology and shipped to shore for treatment and disposal, as per the Project design; or
- If there is a need to discharge LTOBM cuttings offshore, the cuttings should be treated aboard prior to discharge, passing through a solids control and LTOBM removal system prior to discharge into the sea, in compliance with international practices. Monitoring shall be performed onboard the rig to ensure that the oils are removed from the cuttings such that less than 1% oil remains adhered to the cuttings prior to disposal;
- All chemicals used should conform to internationally accepted standards and submitted to MAAP and National Petroleum Institute (INP) for approval when necessary before the drilling activities commence;
- During drilling operations, all safety protocols must be strictly followed and all personnel must be experienced and well trained to prevent unplanned releases of LTOBMs beyond the planned allowable quantities;
- Pre-start readiness checks and frequent periodic inspections of equipment shall be in place for LTOBM operations;
- Use of all drilling fluid components and other chemicals should be monitored and recorded;
- WBM mud and cuttings and treated LTOBM cuttings will be discharged into sea in compliance with international practices.

Impact Assessment Summary:

The impact assessment summary is provided in the following table. Although the application of mitigation results in a decrease of probability of impact, the impact significance remains very low.

Impact BIO3: Effects of the discharge of drill cuttings on marine ecology due to changes in water quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Short-term	Very low	Definite	VERY LOW	-‘ve	Medium
	1	1	1	3				
- Use low toxicity WBMs only, for the drilling of the initial well sections; - Use mud recovery systems for LTOBM; - Monitor and record the use of all drilling fluid components and other chemicals; - If there is a need for LTOBM discharges offshore, monitoring shall be performed onboard the rig to ensure that the oils are removed from the cuttings such that less than 1% oil remains adhered to the cuttings prior to disposal; - Manage and discharge WBM and treated LTOBM mud and cuttings in compliance with international best practices.								
With mitigation	Local	Low	Short-term	Very low	Probable	VERY LOW	-‘ve	Medium
	1	1	1	3				

Impact BIO4: Effects of discharge of drilling muds and cuts on deepwater benthic macrofauna due to smothering and burial effects

Impact Assessment

In addition to the potential changes to water quality from the discharge of drill cuttings (see impact BIO3), this activity may also lead to impacts on deepwater benthic macrofauna due to smothering. As noted in the Volume I, section 6.9.2.3, the predominant habitat at the Coral North location is 'deep sea uniform clay' and limited areas of silty clay, boulders, steep slope, and ledges. The marine benthos at the Coral North location is sparse although with high diversity. Deepwater benthic communities observed in the vicinity of the well sites include soft bottom communities and isolated invertebrate colonies on harder substrates.

When drill cuttings are discharged to the sea, the larger fragments sink rapidly to the sea floor forming a pile and the finer particles are carried further afield by residual currents. The cuttings pile may smother the marine benthos around the well site, regardless of the type of drilling fluid used. The shape and depth of the cuttings pile is determined by the quantity and rate of discharge as well as the oceanographic parameters in the region, such as water depth, current speed, and current direction.

The potential smothering effect resulting from the deposition depends on the sensitivity of the specific benthic organisms that may be affected. There is thus no maximum accepted thickness threshold, above which significant impacts are expected to occur on benthic fauna, as this varies depending on the tolerance of the specific benthic species present, as well as the nature of the deposited materials. However, some authors recommend using a thickness value of 50 mm for a month deposition as a threshold for impacting benthic communities (Ellis & Heim, 1985; MarLIN, 2011). Although threshold values as low as 1 mm have been reported (e.g., Smit *et al.*, 2006), they are associated with instantaneous burial of material on benthic species, not a gradual sedimentation which would provide

opportunity for organisms to remove the load. Therefore, a threshold of 50 mm is used in this study to examine the risk of benthic impacts related to a gradual burial.

The potential smothering effect from the discharge of drill cuttings was assessed through dedicated modelling for this EIA. The modelling approach and results are provided in Annex VII (Volume IV), and the main findings are discussed below, to support the impact assessment.

Figure 7.19 shows the maximum particle deposition thickness for released cuttings and adhered residual LTOBM at the end of the drilling and discharges for one of the production wells (well CO-15). Particles primarily settle within a 450 m² area, which represents the cell area at which discharge takes place and the maximum deposit is estimated to reach a peak of 3.03 m thick. This highly localized deposit is due to the large grain size and associated high settling velocity of the drill cuttings combined with low current velocities at the seabed.

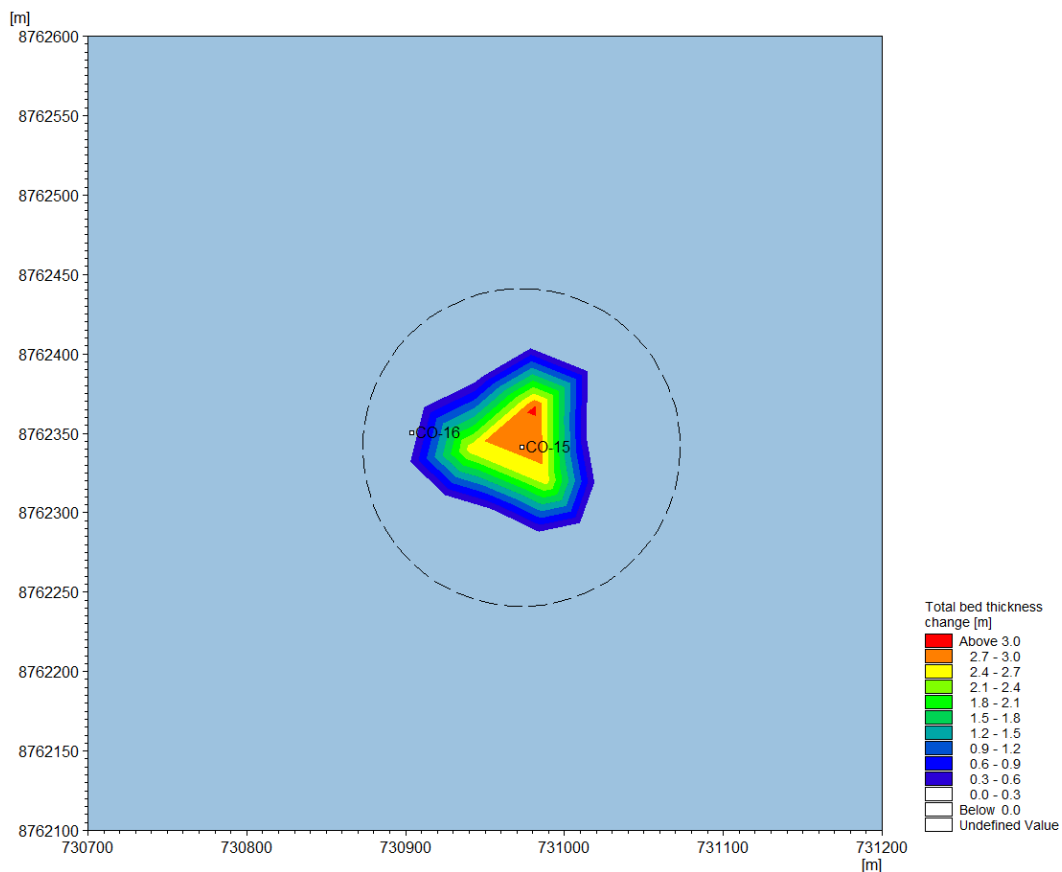


Figure 7.19: Maximum depositional thickness at the end of all drilling and deposition

As such, exceedances of the 50 mm threshold are expected for all six wells, although this will be limited to a relatively small area around the well, within 100 m of the discharge point. Smothering effects resulting from the drilling phase will thus affect a very small portion of the deepwater benthic habitats of the study area.

In addition to the smothering effects of the cuttings, residual LTOBM adhering to the cuttings may contaminate the surrounding water and sediment. It is generally believed that the main agents of

toxicity in drill cuttings are the oil and oil products, characteristic of Oil Based Muds (OBM) (Patin, 1999).

Only WBM and new generation LTOBM will be used, which have low concentrations of aromatic compounds and are completely recyclable. Synthetic components are generally less toxic due to reduced concentrations of aromatic compounds and are less persistent in the environment (OGP, 2003).

The deposition of LTOBM cuttings on the seabed is likely to increase the BOD₅ in the underlying sediment – anoxia is caused by a combination of organic enrichment increasing the biochemical oxygen demand, and introduction of fine sediments restricting oxygen penetration into sediments (Xodus, 2017). This consumption of available oxygen in the sediments may lead to changes in the benthic systems until the drilling fluid has been sufficiently degraded to allow the re-establishment of the natural biota (OGP, 2003).

This is in line with studies in the Norwegian North Sea, that have shown that the discharge of cuttings associated with the use of WBMs and LTOBMs (as opposed to the more toxic OBMs) have little or no effect on benthic fauna more than 250 m from the well (OGP, 2003).

Detected ecological changes attributed to drilling practices have typically been found within 200–300 m of the well-head (e.g., Currie and Isaacs, 2005; Gates and Jones, 2012 in Cordes *et al.*, 2016), and can occasionally extend to 1–2 km for sensitive species (Paine *et al.*, 2014).

While the impact will be negative and direct, it will be of medium duration (recovery of the affected communities may take a number of years), medium intensity (any affected benthic community will experience modified natural processes), and local extent (limited to a small area around each well), resulting in a low significance.

Mitigation Measures

The following mitigation is proposed:

- Prior to the start of drilling, a detailed Remote Operated Vehicles (ROV) analysis of the drilling sites should be undertaken, in order to confirm the presence and/or absence of any sensitive benthic habitat or benthic community as noted during the baseline survey (Fugro, 2016b). If a low or high relief habitat or community are identified, the drilling location should be adjusted at least 250m away to avoid directly affecting the more sensitive habitat. Harder substrates will be avoided;
- Implementation of the proposed mitigation measures to avoid changes in water quality due to the discharge of drilling muds and cuttings will also help mitigate any impact on deep water macrobenthos.

Impact Assessment Summary

The impact assessment summary is provided in the following table. The proposed avoidance measures will lower the impact intensity, resulting in a very low significance residual impact.

Impact BIO4: Effects of discharge of drilling muds and cuts on deepwater benthic macrofauna due to smothering and burial effects								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Medium-term	Low	Definite	LOW	-‘ve	Medium
	1	2	2	5				
- Undertake ROV analysis of the drilling sites prior to start of drilling. Adjust the exact drilling location, as much as possible, in order to avoid impacting on any sensitive benthic community or habitat that may be identified. Harder substrates will be avoided; - Use low toxicity WBMs only, for the drilling of the initial well sections; - When LTOBMs are used, use mud recovery systems; - Monitor and record the use of all drilling fluid components and other chemicals; - Manage and discharge WBM and LTOBM mud and cuttings in compliance with international best practices.								
With mitigation	Local	Low	Medium-term	Very low	Definite	VERY LOW	-‘ve	Medium
	1	1	2	4				

Impact BIO5: Effects of noise on marine fauna in the drilling, installation, commissioning, and decommissioning phases

Impact Assessment

In deep water locations, typical noise levels are expected to lie in the range 90-110 dB re 1 μ Pa over a 1 Hz frequency band (Consultec & Advisian, 2023b; National Research Council *et al.*, 2003). Analysis of the acoustic data collected during the OEBS (Fugro, 2016) covering a 20 km diameter centred on the Coral South site, approximately 13 km from the Coral North FLNG facility, indicated that over a 2-day period, mean spectral noise levels were somewhat lower, lying in the range 55-60 dB re 1 μ Pa/Hz despite short term (<2 minute) incursions of 70 dB re 1 μ Pa/Hz, and corresponding to noise levels in the range 100-110 dB_{rms} re 1 μ Pa.

During the drilling, installation, commissioning, and decommissioning phases, the main project activities that could generate noise impacts on marine fauna include:

- Drilling of production wells: drilling noise is generated principally through the action of the drill bit on the surrounding rocks. The level of noise created is dependent on the size of the drill bit and on the degree to which the seabed rock is consolidated. Given the information available for the Coral North drilling methodology and drilling sites, drilling noise peak, sound pressure level (SPL), was estimated as 162.6 dB re 1 μ Pa @ 1 m;
- Vessel movements: noise from vessels is a major contributor to the overall noise in a given sea area. Vessels expected to be used during these project phases include one (1) drilling ship, three (3) Platform Supply Vessels (PSVs), two (2) installation vessels, and one (1) Multi-Purpose Vessel (MPV). Peak sound pressure levels (SPL) emitted by these vessels vary between 177.8 and 183.8 dB re 1 μ Pa @ 1 m.

In order to evaluate this potential impact, an underwater acoustic modelling of the propagation and potential impact on the marine biota from the Coral North project was carried out using the site specific baseline noise levels (Consultec & Advisian, 2023b).

The objective of the study included the following:

- Determination of the noise source characteristics (i.e., how much underwater noise is emitted by relevant project activities);
- Review of threshold levels of sound relating to acoustic impacts on species of marine mammal, fish, and sea turtles (i.e., what are the sound levels above which an impact on marine fauna is said to occur);
- Noise propagation modelling to understand how project noise propagates and attenuates with distance;
- Application of the acoustic impact models to determine the distances at which relevant noise impacts on marine fauna are expected.

The full results of the underwater acoustic study are provided in Annex VI (Volume IV), with the main findings summarised below to support the impact assessment on biodiversity.

Acoustic impact thresholds for marine fauna

The determination of the threshold levels of noise for marine fauna exposed to man-made noise (i.e., the noise levels above which an impact is assumed to take place) is based on Southall *et al.* (2007; 2019) for cetaceans and pinnipeds; and Popper *et al.* (2014) for fish and sea turtles.

Impact thresholds for marine mammals are to be differentiated for different functional hearing groups (FHG), as shown in Table 7.35.

Table 7.35: Functional hearing groups for marine mammal species known or likely to be present within Area 4 or its surroundings

Functional hearing group	Representative species in Area 4	Noise sensitivity
Low-frequency cetaceans (LF)	Pygmy blue whale; humpback whale	Most sensitive to low frequencies in the range 7 Hz to 35 kHz
High-frequency cetaceans (HF)	Sperm whale; Cuvier's beaked whale; Risso's dolphin; Indian Ocean humpback dolphin; common bottlenose dolphin; Indo-Pacific bottlenose dolphin; Pantropical spotted dolphin; spinner dolphin; striped dolphin; Pygmy killer whale; short-finned pilot whale.	Most sensitive over the range 150 Hz to 160 kHz
Very high-frequency cetaceans (VHF)	Pygmy sperm whale; dwarf sperm whale	Most sensitive to high frequencies across the range 275 Hz to 160 kHz
Sirenia (Si)	Dugong	Most sensitive over the range 150 Hz to 160 kHz

Source: Southall *et al.* (2007; 2019).

From reviewing available data derived from extensive tests involving marine mammals, Southall *et al.* (2019) proposed thresholds representing two types of physiological impacts on marine mammals: the onset of temporary threshold shift (TTS – temporary impacts to hearing) and permanent threshold shift (PTS – permanent impacts to hearing), expressed in terms of SPL and sound exposure level (SEL – i.e., considering the averaging of the SPL over a time period), where the latter metric (expressed as dB re 1 $\mu\text{Pa}^2\cdot\text{s}$) takes note not only of the period of time over which the receptor is exposed but also the sensitivity of the animal to the impacting sound. For continuous type noise such as that generated by vessel activity or drilling, the thresholds are given using only SEL metrics. The resulting impact thresholds, according to Southall *et al.* (2019), are given in Table 7.36.

Table 7.36: Summary of acoustic impact threshold criteria for PTS and TTS in SPL_{peak} and M-weighted SEL metrics for each functional hearing group when exposed to non-impulsive noise

Functional hearing group	Representative species in Area 4	M-weighted SEL thresholds dB re 1 $\mu Pa^2 \cdot sec$	
		PTS	TTS
LF cetacean	Pygmy blue whale; humpback whale	199	179
HF cetacean	Sperm whale; Cuvier's beaked whale; Risso's dolphin; Indian Ocean humpback dolphin; common bottlenose dolphin; Indo-Pacific bottlenose dolphin; Pantropical spotted dolphin; spinner dolphin; striped dolphin; Pygmy killer whale; short-finned pilot whale.	198	178
VHF cetacean	Pygmy sperm whale; dwarf sperm whale	173	153
SI sirenia	Dugong.	206	186

Source: Southall *et al.* (2019).

In addition to physiological impacts, marine mammals can also experience behavioural impacts to high noise levels. Guidance on behavioural impacts is given by the US National Marine Fisheries Service (NMFS, 2005), which sets a Level B Harassment threshold for exposure to continuous-type noise of 120 dB re 1 μPa (rms). NMFS define a Level B exposure as “*any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioural patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioural patterns are abandoned or significantly altered.*” Ambient noise, recently measured in Area 4 in 2022, is sometimes above this threshold (varied between 117.2dB re 1 μPa and 129.5dB re 1 μPa – Consultec & Wavec, 2022⁵), which may indicate that this behavioural threshold is too conservative for the region.

Popper *et al.* (2014) only defines numerical thresholds for fishes where hearing involves a swim bladder: 170 dB rms for 48 h for recoverable injury and 158 dB rms for 12 h for TTS. There is limited data on marine turtle hearing. Popper *et al.* (2014) recommends that until more data become available, fish hearing, rather than mammalian hearing, is the better model to use for sea turtles.

The US Fish and Wildlife Service recommendation of 150 dB_{rms} re 1 μPa as a threshold for behavioural responses in fish was adopted (Stadler *et al.*, 2009) representing the onset of Low-Level Behavioural Responses. For marine turtles, a threshold of 175 dB_{rms} re 1 μPa is used to represent the onset of avoidance behaviour in sea turtles, following Finneran and Jenkins (2012).

Underwater acoustic propagation modelling results

The main objective of the underwater modelling study was to determine the distances over which each acoustic impact criterion are met, assuming that the receptor is stationary, a conservative approach and not necessarily realistic given that marine fauna are free moving and can avoid noise sources. The modelled impacts are thus likely more severe than the actual response.

⁵ Ambient noise was measured at stations located 500 m to 10 km from the Coral Sul FLNG, while the FLNG thrusters were off, to try to minimize project specific noise.

Noise impacts on marine mammals from vessel and drilling noise emissions are summarized as follows (please see detailed results in Annex VI; Volume IV):

- When exposed to vessel noise (i.e., installation vessel, MPV and PSV), the VHF cetacean is the most sensitive marine mammal FHG. For an operational period of 24 hours, the PTS and TTS impact criteria extend over distances of 51 m and 561 m respectively. The least sensitive FHG are the HF cetacean and SI sirenina where both the PTS and TTS impact criteria are met at distances of <10 m. For all marine mammal FHG, the Level B Behavioural Response criterion covers a maximum distance of 3468 m;
- When exposed to noise from the drilling vessel, over an operational period of 24 hours, the LF cetacean is the most sensitive of marine mammal FHG. The modelling indicates that noise levels are insufficient to meet the threshold for PTS impact criterion except at distances <10 m while the TTS impact criterion extends to a maximum distance of 100 m. The Level B Behavioural Response criterion covers a maximum distance of 258 m.

Noise impacts to fish and marine turtles are summarized as follows (please see detailed results in Annex VI; Volume IV):

- Fish and sea turtle species are assessed using SPL metrics. When exposed to vessel noise (i.e., installation vessel, MPV and PSV), both the Recoverable Injury and the TTS impact criteria are met at distance of <10 m for Group 3 and Group 4 fish (being the most audilogically sensitive of fish groupings). The Low-Level Behavioural Response criterion is met over a maximum distance of 51 m for all fish groupings;
- Drilling noise is low level in intensity. Neither the Recoverable Injury, TTS nor the Low-Level Behavioural Response impact criteria are met for fish species at distances beyond 10 m.

The results above indicate that noise impacts on marine fauna during the drilling, installation, commissioning, and decommissioning phases will be very localized. Even when considering an operational period of 24 hours (which is a very conservative approach, given that marine fauna exposed to noise will likely move away to avoid the source, and thus will not be continuously exposed over 24 hours), the maximum impact distance for the most sensitive marine mammals (VHF cetaceans, such as the pygmy sperm whale and dwarf sperm whale), would be 51 m for permanent physiological damage and 561 m for temporary physiological damage. Behavioural impacts may be expected at a maximum distance of 3.5 km from the source.

Thus, this noise impact is assessed as negative and direct, of local extent (limited to the ranges discussed above), medium intensity (marine mammals individuals may be affected, although with no impact at population level), and short-term duration (limited to these temporary phases). This results in a very low significance rating.

Mitigation Measures

The following mitigation is proposed:

- Implement a Marine Mammal Observation (MMO) protocol during drilling operations;
- Maintain standard good maintenance practices of the vessels and drill ships;

- Vessel transits should keep to the defined project vessel route, thus avoiding sensitive marine areas, as well as maintaining a 300 m exclusion zone from any marine mammals encountered during transit. Any sightings of marine fauna throughout the project duration should be recorded to assess the effectiveness of mitigation measures applied.

Impact Assessment Summary

The impact assessment summary is provided in the following table. Post-mitigation the impact is assessed as very low.

Impact BIO5: Effects of noise on marine fauna in the drilling, installation, commissioning and decommissioning phases								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Short-term	Very Low	Probable	VERY LOW	-ive	Medium
	1	2	1	4				
- Standard good maintenance practices of the vessels and drill ships; - Implement a MMO protocol during drilling activities; - Avoidance of sensitive marine areas and receptors during transit (e.g. maintain 300 m exclusion zone from any marine mammals encountered during transit).								
With mitigation	Local	Medium	Short-term	Very Low	Probable	VERY LOW	-ive	Medium
	1	2	1	4				

Impact BIO6: Effects related to artificial lighting on marine fauna in the drilling, installation, commissioning, and decommissioning phases

Impact Assessment

Artificial lighting will be required throughout the project's lifecycle and may impact on marine fauna behaviour. During the drilling, installation, commissioning and decommissioning phases, the illumination impacts will be associated with the navigational lighting of the vessels, drilling rig and helicopters.

Offshore vessels will be operational 24 hours a day during installation, and the FLNG will also be permanently illuminated during commissioning. At night, light emitted by vessels and the FLNG may affect the movement and behaviour of seabirds, and light from helicopters may also disturb seabirds. Lighting from the vessels may attract and disorient certain species, in particular migrating birds, while passing birds may collide with the vessels (Consultec & BIOTA, 2023b).

Helicopters, drilling rig, and flaring during commissioning will also be sources of artificial light (Consultec & Advisian, 2023c).

Artificial lights may disrupt biological processes of marine fauna that rely on visual cues to natural light, resulting in disorientation and adverse effects on the maintenance of species populations, as increase of predation of zooplankton or fish species attracted by lights or changes in the natural behaviour of turtles. An increase in marine mammals foraging on zooplankton and fish may be observed. The prey-predator relationships may be modified, affecting the ecosystems' equilibrium.

Plankton is the basis of the food web, serving as a food source for fish, birds, and marine mammals. Artificial light may cause changes in the lifecycle of some species (such as some zooplankton and invertebrates species) with vertical migrations based on the daily photoperiod. As marine zooplankton drifts passively with the movement of the water mass, the effects are presumed to be of low duration.

Artificial light from offshore platforms has been shown to attract migrating birds, and birds that migrate during the night are especially affected (Verheijen, 1985). Migratory bird species that are attracted to an artificial light source have been noted to circle the light source and remain for varying periods, leading to predation by other predatory bird species. Additionally, the energy levels required for travelling between foraging and feeding sites could be depleted to a point where the bird physically cannot reach its intended destination. Collisions with flares and illuminated structures have also been documented as a cause of avian fatalities (Ronconi *et al.*, 2015).

Any behavioural disturbances such as disorientation and attraction are considered temporary (short-term duration). Physical effects such as exhaustion and mortality may also potentially affect a small proportion of the population; however, this would be dependent on the number birds and type of species affected. Observations during stranding monitoring for the Coral South FLNG have shown that terrestrial migrant species occur in the ADI (Consultec & BIOTA, 2023). During site specific assessment along the transit route, seabirds and shorebirds were the more frequent species observed (Fugro, 2019; Consultec, 2021, 2022; Consultec & BIOTA, 2023b). Several of them are migratory species, and several of the recorded seabirds feed offshore during the night.

The Coral North specialist study on illumination (Consultec & Advisian, 2023) describes different potential distances from light sources influencing different biological taxa; however, for birds the maximum distance was not defined (although considered the wider, and at least 5 km). In the present assessment the UNEP *et al.* (2020) 20 km threshold was used as nominal distance at which artificial light impacts should be considered for marine turtles, seabirds, and migratory shorebirds.

The impact of artificial light on marine organisms is negative and direct. During these project phases, the impact will be short-term and mostly associated with a few moving vessels (one installation vessel, and one to two offshore support vessels) and the drilling rig, of regional extent (considering vessels and helicopter route), and medium intensity (given the presence of threatened species and the registered collisions on Coral South stranding monitoring, Consultec & BIOTA, 2023b), resulting in a low significance.

Mitigation Measures

The objective of the mitigation measures outlined below is to reduce harmful interactions with marine birds by minimising lighting:

- Light emissions should be kept as low as possible;
- Minimize non-essential lighting on vessels, and shield and/or reduce, whenever practicable, the number of lights shining directly onto the water as far as possible;
- Although long wavelength lights are to be avoided to reduce potential impacts to migrating birds (Poot *et al.*, 2008), this conflicts with the preference for amber lighting also with longer

wavelength to reduce impacts to local seabirds (Syposz *et al.*, 2021). Considering the impacts of red light on migrating shorebirds has not been proven, and the literature supporting the heavier impacts of blue light (i.e., short wavelengths) (Rodriguez *et al.*, 2017; Deppe *et al.*, 2017), the use of amber wavelengths should be considered;

- Apply Eni's best practice on illumination;
- Monitoring of bird strike and strandings to be undertaken as part of the project's adaptive management plan to identify areas of concern caused by lighting, with actions to be developed to avoid and/or reduce the impact;
- Keep any disoriented or otherwise unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed and/or banded birds found on vessels should be reported to the appropriate ringing/banding scheme;
- Prohibit all crew members from killing or causing injury to seabirds and establish effective measures for the punishment of crew members found to have deliberately killed or caused injury to avifauna.

Impact Assessment Summary

The impact is considered of low significance, decreasing after mitigation to very low. The impact assessment summary is provided in the following table.

Impact BIO6: Effects related to artificial lighting on marine fauna in the drilling, installation, commissioning, and decommissioning phases								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Medium	Short-term	Low	Definite	LOW	-ve	Medium
	2	2	1	5				
- Light emissions should be kept as low as possible, in accordance with best practice environmental management; - Minimize non-essential lighting on vessels, and shield and/or reduce, whenever practicable, the number of lights shining directly onto the water as far as possible; - Consider the use of amber wavelengths; - Monitoring of bird strike and strandings are to be undertaken as part of the project's adaptive management plan to identify any areas of concern caused by lighting, with actions developed to avoid and/or reduce the impact; - Keep any disoriented or otherwise unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed and/or banded birds found on vessels should be reported to the appropriate ringing/banding scheme; - Prohibit all crew members from killing or causing injury to seabirds and establish effective measures for the punishment of crew members found to have deliberately killed or caused injury to avifauna.								
With mitigation	Regional	Low	Short-term	Very low	Probable	VERY LOW	-ve	Medium
	2	1	1	4				

Impact BIO7: Risk of collisions and entanglement with marine fauna

Impact Assessment

During the drilling, installation, and decommissioning phases, project activities will result in increased vessel movements. Offshore vessels will be operational 24 hours a day, and helicopters will also be employed as logistical support during these phases.

The movement of vessels and helicopters may disturb the movement and behaviour of seabirds through attraction to lighting, disorientation (due to noise and light), and redistribution (resulting in birds' aggregation at some distance from the source impact, Garthe *et al.*, 2023), in particular migrating birds. Collisions may occur with passing birds induced by vessel lights (Black, 2005).

Although localized, the movement of vessels and helicopters may disturb flocks of migrating birds flying at low heights or marine birds feeding in foraging areas. Dankverts *et al.* (2014) show that the All is used by seabirds from nearby colonies to feed.

The number of whales and marine turtles killed or injured by ships as a result of boat collisions is a worldwide concern (Schoeman *et al.*, 2020). Vessel movements transiting to and from the project site will increase during these project phases, when compared to the baseline conditions. The potential risk of collision with whales during the migratory period with vessels may increase. Cetaceans have low population turnover rates and a number of marine mammals that may migrate past the project site are listed as EN (e.g., sei whale and blue whale) and VU (e.g., sperm whale and fin whale), potentially affecting the importance of this impact (Fugro, 2016c; Consultec & Biota, 2022). Moreover, considering the presence of the Coral South FLNG located 13 km to the south, cumulative effects may occur due to the increase in vessel traffic.

The increased vessel traffic around the Coral field may also increase the risk of disturbance to sea turtles' migration patterns, or the risk of collisions. Sea turtles can be difficult to sight from moving vessels and often rest on or just below the surface of the ocean. All five species of sea turtles that may be present in the area are considered to be threatened at a global scale, consequently an impact may cause adverse effects to the overall populations.

The current assessment suggests that the impact would be localized to the vicinity of the vessels and helicopter movement; however, as the route extends for approximately 300 km between Coral North and Pemba, the extent is deemed regional. The duration is short-term and the intensity is medium, given the presence of endangered species. The resulting consequence of the impact is rated as low with the probability of the impact occurring being low. This is supported by the monitoring data of the Coral South FLNG Project, where no collisions with marine mammals and/or turtles were recorded during the drilling, installation, and commissioning phases from 2019 to 2022. Given the low probability of the impact taking place, the significance is therefore evaluated as very low.

Mitigation Measures

The recommended mitigation measures to be applied, in order to minimize the risk of collisions or entanglement with marine fauna, includes the following:

- Ensure constant bridge watch is kept on all vessels involved in the drilling, installation, commissioning and decommissioning phases to look out for cetaceans in danger of collision;
- Keep any disoriented or otherwise unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed and/or banded birds found on vessels should be reported to the appropriate ringing/banding scheme;

- Prohibit all crew members from killing or causing injury to seabirds and establish effective measures for the punishment of crew members found to have deliberately killed or caused injury to avifauna.

Impact Assessment Summary

The adoption of the proposed mitigation will reduce the risk of collisions with marine fauna, thus reducing the duration and intensity scores of the mitigated impact, resulting in an insignificant residual significance rating. The impact assessment summary is provided in the following table.

Impact BIO7: Risk of collisions and entanglement with marine fauna								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Medium	Short-term	Low	Possible	VERY LOW	-‘ve	Medium
	2	2	1	5				
- Ensure constant bridge watch is kept on all vessels to look out for cetaceans in danger of collision; - Keep any disoriented and unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed/banded birds found on vessels should be reported to the appropriate ringing/banding scheme; - Prohibit all crew members from killing or causing injury to seabirds (any crew members found to have deliberately killed or caused injury to marine fauna shall be dismissed immediately and removed to shore).								
With mitigation	Regional	Low	Short-term	Very Low	Possible	INSIGNIFICANT	-‘ve	Medium
	2	1	1	4				

Impact BIO8: Effects of ballast water on the marine environment during the drilling, installation, commissioning, and decommissioning phases

Impact Assessment

The vessels used in the drilling, installation, commissioning, and decommissioning phases will be sourced from the international market. Any discharge of ballast water taken outside of Mozambican waters from these vessels has the potential to introduce invasive alien species (AIS) to the national waters. Additionally, vessels may carry AIS attached to their hulls (biofouling).

It is now acknowledged that AIS may cause major and often irreversible damage to the environment, economy, and human health. Worldwide, they have been implicated in numerous species extinctions and remain a serious threat to many more species. This was confirmed recently by the findings of the Millennium Ecosystem Assessment (2005) from 2001 to 2005, which found that AIS species have been a main direct driver of change in biodiversity and ecosystems over the past 50–100 years. This applies for both terrestrial and marine biodiversity (Knapp *et al.*, 2017). The assessment also predicts that impacts are likely to continue or increase in all biomes globally (IPIECA, 2010).

Many AIS share common biological characteristics such as rapid reproductive capacity and fast growth, hence they can often adapt readily to disturbed or degraded environments, even before native species are able to adapt to the same conditions. Frequently, introduced AIS have no natural predators in the receiving environment, and numbers may be allowed to increase in the absence of predation. The impacts of AIS on biodiversity and ecosystems can be direct, indirect, and synergistic.

Many marine species reproduce by dispersing planktonic eggs and/or larvae, and it is inevitable that

ballast water will contain large numbers of a wide variety of organisms. Ballast is usually taken on in areas of relatively high shipping traffic, in shallow coastal or port waters that have a high natural abundance of plankton, which may be AIS or become AIS if discharge in non-native waters. While some organisms may not survive in ballast tanks, many do, and upon discharge at the destination port or waters, these non-native organisms (AIS) can complete their lifecycle (IPIECA, 2010).

Discharge and loading of ballast water has considerable potential for the transmission of AIS; therefore, the impact of ballast waters on marine biodiversity has been assessed as negative and direct. The exchange of ballast water may occur during the drilling and installation phases, although infrequently and under the ships' Ballast Water Management Plan, and is thus of short-term duration. In the unlikely event that AIS is released, due to the nature of the marine environment through the mass movement of water, it has been deemed a regional impact. Given that the added vessels are a small fraction of the current traffic in the Mozambique Channel, the increased risk of AIS due to project activities is assessed as of low intensity. The resulting significance is assessed as low.

Mitigation Measures

Discharge and loading of ballast water must comply with international and national legislation. Best international practices must be adhered to (IPIECA, 2010; IMO, 2011; eni & FFI, 2013), as follows:

- All vessels containing ballast water should carry a vessel-specific Ballast Water Management Plan, in accordance with IMO and MARPOL standards. The following should be considered for ballast water management:
 - Full ballast exchange shall be conducted in deep sea only, and at least 200 m from the nearest land;
 - If feasible, sterilize ballast water through filtration, heat treatments and/or de-oxygenation with nitrogen prior to discharge (EBI, 2002);
 - No discharge within 20 km of the planned FLNG site.

Impact Assessment Summary

Implementation of international guidelines for management of ballast waters will reduce the risk of introduction of AIS from the project vessels to that of all the current international traffic traversing in the project area. As such, the proposed mitigation lowers the probability score, resulting in a very low significance residual impact. The impact assessment summary is provided in the following table.

Impact BIO8: Effects of ballast water on the marine environment during the drilling, installation, commissioning, and decommissioning phases								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Short-term	Low	Probable	LOW	-‘ve	Medium
	2	1	1	5				
- Discharge and loading of ballast water must comply with international and national legislation. Best international practices have to be followed (see IPIECA, 2010).								
With mitigation	Regional	Low	Short-term	Low	Improbable	VERY LOW	-‘ve	Medium
	2	1	1	5				

7.7.3 Operational Phase

7.7.3.1 Potentially Impact-Generating Project Activities

During the operational phase of the project, the FLNG will extract natural gas from wells, process and liquefy natural gas, store, and offload the LNG onto carriers for export. The FLNG facility operations, the logistic support, the export of the gas and maintenance will lead to activities that may be a source of impacts namely:

- Liquid discharges – these include different types of discharges, with different potential impacts:
 - Wastewater discharges – discharge of liquid effluents normally associated with any marine vessel (including the FLNG vessel, support vessels and LNG carriers), including domestic wastewater, bilge water, etc. These discharges may impact on water quality, and indirectly on marine biota;
 - Water discharges from the LNG plant – these include the discharge of produced water and cooling water. The former may impact on seawater quality and the latter may induce changes in the seawater temperature. Both these effects may impact on marine biota.
- Waste management – inadequate management and disposal of solid waste generated aboard the FLNG during operation could lead to impacts on water quality, and indirectly on marine biota;
- Increased marine traffic (vessel movements from supply vessels and export shipping) – leading to increased noise and light emissions, and an increase to the risk of collisions and entanglement of marine fauna and avifauna;
- Presence of the FLNG vessel – the FLNG vessel itself will be also source of noise and light emissions, with potential associated impacts on marine fauna and avifauna.

The potential impacts on marine ecology from these activities are discussed below.

7.7.3.2 Impact Assessment

Impact BIO9: Effects of discharge of deck drainage, bilge water and sewage on marine ecology due to changes in water quality

Impact Assessment

Liquid effluents will be produced during the operation of the Coral North FLNG and related operational vessels (including LNG carriers) and will include deck drainage, bilge water, and sewage discharge (note that the FLNG operation will also result in the discharge of produced water and refrigeration water, which are assessed in separate subsections below). These effluents will be similar to those generated by any marine vessel moving through the study area, including the current regional and international marine traffic. Liquid effluents may have the potential of degrading the marine environment, mainly through toxicity and oxygen depletion. These effects may then indirectly impact marine mammals, turtles, fish, benthic fauna, and plankton.

The discharge of these waters usually occurs through the supply, support and carrier vessels treatment and drainage system as well as after treatment on the FLNG. However, in the presence of an emergency (e.g., a cyclone or collision with another vessel), these waters may be directly discharged to the sea.

Cumulative impacts may arise due to the presence of Coral South FLNG, located 10 km to the south.

However, the FLNG facilities will have adequate treatment facilities on board to comply with applicable regulation, and as such no significant changes to the marine water quality and associated biota is expected. As discussed above in Impact WQ4, dispersion modelling for nitrogen (N) developed for the Coral South FLNG indicate that the adopted ambient seawater quality standard for Total-N (10 mg/L) is met under all discharge and environmental scenarios (Consultec & Anchor, 2023). Furthermore, ambient water quality monitoring, performed weekly for a three month period, validated that total nitrogen levels measured at 300 m from the Coral South sewage discharge were consistently low (average below 1 mg/l) (Consultec & CLS, 2023). No impact on water quality has been detected from the Coral South FLNG sewage discharge, as expected for the Coral North discharge.

The impact is considered negative and direct. The duration of the impact is long term (although reversible). However, the extent is local (as no relevant impacts on water quality are expected outside of the mixing zone) and the intensity is low. The impact is thus of low significance.

Mitigation Measures

All discharge of deck drainage, bilge water and sewage from the FLNG and associated vessels will need to comply with relevant international maritime standards and regulations, namely those set out in MARPOL (73/78) regulations. The main environmental standards to be complied to are similar to those presented for the drilling and installation phase, and include the following:

- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains). Bund all process areas to prevent contamination by storm waters, contain spills and leaks, and channel drainage water into the closed drains;
- Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system;
- Disposal of deck drainage, bilge water and sewage in accordance with MARPOL 73/78:
 - Liquid effluents must be treated before discharged to the sea;
 - Sewage must be treated (on-board treatment plant) prior to discharge;
 - Sewage treated effluent shall comply with the following emission limits: pH 6.0-8.5, of total suspended solids < 35 mg/l, BOD₅ < 25 mg/l, COD < 125 mg/l, thermotolerant coliform count < 100 MPN / 100 ml;
 - Discharge depth is should not be less than 5m below the surface;
 - Route water from machinery spaces to the closed drainage system, or contain and treat the bilge water before discharge;

- Concentration of oil in the water after treatment in an IMO approved oil/water separator shall not exceed 15 ppm;
- Contain oil and chemical use areas and equipment (deck, mud tanks and pumps);
- Use efficient oil and water separators.
- Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO8: Effects of discharge of deck drainage, bilge water and sewage on marine ecology due to changes in water quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				
- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains); - Discharge of deck drainage, bilge water, and sewage shall comply with MARPOL 73/78 requirements; - Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system; - Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				

Impact BIO10: Effects of solid waste disposal on marine ecology due to changes in water quality

Impact Assessment

The normal operation of the FLNG is expected to generate a significant quantity of solid wastes. These include non-hazardous wastes, similar to urban solid wastes (paper, plastic, metal, etc.), solid hazardous wastes (such as batteries, light bulbs, packages of hazardous materials, etc.) and other wastes associated with the production process. For example, during the period from January to June 2023, the Coral South FLNG facility generated 74.5 tons of food waste (ENI, 2023).

Inadequate management of such wastes (if discharged to the sea) may potentially impact on water quality, and therefore on marine ecology. However, the Coral North FLNG will implement a Waste Management Plan, ensuring and monitoring that all solid waste generated during operational activities is adequately collected, sorted, temporarily stored, and sent onshore to final treatment and disposal. The only exception is food waste, which will be macerated and discharged to sea, in compliance with MARPOL regulations.

No discharge of untreated solid waste to the sea is expected during the operational phase, and as such no relevant impact on water quality is predicted. Therefore, the potential indirect impact on marine ecology is assessed as negative, of long-term duration (during the operation), although of local extent and low intensity, resulting in a low significance.

Mitigation Measures

To ensure that the assessed impact remains of low significance, it is fundamental that the FLNG has in place a Waste Management Plan, to ensure that all solid waste generated in the facility is adequately collected, sorted, temporarily stored, and sent to final treatment or disposal, as indicated in the mitigation measures for the drilling, installation, commissioning, and decommissioning phases. Training should be provided to all workers, in what regards the need to reduce production of solid waste and the adequate procedures of waste management.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO10: Effects of solid waste disposal on marine ecology due to changes in water quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-‘ve	Medium
	1	1	3	5				
- Apply adequate treatment and disposal of solid waste in order to avoid pollution of marine waters; - Apply all solid waste management measures according to national regulations and international standards and best practices; - Food solid waste will be treated in accordance with MARPOL (73/78) regulations. Kitchen waste will be macerated to diameters below <25 mm and discharged to sea; - All other solid waste must be segregated and temporarily stored and contained on the vessel, for appropriate treatment and/or disposal onshore in compliance with Annex V of MARPOL; - Train crew members on waste management procedures.								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-‘ve	Medium
	1	1	3	5				

Impact BIO11: Effects of noise on marine fauna during the operational phase

Impact Assessment

As discussed in Impact BIO5, in deep water locations, typical noise levels are expected to lie in the range 90-110 dB re 1 μ Pa over a 1 Hz frequency band (Consultec & Advisian, 2023b). The OEBS (Fugro, 2016) indicated that over a 2-day period, mean spectral noise levels were somewhat lower, lying in the range 55-60 dB re 1 μ Pa/Hz despite short term (<2 minute) incursions of 70 dB re 1 μ Pa/Hz, and corresponding to noise levels were in the range 100-110 dB_{rms} re 1 μ Pa.

During the operational phase, the FLNG facility will be moored on-station with mooring lines. During LNG offloading and helicopter operations, the FLNG maintains position through the use of thrusters fitted to the hull of the vessel.

The main project activities that may generate noise impacts on marine fauna include:

- Vessel movements: noise from vessels is a major contributor to the overall noise in a given sea area. Vessels expected to be used during the operational phase three (3) Platform Supply Vessels (PSVs), and six (6) anchor handling tug supply (AHTS) vessels (see more information regarding these vessels in the Project description – section 4.3.3; Volume I).

Peak sound pressure levels (SPL) emitted by these vessels vary between 166.2 and 177.8 dB re 1 μ Pa @ 1 m (see Annex VI, Volume IV for more details). Vessel noise during operations is estimated to be lower than during the drilling and installation phases;

- Operation of FLNG thrusters: thruster operation during berthing and unberthing activities has been estimated to reach a peak SPL of the noise 189 dB re 1 μ Pa at 1 m (see Annex VI, Volume IV for more details). This is the noisiest operational activity aboard the FLNG, and it is also greater than the noise generated by vessel movements (see previous bullet).

As discussed in the Impact BIO5, a dedicated noise propagation modelling study was developed for this EIA, to assess potential Project noise impacts on marine fauna (Consultec & Advisian, 2023b). A summary of the main findings is provided below and is used to support the impact assessment on biodiversity.

The operation of the FLNG thrusters will generate the greatest underwater noise during the operational phase, and as such this impact assessment focuses on thruster noise. Impacts from vessel noise are evaluated in Impact BIO5 above for the drilling and installation phases; the findings are also applicable to the operational phase.

Noise sensitive receptors

Several marine species have been identified as being of specific concern to the Coral North project (see the biodiversity baseline section in Volume I), that could be impacted by the project's operational noise, as follows:

- Cetaceans – specifically the pygmy blue whale, sperm whale Cuvier's beaked whale, numerous species of dolphins;
- Sirenia – dugongs are known to inhabit the seagrass beds, shallow coastal waters, and mangroves of Mozambique; in fact, they are highly dependent on seagrass beds, which can occur until depths of 58 m (averagely between 5 to 15m depth in Mozambique). They may still be present in Quirimbas Archipelago, which has not been confirmed recently. It is believed that the last viable east African population lies probably in the Bazaruto Archipelago. Nevertheless, their potential presence was considered (IUCN, 2023), given that the vessel route is offshore of the Quirimbas National Park;
- Fish – members of the ray and shark family; although there are no registers of coelacanth in Cabo Delgado province, it was considered as the fish may be present in water depths up to 700m within the ADI (see baseline section in Volume I);
- Sea turtle – green, hawksbill, leatherback, loggerhead, and olive ridley turtles occur in Mozambique; Quirimbas Archipelago are particularly important for green, hawksbill and olive ridley turtles. Vamizi island, which is adjacent to the Project ADI is very important for green turtle nesting; hawksbill also nests in Vamizi island.

Acoustic impact thresholds for marine fauna

Noise impacts on marine fauna can be grouped into two major types of impacts:

- Injury or mortality – auditory injury, in the form of a loss of sensitivity to sound, from exposure to noise sources. A short-term shift in hearing threshold (i.e., the sound level that is just

audible to the animal) from which an animal recovers is referred to as TTS. Higher intensity exposure over a longer time period can result in PTS. Hearing organs of most animals comprise sensory hair cells that are very sensitive to vibrations, and over-stimulation of these can lead to permanent physical damage. Very loud sounds can also cause (non-auditory) tissue damage, e.g. in animals with gas-filled cavities (e.g. swim-bladders in fish), the formation of micro-bubbles in blood and fat tissue, which could create an embolism and cause small capillaries to burst, or cause damage to fish eyes where tissue may have a high gas saturation (CBD, 2012). Effects can be lethal in extreme cases;

- Behavioural responses – underwater sounds may cause startle responses in most mobile marine animals, which would typically cease their current behaviour to move away from the sound source. Behavioural responses are often hard to detect, and depends on a wide range of factors, including the animal's behavioural state (foraging, migrating, etc.), nutritional state (hungry or not), reproductive state, etc. Single 'noise events' would have short term effects, while continued exposure can result in habituation, followed by a return to normal behaviour. Underwater sounds can also cause interference with communication and/or masking of environmental sounds. While this effect is difficult to measure and/or assess, anthropogenic noise in the underwater environment is likely to interfere with sound based communication between animals or by muffling or even masking natural underwater sounds used by marine organisms for orientation or navigation.

The intensity and significance of noise impacts are dependent on the sensitivity to noise of the receptors. Sensitive receptors to underwater noise include several marine fauna, such as marine mammals, turtles and fish. The sensitivity of marine fauna to noise (including noise levels and frequencies) varies from group to group, and from species to species.

The determination of the threshold levels of noise for marine fauna exposed to man-made noise (i.e., the noise levels above which an impact is assumed to take place) is based on Southall *et al.* (2007; 2019) for cetaceans and pinnipeds; and Popper *et al.* (2014) for fish and sea turtles. These threshold levels are discussed in Impact BIO5 above and are thus not repeated here.

Underwater acoustic propagation modelling results

As stated above, modelling was developed to estimate the propagation of Project underwater noise with distance and to compare against the identified impact thresholds for marine fauna. The detailed modelling approach and results are provided in Annex VI (Volume IV). The main findings of the modelling for the operational phase are discussed below, to inform the impact assessment.

Noise impacts to marine mammals as determined through modelling are as follows (please see detailed results in Annex VI; Volume IV):

- When exposed to FLNG operational noise, the most sensitive FHG is the VHF cetacean. Over an operational period of 15 hours (representing the approximate maximum period of daily operations), the PTS impact criterion is met at a maximum distance of 258 m while the TTS impact criterion extends to 7.9 km. The least sensitive FHG is the SI sirenia where the PTS impact criterion is met at distances less than 10 m while that for TTS extends to 153 m.

The Level B Behavioural response for all marine mammals is met over a distance out to 33 km;

Noise impacts for fish and marine turtles as determined through modelling are as follows (please see detailed results in Annex VI; Volume IV):

- For all fish groupings, FLNG operational noise results in the Recoverable Injury impact criterion extending less than 10 m while the TTS impact criterion extends to 51 m. The Low-Level Behavioural Response covers a maximum distance of 172 m;
- Sea turtles are insensitive to all the noise generating activities. The Aversive Response criterion is met at distances of <10 m from all noise sources.

The noise study indicates that underwater noise generated by the FLNG when operational has the potential to give rise to acoustic impacts on various species of marine mammal. The grouping most likely to be impacted is the VHF cetacean functional hearing group of which representative species found in Area 4 are pygmy sperm whale and dwarf sperm whale.

The modelling indicates that the threshold noise level representing the onset of temporary deafness may extend to a distance of 7.9 km when the FLNG thrusters are in operation for a 15-hour period. Marine visual surveys indicate that these species are elusive in Area 4.

The most prevalent species seen in Area 4 is the humpback whale, classified as the LF cetacean. The modelling indicates that the threshold level representing the onset of TTS is met at a distance of 2.1 km for a 15-hour thruster operational period.

When considering these impact distances, it is very unlikely that any marine mammal would remain within the impact zone long enough to experience a physiological impact. Instead, they would swim away to avoid the impact area. As such, the distances above are conservative evaluations based on the assumption that the receptor is stationary.

The least sensitive group is the SI sirenina. When exposed to operational noise over a 24-hour period, the acoustic impact modelling indicates that the threshold for temporary deafness may extend over a distance of 200 m. Dugong are unlikely to be found in the open ocean and are thus considered very unlikely to be impacted by the FLNG operational noise.

Hence, the operational noise impact is assessed as negative and direct, of local extent (limited to the ranges discussed above), medium intensity (marine mammals could be affected, although with no impact at population level), and long-term duration (intermittent, but throughout the operational lifetime). This results in a medium consequence rating. Given the low density of the more sensitive species in the area (as per monitoring results) and the mobility of these receptors, the probability of the impact occurring is considered to be low (possible), resulting in a low significance rating.

Mitigation Measures

The following mitigation is proposed:

- Apply best practice procedures for thruster operation, which aim to minimize their use, the duration of use and the power engaged to the strictly required to achieve operational safety needs.
- Implement a Marine Mammal Observation (MMO) protocol during berthing and unberthing operations. This protocol requires the monitoring of marine mammals in an exclusion zone of 500m during the use of thrusters at berthing and unberthing of LNGCs and condensate tankers. This task must be conducted by a nominated observer. A 'pre-activity' visual search of 30 minutes to determine the presence of any whale within a 500-meter exclusion zone must be carried out. Upon sighting, the MMO must notify the relevant parties and the FLNG thrusters will not be initiated or temporarily ceased, subject to safe vessel operation considerations.

Impact Assessment Summary

The impact assessment summary is provided in the following table

Impact BIO11: Effects of noise on marine fauna during the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-term	Medium	Possible	LOW	-ve	High
	1	2	3	6				
- As per standard operational practice, thrusters will be engaged when necessary, at the minimum power required and for the shortest duration required, according to operational needs; - All FLNG equipment and thrusters will be adequately maintained throughout the operational phase; - Implement a MMO protocol during berthing and unberthing operations.								
With mitigation	Local	Medium	Long-term	Medium	Possible	LOW	-ve	High
	1	2	3	6				

Impact BIO12: Effects of the cumulative noise on marine fauna due to the simultaneous operations of Coral South and Coral North FLNG

Impact Assessment

Further to the noise impacts from the Coral North operations (addressed in Impact BIO11 above), the cumulative noise impacts with the Coral-SUL FLNG, which is roughly 12.9 km south from the Coral North site was also be considered, as the two FLNG facilities will be in operation simultaneously for most of their operational life.

The simultaneous operation of the two FLNG was also modelled with the detailed findings provided in Annex VI (see Volume IV). The main findings are summarised below, to inform the impact assessment.

The preceding impact presented results when the noise generating activity takes place at one site only. The resulting impact ranges can be thought of conceptually as an acoustic footprint centred on the noise site where the PTS and TTS impact criteria are met at increasingly greater distances. This is shown schematically in Figure 7.20(a). When a noise-generating activity takes place at a second site in relatively close proximity to the first, the individual acoustic footprint zones may overlap. In the

overlap region, the SPLs (and consequently, the SELs) will be greater than would result if only one noise-generating site was active. This may be thought of as an example of an additive exposure and is shown schematically in Figure 7.20(b).

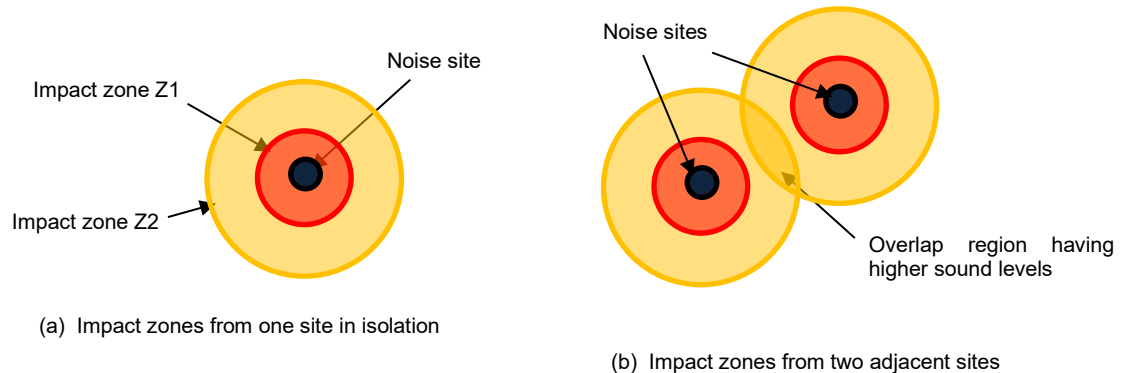


Figure 7.20: Schematic showing (a) single noise-generating site and impact zones; and (b) adjacent noise-generating sites with overlapping zones

The Coral South development in the southern part of Area 4 was commissioned in late 2022 and the Coral Sul FLNG is now fully operational. It is expected that the Coral North development will become operational in 2028 when the Coral North FLNG is hooked-up to its mooring site. Consequently, the two FLNG's will be moored at their respective sites at the same time, and there may be occasions where the thrusters on the two FLNGs would be used simultaneously for berthing and unberthing operations. The noise generated by each has the potential to generate acoustic zones which may overlap to a greater or lesser degree.

Cumulative impacts are assessed using SEL metrics and thus require a time component to model. As the exposure duration increases, the gap between the two FLNGs at which noise levels remain below the thresholds for either PTS or TTS becomes smaller and smaller. When LF cetaceans, HF cetaceans and SI sirenians are exposed to FLNG noise from both facilities for an exposure duration of 15-hours, the gap between the FLNGs through which the animals can pass where the SEL_{cum} remains below the PTS and TTS thresholds, is no smaller in width than 12.4 km and 7.4 km respectively.

VHF cetaceans are much more sensitive to FLNG noise. For an exposure duration of 15 hours, the sub-PTS gap between the two FLNG facilities remains above 12.2 km. However, when noise levels are modelled using an August SSP, for exposure durations of 15 hours and above, the SEL_{cum} in the region between the two facilities remains above the threshold for TTS. Specifically, the SEL_{cum} in the central 5 km between the two facilities fluctuates between 153 dB re $1 \mu Pa^2 \cdot sec$ and 155 dB re $1 \mu Pa^2 \cdot sec$. The SEL_{cum} only falls permanently below the TTS threshold at a distance of 16.6 km from FLNG N (and hence 3.7 km from FLNG S).

Consequently, the cumulative operational noise impact is assessed as negative and direct, of local extent (limited to the overlap areas discussed above, near the FLNG sites), medium intensity (marine mammals could be affected, although with no impact at population level), and long-term duration (intermittent, but throughout the operational lifetime). This results in a medium consequence rating. The impact is however of low probability (improbable), as it would require the thrusters of both FLNGs

to be operational simultaneously for a 15-hour period (which is unlikely, as the thrusters are only used for berthing and unberthing of LNG carriers), and receptors to remain stationary within these overlap impact zones for the duration, again unlikely, due to the mobility of these receptors. As such, the resulting significance rating is low.

Mitigation Measures

Mitigation options are the same as discussed above for the Coral North operational noise: best practice procedures for thruster operation, and the implementation of a MMO protocol. Additionally, simultaneous operation of both FLNG's thrusters will be minimised to the extent possible.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO12: Effects of the cumulative noise on marine fauna due to the simultaneous operations of Coral South and Coral North FLNG								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Improbable	LOW	-ve	High
- As per standard operational practice, thrusters will be engaged when necessary, at the minimum power required and for the shortest duration required, according to operational needs; - Simultaneous operation of both FLNG's thrusters will be minimised to the extent possible, subject to production capacity, operational safety, scheduling of LNG carriers and metocean conditions; - All FLNG equipment and thrusters will be adequately maintained throughout the operational phase; - Implement a MMO protocol during berthing and unberthing operations.								
With mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Improbable	LOW	-ve	High

Impact BIO13: Effects of artificial lighting during the operational phase

Impact Assessment

Artificial lighting will be necessary throughout the project's operational phase and may impact on marine fauna behaviour. The FLNG will require 24 hours external illumination to meet maritime and operational safety standards. Navigational lighting will be required on supply, security, and export vessels, as well as on helicopters. The flare stack will also require navigational lighting to prevent potential collisions with helicopters. Flaring will not occur during normal operations, except for the pilot flame (Consultec & Advisian, 2023c).

Artificial light at night can change critical behaviours in wildlife. Some species may have their daytime or twilight activities extended due to artificial lighting, which can improve their ability to forage (Hill, 1990). However, for nocturnal species, artificial light can result in detrimental changes in their behaviour. The extent to which artificial light negatively affects individuals depends on their vulnerability, which varies between and within species based on their behaviour and the type of light they are exposed to. Figure 7.21 summarizes the sensitivity of different species to different wavelengths of light, showing that most species are sensitive to short wavelength light such as

ultraviolet, violet, and blue light. The growing body of evidence on the potential negative impacts of artificial light includes various types of animals such as zooplankton, invertebrates, fish, marine reptiles, seabirds, and migratory shorebirds.

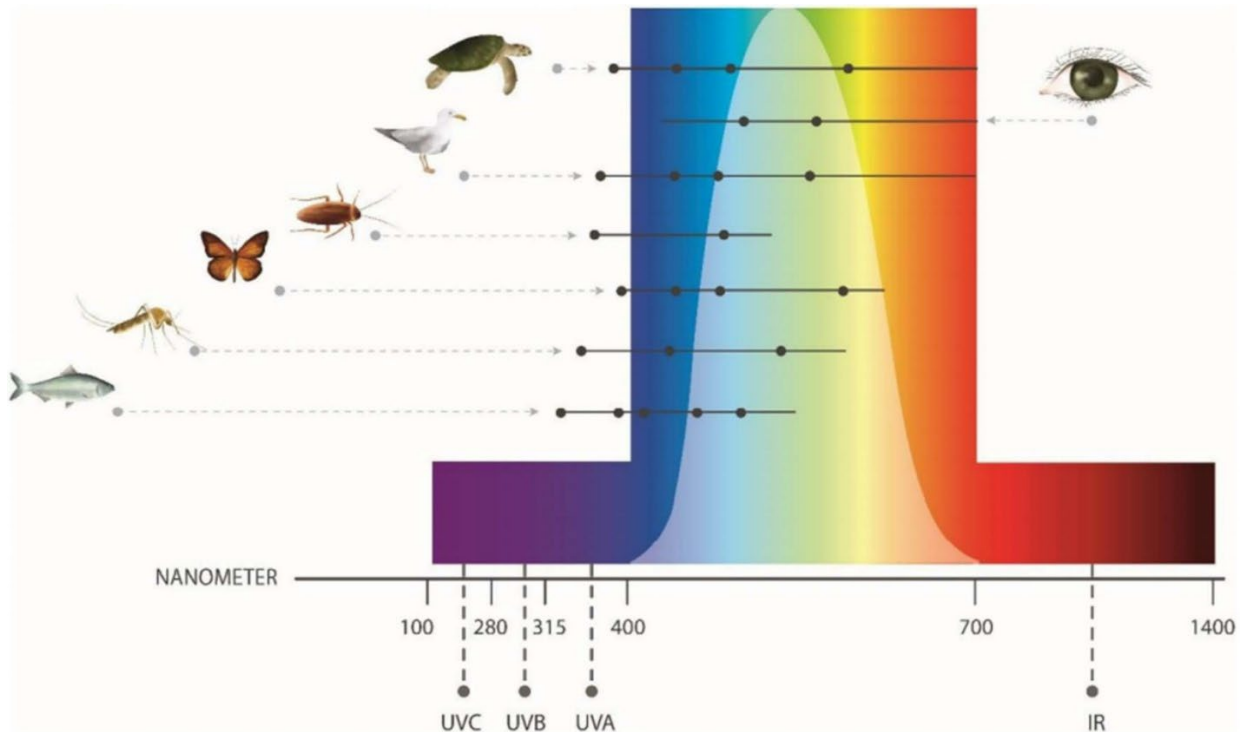


Figure 7.21: Photometric light represented by the area under the CIE curve (white area) compared with ability to perceive different wavelengths (black lines) and reported peak sensitivity (black dots) in humans and wildlife

Potential artificial illumination impacts vary for different groups of marine fauna, depending on their sensitivity to increased nocturnal light levels and the potential associated effects. These are discussed below for the different fauna groups.

Plankton

Diel vertical migration (DVM) is a widespread occurrence among plankton communities, where plankton move to the surface waters during night-time and return to deeper waters at dawn. Scientific findings have demonstrated that the lunar cycle affects DVM patterns (Ochoa-de-la-Torre *et al.*, 2013). Even in the deep sea, where sunlight does not directly reach (van Haren & Compton, 2013), it is believed that light levels in the water column serve as important cues for DVM (Hays, 2003). As DVM plays a crucial role in shaping pelagic communities, particularly by influencing predator behaviour, there is a possibility that artificial light could alter DVM and consequently change the distribution of zooplankton in the water column.

Light serves as a significant regulator of photosynthesis and related growth and cellular processes in primary producers. Research has indicated that artificial light during the night can enhance the production and abundance of chlorophyll in microalgae species (Diamantopoulou *et al.*, 2021). The study also revealed that light across different wavelengths affects the biomass and diversity of the assemblage, with red and green wavelengths having the most significant impact. These findings

suggest that artificial light at night might lead to an overall increase in the abundance of phytoplankton and contribute to the dominance of specific diatom species, potentially resulting in algal blooms (Diamantopoulou *et al.*, 2021).

Zooplankton in the Aol may also include the egg and larval stages of some fish and invertebrates. Under laboratory conditions, eggs of a site attached reef fish (the clown fish, *Amphiprion ocellaris*) failed to hatch when incubated in the presence of artificial light, for the duration of the incubation period (Fobert *et al.*, 2019). Impacts of artificial light on pelagic fish eggs are unknown.

However, the effect of illumination on plankton would be confined to areas of direct light spill on the ocean surface and restricted to within 500 m of the Coral North FLNG and limited to surface waters.

The low abundance of the plankton in the offshore environment of the FLNG location combined with ocean currents in the region continually circulating and replenishing plankton, direct impacts to population or ecosystems, both in terms of the regional biomass of zooplankton and or fish or invertebrate population including egg or larval stages are unlikely to be detectable.

Fish

Behavioural responses of fish to artificial light have been reported in several fish species (Marchesan *et al.*, 2005; Nguyen & Winger, 2019). There are four common movement patterns of fish in response to light; phototaxis (movement towards or away from light), photokinesis (movement or lack of movement in response to light), aggregation and DVM (Nguyen & Winger, 2019). Fish may be directly or indirectly attracted to lights. Artificial light also attracts organisms, increasing food sources for predatory species, which leads to marine predators aggregating at the edges of artificial light halos. In a light trap study conducted by Shaw *et al.* (2002), it was noted that the juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory were preying on the concentrations of zooplanktons that had been attracted to the light field of the platforms. This led to increased predation rates as compared to the unlit areas.

Artificial light is shown to impact hatching success of fish eggs, however, the spawning behaviour of adult fish, in terms of frequency and duration, was no different under artificial light conditions compared to natural conditions (Fobert *et al.*, 2019).

It is anticipated that certain fish species will exhibit specific behaviours in response to the illumination sources, although this is predicted to only occur within areas where the direct light spills onto the ocean surface. These areas are not expected to extend beyond 500 meters from the source. Any gathering or avoidance actions displayed by the fish would only happen at night and are not likely to cause any significant changes in the overall population over the long term.

The potential for increased predator activity is unlikely to result in significant impacts to the fish populations. Given the relatively small impact area in respect to fish habitat, potential impacts are expected to be highly localised and unlikely to have discernible consequences at population level.

Marine mammals

Research on the impact of artificial light on marine mammals is lacking and there are no reports of direct effects of artificial light on marine mammals. It is believed that many dolphin species are active

during the day, potentially due to the availability of prey. Since fish tends to gather in areas with light spill, dolphins might be indirectly attracted to illuminated structures of marine environment for hunting. Mammals rely on changes in the length of daylight to anticipate environmental changes and time their reproduction, therefore any alteration in the perception of day length caused by illumination could result in physiological and/or behavioural changes.

Potential impacts to marine mammals are expected to be limited to temporary aggregation in response to changes in prey distribution. However, it is relevant to note that such an attraction effect has yet to be observed for the Coral South FLNG facility, through the ongoing biodiversity monitoring program. Resident dolphin species that occur all year are mobile, therefore, the likelihood of being exposed to constant nighttime lighting might disrupt their perception of day length is low.

Marine turtles

The vulnerability of turtles to negative impacts of artificial light is influenced by life history stage and behaviour of the turtles as detailed below.

Foraging adult carnivorous turtles have been observed feeding on prey aggregating around offshore platforms in the Gulf of Mexico (Kebodeaux, 1994). Therefore, if the prey species aggregate due to illumination from the FLNG, there may be indirect impacts to foraging marine turtles.

Adult female marine turtles return to land, mostly at night, to nest on sandy beaches. During this process, they rely on visual cues to select, and orientate on, nesting beaches and return to the ocean post nesting. Beaches with light spill, such as those located adjacent to urban developments, roadways, and piers, often have lower densities of nesting females compared to beaches with less development (Salmon, 2003; Hu *et al.*, 2018). Since females are thought to use light cues to return to the open ocean post-nesting (Witherington & Martin, 2003), illumination has the potential to disorientate females post nesting. However, observations of nesting females and emerging hatchlings at the same beach (Witherington, 1992) indicates that nesting females are less vulnerable to impacts of illumination on sea-finding behaviour compared to hatchlings.

Hatchling turtles emerge from the nest at night (Mrosovsky & Shettleworth, 1968), and locate the ocean using a combination of topographic and brightness cues, orienting towards the lower, brighter oceanic horizon, and away from elevated darkened silhouettes of dunes and/or vegetation behind the beach (Pendoley & Kamrowski, 2015; Lohmann *et al.*, 1997; Limpus & Kamrowski, 2013). Marine turtle hatchlings may use celestial lights as navigational markers during oceanic migration and are attracted towards bright light. Therefore, hatchlings can become disoriented and trapped within the light spill around platforms and vessels, leading to increased energy use, increased predation, and decreased survival rates (Witherington & Martin 1996; cited in Lorne *et al.* 1997; Commonwealth of Australia 2019). Hatchlings disoriented or misoriented by illumination may take longer, or fail, to reach the sea., resulting in dehydration, exhaustion, predation, and increased mortality (Salmon & Witherington, 1995).

It has been shown that artificial light rich in short wavelength blue and green light are most disruptive (Fritsches, 2012; Pendoley, 2005; Witherington & Bjorndal, 1991a). Although marine turtles are less sensitive to longer wavelength light compared to shorter wavelengths, long wavelength light can still

disrupt sea-finding of hatchlings (Robertson *et al.*, 2016; Pendoley, 2005; Pendoley & Kamrowski, 2015), and if bright enough can result in a similar level of impact (Mrosovsky, 1972; Mrosovsky & Shettleworth, 1968; Pendoley & Kamrowski, 2015; Cruz *et al.*, 2018).

As the hatchlings swim offshore from their natal beach, they become less influenced by light cues and rely predominantly on wave motion, currents, and the earth's magnetic field (Lohmann and Lohmann, 1992). An internal compass set while crawling down the beach, together with wave cues, are used to guide hatchlings offshore (Lohmann & Lohmann, 1992; Stapput & Wiltshko, 2005; Wilson *et al.*, 2021). In the absence of wave cues, however, swimming hatchlings have been shown to orientate towards light cues (Lorne & Salmon, 2007; Harewood & Horrocks, 2008) and in some cases, wave cues were overridden by light cues (Thums *et al.*, 2013, 2016; Wilson *et al.*, 2018).

The speed and direction of at-sea dispersal is influenced by currents (Wilson *et al.*, 2018, 2021). However, research has shown that when light was present, hatchlings actively swam against currents and towards the light source (Wilson *et al.*, 2018) potentially increasing energy expenditure or increasing risk of predation. Extensive light attraction studies conducted on turtle hatchlings have shown that hatchlings crawl away from tall, dark horizons (sand dunes and vegetation) towards lower and lighter horizons (the sea and stars) and that artificial lighting can alter this response (Pendoley, 2005).

Marine turtles do not forage during the breeding season and light cues are not thought to guide migration, mating, or interesting behaviours. Additionally, considering the water depths at the FLNG location, interesting females are not expected at the FLNG location.

Turtles in the nearshore may be able to see the lighting of the FLNG facility especially during the flaring events but this is not expected to have an adverse impact to nesting turtles or hatchlings given the ~50 km separation distance. Once in the water, hatchling navigation is influenced by wave motion, currents, and the earth's magnetic field. Therefore, there is no expected impact of lighting from the artificial light on hatchlings once in the water. Current speeds in the top 6 m of the water column at the FLNG location are mostly greater than 0.44 m. s⁻¹ (Consultec, 2015). Green turtle hatchlings have been recorded swimming at speeds of 0.49 m/s⁻¹ (Thums *et al.*, 2016) and hawksbill turtle hatchlings at 0.21 m/s⁻¹ (Chung *et al.*, 2009). Considering these speeds, should hatchlings be carried towards the FLNG location, it is highly unlikely that individuals would maintain swimming speeds to remain within the area of light spill, which is not expected to extend further than 500 m from the light source.

Studies also suggest that the light generated by flares may not affect hatchlings as much as other light sources. Witherington and Bjørndal (1991) examined the roles of light wavelength and intensity in the sea finding mechanisms of loggerhead and green turtle hatchlings and found that the most disruptive wavelength are in the range of 300-500 nm (blue-green wavelengths). Studies of spectral analysis of flares by Pendoley (2000) have found that the flare light typically does not contain a high proportion of light wavelengths within this range.

Seabirds and migratory shorebirds

The EIS illumination specialist study (Consultec & Advisian, 2023c) describes different potential distances on the influence of light for different biological taxa; however, for birds the distance was not defined; therefore a 20 km threshold was used for seabirds and migratory shorebirds (UNEP *et al.*, 2020). The 20 km threshold is restricted to the offshore environment.

Artificial light can have a variety of effects on seabirds, shorebirds, and other migrant birds depending upon the species and the life stage or behaviours being undertaken at the time. Negative responses of birds to artificial light may include collision, entrapment, stranding, grounding, disorientation, or interference with navigation (being drawn off course from usual migration route), potentially resulting in reduced fitness, injury and/or death (Consultec & Advisian, 2021b; see Commonwealth of Australia, 2020 for review).

Species with nocturnal habits, such as procellariiforms (albatrosses, petrels, shearwaters) are at greater risk of negative impacts. Fledglings are particularly vulnerable to artificial light (Montevecchi, 2006; Mitkus *et al.*, 2016) with impacts upon the synchronized mass exodus of fledgling seabirds from their nesting sites being well documented (Deppe *et al.*, 2017; Raine *et al.*, 2007; Rodriguez *et al.*, 2015a, 2015b; Le Corre *et al.*, 2002; Reed *et al.*, 1985).

Conversely, reports of interactions between seabirds and artificial light at sea is anecdotal following significant interaction events (e.g., Black, 2005) or opportunistic monitoring (e.g., Day *et al.*, 2015; Glass & Ryan, 2013; Wiese *et al.*, 2001; Ronconi *et al.*, 2015). Deck lights and spotlights on fishing vessels have been recorded attracting numerous seabirds at night, particularly on nights with little moon light or low visibility (Black, 2005; Merkel & Johansen, 2011; Montevecchi, 2006).

While white light poses a potential threat to seabirds as they contain all wavelengths of light (Rich & Longcore, 2006; Wiltchko & Wiltchko, 1999; Deppe *et al.*, 2017), seabirds appear most sensitive to the shorter, violet – blue region of the visible spectrum (380 nm – 440 nm (Machovsky-Capuska *et al.*, 2011)), Further, Raine *et al.* (2007) concluded the intensity of light may be a more important cue than colour.

Nocturnal foraging at sea is known to occur in pelagic seabird species, such as petrel, shearwater, and albatross, with preferences for bioluminescent prey (Imber, 1975). This is linked to the DVM of prey in the water column resulting in the greater abundance of prey closer to the sea surface under darkness. While this is especially true of storm-petrels, petrels, and shearwaters (Imber, 1975), albatrosses are shown to forage most actively during daylight and on bright moonlit nights (Phalan *et al.*, 2007).

Diurnal seabird species, such as terns, gulls, and boobies, in contrast to procellariiforms, are less vulnerable to illumination impacts. The presence of artificial light may alter foraging behaviours and provide artificial roosting sites (Consultec & Advisian, 2023c).

Artificial light may also attract migratory shorebirds in flight (Longcore *et al.*, 2013) influencing stop-over selection and impacting successful migration (McLaren *et al.*, 2018). Sage (1979) (cited in Ronconi *et al.*, 2015), reported incidents of migrating waders colliding with offshore platforms for an oil production platform almost 200 km northeast of Lerwick, Shetland. Furthermore, long wavelength

red light has been shown to impact migration of passerines through disruption of magnetic orientation (Poot *et al.*, 2008).

Migrants sometimes arrive shortly after nightfall and proceed to circle the platforms for variable periods ranging from minutes to hours. It is believed that the birds then circulate inside the cone of light surrounding the platform and are reluctant to leave, seemingly becoming trapped by the surrounding “wall of darkness” and the loss of visual cues to the horizon (Russell 2015). The circulation patterns put the birds at risk for collision with the platform or with each other, and result in non-useful expenditure of energy.

Fledglings leaving the colony for the first time are unlikely to be impacted by artificial light; however, while the distance between land and the FLNG location is sufficiently great, once at sea, newly fledged juveniles may be more susceptible to attraction, disorientation and collision in the weeks or months following fledging, compared to adults and older juveniles (Consultec & Advisian, 2021b). Sixteen species of seabird breed in the Mozambique Channel, totalling more than three million pairs. Major seabirds breeding colonies, in the Mozambique Channel are located in Europa, Juan de Nova and Glorieuses islands. Europa holds some of the last colonies of large Pelecaniforme birds (frigatebirds *Fregata* spp., red-footed boobies *Sula sula* and red-tailed tropicbirds *Phaethon rubricauda*). Of these species 13 are oceanic foragers and are widespread over all the Mozambique Channel. The sooty tern *Sterna fuscata* is the dominant species and breeds at numerous islands of the channel, the main colonies are at Juan de Nova (66%), Europa (25%) and Glorieuses (9%). Colonies on islets off Madagascar and the Mozambique (mainly Coroa (Primeira Archipelago) and Puga Puga (Secunda Archipelago) are only 0.14% of the population (Le Corre & Jaquemet, 2005). During monitoring surveys conducted in Area 4 some juvenile seabirds have been recorded, e.g., greater frigatebird and red-footed booby in 2016 (Fugro, 2016) and the sooty tern and red-footed booby in 2023 (Consultec, 2023).

Some pelagic seabirds are shown to be attracted to artificial lights on land and forage during the night on bioluminescent prey. In general, smaller species, such as storm-petrels, petrels, and shearwaters, are more nocturnal in their foraging compared to larger albatrosses, and therefore may be at greater risk of colliding with the FLNG (Consultec & Advisian, 2021b).

Bird strikes are monitored as part of the Coral South Environmental Performance reporting. From January to June 2023, a total of 2.3 fatalities/month were recorded (Consultec & Biota, 2023b). One sooty tern collided with the structure and while 11 birds were not assigned to a specific cause of injury or death, some appeared to have collided with the structure during the night (probably after sun-blindness with the FLNG lights) (Consultec & Biota, 2023b). The data collection timeframe is short, with no repeatability to assess patterns, and the sample size of records is still too small to draw definitive conclusions on mortality causes (Consultec & Biota, 2023b).

Given the distance from the FLNG location to intertidal habitats of shorebirds, impacts to foraging and/or roosting are not expected (Consultec & Advisian, 2021b).

The FLNG vessel will be visible to birds from several kilometres away. Flaring events at night may increase the area of visibility for birds, owing to the brightness of the flare (Consultec & Advisian,

2023c). It is thus likely that the FLNG vessel will be an attraction point for seabirds and migratory birds and may cause them to change their course whilst in transit and approach the FLNG site (Consultec & Advisian, 2023c).

Whilst attraction to light sources is well documented, the potential impacts on the population viability of migratory seabirds, if any, which result from this attraction to light sources is not well understood (Shell, 2009; Brown *et al.*, 2023). Induced behavioural disturbances, such as disorientation and attraction, are assumed to be temporary. Such disturbances during migrations could, however, lead to physical effects such as exhaustion and mortality. These effects, however, will likely only affect a small proportion of the population, particularly as no stopover sites within the migratory corridor have been identified in the AII.

Impact assessment

Consequently, the illumination impacts on marine fauna can be assessed as follows:

- Impact on plankton, fish, marine turtles, and marine mammals is negative and direct, but of local scale and low intensity, with a long-term duration, resulting in a low significance;
- Impact on seabirds and migratory shorebirds is assessed as negative, direct, long-term (duration throughout the lifetime of the project although reversible). The impact will be of local extent (20 km around the FLNG), of medium intensity, with no significant impact at population level expected. Some threatened species may be affected as the AII is within a region with a high number of seabirds and migratory birds (ERM, 2016). The impact is thus of medium significance.

Mitigation Measures

Proposed mitigation is as follows:

- The external lightings on the FLNG have been designed to reduce the light spill by limiting the effects of reflecting surfaces and locating luminaries in such a way that they are directed inwards on the facility or shielded, as far as practicable;
- Assessment and implementation, if feasible, of adaptive management actions if areas of concern are identified;
- Impacts to seabirds and shorebirds can be reduced by:
 - Implementing seabird strike or stranding monitoring plan to identify sensitive species and areas of concern - areas of lighting which result in a disproportionate number of bird strikes;
 - Evaluation and implementation, if feasible, of adaptive management actions if areas of concern are identified.

While long wavelength lights are to be avoided to reduce potential impacts to migrating birds (Poot *et al.*, 2008), this conflicts with the preference for amber lighting also with longer wavelength to reduce impacts to local seabirds (Syposz *et al.*, 2021). Considering the impacts of red light on migrating shorebirds has not been proven, and is only inferred from impacts to passerines, and the body of literature supporting the heavier impacts of blue light (i.e., short wavelengths) on seabirds

(Rodriguez *et al.*, 2017; Deppe *et al.*, 2017), it is considered that the use of amber wavelengths would result in a greater net reduction in impact.

Additionally, continuous illumination of work and accommodation areas on the FLNG facility and supply vessels will be limited wherever practicable without compromising the safety or navigational requirements.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO13: Effects of artificial lighting during the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Definite	MEDIUM	-ve	Medium
- Impacts to seabirds and shorebirds can be reduced by: - o Implementing seabird strike or stranding monitoring plan to identify sensitive species and areas of concern - areas of lighting which result in a disproportionate number of bird strikes; - o Evaluation and implementation, if feasible, of adaptive management actions if areas of concern are identified.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Probable	LOW	-ve	Medium

Impact BIO14: Risk of collisions and entanglement of marine fauna

Impact Assessment

The number of whales and marine turtles killed or injured by ships as a result of boat collisions is a worldwide concern. Vessel movements transiting to and from the project site will increase during the operational phase, when compared to the baseline conditions. This will include three PSVs, shared with Coral South FLNG, making round trips between the FLNG and Pemba Port, as well as six shared tugs located around the FLNG operational site. The potential risk of collision with whales during the migratory period with vessels may increase. Cetaceans have low population turnover rates with a number of marine mammals that may migrate and/or occur within the AII are listed as endangered and vulnerable. Moreover, some of the priority fauna susceptible to collision and/or entanglement have been observed in the monitoring campaigns, such as the sperm whale, humpback whale, oceanic white tipped shark, bigeye tuna, and skipjack tuna.

Increased vessel traffic, to and from the Coral North location may also increase the risk of disturbance to sea turtles' migration and nesting routes, or the risk of collisions. Sea turtles are difficult to sight from moving vessels and often rest on or just below the surface of the ocean. Sea turtles could also be impacted by entanglement with the subsea infrastructure, such as the risers and the surface buoys. All five species of sea turtles potentially traversing in the AII are considered to be threatened at a global scale; consequently, an impact may cause adverse effects to the overall populations.

As indicated from the Coral South monitoring data where no incidents have been recorded from the drilling phase until the current operations, the likelihood of a collision with a marine mammal or turtle appears to be low.

This impact on the marine fauna of the area will be negative, direct and of regional extent (the impact will occur along the navigation route to be used by Project vessels, which is regional). This risk will continue throughout the operational lifetime, therefore, the duration is long-term. The intensity of the impact has been rated medium. Even though the increase in vessel movement is low, globally threatened marine mammal species are present in the AII, and a single collision with such a species could potentially be important. The impact's consequence is rated high; however, given that the probability of occurrence is relatively low (possible), the significance rating is assessed as medium.

Mitigation Measures

The following mitigation is proposed:

- Ensure constant bridge watch is kept on all vessels to look out for cetaceans in danger of collision;
- Record any marine mammal sightings;
- Vessels shall not knowingly approach within 300 m of whales or 50 m of dolphins;
- If whales are observed within 300-100 m of vessel during transit, vessels will maintain or reduce speed and alter course away from the whales if safe to perform;
- If whales are observed <100 m from vessel, the vessel will decrease power and alter course away from the whales if operationally safe;
- Risers should be periodically checked to detect any entanglement of marine fauna, in particular turtles. If entanglement is frequently detected, more detailed studies should be developed in order to devise additional mitigation measures.

Impact Assessment Summary

The proposed mitigation is expected to reduce the impact's intensity, thus resulting in a low significance residual impact. The impact assessment summary is provided in the following table.

Impact BIO14: Risk of collisions and entanglement of marine fauna								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Medium	Long-term	High	Possible	MEDIUM	-ve	Medium
	2	2	3	7				
- Ensure constant bridge watch is kept on all vessels and at the FLNG to look out for cetaceans in danger of collision; - Record any marine mammal sightings; - Vessels shall not knowingly approach within 300 m of whales or 50 m of dolphins; - If whales are observed within 300-100 m of vessel during transit, vessels will maintain or reduce speed and alter course away from the whales if safe to do so; - If whales are observed <100 m from vessel, the vessel will decrease power and alter course away from the whales if operationally safe; - Periodically check risers to detect any entanglement of marine fauna, in particular with turtles. If entanglement is frequently detected, more detailed studies should be developed in order to devise additional mitigation measures.								
With mitigation	Regional	Low	Long-term	Medium	Possible	LOW	-ve	Medium
	2	1	3	6				

Impact BIO15: Effect of ballast water on the marine biodiversity during the operational phase**Impact Assessment**

As discussed for the drilling, installation, commissioning and decommissioning phase, the release of ballast waters taken outside of Mozambican waters carries the risk of introduction of alien species, which may have significant impacts on local biodiversity (please see impact BIO8).

During operations, the risk of introducing AIS from the release of ballast water from international vessels will be higher, in particular from the LNG carriers. Vessels that are designed to carry a heavy cargo, such as LNG carriers, are potentially unstable at sea once they have offloaded the cargo at the destination port. Therefore, after offloading they take on ballast to weight and correctly balance the vessel. Vessels take on ballast water into specially designed tanks, which is then pumped out in open ocean or on arrival at the port, if treated and acceptable to the port authority, or at a specified location such as at the Coral North FLNG through a Ballast Water Management Plan where cargo is to be loaded. It has been estimated that 14 billion tonnes of ballast water are transferred annually. Thus, discharge and loading of ballast water has considerable potential for the transmission of AIS.

Therefore, the risk of AIS introduction from the ballast waters exchange during the operational phase on the local marine biodiversity is considered to be a negative and indirect impact. It may occur throughout the operation phase, and as such the duration is long term. It may potentially introduce AIS at the ADI, becoming more widespread towards the coast through the circulation of marine waters, and distributing the AIS impact on a regional extent. Given that the added vessels are a small fraction of the vessel traffic in the Mozambique Channel, the increased risk of AIS due to project activities is assessed as of low intensity. The impact has a medium significance.

Mitigation Measures

The discharge and loading of ballast water from LNG carriers and other vessels associated with the Coral North FLNG shall comply with international and national legislation as well as best international practices (IPIECA, 2010), as follows:

- All vessels containing ballast water shall carry a vessel-specific Ballast Water Management Plan and a Ballast Water Record Book shall be carried to register all ballasting operation;
- Ballast exchange shall, as far as practicable, be conducted in deep water (at least 200 m) and as far as possible from land;
- Treat small vessels as potentially significant AIS pathways;
- Use careful cleaning and inspection to minimize AIS transmission.

Impact Assessment Summary

The implementation of the mitigation measures will lower the probability of occurrence, resulting in a low residual significance. The impact assessment summary is provided in the following table.

Impact BIO15: Effect of ballast water on the marine biodiversity during the operational phase								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Long-term	Medium	Probable	MEDIUM	-‘ve	High
	2	1	3	6				
- All vessels containing ballast water shall carry a vessel-specific Ballast Water Management Plan; - Ballast exchange shall, as far as practicable, be conducted in deep water (at least 200 m) and as far as possible from land; - Discharge and loading of ballast water will with national regulation and international best practices.								
With mitigation	Regional	Low	Long-term	Medium	Possible	LOW	-‘ve	Medium
	2	1	3	6				

Impact BIO16: Effects of cooling water discharges on marine ecology

Impact Assessment

The LNG production process will require a refrigeration system. Seawater will be drawn from the ocean at about a water depth of 150 m for the cooling of machinery engines and in the production process and subsequently become heated prior to being discharged to the marine environment, consequently increasing ambient temperature at the point of discharge. Changes in ambient temperature may lead to the loss or gain of species, depending on physiological adaptations.

Water quality data for Area 4 indicates that average monthly temperatures on the surface of the water range from roughly 25°C in winter (August) to almost 30°C in summer (May) (see water quality baseline in Volume I – section 6.7.2). There is a notable decline in temperature with depth: at 100m depth the average temperature is 24°C, while at 400 m the temperature is 11°C, reaching 7°C at 800m. This happens because most of the heat energy of sunlight is absorbed in the first few centimetres at the ocean's surface, which heats up during the day, and cools at night (as heat energy is lost to the atmosphere by radiation). Waves mix the water near the surface layer and distribute heat to deeper water, such that the temperature may be relatively uniform up to 100 m. Below 100 m, the temperature of the deep ocean drops gradually with depth.

Organisms such as plankton may experience changes in their life cycle dynamics as a result of warmer water. Warmer sea temperatures are also associated with the spread of invasive species and marine diseases. The evolution of a stable marine habitat is dependent upon a myriad of factors, including water temperature. If an ecosystem becomes warmer, it may create an opportunity where outside species or bacteria can suddenly thrive where they were once excluded, leading to forced migrations and even species extinctions at the very worst case. Many marine mammal species also require specific temperature ranges.

The potential temperature impacts from the discharge of the FLNG thermal waters on the receiving marine water were assessed through modelling, as discussed above in Impact WQ2. The detailed modelling methodology and results are provided in Annex VIII (Volume IV), and their discussion is provided above in Impact WQ2, and as such are not repeated here.

The main findings of the modelling study are that even in the worst-case scenario, temperature increases in the receiving marine waters are expected to be fairly low. At 100 m from the discharge

point, the maximum expected temperature increase is 0.39 °C (SSW direction). At the edge of the recommended mixing zone, the increase in temperature is below 0.1°C. This is well below IFC's guidelines for thermal discharges, which state that any thermal discharge should not result in a temperature increase greater than 3 °C at the edge of the mixing zone.

Such a small temperature increase from the FLNG thermal discharge (less than 1°C) is not expected to be relevant and will not result in any significant impact on marine ecology.

Consequently, the impact of the heating of water from the FLNG cooling water system is considered to be negative and direct, of long-term duration (operational lifetime). Considering the rapid dilution and mixture of the heated water, and limited to the surface waters, the impact is considered to have a local extent (a slight increase in temperature in the mixing zone, becoming negligible more than 100 m away from the discharge), with low intensity (such a small increase in temperature is unlikely to result in significant changes to the ecological processes), resulting in a low significance.

Mitigation Measures

No relevant impact was identified, and as such no specific mitigation is required. To ensure the impact remains of low significance, good management of the cooling system is recommended, namely the mitigation measures described in Impact WQ2 above.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO16: Effects of cooling water discharges on marine ecology								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
- Maintain correct operation of the cooling system, to maintain designed discharge temperatures; - Ensure that the pumping of cooling water through the system is turned off when cooling is not required; - Continuous monitoring of the discharge temperature; - Biannual monitoring of the receiving seawater temperature, to ensure compliance with the end of mixing zone standard.								
With mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				

Impact BIO17: Effects of produced water discharges on marine ecology, due to potential degradation of seawater quality

Impact Assessment

Gas reservoirs frequently include a percentage of water, which will be abstracted together with the natural gas. During the LNG process, this water, referred to as produced water, is separated from the gas, treated, and discharged into the sea.

Produced water can contain a suite of potential contaminants (hydrocarbons, heavy metals, phenols). The Coral North FLNG is equipped with a Produced Water Treatment Package, which will

remove most of these pollutants, including phenols, prior to discharge. However, the discharge produced water will still contain trace quantities of hydrocarbons (oil and greases), suspended solids, and BOD₅, hence the potential impact from the discharge of these pollutants on seawater quality and associated biota needs to be considered.

The potential water quality impacts were assessed through modelling, as discussed above in Impact WQ3, with the detailed modelling methodology and results provided in Annex VIII (Volume IV), and discussion provided above in Impact WQ3.

The modelling study showed that trace increases in pollutant concentrations are expected. At roughly 30 m from the produced water discharge point, the following increases are expected:

- 0.011 mg/l of oils and grease;
- 0.67 mg/l of BOD₅;
- 0.039 mg/l of TSS.

These concentrations are consistent with site specific water quality monitoring data from the Coral South FLNG, which has not detected any water quality degradation from the produced water discharge to date, as discussed above in Impact WQ3.

The resulting increases in the ambient concentration of oil and greases, BOD₅, and TSS are very low and well below the ambient seawater quality standards of Mozambique (Annex V of Decree 18/2004, as amended by Decree 67/2010). No relevant degradation of seawater quality from the FLNG's produced water discharges is thus expected.

As the impacts on water quality are low, negligible secondary impacts are predicted on the marine biota. The impact on marine ecology resulting from the discharge of produced water is considered to be negative and direct and/or indirect (secondary impact from the degradation of marine water), of long-term duration, although of low intensity (negligible degradation of water quality is expected), and local extent, resulting in a low significance.

Mitigation Measures

While the significance of the impact is low, good management of the produced water treatment system is recommended, namely the same mitigation measures already set out in Impact WQ3.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO17: Effects of produced water discharges on marine ecology, due to potential degradation of seawater quality								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-‘ve	High
	1	1	3	5				
- Maintain correct operation of the treatment system, to maintain designed discharge concentrations; - Periodic monitoring of the produced water effluent, to verify compliance with the emission limits; - Biannual monitoring of the receiving seawater quality, to verify compliance with the ambient quality standards.								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-‘ve	Medium
	1	1	3	5				

Impact BIO18: Bird mortality associated with flaring

Impact Assessment

Bird mortality may occur due to overexposure to heat from or incineration by flare stack. Although it is difficult to quantify mortality (Montevecchi, 2006), several estimates of annual mortality rates due to flares have been reported, ranging from fewer than 100 birds per year to 6,000,000 per year from the oil and gas platforms in the North Sea (Bruinzeel & van Belle, 2010; Bruinzeel *et al.*, 2009; Ronconi *et al.*, 2015).

Information on mortality rates associated with attraction, collision, and subsequent incineration of seabirds, as well as on terrestrial migratory birds, is uncertain, nevertheless remains a risk. Some data has been collected within the scope of the Coral South Project Biodiversity Evaluation and Monitoring Plan that confirm the occurrence of bird mortality through incineration by the flare stack. In the first six months of 2023, six birds were found incinerated by the flare, including broad-billed roller, Eleonora's falcon (a migratory species) and rufous-bellied heron (Consultec & Biota, 2023b). This represents one fatality per month of operation, which is relatively low. However, the monitoring program for the Coral South FLNG has just begun, and these preliminary results should be viewed with caution.

The impact is negative, direct, of local extent, of long-term duration and medium intensity (although the flare does not occur permanently nor regularly, operation lasts 25 years and in near six months of stranding monitoring some burned birds were found, Consultec & Biota 2023). Considering the assessment criteria, the impact has a medium significance.

Mitigation Measures

Proposed mitigation measures are as follows:

- Stack flare must be installed in compliance with the Design and Construction Regulations / Prevention of Fire and Explosion, and Emergency Response (PFEER);
- Maintain zero flaring policy subject to operational constraints without compromising safe plant, operations, and worker requirements;
- Prepare and implement a monitoring plan for potential bird fatalities.

Impact Assessment Summary

The impact assessment summary is provided in the following table. The post-mitigation assessment results in a low residual significance.

Impact BIO18: Bird mortality associated with flaring								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-term	Medium	Definite	MEDIUM	-ve	Medium
	1	2	3	6				
- Stack flare must be installed in compliance with the Design and Construction Regulations/PFEER; - Maintain zero flaring policy subject to operational constraints and without compromising safe plant, operating and worker requirements; - Prepare and implement a monitoring plan for potential bird fatalities.								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	Medium
	1	1	3	5				

Impact BIO19: Potential disturbance to benthic habitats from scouring by flowlines

Impact Assessment

The Subsea Production System (SPS) will be tied up to umbilicals, risers and flowlines which will then be connected to the FLNG vessel. The flowlines will be installed without trenching or rock stabilisation and will be positioned to lay static on the seabed. Slight movements of these flowlines are expected throughout the project duration, due to influences from water currents near the seabed. These movements of the flowlines could cause scouring of the seabed surface, with resulting impacts to benthic habitats.

However, hydrodynamic scouring of the seabed due to flowlines position on the seabed surface is considered to be unlikely due to the small dimension of the flowlines. Each of the six (6) flowlines to be installed is 10 inches in diameter and range from roughly 2 to 5 km in length. As the lines are considered small, any impacts will be localised.

As discussed in section 6.9.2.3 of the biodiversity baseline (Volume I), the dominant benthic habitat type around the survey area is the “deep sea uniform clay”, which is not considered to be of high biodiversity value. Two other habitat types are considered to be of higher biodiversity values, namely “deep sea submarine canyon” and “deep sea rock”; however these are limited and mainly localized in canyon areas. No coldwater reefs or other features of major ecological interest were found in the areas surveyed. No sessile and mobile species were found to be of high biodiversity value, and their distribution was observed to be fairly uniform across all habitats within the survey area.

The impact is considered to be negative and direct and of long-term duration (the umbilicals and flowlines have a minimum design life of 25 years); however, the local extent (any scouring will be limited to the immediate vicinity of the flowlines location), and low intensity (due to presence of habitats with low biodiversity value in association with the flowlines) result in a low significance.

Mitigation Measures

The use of ROV to monitor the laying of the flowline is recommended as it will help to identify the presence of any sensitive benthic habitats that could be impacted. If sensitive hard bottom areas are identified, carry out micro routing to avoid the habitat.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact BIO19: Potential disturbance to benthic habitats from scouring by flowlines								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-‘ve	Medium
	1	1	3	5				
- Place subsea infrastructure in areas of low biodiversity and sensitivity areas; - Use ROV to monitor laying the flowline laying along the target route. If sensitive hard bottom areas are identified, carry out micro routing to avoid the habitat.								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-‘ve	Medium
	1	1	3	5				

7.7.4 Unplanned Events

7.7.4.1 Potentially Impact Generating Project Activities

The effects of unplanned events are largely related with the spillage and/or release of hydrocarbons, whether it may be a diesel spill during transfer or caused by vessel collision, or other emergency scenario, such as fires or explosions. While these events are unlikely to occur, they may result in extensive negative impacts if the released hydrocarbons enter nearshore waters and coastline habitats. Cyclones may also occur in the region of Area 4, potentially resulting in vessel accidents and thus oil spills.

There are many different types of oil; therefore, each oil spill is different depending on the type of oil accidentally released into the environment, the sensitivity of the impacted resources and the surrounding environment including the following:

- Type of oil spilled – physical and chemical characteristics of oil, susceptibility to evaporation, mousse formation, dispersion, etc., and degree of oil weathering that occurs prior to contact;
- Spill location – distance from sensitive resources;
- Species present – temporal (e.g., seasonal presence, migrants), spatial (i.e., distribution, tendency to occur in schools, herds, etc.), and behavioural characteristics (e.g., species-specific response to oil); and
- Timing of breeding cycles and seasonal migrations.

In general, direct oil effects typically include smothering, toxicity from ingestion and/or inhalation, increased levels of hydrocarbons in water and air, and area exclusion. Indirect impacts include adverse effects on prey organisms and/or destruction of habitat. The primary hydrocarbons of

concern are the soluble aromatics (dissolved-phase aromatic hydrocarbons - DAH) which are potential sources of acute toxicological impacts, such as narcosis, on marine fauna. Impacts are dependent on the species, life stage, exposure duration and concentration. In addition, the oil as a whole may cause injury to marine fauna from contact and being ingested.

Sensitive receptors within the AII consist of marine fauna; zooplankton, fish, marine turtles, seabirds, migratory shorebirds, and cetaceans. The nearest sensitive coastal habitats, such as corals, seagrass beds or mangroves are located at 42 km from the Coral North FNLG site.

The potential unplanned events at Coral North that may result in oil spills include the following scenarios:

- Scenario 1: diesel spill associated with vessel collision, in any project phase. Diesel spills may result in impacts to marine and coastal fauna and habitats due to direct exposure to an oil slick and increased concentrations of DAH;
- Scenario 2: release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase;
- Scenario 3: release of LTOBM due to an accidental riser disconnect on the seabed during the drilling phase.

Spills and leaks of LNG have not been considered as this liquid quickly volatilizes and have a minimal impact on the marine environment in the unlikely event of a spill.

The potential impacts of unplanned oil spills and releases on marine fauna and habitats are discussed below, based on the scenarios and modelling results developed by the dedicated oil spill modelling study developed for this EIS (Consultec & Advisian, 2023), as discussed above in Impacts WQ5, WQ6, and WQ7.

7.7.4.2 Impact Assessment

Impact BIO20: Effects on marine fauna and coastal habitats resulting from an accidental diesel spill due to a vessel collision (unplanned event)

Impact Assessment

The Coral North FLNG Project will generate an increase in maritime traffic throughout its life cycle: during the drilling, installation and commissioning phases from the drilling and support vessels; and during the operational phase from support vessels and LNG export carriers.

The increase in traffic will generate an increased risk of vessel collisions, which may result in the release of significant quantities of diesel fuel to the marine environment. Impact WQ5 above (see section 7.5.4) assessed the potential impact from an accidental diesel spill on marine water quality. This section assesses the potential effects on marine fauna and habitats.

The potential impacts of a diesel spill resulting from a vessel collision were assessed through the application of a hydrodynamic and dispersion modelling software (Consultec & Advisian, 2023a). The modelling methodology and detailed results are provided in Annex VII (see Volume IV). Impact WQ5 discussed the main findings of the modelling study, which are not repeated here. Nevertheless, a

summary of these main findings is provided below, to support the impact assessment on marine fauna and habitats.

The main impacts on marine fauna and habitats associated with oil spills are physical fouling from contact with the oil (to which a range of negative effects are associated) and mortality due to dissolved concentrations of DAH above lethal concentration threshold values.

Research has been carried out in estimating exposure thresholds for birds and mammals contacting an oil slick. Peakall *et al.* (1985) and French (2009) found that oil slicks less than 1 µm were not harmful to seabirds. 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)]. As such, the following thresholds were adopted to assess the potential effects of oil slicks on marine fauna:

- Low risk exposure thickness threshold - visible oil between 0.1 µm and 1 µm;
- Moderate exposure threshold - oil with a thickness between 1 µm and 10 µm;
- High exposure threshold - any oil with a thickness above 10 µm.

The oil spill simulations developed for this EIS for a vessel collision scenario show that there is a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania, while it is highly unlikely to ever reach the shorelines of Madagascar or the Comoro Islands. However, spills that may reach the coastal zone would have a very low thickness (i.e., visible oil between 0.1 µm and 1 µm), thus representing a low-risk exposure. The extent of a spill where it can be considered to have a harmful effect on sea life (thickness > 1 µm – moderate exposure threshold), is shown to be limited to a relatively close proximity of the discharge point with a potential median extent of approximately 789 km² (ranging from 237 km² to 1,971 km²), never reaching the coastal islands or the mainland shoreline (see Figure 7.12 in section 7.5.4).

The regions with oil above the wildlife injury threshold (1 µm) are located offshore in the vicinity of the Coral North FLNG site, typically parallel to the coast, with trajectories travelling north and south from the release location and not reaching the coast and associated coastal habitats mentioned above (Consultec & Advisian, 2023).

The following sections provide a more detailed discussion of the potential impacts on marine turtles, mammals, birds, and fish.

Marine Mammals

Marine mammals may be exposed to oil in several ways, including inhalation of hydrocarbon vapours, direct contact between oil and the skin, ingestion of oil droplets or contaminated prey, and fouling of baleen plates. Whales and dolphins can apparently detect oil slicks on the sea surface, although do not always avoid them and have been seen surfacing in oil slicks, without apparent deleterious effects. Because cetaceans apparently do not avoid oil slicks, they may be vulnerable to inhalation of hydrocarbon vapours.

The effects of oil spills on marine mammals depend on the level of exposure and potential for ingestion or inhalation. Direct oiling of whales and dolphins is not considered to be a serious risk as

their skin contains a resistant dermal shield that acts as a barrier to toxic petroleum compounds. Cetacean skin is highly impermeable to oil and is not seriously irritated by brief exposure to oil.

However, the inhalation of hydrocarbon vapours may lead to irritation and congestion of the lungs and bronchi. Absorption of volatile hydrocarbons through the lungs can lead to liver damage and may be a greater hazard to cetaceans than ingestion of oil or oil-contaminated prey. Vapor concentrations of volatile hydrocarbons may be high enough just above a fresh slick to cause systemic damage for a few hours after a spill.

There is no evidence that ingestion of oil as droplets or contaminated prey represents a significant risk to baleen and toothed cetaceans. Fouling of the baleen feeding apparatus of baleen whales has not been observed; if it does occur, it is probably transitory and not debilitating. Preferred prey items are not likely to be sufficiently contaminated to pose a significant health risk to cetaceans. A potential diesel spill would affect an area that holds some of the highest cetacean densities of the Mozambique Channel (Consultec & Advisian, 2023; Laran *et al.*, 2017).

Dugongs are generally scarce within Mozambique, distributed primarily in southern Mozambique within the nearshore waters of Maputo Bay (near Inhaca Island) and Inhambane Bay, Pomene, the Bazaruto Archipelago, and between Inhassoro and the Save River. Their occurrence in Cabo Delgado has been reported, although the current state of the population is unknown. The most recent reported sightings, in the area, was a live observation by a fisherman in 2001, a capture in fishing nets in 2003, and an accidental sighting in 2009 (WWF, 2004; Findlay, 2011). The dugong potential distribution area (IUCN, 2023) overlaps in a strip along the coast approximately 10 km wide and 100 km length with the area potentially affected by a diesel spill (Consultec & Advisian, 2023). However, the dugong's most important habitat (seagrasses) is not predicted to be impacted by the diesel spill, as the 1 µm thickness is restricted to the offshore area (Consultec & Advisian, 2023).

Direct and indirect impacts of diesel fuel upon these highly mobile animals are liable to be very short term and an unlikely occurrence, although relevant if a spill occurs, and affects one endangered and/or threatened animal, such as a sei whale.

Turtles

Turtle nesting occurs throughout Mozambique, although most nesting activity appears to be distributed in the south. Adult turtles utilize a variety of habitats for feeding, including seagrasses, coral reefs, mud flats, and mangroves. All species nest on sandy beach habitats in Mozambique, although current information on turtle nesting sites (especially within northern Mozambique) is lacking. Sea turtles usually do not avoid contact with oil either on the sea surface or onshore and may even seek out and ingest tar balls. If a sea turtle does encounter a large oil slick on the sea surface, there is a high probability that the turtle will suffer injury or possible death.

All species and life stages of sea turtles are vulnerable to injury from encounters with oil. Oil can adhere to the body surface and cling to the nares, eyes, and upper oesophagus of sea turtles, causing contact dermatitis. Mucus membranes around the eyes, nose, and mouth may become irritated and damaged by oil contact.

Short-term contact with or ingestion of the oil may cause significant changes in respiration, blood chemistry, energy metabolism, and diving behaviour. The salt gland function has shown to be inhibited immediately after oil exposure, returning to normal within several weeks following exposure. These responses to oil would cause a variety of sub-lethal physiological effects that may lessen the ability of the turtle to cope with normal environmental stresses. Inhalation of hydrocarbon vapours may cause respiratory pathology and systemic toxicity.

Adult and juvenile turtles can survive and, through their swimming ability, avoid oil slicks. Hatchlings are the most vulnerable stage in the turtle life cycle if oil slick reaches beaches where they are about to emerge and migrate to the sea. An oil slick may disorientate the hatchlings what may increase their exposure time to predators on the beaches and/or interfere with their swimming abilities. Hatchling survival is not high in any case and any increased mortalities can be reflected in the overall population.

While the modelled diesel spills with thickness with negative impacts for wildlife will not reach turtle nesting areas, these species may be negatively impacted in the offshore affected area when surfacing to breathe.

Birds

For birds, impacts may occur due to stains of oil on the plumage. For areas where oil exceeds the thickness threshold of 1 μm (Peakall *et al.*, 1985 and French, 2009), the insulating and water repelling properties may be destroyed which may ultimately cause the death of the bird. Also, there may be toxic effects after the ingestion of oil during preening, ingestion of oiled prey, inhalation of oil fumes or absorption of oil through skin or eggs may also lead to death. Indirect effects may result from destruction of bird habitats or food resources. Diving or swimming species are particularly vulnerable because they react to an encounter with floating oil by diving (as opposed to flying out of the contaminated area) and consequently quickly become totally oiled (Bourne, 1968b and 1970). In small patches of oil, swimming or diving birds could avoid meeting oil, although not in the case of large slicks. Diving is a poor escape mechanism for large oil slicks.

The effect of oil on the plumage causes the fine element of the feathers to stick together losing the insulation value and water repellent capacity of the feathers. Birds with oil contaminated plumage lose their buoyancy and flying capability becoming exposed to cold with an increasing metabolic rate, while being unable to replenish the energy needed. The most affected birds would be ones in direct contact with the water while feeding such as albatrosses that feed on squid, fish and krill by either scavenging, surface seizing or diving; procellariine petrels that feed on fish and molluscs, some fish and crustaceans by dipping and surface-seizing and mainly at night (del Hoyo *et al.* 1992); the gannets (*Morus* spp.) that capture fish by diving from a height into the sea and catching fish much deeper than most airborne birds by pursuing their prey underwater (Harrison, *et al.*, 1997).

The modelled diesel spills would affect an area that hosts intermediate to low seabird densities of the Mozambique Channel (Consultec & Advisian, 2023; Laran *et al.*, 2017).

Fish

Pelagic fish (adults, larvae) mortalities as a result of oil spills are limited in size and have not

translated into measurable effects on fish stocks. However, local mortalities especially in fish larvae and fish eggs can occur, although apparently rare (Baker *et al.*, 1990). Demersal, near-shore, and estuarine stocks, especially those species feeding on the sediment surface may suffer mortalities through ingesting contaminated sediments.

Fish are mobile and can move out of an impacted area. However, the overall habitat range can be significantly decreased, leading to major implications for the fish populations as a whole. An oil spill, therefore, can have a major negative impact upon near-shore and shallow water species; however, modelling results indicated that a diesel spill will not reach the nearshore with threshold values likely to cause impacts on marine fauna (i.e., greater than 1 µm). Crude oil exposure has been found to result in toxicity effects on fish, with localized mortality to fish eggs and larvae also possible. Similar effects may be expected following exposure to diesel fuel.

The regions of the ocean at risk of impacting fish stock are primarily the top few meters beneath the travelling diesel slick where the dissolved plume of aromatics may cause narcosis. The region that may be affected is relatively small compared with the available offshore habitat for these species (Consultec & Advisian, 2023a). To cause narcosis, the organism must remain exposed for threshold concentration for 96-hours; shorter durations would require greater concentrations to cause equivalent effects. Juvenile and adult fish are able to swim below the plume and avoid injury. Also, the threshold concentration was selected as a conservative value associated with sensitive test organisms, below which no acute toxicological effects are expected. Other species of fish may be less sensitive to narcosis and able to survive concentrations one to two orders of magnitude greater.

Coastal habitats

As shown by the modelling results, the extent of a spill considered to have a harmful effect on sea life (thickness > 1 µm) is limited to a relatively close proximity of the discharge point with a potential median extent of approximately 789 km² (ranging from 237 km² to 1,971 km²). The impacted area is restricted to offshore and is not projected to reach important coastal habitats such as corals, seagrasses, or mangroves (the oil spill will be at least 25 km distant from these coastal habitats) (Consultec & Advisian, 2023).

Impact Assessment

Considering the modelling results, the impact on marine fauna resulting from an unplanned vessel collision diesel spill is assessed as a negative and direct impact. While any hydrocarbon spill has a short duration, the effects on marine fauna can extend in time, and as such the duration is assessed as medium (1 to 5 years for full recovery). The extent is of regional scale. The intensity is high (considering the presence of several threatened species of marine mammals, turtles, and seabirds that may be impacted by a spill). The consequence is assessed as high. However, given the probability of the impact occurring is low (<40% - improbable), the impact significance is assessed as medium.

Mitigation Measures

Mitigation is primarily operational controls to prevent unplanned events such as a vessel collision from occurring, and to be prepared to respond in the event an accident does occur. These mitigation controls include:

- Oil Spill Contingency Plan: Develop and implement a comprehensive oil spill contingency plan (OSCP);
- Incident management and crisis management support teams: Develop these teams of highly trained leaders to respond quickly to emergencies;
- Training of personnel: Train personnel to effectively respond in the event of a hydrocarbon spill;
- Equipment: Tier 1 oil spill response equipment will be staged on support vessels and/or at shore;
- Agreements: Promote the use of Tier 2 equipment from peers, if necessary. Maintain membership of Oil Spill Response Limited (OSRL), a global spill response cooperative, that provides Tier 3 response equipment and personnel;
- Stakeholder Agreements: Communicate with stakeholders prior to spill response operations informing potentially affected communities of the OSCP procedures.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a vessel collision and response efforts will minimize the extent of the oil slick, if diesel is released. The post mitigation assessment takes into account the full application of all spill response protocols, all trained staff reacted appropriately, and all containment methods deployed to minimize the spread of the spill. As a result, surface oiling will be maintained within a much closer vicinity to the ruptured vessel. This will reduce the extent from regional to local, and the intensity from high to medium. The overall consequence score is reduced to low after successful application of mitigation measures, and the residual significance to very low, taking into account the low probability of impact occurring. The impact assessment summary is provided in the following table.

Impact BIO20: Effects on marine fauna and coastal habitats resulting from an accidental diesel spill due to a vessel collision (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	High	Medium-term	High	Improbable	MEDIUM	-ive	High
	2	3	2	7				
- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Local	Medium	Medium-term	Low	Improbable	VERY LOW	-ive	Medium
	1	2	2	5				

Impact BIO21: Effects on marine fauna and coastal habitats resulting from a gas condensate blowout (unplanned event)***Impact Assessment***

The second oil spill scenario investigated by the dedicated oil spill modelling study developed for this EIS was the possibility of a release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase. The modelling methodology and detailed results are provided in Annex VII (see Volume IV), while Impact WQ6 above (see section 7.5.4) discussed the main findings of the modelling study for this accidental scenario, which are thus not repeated here, and assessed the potential impact of such an accidental spill on marine water quality. This section assesses the potential effects on marine fauna and habitats.

The main findings of the modelling of a gas condensate blowout are illustrated in Figure 7.14 and Figure 7.15 (see section 7.5.4).

The modelling results show that the extent of a spill where it can be considered to have a harmful effect on sea life (thickness > 1 μm – moderate exposure threshold) is smaller than that from a diesel spill, and shown to be limited to a relatively close proximity of the discharge point, with potential median extent of approximately 552 km² (ranging from 80 to 880 km²).

The regions with oil above the wildlife injury threshold (1 μm) are located offshore in the vicinity of the Coral North FLNG site, typically parallel to the coast, with trajectories travelling south from the release location and at least 27 km from the coast and associated coastal habitats such as corals and seagrasses (Consultec & Advisian, 2023).

The potential effects of a gas condensate blowout on marine fauna and coastal habitats are very similar to those discussed in the previous impact (accidental diesel spills), and thus are not repeated here. As the area affected by the condensate spill is smaller than for diesel spill, impacts on more offshore species are unlikely. The impact is assessed as medium-term, regional extent, with high intensity. The resulting consequence is assessed as high. However, given the probability of the impact occurring is low (<40% - improbable), the impact significance reduces to medium.

Mitigation Measures

Mitigation is primarily operational controls to prevent unplanned events such as a blowout from occurring, and to be prepared to respond if an event occurs. The same mitigation controls listed in the previous impact (Impact BIO20) are applicable here.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a gas condensate blowout, and response efforts will minimize the extent of the oil slick, if there is a release. The post mitigation assessment takes into account the full application of all spill response protocols, all trained staff reacted appropriately, and all containment methods deployed to minimize the spread of the spill. As a result, the spill would be prevented from reaching the shorelines (even at low thickness) and surface oiling maintained within a much closer vicinity to the well location. This will reduce the extent from regional to local and the intensity from high to moderate. The residual consequence score is

reduced to low after successful application of mitigation measures, and the residual significance to very low, due to the low probability of impact occurring. The impact assessment summary is provided in the following table.

Impact BIO21: Effects on marine fauna and coastal habitats resulting from gas condensate blowout (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	High	Medium-term	High	Improbable	MEDIUM	-‘ve	High
	2	3	2	7				
- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Local	Medium	Medium-term	Low	Improbable	VERY LOW	-‘ve	Medium
	1	2	2	5				

Impact BIO22: Effects on marine fauna and coastal habitats from an LTOBM release due to an accidental riser disconnect (unplanned event)

Impact Assessment

The release of LTOBM due to an accidental disconnection of the riser during drilling was also considered in the oil spill modelling study (Consultec & Advisian, 2023a). The modelling methodology and detailed results are provided in Annex VII (see Volume IV), while Impact WQ7 above (see section 7.5.4) discussed the main findings of the modelling study for this accidental scenario, which are thus not repeated here, and assessed the potential impact of such an accidental spill on marine water quality. This section assesses the potential effects on marine fauna and habitats.

The main findings of the modelling of a LTOBM release are illustrated in Figure 7.16 and Figure 7.17 (see section 7.5.4).

The modelling results show that the extent of a spill considered to have a harmful effect on sea life (thickness > 1 µm – moderate exposure threshold) is similar to that from a diesel spill. It was shown to be limited to a relatively close proximity of the discharge point, with median potential extent of approximately 631 km² (ranging from 237 km² to 1,656 km²), never reaching the more sensitive coastal islands or the mainland shoreline.

The regions with oil above the wildlife injury threshold (1 µm) are located offshore in the vicinity of the Coral North FLNG site and typically parallel to the coast, with trajectories travelling south from the release location, never reaching the coast and associated coastal habitats such as corals and seagrasses (Consultec & Advisian, 2023).

The potential effects of a LTOBM release on marine fauna and coastal habitats are the same as discussed in the diesel spill impact (see Impact BIO20), and thus are not repeated here. As the area affected by the LTOBM spill is similar to that of a diesel spill, impacts intensity will also be very similar. The impact is assessed as medium-term, regional extent, with high intensity. The resulting

consequence is assessed as high. However, given the probability of the impact occurring is low (<40% - improbable), the impact significance falls to medium.

Mitigation Measures

Mitigation is primarily operational controls to prevent unplanned events such as a release of LTOBM from occurring, and to be prepared to respond in the event an accident does occur. The same mitigation controls listed in Impact BIO20 are applicable.

Impact Assessment Summary

Post mitigation, operational controls will minimize the risk of occurrence of a LTOBM release, and response efforts will minimize the extent of the oil slick, if released. The post mitigation assessment considers full application of all spill response protocols, all trained staff reacted appropriately, and all containment methods deployed to minimize the spread of the spill. As a result, the spill would be prevented from reaching the shorelines (even at low thickness) and surface oiling maintained within a much closer vicinity to the drilling site. This will reduce the extent from regional to local and the intensity from high to moderate. The residual consequence score is reduced to low after successful application of mitigation measures, and the residual significance to very low, due to the low probability of impact occurring. The impact assessment summary is provided in the following table.

Impact BIO22: Effects on marine fauna and coastal habitats from an LTOBM release due to an accidental riser disconnect (unplanned event)								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	High	Medium-term	High	Improbable	MEDIUM	-ive	High
	2	3	2	7				
- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.								
With mitigation	Regional	Low	Medium-term	Low	Improbable	VERY LOW	-ive	Low
	2	1	2	5				

7.7.5 Ecosystem Services

7.7.5.1 Methodology

The assessment of the project's impacts on ecosystem services followed the framework established by Landsberg *et al.* (2013). The approach considers six steps (presented in Table 7.37) which are broadly consistent with common environmental impact assessment approaches.

The first two steps are decisive in identifying and prioritizing potentially affected services, and establishing priority ecosystem services that will be subject to the impact assessment.

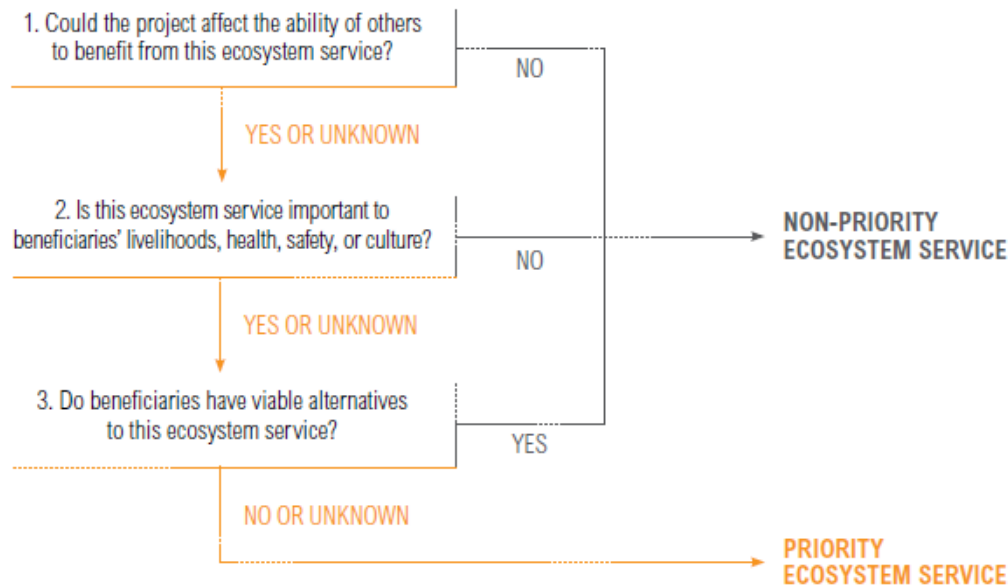
The baseline section (Volume I) identifies the ecosystems and services that may be potentially affected by the project as well as the local beneficiaries and benefits of the ecosystem services.

Table 7.37: Approach followed in the impact assessment of ecosystem services

IMPACT ASSESSMENT	IMPACT SUB-STEPS	BRIEF GUIDANCE TO SUB-STEPS
Step 1: Identify ecosystem services relevant to project impact	1.1 Identify ecosystems the project could impact	Review land cover maps to identify potentially impacted ecosystems.
	1.2 Identify ecosystem services the project could impact	Review standard list of ecosystem services and develop a matrix of services that each potentially impacted ecosystem provides.
	1.3 Identify potentially affected ecosystem service beneficiaries and benefits	Review social profile of project area and identify the people who depend on potentially impacted ecosystem services for their livelihoods, health, safety, and culture.
Step 2: Prioritize relevant ecosystem services according to project impact	2.1 Identify ecosystem services for which project impacts could affect the ability of others to derive benefits	Preliminary estimate of the extent of change in ecosystem services and determination of whether these changes could affect people's livelihoods, health, safety, or culture.
	2.2 Identify ecosystem services that are important to beneficiaries' livelihoods, health, safety, or culture	Hold meetings with stakeholders to assess people's dependence on potentially affected ecosystem services.
	2.3 Identify ecosystem services for which beneficiaries have no viable alternatives	
Step 3: Define the scope and information needs of the ecosystem service impact assessment	3.1 Delineate the ecosystem service impact assessment area	Localize the impacted ecosystems and the locations where people access services.
	3.2 Identify indicators of project impact on ecosystem services	Review literature and engage stakeholders to identify indicators relevant to assessing ecosystem impacts on people's livelihoods, health, safety, and culture.
Step 4: Establish the baseline for priority ecosystem services	4.1 Assess current ecosystem service use and benefit	Engage stakeholders to establish relationships between ecosystem services and people's livelihoods, health, safety, and culture for the indicators identified in Step 3.
	4.2 Assess sustainability of current ecosystem service use and benefit	Conduct field visit, review existing literature, and engage stakeholders about recent trends in ecosystem services.
Step 5: Assess project impacts on priority ecosystem services	5.1 Predict project impacts on ecosystem service supply	Infer impacts on ecosystem service supply from project impacts on ecosystems.
	5.2 Predict project impacts on ecosystem service benefits	Predict impacts on people's livelihoods, health, safety, and culture based on impacts on ecosystem service supply.
	5.3 Assess significance of project impacts on affected stakeholders	Assess the magnitude of impacts on people's livelihoods, health, safety, and culture; and their sensitivity to these impacts. Identify ecosystem services for which impacts need to be mitigated.
Step 6: Mitigate project impacts on priority ecosystem services	6.1 Mitigate loss and enhance gain in ecosystem service benefit	Review existing mitigation measures and supplement them to at least achieve no loss of ecosystem service benefits by implementing the ecosystem service mitigation hierarchy.

Source: Landsberg *et al.* (2014).

Step 2 prioritizes the ecosystem services that are important to the beneficiaries relevant to the project impacts. The prioritization process is exemplified in Figure 7.22 and takes a precautionary approach where there are information gaps. A service is considered a priority when the existing information does not enable a clear designation. Only services considered to be a priority are subject to subsequent impact assessment.



Source: Landsberg *et al.* (2014).

Figure 7.22: Decision tree to prioritize relevant ecosystem services according to potential project impacts on beneficiaries

In step 2.1, the ability of others to obtain benefits is altered under the following scenarios:

- Project's impacts push the service outside a sustainability threshold;
- Impacts of the project trigger a regulatory response, changing the legal status or access;
- Current demand for the ecosystem service exceeds its availability;
- Alteration to the service prevents the use and enjoyment by others;
- Impacts of the project on the service are perceived by others as affecting their ability to benefit from the service.

The methodology does not recommend a specific approach for evaluating the importance of an ecosystem service for the beneficiaries; however, it indicates a service is important when that service satisfies 50% of the need of one or more members of the beneficiary community.

Cultural services are more difficult to quantify; therefore, the assessment is based on the significance of the associated impacts assessed for the other descriptors.

In step 2.3, ecosystem services are identified where beneficiaries have no viable alternatives, including not being able to derive the same benefit over time, without physical, economic, or psychological burdens, considered unacceptable, as well as from the following:

- Non-ecosystem-based solutions;
- Same service is provided by another ecosystem.

Stage 3 is based on the area, indicators, and baseline characterization of elements that underpin the ecosystem services to be assessed. Information gained is used to predict the impacts of the project

on the provision of ecosystem services (5.1) or benefits generated (step 5.2). The assessment of the significance of project impacts on benefits (step 5.3) was carried out according to the impact assessment methodology and matrices shown in Table 7.38 and Table 7.39.

Any proposed mitigation measures (step 6) will aim to complement the proposed measures to mitigate impacts on ecological systems, in that they will be designed to mitigate the loss of benefits to the potential beneficiaries of the services.

Table 7.38: Assessment of significance of loss in ecosystem service benefit brought by a project

		SENSITIVITY OF AFFECTED STAKEHOLDERS TO LOSS IN ECOSYSTEM SERVICE BENEFIT		
		Low Strong and diversified asset portfolio; high ability to adapt to loss in ecosystem service benefit and maintain overall well-being.	Medium Medium-size and moderately diversified asset portfolio; ability to partially adapt to loss in ecosystem service benefit and maintain overall well-being.	High Small and concentrated asset portfolio; limited ability to adapt to loss in ecosystem service benefit and maintain overall well-being.
MAGNITUDE OF LOSS IN ECOSYSTEM SERVICE BENEFIT	Negligible Loss in ecosystem service benefit remains within the range commonly experienced by affected stakeholders. Loss in ecosystem service benefit categorized as "negligible" by affected stakeholders.	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
	Low Relatively small loss in ecosystem service benefit from baseline conditions. The loss in ecosystem service benefit is for a short duration or occurs with low frequency. Loss in ecosystem service benefit categorized as "low" by affected stakeholders.	NEGLIGIBLE	MINOR	MODERATE
	Medium Relatively large loss in ecosystem service benefit from baseline conditions. The loss in ecosystem service benefit is of medium duration or occasional frequency. Loss in ecosystem service benefit categorized as "medium" by affected stakeholders.	MINOR	MODERATE	MAJOR
	High Loss in ecosystem service benefit dominates over baseline conditions. The loss in ecosystem service benefit is of long duration, even irreversible, or frequent. Loss in ecosystem service benefit categorized as "high" by affected stakeholders.	MODERATE	MAJOR	MAJOR

Source: Landsberg *et al.* (2014).

Table 7.39: Assessment of significance of gain in ecosystem service benefit brought by a project

		SENSITIVITY OF AFFECTED STAKEHOLDERS TO GAIN IN ECOSYSTEM SERVICE BENEFIT		
		Low Small and concentrated asset portfolio; limited ability to capture gain in ecosystem service benefit and improve overall well-being.	Medium Medium-size and moderately diversified asset portfolio; ability to partially capture gain in ecosystem service benefit and improve overall well-being.	High Strong and diversified asset portfolio; high ability to capture gain in ecosystem service benefit and improve overall well-being.
MAGNITUDE OF GAIN IN ECOSYSTEM SERVICE BENEFIT	Negligible Gain in ecosystem service benefit remains within the range commonly experienced by affected stakeholders. Gain in ecosystem service benefit categorized as "negligible" by affected stakeholders.	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
	Low Relatively small gain in ecosystem service benefit from baseline conditions. The gain in ecosystem service benefit is for a short duration or occurs with low frequency. Gain in ecosystem service benefit categorized as "low" by affected stakeholders.	NEGLIGIBLE	MINOR	MODERATE
	Medium Relatively large gain in ecosystem service benefit from baseline conditions. The gain in ecosystem service benefit is of medium duration or occasional frequency. Gain in ecosystem service benefit categorized as "medium" by affected stakeholders.	MINOR	MODERATE	MAJOR
	High Gain in ecosystem service benefit dominates over baseline conditions. The gain in ecosystem service benefit is of long duration or frequent. Gain in ecosystem service benefit categorized as "high" by affected stakeholders.	MODERATE	MAJOR	MAJOR

Source: Landsberg *et al.* (2014).

7.7.5.2 Prioritization of Ecosystem Services

The baseline characterization enabled the identification and prioritisation of the ecosystem services and beneficiaries potentially affected in the project area of influence (Landsberg *et al.*, 2013).

The provision of biomass, mainly fisheries, was not a priority ecosystem service as impacts on water quality and biodiversity are predicted to be insignificant to low significance. Hence no alterations in the habitat quality and structure are expected and no resultant changes in the biological communities and system productivity.

The establishment of safety zones around the Coral North FLNG site constitutes a loss of access to fishing grounds for industrial fisheries. However, this corresponds to just 0.1% of the total fishing area available for commercial fishing in the deep-sea marine environment off the coast of Cabo Delgado. Given that the fishing zones used by commercial fishing in the Indian Ocean (including fleets operating in Mozambique and Cabo Delgado) cover a vast area, spanning the EEZs of a number of African and Asian countries, the limitation to the commercial fishing is considered negligible justifying that the provisional ecosystem service is not considered priority.

Regulation and maintenance services were also not considered priority. A significant alteration in the structure of the habitat and biological communities is not expected, therefore the ecosystem will function largely unaltered with no discontinuation of service.

According to the seascape and socioeconomic evaluation, tourism is the only cultural ecosystem service that is used and may potentially be impacted, which is an important element of the local economy, especially for the coastal area and the Quirimbas Archipelago. Tourism is influenced by the attractiveness of the natural environments and the abundant biodiversity that characterize these areas. The visual amenity could be potentially impacted for tourists using the beaches for recreational purposes, or the ocean for water sports or boating. The visual sensitivity of these receptors is high. Nevertheless, the visual impact of the project is considered very low significance as the Project occupies a small area in the seascape and will not be seen from the tourist areas. Cultural services were, therefore, also not considered priority.

In summary, the assessment indicates that none of the ecosystem services are priority given that their function and benefits will not be affected. As such, no further evaluation of impacts on ecosystem services is required.

7.8 Socioeconomics

7.8.1 Project Activities and Associated Potential Impacts

The different phases of the project that may result in socioeconomic impacts are described below.

- Drilling, installation, and commissioning - the installation phase will consist mainly of subsea installation and testing, installing mooring chains and anchors, connecting the FLNG and conducting hydraulic tests. Drilling and completion of the wells will also take place during this phase, followed by the commissioning phase. A number of vessels will be active in Area 4 during these phases of the project, including a drilling vessel, an installation vessel, the FLNG (during installation and commissioning), and a number of support vessels. These activities will lead to increased maritime traffic, as well as increased noise levels (particularly from maritime traffic and general activities), visual pollution (due to generated lighting and emergency flaring) and waste generation. There will be an exclusion zone of 500 m around the submarine infrastructure. Workers involved in these phases will be mostly highly qualified expatriate workers, particularly those aboard the international drilling and installation vessels. Some national workers will also be involved;
- Operation and maintenance - the main activities associated with the operational and maintenance phase will include the operation of the FLNG (liquefaction, storage, and offloading of natural gas), including support and logistics, as well as the maintenance of subsea facilities and infrastructure. These activities will result in a permanent presence and operation of the FLNG unit on site; the establishment of safety zones around the FLNG; and gas tankers traveling between the FLNG and export destinations. Speculative indirect growth and employment opportunities for national workers will be more relevant during this phase;

- Project decommissioning - the decommissioning of the project will result in the removal of the FLNG from the area, the controlled abandonment of the flowline network and the plugging of the wells. This will result in an increase in the number of support vessels in the area, as well as some employment opportunities.

The FLNG will be supported by onshore offices that will function as logistical support and ancillary services for the project, located in Pemba City (port, airport, offices, and logistics base) and Nacala (port, used only for very specific material needs). However, these are currently operational infrastructure. The socioeconomic impacts associated with the operation of these infrastructures are in place and will not change significantly with the implementation of the Coral North Project. As such, these onshore infrastructures are not addressed further in this report.

Based on the assessment methodology presented in above and a description of the activities to be carried out in each of the phases indicated above, the main socioeconomic and human rights impacts expected are listed below and assessed in the following section:

- Potential impacts on tourism: tourism activities in the AI are primarily associated with full package lodges in the coastal islands. However, these activities have ceased in recent years, due to the security situations in the province and the district. Even if these tourism activities resume in the future, the area of operation of the proposed FLNG site does not overlap the touristic areas. As discussed in the landscape impact section above (see section 7.6 above), it is also highly unlikely that the FLNG will be visible from the islands, and as such no visual impact is expected. Given this, no impact or direct rights limitations and/or restrictions on island tourism from the Coral North FLNG is identified. Potential impacts on tourism may arise in the event of accidental spills, and these are addressed in the unplanned events section. The implementation and operation of the Project may stimulate some business tourism in the city of Pemba and the Quirimbas islands, mainly as a result of downstream economic activity stimulated by enhanced economic activity from the onshore support logistics;
- Potential impacts on the local and regional economy: the Project's expenditure on goods and services during all phases of the Project will have an economic effect on the local and regional economy. Additionally, the production and export of LNG will generate significant revenue at provincial and national level, in support of the Mozambican Treasury;
- Potential impacts on labour: project implementation will lead to both direct and indirect job creation. Job creation during the drilling, installation, and commissioning phase will be very limited, as project activities will take place offshore, using international specialized vessels. During the operational phase, job creation will be more significant, particularly on the offshore FLNG vessel. Job creation onshore will be limited to the logistic support activities. Given the nature of the created jobs, it is highly unlikely that the project implementation will generate any influx of migrant workers, as witnessed from the Coral South Project. As such, no migrant worker influx impact is expected for the Coral North Project or further addressed in this report. Job recruitment may also lead to the transfer of skills to the national workforce;

- Potential impacts on social services: large scale development projects usually require the mobilization of large number of workers, which then introduce additional pressure on the local social services (health, education, housing, etc.). Where social services are already extremely overburdened, this can lead to a significant impact on local communities. For the most part, the Coral North FLNG workforce will be accommodated on the FLNG and/or associated flotel and will not interact with the Pemba social structure (the workers are flown into Pemba and then to the FLNG, where they reside, and where all social services are provided to them). The same applies for the health infrastructure: the FLNG will have an onboard clinic, which will deal with minor health issues (please see a description of the onboard clinic and the health issues that can be managed onboard the FLNG in the project description section – section 4.3.1.3; Volume I). Onshore hospitals will only be used for emergency medical evacuation (medevac), and it is likely that hospitals in South Africa would be used, as opposed to hospitals in Pemba. In the event a clinic of private hospital in Pemba is used, an individual and/or a limited number of personnel requiring medical attention would not likely interact or overburden the Pemba public health services. Similarly, workers residing in Pemba and employed to support the onshore logistics are a very small fraction of the workforce and their presence will not have any relevant effect on Pemba's health or social services. Therefore, no or negligible impacts to the health services are predicted;
- Potential impacts on health: the large mobilization of workers associated with large scale development projects typically has an impact on the local health profile, usually through the increased incidence of diseases, including sexually diseases. As highlighted above in the potential impacts to social services, the vast majority of the Coral North workforce will have very limited interaction with the Pemba health structure and/or local populations. The workers residing in Pemba and employed to support the onshore logistics are a very small number of the workforce and it is unlikely that their presence will have an effect on Pemba's public health profile. Nevertheless, this issue is assessed in section 7.8.2;
- Potential security impacts: oil and gas industry projects and associated services, particularly when present in conflict and unstable areas, require the deployment of security services, often armed, to protect their infrastructure, assets, and work force. The presence of armed security personnel in areas with extreme levels of despair and vulnerability also harbours the risk of human rights abuses, including violence, discrimination, sexual violence, harassment, abuse, and exploitation. As there will be no new associated land-based infrastructure or installations and that the majority of the workforce will be offshore, it is not expected that additional security arrangements will be required; although related impacts potentially remain;
- Potential rights violations or abuses: the Project is not expected to have any direct impact on economic, social, or cultural rights⁶; however, in the context of high levels of inequality, poverty and vulnerability, potential impacts on political and civil rights related to labour exploitation, discrimination, gender-based violence, sexual exploitation, harassment and abuse, and abuses of power and violence could occur, as described above about security

⁶ Note that economic, social, and cultural rights and civil and political rights are interlinked and have effects on one another.

activities. Such human rights risks are primarily associated with i) Project related labour practices and/or compliance and Project personnel actions or behaviour, and ii) third and/or fourth party labour practices and/or compliance and third and/or fourth party personnel actions or behaviour;

- Potential impacts on fisheries: the Coral North Project will have no impact on artisanal fisheries, under normal operations. Artisanal fisheries operate up to three nm (5.5 km) from the coastal islands. The Coral North site, located almost 40 km away from the islands, does not overlap with the artisanal fishing grounds. Potential effects to fish stocks operations, as assessed during underwater noise, wastewater, illumination modelling studies, are limited to the vicinity of the FLNG with no impacts further afield including on coastal fish stocks. This has been demonstrated during the Coral South FLNG Project, whereby no interaction with artisanal fisheries was observed during the installation, commissioning, start-up and operational phases of this project. The Coral North site is located within the fishing grounds of industrial fisheries, and the establishment of the FLNG safety zones will introduce a restriction to these fisheries. No relevant sport or recreational fisheries were identified in the region, that could be impacted by these restrictions. Oil spills from unplanned events may reach the coastal zone, resulting in an impact on fisheries, and this is discussed in section 7.8.3.

The social, health, and human rights potential impacts, identified above, are further discussed and assessed in the subsections below. The majority of impacts will arise during all phases of the Project; however, where significant differences in the phases have been identified, the impacts have been assessed separately for the drilling, installation and commissioning, and operational phases. Potential aspects such as use of social and health services where no impacts are deemed to occur have not been considered further in the assessment

The main Project activities during the decommissioning phase that may cause an impact on the social, cultural, and economic aspects of the All communities will essentially be related to the potential loss of employment. However, it is likely that alternative employment of the highly skilled national workforce developed through the 25 years operational period would be found in MRV or other companies. Given the uncertainty in projecting the future and situation of workers and communities in 25 years' time, the impact assessment for the decommissioning phase is not detailed in this study. It is recommended that the project conducts an economic impact and dependency study two years before decommissioning, which will provide more specific and focused recommendations to mitigate the potential impacts of this phase.

7.8.2 Normal Operations

Impact SE1: Stimulation of business tourism

Impact Assessment

The logistical support base for the FLNG Project will be located in Pemba. It is expected that the onshore support base activities will generate an economic stimulation effect (see impact SE2 below),

considering the amount of supply services that will be required for the offshore FLNG. This effect will result in an increase in the number of business opportunities, including the expansion of and creation of companies, which may also result in an increase in business tourists.

This increase in business tourism may result in an increase in new builds or the expansion of accommodation in Pemba City, in order to accommodate the increased number of visiting businessmen and /or business tourists during the life of the project.

This impact will predominantly be relevant during the operational phase, as during the drilling, installation, and commissioning phases, most work activities will be based on specialized vessels working offshore.

This impact is considered to be positive and indirect, long-term (over the project's life cycle), local in extent, and of low intensity (as it pertains only to the logistic support activities), resulting in a positive impact of low significance.

Enhancement Measures

This positive impact does not require any enhancement measures.

Impact Assessment Summary

The following table provides a summary of this impact assessment.

Impact SE1: Stimulation of business tourism								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-ive	High
	1	1	3	5				
- No enhancement measures required.								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-ive	High
	1	1	3	5				

Impact SE2: Stimulation of the local and regional economy

Impact Assessment

The implementation of the FLNG Project will generate direct and indirect stimulation of the local and regional economy, particularly associated with:

- Contracting of services and the purchase of goods and materials, necessary for all project phases, and especially during the operational phase. The FLNG will require between 300 and 350 personnel on the offshore facility, which will need to be continuously supplied with goods and services. While some specialised services will be contracted nationally or internationally, goods and services will also be purchased locally based on the availability and competitive market conditions;
- Logistics base in Pemba, which will accommodate all the support services (such as the maritime terminal, maintenance workshops, offices, logistics facilities, etc.). The operation

of this base will also generate a significant increase in the demand for goods and services; and

- Increase in the disposable income of the contracted workforce, which will lead to an increase in consumption levels. However, this is only applicable to the onshore personnel, as the FLNG's on-board personnel will have very limited interaction with the Pemba economy (the vast majority will be hired from other locations and will be flown-in to the Pemba airport, and from there to the FLNG), as seen for the Coral South project.

These effects will lead to an increase in demand for consumer products, goods, and services. This increased demand may develop local markets, benefiting the local and provincial economy, stimulating the creation of companies and jobs, increasing tax collection, and increasing the income of families and individuals, which in turn will generate associated indirect positive economic impacts.

This impact is assessed as positive and indirect, long-term duration (i.e. throughout the life of the Project), regional in extent (as the increased demand for goods and services will stimulate the creation of companies and the production of goods at a regional level), and of low intensity, resulting in a positive impact of medium significance.

Enhancement Measures

Although a positive impact is expected, there are some measures that could be implemented to boost the local and regional economy, namely:

- Contracting of services and acquisition of goods by the Project should give priority to the local and provincial markets, whenever possible. To this end, it is recommended that MRV:
 - Identify the goods and services needed for the Project that can be supplied locally and encourage and support local businesses in the production and supply of these goods and services;
 - Disseminate timely information on the types of goods and services that will be required to enable local entrepreneurs to invest in training, skills upgrading, and services offered;
 - Develop training and capacity-building initiatives aimed at small and medium-sized local companies, in coordination with the relevant government institutions and business associations, in order to enhance the development of the capacities of local and regional companies in offering quality goods and services and taking advantage of the commercial opportunities created by the Project.

Summary of Impact Assessment

The following table provides a summary of this impact assessment. While the proposed enhancement measures will likely increase the intensity of the impact, its rating is still assessed as low, thus resulting in a medium significance residual impact.

Impact SE2: Stimulation of the local and regional economy								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Long-term	Medium	Probable	MEDIUM	-‘ve	High
	2	1	3	6				
- Priority should be given to the local and regional markets whenever possible in the purchase and acquisition of goods and services; - Small and medium-sized local companies should be involved in capacity building and training, in order to boost their capacity to offer quality services and thus take advantage of the commercial opportunities created by the project.								
With mitigation	Regional	Low	Long-term	Medium	Probable	MEDIUM	-‘ve	High
	2	1	3	6				

Impact SE3: National and provincial growth and development from increased revenue

Impact Assessment

The FLNG project will generate increased revenue for the provincial and central governments through taxes throughout the life of the project (excluding the decommissioning phase). The amount of revenues and the impact on the government budget will depend on the tax regime agreed with the government. The sale of exported gas will also make a significant contribution to national revenues, as the state will be a partner in the Project throughout its operational phase.

This increase in revenue may result in both national and provincial growth and development. It may improve provincial and national governments public financial management capacity and enhance the government's ability to invest in social and public services as well as development initiatives benefiting the nation and population.

This impact is considered positive, direct, of long-term duration (operational life), national in scope, and of medium intensity, resulting in a very high significance.

Enhancement Measures

No enhancement measures apply.

Summary of Impact Assessment

The following table provides a summary of this impact assessment.

Impact SE3: National and provincial growth and development from increased revenue								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	National	Medium	Long-Term	Very High	Probable	VERY HIGH	-ve	High
	3	2	3	8				
- No enhancement measures are applicable.								
With mitigation	National	Medium	Long-Term	Very High	Probable	VERY HIGH	-ve	High
	3	2	3	8				

Impact SE4: Job creation

Impact Assessment

Project implementation will lead to job creation, both by creating direct employment in the Project and through contractors and sub-contractors, which may be local, national, or international.

During the drilling, installation, and commissioning and start-up phases, employed personnel will mostly be that of the offshore marine vessels performing the work, supported by a small number of workers on the onshore logistics base and offices. Most work in these phases will be performed by the marine crews of very specialized international vessels. As such, in these phases the number of direct job opportunities created in Mozambique will be relatively low.

During the operational phase, employment required for the Coral North FLNG project will be structured in three main hubs, namely offshore, onshore logistics base, and home office. The offshore hub will include all personnel aboard the FLNG and marine services personnel, which will include the crew of tug, piloting, and mooring vessels, offshore support vessels, and tankers. It is estimated that the number of direct jobs expected to be created by the Coral North FLNG is likely to be similar to the Coral South Project, expected to be around 300 to 350 personnel. Furthermore, when considering indirect job creation and based on the data from the Coral South Project, it is estimated that cumulatively 1,400 national workers will either be directly or indirectly employed through services required from local companies over the duration of the Project. The need will be for highly specialized personnel (engineers, technicians) as well as personnel for support activities.

Considering the above, this impact is identified as positive, of long term duration (project lifetime), of regional extent, although of low intensity, considering the total number of created jobs, resulting in a medium significance.

Enhancement Measures

Although this impact does not require action, it is recommended that the company develop a recruitment plan, giving priority to national workers. It is also recommended that this recruitment policy and plan include a non-discrimination clause and attention to gender issues.

Summary of Impact Assessment

The following table provides a summary of this impact assessment.

Impact SE4: Job creation								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Long-Term	Medium	Probable	MEDIUM	-ive	High
	2	1	3	6				
- Establish a recruitment policy and plan with a long-term vision for the gradual transfer of skills.								
With mitigation	Regional	Low	Long-Term	Medium	Probable	MEDIUM	-ive	High
	2	1	3	6				

Impact SE5: Transfer of technical and professional skills to national workers

Impact Assessment

Both the drilling and installation phases and the operation phase of the Coral North Project will require highly specialized workers. During the drilling and installation phases, it is expected that most of the specialized workers will be hired internationally, as most activities will be performed by specialized and fully crewed international drilling and installation vessels. For the first few years of the FLNG's operation, it is also expected that most of the work will be hired from abroad, as the specialized skills required to operate the facility are limited in the domestic labour market.

However, given that the FLNG will remain in operation for at least 25 years, it is expected that national workers will be continuously trained to carry out the specialized activities, gradually reducing the need for expatriate workers. This transfer of knowledge and skills to the national labour market will increase the nation's capacity to develop similar projects in the future.

This impact is thus mostly relevant for the operational phase, and is assessed as a positive direct impact, of long-term duration, regional extent, and of low intensity (considering the relatively low number of workers to be trained), resulting in a medium significance.

Enhancement Measures

During the operational phase, it is recommended that MRV develops a Training and Skills Transfer Program, with a long-term vision of gradual skills transfer. The objectives of this program should include:

- Training national workers to occupy positions at all levels of FLNG operations, including technical, engineering and management levels;
- Gradually reducing the need for expatriate workers in FLNG operations; and
- Strengthening Mozambique's LNG industry by training to increase a skilled and competent national workforce.

Summary of Impact Assessment

The following table provides a summary of this impact assessment.

Impact SE5: Transfer of technical and professional skills to national workers								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Long-Term	High	Probable	MEDIUM	-‘ve	High
	2	1	3	7				
- Provide technical training programs for workers to improve their job performance and diversify their skills; - Provide environmental, health and safety training to all employees.								
With mitigation	Regional	Low	Long-Term	High	Probable	MEDIUM	-‘ve	High
	2	1	3	7				

Impact SE6: Increased community expectations

Impact Assessment

The presence of the Coral North FLNG project creates expectations in the community regarding employment opportunities and potential benefits for the communities. These expectations are also a product of the economic context described in the baseline characterization, such as low levels of education, lack of knowledge and understanding of the project's activities, overburdened social infrastructure, low levels of formal employment, and reduced government capacity to provide adequate basic services. Community expectations can be exacerbated by lack of communication, rumours, unfounded fears, and historical dependence on aid. Mismanagement of high community expectations can have a negative impact on project activities and the company's reputation.

If not properly managed, this impact is considered to be negative, direct, long-term, local, and medium intensity, resulting in a medium significance before mitigation.

Mitigation Measures

In order to manage community expectations, MRV should carry out the following:

- Update the Stakeholder Engagement and Communication Plan developed during the Coral North Project concept selection phase, including a stakeholder strategy, mapping and the establishment of communication with relevant stakeholders as initiated during the EIA process, capitalizing on the current ERB and Coral South Stakeholder Engagement and Communication Plan, strategy and ongoing activities. This will enable the company to continue to build a relationship of trust that will facilitate a smoother dialogue between the company and the communities;
- Provide contractors and sub-contractors with guidance on communication and recruitment procedures to ensure consistency in conveying the message of employment opportunities;
- Develop and publicize a Grievance Mechanism, through activities of dissemination of its access and functioning. Monitor its effectiveness. The grievance mechanism is a channel to raise potential claims, allow the company to identify unfounded fears and unmet expectations early and manage them appropriately through company's tools and procedures.

Summary of Impact Assessment

The proposed mitigation will lower the intensity to low, resulting in a low significance residual impact.

Impact SE6: Increased community expectations								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-Term 3	Medium 6	Probable	MEDIUM	-ve	High
- Update the stakeholder engagement and communication plan; - Develop and put in place a grievance mechanism; - Provide guidance to contractors on communication and recruitment procedures.								
With mitigation	Local 1	Low 1	Long-Term 3	Low 5	Probable	LOW	-ve	High

Impact SE7: Security of infrastructure, assets, workforce, and communities**Impact Assessment**

Whilst the Project does not foresee additional land-based infrastructure to be built, given the current context in the province, it will likely require a flexible security position to ensure the support of the additional Pemba based staffing requirements as well as the safety of Project's staff and assets (leveraging on synergies with Coral South). The deployment of armed security services harbours risks of human rights violations and abuses, particularly in conflict settings and when relating to extremely vulnerable communities.

Considering that only a small increase to the current security arrangements for the onshore base is required, if not properly managed, this impact is considered to be negative, direct, long-term, local, and of medium intensity, resulting in a medium significance before mitigation.

Mitigation Measures

The Voluntary Principles on Security and Human Rights are a set of principles designed to guide companies in maintaining the safety and security of their operations within an operating framework that encourages respect for human rights. Whilst the overall duty to protect human rights rests ultimately with national governments, other members in society, including business, also have a responsibility to ensure respect human rights.

In order to mitigate potential negative impact risks, the following actions are recommended:

- Armed security contractors are procured in a transparent manner;
- Armed security services strictly adhere to MRV's approach to human rights and security, including ERB's code of ethics, Eni's Policy "Respect for Human Rights in Eni", Eni suppliers code of conduct, Voluntary principles on Security and Human Rights, and MRV's strategies and actions to minimize risks deriving from security forces;
- Accountability processes, including the Grievance Mechanism are in place to ensure redress in cases of abuse; and
- Actively engage with and ensure relevant project information is fed into both the national and provincial Voluntary Principles working groups lead by the partnership between the *Centro para Democracia e Desenvolvimento* (CDD) and the Geneva Centre for Security Sector Governance (DCAF).

Summary of Impact Assessment

The proposed mitigation will lower the impact's intensity and probability of occurrence, resulting in a very low significance residual impact.

Impact SE7: Security of infrastructure, assets, workforce and communities								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-Term	Medium	Probable	MEDIUM	-ve	High
	1	2	3	6				
- Armed security contractors are procured in a transparent manner; - Armed security services strictly adhere to MRV's approach to human rights and security, including ERB's code of ethics, Eni's Policy "Respect for Human Rights in Eni", Eni's suppliers code of conduct, Voluntary principles on Security and Human Rights, and MRV's strategies and actions to minimize risks deriving from security forces; - Accountability processes, including the GM are in place to ensure redress in cases of abuse; and - Actively engage with and ensure relevant project information is fed into both the national and provincial VP working groups lead by the partnership between the <i>Centro para Democracia e Desenvolvimento</i> (CDD) and the Geneva Centre for Security Sector Governance (DCAF).								
With mitigation	Local	Low	Long-Term	Low	Improbable	VERY LOW	-ve	High
	1	1	3	5				

Impact SE8: Human rights risks

Impact Assessment

As noted, the Project will not result in any new or significant addition to land-based infrastructure or significant recruitment or increase of land-based personnel. Based on the analysis of the Project's footprint, construction, operation, and decommission phases, the Project will have limited or negligible direct human rights impacts. There will be no direct rights impacts associated with the loss or limitations and/or restrictions to the use of natural resources (land, food, or livelihoods), nor community health, education, or any other social and/or public service. However, a number of Project related human rights risks, in part associated with the above Project social impacts (SE1 through to SE7) may arise, which are primarily related to labour and workforce such as the use of child and/or forced labour, discrimination, unsafe working conditions, limited access to collective bargaining, etc..

i) Labour related

In the context of high levels of unemployment, poverty, low levels of education, literacy and skills, and gender power imbalances, together with resource poor institutions, monitoring, and limited access to justice, the potential risk of labour-related human rights abuses remains, unless mitigated. Based on the established Eni policies, such as the Policy "Respect for Human Rights in Eni", which abide by the fundamental rights on work enshrined in the ILO Declaration on Fundamental Principles and Rights at Work and the UNGPs amongst other international standards, these potential risks for MRV personnel may be downgraded to very low. Similarly, through the application of the Eni Supplier Code of Conduct, risks for Project related third party and contractor personnel are also considered to be low. As such the overall labour related risks have been assessed as low.

Summary of Impact Assessment

With the pre-mitigation labour related risks assessed to be low, the proposed mitigation will lower the probability of impact occurrence, resulting in a very low significance residual impact.

Impact SE8 (i): Labour related risk – MRV and third-party personnel								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-Term	Low	Probable	LOW	-‘ve	High
	1	1	3	5				
- Ensure context specific internal redress mechanisms for MRV personnel are elaborated and implemented; - Ensure appropriate labour related due-diligence assessments are performed for all contracted third parties; and - Consider ad-hoc or regular labour rights training – ‘know your rights’ for MRV’s local personnel and third party groups.								
With mitigation	Local	Low	Long-Term	Low	Improbable	VERY LOW	-‘ve	High
	1	1	3	5				

ii) Sexual Exploitation, Abuse and Harassment and Gender Based Violence (SEAH/GBV)

SEAH/GBV is widespread and prevalent globally and is particularly pervasive in areas of high levels of inequality, power imbalances, and vulnerability. SEAH/GBV can be considered both a workplace and an external relations impact. Eni’s Policy “Respect for Human Rights in Eni” and Supplier Code of Conduct mitigates the risk of SEAH/GBV within the Project (institutional) and for Project personnel in external relations, as well as institutional and external relations of third parties. Overall, and given the pervasiveness of SEAH/GBV globally and in Mozambique, even with holistic policies, the risk is considered to be medium.

Summary of Impact Assessment

With the SEAH/GBV related risks assessed to be medium, the proposed mitigation measure may lower the probability of impact occurrence, resulting in a low significance residual impact.

Impact SE8 (ii): SEAH/GBV – MRV and third party								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Medium	Long-Term	Medium	Probable	MEDIUM	-ve	High
	1	2	3	6				
- Ensure context specific internal redress mechanisms for MRV personnel are elaborated and implemented; - Ensure context specific SEAH/GBV identification measures are designed and implemented; - Ensure that all service providers and contractors are made aware and adhere to MRV’s approach to GBV/SEAH and abuse and exploitation of other groups in vulnerable communities; - Consider locally relevant community outreach and training on GBV/SEAH and other forms of abuse and exploitation; - Ensure ‘zero tolerance’ policy of SEAH/GBV is applicable to third parties and ensure, disqualification and/or appropriate criminal charges and/or disciplinary proceeding occur; - Ensure adequate victim support and referral systems are in place; and - Consider ad-hoc or regular SEAH/GBV training or capacity building for MRV personnel and third party groups.								
With mitigation	Local	Medium	Long-Term	Low	Improbable	LOW	-ve	High
	1	2	3	5				

iii) Human Trafficking

The prevalence of human trafficking is associated to the context of inequality, vulnerability, and lack of opportunities, together with the resource and capacity poor institutional identification, protection, and legal protection systems. The Project related risks of human trafficking are assessed to be primarily associated with MRV and third-party personnel direct or indirect involvement in these

activities (utilisation, encouragement, benefit, and/or engagement). Eni's policy framework (Eni's Policy "Respect for Human Rights in Eni" and Supplier Code of Conduct) is considered to reduce human trafficking risks in high-risk environments to low.

Summary of Impact Assessment

With the human trafficking related risks assessed to be low, the proposed mitigation measure may lower the probability of impact occurrence, resulting in a very low significance residual impact.

Impact SE8 (iii): Human Trafficking – MRV and third party								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-Term 3	Low 5	Probable	LOW	-ve	High
- Ensure that all service providers and contractors are made aware and adhere to Eni's Code of Conduct; - Consider locally relevant community outreach and training on human trafficking (link to GBV/SEAH and other forms of abuse and exploitation); - Ensure 'zero tolerance' policy on involvement in human trafficking is applicable to third parties and ensure, disqualification and/or appropriate criminal charges and/or disciplinary proceeding occur; and - Consider ad-hoc training or capacity building on human trafficking in the context for MRV personnel and third-party groups.								
With mitigation	Local 1	Low 1	Long-Term 3	Low 5	Improbable	VERY LOW	-ve	High

iv) Security

The security of Project infrastructure, assets, workforce, and community may result in significant risks to the Project, particularly in a conflict or post conflict setting, with highly vulnerable people and significant power disparities. This risk has been assessed above in Impact SE7.

Impact SE9: Restrictions to access of fishing grounds of commercial fisheries

Impact Assessment

Starting at the drilling phase and continuing throughout the operational phase, safety zones will be established around the Coral North FLNG site, where non-project navigation will be restricted. The safety zone during construction and operations will be 500 m around the subsea infrastructure, which will probably result in a safety zone of no more than 4 km around the FLNG site. Within this area, no commercial fishing will be allowed, resulting in a loss of access to fishing grounds.

National commercial fishing in Cabo Delgado is very limited. As discussed in the baseline, for the 2022 fishing campaign, only eight national vessels were registered to operate in the northern fishing area, and all these are based either in Beira or Maputo ports, none in Pemba port.

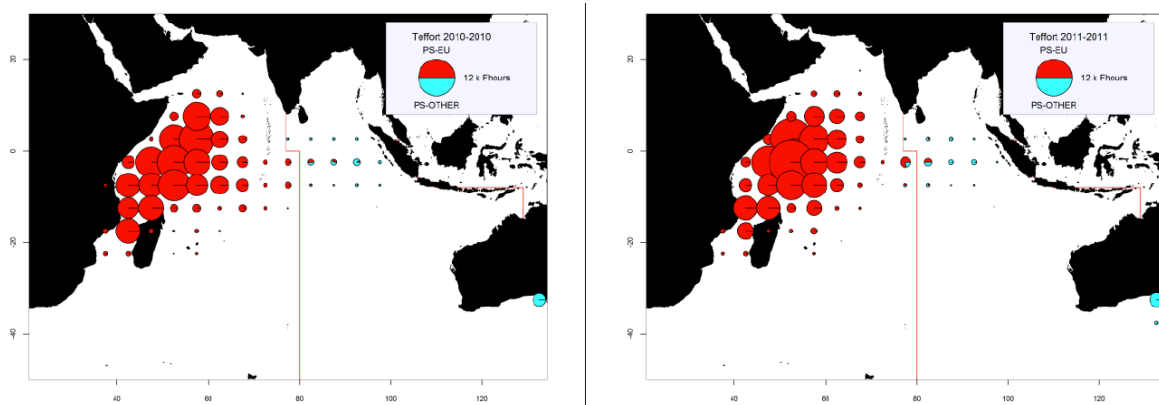
Commercial fishing in this region is mostly carried out by licensed foreign fleets operating in the Economic Exclusive Zone (EEZ) of Mozambique, from 12 nautical miles onward, including vessels from the European Union, Japan, Taiwan, and Korea (Consultec, 2015). Circular net fishing and longline fishing are the two main fishing techniques used, targeting tuna and related species. These activities are carried out all year round. This type of fishing employs exclusively foreign workers.

Catches are preserved on board and transferred to transport vessels or landed in foreign ports. This production, therefore, is not considered a Mozambican export.

These commercial fishing vessels do not operate exclusively in Mozambican waters. Fishing for these large pelagic species (tuna, swordfish, and sharks) leads the vessels along annual migratory routes, crossing multiple EEZs, including those of Mozambique, Tanzania, French Overseas Territories (Reunion Island and Mayotte), Comoros, Madagascar, Mauritius, Seychelles, and South Africa. Consequently, the fishing vessels will not be present in the same EEZ throughout the entire year. Their location depends on the main concentrations of target species, primarily influenced by the availability and location of food resources (small pelagic fish, cephalopods, and pelagic crustaceans). In the case of Mozambique, evidence suggests that the location and abundance of targeted food resources can change significantly from year to year.

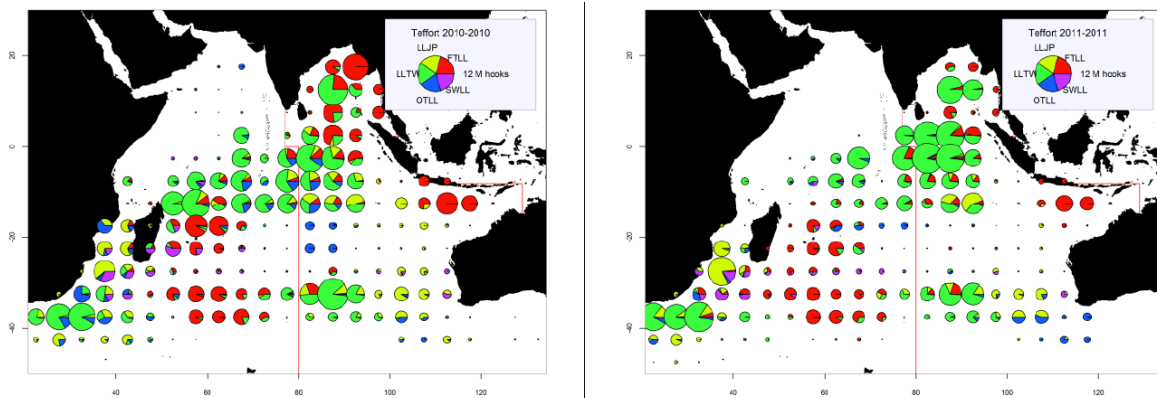
The effort in longline and seine net fishing is asymmetric and highly differentiated in terms of their activity in Mozambican waters. Seine net fishing in the Indian Ocean is heavily concentrated in the Western basin, including the northern part of Mozambique; this type of fishing relies on the nutrient-rich waters provided by the Somalia Current system and its upwelling characteristics. In contrast, longline fishing activities are much more scattered throughout the Indian Ocean, with less effort in the Mozambique Channel, which is dominated by Japan, the EU, and some other Southeast Asian countries' fleets.

Commercial fishing fleets thus operate over a vast geographic area, covering Mozambique's EEZ and also extensive regions across the Indian Ocean, moving within this area in pursuit of the migratory routes of their target species. This is illustrated in Figure 7.23 and Figure 7.24, which show the fishing efforts of seine net and longline fleets across the Indian Ocean.



Source: Herrera *et al.* (2012). Legend: PS-EU (red): EU and Seychelles. PS-OTHER (blue): Other fleets.

Figure 7.23: Effort of industrial seine net fleets in the Indian Ocean, in thousands of fishing hours, between 2010-2011



Source: Herrera *et al.* (2012). Legend: LLJP: Japan ultrafrozen fleet; LLTV: Taiwan and China ultrafrozen fleet. SWLL: swordfish (Australia, EU, Mauritius, Seychelles and others). FTLL fresh tuna (China, Taiwan, and other). OTLL: Other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and others)

Figure 7.24: Effort of the longline fleet in the Indian Ocean, in millions of hooks, for 2010-2011

The figures above clearly show that the fishing zones utilized by commercial fishing in the Indian Ocean (including the commercial fishing fleets operating in Mozambique and Cabo Delgado) cover a vast area, spanning the EEZs of various African and Asian countries.

Compared with the extent of the commercial fishing grounds, the local restriction of access to the area around the Coral North FLNG site will be negligible. A restricted safety zone of 4 km around the FLNG site corresponds to an area of roughly 50 km², which is a negligible fraction of the available international fishing grounds for commercial fisheries.

Even when limiting the analysis to Mozambique's EEZ, and specifically to the Province of Cabo Delgado, the total area of fishing zones available for commercial fishing in the deep-sea marine environment off the coast of Cabo Delgado (calculated from 12 nautical miles outwards, where these fleets are licensed to operate, to the limit of Mozambique's EEZ) amounts to an area of over 42,000 km². This signifies that the restricted area for commercial fishing caused by the FLNG facility corresponds to just 0.1% of the fishing area available to this industry.

As such, the impact of restriction to commercial fisheries due to the FLNG safety zones is assessed as negative, direct, of local extent, and low intensity, although of long-term duration, resulting in a low significance.

Mitigation Measures

The following measures are recommended:

- The Project's Stakeholder Engagement and Communication Plan (SECP) will include actions to inform commercial fishing operators of the use of space by the proposed project (surface and subsurface). This should be carried out through the national and provincial fisheries institutions,
- As part of the Grievance Mechanism, any complaints raised by commercial fishing operators in relation to FLNG operations will be reported and managed.

Summary of Impact Assessment

The summary of the impact assessment is presented in the table below.

Impact SE9: Restrictions to access of fishing grounds of commercial fisheries								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-Term	Low	Probable	LOW	-‘ve	High
	1	1	3	5				
- Include any complaints raised by fishing operators in relation to FLNG operations into the grievance mechanism and consider the specific stakeholder category as part of the stakeholder engagement and communication plan; - As part of the implementation of the stakeholder management plan, the communications to the fishing operators shall be developed in collaboration with ADNAP, DPAPCD, and IDEPA.								
With mitigation	Local	Low	Long-Term	Low	Improbable	VERY LOW	-‘ve	High
	1	1	3	5				

Impact SE10: Potential changes to Pemba's public health profile due to the presence of the Project's workforce

Impact Assessment

The mobilization of large workforces from other national and/or international locations for development projects can generate impacts on local health profiles. The interaction between the mobilized workers and the local population can introduce new diseases or change the local health profile in many different ways such as the increase of sexually transmitted diseases and the demand for medical treatment.

However, the implementation of the Coral North Project is not expected to have any relevant impacts on the Pemba's public health profile. Only a very small portion of the Project's workforce will be located in Pemba and interact with the local population. For the most part, the Coral North FLNG workforce estimated to be 350 employees (see section 4.5; Volume I) will be accommodated on the FLNG and/or associated flotel and will not interact with the Pemba population (the workers are flown into Pemba and then to the FLNG, where they reside).

For the onshore support, the Project will use the current logistical infrastructure servicing the Coral South FLNG, including the Pemba port, airport, and Coral warehouse, which are all currently staffed. A few additional onshore workers may be required to support the additional logistics demands of Coral North, although this is not expected to be a large number.

Hence any addition is not expected to have any relevant influence on the public health profile of Pemba city, which in 2017 had 200 529 inhabitants (INE, 2017).

As such, this impact is assessed as negative, direct, of local extent, and low intensity, of long-term duration, but very low probability (improbable), resulting in a very low significance.

Mitigation Measures

No mitigation is required, other than the continued application of MRV's health policies for its workers.

Summary of Impact Assessment

The following table provides a summary of the impact assessment.

Impact SE10: Potential changes to Pemba’s public health profile due to the presence of the Project’s workforce								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Local	Long-Term	Low	Improbable	VERY LOW	-’ve	High
	1	1	3	5				
- No additional mitigation is required, continued application of MRV’s health policies for its workers.								
With mitigation	Local	Low	Long-Term	Low	Improbable	VERY LOW	-’ve	High
	1	1	3	5				

7.8.3 Unplanned Events

Impact SE11: Impacts from accidental hydrocarbon spills from unplanned events on fisheries and coastal communities

Impact Assessment

The effects of unplanned events are largely related with the spillage and/or release of hydrocarbons, whether it may be a diesel spill during transfer or caused by vessel collision, or other emergency scenario, such as fires or explosions. While these events are unlikely to occur, they may result in extensive negative impacts, depending on the areas reached and on the magnitude of the spill.

A specific oil spill modelling study was developed for this EIA, the main findings of which are reported above in section 7.5.4 (Impacts WQ5, WQ6, and WQ7), where three (3) potential unplanned events were considered, namely:

- Scenario 1 – diesel spill associated with a vessel collision during any of the project phases;
- Scenario 2 – release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase;
- Scenario 3 – release of LTOBM due to an accidental riser disconnect on the seabed during the drilling phase.

Spills and leaks of LNG were not considered as this liquid quickly volatilizes and will have a minimal impact in the unlikely event of a spill.

The results of the modelling study showed that the scenario of a diesel spill from a vessel collision would result in a more extensive oil spill. As such, the assessment below focuses on that worst-case scenario. Please see Impacts WQ6 and WQ7 above (section 7.5.4) for a detailed discussion of the gas condensate blowout and LTOBM release scenarios.

Diesel spill modelling

The EIA oil spill simulations for a vessel collision scenario show that there is a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania, while it is highly unlikely to ever

reach the shorelines of Madagascar or the Comoro Islands. However, spills that may reach the coastal zone would have a very low thickness (i.e., visible oil between 0.1 μm and 1 μm), thus representing a low risk exposure. The extent of a spill with potential harmful effect on sea life (thickness > 1 μm – moderate exposure threshold) was limited to approximately 789 km² (ranging from 237 km² to 1,971 km²) around the discharge point, never reaching the coastal islands or the mainland shoreline (see Figure 7.12 in section 7.5.4).

The potential socioeconomic impacts resulting from an accidental oil spill are associated with the following negative effects:

- Oil spill may result in negative impacts to the fish stocks exploited by both commercial and artisanal fisheries, potentially resulting in decreased catch impacting the livelihoods of fishermen;
- Oil spill reaching the coast may generate potential impacts on coastal habitats, flora, and fauna with value to communities (coral, mangroves, intertidal macrofauna, etc.), with a secondary impact on communities' livelihoods; and
- Inhalation of oil vapours or ingestion of oil droplets, either by direct contact with the spill, or through consumption of oiled biota, may have health implications for coastal communities;
- Oil spill reaching the islands or coast, even with a low thickness (sheen on the water), may result in impacts on tourism activities.

Impacts on fisheries and other coastal resources and on fishermen livelihoods

The potential impacts on marine fauna, including fish stocks, resulting from the simulated diesel spill was assessed in the EIS biodiversity specialist study (Consultec & Biota, 2023), as reported in section 7.7.4 (see Impact BIO20).

According to the biodiversity study, pelagic fish (adults, larvae) mortalities as a result of oil spills are limited in numbers and have not been shown to have measurable effects on fish stocks. Impacts on near-shore and shallow water species may be more relevant, due to oiling, morphological deformities, reduced feeding and growth rates as well as lethal impacts to fish eggs and larvae. Fish and shellfish may become contaminated being unsafe for human consumption. The modelling results indicate that these areas would not be impacted by potential spills at a thickness detrimental to marine life (Consultec & Advisian, 2023a); therefore, negligible to limited impacts are expected on coastal fish stocks with no to negligible impact on artisanal fisheries, which exploit these coastal and near-shore species.

Impacts on commercial fishing, which exploit the offshore pelagic species, may still occur, as offshore areas may be affected in the event of an accidental diesel spill. These however will be of short-term duration, as the modelling results show that weathering of the oil will reduce thickness to below levels harmful to sea life within 24 hours and further weathering to below levels of visible oil within 10 days (Consultec & Advisian, 2023).

Potential health impacts on coastal communities

All simulated oil spills that may reach the coastal zone will be at a thickness unlikely to cause damage to marine fauna (i.e., thickness between 0.1 μm and 1 μm). However, even such a low thickness spill

may have health implications for coastal communities, either through the inhalation of oil vapors or ingestion of oil droplets, either by direct contact with the spill, or through consumption of oiled biota.

Although the potential exposure would be of short-term duration, health effects could be prolonged in time, if exposure is sufficiently high. Potential health effects could range from short-term responses to the exposure, such as respiratory issues, skin and eye irritation, and gastrointestinal problems, due to exposure to volatile organic compounds (VOCs), direct contact with the oil, or ingestion of contaminated seafood, to more long-term risks, such as cancer risk, from prolonged exposure to some chemicals in oil, such as polycyclic aromatic hydrocarbons (PAHs).

These potential health risks would be minimized as the exposure risk will be of short-term duration, and with a very low oil concentration.

Economic costs associated with clean-up

In the event of an accidental oil spill reaching the coastal area, clean-up efforts may be required. The involvement of the local communities of the affected areas, would divert them from the pursuit of their livelihood strategies, potentially resulting in an economic impact, on communities which experiencing high levels of poverty.

Potential impacts on coastal or mainland tourism activities

Tourism activities in the All are primarily associated with high-end lodges in the coastal islands, providing leisure and recreational activities such as diving, sports fishing, whale watching among others. Coastal tourism activities in the All are very limited. While tourism activities have ceased in recent years due to the security situations in the province and the district, they may resume during the project's lifetime, once security conditions improve. Please see additional information regarding tourism in the All in the baseline section (section 6.10.11.2; Volume I).

Generally the main purpose of the tourism activity is the attraction and enjoyment of the natural environment, abundant biodiversity and the typical landscape and/or seascape of the area.

In the event an accidental spill reached these tourism important areas even at a low thickness (i.e., visible oil between 0.1 μm and 1 μm , that would not represent a significant hazard to biodiversity, but would still be visible in the surface of the sea), the image of pristine wilderness would be affected, and would very likely result in decreased enjoyment and loss of revenue for the island tourism industry.

Impact assessment

Considering the discussion above, the potential impact on fisheries, coastal communities, and island tourism from accidental hydrocarbon spills from unplanned events is assessed as negative and direct, of regional extent (several islands and coastal communities in Palma District may be affected), of high intensity (while the oil thickness is low, any degree of modification in the social functions and processes including decreased levels of tourism may exacerbate the impacts to communities already experiencing high levels of poverty), and medium-term duration (while the spill itself would be of short duration, potential health effects may be prolonged, as well as longer term reputational impacts to

the area's tourism), resulting in a high consequence. However, given the probability of the impact actually occurring is low, the significance is assessed as medium.

Mitigation Measures

Mitigation is primarily the operational controls to prevent unplanned events such as a vessel collision from occurring, and to be prepared to respond in the event an accident does occur. The same mitigation controls listed in the water quality and biodiversity sections for unplanned events are also applicable here.

Additionally, in the event a spill reaches the coastal zone, the level of socioeconomic and health impact to the local community and tourism will be assessed and actions defined, as appropriate, to restore affected livelihoods to the pre-impact levels.

Impact Assessment Summary

Post mitigation, operational controls will help minimize the risk of occurrence of a vessel collision and response efforts will help minimize the extent of the oil slick. This will reduce the intensity and the duration scores. The residual significance is reduced to very low after successful application of mitigation measures. The impact assessment summary is provided in the following table.

Impact SE11: Impacts from accidental hydrocarbon spills from unplanned events on fisheries and coastal communities								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	High	Medium-term	High	Improbable	MEDIUM	-ve	High
	2	3	2	7				
- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforcement of all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Readiness of response crew and third-party responders when unplanned event occurs; - If an oil spill occurs and reaches the coastal area, assess the social and health impacts to the local community and tourism, define actions as appropriate to restore affected livelihoods to pre-impact levels.								
With mitigation	Regional	Medium	Short-term	Low	Improbable	VERY LOW	-ve	Medium
	2	2	1	5				

7.8.4 Cumulative Impacts with Coral South FLNG

The effects of the Coral North project could potentially accumulate with those from adjacent gas developments, such as the Coral South FLNG. Considering the results of the Coral North impact assessment and the findings from the Coral South EIA (Consultec, 2015), the main potential socioeconomic cumulative impacts include the following:

- Increase in the number of exclusion zones around the FLNG sites. However, taken together (100 km²), the restricted area is only 0.2% of the available fishing grounds for commercial fisheries, corresponding to a low significance impact;

- Cumulative positive economic effects from both FLNG projects, including those associated with increased job creation, regional economic stimulation, increased revenue, and stimulation of business tourism.

None of these cumulative effects are of concern or require additional mitigation measures, than those for Coral North and/or implemented for Coral South.

7.9 Marine Traffic

7.9.1 Potentially Impact Generating Project Activities

The movement of Project vessels in the Mozambique Channel, between Pemba Port and the Coral North operational site, will generate an overall increase in traffic in that region, with a heightened risk of interference with existing traffic and potential vessel collisions. This risk will be more relevant for the operational phase, due to its long-term duration, and as such this assessment focuses on operations.

The following project traffic vessels will be involved in the operations phase of the project:

- Three (3) tugs⁷;
- Three (3) platform supply vessels (PSV's), moving between Pemba port and the Coral North site;
- LNG carriers; and
- Condensate tankers.

As the tugs will be based at the area of operations, they will not be often transiting between Pemba Port and the operational site and are not considered to contribute to an increase in traffic. The expected frequency of trips for each vessel type contributing to the traffic and typical vessel properties are shown in Table 7.40.

Table 7.40: Project marine traffic during operations

Vessel Type	Route	Frequency		
		Per year	Per week	Per day
PSV	Pemba - FLNG	104	2.0	0.3
Condensate tanker	FLNG - world	6	0.1	0.0
LNG carrier	FLNG - world	52	1.0	0.1
Total		162	3.1	0.4

Source: eni (2023).

The potential impact of the movement of the project vessels to marine traffic is assessed in the following section.

⁷ It is understood 6 x tugs will be in operation, shared with Coral South. For the purpose of this assessment it is assumed an equal split.

7.9.2 Impact of Project Vessels on Marine Traffic during Operations

Impact MT1: Risk of marine vessel collisions due to increased marine traffic

Impact Assessment

The marine vessels involved in the operations phase of the FLNG project will have a direct impact by increasing the traffic at Pemba and the inshore traffic zone, thus generating an increased collision risk in these areas.

In the worst-case scenario, where all project vessels are assumed to join the coastal traffic (i.e., 162 vessels in total, including LNG carriers and condensate tankers) there is a 27% and 10% increase from the baseline traffic in year 2027 (605 vessels - see baseline section – section 6.11, Volume I), when the FLNG operations are planned to start, and year 2052 (1614 vessels), at end of operations, respectively. Conversely, if all LNG carriers and condensate tankers are assumed to arrive from the north or east (104 vessels in total), the resulting traffic increase will be 17% and 6% in year 2027 and 2052 respectively. The actual routes of the LNG carriers and condensate tankers will depend on market demand and are likely to change during the project lifetime.

For the 2052 baseline assumption of 1614 vessels per annum, there will be an average of nine (9) vessel transits every two days in the 25 nm wide coastal traffic zone. It is considered that project traffic will only add a further one vessel transit over the two days, and thus this traffic will not result in a significant change in the collision risk.

The 104 additional trips per year by PSV's at Pemba represent a 53% increase from the baseline. Therefore, the project traffic will have a more significant effect in this area.

Within the 20 nm radius of the FLNG the project vessels will be increasing and / or decreasing speed and will be crossing the general traffic flows and are therefore considered as a marine navigation risk. Vessel movements in 2019 and 2020 show 28 and 44 vessels per annum respectively passing through this zone (MarineTraffic, 2021). This equates to an average of one vessel every eight (8) to 13 days. Assuming the worst-case scenario, where all 58 LNG carriers and condensate tankers are traveling to and from the east, this will add an average of one vessel every six days to this traffic count. The probability of collision is therefore very unlikely.

Almost all of the commercial vessels entering Pemba port will be under pilotage and with only two berths at the Port, the probability of vessel collision between project vessels and conventional traffic within the Pemba approach channel is deemed very unlikely. PSVs transiting between the port and the FLNG are highly manoeuvrable vessels and should easily be able to 'give-way' to fishing vessels on the route to the FLNG. Avoiding the identified peak encounter times and times of restricted visibility will reduce the likelihood of encounter events. MPVs arriving and departing the port will be under pilotage with tugs in attendance. Encounters with fishing vessel traffic will therefore be managed by the port control and the assisting pilot and tugs as is standard practice for port and pilotage operations.

The resulting increase in traffic and risk of vessel collision from the project added traffic is assessed as negative and direct, of regional extent (affecting the route between Pemba and Area 4), long-term

duration (operational life), and low intensity (low increase in overall traffic), resulting in a medium consequence. Given the low probability of a vessel collision occurring due to the increase traffic (improbable), the significance rating is classified as low.

Mitigation Measures

Despite the low significance, adequate mitigation measures should be implemented to further minimize the risk of collisions of marine navigation in the Mozambique channel.

The following procedures will be adhered to:

- Safe and efficient navigation watch;
- Consideration of daylight operations;
- Strict application of the Convention on the International Regulations for Preventing Collisions at Sea (ColReg);
- Contracted vessel performance and crew vetting for assurance;
- Notification by logistics to Marine department, local authority and port authority on the Company's logistics and supply chain activities;
- Avoid transits during extreme wind and waves, and times of poor visibility; and
- Carry out regular safety audits and exercise drills.

Navigation near and at the Pemba port will adhere to the following:

- Monitoring and registering of vessel traffic movements within port limits diligently maintained during increased traffic times;
- Training all staff involved in the handling of the vessels in the port;
- Avoid transits during extreme wind and waves, and times of poor visibility;
- Bridge Resource / Team Management, Engine Room Management;
- Marine crew competency and experience;
- Navigation Safety Critical Elements register;
- Pre-entry / departure briefing, navigational audit;
- Master overriding authority;
- Stop work authority policy;
- Carry out regular safety audits and exercise drills;
- Comprehensive Standard Operating Procedures providing guidelines and recommendations for UKC, port arrivals and departures and extreme weather events.

The risk of collision with fishing vessels near the Pemba port can be effectively mitigated by adopting the following procedures:

- PSV operator should be aware of the typical movements and schedules of fishing vessels;
- Maintain proper lookout as these vessels are often small and may be difficult to pick up visually or by vessel radar;
- Avoiding peak encounter times and times of restricted visibility;
- Strict application of ColReg;
- Early course alteration to avoid penetration into concentrated fishing fleet;
- Additional bridge watchkeeping / higher level with additional OOW or assistant;

- Company/Logistics engagement with local authority, fishery department, marine department on addressing issue, risk of fishing at traffic area / port area;
- Local authority control and patrol, sweeping of fishing boats;
- Safety awareness with fishermen;
- Consider employing a community liaison group to keep open channel of communication with local community and fisherman.

To minimize risk of collision at the Coral North operational site, the following will be implemented:

- Establish a safety zone of 500 m around the FLNG facilities limits;
- Contact all vessels with closest point of approach within safety zone by VHF;
- Transmitting security level navigational warnings when conducting vessel operations at FLNG;
- Strict application of the provisions of the Convention on the International Regulations for Preventing Collisions at Sea (ColReg);
- Fishing to be prohibited within the FLNG safety zone;
- Project vessels should maintain an efficient navigation watch (lookout, radar, and AIS);
- FLNG to be equipped with fog signal, obstruction light;
- Guard tugs at FLNG should be available to force vessels to turn if on a collision course with FLNG.

Impact Assessment Summary

The impact assessment summary is provided in the following table.

Impact MT1: Project impacts on marine traffic								
	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional	Low	Long-term	Medium	Improbable	LOW	-ve	High
	2	1	3	6				
- Implement all standard navigation safety measures and procedures (as listed above); - Strict application of ColReg; - Notification by logistics to Marine department, local authority and port authority on the Company’s logistics and supply chain activities; - Establish a safety zone of 500 m around the FLNG facilities limits.								
With mitigation	Regional	Low	Long-term	Medium	Improbable	LOW	-ve	High
	2	1	3	6				

7.10 Impact Assessment Summary

This section presents a summary of all impacts assessed for the proposed Project, including pre- and post-mitigation assessments. It further presents the proposed key mitigation and/or enhancement measures, to facilitate an overall view of the Project's impacts. The impact assessment summary is presented in tabulated form, separated by environmental component and per Project phase, as follows:

- Table 7.41: impacts associated with construction, drilling, installation, and commissioning;

- Table 7.42: impacts associated with the start-up and operational phases;
- Table 7.43: impacts associated with unplanned events.

The operational lifetime of the Coral North FLNG project is 25 years. While some impacts may take place during the decommissioning phase as identified in some of the sections above, assessing their significance and defining adequate mitigation measures 25 years before they occur and with any acceptable degree of rigour is extremely difficult, given the uncertainty regarding the evolution of the socioeconomic baseline and of the industry's best practices for development and for environmental and social management, during that time span.

As such, the decommissioning and abandonment will be carried out through a Decommissioning Plan developed in accordance with Article 15 of the Area 4 Exploration and Production Concession Contract, Eni internal standards, and International Codes and Standards relevant to offshore petroleum activities. The Decommissioning Plan will assess all environmental and social impacts associated with the planned decommissioning activities and propose adequate mitigation measures. The final aim of this activity is to assure the restoration of the environment to a reasonable condition. Given the above, decommissioning impacts are not addressed in this report.

Table 7.41: Summary of Project impacts – construction, drilling, installation, and commissioning phases

#	Impact Description – Construction, Drilling, Installation, and Commissioning Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
Air Quality					
AQ1	Air quality impacts during the drilling, installation, and commissioning phases.	VERY LOW	VERY LOW	(-)	- Implement standard maintenance procedures of the project vessels' engines and generators.
Atmospheric Noise					
AN1	Noise impacts from general land-based construction activities.	VERY LOW	VERY LOW	(-)	- Operate earth moving equipment within specification and capacity (e.g., ensure machines are not overloaded). Use noise abatement accessories such as sound hood and mufflers where feasible; - Use intake and exhaust silencers in all internal combustion powered equipment, ensuring that equipment have good quality mufflers installed; - Specific access routes should be chosen for the transport of materials and equipment to avoid passing through inhabited areas, as much as feasibly possible; - The noisiest construction operations (including earthworks and the transport of materials), should only take place on working days, during daytime hours; - Maintain all mechanical equipment on a regular basis, replace worn parts and lubricate as required; - All equipment fitted with combustion engines should be regularly inspected to check their operating conditions (periodic maintenance), to minimize increased noise emissions resulting from poor operating conditions. - Residents living near the area where the construction work is being carried out must be informed of the occurrence of construction activities by the contractor and site supervisors.
Water quality					
WQ1	Potential seawater quality degradation due to the discharge of drill cuttings	VERY LOW	INSIGNIFICANT	(-)	- Collect all LTOBM cuttings and muds to the vessel and transport them onshore by supply vessels for treatment and disposal at a recognized landfill; - If an unplanned event prevents transfer of drilling wastes to shore, the drilling operation will be temporarily suspended until transfer to shore can be resumed.
Landscape and Seascape					
L1	Project impacts on landscape and / or seascape character.	VERY LOW	VERY LOW	(-)	- No mitigation is required.

#	Impact Description – Construction, Drilling, Installation, and Commissioning Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
Biodiversity					
BIO1	Effects of vessel liquid effluents on marine ecology due to changes in water quality	VERY LOW	INSIGNIFICANT	(-)	- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains); - Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system; - Discharge of deck drainage, bilge water and sewage shall comply with MARPOL 73/78 requirements; - Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.
BIO2	Effects of solid waste disposal on marine ecology due to changes in water quality	INSIGNIFICANT	INSIGNIFICANT	(-)	- Apply adequate treatment and disposal of solid waste in order to avoid pollution of marine waters; - Apply all solid waste management measures according to national regulations and international standards and best practices; - Food solid waste will be treated in accordance with MARPOL (73/78) regulations; - All other solid waste must be segregated and temporarily stored and contained on the vessel, for appropriate treatment and/or disposal onshore in compliance with Annex V of MARPOL; - Train crew members on waste management procedures.
BIO3	Effects of the discharge of drill cuttings on marine ecology due to changes in water quality	VERY LOW	VERY LOW	(-)	- Use low toxicity WBMs only, for the drilling of the initial well sections; - Use mud recovery systems for LTOBM; - Monitor and record the use of all drilling fluid components and other chemicals; - If there is a need for LTOBM discharges offshore, monitoring will be performed onboard the rig to ensure that the oils are removed from the cuttings such that less than 1% oil remains adhered to the cuttings prior to disposal; - Manage and discharge WBM mud and cuttings in compliance with international best practices.

#	Impact Description – Construction, Drilling, Installation, and Commissioning Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
BIO4	Effects of discharge of drilling muds and cuts on deepwater benthic macrofauna due to smothering and burial effects.	LOW	VERY LOW	(-)	- Undertake ROV analysis of the drilling sites prior to start of drilling. Adjust the exact drilling location, as much as possible, in order to avoid impacting on any sensitive benthic community or habitat that may be identified. Harder substrates will be avoided; - Use low toxicity WBMs only, for the drilling of the initial well sections; - When LTOBMs are used, use mud recovery systems; - Monitor and record the use of all drilling fluid components and other chemicals; - Manage and discharge WBM and treated LTOBM mud and cuttings in compliance with international best practices.
BIO5	Effects of noise on marine fauna in the drilling, installation, commissioning, and decommissioning phases.	VERY LOW	VERY LOW	(-)	- Standard good maintenance practices of the vessels and drill ships; - Implement a MMO protocol during drilling activities; - Avoidance of sensitive marine areas and receptors during transit (e.g. maintain 300 m exclusion zone from any marine mammals encountered during transit).
BIO6	Effects related to artificial lighting on marine fauna in the drilling, installation, commissioning, and decommissioning phases.	LOW	VERY LOW	(-)	- Light emissions should be kept as low as possible, in accordance with best practice environmental management; - Minimize non-essential lighting on vessels, and shield and/or reduce, whenever practicable, the number of lights shining directly onto the water as far as possible; - Consider the use of amber wavelengths; - Monitoring of bird strike and strandings are to be undertaken as part of the project's adaptive management plan to identify any areas of concern caused by lighting, with actions developed to avoid and/or reduce the impact; - Keep any disoriented or otherwise unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed and/or banded birds found on vessels should be reported to the appropriate ringing/banding scheme; - Prohibit all crew members from killing or causing injury to seabirds and establish effective measures for the punishment of crew members found to have deliberately killed or caused injury to avifauna.

#	Impact Description – Construction, Drilling, Installation, and Commissioning Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
BIO7	Risk of collisions and entanglement with marine fauna.	VERY LOW	INSIGNIFICANT	(-)	- Ensure constant bridge watch is kept on all vessels to look out for cetaceans in danger of collision; - Keep any disoriented and unharmed seabirds found on vessels at night in dark containers and release them during daylight. Any ringed/banded birds found on vessels should be reported to the appropriate ringing/banding scheme; - Prohibit all crew members from killing or causing injury to seabirds (any crew members found to have deliberately killed or caused injury to marine fauna shall be dismissed immediately and removed to shore).
BIO8	Effects of ballast water on the marine environment during the drilling, installation, commissioning, and decommissioning phases	LOW	VERY LOW	(-)	- Discharge and loading of ballast water must comply with international and national legislation. Best international practices have to be followed (see IPIECA, 2010).

Table 7.42: Summary of Project impacts – start-up and operations phase

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
Air Quality					
AQ2	Air quality impacts during the start-up phase.	VERY LOW	VERY LOW	(-)	- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions.
AQ3	Air quality impacts during the operational phase.	LOW	LOW	(-)	- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions; - Annual monitoring survey of project emissions and ambient air quality. If the monitoring surveys detect either higher emissions than expected or relevant impacts on ambient air quality, the causes for those impacts will be investigated and relevant mitigation implemented, to be defined on a case by case, as part of an adaptive management process.
AQ5	Air quality impacts from the cumulative emissions of Coral South and Coral North FLNGs	LOW	LOW	(-)	- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions; - Annual monitoring survey of project emissions and ambient air quality. If the monitoring surveys detect either higher emissions than expected or relevant impacts on ambient air quality, the causes for those impacts will be investigated and relevant mitigation implemented, to be defined on a case by case, as part of an adaptive management process.
Greenhouse Gases					
GHG1	Project GHG emissions.	MEDIUM	MEDIUM	(-)	- Implementation of the best available technologies; - Implementation of preventative maintenance routines to avoid performance degradation; - Installation of waste heat recovery units; - Zero flaring policy during normal operations; - Preventative maintenance and operational efficiencies to reduce flaring; - Development and implementation of a GHG management plan to monitor and assess GHG emissions from the FLNG operation. GHG emissions monitoring will include the accounting of methane emissions. Project GHG emissions will be reported to the environmental authorities twice per year; - Project design to minimise fugitive emissions; - Plant design to guarantee energy efficient production; - LDAR program.

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
Atmospheric Noise					
AN2	Increase in noise levels from the logistics base operation.	VERY LOW	VERY LOW	(-)	- Ensure that predictive and regular maintenance is carried out on all noise emitting equipment operating in the warehouse; - Ear plugs should be provided to workers if near high noise generating equipment; - Maintain a complaint register and proceed with a follow up to the noise events.
Water quality					
WQ2	Potential increase of marine water temperature due to the discharge of the FLNG's cooling water.	LOW	LOW	(-)	- Maintain correct operation of the cooling system, to maintain designed discharge temperatures; - Ensure that the pumping of cooling water through the system is turned off when cooling is not required; - Continuous monitoring of the discharge temperature; - Biannual monitoring of the receiving seawater temperature, to ensure compliance with the end of mixing zone standard.
WQ3	Potential seawater quality degradation due to the discharge of produced water in the operational phase.	LOW	LOW	(-)	- Maintain correct operation of the treatment system, to maintain designed discharge concentrations; - Periodic monitoring of the produced water effluent, to verify compliance with the emission limits; - Biannual monitoring of the receiving seawater quality, to verify compliance with the ambient quality standards.
WQ4	Potential seawater quality degradation due to the discharge of other FLNG effluents in the operational phase.	LOW	LOW	(-)	- Monitor end of pipe concentrations and operations adjusted should adverse effects be detected by the monitoring program; - Monitor for total nitrogen at 300 m from the outfall to validate dispersion modelling results and ensure compliance with ambient quality standards.
Landscape					
L2	Project impacts on visual amenity.	VERY LOW	VERY LOW	(-)	- FLNG lighting will be restricted to the minimum required for safety and security; - Whenever possible, directional lighting will be used to limit light spill (i.e., spread of light outwards from where it is needed into adjacent areas).

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
L3	Cumulative impacts on landscape character and visual amenity from Coral South and Coral North FLNGs.	VERY LOW	VERY LOW	(-)	- FLNG lighting will be restricted to the minimum required for safety and security; - Whenever possible, directional lighting will be used to limit light spill (i.e., spread of light outwards from where it is needed into adjacent areas).
Biodiversity					
BIO9	Effects of discharge of deck drainage, bilge water and sewage on marine ecology due to changes in water quality	LOW	VERY LOW	(-)	- Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains); - Discharge of deck drainage, bilge water, and sewage shall comply with MARPOL 73/78 requirements; - Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system; - Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.
BIO10	Effects of solid waste disposal on marine ecology due to changes in water quality.	LOW	VERY LOW	(-)	- Apply adequate treatment and disposal of solid waste in order to avoid pollution of marine waters; - Apply all solid waste management measures according to national regulations and international standards and best practices; - Food solid waste will be treated in accordance with MARPOL (73/78) regulations. Kitchen waste will be macerated to diameters below <25 mm and discharged to sea; - All other solid waste must be segregated and temporarily stored and contained on the vessel, for appropriate treatment and/or disposal onshore in compliance with Annex V of MARPOL; - Train crew members on waste management procedures.
BIO11	Effects of noise on marine fauna during the operational phase.	LOW	LOW	(-)	- As per standard operational practice, thrusters will be engaged when necessary, at the minimum power required and for the shortest duration required, according to operational needs; - All FLNG equipment and thrusters will be adequately maintained throughout the operational phase; - Implement a MMO protocol during berthing and unberthing operations.

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
BIO12	Effects of the cumulative noise on marine fauna due to the simultaneous operations of Coral South and Coral North FLNG.	LOW	LOW	(-)	- As per standard operational practice, thrusters will be engaged when necessary, at the minimum power required and for the shortest duration required, according to operational needs; - Simultaneous operation of both FLNG's thrusters will be minimised to the extent possible, subject to production capacity, operational safety, scheduling of LNG carriers and metocean conditions; - All FLNG equipment and thrusters will be adequately maintained throughout the operational phase; - Implement a MMO protocol during berthing and unberthing operations.
BIO13	Effects of artificial lighting during the operational phase	MEDIUM	LOW	(-)	- Impacts to seabirds and shorebirds can be reduced by: - o Implementing seabird strike or stranding monitoring plan to identify sensitive species and areas of concern - areas of lighting which result in a disproportionate number of bird strikes; - Evaluation and implementation, if feasible, of adaptive management actions, if areas of concern are identified.
BIO14	Risk of collisions and entanglement of marine fauna.	MEDIUM	LOW	(-)	- Ensure constant bridge watch is kept on all vessels and at the FLNG to look out for cetaceans in danger of collision; - Record any marine mammal sightings; - Vessels shall not knowingly approach within 300 m of whales or 50 m of dolphins; - If whales are observed within 300-100 m of vessel during transit, vessels will maintain or reduce speed and alter course away from the whales if safe to do so; - If whales are observed <100 m from vessel, the vessel will decrease power and alter course away from the whales if operationally safe; - Periodically check risers to detect any entanglement of marine fauna, in particular with turtles. If entanglement is frequently detected, more detailed studies should be developed in order to devise additional mitigation measures.
BIO15	Effect of ballast water on the marine biodiversity during the operational phase.	MEDIUM	LOW	(-)	- All vessels containing ballast water shall carry a vessel-specific Ballast Water Management Plan; - Ballast exchange shall, as far as practicable, be conducted in deep water (at least 200 m) and as far as possible from land; - Discharge and loading of ballast water will with national regulation and international best practices.

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
BIO16	Effects of cooling water discharges on marine ecology.	LOW	LOW	(-)	- Maintain correct operation of the cooling system, to maintain designed discharge temperatures; - Ensure that the pumping of cooling water through the system is turned off when cooling is not required; - Continuous monitoring of the discharge temperature; - Biannual monitoring of the receiving seawater temperature, to ensure compliance with the end of mixing zone standard.
BIO17	Effects of produced water discharges on marine ecology, due to potential degradation of seawater quality.	LOW	LOW	(-)	- Maintain correct operation of the treatment system, to maintain designed discharge concentrations; - Periodic monitoring of the produced water effluent, to verify compliance with the emission limits; - Biannual monitoring of the receiving seawater quality, to verify compliance with the ambient quality standards.
BIO18	Bird mortality associated with flaring	MEDIUM	LOW	(-)	- Stack flare must be installed in compliance with the Design and Construction Regulations/PFEER; - Maintain zero flaring policy subject to operational constraints and without compromising safe plant, operating and worker requirements; - Prepare and implement a monitoring plan for potential bird fatalities.
BIO19	Potential disturbance to benthic habitats from scouring by flowlines	LOW	LOW	(-)	- Place subsea infrastructure in areas of low biodiversity and sensitivity areas; - Use of ROV to monitor laying the flowline along the target route. If sensitive hard bottom areas are identified, carry out micro routing to avoid the habitat.
Socioeconomics					
SE1	Stimulation of business tourism.	LOW	LOW	(+)	- No enhancement measures required.
SE2	Stimulation of the local and regional economy.	MEDIUM	MEDIUM	(+)	- Priority should be given to the local and regional markets whenever possible in the purchase and acquisition of goods and services; - Small and medium-sized local companies should be involved in capacity building and training, in order to boost their capacity to offer quality services and thus take advantage of the commercial opportunities created by the project.
SE3	National and provincial growth and development from increased revenue	VERY HIGH	VERY HIGH	(+)	- No enhancement measures are applicable.

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
SE4	Job creation.	MEDIUM	MEDIUM	(+)	- Establish a recruitment policy and plan with a long-term vision for the gradual transfer of skills.
SE5	Transfer of technical and professional skills to national workers.	MEDIUM	MEDIUM	(+)	- Provide technical training programs for workers to improve their job performance and diversify their skills; - Provide environmental, health and safety training to all employees.
SE6	Increased community expectations.	MEDIUM	LOW	(-)	- Update the stakeholder engagement and communication plan; - Develop and put in place a grievance mechanism; - Provide guidance to contractors on communication and recruitment procedures.
SE7	Security of infrastructure, assets, workforce, and communities.	MEDIUM	VERY LOW	(-)	- Armed security contractors are procured in a transparent manner; - Armed security services strictly adhere to MRV's approach to human rights and security, including ERB's code of ethics, Eni's Policy "Respect for Human Rights in Eni", Eni's suppliers code of conduct, Voluntary principles on Security and Human Rights, and MRV's strategies and actions to minimize risks deriving from security forces; - Accountability processes, including the GM are in place to ensure redress in cases of abuse; and - Actively engage with and ensure relevant project information is fed into both the national and provincial VP working groups lead by the partnership between the <i>Centro para Democracia e Desenvolvimento</i> (CDD) and the Geneva Centre for Security Sector Governance (DCAF).
SE8(i)	Human Rights risks – labour related	LOW	VERY LOW	(-)	- Ensure context specific internal redress mechanisms for MRV personnel are elaborated and implemented; - Ensure appropriate labour related due-diligence assessments are performed for all contracted third parties; and - Consider ad-hoc or regular labour rights training – 'know your rights' for MRV's local personnel and third-party groups.
SE8(ii)	Human Rights risks – ii) sexual exploitation, abuse and harassment and GBV	MEDIUM	LOW	(-)	- Ensure context specific internal redress mechanisms for MRV personnel are elaborated and implemented; - Ensure context specific SEAH/GBV identification measures are designed and implemented; - Ensure that all service providers and contractors are made aware and adhere to MRV's approach to GBV/SEAH and abuse and exploitation of other groups in vulnerable communities;

#	Impact Description – Start-up and Operations Phases	Significance Rating		Nature of Impact	Key Mitigation / Enhancement Measures
		Pre-mitigation	Post-mitigation		
					- Consider locally relevant community outreach and training on GBV/SEAH and other forms of abuse and exploitation; - Ensure 'zero tolerance' policy of SEAH/GBV is applicable to third parties and ensure, disqualification and/or appropriate criminal charges and/or disciplinary proceeding occur; - Ensure adequate victim support and referral systems are in place; and - Consider ad-hoc or regular SEAH/GBV training or capacity building for MRV personnel and third party groups.
SE8(iii)	Human Rights risks – human trafficking	LOW	VERY LOW	(-)	- Ensure that all service providers and contractors are made aware and adhere to Eni's Code of Conduct; - Consider locally relevant community outreach and training on human trafficking (link to GBV/SEAH and other forms of abuse and exploitation); - Ensure 'zero tolerance' policy on involvement in human trafficking is applicable to third parties and ensure, disqualification and/or appropriate criminal charges and/or disciplinary proceeding occur; and - Consider ad-hoc training or capacity building on human trafficking in the context for MRV personnel and third-party groups.
SE9	Restrictions to access of fishing grounds of commercial fisheries.	LOW	VERY LOW	(-)	- Include any complaints raised by fishing operators in relation to FLNG operations into the grievance mechanism and consider the specific stakeholder category as part of the stakeholder management plan; - As part of the implementation of the stakeholder management plan, the communications to the fishing operators shall be developed in collaboration with ADNAP, DPAPCD, and IDEPA.
SE10	Potential changes to Pemba's public health profile due to the presence of the Project's workforce	VERY LOW	VERY LOW	(-)	- No additional mitigation is required, continued application of MRV's health policies for its workers.
Marine traffic					
MT1	Risk of marine vessel collisions due to increased marine traffic.	LOW	LOW	(-)	- Implement all standard navigation safety measures and procedures (as listed above); - Strict application of ColReg; - Notification by logistics to Marine department, local authority and port authority on the Company's logistics and supply chain activities; - Establish a safety zone of 500 m around the FLNG facilities limits.

Table 7.43: Summary of Project impacts – unplanned events

#	Impact description – unplanned events	Significance rating		Nature of impact	Key mitigation / enhancement measures
		Pre-mitigation	Post-mitigation		
Air quality					
AQ4	Air quality impacts during emergency /unplanned flaring.	VERY LOW	VERY LOW	(-)	- Implement standard maintenance procedures of the combustion equipment, to maintain design emissions.
Water quality					
WQ5	Risk of seawater quality degradation resulting from accidental diesel spills due to vessel collision (unplanned event).	MEDIUM	VERY LOW	(-)	- Vessel operations will adopt preventative measures in compliance with national regulation and international best practices; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.
WQ6	Risk of seawater quality degradation resulting from and accidental gas condensate blowout (unplanned event)	MEDIUM	VERY LOW	(-)	- Install blowout preventers (BOP) in the wellheads; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.
WQ7	Risk of seawater quality degradation resulting from an LTOBM release due to an accidental riser disconnect (unplanned event)	MEDIUM	VERY LOW	(-)	- Well drilling plans should be reviewed by subject matter experts to assure operational readiness; - Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.

#	Impact description – unplanned events	Significance rating		Nature of impact	Key mitigation / enhancement measures
		Pre-mitigation	Post-mitigation		
Biodiversity					
BIO20	Effects on marine fauna and coastal habitats resulting from an accidental diesel spill due to a vessel collision (unplanned event).	MEDIUM	VERY LOW	(-)	- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.
BIO21	Effects on marine fauna and coastal habitats resulting from a gas condensate blowout (unplanned event).	MEDIUM	VERY LOW	(-)	- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.
BIO22	Effects on marine fauna and coastal habitats from an LTOBM release due to an accidental riser disconnect (unplanned event)	MEDIUM	VERY LOW	(-)	- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs.
Socioeconomics					
SE11	Impacts from accidental hydrocarbon spills from unplanned events on fisheries and coastal communities.	MEDIUM	LOW	(-)	- Develop and implement a comprehensive oil spill contingency plan (OSCP); - Train personnel to effectively respond in the event of a hydrocarbon spill; - Enforce of all policies and procedures. Tier 1 oil spill response equipment will be staged on support vessels and/or at shore; - Ensure readiness of response crew and third-party responders when unplanned event occurs; - If an oil spill occurs and reaches the coastal area, assess the social and health impacts to the local community and tourism; and define actions as appropriate to restore affected livelihoods to pre-impact levels.

7.11 Cumulative Impact Assessment

7.11.1 Introduction

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity in combination with other existing, planned, and/or reasonably anticipated future ones.

For practical reasons and as per IFC's *Good Practice Handbook for Cumulative Impact Assessment* (2013), the identification and management of cumulative impacts in this report are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

According to IFC (2013), a Cumulative Impact Assessment (CIA) is the process of:

- Analysing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on chosen Valued Environmental and Social Components (VECs) over time; and
- Proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risks to the extent possible.

Because it is unrealistic to think that every environmental and social component can be subject to a cumulative impact assessment, it is good practice to focus on VECs. VECs are sensitive or valued receptors of impact. In other words, they are environmental and social attributes that are considered to be important in assessing risks and may include physical features, biodiversity (e.g., habitats or wildlife populations), ecosystem services, natural processes (e.g., water and nutrient cycles, microclimate), social conditions (e.g., health, economics), or cultural aspects (e.g., traditional spiritual ceremonies).

The key analytical task is to discern how the potential impacts of a proposed development may combine, cumulatively, with the potential impacts of other human activities and other natural stressors such as droughts or extreme climatic events. Other human activities of greatest importance in a CIA are those that (a) will occur in the future, or, if already present, have ongoing influences on the environment in the future, and (b) are expected to interact with the same VECs in the future as does the development under assessment.

This CIA has the following main objectives:

- Assess the potential impacts and risks of the Coral North FLNG Project over time, in the context of potential effects from other developments and natural environmental and social external drivers on the identified VECs;
- Where possible, verify that the cumulative social and environmental impacts and risks associated with the proposed Coral North FLNG Project will not exceed a threshold that could compromise the sustainability or viability of selected VECs;
- Confirm that the proposed Coral North FLNG Project's value and feasibility are not limited by cumulative social and environmental effects;

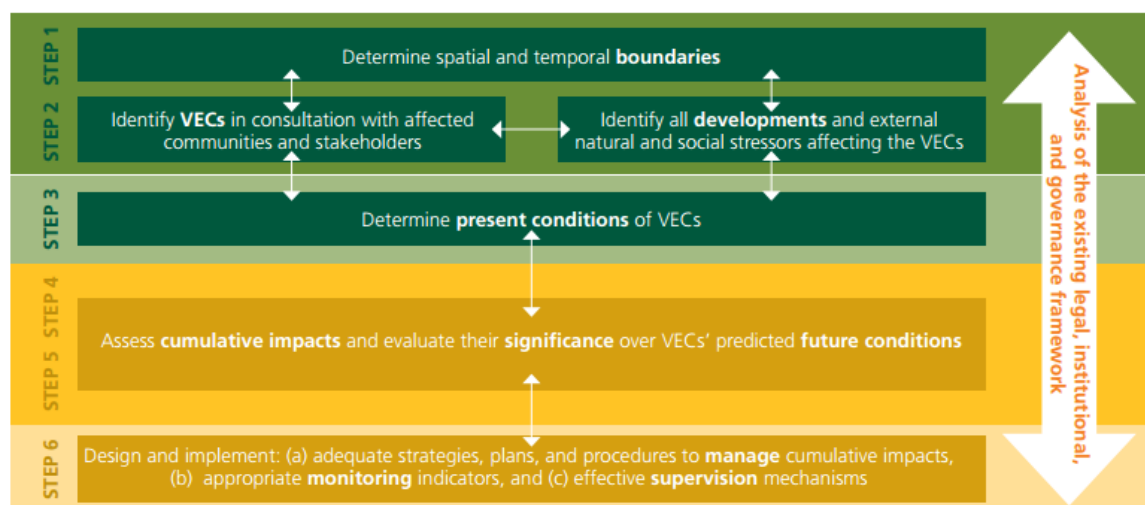
- Support the development of governance structures for making decisions and managing cumulative impacts at an appropriate geographic scale (e.g., airshed, fishing grounds, town, landscape level).
- Ensure that the concerns of stakeholders and affected communities about cumulative impacts are identified, documented, and addressed; and
- Manage potential cumulative impacts.

7.11.2 Methodology

The CIA was developed with the guidance of the following documents:

- IFC's performance standards 1 and 3 (IFC, 2012); and
- IFC's Good Practice Handbook on *CIA and Management: Guidance for the Private Sector in Emerging Markets* (IFC, 2013).

This report provides a High-Level CIA, or a rapid CIA as defined in IFC (2013), based on a desk review and the findings of the consultation process undertaken during the Coral North Project EIA process. The overall methodology for the High Level, or rapid, CIA followed the six-step approach suggested by IFC (2013) for a rapid cumulative impact assessment, as illustrated in Figure 7.25 and further detailed below.



Source: IFC (2013).

Figure 7.25: Six-step approach to a rapid CIA, as outlined by the IFC (2013)

Step 1: scoping phase I – VECs, spatial and temporal boundaries

This phase established the scope of the analysis. It entailed the definition of VECs taking into account the characteristics of the Project, as well the biophysical and social conditions within the areas that can be potentially affected by the project. This identification of VECs was assisted through engagement with relevant stakeholders (including local communities) carried out during this and past

similar EIA processes in the region, as well as review of national guidelines and regulations. In addition, this step also set the temporal and spatial boundaries of the CIA for the selected VECs.

In addition to identifying VECs and defining their spatial and temporal boundaries, a sensitivity and value assessment for each VEC was also carried out.

Step 2: scoping phase II – other activities and environmental drivers

This phase entailed the identification of other projects, plans, activities, and actions that could potentially impact upon the VECs in combination with the Coral North Project and result in cumulative impacts. As such, the findings and conclusions of related and applicable plans, studies and assessments prepared by relevant government authorities or other parties that are directly related to the Project and its area of influence were taken into account. The time horizon taken into account was four years from the Coral North Project timeframe, as per European Union recommendations, given the uncertainty of longer-term and future developments (IFC, 2013).

In addition, natural drivers that can exert an influence on VEC conditions were also scoped for inclusion, where relevant. Furthermore, other projects, actions or activities that are likely to be induced by the project were also taken into account.

Step 3: establish information on baseline status of VECs

IFC's guidelines for CIA (IFC, 2013) recommend baseline assessment of VECs with a lesser detail than that performed during the EIA, because of the larger area covered and/or changes in the type of data required for the different scale of the assessment.

The establishment of the baseline status of VECs in this CIA was based on the information available in the Coral North EIS, and in the EIA processes of other developments.

Step 4: assess cumulative impacts on VECs

Taking into account the Coral North FLNG project's predicted impacts on the VECs, an assessment was undertaken to evaluate the ability of the Project to interact with other planned or reasonably defined developments in such a manner that gives rise to a cumulative impact (where the temporal and spatial influences coincide).

It should be noted that the assessment only considers residual impacts arising from the Project, i.e., impacts following the application of mitigation measures. In other words, this report only considers VECs that will experience a degree of residual impact associated with the Coral North FLNG project. As such, those VECs for which the EIS identified a LOW or lower significance residual impact were not included in this CIA, as illustrated in Table 7.44 below.

Table 7.44: Scoping criteria for including VECs in the CIA

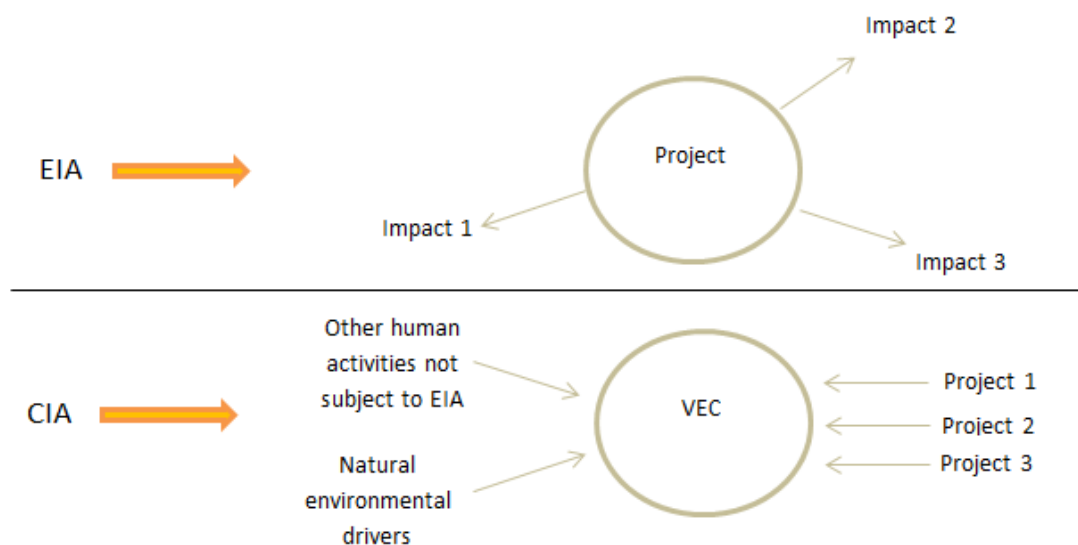
Residual Impact	Scope in CIA
Insignificant, Very Low or Low	Excluded from the CIA
Medium	Included in the CIA / reviewed for potential cumulative impacts
High	Included in the CIA
Very High	Included in the CIA

As outlined in Table 7.44 above, where residual impacts are defined as “HIGH” or “VERY HIGH”, their associated VECs were automatically included in the CIA. Where residual impacts were assessed as “MEDIUM”, their associated VECs were reviewed for potential cumulative impacts. For residual impacts assessed as “LOW” or lower, their associated VECs were initially excluded from the CIA given their negligible sensitivity and/or negligible magnitude of impact, although a brief revision was carried out for potential cumulative impacts that could merit inclusion in the CIA, as discussed below on section 7.11.3.4.

As per IFC (2013), the identification and management of cumulative impacts was limited to those effects on VECs recognized as important in terms of community and/or scientific concerns.

Step 5: assess significance of predicted cumulative impacts

The significance assessment of a cumulative impact is evaluated not in terms of the amount of change as the result of a project, as performed in EIAs, but in terms of the potential resulting impact to the vulnerability and/or risk to sustainability of the VEC being assessed (see Figure 7.26 below). In other words, it requires the determination of the extent of further effects that can be sustained by a VEC before it suffers irreversible changes to its condition or state (World Bank, 2012).



Source: Adapted from IFC (2013).

Figure 7.26: Assessing impacts on VECs as opposed to assessing impacts in EIAs

However, the determination of impact significance in CIAs is not straightforward. While this often means evaluating cumulative impacts in the context of ecological thresholds for biological and social VECs, this has proven to be difficult given that thresholds may not be identified until they are actually crossed (Lawrence, 2007). On the other hand, there is little if any guidance available for significance determination in CIAs, and methods used in EIAs are largely useless in CIAs (Bérubé, 2007).

In addition, Bérubé (2007) highlights the fact that many future projects assessed in CIAs lack sufficient information to such an extent that impact significance cannot be determined precisely. He

further states that no single significance determination methodology exists for cumulative effects given the longer-term timeframe of effects, the extended geographical area that must be considered, the lack of detail and imprecision of many future actions and threshold limits.

Given this difficulty in assigning thresholds to VECs on the one hand, and the lack of an available methodology to assess the significance of cumulative impacts on the other, this report followed the EIS standard impact assessment approach (see section 7.1.2) also taking into account the sensitivity and/or value of each VEC, attributed based on professional judgement, societal values as well as concerns from affected communities (please refer to Table 7.46).

Step 6: management of cumulative impacts – design and implementation

Where the CIA carried out in step 5 above indicated that there is a potential for a cumulative impact of moderate to high significance, the need for additional mitigation or management actions (or monitoring) beyond those outlined in EIS Report.

7.11.3 VECs, Temporal and Spatial Boundaries

7.11.3.1 VEC Identification

The previous sub sections of the impact assessment considered all potential project impacts on the physical, biological, and socioeconomic environment. These components have been defined by taking into account prevailing biophysical and social conditions in the project's area of influence, and the ability of the project to impact upon these resources throughout its different phases.

Based on the above, a number of VECs have been considered for this CIA. The selection of VECs was based on:

- Review of the Coral FLNG projects (North and South) and associated impacts on the physical, biological and socio-economic environment;
- Review of the Coral South FLNG Project monitoring data and additional specialist studies;
- Review of recent environmental assessments and/or proposed developments in the region;
- Review of the consultation process carried out with relevant stakeholders, including local and fishing communities for both the Coral North and Coral South FLNG projects; and
- Review of relevant national and international guidelines and legislation, plans and programs.

It should be noted that no specific stakeholder engagement activities were undertaken for the CIA purpose, as it was considered that the past consultation process developed in the Coral South and the Coral North projects provided a clear view of the environmental and social features which are most valued by the relevant stakeholders, thus supporting the selection of the most adequate VEC's for the Coral North Project case, given the similarities between the two projects.

The selected VECs, as well as the reasons for having selected them, are outlined in Table 7.45 below.

Table 7.45: Selected VECs

VEC	Reasoning
Physical Environment	
GHG emissions and contribution to climate change	- Contribution from fossil fuels projects to climate change; - Increasingly important subject for the stakeholders and society in general.
Biotic Environment	
Marine biodiversity, specifically the following high biodiversity value species: - Marine mammals: sei whale (EN), fin whale (VU), and sperm whale (VU). - Marine turtles: loggerhead (VU), green (EN), leatherback (VU), hawksbill (CR), and olive ridley (VU); - Marine birds: Jouanin's Petrel (NT) and cape gannet (EN).	- Potential impacts of the FLNG project on marine animals; - Project located offshore of the Cabo Delgado coastline, which is considered one of the richest biodiversity regions in the country (both deepwater and nearshore environment); - Relative proximity of the Project to the Quirimbas National Park (the Coral North FLNG is located roughly 120 km Northeast of the park), an important conservation area in the country and the region (part of the conceptual Mnanzi Bay – Quirimbas Transfrontier Conservation Area between Mozambique and Tanzania); - Marine fauna and biodiversity are valued by the general Mozambican public given their association with the Quirimbas National Park and the Quirimbas Archipelago, an important tourist destination; - Conservation status of some species occurring in Cabo Delgado's coastal and offshore waters.
Socioeconomic Environment	
Employment, skills transfer, business opportunities, revenue	- Potential contribution of the Project to local and national employment opportunities, transfer of skills, stimulation of business opportunities and increased government revenue; - Extensive public interest in available employment and business opportunities from the Project; - Low employment and business opportunities in the region.

Legend: VU – Vulnerable; EN – Endangered; CR – Critically endangered. (International Union for the Conservation of Nature and Natural Resources - IUCN Red List).

Other potential social and economic negative impacts that are typically valued by stakeholders, such as impacts on fisheries (commercial, artisanal, recreational in Pemba/Cabo Delgado), on island tourism (Quirimbas archipelago and others) and on health (social services and incidence of diseases in Pemba), were deemed of low relevance in the EIS. This assessment is consistent with the monitoring data from the operational Coral South Project, for which no significant real impacts have been registered to date for these components.

7.11.3.2 Sensitivity and Value of the VECs

As outlined above, there is a range of VECs with varying degrees of sensitivity and each valued differently at different social and geographical scales. Given the difficulty in attributing sensitivity and values, a conservative approach was adopted (i.e., by identifying the highest sensitivity and values likely for each VEC). These sensitivity and value scores have been used in the consideration of the significance of the cumulative impacts.

“Sensitivity” is the degree to which the component is susceptible to and unable to cope with injury, damage, or harm. Sensitivity is also dependent on the nature of the changes/influences upon the VEC.

“Value” is the extent to which a particular component is valued by the public.

Table 7.46: Sensitivity and value of selected VECs

VEC	Sensitivity	Value
GHG emissions and contribution to climate change	High	Medium - High
Marine biodiversity (high biodiversity value species and habitats)	High	High
Employment, business opportunities, skills transfer, revenue	.*	High

Note: *This VEC has not been assessed in terms of sensitivity given that in this analysis, it is not susceptible to any negative effects, just positive ones.

7.11.3.3 Temporal and Spatial Boundaries

To determine the temporal scale of the CIA, the following timeframes for the Coral North FLNG Project were taken into consideration, considering the project execution schedule:

- The drilling, installation, and commissioning phases - planned to run from 2025 – 2027; and
- The start-up and operational phases (production and maintenance) – planned to run from 2027 to 2052.

The decommissioning phase of the project was not assessed given that decommissioning activities are still uncertain and will only be developed during the operational phase, with the assessment of different alternatives. A review and drafting of relevant studies, if deemed necessary, will be carried out during the operational phase to confirm that the decommissioning activities are appropriate and that do not cause unacceptable cumulative impacts if there are other developments in the vicinity of the proposed decommissioning works.

While in theory the temporal boundaries of the CIA should extend back in time to a pre-impact condition as well as into the future until environmental values have recovered and effects become insignificant, this is rarely practical. In addition, the temporal boundaries of a CIA should vary depending on the VEC being assessed (given that effects in some VECs may show a temporal trend) as well as the duration of effects (given that some effects do not occur immediately, leading to a delayed temporal variation) (Masden *et al.*, 2010). Given the complexity and uncertainty surrounding temporal scales in CIA, in practice, it is more adequate to address scenarios that typically commence with current conditions and extend into the future to a point where there is still a reasonable level of certainty (MCA, 2015). As such, the temporal limits of the analysis extend between 2025 and 2052.

The spatial boundaries of the CIA have been defined taking into account the geographical extent of impacts that influence the different VEC conditions. The geographical extent of the assessment was based on:

- Area of Influence (AoI) of the Project as the defined in the EIS, more specifically the Area of Direct Influence (ADI), as recommended by IFC (2013);
- Wider area occupied by VECs beyond the ADI;

- Distance impacts can travel within this wider area when exposed to different cumulative impacts.

A flexible approach was maintained in order that the boundaries of the assessment vary depending on the characteristics of the potentially impacted VEC.

Table 7.47 below outlines the ADI for each VEC as per the Coral North EIS and defines the geographical boundary used in this CIA.

Table 7.47: Aol and geographical boundary for the VECs

VEC	ADI as per the EIS	Wider area occupied by VEC's beyond the ADI	Geographical boundary for the CIA
GHG emissions and contribution to climate change	Northern Cabo Delgado coastal zone	Cabo Delgado Province	Cabo Delgado Province
Marine biodiversity (high biodiversity value species and habitats)	Area defined by a 33 km radius around the FLNG facility. Zone of potential behavioral impacts on marine mammals due to project noise emissions. This distance is informed by the underwater noise specialist study developed for this EIS (see Impact BIO11). Note that for the other high biodiversity value species listed under this VEC (turtles and birds), the ADI will be much smaller. Fauna collisions are possible on the vessel and aircraft routes (Pemba – operational site).	The listed high biodiversity value species occur both in the nearshore and offshore waters of Cabo Delgado.	Northern Cabo Delgado coastal zone and Cabo Delgado offshore waters
Employment, skills transfer, and business opportunities	n/a	n/a	Cabo Delgado Province
Revenue	n/a	n/a	Mozambique

As listed in Table 7.47 above, the geographical boundaries adopted for the VEC's marine fauna includes the Northern Cabo Delgado coastal zone and shallow nearshore waters (mostly corresponding to Palma District, although a small area of Mocímboa da Praia District is also included), as well as the deep offshore waters of Cabo Delgado. Figure 7.27 below illustrates these boundaries. Note that in the nearshore areas, only the Northern Cabo Delgado coastal zone was considered, as that is the only coastal zone where cumulative impacts may be expected, considering the developments included in the scope of this CIA (see section 7.11.4.1 below), namely the potential cumulative impacts with the Mozambique LNG Project (Afungi). The adopted boundary for the offshore area includes a wider area off Cabo Delgado, considering the potential cumulative impacts of increased maritime traffic between Area 4 and Pemba's onshore support base.

The socioeconomic VECs (employment, skills transfer, business opportunities and revenue) CIA boundaries correspond to the wider administrative areas of Cabo Delgado Province and even Mozambique (revenue only), as illustrated in Figure 7.28 below.

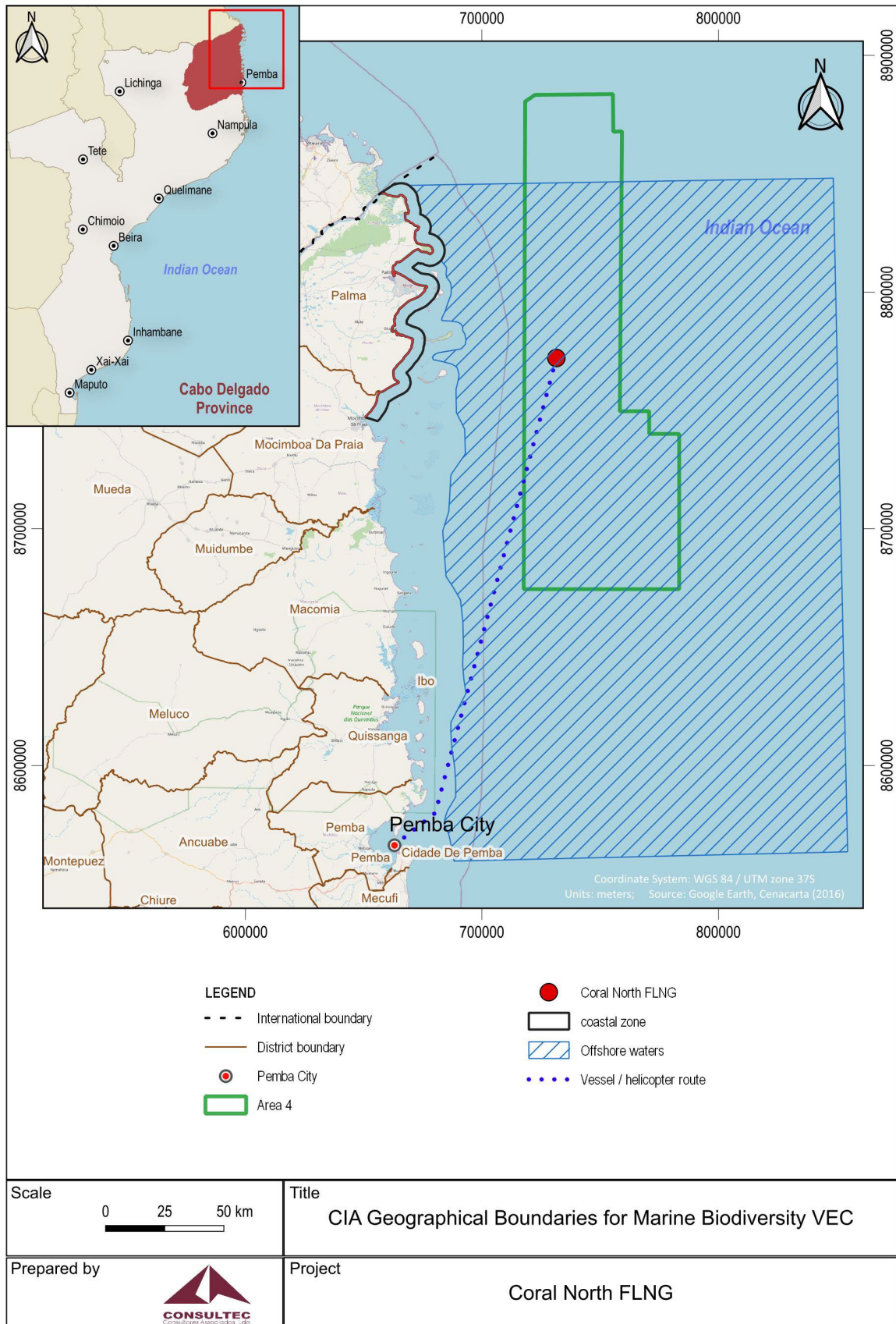


Figure 7.27: CIA Boundaries for marine biodiversity

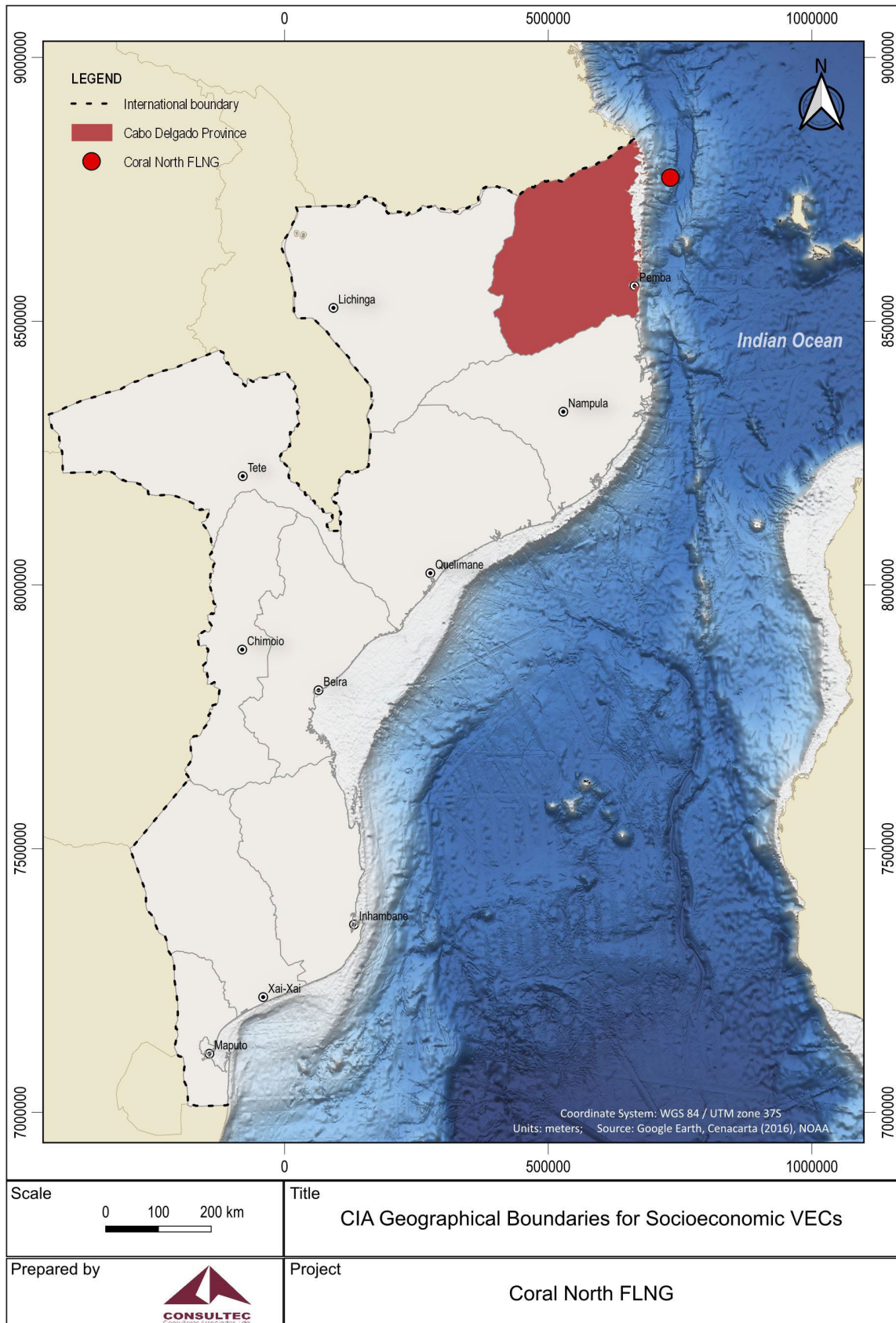


Figure 7.28: CIA Boundaries for socioeconomic VECs: Cabo Delgado Province and Mozambique

7.11.3.4 Project Residual Impacts

Table 7.48 below presents a summary of the impact assessment identified in the Coral North EIS report showing only:

- Residual impacts with MEDIUM, HIGH, and VERY HIGH significance;
- Impacts over the identified VECs; and
- Impacts associated to: i) the drilling, installation, and commissioning phases, and ii) the operational phase.

Table 7.48: Summary of project residual impacts (of MEDIUM or higher residual significance) included in the CIA and linked to the identified VECs

VEC	Impact Source	Residual Impacts		Nature of impact
		Drilling, Installation and Commissioning Phase	Operational Phase	
GHG emissions and contribution to climate change	Emissions from fuel usage in the marine vessels and helicopters, GTG/GTC, thermal incinerator and flaring; fugitive emissions	-	MEDIUM	(-)
Employment, business opportunities	Hiring of workers, presence of foreign workers in Pemba, procurement of services, goods and materials, increased income /consumption levels	MEDIUM	MEDIUM	(+)
Skills transfer	Transfer of skills to Mozambican workforce	MEDIUM	MEDIUM	(+)
Revenue	Payment of taxes and other fees, sale of exported gas	VERY HIGH	VERY HIGH	(+)

As described under Methodology (see section 7.11.2), those VECs with LOW or lower significance residual impacts have been excluded from this CIA. Where the Coral North Project's residual impact significance is MEDIUM or higher, the applicable VEC is included in the assessment if considered relevant (i.e., as per the value and sensitivity scores of these VECs). Notwithstanding, and as also described in the methodology section, a brief revision was carried out for impacts which were assessed in the EIS as having LOW or lower residual significance, in order to identify any potential cumulative impacts that would merit inclusion in the CIA (independent of VEC value and sensitivity scores). From this revision two LOW residual significance impacts were added to the CIA, namely:

- Underwater noise impacts on marine fauna, in particular on VHF cetacean functional hearing group (which are more sensitive to noise to be generated by the Project) were assessed in the EIS as of LOW residual significance, which would exclude this impact from being considered in the CIA, as per the adopted methodology. However, given the presence (or potential presence) in the Project area of several baleen whale species, some of which are globally threatened, this impact was included in the CIA in order to verify the relevance of the cumulative underwater noise impact of the considered developments;
- Oil spill risks of the Coral North FLNG Project were assessed in the EIS through modelling of three worst-case unplanned events: large diesel spill resulting from vessel collision, release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase, and release of LTOBM due to an accidental disconnection of the riser during the drilling phase. In the non-mitigated scenario, the impacts of an accidental diesel spill were

considered to be of MEDIUM significance, with a definitive likelihood of a spill reaching the eastern shoreline of Mozambique and Tanzania. However, the extent where a spill can be considered to have a harmful effect on sea life (thickness > 1 µm), shown to be limited to a relatively close proximity of the discharge point. Nevertheless, the residual significance was considered to be VERY LOW, as the implementation of a comprehensive Oil Spill Response Plan would greatly minimize the extent of a potential spill. Even though the residual significance was considered to be VERY LOW, this potential impact was included in the CIA, in order to assess the relevance of the increased cumulative risk of oil spills, resulting from the concurrent operation of the considered developments.

Table 7.49 below presents a summary of the impact assessment contained in the EIS for these two lower residual significance impacts.

Table 7.49: Summary of project residual impacts (lower than medium residual significance) included in the CIA and linked to the identified VECs

VEC	Impact Source	Residual Impacts		Nature of impact
		Drilling, Installation and Commissioning Phase	Operational Phase	
Marine biodiversity (high biodiversity value species and habitats)	Project-specific underwater noise, in particular the noise from vessels and the FLNG thrusters.	LOW	LOW	(-)
	Oil spill risk associated with accidental unplanned events, such as vessel collisions Release of gas condensate due to a blowout of the wellhead on the seabed Release of LTOBM due to a disconnection of a riser during the drilling phase	VERY LOW	VERY LOW	(-)

7.11.4 Other Activities and Environmental Drivers

This section identifies planned and reasonably defined developments within the defined CIA geographic boundaries with potential to affect the identified VECs, as described in the previous section. The reasoning was that, if the Coral North Project and these developments are developed concurrently – either temporally or spatially – they could result in cumulative impacts on these VECs.

No relevant environmental drivers were identified that could significantly influence the condition of the considered VECs within the CIA temporal boundaries.

The tasks carried out during this phase included the identification of developments and plans relevant to the CIA, screening of these for relevancy and scale, obtaining available information on these developments and plans and finally screening impacts on the identified VECs for each of these developments.

Information on relevant projects and plans varied in terms of content, with some containing more detail than others depending on where the project is in terms of planning. The sources of information for each of the identified developments are indicated in the following section.

No seismic acquisition projects have been included in the assessment given that all the required seismic data has already been acquired during the exploration phase, and no further seismic surveys will be required for the Area 4 developments. Area 1 has also already concluded its exploration phase, and no further seismic surveys are likely.

7.11.4.1 Development Projects or Proposals

The following developed and/or planned developments were identified in the vicinity of the Coral North Project:

- Palma region
 - Mozambique LNG (onshore LNG facilities in Afungi and offshore wells in Area 1 and 4);
 - Coral South FLNG (offshore).
- Pemba region
 - Onshore support bases.

The sources of information for each were mainly the EIS's (Afungi Onshore LNG Project: ERM & Impacto, 2014) and Coral South FLNG (Consultec, 2015 and subsequent EIS Addendums I (2015, II (2019) and III (2023) and specialist studies conducted along the process) and the latest information publicly available and/or provided by the promoters.

No other planned and reasonably defined developments were identified for the Area 4 and Area 1 concession areas.

The location of the proposed developments is illustrated in Figure 7.29 below and discussed in the following sections. No other planned or reasonably defined developments have been identified within the CIA geographical boundaries which could result in significant impacts on the selected VECs.

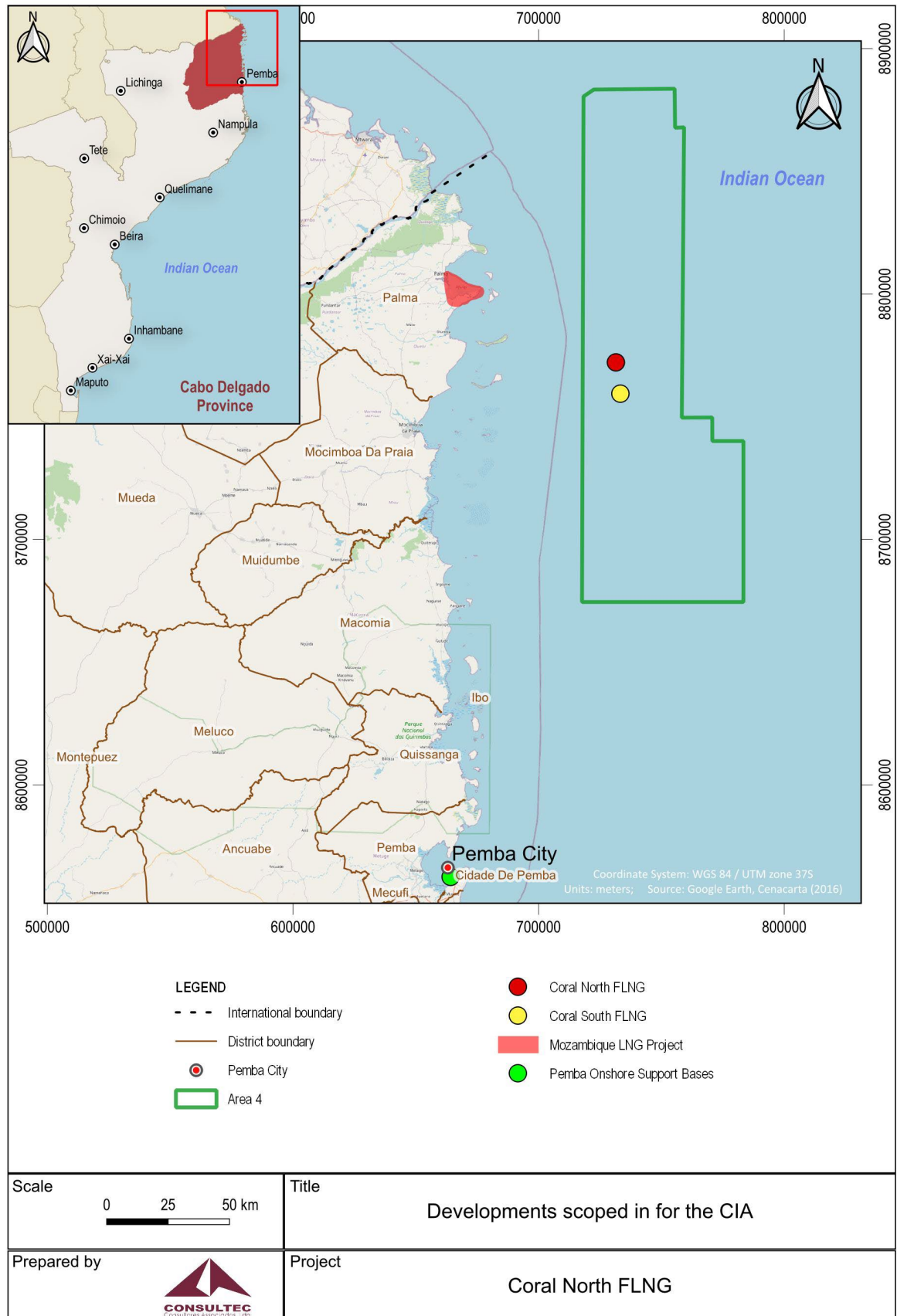


Figure 7.29: Proposed developments relevant to the CIA

Palma Region

Mozambique LNG Project (Afungi)

The Mozambique LNG project is located onshore in the Afungi site, District of Palma and is associated with gas fields within Area 1 and Area 4. The project operator is TotalEnergies. The Project (originally named Rovuma LNG) has been subject to an EIA Process (ERM & Impacto, 2014) and an environmental license has been issued.

Considering the evolution of the security situation in the north of the Cabo Delgado province in Mozambique, TotalEnergies confirmed in 2021 the withdrawal of all Mozambique LNG project personnel from the Afungi site, due to force majeure circumstances.

The Mozambique LNG Project can contribute to cumulative impacts with the Coral North Project on the selected VECs, in particular given that the former also has activities that fall within the offshore area of the Rovuma basin (specifically in Area 4). While the gas is processed onshore, the process begins offshore, where natural gas will be extracted from gas reservoirs below the seafloor via subsea wells. The gas will be collected and transported to the onshore LNG facilities by pipelines for processing, conversion into liquid form and stored in storage tanks. The liquefied gas will then be transported through pipelines to jetties and loaded into LNG vessels to be exported to international markets.

A summary of the main activities associated with the Afungi Onshore LNG Project is provided in Table 7.50 below and the Project is illustrated in Figure 7.30.

Table 7.50: Summary of main project activities and components expected for the Afungi Onshore LNG Project

Project Activities and Components	Description
<i>Offshore</i>	
Drilling and commissioning of offshore wells	- Mobilization and vessel circulation; - Drilling of 120 subsea wells in Areas 1 and 4 with drilling vessels; - Delivery of fuel, water, food, drilling fluid chemicals, oil well cement and chemicals, drill pipe and wellheads, equipment, tools etc. to the drilling vessels; - Production of drilling mud and cuttings;
Subsea production system	- Subsea production trees installed at wellheads and characterized by valves, gauges and chokes to control gas flow; - Salt and water waste effluents to be discharged in the bay; - Subsea production infrastructure to be connected via manifolds, pipeline end termination structures and jumpers; - Umbilical cables to control the subsea equipment; - Subsea gas pipelines; - Movement of construction vessels; - Use of temporary exclusion zone during construction; - Use of drill ships or installation vessels for the subsea production system; - Movement of support vessels; - Dredging in shallower waters to lay the pipelines with trailing suction hopper dredgers and cutter suction dredger (no dredging in deeper waters); - Disposal of dredge material.

Legend

- Villages / Settlements
- Regional Roads
- Proposed Pipeline Corridor Route
- Jetty
- Onshore Layout
- Afungi Project Site
- Prosperidade Gas Field
- Golfinho Gas Field *
- Mamba Complex Gas Fields

* Indicative area not yet approved by INP

Figure 4-1:
Indicative Project Layout

CLIENT: Anadarko Mozambique Area 1 Ltd.			
DATE: Oct 2013	CHECKED BY:	APPROVED BY:	PROJECT NUMBER:
DRAWN BY:	SCALE: 1:600,000		
INDICATIVE PROJECT LAYOUT MUST			
ERM Great Westworf Building 2nd Main Road Rondebosch, 7705 Cape Town, SOUTH AFRICA Tel: +27 21 681 5400 Fax: +27 21 688 0275			
ANADARKO Project: LTW Zone 37 S. Datum: WGS84 Journal Map: GSD 2010 Microsoft Corporation. AMAI, 2010. Free Map: Earth & Maps.			

⁸ <https://mzlng.totalenergies.co.mz/en/about-mozambique-liquefied-natural-gas-project>

a subsea production system with umbilicals, risers and flowlines system, and a FLNG vessel moored offshore at about 50 km off the coast of Palma District (Cabo Delgado Province).

Given that the Coral South Project is located within Area 4 and includes the same types of activities as the Coral North Project, cumulative impacts from the two projects on the selected VECs are likely.

Pemba Region

Onshore support bases

The main onshore support bases for Area 4 projects, namely Coral South, are established in Pemba, and are related to onshore personnel and support logistic operations to the offshore projects:

- Port facilities in Pemba Port, namely berthing for supply vessels;
- Facilities of Pemba airport, namely the operation of existing helicopter services;
- Logistics yard in Pemba;
- Offices in Pemba.

7.11.4.2 Assessment of the Development Projects

The section above provides a brief description of the reasonably defined developments within the CIA geographical boundaries, which could result in cumulative impacts on the selected VECs. An analysis was then carried out of the possible characteristics of these projects such as schedule of activities, footprint characteristics and size, areas of influence and affected VECs, in order to ascertain their potential to generate cumulative impacts during the drilling and installation, commissioning and operational phases of the Coral North FLNG Project.

This analysis is presented in Table 7.51 below and outlines which developments have been scoped in or out of the CIA.

Table 7.51: Analysis of development proposals in the CIA

Development	Interaction with the Coral North FLNG Project	Scoped in / out of CIA
Palma Region		
Mozambique LNG Project (gas fields in Area 1 and Area 4 offshore of the Rovuma Basin; Onshore LNG facilities at Afungi, Palma)	The project is currently on hold due to force majeure circumstances. Supposing that activities will resume in the short-term, the drilling and installation, and commissioning phase may overlap with the initial stages of the Coral North FLNG (2025-2027), thus resulting in the potential for concurrent activities to generate cumulative impacts. These activities will also take place in areas which are relatively close to each other, namely the offshore area of Palma (please refer to Figure 7.29). Given the physical distance and similar timeframes, it is considered that concurrent activities from the Mozambique LNG Project and the Coral North FLNG Project will be able to generate cumulative impacts. The operation phase of both projects will surely coincide in the future 2027 onwards, thus any concurrent operational phase activities taking place are anticipated to generate cumulative impacts.	Scoped in
Coral South FLNG	As outlined above, this Project is very similar to the Coral North Project and is also located within Area 4. As such, it has the potential to result in cumulative impacts when combined with the Coral North Project given that the same environment will be affected (i.e., same geographical setting) and that both projects will occur within the same timeframe (with the Coral North Project planned to start drilling three years from the Coral South Project operational start).	Scoped in

Development	Interaction with the Coral North FLNG Project	Scoped in / out of CIA
Pemba Region		
Pemba onshore support bases	As outlined above, Area 4 operators' hubs are located in Pemba and serve as onshore support for Coral South FLNG Project and future others, including Coral North FLNG. It includes port and airport facilities, logistic and office bases. Given that both Coral projects will be operating simultaneously and will share the same bases, cumulative impacts, mainly social and economic, are expected in Pemba region. In addition, given Cabo Delgado's biodiverse coast and its regional importance for marine fauna (including mammals and charismatic species), it may be that the two projects will, together, exert a cumulative impact on some of these species given the associated increased movement of vessels and helicopters between the two project sites.	Scoped in

7.11.5 Assessment

Section 7.11.3.4 has indicated that the significance of the Coral North Project impacts on GHG emissions and social (socio-economic) VECs are MEDIUM to VERY HIGH (with the exception of the residual impacts associated with underwater noise and oil spill risk, which are LOW or VERY LOW).

Section 7.11.4.1, on the other hand, identified development projects that should be considered in the CIA given their potential to affect the selected VEC's within the CIA geographical boundary, concurrently with the Coral North FLNG Project. The section below assesses the potential for significant cumulative impacts to occur as associated with the identified development projects.

As previously stated, this assessment focuses on the identified VECs and associated impacts, as highlighted in Table 7.48 and Table 7.49. The methodology used is outlined in section 7.11.2. When a cumulative impact is identified, the significance of the potential cumulative impact is assessed either quantitatively or qualitatively (depending on data availability).

7.11.5.1 Physical Environment

Coral North's Project life-cycle emissions (25 years) were estimated to be around 26.5 MMt CO_{2e} (or circa 1.04 MMt CO_{2e} annual average) of which 26 MMt were attributed to the FLNG operations (including initial start-up year).

Mozambique's annual emissions are circa 106 MMtCO_{2e}, of which 10 MMtCO_{2e} is associated with the energy sector (based on 2019 data). Given these values, Coral North is anticipated to contribute ~1% to the overall national emissions during standard operation or ~10% when compared solely to the energy sector emissions.

This impact Coral North FLNG to Mozambique's GHG emissions has been assessed as MEDIUM due to the relatively small annual contribution.

The latest GHG emission estimates from Coral South FLNG Project (Consultec, 2023) indicate average annual emissions over 25 years of 0.8 MMt CO_{2e}, which accounts for ~0.8% of the overall national emissions (based on 2019 data) or ~8% when compared solely to the energy sector emissions.

Together, the Coral FLNG projects can account up to ~2% of the overall national emissions and ~18% of the energy sector (based on 2019 data).

The EIA report for the proposed LNG project associated with the gas fields within Area 1 Offshore of the Rovuma Basin (Area 1) and Area 4 Offshore of the Rovuma Basin (Area 4) (ERM & Impacto, 2014), overall corresponding to the present Mozambique LNG project (operated by TotalEnergies), whose onshore LNG operations are based in the Afungi Peninsula in Pemba, estimates that the project could emit approximately 13 MMt of CO₂ per year during full operation of six LNG trains. This would increase national GHG emissions by 6.4% in 2027 (based on the national annual emissions projections made back in 2014, with 1994 baseline and using an 8% GDP growth, resulting in ~202 MMt CO₂).

Adding the Coral North and South FLNG Projects to the Mozambique LNG can result in a combined annual GHG emissions from their operation of ~15 MMt CO_{2e}, which, comparing to 2019 national emissions, would account for ~14% of the total emissions and 140% of the emissions associated with the energy sector.

Project emissions are expected to remain relatively steady throughout project life, after the initial start-up year. Given Mozambique's emissions are likely to continue to increase over time, the relative annual contribution from this project is anticipated to reduce year on year.

The cumulative impact is anticipated to be of MEDIUM significance due to the relatively moderate expected annual contribution in terms of the total national GHG emissions.

7.11.5.2 Biotic Environment

Chapter 7 of the EIS reports no residual biotic environment impacts with MEDIUM significance or higher. However, two LOW and VERY LOW residual significance impacts on this VEC were scoped into the CIA, namely:

- Impacts of underwater noise on marine fauna, particularly VHF cetacean functional hearing group which are more sensitive to noise to be generated by the Project;
- Effects of hydrocarbon spills resulting from unplanned events.

The northern coast of Mozambique is a biodiverse rich area with important charismatic species, in particular species dependent on inshore waters for feeding, reproduction and/or nursery. The most important areas for charismatic species along Cabo Delgado's coastline are illustrated in Figure 7.31, while Figure 7.32 below illustrate key marine mammal sightings in Area 4 from the ongoing biodiversity monitoring for Coral South.

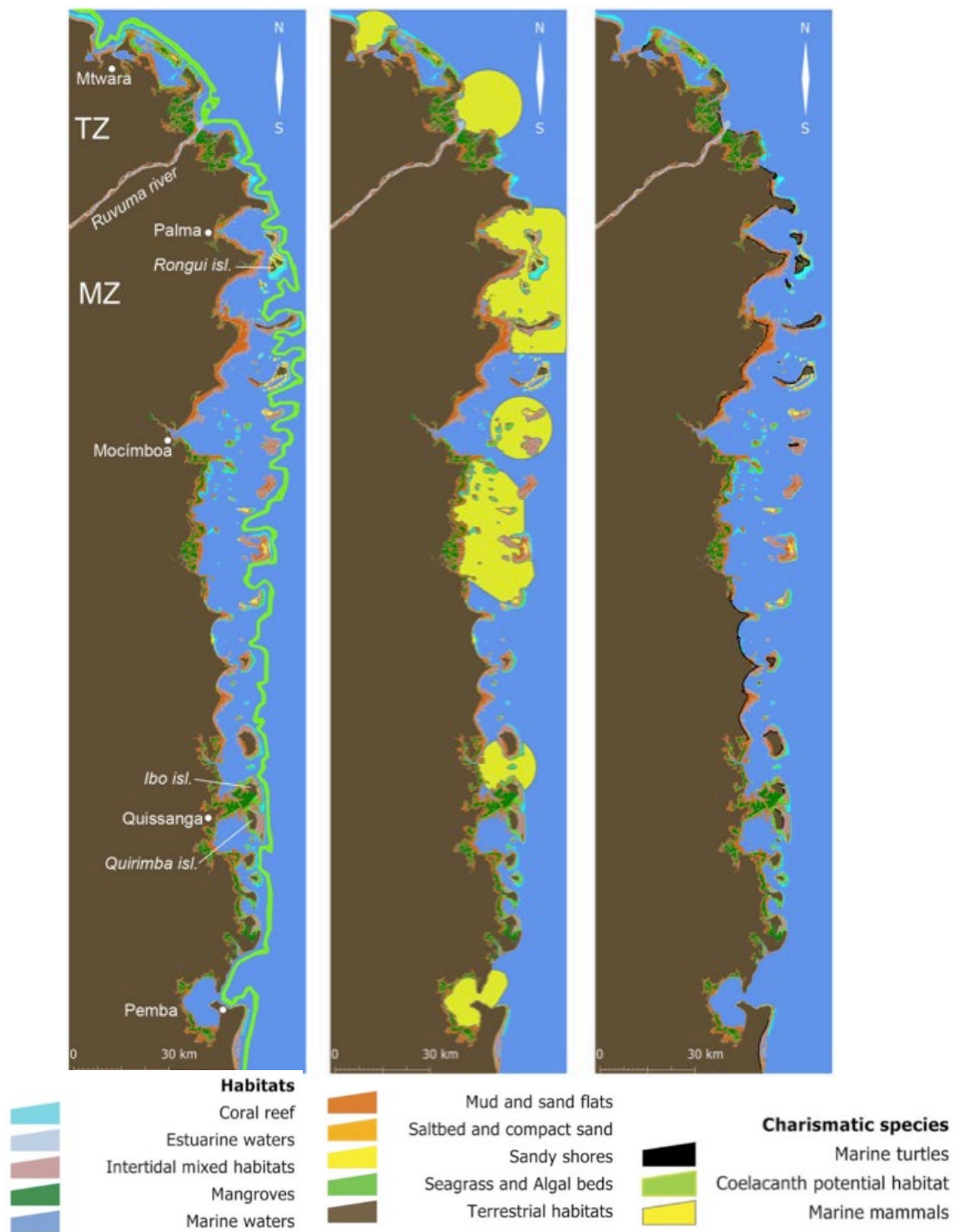
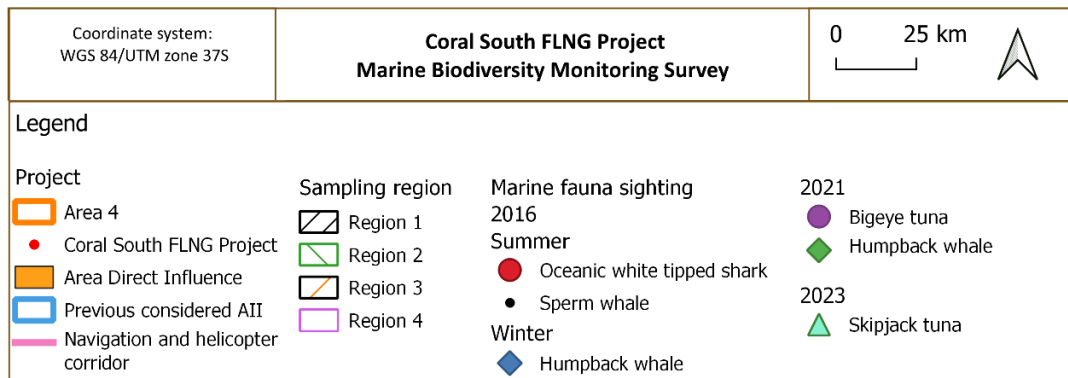
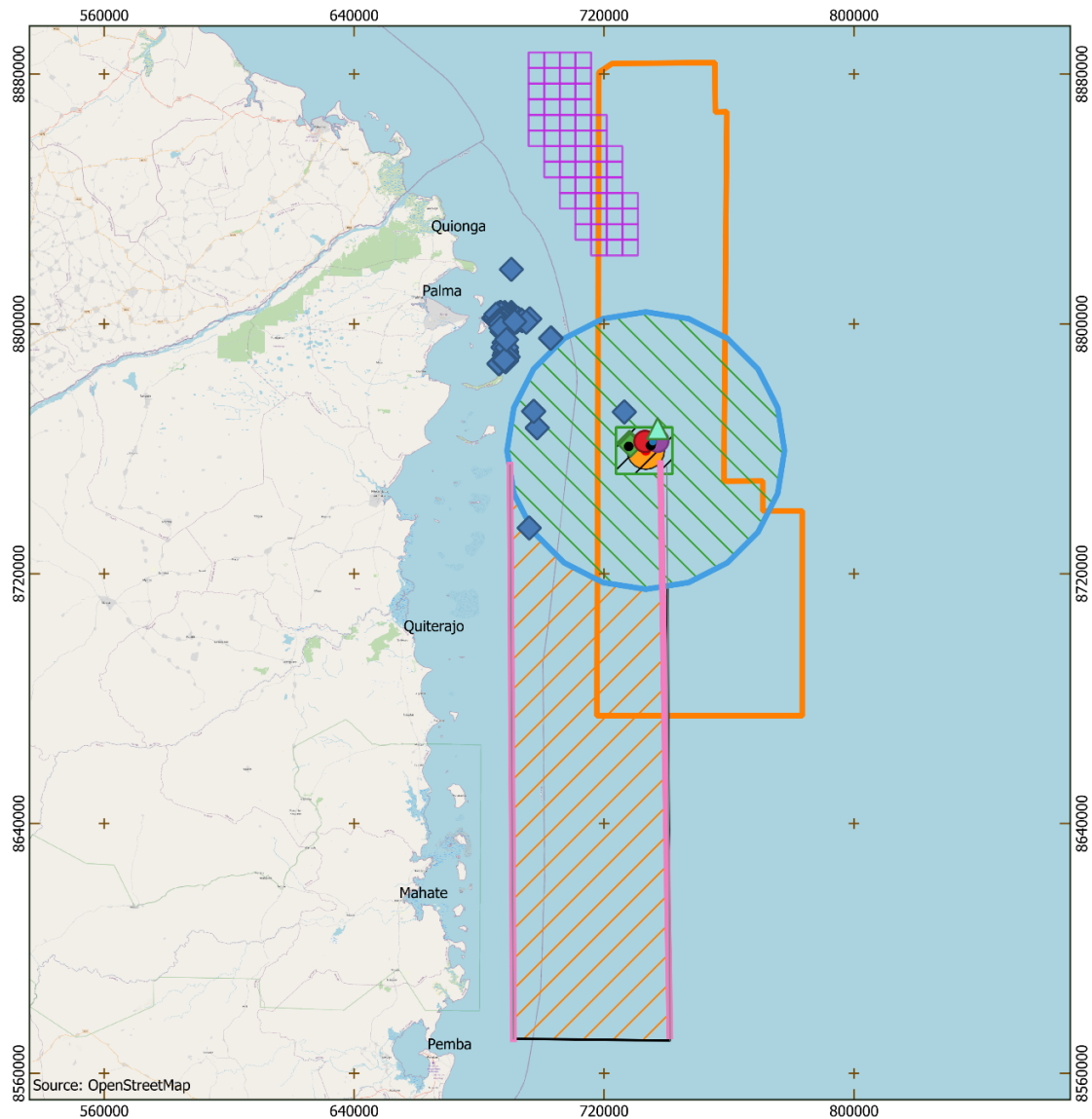


Figure 7.31: Distribution of charismatic species: potential habitat for marine mammals and turtles nesting areas



Source: Consultec & Biota (2023).

Figure 7.32: Sightings of priority marine fauna in the 2016 baseline study and in the 2021 and 2023 monitoring surveys in Area 4

Some of these marine mammals also occur in Pemba Bay, including two species of dolphins (humpback dolphin and bottlenose dolphin) and the humpback whale (this latter as a seasonal visitor during the humpback whale migration period between June and December).

The potential impacts from underwater noise of the Coral North FLNG will be more relevant during the operational phase. The noise from the FLNG thrusters is likely to give rise to the highest noise impacts. When exposed to FLNG operational noise, the most sensitive group is the VHF cetaceans. Over an operational period of 15 hours (representing the approximate maximum period of daily operations), the PTS impact criterion is met at a maximum distance of 258 m while the TTS impact criterion extends to 7.9 km. The Level B Behavioral response for all marine mammals is met over a distance out to 33 km.

Cumulative noise impacts can arise from the other developments currently in operation in Area 4, namely the Coral South FLNG. When a noise-generating activity takes place at a second site in relatively close proximity to the first, the individual acoustic footprint zones may overlap. Assuming that both FLNGs are offloading and/or carrying out helicopter operations at the same time, the noise generated by the thrusters at each facility has the potential to generate overlapping acoustic footprints thus giving rise to higher noise levels than if only thrusters at one FLNG was operational.

When LF cetaceans, HF cetaceans and SI sirenians are exposed to FLNG noise from both facilities for an exposure duration of 15-hours, the gap between the FLNGs through which the animals can pass where the results remain below the PTS and TTS thresholds, is no smaller in width than 12.4 km and 7.4 km respectively.

VHF cetaceans are much more sensitive to FLNG noise. For an exposure duration of 15 hours, the sub-PTS gap between the two FLNG facilities remains above 12.2 km. However, when noise levels are modelled using an August SSP, for exposure durations of 15 hours and above, the cumulative result in the gap region between the two facilities remains above the threshold for TTS.

This possible cumulative impact is considered to be of local extent although of medium intensity, resulting in a LOW significance.

Oil spill risks of the Coral North FLNG Project were assessed in the EIS through modelling of three worst-case unplanned events: large diesel spill resulting from vessel collision, release of gas condensate due to a blowout of the wellhead on the seabed during the drilling phase, and release of LTOBM due to an accidental disconnection of a riser during the drilling phase. In the non-mitigated scenario, the impacts of an accidental diesel, condensate or LTOBM spill were considered to be of high intensity, although low probability, resulting in a MEDIUM significance. Nevertheless, the residual significance of both was considered to be VERY LOW, as the implementation of a comprehensive Oil Spill Contingency Plan and personnel training would greatly minimize the extent of a potential spill.

When considering cumulative effects with the other developments considered in this CIA, the discussion should not focus on cumulative impacts; instead focus on the cumulative increase of spill risk. Unplanned events that may result in large oil spills are a very low frequency event in the oil and gas industry. The probability of two of these events occurring simultaneously among the considered

developments (and thus generating cumulative impacts) is so low that it can be considered to be negligible. As such, no cumulative impacts per se are identified, for oil spills.

However, the concurrent development of the activities of all considered developments will increase the risk of the occurrence of one unplanned event resulting in a large oil spill. Should a large oil spill occur, in the non-mitigated scenario, and as discussed in the EIS, the impacts on the biodiversity VEC would likely be of HIGH significance⁹, although this would heavily depend on the location and dimension of the oil spill. HIGH significance impacts would also be expected on socioeconomics (fisheries, tourism, etc.). The implementation of project-by-project best practices in terms of oil spill preventive procedures and response measures (such as the Oil Spill Response Plan proposed for the Coral North Project) would reduce the extent and severity of the impact to LOW¹⁰ residual significance. However, given the cumulative increase of oil spill risk, it is recommended that the operators of these developments coordinate with each other, and with the authorities, to promote synergies and linkages between their oil spill risk contingency and response plans, as discussed further down below in the mitigation section.

7.11.5.3 Socioeconomic Environment

Chapter 7 of the EIS (as summarized in Table 7.48) reports that residual impacts on socio-economic VECs are predicted to be LOW or lower significance, except the following positive ones:

- Job creation;
- Economic stimulation of local and regional economy;
- Transfer of technical and professional skills to national workers; and
- Increased revenue for provincial and central governments.

Residual impacts on socio-economic VECs with a HIGH and VERY HIGH significance indicate that the Project has the ability to exert a potentially very high cumulative impact when considering other developments. These VECs are highly valued by Mozambican society given:

- High unemployment rates at the national level in general and Cabo Delgado Province in particular and very low skilled workers;
- General lack of business opportunities, in particular in the northern region of the country;
- Generally low national and provincial state revenue.

Estimated job numbers for the different projects are provided in Table 7.52 below.

Table 7.52: Estimated employment numbers per project

Project	Initial Phase	Operational Phase	% Mozambican during operational phase
Coral North FLNG [#]	1 350	820	25-70
*Coral South FLNG	1 350	820	25-70
*Mozambique LNG	7 000 – 10 000	400 (onshore project)	20 (construction)

⁹ The impact is assessed in the EIS as medium significance, due to the low probability of occurrence. If a spill does take place (i.e., probability is now definite), the assessment criteria would result in a high significance.

¹⁰ The residual impact is assessed in the EIS as very low significance, due to the low probability of occurrence. If a spill does take place (i.e., probability is now definite), the assessment criteria would result in a low significance.

Project	Initial Phase	Operational Phase	% Mozambican during operational phase
Total	9 700 – 12 700	2 040	-

Note: # Includes jobs at Pemba onshore support base; * Consultec (2015); +ERM & IMPACTO (2014)

Given that these projects will be operational for a long period (at least 25 years for the Coral FLNGs) it is expected that national workers will be continuously trained to carry out the specialized activities, gradually reducing the need for expatriate workers and transferring the specialized knowledge and skills to the national workforce. This transfer of knowledge and skills to the national labor market will increase the nation's capacity to develop similar projects in the future. This is a HIGH significance cumulative impact.

In addition, all these projects will procure services, goods, and materials throughout the project's life cycle. While some of these are likely to be highly specialized and therefore sourced internationally, many goods and services will be procured locally and nationally. The increased number of the workforce in the region as well as increased income of hired workers is likely to bring increased levels of consumption.

The combined effect of these projects would be increased government revenues in the form of corporate income tax, royalties, export sales of gas, import duties, dividend withholding tax, among many others, although the actual contribution would be highly dependent on taxation arrangements and other agreements between the project proponents and the Government of Mozambique. The sale of exported gas will also make a significant contribution to national revenues, as the state will be a partner in the project throughout its operational phase.

This increased revenue will potentially result in a greater capacity of the provincial and national government to invest in the development of the provincial and national economies and social services, therefore indirectly benefiting the population.

The combined effect of these projects on employment and economic stimulation of regional and local services will have a wide extent, in the sense that it is likely to affect nation-wide service providers and people.

The resulting cumulative positive impact is thus considered of HIGH significance.

7.11.5.4 Summary

Table 7.53 below summarizes the CIA developed in the previous section, for ease of reference.

Table 7.53: Summary of the CIA

VEC	Cumulative Impact Source	Cumulative Impacts		Nature of impact
		Drilling, Installation and Commissioning Phase	Operational Phase	
GHG emissions and contribution to climate change	Emissions from fuel usage in the marine vessels and helicopters, GTG/GTC, thermal incinerator and flaring; fugitive emissions	-	MEDIUM	(-)
Marine biodiversity (high biodiversity)	Underwater noise, in particular the noise from thrusters	LOW	LOW	(-)

VEC	Cumulative Impact Source	Cumulative Impacts		Nature of impact
		Drilling, Installation and Commissioning Phase	Operational Phase	
value species and habitats)	Oil spill risk associated with accidental unplanned events, such as vessel collisions Release of gas condensate due to a blowout of the wellhead on the seabed Release of LTOBM due to an accidental disconnection of a riser	VERY LOW	VERY LOW	(-)
Employment, business opportunities	Hiring of workers, presence of foreign workers in Pemba and Palma, procurement of services, goods and materials, increased income / consumption levels	HIGH	HIGH	(+)
Skills transfer	Transfer of skills to Mozambican workforce	HIGH	HIGH	(+)
Revenue	Payment of taxes and other fees, sale of exported gas	VERY HIGH	VERY HIGH	(+)

7.11.6 Recommendations for Cumulative Impact Management

Given that the cumulative impacts identified in this report are the result of actions from multiple stakeholders, the responsibility for their management should be collective, although requiring individual actions to reduce or eliminate individual development's contributions, in a level commensurate with the level of contribution to the cumulative impact. At the same time, mitigation is likely to require cooperation from government.

Rather than providing specific mitigation measures for each of the contributors to the cumulative impacts on VECs, this section concentrates on highlighting general recommendations to manage cumulative impacts. There are two sets of recommendations, (i) general ones and (ii) specific ones pertaining to each of the impacts on VECs (please note that these may, at times, overlap).

7.11.6.1 General Recommendations

Strategic Regional Assessment

In general, a Strategic Regional Environmental and Social Impact Assessment is recommended to fully assess the potential impacts that may result from the oil and gas industry and associated developments in the Cabo Delgado region (onshore and offshore). This type of assessment would consider cumulative impacts associated with the implementation of several gas and oil related projects, preventing isolated and repetitive decision-making while ensuring ecosystem functions, services and social wellbeing is maintained or improved.

The assessment would require greater integration of planning by private developers and should be led by the Government of Mozambique (GoM). The results of this assessment should then feed into combined and specific mitigation and enhancement measures.

Shared Infrastructure

It is suggested that developers should share, as far as possible, onshore support hubs and transportation routes (navigation, helicopter, roads, etc.) to reduce the potential disturbance caused by using separate sites in close proximity to each other.

Oil spill prevention and response planning

Collaboration and liaison with the other oil and gas operators in Cabo Delgado, with port operators and with marine authorities is recommended, in order to establish linkages and synergies between each operator oil spill response plan, and to enable a coordinated response to larger spills, if required. Such coordination can, for example, include the establishment of communication channels between all relevant actors in the event of an oil spill, the shared provision and deployment of Tier 2 response resources and shared protocols to trigger the request, approval and mobilization of Tier 3 response resources (which will likely be sourced internationally, and as such rapid authorization from the competent authorities to allow their rapid movement across international borders will be crucial).

7.11.6.2 Marine Biodiversity

Gas and oil companies operating in the region should collaborate with one another and with the regional government (Province of Cabo Delgado) and other relevant authorities (e.g., Quirimbas National Park; WWF, etc.) to discuss solutions to adverse regional effects on marine fauna and biodiversity that may occur as a result of increased pressure on these VECs.

In addition, potential cumulative impacts on marine fauna and biodiversity should be monitored throughout the life-cycle of these projects. For example, a monitoring program of the effects of the cumulative underwater noise impacts on cetaceans, coordinated between all operators, would be recommended.

7.11.6.3 Employment, Business Opportunities, Skills and Revenue

In collaboration with other operators, communicate with the Confederation of Business Associations of Mozambique (CTA) and other such organizations and consult local development plans such as the Cabo Delgado Provincial Strategic Development Plan in order to identify which downstream activities can be supported by the industry.

Exchange ideas with other regional operators and government officials on how to contribute to employment generation locally and regionally and develop skills and training development programs for Mozambicans.

MRV, in collaboration with other regional operators, should maintain a close cooperation with the GoM and contribute to social development in the region or country, which would add to the operators' corporate social responsibility.

8 Public Participation Process

8.1 Introduction

Public participation is a key component of an EIA process. Its main objective is to engage Interested and Affected Parties (I&APs), in order that they may highlight the opportunities, risks, and issues that concern them. Public participation helps the EIA team and the Proponent to take relevant local conditions into account, avoiding adopting potentially inadequate project concepts, from a social and environmental perspective. Compliance with the basic requirement for public participation is a legal requirement and failure to perform this activity may cause significant risks to the Project's regulatory approval.

The Public Participation Process (PPP) for the Project's EIA Process was carried out in accordance with Mozambican legislation and with international best practices. The relevant documents that guided the PPP included the following:

- General Guidelines for Public Participation Process in the EIA process, Ministerial Diploma No. 130/2006: this diploma provides the guidelines to be followed in any PPP undertaken as part of an EIA process;
- Equator Principle (EP) 5 (Consultation and Disclosure), which states that public consultation with the project affected communities shall be well structured and undertaken in a culturally adequate manner;
- IFC Performance Standard 1 (Assessment and Management of Social and Environmental Risks and Impacts), which states that adequate engagement with affected communities, throughout the project cycle, on issues that could potentially affect them must be provided and that grievances from affected communities and external communications from other stakeholders must be responded to and managed appropriately.

In accordance with Ministerial Diploma No. 130/2006, the PPP for this EIA included consultation in two phases: early in the EIA process, during the scoping phase (EPDA) and again in the impact assessment phase (EIS). This is also in accordance with EP 5, which states that disclosure should occur early in the assessment process and on an ongoing basis.

The overall PPP strategy included the following:

- The disclosure and availability of EIA documentation for I&APs;
- Conducting consultation meetings, namely open public meetings in Maputo and Pemba cities, and engaging with stakeholders as needed; and
- Consideration and analysis of the questions and concerns raised in the referred meetings or in comments received subsequently, and inclusion in the EIA reports.

The EPDA phase PPP for the Coral North Development Project was undertaken in June and July 2023. The main activities of the EPDA phase PPP are described in section 8.3 below. The PPP for the EIS phase was undertaken in April and May 2024. Volume V of this EIS presents the PPP report, that describes and documents the PPP activities developed for the EIS. The approach and methodology for the EIS PPP is also summarized in section 8.4.

Section 8.5 presents the comment register table, which provides a summary of all the main comments and issues raised by I&APs during the EPDA and EIS PPP, and the way they were considered or addressed in the EIA process.

8.2 Objectives of the Public Participation Process

The main objective of the public participation process is to inform all I&APs about the proposed activities and their potential impacts, giving them an opportunity to present their opinions, concerns, and expectations regarding the project. Table 8.1 summarizes the aims and objectives of the PPP undertaken in this EIA process, in accordance with the guidelines referred to above.

Table 8.1: Summary of PPP objectives

Objective	Motivation
Identify the I&APs of the Project	Involving as many I&APs as possible can facilitate good communication and capture a wider range of issues and concerns. Interaction with stakeholders should aim to represent the perspectives of all stakeholders, including relevant civil society groups.
Disseminate accurate information about the project	Ensure that information is available to the I&APs, particularly those directly affected by the proposed project, to allow them to make informed comments and enable them to plan for their future, thereby reducing levels of uncertainty and anxiety. The information should allow parties to develop an understanding of the potential impacts, risks, and benefits of the Project.
Collect relevant information for technical and environmental studies	Identifying issues through people familiar with the local environment, and including them in the scope of the assessment, ensures experts focus on relevant issues. It is also important to ensure the best appropriate Project design and management.
Promotion of constructive interaction between all parties	Developing a relationship of trust between the developer and I&APs contributes to proactive interactions and avoids, where possible, unnecessary conflicts based on rumours and lack of information. Identifying structures and processes for resolving conflicts and complaints, rather than stonewalling disputes, can provide a better understanding of stakeholder concerns and expectations, thereby increasing the opportunities to enhance the benefit of the Project for them.
Record and respond to the public's concerns, questions, and suggestions	Documentation of I&AP issues allows for follow-up and justification of Project decisions and provides the opportunity for participants to track the inclusion of their input into the planning and design process. This documentation reduces the potential concern of I&APs that their consultation is merely a token gesture by developers to comply with legal requirements.
Manage I&APs expectations	Maintaining realistic expectations (e.g., about employment opportunities, provision of local infrastructure, social development, disruption to daily life), limits disillusionment and frustration of directly affected parties at later stages of Project implementation. Frustration and unrealized expectations are conflict instigating factors and require mitigation and management, which can be avoided through proper PPP.
Comply with national and international public consultation requirements	Ensuring compliance with regulatory standards can avoid potential project delays resulting from purely procedural issues.

8.3 Public Participation Process of the EPDA Phase

In accordance with the EIA regulations, a PPP was undertaken in the EPDA phase. Two public meetings were held for the EPDA PPP, as listed in Table 8.2.

Table 8.2: Public meetings held for the EPDA PPP

Location	Venue	Date	Number of participants
Maputo City	Radisson Hotel	30/06/2023	64
Pemba City	Avani Beach Hotel	04/07/2023	34

The results of the EPDA PPP were documented in the EPDA Report, which was submitted to the then Ministry of Land and Environment (MTA)¹¹ for approval. More details on the EPDA PPP activities are provided in Volume V of this EIS.

8.4 PPP in the EIS Phase

8.4.1 Identification of I&APs

The I&AP database compiled during the EPDA was updated for the EIS PPP, considering the results of the EPDA PPP.

8.4.2 Release of Draft EIS for Comment

A Draft EIS report, together with a Nontechnical Summary, was made available to I&APs to allow public analysis and comments. These documents were made available at the following venues:

- National Directorate of Environment (DINAB), in Maputo;
- Provincial Environmental Service (SPA) of Cabo Delgado;
- Consultec's office, in Maputo.

The EIS Draft Report was also made available on Consultec's website (www.consultec.co.mz) throughout the consultation period. The Draft EIS was made available to I&APs for comment 15 days prior to the public meetings (see Section 8.4.4), to allow enough time for I&APs to review the EIS and effectively participate in the public meetings.

8.4.3 Advertisement and Notifications

Concurrent with the disclosure of the Draft EIS, public advertisements were made using two methods: media and individual letters / faxes. Media advertisements included newspaper advertisements in Mozambique's main newspaper (*Jornal Notícias*), in the two weeks preceding the public meetings. Radio ads were also run in the *Radio Moçambique* Pemba station, on the week preceding the Pemba meeting. Individual invitation letters and faxes were sent to all I&APs on the stakeholder database. During the week prior to the consultation meetings, telephone calls were made as a follow up.

¹¹ The Ministry of Land and Environment (MTA) was the environmental authority at the time of the submission of the EPDA. MTA has been recently abolished by Presidential Decree No. 1/2025, and its responsibilities have been transferred to the recently created Ministry of Agriculture, Environment and Fisheries (MAAP). References to the abolished MTA are maintained in this report, when referring to past events.

8.4.4 Consultation Meetings

As in the EPDA phase, two public meetings were held as part of the EIS PPP: one in Maputo and another in Pemba City. Table 8.3 lists the location and dates of the public meetings, and the number of registered participants in each meeting.

Table 8.3: Consultation meetings held as part of the EIS PPP

Location	Venue	Date	Number of participants
Pemba City	Avani Beach Hotel	30/04/2024	59
Maputo City	Radisson Hotel	06/05/2024	62

The PPP report (see Volume V) provides additional information and documentation regarding these public meetings, including attendance registers, minutes and photographs. Following the public consultation meetings, a period of four weeks was given to I&APs to provide additional inputs for inclusion in the Final EIS Report.

8.4.5 Summary of PPP Activities

The PPP activities undertaken in the EIS phase are documented in the PPP Report, which is presented in Volume V of this EIS. Table 8.4 provides a summary of the EIS PPP activities.

Table 8.4: Summary of the PPP activities undertaken for the EIS

Activity	Objective	Date
Update of the I&APs database.	To identify the I&APs to be included in the consultation process.	13 to 26 March 2024
Disclosure of the EIS draft report for public consultation.	To allow the authorities and general public to comment on the Project and the EIS.	15 April to 20 May 2024
Advertisement for the public meetings in newspapers and radios.	To convoke the I&APs to participate in the public meetings.	15 to 29 April 2024
Delivery of invitations to the public meetings (letters and faxes)	To convoke the I&APs to participate in the public meetings.	19 to 26 April 2024
Public meetings	To present the EIA process and the Project to the public and collect comments from the public	30 April and 06 May 2024
Written comments reception period.	To receive written comments to the Project or EIS.	Up to 30 May 2024

8.5 Comments and Responses Register

Table 8.5 below presents a summary of the I&APs comments and issues raised during the EPDA and EIS PPP. The table also indicates the manner these issues were considered, or will be considered, either in the project design or in the EIA process, where applicable.

Table 8.5: Main comments received throughout the Public Participation Process (EPDA and EIS) for the Coral North Project

Issues / Comments		Date	Stakeholder	Answers / Comments
Project Design / Project Description				
1.	What are the synergies between the Coral South and Coral North projects?	30/06/2023	- Confederation of the Mozambican Economic Associations (CTA)	The Coral South and Coral North projects will have several synergies: the Coral North design will replicate the Coral South design, which will make the design process less costly and time-consuming. The project shall have synergies by using the same existing onshore infrastructure to support offshore operations during implementation and production operations phases, gaining logistics efficiencies. In addition, any lessons learned from the Coral South project will be applied to the Coral North Project.
2.	Who are the Project's shareholders?	30/06/2023	- Justiça Ambiental / Natural Justice	This information is provided in section 1.1 of the EIS report (Volume I). The Project shareholders are MRV (the concessionaire of Area 4, with 70% interest), ENH (10% interest), Galp Energia (10% interest), and Kogas (10% interest).
3.	How will boil-off gas (BOG) be managed in the plant and LNG carriers?	30/06/2023	- Eduardo Mondlane University (UEM)	BOG generated in the plant will be reused as fuel for various internal process. BOG management in the LNG carriers depends on the specific carrier procedures, but it is also typically reused as fuel.
4.	What happens after the 25 years of operations end?	04/07/2023	- Provincial Directorate of Transports and Communication (DPTC)	This information is provided in section 4.4.5 of the EIS report (Volume I). Decommissioning and abandonment will take place in line with the Exploration and Production Concession Contract.
5.	Are the Coral reservoirs connected to the reservoirs in Tanzania?	04/07/2023	- Provincial Service of Social Action (SPAS)	The Coral reservoir is fully contained within Area 4. It has no connection with other reservoirs, national or international.
6.	The EPDA states that the FLNG will be located 50 km from the coast, (approximately 28 nautical miles), but does not indicate the safety radius around the FLNG. This is an important information to assess the direct impacts on fisheries, taking into consideration the traditional areas of fishing activity.	13/07/2023	- National Institute for the Development of Fisheries and Aquaculture (IDEPA)	This information is provided in section 4.4.4.1 of the EIS report (Volume I). The safety zone will be 500 m around the subsea infrastructure. Vessel traffic and fishing will be restricted from this safety zone with concurrence of the coastal state authority. This safety zone does not interfere with the fishing grounds used by artisanal fisheries. The impact of the restriction to commercial fishing by this safety zone is assessed in Impact SE9 (see section 7.8.2).
7.	Disclosure of the project's investment value.	26/09/2023	- MTA	This information is provided in section 4.8 of the EIS report (Volume I). The Project's cost investment budget is currently estimated at ~7 billion USD.
8.	Detailed description of the treatment and management systems for effluent discharges, including phenol, nitrates, domestic wastewater, and brine resulting from seawater desalination on the FLNG.	26/09/2023	- MTA	Design information regarding the FLNG's liquid effluent treatment and management systems is provided in the Project description, namely in section 4.4.4.4 of Volume I.

Issues / Comments		Date	Stakeholder	Answers / Comments
9.	Provide a specific and detailed project timeline covering all phases to enhance proposed management measures.	26/09/2023	- MTA	The Project's schedule is provided in section 4.7 of the EIS report (Volume I).
10.	Presentation of a process flowchart outlining the production process, allowing for the correlation of each waste stream to its generation process.	26/09/2023	- MTA	A flowchart for the LNG production process is provided in Figure 4.15, section 4.4.4.2 of the EIS report (Volume I).
11.	Presentation of a detailed plant layout, indicating the locations of waste-generating sources and the types of waste generated at each source.	26/09/2023	- MTA	A layout of the FLNG is provided in Figure 4.5, section 4.3.1.3 of the EIS report (Volume I).
12.	Provision of geographic coordinates for drilling areas, equipment characteristics, and the type of signalling used.	26/09/2023	- MTA	The geographic coordinates of the drilling wells are provided in Table 4.1, section 4.2.3 of the EIS report (Volume I). Drilling activities are described in section 4.4.1 of the EIS report (Volume I).
13.	Identification of the country where the FLNG vessel will be constructed.	26/09/2023 05/06/2024	- MTA - Technical University of Mozambique (UDM)	The FLNG infrastructure will be assembled in South Korea, as no national shipyard has the capability to carry out this work. This information is included in section 4.2.4 of the EIS report (Volume I).
14.	Indication of the quantity of labour, highlighting the number of women and men to be employed by the project, their origin, mobilization start date, and training requirements.	26/09/2023 05/06/2024	- MTA - National Migration Service (SENAMI) - Ministry of Transports and Communication (MTC)	Information regarding the number and type of jobs that are estimated to be created by the Coral North Project is provided in section 4.5 of the EIS report (Volume I). The Coral North project will directly employ about 350 people. With the contractors and subcontractors the project may cumulatively indirectly employ more than 1,000 people.
15.	The presentation of proposals for measures that can reduce the risks associated with extreme events that may impact project infrastructure and result in damage to infrastructure or human lives.	26/09/2023	- MTA	The FLNG has been designed for a 10,000-year return period survival event including full personnel onboard remaining within the main temporary refuge during and after the event. Information regarding the design options adopted to reduce the risks from extreme events has been included in the project description – see section 4.3.1.3 of the EIS report (Volume I).
16.	What are the criteria for hiring of companies? Are the tenders international only, or are national companies hired?	30/04/2024	- Provincial Service of Economics and Finance (SPEF)	Company procurement processes are regulated by internal procedures and are in full alignment with the applicable local legislation. The procurement function maximizes competition between vendors, in accordance with applicable legislation and operational requirements. Company tendering opportunities above a certain threshold (currently US\$ 1M), are published in the national newspapers and also in Company's portal. Participation to Company's tenders is open to all suppliers capable of providing the goods or services, and only subject to the vendor qualification and award criteria.

Issues / Comments		Date	Stakeholder	Answers / Comments
17.	Does the project include a domestic gas component and/or strategy?	06/05/2024	- Mozambique Investment and Export Promotion Agency (APIEX) - CTA	The Project will produce LNG, which will be sold in the international market to prospective buyers. While the Project does not specifically include a domestic gas component through the installation of a pipeline, some LNG volume generated by the project will be made available for the domestic market. The use of this gas will be decided by the Mozambique government.
18.	What is the project justification, considering Mozambique's economic context?	06/05/2024	- Natural Justice	The Project's desirability and justification is discussed in Section 4.2.1 of the EIS Report (Volume I). The Government of Mozambique, recognizing the strategic need to develop its natural resources issued a number of bids to identify companies who were willing to invest in the development of these resources. MRV is the company that was awarded Area 4 and subsequently signed an EPCC contract with the GoM. Without these projects and the revenue generated, the country of Mozambique would be in a more difficult and challenging position to alleviate poverty, estimated at 73.4 percent in 2023 (World Bank).
19.	The EIS does not specify what is the destination of the exported LNG. Without knowing the buyers it is not possible to assess if the project is economically feasible. The EIS socioeconomic does not consider the risk of Coral North becoming an unrecoverable asset, due to a potential decrease in global demand for gas.	30/05/2024	- Justiça Ambiental / Natural Justice	The assessment of the prospective buyers and associated economic feasibility, fiscal conditions, expenditures and public revenues is outside of the scope of the EIA and falls under the scope of other project documentation, such as the Plan of Development, which is submitted for the approval of the Government of Mozambique. The LNG will be sold in the international open market. Globally, the demand for LNG is projected to increase by more than 50% by 2040, fuelled by the industrial coal-to-gas switching in China, as well as economic development in South Asia and Southeast Asia (Shell, 2024 ¹²).
20.	Dismantling offshore installations is notoriously expensive and can cost hundreds of millions of dollars for deepwater projects. For offshore gas projects like Coral Norte, the risk of decommissioning failure can increase if wells underperform, if LNG demand declines or mandatory climate actions accelerate, leading to earlier-than-expected production shutdowns and abandoned wells. If companies are not prepared to cover the costs of early decommissioning, there is a strong likelihood that they will abandon projects without adequate closure - risking well leaks and other environmental damage - or leave governments and taxpayers in resource-poor countries to assume the costs.	30/05/2024	- Justiça Ambiental / Natural Justice	Decommissioning and abandonment are described in Section 4.4.5, Volume I and will be carried out through a Decommissioning Plan developed in accordance with Petroleum Operations Regulation Decree 34/2015 Article 15 of the Area 4 EPCC, Eni internal standards, and International Codes and Standards relevant to offshore petroleum activities. In compliance with Articles 4, 15, 26, etc, decommissioning of the assets are part of the Plan of Development that is submitted and approved by Government of Mozambique. Furthermore, Article 41 establishes clear and specific mechanisms to be followed with respect to the decommissioning.

¹² Shell (2024). Shell LNG Outlook 2024.

Issues / Comments		Date	Stakeholder	Answers / Comments
Assessment of alternatives				
21.	If the EIS had correctly assessed the Project's impacts, it would be clear that the "no go" alternative would be the preferred alternative.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIA has assessed the Project's impacts pursuant to applicable national legislation and in accordance with the current scientific knowledge. As with any other project, the Coral North Project has both negative and positive impacts, as discussed in Chapter 7 of Volume II: negative impacts have been addressed through mitigation measures, while positive impacts were maximized as possible, through enhancement measures.
EIA Process				
22.	The information provided in the EPDA report is preliminary. More detailed information would be desirable.	30/06/2023	- State Secretariat for Youth and Enterprise (SEJE)	The EPDA phase is a preliminary stage of development of the environmental and engineering studies. The main goals of the EPDA are to screen for fatal flaws and compile the terms of reference for the more detailed studies to be developed in the EIS phase. The EPDA report provided an adequate detail of information to achieve these goals. More detailed information on the Project and its potential environmental and social impacts is now provided in this EIS report.
23.	Why was the Project categorized under Decree 56/2010 (Environmental Regulation for Petroleum Operations), instead of Decree 54/2015 (EIA Regulation), which establishes a stricter regime?	30/06/2023 14/07/2023	- Justiça Ambiental / Natural Justice	As stated in section 3.2 of the EIS report (Volume I), the categorization process was undertaken by SPA-CD, in compliance with number 2, article 7 of Decree 54/2015. SPA-CD categorized the Project as Category A, as per the dispositions of Decree No. 56/2010, and in compliance with number 2 or article of Decree 54/2015, which states that the EIA for oil and gas operations is ruled by specific sector regulation.
24.	The consultant and the proponent failed to comply with some of the requirements of Article 11 of Decree No. 56/2010 of 22 November by failing to provide [in the EPDA] information on the assessment of the importance of the project's impacts, insufficient factual and legal justifications, an exhaustive description of the biophysical environment and the area of direct and indirect influence.	14/07/2023	- Justiça Ambiental / Natural Justice	The main goals of the EPDA report, as per number 1 of article 10 of Decree 54/2015 are to screen for potential fatal flaws and in their absence to determine the terms of reference for the EIS, including for the specialist studies to develop in the EIS phase to investigate impact significance. The EPDA report provided information on the Project's legal and regulatory framework, desirability, areas of influence, and baseline assessment at an appropriate level of detail to support the above-referenced goals. Regarding impacts, the EPDA report provided the identification of the Project's potential impacts, which supported the determination of the terms of reference of the detailed specialist studies that were then developed in the EIS phase, to investigate the significance of those impacts. This approach is fully in line with national and international EIA regulations, guidelines, and praxis (see and contrast, for example, letter g, number 2, article 10, and letter l, number 2, article 11 of Decree 54/2015). This EIS report builds on the information provided in the EPDA, and provides more detailed information regarding the Project, areas of influence, baseline, and impact assessment, based on the specialist studies developed for this EIS, as approved in the EPDA Terms of Reference.

Issues / Comments		Date	Stakeholder	Answers / Comments
25.	MRV should submit the EIS to an independent peer review process.	30/06/2023 14/07/2023	- Justiça Ambiental / Natural Justice	According to Decree No. 56/2010, independent peer review is not required for Category A EIA processes.
26.	The Coral North EIA should be informed by the lessons learned from the Coral South EIA and implementation processes.	30/06/2023	- UEM - IZI Consulting	The Coral North EIA process has been informed by all the experience, data, and lessons learned resulting from the Coral South EIA and from the Coral South EMP implementation, and continuous improvement process.
27.	How is the significance of an impact determined?	30/06/2023 04/07/2023	- Gabriel Manguela - Lúrio University (UniLúrio)	The determination of an impact's significance was done by applying a standardized impact assessment methodology, that considers multiple impact descriptors, including the impact extent, intensity, and duration. The impact assessment methodology is provided in section 7.1.2 of the EIS report (Volume II).
28.	The consultation process should include public meetings in Palma District.	04/07/2023 30/04/2024 06/05/2024 30/05/2024	- Provincial Directorate of Land and Environment (DPDTA) - Provincial Farmers Union (UPC) - Agency for the Integrated Development of Northern Mozambique (ADIN) - Associação Kuendeleya - Natural Justice	No impacts from the Project normal operations were identified for the Palma District, and as such consultation in Palma District is not warranted.
29.	The local communities of Pemba should be engaged in the consultation process.	30/04/2024	- UPC	Representatives of the Pemba neighbourhoods potentially affected by Project activities in Pemba were engaged with and invited to the public meetings.
30.	Given the likely concerns around the costs and benefits with regard to the viability of the project in light of the threat of climate change, it is imperative that the socio-economic study includes an assessment of the efficiency, equity and sustainability of the project. This should be included in the existing scope of the specialized socio-economic study, with an economic expert carrying out the above-mentioned assessment. An expert in economics must therefore provide an assessment of what the opportunity costs will be – that is, the net benefit that would have been generated by the next best alternative.	14/07/2023	- Justiça Ambiental / Natural Justice	The EIA process, as defined in the Environmental Law (see number 5, article 1 of Law 20/97), is a preventive environmental management tool that aims to identify and assess, both quantitatively and qualitatively, positive and negative environmental effects of a proposed project. A socioeconomic specialist study was developed for the EIS, which investigated the Project's potential socioeconomic impacts, and defined adequate mitigation and/or enhancement measures, as required. The findings of that study are provided in this EIS report. The development of economic feasibility studies, cost-benefit analysis, or opportunity cost assessments, while relevant for project development, fall outside of the scope of the EIA process and are dealt elsewhere, such as in the Project's Plan of Development.

Issues / Comments		Date	Stakeholder	Answers / Comments
31.	The Project proponent did not make information about the public hearing and the project available to all I&APs in the District of Palma, and also provided extremely technical information and without technical support required by the principle of availability and accessibility of information proper.	30/05/2024	- Justiça Ambiental / Natural Justice	As described in the PPP report (Volume V), the public hearings were advertised in the most widely distributed information media in Cabo Delgado Province, namely <i>Jornal Notícias</i> and Radio Mozambique, which cover the Palma District. The EIA report was made available in SPA Cabo Delgado, and on Consultec's website, throughout the consultation period and as such available to everyone. The EIA is a technical document, which is why a Non-Technical Summary was also disclosed and made available together with the main report. Consultec was available to provide technical support as required by the PI&As throughout the consultation period, and this was communicated to PI&As in all consultation activities.
32.	The Proponent did not make available the specialist studies that were developed for the Coral North Project EIA.	30/05/2024	- Justiça Ambiental / Natural Justice	All the information in the specialist studies developed for the Coral North EIA is fully reported in Volume I (baseline), Volume II (impact assessment and mitigation measures) and Volume IV (annexes) of the EIS report.
33.	The Proponent did not make available the Coral South impact assessment and monitoring reports that are referenced in the EIS report.	30/05/2024	- Justiça Ambiental / Natural Justice	This is not a requirement of the Coral North EIA process. The assessments and evaluations provided in the EIS report take into consideration all relevant information sources for the project area, including scientific papers and reports, government reports and information, and information generated under the scope of other development projects in the region, including the Coral South Project.
34.	Even with the numerous flaws and gaps in the EIA that make it inadequate, the EIA's conclusions show that the Project should not be authorized due to the high risks of significant damage that would result. These damages would be greater than any alleged benefits arising from the Project. Based on the above, the environmental authorization must be refused.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIA has assessed the Project's impacts pursuant to applicable national legislation and in accordance with the current scientific knowledge. As with any other project, the Coral North Project has both negative and positive impacts, as discussed in Chapter 7 of Volume II: negative impacts have been addressed through mitigation measures, while positive impacts were maximized as possible, through enhancement measures.
Legal and administrative framework				
35.	The National Development Strategy is currently being revised; this should be mentioned in the EPDA report. The report should also make mention of the Mozambique Gas Masterplan.	30/06/2023	- Gabriel Manguale	Information regarding these instruments have been included in the EIS report, in sections 2.2.1 and 2.2.4 (Volume I), respectively.
36.	Submission of the Private Use Title of the Sea in accordance with Decree No. 21/2017, dated May 24 th , which establishes the Legal Regime for the Use of Maritime Space (RJUEM), in conjunction with Ministerial Decree No. 99/2023, dated July 24 th , for	26/09/2023	- MTA	This requirement is not applicable to the Coral North Project, as per INAMAR's letter to MRV (letter no. 240/175/INAMAR, IP/CA, dated 05/06/2023), which confirms the non-applicability of the Regulation that Establishes the Legal Regime for the Use of the National Maritime Space approved by Decree 21/2017, of 24 May ("RJUEM") and the Joint Ministerial Order of the Ministers of the Sea, Fisheries and Inland Waters and of Economy and Finance, dated 24 August 2021 regarding the payment of Fees for the Use of the National Maritime Space

Issues / Comments		Date	Stakeholder	Answers / Comments
	the acquisition of the Maritime and Coastal Space Use Title.			("TUPRI"), on the Areas covered by Decree-Law no. 2/2024 of December 2, establishes the Special Contractual Legal Regime Applicable to the Liquefied Natural Gas Project in Areas 1 and 4 of the Rovuma Basin, in order to ensure the financial stability of the proponent and not make the course of petroleum operations unfeasible. With confirmation of understanding from MRV sent to INAMAR on 23/06/2023 (Ref. No 211/MRV/LEG/2023).
37.	The licensing of the platform and all maritime equipment and materials, as required by Article 6, Section 2, Subsection viii) of Decree No. 87/2021, dated October 28 th , which establishes the National Maritime Institute as a public institution.	26/09/2023	- MTA	All applicable permits will be acquired by the Proponent prior to the respective activity taking place, in compliance with applicable regulations.
38.	Inclusion in the legal framework of the following legal instruments: - Law No. 3/2022, dated February 10th, law that establishes mechanisms for the protection and promotion of health, prevention, and control of diseases, as well as threats and risks to public health; - Law No. 10/2020, dated August 24th, which approves the Legal Regime for the Management and Reduction of Disaster Risk; - Law No. 24/2009, dated September 28th, which approves the Private Medical Practice Act; - Decree No. 53/2008, dated December 30th, which approves the Regulation for the Construction and Maintenance of Technical Accessibility, Circulation, and Use of Public Service Systems for Persons with Disabilities or Reduced Mobility.	26/09/2023	- MTA	The referenced legal instruments have been added to section 2.4 of the EIS report (Volume I), which provides the Project's legal framework analysis.
Socioeconomic baseline				
39.	The EPDA states that there is no deep-sea fishing in the district. In the deep waters of the district in question there are resources that currently fishermen use deep gear for their extraction.	13/07/2023	- IDEPA	Baseline information on fisheries is provided in section 6.10.12 of the EIS report (Volume I), including information on deep-sea commercial and industrial fisheries, based on the socioeconomic specialist study.

Issues / Comments		Date	Stakeholder	Answers / Comments
GHG emissions				
40.	The EIS underestimates the Project's scope 1 GHG emissions by using the incorrect emission factors for methane and nitrous oxides emitted by gas turbines and compressors.	30/05/2024	- Justiça Ambiental / Natural Justice	Review of the report indicates the table containing the emission factors referred to by the stakeholder is in error (Table AIII.1.5 of Annex III; Volume IV). The turbine and compressor emission factors for methane (CH ₄) and nitrous oxide (N ₂ O) are mistakenly quoted in the units of lb/mmBTU as from source guidance. The calculation has used the correct factors (converted to kg/TJ) and only the report table contains the incorrect units. Therefore, the emission estimation has not underestimated CH ₄ /N ₂ O emissions.
41.	The EIS underestimates the Project's scope 1 GHG emissions because the assumed fugitive emissions values are much lower than the estimates from the literature and other oil and gas platforms.	30/05/2024	- Justiça Ambiental / Natural Justice	The Coral North FLNG is a replicate of the Coral South FLNG. The fugitive emissions estimates adopted for Coral North are taken from data for the Coral South FLNG, a currently operational facility. These FLNGs are brand new, state of the art, custom built facilities, and their fugitive emissions are not comparable to older oil and gas platforms. Additionally, the IPPC factors referenced by the stakeholder include both leaks and venting activities; the latter is not captured under the fugitive assessment which is focused on diffuse emissions from various components on the facility (i.e., pump seals, valves, flanges etc). As such, the two sets of estimates are not directly comparable.
42.	The EIS does not take into account methane emissions from wells after their decommissioning.	30/05/2024	- Justiça Ambiental / Natural Justice	Decommissioned wells will be sealed prior to abandonment. No GHG emissions are expected from the sealed wells.
43.	The EIS does not take into account the downstream scope 3 GHG emissions.	30/05/2024	- Justiça Ambiental / Natural Justice	The GHG assessment provided in the EIS is aligned with the GHG Protocol corporate standard which considers Scope 3 emissions as an optional reporting category. There is increasing attention to quantify and disclose scope 3 emissions. However, the EIA is a licensing process which aims to assess the impacts of the project's activities and define mitigation measures applicable to those activities. As such, the scope of the assessment only includes emission where the project has the remit to implement emission controls/mitigations. Although the project may influence positive emission reduction behaviour in its down-stream supply chain, implementation responsibility will lie with the consumers. The consumer's operation (and implemented emission reduction technology) will dictate the quantity of emissions from the product use.
44.	The application of the impact assessment methodology to the project GHG emissions impact [Impact GHG1] is incorrect. The project emissions should not be compared against national emissions. Instead, because the climate changes impacts are global, the extension of the project's emissions should be considered international, not regional. Similarly, because GHG emissions are globally	30/05/2024	- Justiça Ambiental / Natural Justice	The comparison of a project's GHG emissions against national emissions to evaluate their significance is a standard procedure in EIA practice. This is precisely because of the global and cumulative nature of climate change, that makes it impossible to establish a linear relationship between a project's emissions and their contribution to global effects. For example, all activities including minor activities such as driving a car or continuously running a small homestead generator would then be assessed of international extent and high intensity, which is not realistic.

Issues / Comments		Date	Stakeholder	Answers / Comments
	cumulative, the intensity should be assessed as high, not low.			
45.	The EIS does not contextualize the project within the framework of the 1.5°C global trajectory. Based on an analysis of climate and energy scenarios selected by intergovernmental organizations, the International Institute for Sustainable Development reached a consensus that no new oil and gas fields should be developed if the world is to achieve the 1.5°C target.	30/05/2024	- Justiça Ambiental / Natural Justice	Achieving any global climate change target is dependent on global GHG emissions levels. Mozambique's total national emissions represent 0.15% of global emissions (Jones <i>et al.</i> , 2024 ¹³). The Coral North Project represents roughly 1% of national emissions, or 0.0015% of global emissions, which is not measurable for the evaluation for the achievement of any global target. Nevertheless, this amount was taken into consideration as well as the benefits to Mozambique derived from developing its hydrocarbon reserves.
Climate change				
46.	Eni has a global commitment for reduction of GHG emissions and a net zero strategy. How is this compatible with the Coral North Project?	30/06/2023 06/05/2024 30/05/2024	- Justiça Ambiental / Natural Justice	Eni has the commitment to reach net carbon zero by the year 2050. In this transitional period, gas is considered a viable energy source in reducing total emissions (as natural gas has lower emissions than comparable energy sources, such as coal or oil) while meeting global energy demands.
47.	The proponent ignored the Constitution of the Republic of Mozambique which establishes the right to a balanced environment (Article 90) and guarantees the safeguarding of renewal capacity, ecological stability and the right of future generations (Article 117/2(d)). In the context of climate change, whose effects on the environment and people may be irreversible, these rights cannot be ignored in the decision-making process of projects responsible for greenhouse gas emissions and climate change.	14/07/2023	- Justiça Ambiental / Natural Justice	The Constitution of Mozambique, including its articles 90 and 117, were considered in the legal framework of the Project (see section 2.4 of the EIS report – Volume I). Climate change related issues were taken into consideration in the development of this EIS. Both a GHG assessment and a climate change risk assessment were prepared, based on the terms of reference approved in the EPDA. The findings of those assessments are provided in this EIS report, for due consideration in the decision-making process of the competent authorities.
48.	The scoping report does not sufficiently address climate change.	14/07/2023	- Justiça Ambiental / Natural Justice	Climate change issues were addressed as part of the specialist studies developed for this EIS. The findings of those studies are reported in this EIS report, including a GHG Assessment and a Climate Change Risk Assessment.
49.	The environmental impact assessment carried out in the EPDA report does not correctly identify or assess the cumulative impacts of the project, in conjunction	14/07/2023	- Justiça Ambiental / Natural Justice	The Project's cumulative contribution to GHG emissions and associated climate change effects are addressed in the GHG impact assessment section of the EIS report (see section 7.3; Volume II). A more wide ranging cumulative impact assessment for the Project is also provided in section 7.11 (Volume II).

¹³ Jones, Matthew W., Glen P. Peters, Thomas Gasser, Robbie M. Andrew, Clemens Schwingshackl, Johannes Gütschow, Richard A. Houghton, Pierre Friedlingstein, Julia Pongratz, and Corinne Le Quéré. "National Contributions to Climate Change Due to Historical Emissions of Carbon Dioxide, Methane and Nitrous Oxide". Scientific Data. Zenodo, March 19, 2024. <https://doi.org/10.5281/zenodo.10839859>.

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	with the current and projected impacts of climate change.			
50.	The identification of the vulnerability of the project area to the effects of climate change.	26/09/2023	- MTA	A Climate Change Risk Assessment is provided in section 7.3.2 of the impact assessment chapter of the EIS (Volume II).
51.	The EIS does not include an assessment of the environmental and human rights impacts to Mozambique resulting from climate change.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIA includes an evaluation of the GHG emissions impact in compliance with the local legal framework and consistently with the currently available scientific knowledge and techniques (please refer to Section 7.3; Volume II). As of today, there are no globally recognized technical means to measure how GHG emissions produced locally may directly impact climate change locally, for climate change has multiple causes and is a global phenomenon.
52.	The EIS does not adequately assess the Project's vulnerability to climate impacts.	30/05/2024	- Justiça Ambiental / Natural Justice	Section 7.3.2 of Volume II of the EIS report provides a full Climate Change Risk Assessment (CCRA), produced to understand the potential climate change threats to the Coral North FLNG Project. The CCRA was developed taking into consideration the more up-to-date range of future emission scenarios, as per the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) (IPCC, 2023). The CCRA also takes into consideration the location of the Project, in deep offshore waters, which will minimize some of the temperature-related increases projected for the coastal and inland areas.
53.	The EIS does not include measures to safeguard the Pemba port facilities against sea level rises and coastal erosion.	30/05/2024	- Justiça Ambiental / Natural Justice	The port facilities to be used by the Coral North Project are owned and managed by third parties, not the Proponent. Any management or mitigation measures aimed at safeguarding those infra-structures against climate change effects are under the jurisdiction of the infra-structure owner and manager, and outside of the scope of the Coral North EIA.
54.	The EIS does not include measures to safeguard the onshore logistic base against sea level rises and coastal erosion.	30/05/2024	- Justiça Ambiental / Natural Justice	The onshore logistics base location is located 2 km from the coast at an altitude of ~100 m; therefore, any predicted sea level rise or coastal erosion will not pose a risk to the base requiring safeguard measures.
FLNG liquid effluents				
55.	A desalination plant will be used to generate drinkable water for the FLNG. How will the desalination effluent be treated prior to discharge?	30/06/2023	- UEM	The brines from the freshwater generation package are initially sent to an electro chlorination package which are then used in various process components such as seawater intake pumps. Very rarely, any excess brine is discharged; however, other than the concentrated salinity, the discharged brine is only expected to carry residual trace amounts of potential constituents (such as leached metals or residual chlorine) at negligible concentrations unlikely to cause relevant impacts to the well-mixed oceanic deepwater receiving environment.

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56.	A detailed characterization of effluents, including phenol and nitrate levels, to assess the risks of water pollution in receiving waters and to enable the scaling of effluent treatment facilities to comply with emission standards established by national and international legislation.	26/09/2023	- MTA	A detailed characterization of expected pollutant concentrations in the Project effluents is provided in Impacts WQ3 and WQ4 (see section 7.5.3; Volume II), which also assess the risk of contamination of the receiving marine waters due to the discharge of the FLNG's effluents.
57.	The assessment of cooling water impacts, taking into account temperature, depth, discharged volume, and velocity, on the marine ecosystem.	26/09/2023	- MTA	The potential impacts of the FLNG's cooling water discharge were evaluated based on hydrodynamic modelling (see Annex VIII, Volume IV) and are assessed in Impact WQ2 (section 7.5.3; Volume II), in what concerns impacts on water quality, and Impact BIO16 (see section 7.7.3; Volume II), in what concerns impacts on biodiversity.
58.	The characteristics of the gas feed will change as the reservoir ages, and that may cause the produced water effluent to have greater concentration of pollutants with time. Has this been considered by the Project?	06/05/2024	- TotalEnergies	A long-term monitoring program is proposed for both the FLNG effluents and the receiving marine waters. This will allow the identification of any potential changes in the effluent pollutant concentrations, with the reassessment of project impacts and development and implementation of modified and/or additional mitigation measures, as appropriate, if any significant change is detected.
Waste management				
59.	Provision of information regarding the treatment and final disposal location of sludge and cuttings that will be generated and transferred to land. The presentation of actions to be implemented to ensure that drilling waste (LTOBM) meets risk reduction criteria in terms of its hazardous nature at different stages of treatment.	04/07/2023 26/09/2023	- SPAS - MTA	This information is provided in section 4.4.1.2 of the EIS report (Volume I). The treatment and disposal location will be in Pemba. It is envisioned that the drill cuttings will be treated through a thermal desorption unit; however, the detailed treatment process and final disposal location will be provided in the Waste Management Plan (WMP) that will be submitted to the environmental regulator prior to the drilling operations.
Physical impacts				
60.	Presentation of the underwater noise intensity within a 10-kilometer radius during the operational phase of the FLNG facility. Development of a comprehensive study on the impact of noise on marine species during different project phases, along with the provision of a sound dispersion / reduction table.	26/09/2023	- MTA	The underwater noise impacts of the Project have been investigated through a dedicated underwater noise propagation modelling study. Detailed information on modelling approach and results is provided in Annex VI (Volume IV), and the potential impacts on biodiversity are discussed in Impacts BIO5 and BIO 11 (see section 7.7; Volume II), including the presentation of noise levels expected at a range of distances from the FLNG.
61.	How will the proponent manage impacts from the activities of its suppliers and contractors?	30/04/2024	- National Petroleum Institute (INP)	The Proponent has very strict environmental, safety and social requirements for its contractors and suppliers, which are communicated during the tender processes, specified in the contractors and subcontractors, contract documents, and verified periodically through

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			- Associação Kuendeleya	audits, inspections and regular reporting. In addition, as per national regulation, all companies with activities that may generate environmental or social impacts are required to develop their own EIA processes and implement a specific EMP to manage those impacts.
62.	After decommissioning, are there restoration activities planned for the project's impacts?	30/04/2024	- UPC	As discussed in section 4.4.5 of the EIS report (Volume I), a Decommissioning Plan will be prepared prior to decommissioning, the final goal of which is to ensure the restoration of the environment to a reasonable condition. If there is the need for any type of restoration activities, these will be identified and defined in the Decommissioning Plan.
Biodiversity baseline				
63.	The biodiversity baseline provided in the EIA does not provide lists of the species potentially affected, does not indicate their conservation status, and may not reflect all species that are present or potentially present in the region, due to lack of scientific knowledge of the regional biodiversity.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIS report lists all species that are confirmed or likely to be present in the study area in Volume I (section 6.9) and Volume IV (Annex V; Biodiversity – List of Species), including their conservation status as per the IUCN Red List. The EIS report biodiversity baseline was compiled considering the scientific literature available for the region, which is indeed relatively scarce, as well as specific biodiversity monitoring surveys developed in the project's area of influence, under the scope of oil and gas development projects, in 2016, 2019, 2021, 2022, and 2023 (Fugro, 2016, 2019; Consultec & BIOTA, 2021, 2022, 2023), as referenced in the EIS report. Considering the combined effort of these monitoring surveys, the biodiversity baseline provided in the EIS is adequately robust to support the impact assessment of the Project.
Biodiversity impacts				
64.	The EIA should take into consideration potential impacts in coastal habitats, including coral reefs, mangroves, estuaries, etc.	30/06/2023	- Oceanographic Institute of Mozambique	Potential project impacts on biodiversity were investigated in the biodiversity specialist study and are reported in section 7.7 of the EIS report (Volume II). No impacts on coastal habitats were identified as a result of the Project's normal operations. The only potential impact on coastal habitats identified was from an accidental oil spill resulting from a vessel collision (unplanned event). Please see section 7.7.4 (Volume II) for the assessment of that potential impact.
65.	Drilling will disturb abyssal clays. Will this have an effect on coastal sedimentation?	04/07/2023	- UniLúrio	The disturbance of abyssal clays by drilling will be a local phenomenon, with no impacts on the coastal sedimentation processes.
66.	Presentation of impacts related to the effect of lighting on sensitive and vulnerable species during all project phases, along with corresponding mitigation / minimization measures. The investigation of the appropriate light spectrum to reduce attraction to marine birds and the proposal of	26/09/2023	- MTA	Biodiversity impacts associated with artificial lighting are discussed in Impact BIO6 (see section 7.7.2; Volume II), for the drilling, installation, commissioning and decommissioning phase, and Impact BIO13 (see section 7.7.3; Volume II), for the operational phase.

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	key locations for implementing this type of ship lighting to mitigate this impact.			
67.	The development of an environmental sensitivity map aimed at protecting sensitive or ecologically valuable areas near well installations.	26/09/2023	- MTA	The sensitive and ecologically valuable areas, including conservation areas, nearest to the Project site are discussed in section 6.9.1.7 of the biodiversity baseline (see Volume I). Benthic habitats present around the well sites are discussed in section 6.9.2.3. Additionally, a Critical Habitat assessment, under IFC PS6, is provided in section 6.9.4
68.	Presentation of the impact related to the destruction of benthic habitats due to scouring caused by line movements, along with the proposal of specific mitigation measures.	26/09/2023	- MTA	The potential impact on benthic habitats from flowline scouring is assessed in Impact BIO19 (section 7.7.3; Volume II).
69.	Can the Project cause the exclusion of species from national waters?	06/05/2024	- Associação Vida.	No. While it is possible for some marine species to exhibit avoidance responses of the operational site (e.g., avoidance responses in cetaceans due to noise, section 7.7.3.2 of the EIS report [Volume II]), this will be a localized effect, with no significance at regional or national level.
70.	The findings of the impact assessment of noise effects on marine mammals (Impact BIO11) does not take into consideration cumulative impacts.	30/05/2024	- Justiça Ambiental / Natural Justice	Impact BIO11 evaluates the impact of the Coral North FLNG's operational noise emissions on marine biodiversity. The cumulative noise impact is evaluated in Impact BIO12 (Section 7.7.3.2) as well as in Section 7: Cumulative Impact Assessment, both found in Volume II.
71.	The results of noise modelling should be considered guidelines rather than hard facts. Ultimately, in situ measurements of sound levels are necessary to assess the actual results of model estimates and adjust attenuation guidelines. Therefore, it is not advisable to rely exclusively on model results to assess potential impacts.	30/05/2024	- Justiça Ambiental / Natural Justice	The noise modelling approach undertaken for the EIS used state-of-the art methodologies and models and is considered adequately robust to support the impact assessment. The assessment of noise impacts took into consideration the results of <i>in situ</i> measurements of underwater noise levels in Area 4, from surveys undertaken in 2015 (ERM, 2016) and 2022 (Consultec & WavEC, 2022), which are still valid and applicable to this Coral North EIA.
72.	The EIS underestimates noise impacts on marine mammals as it incorrectly assumes that these animals will move away from the noise source, and thus avoid long exposures to hazardous noise levels, which may not be possible.	30/05/2024	- Justiça Ambiental / Natural Justice	The noise impact assessment discussed in Impact BIO11 (Volume II, section 7.7.3.2) is a conservative worst-case scenario that considers a continuous 15-hour operation period of the FLNG thrusters (when typical operations of the thrusters are under 2 hours) and stationary biodiversity receptors (including marine mammals) to estimate worst-case impact ranges and the associated impact intensity. The assumption that marine mammals would not remain stationary for 15-hours when exposed to hazardous noise levels is reasonable, given the very high mobility of these animals and the open marine environment, and is applied in the EIS not to minimize the impact intensity but to rate the probability that the impact will occur.
73.	The noise impact assessment does not provide an accurate list of potentially affected marine species.	30/05/2024	- Justiça Ambiental / Natural Justice	While some marine mammal species that may be present at the Project location were not specifically included as representative species for the particular functional hearing group, the

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The provided list of species for each functional hearing group is inaccurate and incomplete. This makes it difficult, if not impossible, to accurately assess potential impacts.			noise modelling approach undertaken for the EIS used state-of-the art methodologies and models, considered all functional hearing groups, and is considered adequately robust to support the impact assessment.
74. The EIS underestimates the cumulative noise impacts of the simultaneous operations of the Coral North and Coral South FLNG. Natural Justice considers that if both FLNG's thrusters operate simultaneously, the entire area between the two FLNGs will be noisy enough to cause physical damage to the hearing of cetaceans in the area. To minimize this impact, the EIA should propose as a mitigation measure that operation of both FLNG's thrusters simultaneously should be avoided, except in cases where operation safety makes it unavoidable.	30/05/2024	- Justiça Ambiental / Natural Justice	The cumulative noise impact assessment discussed in Impact BIO12 (Volume II, section 7.7.3.2) and in Section 7: Cumulative Impact Assessment (Volume II) is a conservative worst-case scenario that affects a relatively small area (the ~13km corridor between both FLNGs), considers a continuous 15-hour operation period of both FLNGs thrusters (typical operations of the thrusters are under 2 hours) and stationary biodiversity receptors (including marine mammals) to estimate worst-case impact ranges and the associated impact intensity. The assumption that marine mammals would not remain stationary for 15-hours when exposed to hazardous noise levels is reasonable, given the very high mobility of these animals and the open marine environment. It is also very unlikely that both FLNG's thrusters would operate simultaneously for long periods, as that would only occur in the event of simultaneous offloading operations of LNG or condensate. These assumptions are not used in the EIS to reduce the impact intensity, which is assessed as medium, but to rate the probability that the impact will occur. Notwithstanding, the proposed mitigation measure suggested by the stakeholder has been evaluated and has now been included as mitigation for impact BIO12 in Volume II and added to the EMP (Volume III).
75. The project area in northern Mozambique is located far from the main ports and shipping routes and therefore has a very low human footprint in terms of navigation. The Coral North project will essentially double the level of existing maritime traffic and associated risks to marine wildlife from ship strikes, oil spills, introduction of invasive species and noise.	30/05/2024	- Justiça Ambiental / Natural Justice	Section 6.11 of the EIS report (Volume I) provides the marine traffic baseline for the project area, showing that the FLNG location is situated on the eastern edge of the regional coastal traffic zone, with a baseline traffic of 460 vessels per year (in 2020), estimated to grow to 605 vessels per year in 2027 (project start) and 1614 in 2052 (project end). As discussed in Impact MT1 (section 7.9.2; Volume II) the increased project generated traffic in that marine traffic zone will be 17% in year 2027 (project start) and 6% in 2052 (project end), not double the baseline. All referred project impacts on marine biodiversity associated with vessel movements are duly addressed in the EIS in Sections 7.7.2.2 and 7.7.2.3 in Volume II, including potential collisions of marine fauna with vessels (impacts BIO7 and 14), oil spills (impacts BIO20, 21 and 22), introduction of invasive species (impacts BIO8 and 15), and noise (impact BIO5).
76. Some of the marine fauna species that may be affected by project impacts are migratory species, that travel into Tanzanian waters during their migration. As such, the EIS should address transboundary impacts to Tanzania biodiversity.	30/05/2024	- Justiça Ambiental / Natural Justice	A transboundary impact is an impact within an area under the jurisdiction of one country caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another country (as per the Espoo Convention). That a species potentially impacted by a project aspect (the project component that interacts with the environment) is migratory does not turn that impact into a transboundary impact (for example, any project with impacts on palearctic migratory birds, which is practically all

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				projects, would have transboundary impacts with the northern hemisphere). For a transboundary impact to take place, the project aspect would need to cause an impact on areas with foreign jurisdiction (for example, the Project's potential noise impact ranges would need to extend to Tanzanian waters, which is not the case). Therefore, no transboundary impacts have been identified for the Coral North Project.
77.	The EIS underestimates the impact of discharge of drilling muds and cuttings on benthic macrofauna due to smothering and burial effects. The burial effect will be permanent and lead to total loss of habitat around the drilling locations, and as such impact duration should be rated long-term and intensity rated high, leading to high significance and requiring mitigation. The proposed mitigation is unclear and should be more detailed.	30/05/2024	- Justiça Ambiental / Natural Justice	The potential effects of the discharge of drilling muds and cuttings on deepwater benthic macrofauna due to smothering and burial effects are assessed in Impact BIO 4 (Volume II, section 7.7.2.2). Based on scientific literature and the modelling results, a very small area around each well is expected to be impacted. Smothering and burial effects are not permanent, as benthic communities will recolonize the affected area in time, and consequently duration has been assessed as medium. The impact will not lead to total loss of habitat and communities, and as such the intensity was also rated medium. Given the very small area affected, the significance rating is low. The proposed mitigation includes pre-drilling surveys of the drilling location, to identify potential sensitive habitats. If a low or high relief habitat or community are identified, the drilling location should be adjusted at least 250m away (which is the maximum distance likely to be affected by smothering or burial effects, according to modelling) to avoid directly affecting the more sensitive habitat. Harder substrates will be avoided. The proposed mitigation is considered to be detailed enough to successfully avoid impacts on sensitive benthic habitats.
78.	The oil spill modelling used in the EIS to evaluate the potential risks and impacts associated with accidental spills from unplanned events is inadequate, as it is very simplistic and does not include a shoreline interaction algorithm or other physical processes such as entrainment or dissolution, does not include near-field modelling, included only surface transport, stochastic mass balance results do not show the mass of submerged oil or the mass of oil stranded on the shore, does not address dissolved aromatics, uses circulation data from a global model, and the stochastic modelling only used one year of "representative" wind and current data.	30/05/2024	- Justiça Ambiental / Natural Justice	The oil spill study covered shoreline interaction and weathering processes, including spreading, evaporation, dispersion, and dissolution (Section AVII.3.6.2 of Annex VII; Volume IV). Section AVII.3.6.3 (Annex VII; Volume IV) considered estimates of the shortest time for the oil to reach the shore (maximum westerly currents) and maximum oil extent at the sea surface (minimum current speeds). The simulation period was based on a period of available <i>in situ</i> measured data, covering 3 representative months of minimum, typical, and maximum hydrodynamic conditions. The applied modelling methodology is in line with best practice in EIA studies and is considered adequate to support the impact assessment process.
79.	It is unclear on what basis the EIA asserts that only condensate (and not crude oil) would be discharged in the event of a blowout.	30/05/2024	- Justiça Ambiental / Natural Justice	The characteristics of the Coral gas reservoir are well known from past exploration drilling and the ongoing production activities at Coral South. The Coral reservoir does not contain crude oil, and as such there is no possibility of a crude oil blowout.

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80. The EIA underestimates the potential impacts on marine mammals from oil spills. Studies from large scale events, such as the Exxon Valdez and Deep Water Horizon spills, showed significant health impacts and increased mortality in cetacean populations.	30/05/2024	- Justiça Ambiental / Natural Justice	The Exxon Valdez and Deepwater Horizon spills are not relevant examples for the purpose of Coral North Project. The Exxon Valdez spill is estimated to have resulted in the release of approximately 260,000 to 750,000 barrels of crude oil. The Deepwater Horizon spill is estimated to have resulted in the release of 4.9 million barrels of crude oil. These two catastrophic large-scale spills are not comparable with the potential spill scenarios at Coral North, which would involve gas condensate, not crude oil (gas condensate has a much lesser risk than crude oil), with a maximum estimated spill of 60 300 barrels.
81. The mitigation measures proposed in the EIA for minimizing oil spill risk are inadequate, they are based on future plans and protocols yet to be developed. The EIA does not include an Oil Spill Contingency Plan, an Emergency Response Plan or a Blowout Response Plan, which are essential to assess the impacts of proposed activities.	30/05/2024	- Justiça Ambiental / Natural Justice	As stated in section 9.5.7 of the EMP (Volume III of the EIS report), an Emergency Response Plan (ERP) is already in place to cover all MRV activities and to describe all stages and phases of the emergency response process, from call out until the emergency is over and the normal operations has commenced. MRV's ERP was submitted to and approved by INP. The EMP (Volume III of the EIS) also provides guidelines for the development of the project, drilling vessel and activity specific Oil Spill Contingency Plan (OSCP) for the Coral North Project (section 9.5.7.1 of the EMP) and Blowout Emergency Response Plan (section 9.5.7.2 of the EMP), which will be prepared and submitted for regulatory approval, as per standard industry practice and in compliance with national regulation. The Regulation of Petroleum Operations (Decree 34/2015) states in Article 96 that the OSCP should be submitted to INP for approval prior to start of drilling. Article 108 reiterates that the OSCP for operations should be submitted to INP for approval.
82. The EIS underestimates the ways in which offshore gas production activities can cause ecological damage to the coral reef systems of the North Mozambique Channel due to the discharge of produced water and associated sedimentation.	30/05/2024	- Justiça Ambiental / Natural Justice	Impacts WQ3 and BIO17 (see Volume II; sections 7.5.3 and 7.7.3.2) assess the potential impacts of the discharge of treated produced water on marine water quality and biodiversity, based on modelling. Modelling results show that effects to water quality (including increased suspended solids) are negligible outside of the mixing zone (i.e., at distances greater than 300 m from the discharge point). The FLNG is located at more than 40 km from the nearest coral reefs of the coastal islands of the Quirimbas Archipelago. No water quality or sedimentation effects are expected at those distances (please see Chapter 5 of Volume I for the definition of the Project's Areas of Influence, including the Area of Direct Influence).
83. The EIS underestimates the impacts of potential oil spills to the coral reef systems of the North Mozambique Channel, considering the high vulnerability of the initial life stages of coral species.	30/05/2024	- Justiça Ambiental / Natural Justice	Impact BIO20 (section 7.7.4.2; Volume II) assesses the potential impacts associated with accidental oil spills from unplanned events on biodiversity, including coastal habitats. Modelling results show that no oil spill considered to have a harmful effect on sea life (thickness > 1 µm) will reach the nearest coral reefs (oil spills with thickness > 1 µm will be at least 25 km distant from these coastal habitats). Any oil spill likely to reach coastal habitats are predicted to be at a low level of risk (thickness > 0.1 µm and < 1 µm), which is reflected in the impact assessment.

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84.	Even with the substantial gaps and failures in the assessment of marine impacts, the risk that this project poses to sensitive marine species and ecosystems is simply too high and exceeds any alleged benefits that may arise from the Project. Article 12(1) of the Environment Law establishes that all activities that threaten the conservation, reproduction, quality and quantity of biological resources are prohibited, especially those threatened with extinction. For this reason, authorization must be refused.	30/05/2024	- Justiça Ambiental / Natural Justice	The identification of species and ecosystems, project activities and aspects, and the assessment were carried out according to the Mozambique EIA regulations and international standards, specifically IFC PS6; no significant risks to biological resources were identified.
Socioeconomic impacts				
85.	What is the estimated number and type of jobs to be created by the Coral North Project?	30/06/2023 04/07/2023 30/04/2024	- SEJE - National Institute of Tourism (INATUR) - Provincial Directorate of Youth and Labor (DPJT) of Cabo Delgado	Information regarding the number and type of jobs that are estimated to be created by the Coral North Project is provided in section 4.5 of the EIS report (Volume I).
86.	What is the estimated ratio of national to foreign workers?	30/06/2023	- Gabriel Manguela - Politécnica	Information regarding the number and type of jobs that are estimated to be created by the Coral North Project is provided in section 4.5 of the EIS report (Volume I).
87.	Will the project have impacts on artisanal fisheries?	30/06/2023 04/07/2023 30/04/2024	- Gabriel Manguela - UniLúrio - Associação Kuendeleya - AZMOC - Ibo	The Project's potential socioeconomic impacts, including on artisanal fisheries, were investigated in the socioeconomic specialist study, and are reported in section 7.8 (Volume II). No impacts on artisanal fisheries were identified resulting from the Project's normal operations. Only in the event of a large oil spill resulting from an accidental event artisanal fisheries may be affected. This impact from an unplanned event is reported in Impact SE11 (section 7.8.3; Volume II). This finding is consistent with previous studies (Coral South EIA) and ongoing monitoring of activities in Area 4, where no impacts on artisanal fisheries have been identified or reported to date.
88.	The presentation of all anticipated impacts, directly or indirectly affecting the fisheries value chain, with an analysis and proposal of mitigation measures to ensure the continuity of fishing activities.	26/09/2023	- MTA	The Project's potential impacts on fisheries were investigated in the socioeconomic specialist study and are reported in section 7.8 (Volume II). No impacts on artisanal fisheries were identified resulting from the Project's normal operations. Impacts on commercial fisheries will be associated with the restriction of fishing in the FLNG safety zone, and this is discussed in Impact SE9 (section 7.8.2; Volume II). Potential impacts on fisheries associated from an oil spill resulting from an unplanned event are discussed in Impact SE11 (section 7.8.3; Volume II).

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89.	Is there any expected social impact on the communities that would justify the payment of compensations?	06/05/2024	- Associação Vida	The Project's potential socioeconomic impacts were assessed in the socioeconomic specialist study and are reported in section 7.8 (Volume II). No negative impact on local communities were identified that would warrant compensation.
90.	The fisheries sector plans to introduce in the medium to long term a semi-industrial and/or industrial fishing fleet in Cabo Delgado Province. Taking into account that the project plans to operate for more than 25 years, it may create significant impacts to these fishing activities with operators.	13/07/2023 30/04/2024	- IDEPA - Maritime (ADMAR) Administration	Impacts on fisheries were investigated in the socioeconomic specialist study and reported in section 7.8 of this EIS report (Volume II). This comment raised during the EPDA PPP was taken into consideration for that assessment. More detailed information regarding this plan to introduce in the medium and long term a semi-industrial fishing fleet in Palma District was requested from IDEPA. However, at this stage, no specific information is available on the nature of such a fleet, planned fishing activities and fishing grounds, the dates for a possible implementation, or the likelihood of the implementation going forward. Given the lack of specific information, and that Project impacts are assessed against the baseline (where currently no such fleet exists), no considerations are possible on the possible interference of the Project's activities with that future intention. It should be noted, however, that the interference between Coral North and the fishing grounds used by industrial fisheries is very limited. As the exclusion will only be 500m around the subsea infrastructure, the restricted area is 0.2% of the available fishing grounds for commercial fisheries and semi-industrial fleet. Marine traffic will keep to the defined project vessel route and is consistent with the current marine traffic. Project implementation will thus not compromise the potential future development of provincial industrial or semi-industrial fisheries.
91.	The lighting of the platform will attract/concentrate the fishing resource around the platform and within the safety radius of the same, which will impact on the current fishing zones, forcing the migration of fishermen to other fishing zones.	13/07/2023	- IDEPA	Impacts on fisheries are investigated in the socioeconomic specialist study and reported in section 7.8 of this EIS report (Volume II). The potential attraction effect of the FLNG artificial illumination on fish is also assessed in the biodiversity section (see Impact BIO13; section 7.7.3.2), where the conclusion was that potential impacts are expected to be highly localised and unlikely to have discernible consequences at population level. As no impacts at population level for fishes are expected due to illumination, no relevant impact is expected in terms of fisheries stocks and the activities of fishing vessels. This is consistent with the ongoing biodiversity monitoring results for the Coral South FLNG, where no such impact on fishes or fisheries has been identified to date.
92.	On the route from the platform to the port of Pemba, the movement of artisanal fishing vessels may probably be limited to avoid accidents or interference, which will also create inconvenience to operators in the fishing value chain.	13/07/2023 30/04/2024	- IDEPA - Associação Kuendeleya	No limitations to marine navigation, including movement of artisanal fisheries, will be imposed on the route between the Pemba Port and the FLNG. The Coral North support vessels will use the same route that is currently used by the Coral South support vessels, with no expected restrictions to artisanal fishing vessels.

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93.	All expected impacts (direct and indirect) for the entire fishing value chain should be clearly and thoroughly described, analysed and proposed the respective safeguard measures in order to ensure the continuity of the activities that are the source of income and survival of most communities at the level of the district of Palma and beyond.	13/07/2023	- IDEPA	Impacts on fisheries, including artisanal fisheries, were investigated in the socioeconomic specialist study, and are reported in section 7.8 of this EIS report (Volume II). No impacts on artisanal fisheries from Project normal operations were identified.
94.	Will the project have other socioeconomic impacts on the communities of Palma District?	04/07/2023 30/04/2024	- USTM - INATUR - UPC	The Project's potential socioeconomic impacts were investigated in the socioeconomic specialist study and are reported in section 7.8 of this EIS report. No socioeconomic impacts on the communities of Palma District were identified resulting from Project's normal operations. Only in the event of an accidental large scale oil spill impacts may occur in the district coastal zone, and these are reported in section 7.8.3 of this EIS.
95.	Will the EIS take into consideration health issues?	30/06/2023	- Manhiça Health Research Center.	Potential health impacts resulting from the Project were investigated in the socioeconomic specialist study and are reported in section 7.8 of this EIS (Volume II). No relevant health impacts were identified resulting from Project's normal operations. Only in the event of an accidental large scale oil spill health impacts may occur in the district coastal zone, and these are reported in section 7.8.3 of this EIS (Volume II).
96.	Does the Project include a plan for the management of workers' health?	06/05/2024	- Ministry of Health (MISAU)	The EMP (Volume III) includes several plans related to the management of workers' health, including an Occupational Health and Safety Plan (section 9.5.10), a Medical Emergency Response Plan (section 9.5.7.3) and a Pandemic Preparedness and Response Plan (section 9.5.7.4).
97.	What gains does the project bring to the Cabo Delgado Province.	04/07/2023	- INATUR	The Project's potential socioeconomic impacts were investigated in the socioeconomic specialist study and are reported in section 7.8 of this EIS report (Volume II). Potential positive socioeconomic impacts include job creation, with associated income generation and skill transfer for national workers, stimulation of the regional and local economy due to the procurement of goods and services, and increased revenue to the provincial and central governments, with associated increased availability for investment in public goods and services.
98.	How will the influx of migrant workers caused by the Project be managed?	30/04/2024	- ADIN	As discussed in the socioeconomic impact assessment section (see Section 7.8.1; Volume II), given the nature of the created jobs, it is highly unlikely that the project implementation will generate any influx of migrant workers, as witnessed from the Coral South Project.
99.	The assessment of the economic stimulation impact is too focused on tourism issues. Were the other economy sectors considered when assessing the project's socioeconomic impacts?	06/05/2024	- APIEX	Section 7.8 of the EIS (Volume II) provides the socioeconomic impact assessment. Impact SE1 does deal with the stimulation of business tourism specifically, but the other sectors of economic activity were also considered in Impact SE2, which deals with the potential stimulation of the local and regional economies in a broader sense.

Issues / Comments		Date	Stakeholder	Answers / Comments
100.	How does the company intend to manage local content, in order to improve local business sector?	06/05/2024	- CTA	MRV is engaged in the development and improvement of local content. As stated in section 9.5.4 of the EMP (Volume III), a Local Content Plan will be prepared for the Coral North Project, in compliance with Decree-law n° 2/2014, and submitted to MIREME/INP for approval, following which it will be updated and resubmitted for approval every three years.
101.	The Project should include cooperation activities with local universities, to develop skilled national labour.	06/05/2024	- MTC	MRV has developed various exchange programs with some local universities, such as UEM and UniLúrio, where workshops and degrees have been organized to interact and share knowledge. In addition, MRV is directly training national workers in various oil and gas areas, both nationally and abroad.
102.	Do the Project's local content and recruitment plans include job opportunities for unskilled labour?	06/05/2024	- Associação VIDA	MRV's strategy is to engage throughout the entire lifecycle of the project with local companies, for the provision of support services that can absorb local low-skill workers, such as security, catering, cleaning, etc.
103.	Will the Project have any impact on air traffic?	06/05/2024	- Jacob Chimuca	None of the project's infrastructure has any interference with air traffic. The helicopter service (Pemba Port – FLNG) will result in a small increase to the regional traffic, but with no significant increase to aviation risk, assuming implementation of standard aviation procedures.
104.	The EIS states that project implementation will lead to high socioeconomic impacts, including local and regional stimulation of the local economy due to project expenditure and increased state revenue from GNL sales, which can lead to increased public investment. The EIS does not provide data or proof that these effects will actually occur.	30/05/2024	- Justiça Ambiental / Natural Justice	According to the World Bank, in 2023 Mozambique's economy grew by 5%, "primarily driven by the start of Liquefied Natural Gas (LNG) production at the Coral South offshore facility" ¹⁴ . The Coral North Project will be a replicate of Coral South, and thus likely to generate similar socioeconomic effects. The same report highlights that delays in the larger LNG projects could undermine growth prospects.
105.	The EIS claims that the Coral North Project will likely create 1400 job opportunities for national workers, including direct and indirect jobs, but does not provide data to support this claim.	30/05/2024	- Justiça Ambiental / Natural Justice	The number of potentially created jobs that are provided in EIAs are estimates based on project design and data from other similar projects. The estimates provided in the Coral North EIS are based on data from jobs created by the operational Coral South FLNG project. Considering that the Coral North is a replicate of Coral South, these estimates are directly applicable and considered to be robust.
106.	The EIS states that no impacts on artisanal fisheries are expected, because the Coral North Project does not directly overlap with any artisanal fishing area. This assessment is limited and does not take into account the likely impacts that will extend to beyond the project area.	30/05/2024	- Justiça Ambiental / Natural Justice	As stated in section 7.8.1 of the EIS report (Volume II), no impacts from project operations were identified over artisanal fisheries, as the Coral North site, located almost 40 km away from the islands, does not overlap with the artisanal fishing grounds, and because potential effects to fish stocks operations, as assessed during underwater noise, wastewater, illumination modelling studies, are limited to the vicinity of the FLNG with no impacts further

¹⁴ World Bank (2024). *The World Bank in Mozambique* website, available at <https://www.worldbank.org/en/country/mozambique/overview#1>. Accessed on June 4th, 2024.

Issues / Comments		Date	Stakeholder	Answers / Comments
				afield including on coastal fish stocks, as reported throughout the EIS. Potential impacts from the FLNG operations in fish stocks include: - Noise emissions may have an impact on fish up to 51 m from the FLNG (Impact BIO11; section 7.7.3.2; Volume II); - Light emissions may cause behavioural response on fishes up to 500 m from the FLNG (Impact BIO13; section 7.7.3.2; Volume II); - Marine discharges (cooling water, treated produced water, sewage, and bilge effluents) may cause very localized and low intensity impacts on water quality, not extending beyond the immediate surroundings of the FLNG (impacts BIO9, BIO16, and BIO17; section 7.7.3.2; Volume II). All the impacts above are limited to the vicinity of the FLNG, with no discernible consequences at population level, and with no impacts further afield including on coastal fish stocks. Considering the above, the Coral North Project will have no impact on artisanal fisheries, under normal operations. Potential impacts from unplanned events to artisanal fisheries are assessed in Impact SE11.
107.	The EIS states that no impacts on coastal tourism activities are expected, because the Coral North Project does not directly overlap with areas of touristic interest. This assessment is limited and does not take into account the likely impacts that will extend to beyond the project area.	30/05/2024	- Justiça Ambiental / Natural Justice	As stated in section 7.8.1 of the EIS report (Volume II), no impacts from project operations were identified on coastal tourism activities as the proposed FLNG site does not overlap the touristic areas, and it was also determined as highly unlikely that the FLNG will be visible from the islands, and as such no visual impact is expected. As discussed elsewhere, no significant impacts on biodiversity or other natural features were identified that would affect the areas where coastal tourism activities are developed.
108.	The EIS does not provide an assessment of economic externalities.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIS was developed in compliance with national EIA regulations and international best practices, namely the IFC Performance Standards. Under these standards, the assessment of economic externalities is not within the scope of an EIA.
109.	The EIS should describe the additional actions that the Proponent will take to consult in a significant way the potentially affected groups and other interested parties.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIS requires the development of a project-specific Stakeholder Engagement and Communication Plan. The EMP includes guidelines for the development of this plan (see section 9.5.2; Volume III), including the target groups of stakeholders and the proposed engagement actions.
110.	The EIS assessment of potential health impacts due to an oil spill is inadequate as it underestimates the risks.	30/05/2024	- Justiça Ambiental / Natural Justice	Impact SE11 (section 7.8.3; Volume II) assesses potential health impacts of accidental oil spills from unplanned events, based on the findings of the oil spill modelling developed for the EIS. In addition, the Coral reservoir does not contain crude oil.
111.	The EIS does not adequately assess the potential impacts of gas flaring in human health. It also does	30/05/2024	- Justiça Ambiental / Natural Justice	Impacts AQ2 to AQ5 (Volume II; section 7.2.3) evaluate the potential air quality impacts (which are evaluated against human health concerns) for several modelled scenarios of the Project's atmospheric emissions, including a scenario of emergency / unplanned gas flaring

Issues / Comments		Date	Stakeholder	Answers / Comments
	not consider cumulative effects with other facilities, such as Coral South.			and a cumulative emissions scenario with Coral South. No exceedances of applicable ambient air quality standards were identified (air quality standards are defined to protect human health) and thus no impact on human health is expected.
112.	The EIS does not adequately assess how the Project can negatively affect issues related to gender, such as violence of discrimination based on gender.	30/05/2024	- Justiça Ambiental / Natural Justice	Gender issues, including gender-based violence, were taken into consideration in the socioeconomic impact assessment for the identified impacts that interact with the gender dimension, such as job creation (Impact SE4) and human rights risks (Impact SE8).
Human rights				
113.	The EIS assessment of potential project impacts on human rights is deficient because it does not take into consideration the project location in a conflict zone.	30/05/2024	- Justiça Ambiental / Natural Justice	The Coral North FLNG offshore infrastructure is located in the deep waters of the Mozambique Channel, 50 km offshore the coast of Cabo Delgado Province. Onshore logistic activities will use infrastructure in Pemba City.
114.	The EIS does not adequately evaluate the ways in which the Project can limit communities' rights to access food and cultural and economic development.	30/05/2024	- Justiça Ambiental / Natural Justice	The Coral North FLNG offshore infrastructure is located in the deep waters of the Mozambique Channel, 50 km offshore the coast of Cabo Delgado Province, outside of any area where local communities practice subsistence activities. None of the Project's activities or component interferes with communities' rights to access food and cultural and economic development.
115.	The EIS should include an assessment of how the project intends to avoid or contribute to human rights impacts due to their activities and what measures to implement to minimize such impacts.	30/05/2024	- Justiça Ambiental / Natural Justice	Impact SE8 (section 7.8.2; Volume II) provides the assessment of the potential human rights impacts of the Project and the proposed mitigation to minimize such impacts.
116.	The human rights impact assessment should demonstrate the company's compliance with UNGP's Voluntary Principles on Security and Human Rights.	30/05/2024	- Justiça Ambiental / Natural Justice	As discussed in Impact SE7 (section 7.8.2; Volume II), armed security services will be required to strictly adhere to the Voluntary Principles on Security and Human Rights, through the application of existing Proponent policies, including MRV's approach to human rights and security, ERB's code of ethics, Eni's Policy "Respect for Human Rights in Eni", and Eni suppliers code of conduct.
117.	Although the project is located off the coast, the fact that it uses onshore infrastructure and located in the province of Cabo Delgado - a conflict zone, where communities are already heavily affected - is a fundamental consideration. This fact requires a higher level high level of due diligence in the AIA. Due diligence and additional measures necessary to safeguarding vulnerable communities are absent from this project's EIS.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIS was developed in compliance with national EIA regulations and international best practices, namely the IFC Performance Standards, and assessed the potential impacts on social and human rights aspects (Section 7.8.2, Volume II).

Issues / Comments		Date	Stakeholder	Answers / Comments
118.	The EIA did not adequately assess the impacts on vulnerable groups and communities. We also affirm that, regardless of the adequacy of the assessment, the current circumstances in Cabo Delgado, for vulnerable groups and affected communities, must weigh heavily in favor of refusing authorization for the Project.	30/05/2024	- Justiça Ambiental / Natural Justice	The EIS was developed in compliance with national EIA regulations and international best practices, namely the IFC Performance Standards, and assessed the potential impacts on social and human rights aspects (Section 7.8.2, Volume II),
Unplanned Events				
119.	In the event of a gas blowout, what procedures will be carried out to minimise environmental damage?	06/05/2024	- UDM - MISAU	A Project-specific Blowout Emergency Response Plan will be prepared and approved by the competent authorities, including all response procedures in the event of a blowout. Section 9.5.7.2 of the EMP (Volume III) provides the guidelines for this plan.
Environmental and Social Management Plan				
120.	In addition to compliance with the International Maritime Organization (IMO) guidelines, the development of a Ballast Water Management Plan.	26/09/2023	- MTA	Ballast water management plans are vessel specific, and are prepared for each vessel by their operator, taking into account the vessel design and history. The requirement that all project associated vessels, including the FLNG, require the development of a specific ballast water management plan, prior to the vessel's incorporation to the Project area of operations has been included in the EMP, specifically in the Effluent and Marine Discharges Management Plan (see section 9.3.3 of Volume III).
121.	Inclusion in the Radioactive Waste Management Plan of explanations on how radioactive waste will be handled, stored, and disposed of.	26/09/2023	- MTA	Section 9.3.4 of the EMP (Volume III) provides the Naturally Occurring Radioactive Materials (NORM) Management Plan, which includes handling, storage, transportation, and disposal requirements for radioactive materials.
122.	The inclusion in the Environmental Management Plan of the following Plans/Programs: - Individual contingency plan for combating pollution by oils and harmful or hazardous substances;	26/09/2023	- MTA	Section 9.5.7 of the EMP (Volume III) provides guidance and requirements for the development of the Project's Oil Spill Contingency Plan (OSCP). The stand-alone project-specific OSCP for the Coral North Project will be prepared and submitted for regulatory approval prior to the start of the drilling phase.
123.	- Occupational Health and Safety Program;	26/09/2023	- MTA	A summary of the occupational health and safety requirements for the Coral North Project are provided in sections 9.3.6 (Industrial Hygiene Monitoring Plan) and 9.5.10 (Occupational Health and Safety) of the EMP (Volume III).
124.	- Environmental Education Program;	26/09/2023	- MTA	Section 9.5.6 of the EMP (Volume III) provides the Environmental and Social Training Program.
125.	- Sediment Management Program;	26/09/2023	- MTA	The Coral North Project will have no interaction with marine sediments, beyond the drilling required at each well site. Impacts on biodiversity associated with that physical impact are

Issues / Comments		Date	Stakeholder	Answers / Comments
				assessed in Impact BIO4 (section 7.7.2; Volume II), and mitigation is proposed for those impacts. Given the assessed impacts, no Sediment Management Program is required for the Project.
126.	- Biodiversity Management Plan;	26/09/2023	- MTA	Section 9.3.5 of the EMP (Volume III) provides the Biodiversity Management Plan.
127.	- Chemicals Management Program;	26/09/2023	- MTA	Section 9.3.7 of the EMP (Volume III) provides the Chemical Management Program.
128.	- Recruitment and Training Program.	26/09/2023	- MTA	Section 9.5.5 of the EMP (Volume III) provides the Work Force Plan, including the requirements for recruitment, training, and nationalization.
129.	Presentation of the Dialogue and Complaint Mechanism.	26/09/2023	- MTA	Section 9.5.3 of the EMP (Volume III) provides the Grievance Mechanism.
130.	The indication of chemical substances (chemical additives) for incorporation into the hydrotesting water of the underwater equipment, during different phases of the project, considering their concentration, toxicity, biodegradability, and potential for accumulation. Additionally, information regarding wastewater treatment facilities for hydrotesting water should be provided.	26/09/2023	- MTA	Section 9.3.7 of the EMP (Volume III) provides the Chemical Management Program, which includes the requirements for selection and handling of chemicals used for hydrotesting.
131.	Inclusion of information on the frequency of internal audits during drilling and completion phases, as well as the reporting of non-conformities to relevant authorities such as MTA, INAMAR, ITRANSMAR, AQUA, and INP.	26/09/2023	- MTA	Section 10 of the EMP (Volume III) defines the auditing and non-compliance reporting requirements for the Coral North Project.

9 Conclusions

MRV proposes the development of the Coral North Project, which plans to install and operate a FLNG in Area 4, located offshore the District of Palma, and roughly 10 km north of the operational Coral-SUL FLNG. This report presents the findings of the impact assessment of the proposed project, developed in compliance with the Terms of Reference for the EIS, defined in the EPDA phase and approved by MTA on 27th September, 2023. Potential negative and positive impacts on the receiving biophysical and socioeconomic environment were identified and evaluated both in the pre-mitigation scenario and following the implementation of the recommended mitigation and enhancement measures (the residual impacts).

The drilling, installation, commissioning, operational, and decommissioning phases of the FLNG project imply a wide range of different impacts on the receiving environment. Impacts associated with the drilling, installation, commissioning, and decommissioning phases are mostly related, directly or indirectly, to increases in vessel traffic with consequent noise and illumination effects on people (including tourism) and marine fauna, increased air and greenhouse gas emissions, potential seawater degradation due to discharge of drill cuttings and effects on the marine ecology due to effluents, waste, potential entanglement of marine fauna, introduction of alien species, among others. In the operational phase, impacts are likely to be similar, however with a long-term duration given that the FLNG is expected to operate for 25 years. In addition, operational impacts will also include operational discharges including thermal and produced water. Impacts associated with unplanned events are mainly related to oil spills, from accidental vessel collisions, condensate blowouts and accidental LTOBM releases.

The results of the impact assessment exercise conducted in this EIS are summarized in the form of a table in Section 7.10. The vast majority of the FLNG's impacts were rated as low or lower significance in the pre-mitigation scenario. The exceptions were some impacts on biodiversity, namely those associated with artificial lighting and risks of collisions with marine fauna, the risk of introduction of alien species due to inadequate ballast water management, as well as potential impacts from unplanned events, namely accidental oil spills and their associated impacts on biodiversity and coastal ecosystems and communities, which were assessed to be of medium significance prior mitigation.

Following mitigation, i.e., assuming the implementation of the proposed mitigation, all negative impacts were assessed to have a residual significance rating of low, or lower, with one exception – the Project's total GHG operational emissions were assessed to be a negative medium residual significance impact due to the longevity of the project.

A few positive impacts were rated as medium or high significance post mitigation, namely those related to the economic stimulation of the local and regional economy, increased revenue for provincial and central governments, job creation and transfer of technical and professional skills to national workers.

The Coral North Project is thus likely to result in both negative and positive residual impacts on the receiving environment. No residual negative impacts of high significance were identified and a few

high significance positive impacts were identified, especially during the operational phase. As such, the Coral North Project is considered environmentally feasible if all mitigation and enhancement measures outlined in the EIS are implemented by MRV.

The Project's EMP (Volume III) summarizes and structures all management, mitigation and monitoring requirements defined in this EIS. It is recommended that the EMP is strictly complied to and updated across the Project's life cycle. This will require action by several entities, namely the Project's Proponent (MRV), its contractors, and several other governmental agencies.

10 References

- Abdulla A & Linden O (editors) (2008) Maritime traffic effects on biodiversity in the Mediterranean Sea: Review of impacts, priority areas and mitigation measures. Malaga, Spain: IUCN Centre for Mediterranean Cooperation. 184 pp.
- ADNAP - Administração Nacional das Pescas. (2022). Campanha de Pesca. Ano de 2022. Número da Campanha 2021/12. Maputo.
- Advisian. (2019). Oil Spill Modelling Mozambique Block A5-A. Specialist Study in Support of ENI EIA. Consultec.
- AECOM (2020). MRV Document Marine Mammal Study Rovuma LNG Phase 1 Project. (MZLN-EL-RRRPT-00-0049).
- Allport, G & Curtis, C & Simões, T & Rodrigues, M. (2017). The first authenticated record of Pygmy Killer Whale (*Feresa attenuata* Gray 1874) in Mozambique; has it been previously overlooked?. *Marine Biodiversity Records*. 10. 1-8. 10.1186/s41200-017-0119-9.
- Allport, G (2018) Notable recent records of terns, gulls and skuas in southern Mozambique including the first country records of Black Tern *Chlidonias niger*. *Bulletin of the British Ornithologists Club* 138(2): 101-116.
- Almeida, A.J., Amoedo, L. & Saldanha, L. (2001). Fish assemblages in the seagrass beds at Inhaca Island (Mozambique) - Cold season. *Bol. do Mus. Munic. do Funchal*.
- Alongi, D.M., Tirendi, F., Trott, L.A. & Xuan, T.T. (2000). Benthic decomposition rates and pathways in plantations of the mangrove *Rhizophora apiculata* in the Mekong delta, Vietnam. *Mar. Ecol. Prog. Ser.* 194, 87–101.
- Amemiya, C., Alföldi, J., Lee, A. et al. The African coelacanth genome provides insights into tetrapod evolution. *Nature* 496, 311–316 (2013). <https://doi.org/10.1038/nature12027>.
- ANZECC (2000). Ammonia in freshwater and marine water. In Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council.
- Avery M.L. (1976) The effects of a tall tower on nocturnal bird migration – a portable ceilometer study. *Auk* 93(2): 281-291.
- Avibase. (2023) Quirimbas National Park Bird Checklist. <https://avibase.bsc-eoc.org/checklist.jsp?region=MZcd01>
- Avila, Isabel C.; Kaschner, Kristin; Dormann, Carsten F. (2018). Current global risks to marine mammals: Taking stock of the threats. *Biological Conservation*, 221 (1), 44–58.
- Baird, R. W. (2009) *Risso's dolphin* *Grampus griseus*. In: Perrin WF et al. (eds) *Encyclopedia of Marine Mammals*, 2nd ed., 975–976. Academic Press, San Diego, California, USA
- Baird, R. W. (2018a) *Pseudorca crassidens*. International Union for Conservation of Nature (Ed.), The IUCN red list of threatened species.

- Baird, R. W. (2018b). *Cuvier's beaked whale: Ziphius cavirostris*. In *Encyclopedia of Marine Mammals* (pp. 234-237). Academic Press.
- Baird, R. W., McSweeney, D. J., Bane, C., Barlow, J., Salden, D. R., La'Ren, K. A., LeDuc, R. G., & Webster, D. L. (2006). Killer whales in Hawaiian waters: Information on population identity and feeding habits. *Pacific Science*, 60(4), 523-530.
- Bandeira, S., Gullstrom, M., Balidy, H., Samussone, D. & Cossa, D. (2014). Seagrass Meadows in Maputo Bay. In *The Maputo Bay Ecosystem: 427*. Bandeira, S. & Paula, J. (Eds.). Zanzibar: WIOMSA.
- Bandeira, S., Macamo, C.C., Kairo, J., Amade, F., Jiddawi, N., Paula, J., (2009). Evaluation of mangrove structure and condition in two transboundary areas in the Western Indian Ocean. *Aquatic Conservation: marine and freshwater ecosystems*, 19 (S1): S46-S55.
- Banks, Aaron & Best, Peter & Gullan, Angie & Guissamulo, Almeida & Cockcroft, Vic & Findlay, Ken. (2023). Recent sightings of southern right whales in Mozambique. SC/S11/RW17
- BAOAC. (2017). Bonn Agreement Aerial Operations Handbook. Bonn Agreement.
- Barbier, Edward B. "Marine ecosystem services." *Current Biology* 27.11 (2017): R507-R510
- Barr, R., Garnier, J., 2005. Marine Turtle Programme, Report of Activities 2005. Cabo Delgado Biodiversity and Tourism Project, Pemba, Mozambique. 35 pp. Beentje H, Bandeira S., 2007. *Field Guide to the Mangrove Trees of Africa and Madagascar*. Kew Publishing: UK.
- Benayahu, Y., A. Shlagman & M. H. Schleyer (2003). Corals of the South-west Indian Ocean: VI. The Alcyonacea (Octocorallia) of Mozambique, with a discussion on soft coral distribution on south equatorial East African reefs. *Zoologische Verhandelingen*, 345: 49-58.
- Berggren, P., (2009). *Whales and Dolphins: a field guide to marine mammals of East Africa*. WIOMSA & East Publishing, 128 pp.
- Berglund, B; Lindvall, T; Schwela, D.H. (eds.) (1999). *Guidelines for Community Noise*. World Health Organization. Geneva, April 1999.
- Bérubé, M. (2007). Cumulative effects assessments at Hydro-Québec: what have we learned? Impact Assessment and Project Appraisal. Vol. 25 (2), pp. 101-109.
- Best, P.B., Findlay, K.P., Sekiguchi, K., Peddemors, V.M., Rakotonirina, B., Rossouw, A. and Gove, D. (1998). Winter distribution and possible migration routes of humpback whales, *Megaptera novaeangliae*, in the southwest Indian Ocean. *Mar. Ecol. Prog. Ser.* 152: 287–99.
- BirdLife International (2023a). *Species factsheet: Larus heuglini*. Downloaded from <http://www.birdlife.org> on 19/04/2023.
- BirdLife International (2023b) *Important Bird Area factsheet: Mnazi Bay*. Downloaded from <http://datazone.birdlife.org/site/factsheet/mnazi-bay-iba-tanzania>

BirdLife International (2023c) *Important Bird Area factsheet: Mtwara District Coastal Forests*. Downloaded from <http://datazone.birdlife.org/site/factsheet/mtwara-district-coastal-forests-iba-tanzania>

BirdLife International (2023d) *Important Bird Area factsheet: Newala District Coastal Forests*. Downloaded from <http://datazone.birdlife.org/site/factsheet/newala-district-coastal-forests-iba-tanzania>

Black A. (2005) Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. *Antarctic Science* 17 (1): 67–68.

Boesch, D.F., 2002. Causes and consequences of nutrient overenrichment of coastal waters. In *International Seminar on Nuclear War and Planetary Emergencies. 26th Session. World Scientific Publishing, Singapore* (pp. 165-180).

Bourjea, J., Lapègue, S., Gagnevin, L., Broderick, D., Mortimer, J.A., Ciccione, S. (2007b.) Phylogeography of the green turtle, *Chelonia mydas* in the Southwest Indian Ocean. *Molecular Ecology*, 16, 175–186.

Branch TA, Abubaker EMN, Mkango S, Butterworth DS. 2007b. Separating southern blue whale subspecies based on length frequencies of sexually mature females. *Marine Mammal Science* 23: 803–833.

Branch TA, Stafford KM, Palacios DM, Allison C, Bannister JL, Burton CLK et al. 2007a. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the Southern Hemisphere and northern Indian Ocean. *Mammal Review* 37: 116–175.

Branch, G. & Branch, M. (1981). *The Living Shores of Southern Africa*. Cape Town: Struik.

Braulik, G.T., Findlay, K., Cerchio, S., Baldwin, R. & Perrin, W. 2017. *Sousa plumbea*. The IUCN Red List of Threatened Species 2017: e.T82031633A82031644. <https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T82031633A82031644.en>. Accessed on 01 October 2023.

British Standard BS 5228-1: 2009. 'Code of practice for noise and vibration control on construction and open sites'

Broderick AC, Coyne MS, Fuller WJ, Glen F & Godley BJ, 2007. Fidelity and over-wintering of sea turtles. *Proc R Soc Lond B Biol Sci* 274:1533–1538.

Brooke, M. (2004) "The food consumption of the world's seabirds." *Proceedings of the Royal Society of London. Series B: Biological Sciences* 271.suppl_4. S246-S248.

Brown, T. M., Wilhelm, S. I., Mastromonaco, G. F., & Burness, G. (2023). A path forward in the investigation of seabird strandings attributed to light attraction. *Conservation Science and Practice*, 5 (1) e12852.

Brownell RL, Ralls K, Baumann-Pickering S, Poole MM. 2009. Behavior of melon-headed whales near oceanic islands. *Marine Mammal Science* 25: 639-658.

- Burger, J., & Gochfeld, M. (1996). Use of space by nesting black-billed gulls *Larus bulleri*: Behavioural changes during the reproductive cycle. *Emu*, 96(2), 73-80.
- Capaina, N. (2021). Caracterização do Sector das Pescas em Moçambique. Maputo: OMR - Observatório do Meio Rural.
- CargoFrete. (2017). Traffic Survey.
- Cartaxana, A., & Paula, J. (2012). Environmental Impact Assessment for 2D and 3D seismic surveys offshore Mozambique. Report on Fisheries. Maputo.
- Castro, P. & Huber, M. (1997). Life on the Continental Shelf. In Marine Biology Second Edition: 460. McGraw-Hill.
- CBD (2012). Southern Indian Ocean regional workshop to facilitate the description of ecologically or biologically significant marine areas.
- CEAGRE (2015). *Mapeamento de Habitats de Moçambique. Criando as bases para contrabalanços de biodiversidade em Moçambique*. Centro de Estudos de Agricultura e Gestão de Recursos Naturais. Abril de 2015.
- Cerchio, S., Ersts, P.J., Pomilia C., Loo, J., Razafindrakoto Y., Leslie M., Andrianarivelo N., Minton G., Dushane, J., Murray, A., Collins T. and Rosenbaum, H. (2009). *Updated estimated abundance for humpback whale breeding stock C3 off Madagascar, 2000–2006*. IWC Scientific Committee SC/61/SH7.
- Cerchio, S., Willson, A., Muirhead, C., Al Harthi, S., Baldwin, R., Cholewiak, D. & Willson, M. S. (2018). *A new baleen whale song type described for the Western Indian Ocean off Oman and Northwest Madagascar* (Vol. 67). Document SC.
- CH2 M Hill (2017) Critical Habitat Screening and Assessment using IFC PS6 Criteria. Mamba Straddling Resources Onshore LNG Project. Mozambique Program.
- Chassot E, Bodin N, Sardenne F, Obura D (2019). The key role of the Northern Mozambique Channel for Indian Ocean tropical tuna fisheries. *Reviews In Fish Biology And Fisheries*, 29(3), 613-638.
- Chen, Z., Sun, J., Gu, T., Zhang, G. and Wei, Y., 2021. Nutrient ratios driven by vertical stratification regulate phytoplankton community structure in the oligotrophic western Pacific Ocean. *Ocean Science*, 17(6), pp.1775-1789.
- Chung, F.C., Pilcher, N.J., Salmon, M., & W Yneken, J. (2009) Offshore migratory activity of hawksbill turtle (*Eretmochelys imbricata*) hatchlings, ii. Swimming gaits, swimming speed, and morphological comparisons. *Chelonian Conservation and Biology*, 8: 35-42
- Clarke SC, McAllister MK, Milner-Gulland EJ, Kirkwood GP, Michielsens CGJ, Agnew DJ et al. (2006) Global estimates of shark catches using trade records from commercial markets. *Ecol Lett*, 9:1115–1126

Clarke, C., Lea, J., & Ormond, R. (2012). Comparative abundance of reef sharks in the Western Indian Ocean. In Proceedings of the 12th international coral reef symposium, Cairns, Australia (pp. 9-13).

Commonwealth of Australia (2020) National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds. January 2020.

Connor, D. et al., 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05., Peterborough: JNCC.

Conservation International (2023). *Biodiversity Hotspots*. Critical Ecosystem Partnership Fund. Retrieved from: <https://www.cepf.net/our-work/biodiversity-hotspots>.

Consultec & Advisian (2021a). Coral South Project. Air Emissions Impact Assessment. November 2021. Coral FLNG S.A.

Consultec & Advisian (2021b). Coral South Project. Illumination Impact Assessment. February 2022. Coral FLNG S.A.

Consultec & Advisian (2021c). Underwater Noise Impact Study. Coral South Project – CSU Phase. Coral FLNG S.A.

Consultec & Anchor (2023a). Coral South Project. Best Practicable Environmental Option and Dispersion Modelling Study for Sewage Discharge. May 2023. Coral FLNG S.A.

Consultec & Anchor (2023b). Coral South Project. Marine Impact Assessment Study of Elevated Phenols Content in Produced Water Discharge. April 2023. Eni Rovuma Basin.

Consultec & Biota (2022a). Coral South Project Biodiversity Management Plan. Eni Rovuma Basin.

Consultec & Biota (2022b). Marine Biodiversity Monitoring Survey - Final Report. Coral South Project. September 2022. Eni Rovuma Basin BV.

Consultec & Biota (2023) Marine Biodiversity Monitoring Survey - Wet Season 2023. Coral South Project. Coral FLNG S.A.

Consultec & CLS (2022). Coral South Project. Water Quality Monitoring Survey (2022). Monitoring Report. September 2022. Coral FLNG S.A.

Consultec & CLS (2023a). Coral South Project. Water Quality Monitoring Survey (2023). Monitoring Report. May 2023. Coral FLNG S.A.

Consultec & CLS Southern Africa. (2023b). Coral South Project: Weekly Water Quality Monitoring Survey (May – July 2023). Data Report. Eni Rovuma Basin.

Consultec & CLS (2024). Coral South Project. Water Quality Monitoring Survey. Wet Season 2023-2024. Monitoring Report. March 2024. Coral FLNG S.A.

Consultec & PRDW (2021). Coral South Project. Traffic Impact Assessment Report. December 2021. Coral FLNG SA.

Consultec & SRK (2013). Environmental Impact Assessment for 2D and 3D Seismic Surveys, Offshore Mozambique. WesternGeco. Maputo, Mozambique.

Consultec & Wavec (2022). Coral South Project. Underwater Noise Survey. Monitoring Report. December 2022. Coral FLNG S.A.

Consultec (2014). *Environmental Impact Assessment for the Muepane – Mocimboa da Praia Coastal Road Project. Draft EIS Report*. Eni East Africa, S.p.A.

Consultec (2014a). Marine Avifauna specialist study – Final Report. December 2014. Eni East Africa, S.p.A.

Consultec (2014b). Marine Ecology specialist study – Final Report. December 2014. Eni East Africa, S.p.A.

Consultec (2015). Environmental Impact Assessment Process for the Floating Liquefied Natural Gas Project. Environmental Impact Study. Volume I – Introduction, description of the project and baseline assessment. Eni East Africa, S.P.A.

Consultec (2018). *Coral South FLNG Project - EIA GAP Analysis and Action Plan*. Draft report. Eni East Africa, S.p.A

Consultec (2019). *Biodiversity Monitoring and Evaluation Program*. Coral South Project. Eni Rovuma Basin BV.

Consultec (2019). Environmental Impact Assessment Process for the Coral Floating Liquefied Natural Gas Project. Environmental Impact Study. Addendum II.

Consultec (2021). Marine Biodiversity Monitoring Survey - Final Report. Coral South Project. September 2021. Eni Rovuma Basin BV.

Consultec (2022). *Biodiversity Monitoring and Evaluation Program*. Coral South Project. Eni Rovuma Basin BV.

Consultec (2023). *Environmental Impact Assessment Process for the Coral Floating Liquefied Natural Gas Project. Environmental Impact Study. Addendum III*. Eni Rovuma Basin, B.V. November 2023.

Consultec (2023a). Projecto Coral Norte. Estudo de Pré-Viabilidade e Definição do Âmbito. Relatório Final. Maputo.

Consultec (2023b). Environmental Impact Assessment Process for the Coral Floating Liquefied Natural Gas Project. Environmental Impact Study. Addendum III.

Consultec 2021. Survey of Access to Water Sources in Pemba City and Resettlement Centres. Fundo de Investimento e Património do Abastecimento de Água (FIPAG).

Cordes, Erik E. Daniel O. B. Jones, Thomas A. Schlacher, Diva J. Amon, Angelo F. Bernardino, Sandra Brooke, Robert Carney, Danielle M. DeLeo, Katherine M. Dunlop, Elva G. Escobar-Briones, Andrew R. Gates, Luciana Génio, Judith Gobin, Lea-Anne Henry, Santiago Herrera, Sarah Hoyt, Mandy Joye, Salit Kark, Nélia C. Mestre, Anna Metaxas, Simone Pfeifer, Kerry Sink, Andrew K.

Sweetman & Ursula Witte (2016) Environmental Impacts of the Deep-Water Oil and Gas Industry: A Review to Guide Management Strategies. *Frontiers in Environmental Science* Volume 4 | Article 58 doi: 10.3389/fenvs.2016.00058

Costa A & Siteo, A (2008). Marine Turtles of the Primeiras and Segundas Islands. Unpubl.Report.

Costa, A., Motta, H., Pereira, M.A., Videira, E.J., Louro, C.M., João, J. (2007). Marine Turtles in Mozambique: towards an effective conservation and management program. *Marine Turtle Newsletter*, 117: 1–3.

Cruz, L.M., Shillinger, G.L., Robinson, N.J., Tomillo, P.S. & Paladino, F.V. (2018) Effect of light intensity and wavelength on the in-water orientation of olive ridley turtle hatchlings. *Journal of Experimental Marine Biology and Ecology*, 505, 52-56.

CSA, 2007. *Aerial census surveys of marine mammals and sea turtles within the Rovuma Concession Block and Parque Nacional das Quirimbas, Mozambique*. In: Specialist studies for a proposed offshore seismic survey in Rovuma offshore Area 1. Environmental Impact Report, Vol. III, Anadarko Mozambique Area 1, Lda and Empresa Nacional de Hidrocarbonetos, EP, 33 pp.

Cunha, T. 2019. Estudo de Caso: Cabo Delgado (Moçambique), a terra onde não se come o que se produz e produz o que não se come

D'Appolonia & Fugro, 2014. Mozambique Program: Nearshore Geophysical, Geotechnical and Environmental Survey. Final report environmental survey– Tungue Bay

Dankverts, D.K., McQuaid, C.D., Jaeger, A., McGregor, G.K., Dwight, R., Le Corre, M. & Jaquemet, S. 2014. Biomass consumption by breeding seabirds in the western Indian Ocean: indirect interactions with fisheries and implications for management. *ICES Journal of Marine Science* 71 (9): 2589-2598.

Day R.H., Rose J.R., Prichard A.K., Streever B. (2015) Effects of Gas Flaring on the Behaviour of Night- Migrating Birds at an Artificial Oil-Production Island, Arctic Alaska. *Arctic*. 68, 367–379.

de Boer M.N., Baldwin, R., Burton, C.L.K., Eyre, E.L., Jenner, K.C.S., Jenner, M.N.M., Keith, S.G., McCabe, K.A., Parsons, E.C.M., Peddemors, V.M., Rosenbaum, H.C., Rudolph, P. and Simmonds, M., 2002. *Cetaceans in the Indian Ocean Sanctuary: A Review*. Whale and Dolphin Conservation Society, 52 pp.

de Paula e Silva, R., Sousa, M. & Carmelo, A. (1993). The Maputo Bay ecosystem (Mozambique). In *Trophic Models of Aquatic Ecosystems*: 214–223. Christensen, V. & Pauly, D. (Eds.). Philippines: ICLARM Manila.

De Ruijter, W.P.M., Ridderinkhof, H., Lutjeharms, J.R.E., Schouten, M.W. & Veth, C. (2002). Observations of the flow in the Mozambique Channel. *Geophys. Res. Lett.* 29, 141–143.

Deppe L., Rowley O., Rowe L.K., Shi N., McArthur N., Gooday O., Goldstien S.J. (2017) Investigation of fallout events in Hutton's shearwaters (*Puffinus huttoni*) associated with artificial lighting. *Notornis*. 64(4): p. 181-191.

Diamantopoulou C., Christoforou E., Dominoni D.M., Kaiserli E., Czyzewski J., Mirzai N., Spatharis S. (2021) Wavelength-dependent effects of artificial light at night on phytoplankton growth and community structure. *Proceedings of the Royal Society B: Biological Sciences*, Volume 288, Issue 1953.

EAME, 2004. *The Eastern African Marine Ecoregion*. Biodiversity Conservation Strategic Framework 2005 - 2025 Dar es Salaam, Tanzania.

EEA (2013). Mozambique – Area 4. Technical Specification for Offshore Deep Geotechnical and Environmental Monitoring Survey. Document 4402 00 FGSS 10007. Eni S.p.A. Exploration & Production Division.

Elkins N, 1988. Weather and bird behaviour. Second edition. T & AD Poyser, Calton, Staffordshire, England.

Emmel B., R. Kumar, J. Jacobs, K. Ueda, M. Van Zuilen and R. Matola (2013). The Low-temperature thermochronological record of sedimentary rocks from the central Rovuma Basin (N Mozambique) – Constraints on provenance and thermal history. *Gondwana Research* 25, p 1216-1229. Elsevier.

ENERDATA (2023). *Mozambique Energy Information*. Available online at <https://www.enerdata.net/>.

EnergyCapitalPower (2023). Ncondezi Energy Secures Land Agreement for Solar Project in Mozambique. Available online at <https://energycapitalpower.com/ncondezi-energy-solar-project-mozambique/>.

ENI & FFI, 2013. *Application of the Mitigation Hierarchy to Inform Project Development Options for Mozambique Rovuma Area 4. Biodiversity and Ecosystem Services Mitigation Hierarchy Matrix on Deepwater*. eni e&p division AMTE / Fauna & Flora International. 29 September 2013.

Eni Doc. 440200BRRS01016, Mozambique Program, Deepwater Geotechnical and Environmental Surveys, Integrated Report, June 2017.

Eni Doc. 440206FGCS83101, Desk Study, Coral North and 505E Geophysical, Geotechnical and Metocean Data. Rev. 01, November 2021.

Eni (2023). Eni Doc. 4404UUDNRZ004S1, Coral South TMS – Extreme and Survival Analysis Report

Eni Exploration & Production (2014). Mozambique Mozambique Program Metocean Design Basis for FLNG (Coral) 05 CS-FS 25/08/2014 Final Issue Issue for comments.

ENI, 2023. *Environmental and Social Performance Report of Coral South Project – 08. August 2023*. Eni East Africa, S.p.A.

eni. (2014). Mozambique Program. METEOCEAN DESIGN BASIS FOR FLNG (CORAL). eni.

ERM & ENI (2016). *Floating Liquefied Natural Gas - Environmental Management Plans - Environmental Baseline Report*. October 2016

ERM & Impacto (2013). *Environmental Baseline – Offshore and near shore*. Report to Anadarko and ENI, Chapter 7, 98 pp.

ERM & Impacto (2014). Environmental Impact Assessment Report for the Liquefied Natural Gas Project in Cabo Delgado. Final EIA Report.

ERM (2014). Illumination Specialist Study for the FLNG Project in Area 4 of the Rovuma Basin, Mozambique – Impact Assessment Report.

ERM (2014). Oceanography Specialist Study for the FLNG Project in Area 4 of the Rovuma Basin, Mozambique –Draft Produced Water Discharge Modelling Report.

ERM (2014b). *Oceanography Specialist Study: Drill Cuttings Discharge Modeling Report. Floating Liquefied Natural Gas (FLNG) Project in Area 4 of the Rovuma Basin, Mozambique*. October 2014. Eni East Africa, S.p.A.

ERM (2014f). *Underwater Noise Specialist Study for the FLNG Project in Area 4 of the Rovuma Basin, Mozambique*. October 2014. Eni East Africa, S.p.A.

ERM (2016). *Critical Habitat Screening and Assessment. FLNG Project*. October 2016.

ERM (2016). *Critical Habitat Screening and Assessment. Floating Liquefied Natural Gas (FLNG) Project in Area 4 of the Rovuma Basin, Mozambique*. October 2016. Eni East Africa, S.p.A

ERM (2016). *Floating Liquefied Natural Gas Project. Environmental Baseline Report*. eni east africa, S.p.A. August, 2016.

ERM (2019). Oceanography Specialist Study: Produced Water Discharge Modeling Report - Coral South Project in Area 4 of the Rovuma Basin, Mozambique.

Federal Transit Administration (2006). Transit Noise and Vibration Impact Assessment, May 2006.

Fennelly, L., Jones, L., Power, D., McLean, C., Joyce, T., (2014). *Marine mammal observation and passive acoustic monitoring report. 3D Seismic survey, Area 4, Rovuma Basin, Mozambique*. Report to Polarcus/ENI East Africa, 18 pp.

Fernandes R S, Williams J L, Gonzalez S, Muaves L, Louro CMM & Pereira MAM, (2017). *Monitoring, tagging and conservation of marine turtles in Mozambique: Annual report 2016/17*. 30 pp. Maputo, CTV.

Fernandes RS, Williams J L, Gonzalez-Valladolid S, Muaves L & Pereira MAM, (2018). *Monitoring, tagging and conservation of marine turtles in Mozambique: Annual report 2017/18*. 42 pp. Maputo, CTV.

Fernandes RS, Williams J L, Louro CMM & Pereira MAM, (2014). *Monitoring, tagging and conservation of marine turtles in Mozambique: annual report 2013/14*. 6 pp. Maputo, CTV.

Fernandes RS, Williams J, Trindade J & Pereira MAM, (2015). *Monitoring, tagging and conservation of marine turtles in Mozambique: annual report 2014/15*. 21 pp. Maputo, CTV.

Fernandes, R. S., G. E. Inteca, J. L. Williams, A. Tajú, L. Muaves, & M. A. M. Pereira (2020). *Monitoring, tagging and conservation of marine turtles in Mozambique: Annual report 2018/19*. 36 pp. Maputo, CTV.

- Fernandes, RS, Inteca GE, Williams JL, Muaves L & Xavier M, (2021). Monitoring, tagging and conservation of marine turtles in Mozambique: Annual report 2019/20. 59 pp. Maputo, CTV. Ferreira, M.A., F. Andrade, P. Cardoso, J. Paula, 2009a. Coastal habitat mapping along the Tanzania/Mozambique transboundary area using Landsat TM5 imagery. *Western Indian Ocean Journal of Marine Science*, 8: 1-13.
- Ferreira, M. A., F. Andrade, S. O. Bandeira, P. Cardoso, R. Nogueira Mendes, J. Paula, (2009b). *Analysis of covers change (1995-2005) of Tanzania/Mozambique transboundary mangroves using Landsat imagery*. Aquatic Conservation: Marine and Freshwater Ecosystems, 19: 38-45.
- Findlay, K. P., Cockcroft, V. G., & Guissamulo, A. T. (2011). Dugong abundance and distribution in the Bazaruto Archipelago, Mozambique. *African Journal of Marine Science*, 33(3), 441-452.
- Findlay, K., Meyer, M., Elwen, S., Kotze, D., Johnson, R., Truter, P. & Van Derwesthuizen, J. (2020). Distribution and abundance of humpback whales, *Megaptera novaeangliae*, off the coast of Mozambique, 2003. *J. Cetacean Res. Manage.*, 163-174.
- Finneran J. J., Jenkins A. K. (2012), "Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis", SSC Pacific Technical Report, April 2012.
- Fischer, R., 2000. *Bow thruster induced noise and vibration*. Paper presented at Dynamic Positioning Conference, October 17 – 18, 2000.
- Fishpool, L. D. C. and Evans, M. I., eds (2001) *Important Bird Areas in Africa and Associated Islands: Priority Sites for Conservation*. Pisces Publications; Cambridge: Birdlife International, 2001.
- Fleming, A. & Jackson, J., (2011) *Global Review of Humpback Whales (Megaptera novaeangliae)*. U.S. Department of Commerce, NOAA Technical Memorandum NMFS, NOAA-TM- NMFS-SWFSC-474 (206 pp.).
- Fobert E.K., da Silva K., Swearer S.E. (2019) Artificial light at night causes reproductive failure in clownfish. *Biology Letters*. Volume 15, Issue 7.
- Freiwald, A. & Roberts, L. (2005). Cold-Water Corals and Ecosystems. Berlin: Springer.
- Fricke, H., Reinicke, O., Hofer, H., and Nachtigall, W. (1987). Locomotion of the coelacanth *Latimeria chalumnae* in its natural environment. *Nature* 329, 331–333.
- Fritsches, K.A. (2012) Australian Loggerhead Sea turtle hatchlings do not avoid yellow. *Marine and Freshwater Behaviour and Physiology*, 45(2), 79-89. doi:10.1080/10236244.2012.690576
- Frontier Mozambique (1997). Whittington M.W. & M. Myers (eds). *Introduction and Methods. Marine Biological and Resource Use Surveys of the Quirimba Archipelago*. Frontier Mozambique Environmental Research Report 1. Society for Environmental Exploration, London and Ministry for the Co-ordination of Environmental Affairs, Maputo
- Fugro (2016). Eni Doc. 440200BRRV01064_CDFE04, Environmental Baseline Survey Report, Coral.
- Fugro (2016). *Marine Fauna Observation (MFO) Report Coral and Mamba Fields*. Unpubl. Rep.

Fugro (2016b). Eni Doc. 440200BRRV01066_CDFE04, Mozambique Program, Deepwater Geotechnical and Environmental Surveys – Marine Fauna Observation (MFO) Report Coral and Mamba Fields.

Fugro (2017a). ROV Final Report, Fugro Report No. N5946-D3108-002-N0 ROV, EDAM Ref. 440200BRRS01080. Wallingford: Fugro GeoConsulting Ltd.

Fugro (2017b). Shelf Break Model – Geological and Geotechnical Testing Report – ROV Samples. Fugro Report No. J31144-R-002(02), EDAM Ref. 440200BRRS01049. Wallingford: Fugro GB Marine Limited. Fugro (2019a). Mozambique Program – Offshore/Onshore Geohazard, Geophysical and Geotechnical Survey: Rovuma LNG Phase 1 Project – Environmental Baseline Survey Report - Package E1

Fugro (2019). Eni Doc 440206BGRS50048_CDFE, Coral South Marine Biodiversity Baseline Monitoring Report.

Fugro (2019a). Eni Doc. 440206BGRS50002_CDFE02, Offshore/Onshore Geohazard, Geophysical and Geotechnical Survey: Environmental Baseline Survey Report – Package E1.

Fugro (2019b). Eni Doc. 440206BGRS50017_CDFE02, Offshore/Onshore Geohazard, Geophysical and Geotechnical Survey: Marine Fauna Observation (MFO) Report.

Fugro, (2016a). Mozambique program – Deepwater geotechnical and environmental surveys – environmental baseline survey report Mamba. Unpubl. Rep.

Fugro, (2016b). Mozambique program – deepwater geotechnical and environmental surveys – environmental baseline survey report Coral. Unpubl. Rep.

Fugro, 2019b. Marine fauna observation (MFO) report. Mozambique. offshore/onshore geohazard, geophysical and geotechnical survey. Rovuma LNG Phase 1 Project. Unpubl. Rep.

Fugro. (2013). Metocean survey offshore Mozambique Rovuma basin area 4.

Fugro. (2016a). Eni Doc. 440200BRRV01065_CDFE04, Mozambique Program, Deepwater Geotechnical and Environmental Surveys – Environmental Baseline Survey Report Mamba.

Garnier J., Hill N., Guissamulo A., Silva I, Witt M & Godley B. (2012). Status and community-based conservation of marine turtles in the Northern Querimbas Islands (Mozambique). *Oryx*. 46(3): 359-367.

Garnier, J. (2003). *Cabo Delgado Biodiversity and Tourism Project. Management Plan (2003–2006)*. Cabo Delgado Biodiversity and Tourism Project, Bairro Natite, Pemba, Mozambique.

Garrison, L. and Rosel, P. (2017). *Partitioning short-finned and long-finned pilot whale bycatch estimates using habitat and genetic information*. NOAA National Marine Fisheries Service, Southeast Fisheries Science Center, Protected Resources and Biodiversity Division Contribution No. PRBD-2016-17.

Garthe, S., Schwemmer, H., Peschko, V. (2023). Large-scale effects of offshore wind farms on seabirds of high conservation concern. *Sci Rep* 13, 4779.

- Gedamke J, Robinson SM. 2010. Acoustic survey for marine mammal occurrence and distribution off East Antarctica (30–80° E) in January–February 2006. *Deep-Sea Research II* 57: 968–981
- Gell, F.R., Whittington, M.W., 2002. Diversity of fishes in seagrass beds in the Quirimbas Archipelago, northern Mozambique. *Marine and Freshwater Research*, 53: 115-121.
- GeoTeam, 2017a. Field Report Wet Season (March-April 2017) BES Benthic Habitats and Associated Species - Field data report Document 440202BFRV00412 produced for Eni. S.p.A
- GeoTeam, 2017b. Field Report Dry Season (November-December 2017) BES Benthic Habitats and Associated Species - Field data report Document 440202BFRV00419 produced for Eni. S.p.A.
- Gil, F. (12 de September de 2020). Cabo Delgado: Insurgentes incendiaram todas estâncias turísticas de Vamisse. Obtido de Moçambique para todos: <http://macua.blogs.com>
- Glass J.P., Ryan P.G. (2013) Reduced seabird night strikes and mortality in the Tristan rock lobster fishery. *African Journal of Marine Science*. 35, 589 – 592.
- GNBR, 2010. *Biodiversity baseline of the Quirimbas National Park, Mozambique*. 104 pp. Final Report. GNBR.
- Google Maps. (2023, June 110). Retrieved from <https://www.google.com/maps>
- Gorsky, G., & Fenaux, R. (1998). The role of Appendicularia in marine food webs. The biology of pelagic tunicates, 161-169.
- Gove, D., Magane, S. (1996). *The status of sea turtle conservation in Mozambique*, pp. 89-94. In: S.L. Humphrey and R.V. Salm (eds.), *Status of sea turtle conservation in the western Indian Ocean*. IUCN/UNEP Regional Seas Reports and Studies No.165.
- Governo do Distrito de Palma. 2023. Informe do Governo do Distrito por Ocasão da Visita de Sua Excelência Filipe Jacinto Nyusi, Presidente da República de Moçambique
- Guissamulo A.T., 1996. *Current status of marine mammal research in Mozambique*. In: Proceedings of the Seminar: o papel da investigação na gestão da zona costeira. Department of Biological Sciences, UEM, Maputo.
- Gullström, M., de la Torre Castro, M., Bandeira, S. O., Björk, M., Dahlberg, M., Kautsky, N., ... Öhman, M. C. (2002). *Seagrass Ecosystems in the Western Indian Ocean*. *AMBIO: A Journal of the Human Environment*, 31(7), 588–596. doi:10.1579/0044-7447-31.7.588
- Gumbs, R., Gray, C.L., Böhm, M., Burfield, I.J., Couchman, O. R., Faith, D.P., Forest, F., Hoffmann, M., Isaac, N.J.B., Jetz, W., Mace, G.M., Mooers, A.O., Safi, K., Scott, O., Steel, M., Tucker, C.M., Pearse, W.D., Owen, N.R. & Rosindell, J. 2023. The EDGE2 protocol: Advancing the Prioritization of Evolutionarily Distinct and Globally Endangered species for practical conservation action. *PLOS Biology* <https://doi.org/10.1371/journal.pbio.3001991>
- Gutierrez *et al.* (2021). Atlas. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. (Online).

- Harari, N. (2005). Literature Review on the Quirimbas National Park, Northern Mozambique.
- Harewood, A., Horrocks, J.A. (2008) Impacts of coastal development on hawksbill hatchling survival and swimming success during the initial offshore migration. *Biological Conservation*, 141, 394-401.
- Harrison, J. A., & Cherry, M. (1997). The atlas of southern African birds. *Nature*. 389(6646):
- Harrison, P., Perrow, M. R. & Larsson, H. (2021) *Seabirds. The New Identification Guide*. Lynx Edicions, Barcelona.
- Harvey E.S., Watts, S.L., Saunders, B.J., Driessen, D., Fullwood, L.A.F., Bunce, M., Songploy, S., Kettratad, J., Sitaworawet, P., Chaiyakul, S., Elsdon, T.S. and Marnane, M.J. (2021) Fish Assemblages Associated With Oil and Gas Platforms in the Gulf of Thailand. *Front. Mar. Sci.* 8:664014.
- Hayes, F. E. (1995). Definitions for migrant birds: What is a Neotropical migrant?. *The Auk* 112(2): 521-523.
- Hays, G.C. (2003) A review of the adaptive significance and ecosystem consequences of zooplankton diel vertical migrations. *Hydrobiologia* 503, 163–170.
- HeRAMS. 2022. HeRAMS Cabo Delgado. Relatório de Referência 2022. Estado Operacional das Unidades Sanitárias. Levantamento Exaustivo da Disponibilidade do seu Estado Operacional. HeRAMS
- Heyning J. E. and Mead, J. G. 2009. *Cuvier's beaked whale*, *Ziphius cavirostris*. In: *Encyclopedia of Marine Mammals* (eds Perrin W. F., Wursig B., Thewissen J. G. M.), pp. 294–295. Academic Press, San Diego.
- Hill, D. (1990) The impact of noise and artificial light on waterfowl behaviour: a review and synthesis of the available literature. Norfolk, United Kingdom: British Trust for Ornithology Report No. 61.
- Hill, N., Garnier, J., 2004. *Report on the marine turtle programme 2004*. Cabo Delgado Biodiversity and Tourism Project.
- Hoppenrath, M., Elbrächter, M. and Drebes, G., 2009. Marine phytoplankton: Selected microphytoplankton species from the North Sea around Helgoland and Sylt. *Kleine Senckenberg-Reihe* 49 pp. 264.
- Horton, T., Kroh, A., Ahyong, S., Bailly, N., Boyko, C. B., Brandão, S. N., Gofas, S., Hooper, J. N. A., Hernandez, F., Holovachov, O., Mees, J., Molodtsova, T. N., Paulay, G., Decock, W., Dekeyzer, S., Poffyn, G., Veneitte, L., Vanhoorne, B., Adlard, R., Zhao, Z. (2021). *World Register of Marine Species*. Available from <https://www.marinespecies.org> at VLIZ. Accessed 2021-07-15.
- Hu, Z., Hu, H., Huang, Y. (2018). Association between nighttime artificial light pollution and sea turtle nest density along Florida coast: A geospatial study using VIIRS remote sensing data. *Environmental Pollution* 239: 30–42.

- Huang Z, Xu Z, Quan Y, Jia H, Li J, Li Q, Chen Z, Pu K. 2018. A review of treatment methods for oil-based drill cuttings. IOP Conf. Series: Earth and Environmental Science. 2018;170:022074. <https://doi.org/10.1088/1755-1315/170/2/022074>
- Hughes, G. 1971. Preliminary report on the sea turtles and dugongs of Mozambique. *Veterinaria Moçambicana*, 4 (2): 45-62.
- IDPPE. (2012). Projecto de Promoção da Pesca Artesanal (Propesca). Pólo de Crescimento de Palma (Província de Cabo Delgado). Plano de Acção. Versão Preliminar. Maputo
- IFC (2007). *Environmental, Health and Safety Guidelines. General EHS Guidelines: Environmental. Air Emissions and Ambient Air Quality*. April 30, 2007.
- IFC (2012). IFC Performance Standards on Environmental and Social Sustainability. International Finance Corporation, World Bank Group.
- IFC (2013). Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. International Finance Corporation, World Bank Group.
- IFC (2019). *Guidance Note 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources*. Washington DC, USA: International Finance Corporation.
- Imber (1975) Behavior of petrels in relation to the moon and artificial lights. *Notornis* 22: 302-306.
- IMO (International Maritime Organization), 2004, *Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life*.
- IMO (International Maritime Organization), 2011. *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*. Adopted at the 62 session of the Marine Environment Protection Committee on 15 July 2011.
- Impacto, 2008. Relatório do Estudo de Impacto Ambiental do Projecto de Perfuração de Poços de Prospecção de Hidrocarbonetos em Águas Profundas na Área 1 da Bacia do Rovuma, Moçambique.
- Impacto, 2012. Projecto de Avaliação Ambiental Estratégica da Zona Costeira – Moçambique. Volumes I, II e III – Versão Preliminar. Ministério para a Coordenação da Acção Ambiental.
- INDPA. 2017. Relatório do Inquérito aos Agregados Familiares dos Pescadores e Aquacultores da Província de Cabo Delgado
- INE (2017). Instituto Nacional de Estatística. Resultados Finais do Recenseamento Geral da População e Habitação. Moçambique.
- INE. 2017. Censo 2017, Cabo Delgado
- INE. 2022. Inquérito sobre Orçamento Familiar – IOF 2022, Relatório Final
- INE. 2023a. Estatísticas do Distrito de Palma, 2017-2021
- INE. 2023b. Estatísticas do Distrito de Pemba, 2017-2021

International Organization for Standardization (2003). ISO 1996-1:2017 Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures, Geneva, 2003.

International Organization for Standardization (2003). ISO 1996-2:2018 Description and measurement of environmental noise - Part 2: Acquisition of data pertinent to land use, Geneva.

International Organization for Standardization (2003). ISO 1996-3:2018 Description and measurement of environmental noise - Part 3: Application to noise limits, Geneva (Suíça).

IPCC (2023). Sections. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647.

IPIECA (International Petroleum Industry Environmental Conservation Association), 2007. *Oil Spill Preparedness and Response. Guide to Tiered Preparedness and Response*. IPIECA Report Series, Volume XIV.

IPIECA. 2013. Integrating human rights into environmental, social and health impact assessments: A practical guide for the oil and gas industry

IPIECA (2020). Estimating the costs of physical climate risk: an exploration of approaches.

IUCN (2023). The IUCN Red List of Threatened Species. Version 2022-2. <https://www.iucnredlist.org>

IUCN-Marine Mammal Protected Areas Task Force, 2021. South West Madagascar and Mozambique Channel IMMA Factsheet. <https://www.marinemammalhabitat.org/wpcontent/uploads/imma-factsheets/WesternIndianOcean/south-west-madagascarmozambique-channel-WesternIndianOcean.pdf>. Downloaded on 30 september 2023.

Jalkanan J-P, Johansson L., Liefvendahl M., Bensow R., Sigray P., Östberg M, Karasalo I., Andersson M., Peltonen H., Pajala J., (2018), "Modelling of ships as a source of underwater noise", Ocean Science 14, 1373–1383, 2018.

Jaquemet, S., Ternon, J. F., Kaehler, S., Thiebot, J. B., Dyer, B., Bemanaja, E., & Le Corre, M. (2014). Contrasted structuring effects of mesoscale features on the seabird community in the Mozambique Channel. Deep Sea Research Part II: Tropical Studies in Oceanography, 100, 200-211.

Jefferson, Thomas & Weir, Caroline & Anderson, R Charles & Ballance, Lisa & Kenney, Robert & Kiszka, Jeremy. (2014). Global distribution of Risso's dolphin Grampus griseus: A review and critical evaluation. Mammal Review. 10.1111/mam.12008.

JNCC (Joint Nature Conservation Committee), 2010. *Statutory Nature Conservation Agency Protocol for Minimizing the Risk of Injury to Marine Mammals from Piling Noise*. United Kingdom.

Kalk, M. (1995). A natural history of Mozambique. 3rd edn. Johannesburg.

Kamrowski R.L., Pendoley K., Hamann M. (2014) Influence of industrial light pollution on the sea-finding behaviour of flatback turtle hatchlings. Wildlife Research 41:421-434.

- Kawakami, T. A. K. E. H. I. K. O. (1980). A review of sperm whale food. *Sci. Rep. Whales Res. Inst.* 32: 199-218.
- Kebodeaux, T.R. (1994). Increased sea turtle sightings present no cause for concern. *Underwater Magazine*.
- Kennedy, M., & Spencer, H. G. (2014). Classification of the cormorants of the world. *Molecular Phylogenetics and Evolution*, 79, 249-257.
- Kiszka, J. (2015). *Vulnerable Teleost fish*. In: van de Elst, R.P. and Everett B.I. (eds). Offshore fisheries of the Southern Indian Ocean: their status and the impact on vulnerable species. Oceanographic Research Institute, Special Publication. 10. pp 305-323.
- Kiszka, J., Ersts, P. J., Ridoux, V., 2007. Cetacean diversity around the Mozambique Channel island of Mayotte (Comoros archipelago). *Journal of Cetacean Research and Management*, 9 (2): 105-109.
- Knapp, S., Schweiger, O., Kraberg, A., Asmus, H., Asmus, R., Brey, T., Frickenhaus, S. Gutt, J., Kühn, I., Liess, M., Musche, M., Pörtner, H-O., Seppelt, R., Klotz, S., Krause, G. 2017. Do drivers of biodiversity change differ in importance across marine and terrestrial systems — Or is it just different research communities' perspectives? *Science of The Total Environment* 574: 191-203.
- Kyba, C.C.M., Ruhtz, T., Fischer, J. & Hölker, F. (2011) Cloud coverage acts as an amplifier for ecological light pollution in urban ecosystems. *PloS ONE*, 6(3): e17307.
- Lambardi, L., Lutjeharms, J.R.E., Mencacci, R., Hays, G.C., Luschi, P. (2008). Influence of ocean currents on long-distance movement of leatherback sea turtles in the Southwest Indian Ocean. *Marine Ecology Progress Series*, 353: 289-301.
- Landsberg, F., Treweek, J., Mercedes, M. (2013). Weaving Ecosystem Services Into Impact Assessment. A Step-By-Step Method. Version 1.0. World Resources Institute.
- Laran, S., Authier, M., Van Canney, O., Dorémus, G., Watremez, P. & Ridoux, V. 2017. A Comprehensive Survey of Pelagic Megafauna: Their Distribution, Densities, and Taxonomic Richness in the Tropical Southwest Indian Ocean. *Frontiers in marine Science* vol 4 <https://doi.org/10.3389/fmars.2017.00139>.
- Lauridsen, H., Pedersen, J.M.H., Ringgaard, S. et al. Buoyancy and hydrostatic balance in a West Indian Ocean coelacanth *Latimeria chalumnae*. *BMC Biol* 20, 180 (2022). <https://doi.org/10.1186/s12915-022-01354-8>.
- Lawrence, P.L. (2007). Impact significance determination – Designing an approach. *Environmental Impact Assessment Review*, Vol. 27, pp. 730 – 754.
- Le Corre M., Jaquemet S. (2005). Assessment of the seabird community of the Mozambique Channel and its potential use as an indicator of tuna abundance. *Estuarine, Coastal and Shelf Science* 63(3): 421–428.
- le Corre M., Ollivier A., Ribes S., Jouventin P. (2002) Light-induced mortality of petrels: a 4-year study from Réunion Island (Indian Ocean). *Biological Conservation* 105:93-102.

- Leeney R. H. (2017). Are sawfishes still present in Mozambique? A baseline ecological study. PeerJ, 5, e2950. <https://doi.org/10.7717/peerj.2950>
- Limpus, C.J., R.L. Kamrowski (2013) Ocean-finding in marine turtles: The importance of low horizon elevation as an orientation cue. Behaviour. 150: p. 863-893.
- Lohmann, C.M.F., Lohmann, K.J. (1992) Geomagnetic orientation by sea turtle hatchlings. In: Proceedings of the 12th International Symposium on Sea Turtle Biology and Conservation (eds. J.I. Richardson & T.H. Richardson), Jekyll Island.
- Lohmann, K.J., Witherington B.E., Lohmann C.M.F. Salmon M. (1997) Orientation, navigation, and natal beach homing in sea turtles. In: The Biology of Sea Turtles. Volume I, P.L. Lutz and J.A. Musick, Editors., CRC Press: Washington D.C. p. 107-135.
- Longcore T., Rich C., Mineau P., MacDonald B., Bert D.G., Sullivan L.M., Mutrie E., Gauthreaux S.A., Avery M.L., Crawford R.L., Manville A.M., Travis E.R., Drake D. (2013) Avian mortality at communication towers in the United States and Canada: Which species, how many, and where? Biological Conservation 158:410-419.
- Louro C MM, Litulo C, Pereira MAM, & Pereira TIFC, (2017). *Investigação e monitoria de espécies e ecossistemas nas áreas de conservação marinhas em Moçambique: Parque Nacional das Quirimbas 2016*. 43 pp. Maputo, Centro Terra Viva.
- Louro CMM & Fernandes R, (2013). *Monitoring, tagging and conservation of marine turtles in Mozambique: annual report 2012/13*. Maputo. CTV.
- Louro CMM, Pereira AM & Costa ACD, (2006). Report on the conservation status of marine turtles in Mozambique.
- Louro CMM, Videira EJS, Pereira MAM, Fernandes R, 2012. *Monitoring, tagging and conservation of marine turtles in Mozambique: annual report 2011/12*. Maputo. CTV/AICM
- Macamo, C., Nicolau, D., Machava, V., Chitará. S. & Bandeira. S. (2021). A contribution to Mozambique's biodiversity offsetting scheme: Framework to assess the ecological condition of mangrove forests. UEM, Biofund, WCS, COMBO. Maputo.
- Machovsky-Capuska, G., Huynen, L., Lambert, D. Raubenheimer, D. (2011). UVS is rare in seabirds. Vision research. 51. 1333-7. 10.1016/j.visres.2011.04.008.
- Mahanjane, E. S., Franke, D. (2013). The Rovuma delta deep-water fold-and-thrust belt, offshore Mozambique. Tectonophysics 614, p 91-99
- Mahanjane, Estevão. (2014). The Davie Fracture Zone and adjacent basins in the offshore Mozambique Margin – A new insights for the hydrocarbon potential. Marine and Petroleum Geology. 57. 561–571. 10.1016/j.marpetgeo.2014.06.015.
- Marchesan M., Spoto M., Verginella L., Ferrero E.A. (2005) Behavioural effects of artificial light on fish species of commercial interest. Fisheries Research 73: 171-185.

MarineTraffic. (2021). marinetraffic.com. Retrieved August 2, 2021, from <https://www.marinetraffic.com/en/ais/home>

Marquenie, J. Donners, M., Poot, H., Steckel, W. and de Wit, B. (2008) "Adapting the spectral composition of artificial lighting to safeguard the environment", Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications. Nederlandse Aardolie Maatschappij (NAM), The Netherlands, Vol. 5, Iss. 10-12, June 2008 pp. 1-6.

Marquenie, J. Donners, M., Poot, H., Steckel, W. and de Wit, B. (2008) "Adapting the spectral composition of artificial lighting to safeguard the environment", Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications. Nederlandse Aardolie Maatschappij (NAM), The Netherlands, Vol. 5, Iss. 10-12, June 2008 pp. 1-6.

Masden, E.A.; Fox, A.D.; Furness, R.W.; Bullman, R. & Haydon, D.T. (2010). Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework

Massingue, A.O., Bandeira, S.O., 2005. Distribution of Seagrasses and Common Seaweeds Around Nampula Province (Northern Mozambique) with Emphasis on Moçambique Island. *Western Indian Ocean Journal of Marine Science*, 4 (2): 175-184.

MCA 2015. Environmental Impact Assessment Review, Vol. 30, pp. 1-7.

McLaren J.D., Buler J.J., Schreckengost T., Smolinsky J.A., Boone M., van Loon E., Dawson D.K., Walters E.L. (2018) Artificial light at night confounds broad-scale habitat use by migrating birds. *Ecology Letters* 21(3):356-364.

McLaren, J. D., Buler, J. J., Schreckengost, T., Smolinsky, J. A., Boone, M., Emiel van Loon, E., ... & Walters, E. L. (2018). Artificial light at night confounds broad-scale habitat use by migrating birds. *Ecology Letters*, 21(3), 356-364.

McRoy, C. & McMillan, C. (1977). Production Ecology and Physiology of Seagrasses. In *Sea Grass Ecosystems*: 314. McRoy, C. & Helfferich, C. (Eds.). New York: Dekker.

McSweeney DJ, Baird RW, Mahaffy SD, Webster DL, Schorr GS. (2009) Site fidelity and association patterns of a rare species: Pygmy killer whales (*Feresa attenuata*) in the main Hawaiian Islands. *Mar Mamm Sci*. 25:557–72.

McSweeney, C., New, M., and Lizcano, G. (2010). UNDP Climate Change Country Profiles: Mozambique. (Online)

Ménard F, Benivary HD, Bodin N (2014) *Stable isotope patterns in micronekton from the Mozambique Channel*. *Deep Sea Res Part II Top Stud Oceanogr* 100:153–163.

Merkel, F.R. Johansen K.L. (2011) Light-induced bird strikes on vessels in Southwest Greenland. *Marine Pollution Bulletin*. 62: p. 2330-2336.

MICOA (1998). The Biological Diversity of Mozambique. Programa das Nações Unidas para o Desenvolvimento – PNUD. Maputo. Mozambique.

MICOA, 1998. *The Biological Diversity of Mozambique*. Programa das Nações Unidas para o Desenvolvimento – PNUD. Maputo. Mozambique.

Millenium Ecosystem Assessment (2005). *Ecosystems and human well-being: biodiversity synthesis*. World Resources Institute, Washington, DC.

MIMAIP. (2020). *Plano de Gestão da Pescaria de Peixes Demersais de Fundos Rochosos - 2021 - 2025*. Maputo: MIMAIP.

Ministério da Saúde. 2022. *Relatório Anual de Balanço do Sector da Saúde 2021*. Maputo: MISAU - Direcção de Planificação e Cooperação.

MISAU - Direcção de Planificação e Cooperação. 2023. *Boletim Estatístico Mensal de Saúde Fevereiro 2023*. Maputo: MISAU.

Mitkus M., Nevitt G.A., Danielsen J., Kelber A. (2016) Vision on the high seas: spatial resolution and optical sensitivity in two procellariiform seabirds with different foraging strategies. *Journal of Experimental Biology* 219:3329-3338.

MMPATF- Marine Mammal Protected Area Task Force (2009). *Report on criteria for identifying Important Marine Mammal Areas*. Report to the IUCN Species Survival Commission. 24 pp.

Montano, S, Fattorini, S, Parravicini, V, Berumen, ML, Galli, P, Maggioni, D, Arrigoni, R, Seveso, D & Strona, G (2017) Corals hosting symbiotic hydrozoans are less susceptible to predation and disease. *Proc. R. Soc. B* 284: 20172405.

Montevecchi, W.A. (2006). Influences of artificial light on marine birds. In: Rich, C., Longcore, T. (Eds.), *Ecological Consequences of Artificial Night Lighting*. Island Press, Washington, D.C., USA, pp. 94e113.

Mozambique Data Portal. 2022. <https://mozambique.opendataforafrica.org/#>

Mrosovsky N. (1972) The water finding ability of sea turtles. *Brain Behaviour and Evolution* 5:202-225.

Mrosovsky N., Shettleworth S.J. (1968) Wavelength preferences and brightness cues in the water finding behaviour of sea turtles. *Behaviour* 32:211-257.

MRV (2018) *Integrated Environmental Baseline Report: Area 1 and Area 4*. MZLN-EL-RRRPT-00-0012.

Muir, C. E., Kiszka, J. J., & Aragonés, L. (2012). *Eastern African dugongs. Sirenian conservation: issues and strategies in developing countries*. University Press of Florida, Gainesville, 84-90.

Narane DA (2009). *Identificação de habitats e períodos de nidificação de Tartarugas-marinhas na provincia de Cabo Delgado (Quiterajo-Rio Rovuma)*.

National Marine Fisheries Service. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.

National Research Council, Commission on Geosciences, Water Science, Technology Board, Ocean Studies Board, Committee on the Causes and Management of Coastal Eutrophication, 2000. *Clean coastal waters: understanding and reducing the effects of nutrient pollution*. National Academies Press.

National Research Council *et al.* (2003) National Research Council, Committee on potential impacts of ambient noise in the ocean on marine mammals, ocean studies board, and division on earth and life studies . Ocean noise and marine mammals. National Academies Press. Washington, D.C, 2003.

Neenan S. T. V., White P. R., Leighton T. G., Shaw P. J., (2016), “Modeling vessel noise emissions through the accumulation and propagation of Automatic Identification System data”, Proceedings of the Fourth International Conference on the Effects of Noise on Aquatic Life Dublin, Ireland, 10-16 July 2016.

Neff J.M., McKelvie, S., Ayers, R.C., Jr, 2000. Environmental impacts of synthetic based drilling fluids. Report prepared for MMS by Robert Ayers & Associates, Inc. August 2000. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064, 118 pp.

Ng, A. K. Y., & Song, S. (2010). *The environmental impacts of pollutants generated by routine shipping operations on ports*. *Ocean & Coastal Management*, 53(5-6), 301–311. doi:10.1016/j.ocecoaman.2010.03.002

Nguyen K.Q., Winger P.D. (2019) Artificial Light in Commercial Industrialized Fishing Applications: A Review, *Reviews in Fisheries Science & Aquaculture*, 27:1, 106-126, DOI: 10.1080/23308249.2018.1496065.

Niang *et al.* (2014). Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC, pp.1199-1265.

NOAA (National Oceanic and Atmospheric Administration , 2013. <https://www.fisheries.noaa.gov/national/habitat-conservation/deep-sea-coral-habitat>

NOAA. (2016). Open Water Oil Identification Job Aid. Seattle: NOAA.

Nordlund, Lina Mtwana; Gullström, Martin (2013). *Biodiversity loss in seagrass meadows due to local invertebrate fisheries and harbour activities*. *Estuarine, Coastal and Shelf Science*, 135(), 231–240. doi:10.1016/j.ecss.2013.10.019

Observatório do Meio Rural. 2022. Exploring the socio-economic conditions of internally displaced persons in northern Mozambique in 2021

Observatório do Meio Rural. 2023a. Observatório do Meio Rural. 2022. Exploring the socio-economic conditions of internally displaced persons in northern Mozambique in 2021

Observatório do Meio Rural. 2023b. Return of the populations and reconstruction of the northeast of Cabo Delgado – from the weakening of the state to the emergence of a totaland

Obura, D., Church, J. & Gabrié, C. (2012). Assessing Marine World Heritage from an Ecosystem Perspective: The Western Indian Ocean.

Obura, D.O. (2019). World Seas: an Environmental Evaluation || The Northern Mozambique Channel. , (), 75–99. doi:10.1016/B978-0-08-100853-9.00003-8

Obura, D.O., Church, J.E., Gabrié, C., 2012. *Assessing Marine World Heritage from an Ecosystem Perspective: The Western Indian Ocean*. World Heritage Centre, United Nations Education, Science and Cultural Organization (UNESCO), 124 pp.

Ochoa-de-la-Torre, J., Maske, H., Sheinbaum, J., Candela J. (2013). Diel and lunar cycles of vertical migration extending to below 1000 m in the ocean and the vertical connectivity of depth- tiered populations. *Limnology and Oceanography*. 58. 1207-1214. 10.4319/lo.2013.58.4.1207.

Ogeleka D.F and Tudararo-Aherobo L.E. Assessment of the Toxic Effects of Oil-based Drilling Mud (drilling waste) on Brackish Water Shrimp (*Palaemonetes africanus*). *Bull. Env. Pharmacol. Life Sci.*, Vol 2 (8) July 2013: 113-117.

OGP (International Association of Oil & Gas Producers), 2003. *Environmental aspects of the use and disposal of non aqueous drilling fluids associated with offshore oil and gas operations*. OGP (International Association of Oil & Gas Producers) Report nº 342, 103 pp.

Olsen, E., Padera, M., Funke, M., Pires, P., Wenneck, T., Zacarias, L., 2009. *Survey of the living marine resources of North Mozambique (SWIOFP/ASCLME 2009 Cruise 1) 6 August – 20 August 2009*. Preliminary Cruise Report FAO/ASCLME/SWIOFP, 48 pp.

Olsford, F., & Gray, J. S. (1995). A comprehensive analysis of the effects of offshore oil and gas exploration and production on the benthic communities of the Norwegian continental shelf. *Marine Ecology Progress Series*, 122, 277-306.

Olson, P.A. 2018. *Pilot Whales, Globicephala melas and G. macrorhynchus*. In: Würsig, B., Thewissen, J. G. M. and Kovacs, K. M. (eds), *Encyclopedia of Marine Mammals Third Edition*, pp. 701-705. Elsevier, San Diego, California, USA.

Onwuka, O. S., Igwe, O., Ifediegwu, S. I., & Uwom, C. S. (2018). An assessment of the effectiveness of drilling waste treatment process in X-gas field, Niger Delta, Nigeria. *Geology, Ecology, and Landscapes*, 2(4), 288-302.

Osório, C. & T, Silva. 2018. Silenciando a Discriminação: conflitos entre fontes de poder e os direitos humanos das mulheres em Pemba

OSPAR, 2019. Assessment of the disturbance of drill cuttings during decommissioning. Offshore Oil & Gas Industry Series.

Paerl, H.W., 2006. Assessing and managing nutrient-enhanced eutrophication in estuarine and coastal waters: Interactive effects of human and climatic perturbations. *Ecological Engineering*, 26(1), pp.40-54.

Paine, M. D., DeBlois, E. M., Kilgour, B. W., Tracy, E., Pocklington, P., Crowley, R. D., et al. (2014). Effects of the Terra Nova offshore oil development on benthic macro-invertebrates over 10 years of

development drilling on the Grand Banks of Newfoundland, Canada. Deep Sea Res. II 110, 38–64. doi: 10.1016/j.dsr2.2014.10.015

Parry, M. et al., 2015. A Deep-sea Section for the Marine Habitat Classification of Britain and Ireland, Peterborough: JNCC.

Patin, S.A., 1999. *Environmental Impacts of the Offshore Oil & Gas Industry*. Eco Monitor Publishing, East Northport, New York.

Paula, J., Macamo, C. & Bandeira, S. (2014). Mangroves of Maputo Bay. In The Maputo Bay Ecosystem: 427. Bandeira, S. & Paula, J. (Eds.). Zanzibar: WIOMSA.

Pendoley, K. (2000). The Influence of Gas Flares on the Orientation of Green Turtle Hatchlings at Thevenard Island, Western Australia. Presented at the Second ASEAN Symposium and Workshop on Sea Turtle Biology and Conservation, ASEAN Academic Press, Kota Kinabalu, pp. 130–142.

Pendoley, K., Kamrowski R.L. (2015) Influence of horizon elevation on the sea-finding behaviour of hatchling flatback turtles exposed to artificial light glow. Marine Ecology Progress Series. 529: p. 279-288.

Pendoley, K.L. (2005) Sea turtles and the environmental management of industrial activities in northwest Australia (Doctor of Philosophy). Murdoch University, Perth.

Pereira, M. A. M., C. Litulo, R. Santos, M. Leal, R. S. Fernandes, Y. Tibiriçá, J. Williams, B. Atanassov, F. Carreira, A. Massingue & I. Marques da Silva (2014). *Mozambique marine ecosystems review. Final report submitted to Fondation Ensemble*. 139 pp. Maputo, Biodinâmica/CTV.

Pereira, M.A.M., Videira, E.J.S, Narane, D.A., (2009). Monitoria, marcação e conservação de tartarugas marinhas em Moçambique. Relatório anual 2008/09, Maputo, AICM/GTT, 4 pp.

Pereira, M.A.M., Videira, E.J.S, Narane, D.A., Louro, C.M.M., (2010). Monitoring, tagging and conservation of marine turtles in Mozambique. 2009/10 annual report, Maputo, AICM/GTT, 7 pp.

Perryman, W. L. and Danil, K. 2018. *Melon-headed whale - Peponocephala electra*. In: B. Würsig, J. G. M. Thewissen and K. M. Kovacs (eds), *Encyclopedia of Marine Mammals*, pp. 593-595. Academic Press.

Phalan, B., Phillips, R., Silk, R.D., Vsevolod. A., Fukuda, A., fox, J., Paulo, C., Hiroyoshi, H., Croxall, J. (2007). Foraging behavior of four albatross species by night and day. Marine Ecology-Progress Series. 340. 271-286. 10.3354/meps340271.

Politikon. 2022. The Political Economy of Mozambique's Cabo Delgado Insurgency and its Impact on Southern Africa's Regional Security

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernard, M.R. & Marquenie, J.M. 2008. Green light for nocturnally migrating birds. Ecology and Society 13 (2): 47.P

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W. T., Gentry, R., Halvorsen, M. B., Løkkeborg, S., Rogers, P., Southall, B. L., Zeddies, D., and Tavalga,

- W. N. (2014). "Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report," ASA S3/SC1.4 TR-2014 prepared by ANSI Accredited Standards Committee S3/SC1 and registered with ANSI. Springer and ASA Press, Cham, Switzerland.
- Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W. T., Gentry, R., Halvorsen, M. B., Løkkeborg, S., Rogers, P., Southall, B. L., Zeddis, D., and Tavalga, W. N. (2014). "Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report," ASA S3/SC1.4 TR-2014 prepared by ANSI Accredited Standards Committee S3/SC1 and registered with ANSI. Springer and ASA Press, Cham, Switzerland.
- Price, M.E., Randall, M.T., Sulak, K.J., Edwards, R.E. and Lamont, M.M. (2022). Temporal and Spatial Relationships of Yellowfin Tuna to Deepwater Petroleum Platforms in the Northern Gulf of Mexico. *Mar Coast Fish*, 14: e10213.
- Raine H., Borg J.J., Raine A., Bairner S., Borg Cardona M. (2007) Light Pollution and Its Effect on Yelkouan Shearwaters in Malta; Causes and Solutions. BirdLife Malta: Malta: Life Project Yelkouan Shearwater.
- Reed J.R., Sincock J.L. Hailman J.P. (1985) Light attraction in endangered procellariiform birds: Reduction by shielding upward radiation. *Auk* 102:377-383.
- Rich, C., Longcore T., eds. (2006) Ecological consequences of artificial night lighting. Island press: Washington DC. 480.
- Richmond, M. (ed.), 2002. *A field guide to the seashores of Eastern Africa and the Western Indian Ocean Islands*. Sida/SAREC-UDSM, 461 pp.
- Roberts MJ, Ternon J-F, Morris T (2014) Interaction of dipole eddies with the western continental slope of the Mozambique Channel. *Deep Sea Res Part II Top Stud Oceanogr* 100:54–67.
- Roberts, C. M., McClean, C.J., Veron, J. E. N., Hawkins, J. P., Allen, G. R., McAllister, D.E., Mittermeier, C. G., Schueler, F. W., Spalding, M., Wells, F., Vynne, C., Werner, T.B (2002). Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science*, Vol. 295, pp. 1280–1284.
- Roberts, J.M., Wheeler, A.J. & Freiwald, A. (2006). Reefs of the deep: The biology and geology of cold-water coral ecosystems. *Science* (80-.). 312, 543–547.
- Robertson K., Booth D.T., Limpus C.J. (2016) An assessment of 'turtle-friendly' lights on the sea-finding behaviour of loggerhead turtle hatchlings (*Caretta caretta*). *Wildlife Research* 43:27-37.
- Rodríguez A., García D., Rodríguez B., Cardona E.P., Pons P. (2015a) Artificial lights and seabirds: Is light pollution a threat for the threatened Balearic petrels? *Journal of Ornithology* 156:893-902.
- Rodríguez A., Holmes N.D., Ryan P.G., Wilson K.J., Faulquier L., Murillo Y., Raine A.F., Penniman J.F., Neves V., Rodríguez B., Negro J.J., Chiaradia A., Dann P., Anderson T., Metzger B., Shirai M., Deppe L., Wheeler J., Hodum P., Gouveia C., Carmo V., Carreira G.P., Delgado-Alburquerque L., Guerra-Correa C., Couzi F.X., Travers M., Corre M.L. (2017a) A global review of seabird mortality caused by land-based artificial lights. *Conservation Biology*. 31(986-1001).

- Roger C (1994) Relationships among yellowfin and skipjack tuna, their prey-fish and plankton in the tropical western Indian Ocean. *Fish Oceanogr* 3:133–141.
- Roger, C, 1994a. Relationships among yellowfin and skipjack tuna, their preyfish and plankton in the tropical western Indian Ocean. *Fisheries Oceanography*, 3: 133-141.
- Roger, C, 1994b. The plankton of the tropical western Indian Ocean as a biomass indirectly supporting surface tunas (yellowfin, *Thunnus albacares* and skipjack, *Katsuwonus pelamis*). *Environmental Biology of Fishes*, 39: 161-172.
- Rogers, 2004. The biology, ecology and vulnerability of deep-water coral reefs. IUCN.
- Roman, R., Kaehler, S., Michalsen, K., Olsen, M., Perri, M. 2009. *Survey of the Comores Gyre (ASCLME & SWIOFP). 5 October – 3 November 2009*, NORAD - FAO Project GCP/INT/003/NOR, Cruise Reports "Dr. Fridtjof Nansen" EAF - N2009/9, 84 pp.
- Ronconi, R. A., Allard, K. A., & Taylor, P. D. (2015). Bird interactions with offshore oil and gas platforms: review of impacts and monitoring techniques. *Journal of environmental management*, 147, 34–45. <https://doi.org/10.1016/j.jenvman.2014.07.031>
- Ronconi, R.A., Mallard, K.A. Taylor, P.D. (2015). Bird interactions with offshore oil and gas platforms: review of impacts and monitoring techniques. *Journal of Environmental Management*, 147, pp.34-45.
- Rufin, JC; Glowacki, J. 2023. Report on the socioeconomic, humanitarian and human rights situation in the Palma-Afungi-Mocimboa Area (Cabo Delgado)
- Sá, C., M.C. Leal, A. Silva, S. Nordez, E. André, J. Paula, V. Brotas, 2013b. Variation of phytoplankton assemblages along the Mozambique coast as revealed by HPLC and microscopy. *Journal of Sea Research*, 79: 1-11.
- Sabarro PS, Ménard F, Lévêze J-J, et al (2009) Mesoscale eddies influence distribution and aggregation patterns of micronekton in the Mozambique Channel. *Mar Ecol Prog Ser* 395:101–107.
- Saetre, R., Paula e Silva, R., 1979. *The Marine Fish Resources of Mozambique*. Report on survey with the R/V Dr Fridtjof Nansen, 134 pp.
- Sage, B., 1979. Flare up over North Sea birds. *New Sci.* 81, 464-466,
- Sakaue J, Maeda K, Miller MJ, Sakai R, Tahara K-i, Abe H, Maeda K and Ida H (2021) New Insights About the Behavioral Ecology of the Coelacanth *Latimeria chalumnae* Video Recorded in the Absence of Humans Off South Africa. *Front. Mar. Sci.* 8:75 52-75.
- Salmon, M. (2003) Artificial night lighting and sea turtles. *Biologist*, 50: 163-168.
- Salmon, M., Witherington, B.E. (1995) Artificial lighting and seafinding by loggerhead hatchlings: evidence for lunar modulation. *Copeia* 931–938.
- Samaran F, Adam O, Guinet C. 2010. Discovery of a mid-latitude sympatric area for two Southern Hemisphere blue whale subspecies. *Endangered Species Research* 12: 157–165.

- Santos C (2010). *Marine turtles in the North of Mozambique - Notes for their conservation*. MsC Thesis. Univ. de Aveiro, Portugal.
- Santos C.D., Miranda A.C., Granadeiro J.P., Lourenço P.M., Saraiva S., Palmeirim J.M. (2010). Effects of artificial illumination on the nocturnal foraging of waders. *Acta Oecologica* 36:166-172.
- Santos M.B., Martin V., Arbelo M., Fernandez A., Pierce G.J. (2007). Insights into the diet of beaked whales from the atypical mass stranding in the Canary Islands in September 2002. *J. Mar. Biol. Assoc. UK* 87: 243-251.
- Schleyer, M. H., Obura, D., Motta, H. & Rodrigues, M. J., (1999) A preliminary assessment of coral bleaching in Mozambique. In: Lindén, O. & N. Sporrang (eds.). *Coral reef degradation in the Indian Ocean: Status reports and project presentations 1999*. 37–42 pp. Stockholm, CORDIO/SAREC.
- Schoeman, R.P., Patterson-Abrolat, C. & Plön, S. 2020. A Global Review of Vessels Collision with Marine Animals. *Frontiers in Marine Science* vol. 7 <https://doi.org/10.3389/fmars.2020.00292>
- Scoping Report for NMFS EIS for the National Acoustic Guidelines on Marine Mammals (2005). National Marine Fisheries Service.
- Seebens, H., Schwartz, N., Schupp, P. & Blasius, B. 2016. Predicting the spread of marine species introduced by global shipping. *Proc Nat Acad Sci USA* 113 (20) 5646–5651.
- Sequeira, A., Mellin, C., Rowat, D., Meekan, M. G., & Bradshaw, C. J. A. (2012). Ocean-scale prediction of whale shark distribution. *Diversity and Distributions*, 18, 504–518.
- Shapiro 2018. *Mozambique Mangrove Mapping via Satellite from 1994 – present*. WWF. 14pp.
- Shaw, R. F., Lindquist, D. C., Benfield, M. C., Farooqi, T., Plunket, J. T., (2002) Offshore petroleum platforms: functional significance for larval fish across longitudinal and latitudinal gradients. Prepared by the Coastal Fisheries Institute, Louisiana State University. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-077, p. 107.
- Shell (2009) Prelude Floating LNG Project, Draft Environmental Impact Statement (EPBC No. 2008/4146) Shell Development (Australia) Pty Ltd, pp. 77-92.
- Sinclair, I. and Ryan, P. (2003) *A Comprehensive Illustrated Field Guide. Birds of Africa South of the Sahara*. Struik Publishers, Cape Town, 759 p.
- Sitoi, A. A., L. J. C. Mandlate & B. S. Guedes, 2014. Biomass and carbon stocks of Sofala bay mangrove forests. *Forests*, 5: 1967-1981.
- Sommer, U. (Ed.). (2012). *Plankton ecology: succession in plankton communities*. Springer Science & Business Media.
- Soulsby, R. (1997). *Dynamics of marine sands. A manual for practical applications*. London.
- Southall B L, Finneran J J, Reichmuth C, Nachtigall P E, Ketten D R, Bowles A E, Ellison W T, Nowacek D P, Tyack P L (2019). *Marine Mammal Noise Exposure Criteria: Updated Scientific*

Recommendations for Residual Hearing Effects. *Aquatic Mammals* 2019, 45(2), 125-232, DOI 10.1578/AM.45.2.2019.125.

Southall B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas & P. L. Tyack (2007), *Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations*, *Aquatic Mammals*, Volume 33, Number 4.

Southall B. L., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. P. Nowacek and P. L. Tyack (2019) *Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects*, *Aquatic Mammals* 2019, 45(2), 125-232, DOI 10.1578/AM.45.2.2019.125

Southall, B.L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, P. L. Tyack, (2007). "Marine mammal noise exposure criteria: initial scientific recommendations." *Aquatic Mammals* 2007, 33, 411–521.

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P., & Tyack, P.L. (2019). *Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects*. *Aquatic Mammals* 45(2).

Spalding, M D & Leal, M. (eds), (2021). *The State of the World's Mangroves 2021*. Global Mangrove Alliance.

Stadler, J.H. and D.P. Woodbury. (2009). Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. In: *Inter-Noise 2009 Innovations in Practical Noise Control*.

Stapput, K. & Wiltchko, W. (2005). The sea-finding behaviour of hatchling olive ridley sea turtles, *Lepidochelys olivacea*, at the beach of San Miguel (Costa Rica). *Naturwissenschaften*, 92(5): 250-253.

Stehfest, K.M. and Dagorn, L. (2010). Differences in large scale movement between free swimming and fish aggregating device (FAD) caught tuna. IOTC-2010- WPTT-06.

Surman, C. (2002) Survey of the marine avifauna at the Laverda-2 appraisal well (WA-271-P) Enfield Area Development and surrounding waters. Report prepared for Woodside Energy Ltd., Perth.

SWOT (2016). *The State of the World's Sea Turtles - SWOT Report*, Vol. XII.

Syposz, M., Padget, O. Willis, J., Van Doren, B.M., Gillies, N., Fayet, A.L., Wood, M.J., Alejo, A., & Guilford, T. 2021. Avoidance of different durations, colours and intensities of artificial light by adult seabirds. *Scientific Reports* 11: doi: [10.1038/s41598-021-97986-x](https://doi.org/10.1038/s41598-021-97986-x)

TEEB (2010) TEEB for local and regional policy makers. TEEB, Geneva.

Tew-Kai E, Marsac F (2009) Patterns of variability of sea surface chlorophyll in the Mozambique Channel: A quantitative approach. *J Mar Syst* 77:77–88.

Task Force on Climate-Related Financial Disclosures (TCFD) (2017). Recommendations of the Task Force on Climate-related Financial Disclosures.

The Borgen Project (2023). Renewable Energy In Mozambique helps fight poverty. Available online at <https://borgenproject.org/renewable-energy-in-mozambique/>.

The UK National Ecosystem Assessment - Synthesis of Key Findings. UK DEFRA URL

Thomas PO, Reeves RR, Brownell RL. 2015. Status of the world's baleen whales. *Marine Mammal Science* 32: 682–734

Thums, M., Whiting, S.D, Reisser, J.W., Pendoley, K.L., Pattiaratchi C.B., Harcourt, R.G., McMahon, C.R. & Meekan, M.G. (2013) Tracking Sea turtle hatchlings—A pilot study using acoustic telemetry. *Journal of Experimental Marine Biology and Ecology*, 440: 156-163.

Thums, M., Whiting, S.D., Reisser, J., Pendoley, K.L., Pattiaratchi, C.B., Proietti, M., Meekan, M.G. (2016) Artificial light on water attracts turtle hatchlings during their near shore transit. *Royal Society Open Science*, 3(5), 160142.

TRANSMAP (2008a). *Identification of areas of particular conservation and ecological value*. TRANSMAP Deliverable D22, 44 pp

TRANSMAP (2008b). *Description of the status of abundance of species of charismatic fauna*. TRANSMAP Deliverable D11, 85 pp.

UNEP/CMS/COP13, 2020. Light pollution guidelines for wildlife including marine turtles, seabirds and migratory shorebirds. 13th meeting of the Convention of the Parties, India.

UNEP-Nairobi Convention and WIOMSA. (2015). The Regional State of the Coast Report: Western Indian Ocean (546 pp). Nairobi, Kenya: UNEP and WIOMSA.

UNESCO, 2018. Quirimbas Biosphere Reserve, Mozambique. <https://en.unesco.org/biosphere/africa/quirimbas>

United States. National Marine Fisheries Service "Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico" (2020), <https://doi.org/10.25923/hyeh-mb74>

Universidade Rovuma. 2021. Ataques Terroristas em Cabo Delgado (2017-2020): as causas do fenómeno pela boca da população de Mocímboa da Praia

Urick, Robert J. (1983), Principles of Underwater Sound, 3rd Edition. New York. McGraw-Hill.

Van de Greer, CH, Bourjea J., Broderick AC, Dalleau M, Fernandes RS, Harris LR, Inteca G Kiponda FK, Louro CM, Mortimer JA, Msangameno D, Mwasi LD, Nel R, Okemwa GM, Olendo M, Pereira MA, Rees AF, Silva I, Singh S, West L, Williams JL, Godley BJ (2022). Marine turtles of the African east coast: current knowledge and priorities for conservation and research. *Endangered Species Research* Vol. 47: 297–331.

Van Haren H., Compton T. J. (2013) Diel Vertical Migration in Deep Sea Plankton Is Finely Tuned to Latitudinal and Seasonal Day Length. *PLoS ONE* PLOS ONE 8(5): e64435.

- Verheijen, F. J. (1985) "Photopollution: artificial light optic spatial control systems fail to cope with. Incidents, causations, remedies," *Experimental Biology*. Iss. 44, pp. 1–18.
- Videira, E. J. S. & M. A. M. Pereira, 2007. *Rapid assessment of the coral reefs in the Primeiras and Segundas islands, northern Mozambique*. Poster presented at the 5th Scientific Symposium of the Western Indian Ocean Marine Science Association. Durban, 22-26 October 2007.
- Videira, EJS, Pereira, MAM & Louro, CMM (2011). Monitoring, Tagging and Conservation of Marine Turtles in Mozambique: Annual Report 2010/11. Maputo, AICM/GTT.
- WBG (1999). *Pollution Prevention and Abatement Handbook*. The World Bank Group. Washington, D.C.
- WCS, Government of Mozambique & USAID. (2021). Key Biodiversity Areas (KBAs) Identified in Mozambique: Factsheets VOL. II. Red List of threatened species and ecosystems, identification, and mapping of key biodiversity areas (KBAs) in Mozambique. USAID / SPEED+. Maputo. 70pp.
- Wenz G. M., (1962), "Acoustic Ambient Noise in the Ocean: Spectra and sources", *Journal of the Acoustical Society of America*, 34 (12), pp 1936-1956.
- Whittington, M.W., António, C.M., Heaseman, M.S., Myers, M., Stanwell-Smith, D. (1998). *Marine biological and resource use surveys of the Quirimba Archipelago, Mozambique*. Technical Report 6: Results Summary and Management Recommendations, Maputo, SEE/MICOA, 49 pp.
- WHO. 2023. World Health Statistics 2023. Monitoring Health for the Sustainable Development Goals (SDGs). Annex 1. Country, area, WHO region and global health statistics. Geneva: WHO.
- Wiese, F., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W., Linke, J. (2001) Seabirds at risk around offshore oil platforms in the Northwest Atlantic. *Marine Pollution Bulletin*. 42, 1285 – 1290.
- Williams JL, Pierce SJ, Rohner CA, Fuentes MMPB and Hamann M (2017) Spatial Distribution and Residency of Green and Loggerhead Sea Turtles Using Coastal Reef Habitats in Southern Mozambique. *Front. Mar. Sci*. 3:288.
- Wilson, P., Thums, M., Pattiaratchi, C., Meekan, M., Pendoley, K., Fisher, R. & Whiting, S. (2018) Artificial light disrupts the nearshore dispersal of neonate flatback turtles *Natator depressus*. *Marine Ecology Progress Series*, 600, 179-192. doi:<https://doi.org/10.3354/meps12649>
- Wilson, P., Thums, M., Pattiaratchia, C., Whiting, S., Meekan, M., Pendoley, K. (2021) Nearshore wave characteristics as cues for swimming orientation in flatback turtle hatchlings. *Journal of Experimental Marine Biology and Ecology*, Volume 535,
- Wiltschko, W., Munro, U. Ford, H. Wiltschko. R. (1993). Red light disrupts magnetic orientation of migratory birds. *Nature* 364:525–527.
- Witherington, B.E. Bjorndal, K.A. (1991a) Influences of wavelength and intensity on hatchling sea-turtle phototaxis: implications for sea-finding behavior. *Copeia*, 1991(4), 1060-1069.

Witherington, B.E., Martin, R.E. (2003). Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches (FMRI Technical Report No. TR-2). Florida Marine Research Institute, Florida.

World Bank (2012). Sample Guidelines: Cumulative Environmental Impact Assessment for Hydropower Projects in Turkey. Energy Sector Management Assistance Program, World Bank.

WRI (2023). *World Resources Institute's Climate Watch database. Historical GHG Emissions for Mozambique*. Available online at <https://www.climatewatchdata.org/>.

WWF. 2004. Towards a Western Indian Ocean dugong conservation strategy: the status of dugongs in the Western Indian Ocean region and priority conservation actions. WWF Eastern African Marine Ecoregion programme, Dar es Salaam, Tanzania.

Wyat R. (2008). *Joint Industry Programme on Sound and Marine Life Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry*, Issue 1, 2008.

Xodus, 2017. Merlin Subsea Decommissioning Environmental Statement.

Zaeschmar, J.R. 2014. False killer whales (*Pseudorca crassidens*) in New Zealand waters. M.Sc. Thesis, Massey University, New Zealand.