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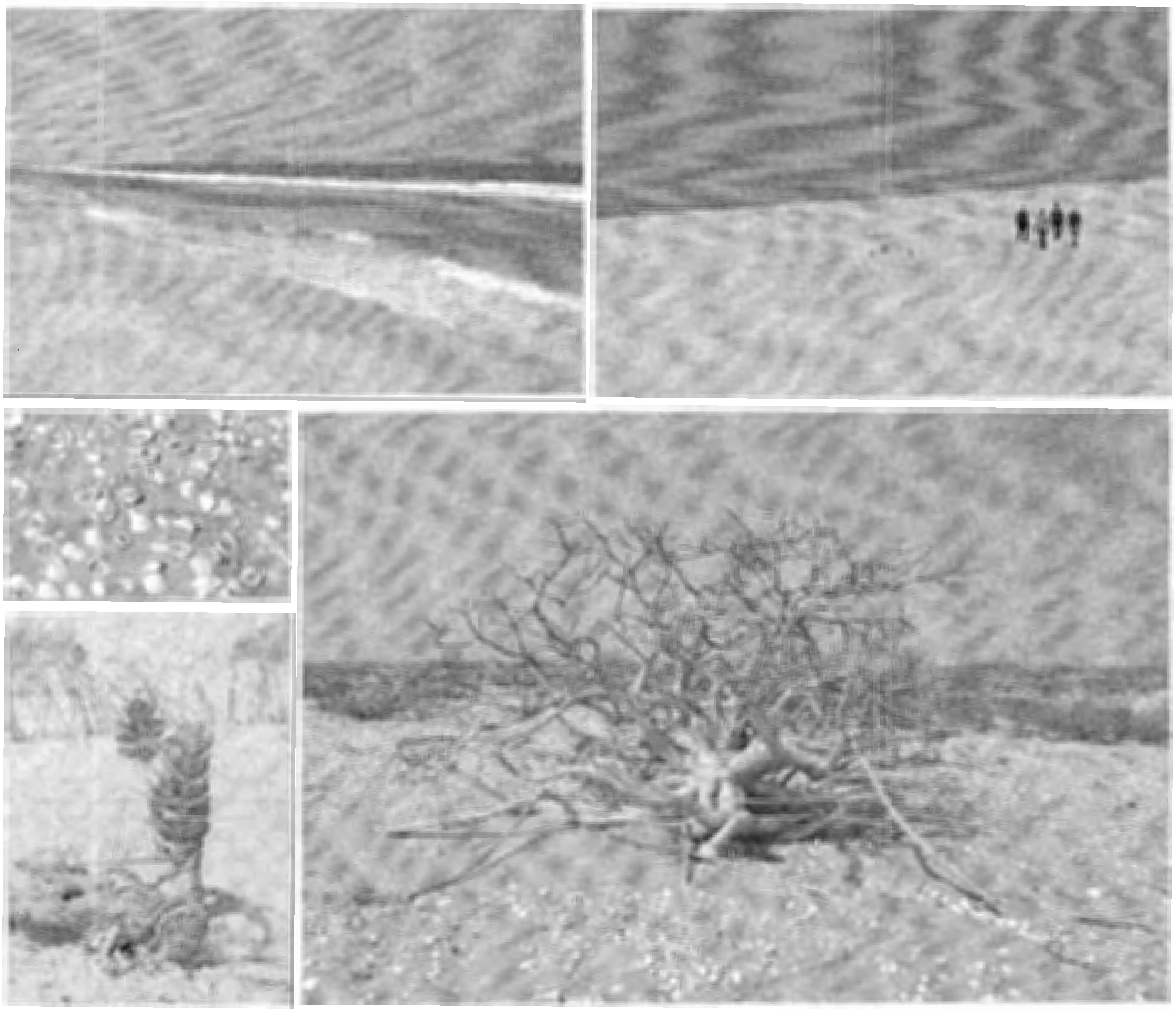

Banda Field Development - Gas Project

Environmental Impact Assessment

August 2013

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FINAL REPORT

Tullow Petroleum (Mauritania) Pty Ltd

Banda Field development - Gas Project

Environmental Impact Assessment

August 2013

Prepared by Environmental Resources Management

For and on behalf of
Environmental Resources Management

Approved by: Camille Maclet

Signed:

Position: Partner

Date: 14 August 2013

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LIST OF ACRONYMS USED IN THIS DOCUMENT

ACE	Africa Coast to Europe (optic fiber)
AETs	Apparent Effects Thresholds
AEWA	African-Eurasian Waterbirds Agreement
ALARP	As Low As Reasonably Practicable
ARPA	Automatic Radar Plotting Aid
BID	Islamic Development Bank *(Banque Islamique de Développement)*
BOD	Biological Oxygen Demand
BOP	Blow-Out Preventer
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CETMO	Centre for Transport Studies for the Western Mediterranean *(Centre d'Etudes des Transports pour la Méditerranée Occidentale)*
CFSR	Climate Forecast System Reanalysis
CLC	International Convention on Civil Liability (for Oil Pollution Damage)
CMS	Convention on Migratory Species
COD	Chemical Oxygen Demand
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
COSIM	Chemical/Oil Spill Impact Module
CR	Critical danger of extinction
DAPL	Protected and Coastal Areas Department (*Direction des Aires Protégées et du Littoral)*
DARO	Resources Management and Oceanography Department (*Direction de l'Aménagement des Ressources et de l'Océanographie)*
DCE	Directorate for Environmental Control (*Direction du Contrôle Environnemental)*
DCQ	Daily Contract Quantity
DHB	Department of Crude Oil (*Direction des Hydrocarbures Brut)*
DMM	Commercial Shipping Department (*Direction de la Marine Marchande)*
DPAC	Artisanal and Coastal Fisheries Department (*Direction des Pêches Artisanales et Côtières)*
DPI	Industrial Fishing Department (*Direction de la Pêche Industrielle)*
DPUE	Pollution and Environmental Emergencies Department (*Direction de la Pollution et des Urgences Environnementales)*
DSPCM	Delegation to the Fisheries Monitoring and Control at Sea *(Délégation à la Surveillance des Sêches et au Contrôle en Mer)*
E&S	Environmental and social
EBS	Environmental Baseline Survey
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Leads
EHS	Environment Health and Safety
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EMS	Environmental Management System
ERM	Environmental Resources Management
ERRV	Emergency Response Rescues Vessel
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agriculture Organization
HC	Hydrocarbon
HFL	Hydraulic Flying Leads
HP	High Pressure
IBA	Important Bird Area

ICSS	Integrated Control and Safety System
IFC	International Finance Corporation
IFC EHS Guidelines	Environmental, health and safety guidelines issued by the International Finance Corporation
IFC PS	The International Finance Corporation's Performance Standards on Social & Environmental Sustainability (current version at the date of issuing of this report is dated 01 January 2012)
IMO	International Maritime Organisation
IMROP	Mauritanian Institute for Oceanographic Research and Fisheries (*Institut Mauritanien de Recherches Oceanographiques et des Pêches)*
IPECA	International Petroleum Industry Environmental Conservation Association
ITCZ	Inter Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
LP	Low Pressure
MBBR	Moving Bed Biological Reactor
MEDD	Ministry for Environment and Sustainable Development (*Ministère de l'environnement et du développement durable)*
MEG	Monoethylene Glycol
MMI	Mauritanian Investment Group
MMscfd	Million standard cubic feet per day
MODU	Mobile Offshore Drilling Unit
MOU	Memoranda of Understanding
MP	Medium Pressure
MPEM	Ministry of Fisheries and Maritime Economy *(Ministère de la Pêche et de l'Economie Maritime)*
MPEM	Ministry of Oil, Energy and Mines (*Ministère du Pétrole, de l'Energie et des Mines)*
MSV	Multi-purpose Support Vessel
NADF	Non-Aqueous Drilling Fluid
NCEP	National Centre for Environmental Prediction
OGP	International Association of Oil & Gas Producers (former E&P Forum)
ONS	National Office for Statistics *(Office Nationale des Statistiques)*
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSCP	Oil Spill Contingency Plan
OSPAR	Convention for the protection of the marine environment of the North East Atlantic
OSRL	Oil Spill Response Limited
PAH	Poly Aromatic Hydrocarbons
PANE	National Action Plan for the Environment (*Plan d'action national pour l'environnement)*
PANPA	Nouakchott's Autonomous Harbor *(Port de l'Amitié)*
PEC	Predicted Environmental Concentration
PLET	Pipeline End Termination
POPs	Persistent Organic Pollutants
PSC	Production Sharing Contract
ROV	Remote Operated Vehicle
RPS	RPS Group, Environmental Consultancy
SANS	South African National Standards
SBM	Synthetic Base Mud
SCM	Subsea Control Module
SMH	Mauritanian Hydrocarbons Company (*Société Mauritanienne des Hydrocarbures)*
SNDD	National Strategy for Sustainable Development *(Stratégie Nationale de Développement Durable)*
SOLAS	Safety Of Life at Sea

SOPEP	Shipboard Oil Pollution Emergency Plan
SPEG	Electricity from Gas Production Company *(Société de Production d'Electricité à partir du Gaz)*
STCW	Standards of Training, Certification, and Watch keeping for seafarers
SWRI	Short Wave InfraRed
THC	Total Hydrocarbon Content
TOES	Tullow Oil Environmental Standards
TOP	Take Or Pay
TOR	Terms of References
TSS	Total Suspended Solids
UNCLOS	United Nations Convention on the Laws Of the Sea
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compound
WBF	Water-Based Fluids
WHO	World Health Organisation
WTN	Waste Transfer Notes

BANDA GAS PROJECT ENVIRONMENTAL IMPACT ASSESSMENT EXECUTIVE SUMMARY

Project proponent

Tullow Petroleum Mauritania Pty Ltd (Tullow), a 100% subsidiary of Tullow Oil Plc, proposes to develop the Banda gas field, offshore Mauritania in Block PSC (Production Sharing Contract) A.

Tullow Oil Plc is an independent oil and gas exploration and production company, headquartered in London.

Environmental impact assessment (EIA)

An EIA is a systematic process that predicts and evaluates the potential impacts a proposed project may have on aspects of the physical, biological, socio-economic and human environment. It also documents the mitigation measures to be implemented to eliminate or reduce adverse impacts and, where practicable, to enhance benefits.

There is a Mauritanian regulatory requirement for oil and gas developments to undertake an EIA and to report the findings to the *Direction du Contrôle Environnemental* (DCE) of the *Ministère de l'environnement et du développement durable.*

This EIA was developed from June 2012 to April 2013 by Environmental Resources Management (ERM) an independent international sustainability consultancy, in collaboration with Mauritanian consultants Mr. Amadou Ba and Mr. Moustapha Ould Taleb.

It was developed with a view to comply with the regulatory requirements of Mauritania and Tullow's corporate environmental and social management standards. International best practice, in particular the International Finance Corporation's Performance Standards (2012), were also considered in developing this impact assessment.

Proposed project

Field history

The Banda field was discovered in 2002 and appraised by the then operator Woodside and the subsequent operator, Petronas. Tullow acquired operatorship of the field in November 2011. This field is located approximately 55 km off the Mauritanian coast, 20 km to the east of the Chinguetti field, currently under production by Petronas.

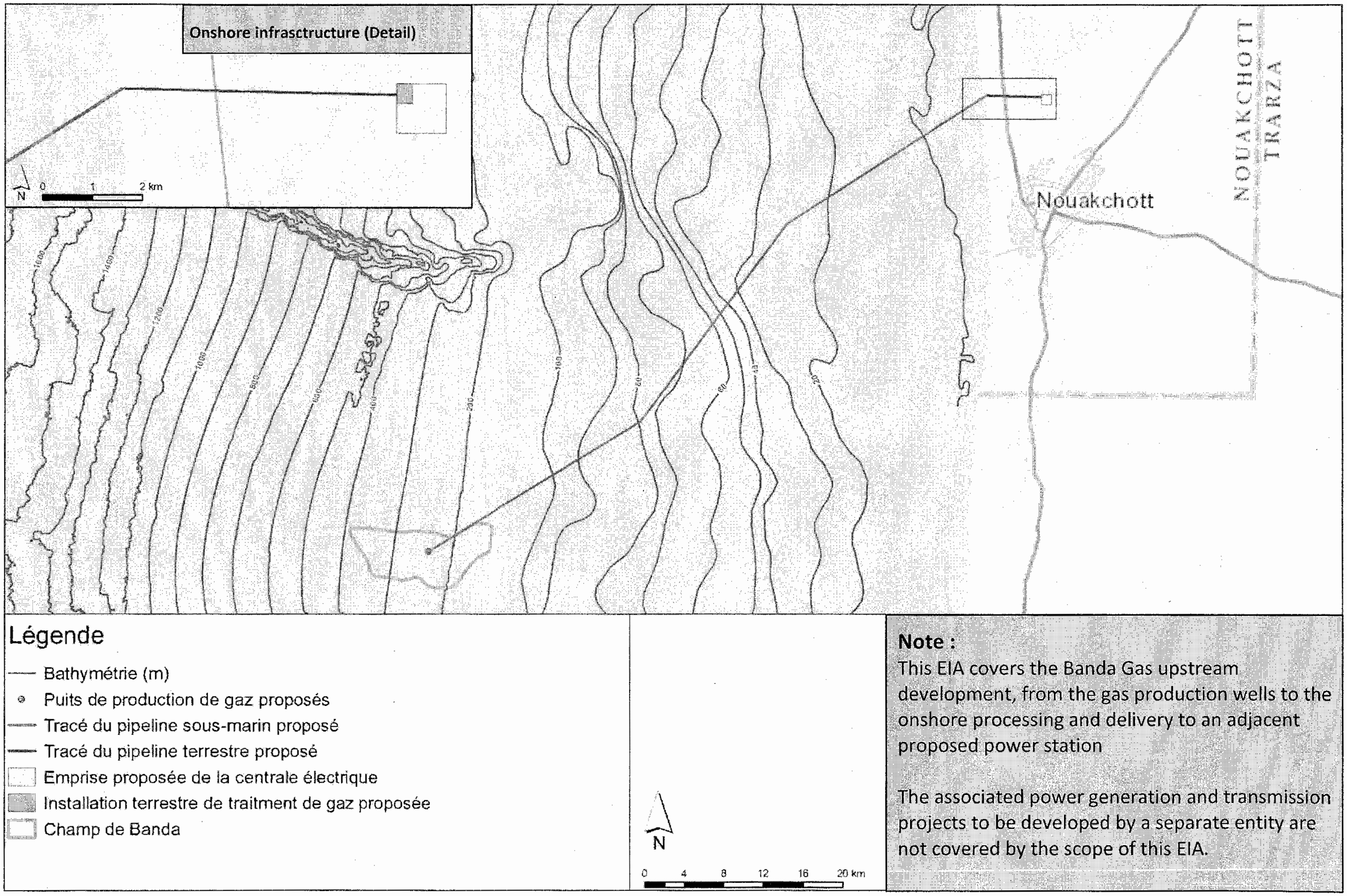
Project overview

The Banda gas development will constitute an important milestone in Mauritania's oil and gas history, as it will be the first offshore development to bring Mauritanian hydrocarbons to the shore.

It will involve the drilling and installation of two gas production wells, and their connection to an onshore gas processing facility, via a sub-sea pipeline. The processing facility will be located at approximately 9 km to the north of the city of Nouakchott.

Once processed to the required specification, the gas will be flowed to a nearby power station, to be developed, owned and operated by a consortium called SPEG (*Société de Production d'Electricité à partir du Gaz*), jointly owned by the Government of Mauritania, Somelec, SNIM, and international mining company Kinross. The proposed power station will provide energy for domestic and industrial customers within Mauritania as well as potential power export capabilities to neighbouring countries. The power generation project and associated transmission infrastructure are being developed separately by SPEG, and are not covered in this document.

Project overview



Offshore drilling

The wells will be drilled and completed from a single drill centre, using a moored semi-submersible Mobile Offshore Drilling Unit (MODU).

The MODU will be surrounded by a 500 m temporary safety exclusion zone.

Drilling is expected to take place in Q3 and Q4 2015. It will take up to approximately 45 days to drill and complete each well.

Subsea installation

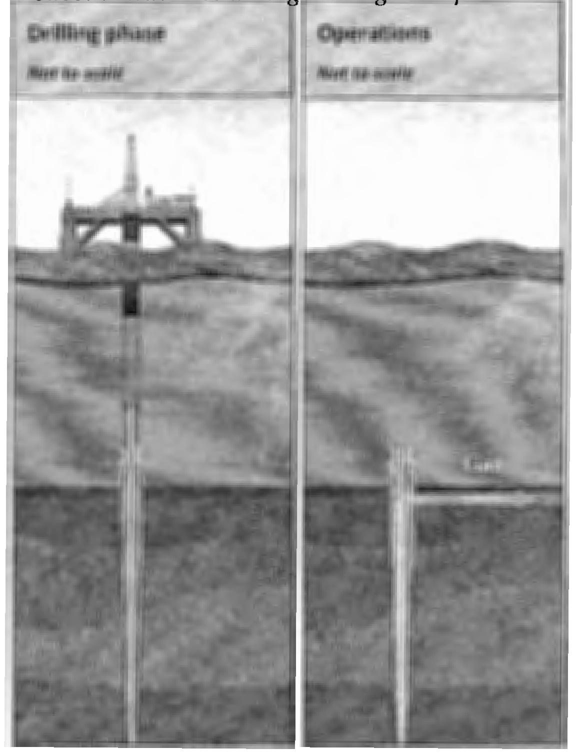
Produced gas will be exported to shore via a 75 km long, 10 inch (25.4 cm) subsea pipeline. The pipeline will be trenched, or protected by rock-dump for sections where trenching is not possible. An umbilical will be laid alongside the pipeline within the same trench.

The subsea pipeline will be installed by two pipe-laying vessels (one for the nearshore section and one for the offshore section) supported by a survey vessel.

Onshore pipeline

Another 5.6 km onshore pipeline and umbilical will connect the subsea pipeline and umbilical to the onshore gas plant. These will be trenched along their entire length. They will cross under the Nouadhibou road at approximately PK 9.

Subsea structures during drilling and operations

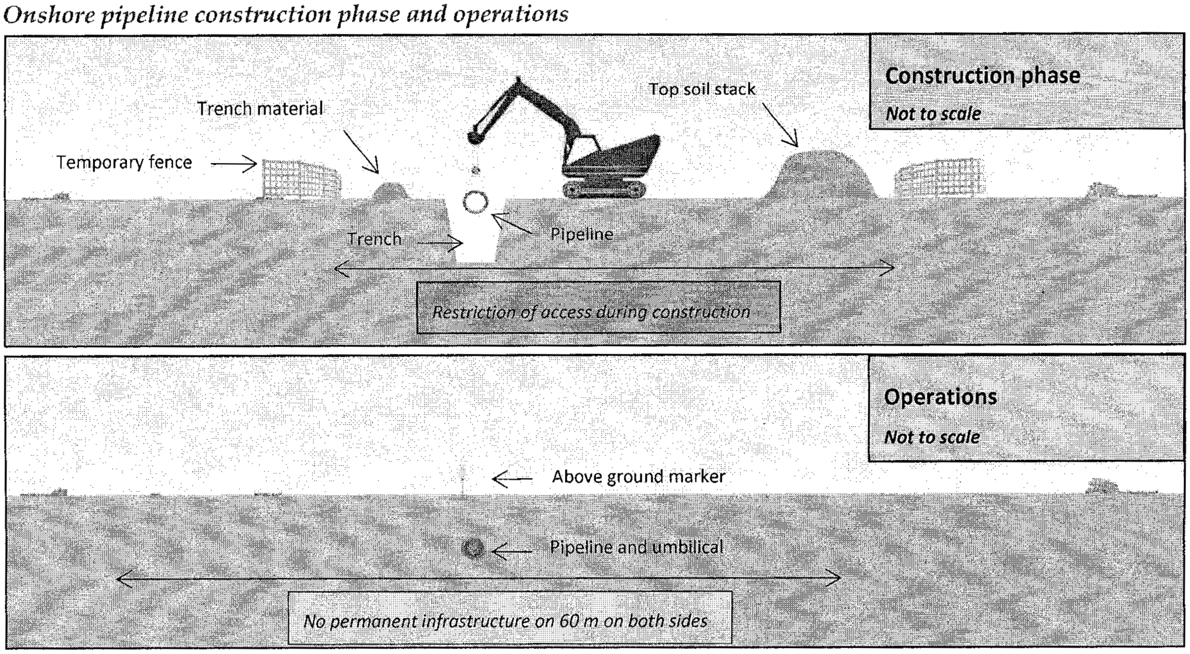


Onshore gas processing plant

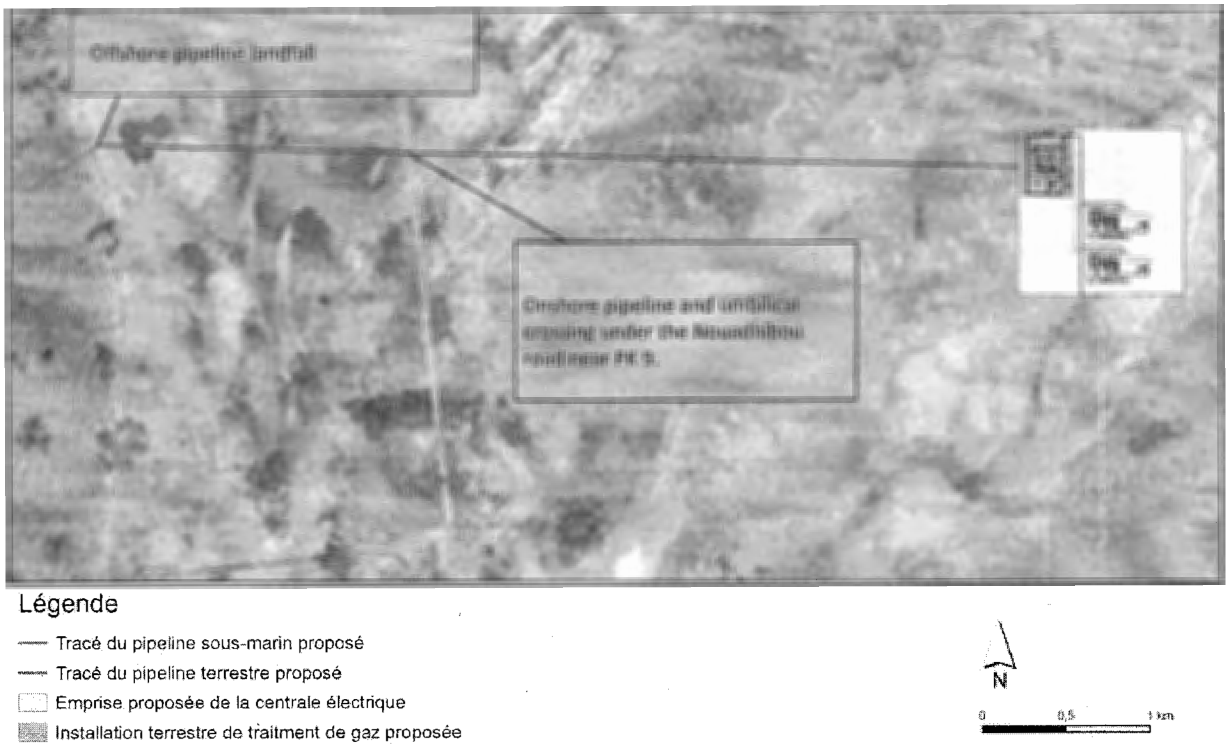
The onshore gas processing plant will be constructed at approximately 9 km to the north of Nouakchott. Its footprint is estimated to cover a 400 m x 325 m rectangle within a 1 km x 1 km plot (this 1 km² plot will also host the proposed SPEG power station).

Construction of the plant is expected to start in Q4 2014 and last an estimated 15 months.

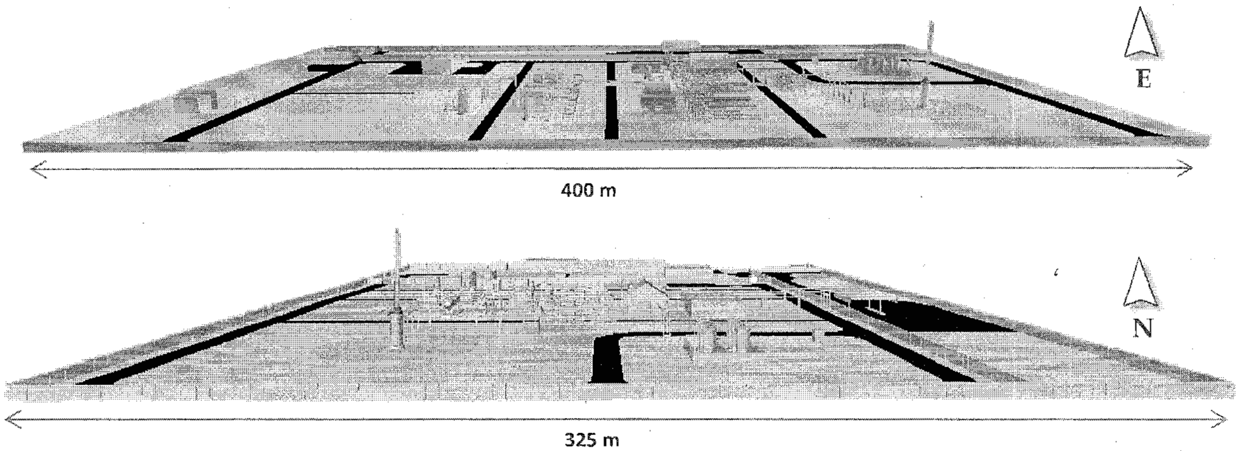
Onshore pipeline construction phase and operations



Location of the proposed onshore infrastructures



Design of the proposed onshore gas processing plant



Environmental baseline

The EIA describes the existing environmental and socio-economic conditions, to provide a baseline against which potential Project impacts can be assessed.

This includes the results of an Environmental Baseline Survey commissioned by Tullow which aimed to characterize water and sediment quality in the offshore Project area. It was completed by onshore field visits (covering, among other topics, biodiversity and habitats, ambient noise, cultural heritage, land use) and two socio-economic surveys (focussing on the coastal encampments and villages from PK 144 to M'Haijratt).

Offshore baseline overview

Artisanal and coastal fishing activities were found to mostly occur within six nautical miles off the coast. The Banda field area is moderately used for industrial fishing (pelagic and demersal trawlers) and is used as a transit route by fishing vessels along the coast.

No evidence of sensitive benthic habitats was identified in the Banda field or along the pipeline route.

The proposed pipeline crosses over the existing African Coast to Europe (ACE) subsea communication cable.

Pictures taken during the biodiversity and socio-economic baseline surveys

Onshore baseline overview

The onshore component of the Project is located on mostly undeveloped land, 5 km north of the edge of the city of Nouakchott. The natural habitats within the plant layout and the pipeline route were not found to be of particular environmental sensitivity at a regional scale. There are no land users directly within the Project footprint; nearby housing (along the highway) were identified as mainly temporary and not relying on land for livelihoods.

The EIA identified several usages of the area generally located within 15 km north of Nouakchott, encompassing the proposed Banda site:

- some livelihood activities (herds of camels grazing within the area and crossing it between Nouakchott and more remote locations; shell extraction in the dunes for usage as construction material);
- some very sparse residential housing, with a limited number of permanent buildings (only one shed identified within the pipeline exclusion zone) and a villa 300m south of the pipeline landfall point; and
- environmental enhancement activities, with the recent planting of vegetation to establish a "green belt" around Nouakchott.

The proposed pipeline will cross under the existing Nouakchott-to-Nouadhibou highway.

Four important development projects were identified within the vicinity of the onshore component of the Project:

- the proposed SPEG power plant adjacent to the gas plant;
- the new university (under construction), 3 km to the southwest of the proposed gas processing facility;
- the new airport (under construction), located approximately 20 km to the north of the proposed gas processing facility; and
- a proposed tourism/residential development located between the coastline and the highway.

In terms of cultural heritage, neolithic artefacts (mainly pottery fragments) were found within the Project footprint. These are relatively common at a regional level. No site of significant cultural or historical value was identified within the Project footprint.

Assessing and managing impacts

Managing offshore construction impacts

The majority of the impacts from the drilling, completion, installation and commissioning activities were assessed as being *Negligible* or *Minor*.

- Only the potential impacts resulting from an unlikely spill of hydrocarbons at sea were assessed as *Moderate*. These would be associated with an accidental loss of fuel from the mobile offshore drilling unit and / or the supply vessels used in the drilling, subsea installation or pipelay phases. As the drilling activities are only targeting gas, an oil spill associated with a loss of well control was not considered as a potential impact from this Project.

  In the unlikely event of a large diesel spill, Tullow's proposed emergency response procedure would likely prevent the majority of diesel reaching the shoreline. This was verified in the ESIA through modelling of spill dispersion, weathering processes, distance to shore, and travel time of the spill.

- Drilling activities will occur at a distance of 55 km away from the coast and are not expected to cause any significant impact on other sea users (navigation, fishing).

- Drilling and completion fluids will be selected taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard.
- Liaison with other sea users and presence of fisheries liaison officers onboard the Project vessels will contribute to manage the impacts associated with the nearshore pipelay activities.
- The crossing of the existing ACE subsea communication cable will be managed in a conventional manner providing physical separation between the pipeline and the cable in coordination with the cable operator.

Managing onshore construction impacts

All onshore construction impacts were assessed as *Negligible* or *Minor*.

- Construction noise contribution predicted through noise modelling did not identify any significant impacts according to international standards.
- Potential archaeological finds will be managed in coordination with the *Institut Mauritanien des Recherches Scientifiques*. No burial site is expected to be found within the Project footprint.
- Crossing under the Nouadhibou road will be managed in coordination with the Transport authorities.

Managing operational impacts

Only the impact resulting from the pipeline exclusion zone was assessed as *Moderate*. The presence of this 0,68 km^2 exclusion zone creates an additional constraint in a suburban area.

In response to stakeholder concerns regarding the proximity of the proposed plant to some sensitive receptors, such as the new university of Nouakchott currently being built 3km south west, operational noise and air quality impacts were assessed in detail.

- Operational noise contribution predicted through noise modelling did not identify any significant impacts according to international standards.
- CO, NO_2 and PM_{10} concentrations modelled at the nearest receptors for operations and emergency scenario accounts for less than 5% of the air quality standards set by the IFC guidelines.
- Physical monitoring of the trenched pipeline and a 60 m exclusion zone with no permanent infrastructure on both sides will prevent intentional or accidental damage to it.

Conclusion

In this EIA, no impacts were identified, that could not be avoided or reduced to acceptable levels through the application of the proposed mitigation measures described in the Environmental Management Plan.

Environmental management plan (EMP)

The Project committed through the EIA to a number of measures designed to mitigate adverse impacts and ensure benefits are delivered. These are compiled in the EMP which defines the actions that will be taken for each phase of the development.

In addition to the Project's EMP, specific procedures will be prepared prior to the start of the construction activities:

- a vessel emergency oil spill contingency plan;
- an onshore oil and chemical spills prevention and contingency procedure;
- a waste management plan;
- a maritime and fisheries liaison procedure;
- an archaeological chance finds procedure.

The implementation of the EMP will be monitored by the Mauritanian authorities.

Stakeholder engagement

Stakeholder engagement activities started during the scoping stage of the Project and ran throughout the EIA. The objective was to ensure that sources of existing information and expertise are identified, legislative requirements are met and that stakeholder concerns and expectations are addressed. 26 consultation meetings were held with stakeholder groups or organisations from Nouakchott and coastal communities in July 2012 and between November 2012 and February 2013.
A public consultation meeting attended by nearly 60 representatives of ministries, local governments, fishermen unions and Non-Governmental Organisations was held on 20th March 2013 in Nouakchott.

Next steps

In accordance with the Mauritanian EIA regulations, the EIA Report was submitted to the DCE to obtain an *avis de faisabilité environnementale*. This submission will be followed by a public enquiry designed to provide all interested parties with an opportunity to understand and comment on the EIA.

1 INTRODUCTION

1.1 BACKGROUND

The Project

Tullow Petroleum Mauritania Pty Ltd (Tullow) proposes to develop the Banda offshore gas field, located approximately 55 km off the coast of Mauritania in Block PSC (Production Sharing Contract) A, as shown in *Figure 1.1*.

This development, hereinafter referred to as "the Project", will consist in the drilling and installation of two gas production wells, and their connection to an onshore gas processing facility, via a sub-sea pipeline. The processing facility will be located 9 km to the north of the city of Nouakchott.

Once processed to commercial specifications, the gas will then be flowed to an adjacent proposed power station, to be developed, owned and operated by a separate entity, the *Société de Production d'Electricité à partir du Gaz* (SPEG). The SPEG power plant is not covered by the scope of this EIA.

Figure 1.1 *Location of the Banda Field*

Prior Studies on the Banda Field

The Banda reservoir includes an oil phase, underlying the gas phase discussed in this EIA. In 2012, studies were initiated to assess the feasibility of developing this oil phase, and an EIA was developed. The terms of reference for the EIA of the oil phase development were submitted to the DCE in June 2012, and approved on 11 July 2012. Since then, the opportunity for developing the oil phase has been re-assessed, and all study activities (including EIA) have been stopped. However, stakeholder engagement activities that were carried out for the Gas Phase in July 2012 occurred in conjunction with those initiated for the oil phase development EIA, and marine environmental and social baseline data collected was found to be relevant to both phases.

Justification for the EIA Process

An EIA is a systematic process that predicts and evaluates the potential impacts a proposed project may have on aspects of the physical, biological, socio-economic and human environment. Mitigation measures are developed as part of the project plan to eliminate, minimise or reduce adverse impacts and, where practicable, to enhance benefits.

According to Mauritanian legislation, more particularly Decree n°2004-094 dated 4 November 2004 relating to Impact Studies, modified and supplemented by Decree n°2007–105 dated 13 April 2007, completing and modifying certain provisions of Decree 2004-094, a gas field development project should be covered by an Environmental Impact Assessment (EIA). The findings of the EIA must be reported to the *Direction du Contrôle Environnemental* [Directorate for Environmental Control] (DCE) of the Ministry in charge of environment. As a pre-requisite to the development, the EIA must be approved by the Ministry in charge of environment.

Undertaking an EIA in the design phase of a gas field development is also a requirement of Tullow's environmental and social standards.

1.2 *PURPOSE OF THIS REPORT*

This report presents the process and findings of the EIA for the Banda Gas development, in line with Mauritanian regulations, internationally accepted best practice, and Tullow's corporate environmental and social standards (requirements applicable to this EIA are detailed in *Chapter 2* of this report). The scope of this EIA is further detailed in *Section 1.3*.

1.3 *SCOPE OF THIS EIA*

This EIA addresses the Banda gas field development which includes the following phases:

- offshore drilling and completion;
- subsea installation;
- onshore construction;
- commissioning ;
- operation; and
- decommissioning.

A detailed project description is provided in *Chapter 3* of this report.

1.4 *PRESENTATION OF THE PROJECT PROPONENT*

The Project proponent is Tullow Petroleum (Mauritania) Pty Ltd, a 100% subsidiary of Tullow Oil plc.

Tullow Oil Plc is an independent oil and gas exploration and production group of companies, with its registered headquarters in London. The Tullow group holds interest in a number of licences in Mauritania, as outlined in *Table 1.1*.

In Mauritania, Tullow is the operator for offshore Block PSCA. Tullow also holds interests in six neighbouring blocks (Blocks C1, C2, C10, C18, C6, C7).

Tullow's contact details for this project are provided in *Table 1.2*.

Table 1.1 Tullow Equity in Mauritania

Licence (Fields)	Tullow Equity (%)	Operator	Other Partners
PSC A	**66.00**	**Tullow**	**Premier, Kufpec, Petronas**
C1	40.00	Dana Petroleum	GDF Suez
C2	89.27	Tullow	Dana Petroleum
C10	59.15	Tullow	Premier, Kufpec, Petronas, SMH
C18	90.00	Tullow	SMH
C6	88.00	Petronas	Roc Oil
C7	36.15	Dana Petroleum	Petronas, GDF Suez

Source: Tullow (as at 14 february 2013)

Table 1.2 Tullow's contact details

Mr Kemal Mohamedou	Mr David Wright
President	Project Manager
Tullow Petroleum Mauritania (Pty) Ltd	Tullow Oil Plc
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Fax +222 4525 6182	Fax +44 (0)20 3249 8801
Email : kemal.mohamedou@tullowoil.com	Email: david.wright@tullowoil.com

1.5 PRESENTATION OF THE EIA CONSULTANTS

This document has been developed by Environmental Resources Management (ERM), in collaboration with Mauritanian consultants Mr. Amadou Ba and Mr. Moustapha Ould Taleb.

Environmental Resources Management

ERM is a multinational sustainability consultancy. It employs over 4,000 people in 140 offices across the world. ERM operates exclusively in the environmental, social and health fields and the vast majority of its clients are private industrial clients or public sector clients of an industrial nature. ERM has been operating on the African continent for several decades out of France, the United Kingdom, the United States and its offices in South Africa. ERM's experience covers numerous sectors, particularly oil and gas, mining and power. ERM has undertaken numerous EIAs on the African continent. In

Mauritania, ERM has recently undertaken EIAs for 3D seismic surveys in Block C2 and C10 on behalf of Tullow and an EIA for a drilling exploration programme in Block C7 on behalf of Dana Petroleum.

Mauritanian Experts

ERM has carried out this EIA in partnership with the following Mauritanian experts:

- Mr. Amadou Ba is an independent senior environmental consultant based in Nouakchott. He specialises in EIA and environmental monitoring for projects in the aquatic or coastal environments. He has extensive experience working with environmental authorities in Mauritanian and international agencies such as the International Union for Conservation of Nature (IUCN) and United States Agency for International Development (USAID). He has worked as Director of Coastal Protected Areas in Mauritania, focussing on integrated management of natural resources, including fisheries, marine and coastal. For this EIA, Amadou Ba provided technical expertise on biodiversity and fish resources in the study area.

- Moustapha Ould Taleb is an independent social consultant based in Nouakchott, Mauritania. He worked for several years as food and agriculture (FAO) expert and as a social expert for the Mauritanian Institute for Oceanographic Research and Fisheries (IMROP). His research interests include the social organisation of fishermen, professional organisations, traditional medicine systems and health information in pastoral areas, with a geographical focus on Mauritania, Chad, and Mali. For this EIA, Moustapha Ould Taleb provided technical expertise on social aspects in the study area and led the contributed to the stakeholder engagement consultations.

1.6 PURPOSE OF THE EIA

The purpose of the EIA is to provide information to regulators, the public and other stakeholders to aid the decision making process. The main objectives of the EIA are therefore as follows.

- To define the scope of the project and the potential interactions of project activities with the natural and social (including socio-economics and health) environment that should be defined and assessed during the EIA.

- To review national and international legislation, standards and guidelines, to ensure that all stages of the proposed project through its complete lifecycle take into consideration the requirement of Mauritanian legislation, internationally accepted environmental management practices and guidelines, and project-related EHS policies and standards.

- To provide a description of the proposed project activities and the existing physical, chemical, biological, socio-economic and human environment that these activities may interact with.

- To assess the potential environmental and social impacts resulting from the project activities and identify viable mitigation measures and management actions that are designed to avoid, reduce, remedy or compensate for any significant adverse environmental and social impacts and, where practicable, to maximise potential positive impacts and opportunities that may arise due to the project.

- To provide the means by which the mitigation measures will be implemented and residual impacts managed, through the provision of a provisional Environmental Management Plan (EMP).

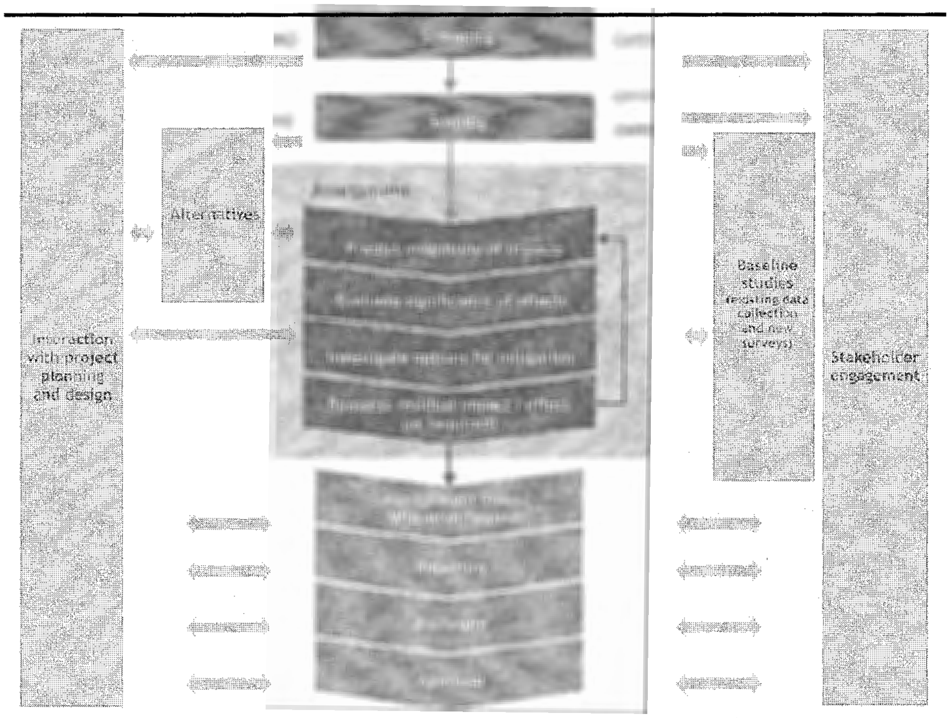
1.7 SUMMARY OF THE EIA PROCESS

1.7.1 *Typical EIA Process Overview*

Figure 1.3 overleaf presents the typical EIA process. This process is consistent with the specifications of Mauritanian legislation, further described in *Chapter* 2 of this report. The EIA process includes the following key steps:

- screening;
- scoping;
- baseline data collection;
- project planning and design;
- stakeholder engagement;
- impact assessment;
- management and mitigation plans; and
- reporting and disclosure.

Figure 1.2 *Generic Overview of the Impact Assessment Process*



1.7.2 *Scoping*

The aim of scoping is to identify environmental and social sensitivities and Project activities with the potential to contribute to, or cause, impacts to environmental resources and social receptors.

At the scoping stage it is necessary to identify and understand the key issues to a level that allows the remainder of the impact assessment to be planned. An important part of this process is identifying and consulting with a range of stakeholders including representatives of government, civil society groups, and community to identify key issues and sources of information.

The main outputs of the scoping phase were the Terms of Reference of the EIA which were completed in line with Article 11 of Decree n°2004-094.

The Terms of Reference document was submitted to the Ministry of Oil, Energy and Mines [*Ministère du Pétrole, de l'Energie et des Mines*] (MPEM) and to the Environmental Control Department [*Direction du Contrôle Environnemental*] (DCE) on 25 Septembre 2012 (*Lettre n°1292 MPEM/M du 25 septembre 2012*). The document provided an overview of the Project and outlined the key issues to be addressed in the EIA.

A scoping meeting was held on 02 October 2012 with the MPEM and the DCE to present the findings of the scoping phase and agree on the proposed EIA execution plan.

A final version of the Terms of Reference taking into account the comments received during the scoping meeting was submitted to the DCE on 7 October 2012.

The Terms of Reference were approved by the DCE on 17 October 2012. *(Lettre n° 646/DCE/ MDEDD du 17 octobre 2012).*

1.7.3 *Baseline Data Collection*

Purpose

The EIA provides a description of the existing environmental and socio-economic conditions as a basis against which the impacts of the Project can be assessed. The baseline includes information on environmental and social receptors and resources that were identified during scoping as having the potential to be significantly affected by the proposed Project. It also includes technical information that has been used in the assessment and for modelling studies.

The description of the baseline has the following main objectives:

- to identify the key environmental and socio-economic resources and conditions in areas potentially affected by the Project and highlight those that may be vulnerable to aspects of the Project;
- to describe, and where possible quantify, their characteristics ie their nature, condition, quality and extent;
- to provide data to aid the prediction and evaluation of possible impacts; and
- to inform judgements about the importance, value and sensitivity or vulnerability of resources and receptors.

Key baseline data sources used for this EIA are described hereinafter. A detailed list of references is provided at the end of this report.

Environmental Baseline

- *Metocean criteria study for Banda field offshore, Mauritania (FugroGeos, 2012).* Tullow appointed Fugro Geos Ltd to conduct a study of metocean conditions off the Mauritanian coast in March and August 2012.
- *Meteorological statistics at Nouakchott, Mauritania (FugroGeos, 2012).* Tullow appointed Fugro Geos Ltd to conduct a study of meteorological conditions for the onshore gas processing plant of the Project in September 2012.
- *Environmental Baseline Survey* (*Gardline, 2012*). This Environmental Baseline Survey commissioned by Tullow aimed to characterize water and sediment quality in the Project area. The offshore (depth greater than 10 metres) part of the survey was completed at the end of August 2012 and

the nearshore (water depths less than 10 metres) part during September/October 2012.

- *Marine Mammal and Turtle Observations* (*RPS, 2011; RPS, 2012*). Tullow appointed RPS Ltd to record marine mammal and turtle sightings data during seismic studies undertaken in June-July 2011 and May-June 2012 from Block 2, 85 km to the south of the Banda development. Due to this proximity, the sightings from Block 2 represent a recent record of the species likely to be present within the vicinity of the Banda development. Copies of these observation reports are included in *Annex D*.

- *Collision Risk Assessment* (*Anatec, 2012*). This study was commissioned to identify shipping routes passing the Banda licence area, calculate collision frequencies and review mitigation measures.

- Internationally recognised published sources and databases such as the FAO, the IUCN and Fishbase.

This data has been completed by field visits of the onshore area of the Project:

- a scoping visit, to identify the main issues related to the Project, from 9 to 13 July 2012;

- a biodiversity survey, from 9 to 13 July 2012 and from 6 to 9 November 2012;

- a cultural heritage site reconnaissance from 6 to 9 November 2012; and

- a baseline noise monitoring study, carried out at the onshore site location from 6 to 9 November 2012.

Socio-economic Baseline

In order to supplement secondary socio-economic information, primary socio-economic data was collected during two surveys.

A first survey undertaken in the coastal encampments and villages from PK 144 to M'Haijratt in July 2012 focused on the stakeholders identified for the offshore component of the Project. Three camps South of Nouakchott and four villages North of Nouakchott were visited and data gathered through focus group discussions and key informant interviews.

A second survey focused on the onshore component of the Project was undertaken between November 2012 and February 2013.

1.7.4 *Stakeholder Engagement Activities*

Stakeholder engagement activities started during the scoping stage of the Project and ran throughout the EIA. The objective was to ensure that sources of existing information and expertise are identified, legislative requirements are met and that stakeholder concerns and expectations are addressed.

Meetings were held in June 2012 during the scoping phase to engage with various stakeholders relevant in terms of data collection for the EIA such as the Mauritanian representation of the IUCN and several departments from the Ministry of Environment. The consultation reports are provided in French in *Annex A.*

During the EIA phase, 26 consultation meetings were held with stakeholder groups or organisations from Nouakchott and coastal communities (including three camps south of Nouakchott and four villages north of Nouakchott) in July 2012 and between November 2012 and February 2013. Stakeholders consulted included government authorities, cooperation programs, fishermen associations, private investors, representatives of villagers and traditional leadership.

The objectives of scoping and EIA consultations were to share Project information, collect baseline data and understand key stakeholder concerns. The consultation reports are provided in French in *Annex A.*

A public consultation meeting was held on 20th March 2013 at Hotel Sabah in Nouakchott. Nearly 50 fifty representatives of ministries, local governments, fishermen unions and local Non-Governmental Organisations attended this meeting. The public consultation report is provided in French in *Annex A.*

1.7.5 Impact Assessment

Impact assessment and development of mitigation measures is an on-going process that commences during the scoping stage and continues throughout the EIA process. The key objectives of this process are as follows:

- to analyse how the Project may interact with receptors and resources identified during baseline studies, in order to define, predict and evaluate the likely extent and significance of environmental and social impacts that may be caused by the Project;
- to develop and describe acceptable and cost effective mitigation measures that avoid, reduce, control, remedy or compensate for negative impacts and enhance positive benefits;
- to evaluate the predicted positive and negative residual impacts of the Project; and
- to develop a system whereby mitigation measures will be integrated with the Project and will be taken forward as commitments. This is achieved through the development of a provisional Environmental Management Plan.

The impact assessment and mitigation definition processes for the Banda Gas EIA were undertaken based on the baseline study results, between December 2012 and March 2013.

1.8 STRUCTURE OF THIS REPORT

The structure of this EIA report is summarised in *Table 1.3*.

Table 1.3 ***EIA Report Structure***

Chapter	Title	Content
0	Executive summary	Summary of the EIA for the benefit of the decision-makers and the public.
1	Introduction	Provides background to the project, purpose of the EIA, scope of the EIA, EIA process that was followed and report structure.
2	Legal and Administrative Framework	Describe the Mauritanian environmental legislation applicable to the project, as well as applicable international standards and Tullow's corporate environmental management standards.
3	Project Description	Technical description of the project schedule, facilities, activities, emissions, wastes and discharges.
4	Environmental and Socio-economic Baseline	Description of the relevant environmental, fisheries and socio-economic existing conditions and review of sensitive resources or receptors that may be affected by the project. Presents the results of the public consultations.
5	Impact Assessment and Mitigation	Evaluation of potential impacts; proposed mitigation measures and identification of residual impacts.
6	Environmental management plan	Compilation of the Project's mitigation and compensation measures in the form of a detailed plan to ensure that they are implemented at each stage of the Project.
7	Stakeholder Engagement	Summary of stakeholder engagement works undertaken; identification of the stakeholders consulted, reports of meetings held, summary of public expectations expressed during consultation meetings.
8	Project Schedule	Indicative schedule of the Project's activities.

ANNEXES		
A	Consultation Records	Supporting consultation documentation such as meeting notes, photographs.
B	Modelling Reports	B-1 Drill Cuttings Modelling Report B-2 Air Quality Modelling Report B-3 Noise Baseline and Modelling Report B-4 Oil Spill Modelling Report
C	Collision Risk Assessment	Report by Anatec describing shipping routes, collision frequencies and risk mitigation measures.

2 *ADMINISTRATIVE AND REGULATORY FRAMEWORK*

2.1 *INTRODUCTION*

This chapter outlines the legal and administrative framework applicable to the Project. It describes the Mauritanian policies, laws and regulations as well as the international conventions and agreements that Mauritania is signatory to. It also describes the industry standards that the Project has adopted and Tullow's EHS policies.

2.2 *NATIONAL ADMINISTRATION*

2.2.1 ***Environmental Authorities***

Ministry for Environment and Sustainable Development (MEDD)

The *Ministère de l'environnement et du développement durable (*MEDD) is the national authority responsible for the preparation, coordination, implementation, monitoring and assessment of the government's environmental and sustainable development policy.

Environmental Control Department (DCE)

The *Direction du contrôle environnement* (DCE), which is a part of the MEDD, has a mandate to give directives and guidance on the various measures necessary for EIA and ensures the effective implementation of the measures to mitigate risks which are identified in the EIAs, in particular in the environmental management plans.

Protected and Coastal Areas Department (DAPL)

The *Direction des aires protégées et du littoral (*DAPL) is responsible for the protection and conservation of Mauritanian biodiversity. It has a mandate to develop national policies for protected areas, coastal areas and wetlands, and to integrate sustainable development matters in these policies.

Pollution and Environmental Emergencies Department (DPUE)

The *Direction de la pollution et des urgences environnementales (*DPUE) was mandated to prepare and coordinate the implementation of national strategies, to prevent and control chemical, biological, radioactive and acoustic pollution and the risks to human activities. It is also responsible for developing and implementing environmental emergency plans such as MARPOL.

2.2.2 *Petroleum and Energy Authorities*

Ministry of Oil, Energy and Mines (MPEM)

The oil and gas sector is directly managed by the *Ministère du pétrole, de l'énergie et des mines* (MPEM). Its mission is to implement and formulate government's policies concerning oil, mines and energy sector. It is responsible for promoting and managing the exploration activities and the production, import, export, transportation, storage and marketing of oil and gas resources. The government agency is responsible for issuing concessions (through production sharing contracts) and the allocation of oil and gas blocks. Among other responsibilities include laws and regulations formulation and their implementation for exploration, transportation and storage of hydrocarbons.

Department of Crude Oil (DHB)

The *Direction des Hydrocarbures Bruts* (DHB) is responsible for the development, implementation and monitoring of the strategies related to crude oil, including the development and enforcement of the policy on crude oil as well as the monitoring and implementation of laws and regulations. It is also involved in the preparation of regulations relating to oil research activities and exploration of crude oil and the consolidation, storage and dissemination of crude oil data.

Mauritanian Hydrocarbons Company (SMH)

Created in 2004, the *Société mauritanienne des hydrocarbures* (SMH) is a public company under the Ministry of Oil and Energy. Its primary aim is to manage the participation of the State in exploration, development, production and commercialisation of oil and gas resources. The SMH advises the government regarding the oil and gas industry.

2.2.3 *Maritime and Fisheries Authorities*

Ministry of Fisheries and Maritime Economy (MPEM)

The *Ministère de la pêche et de l'économie maritime* (MPEM) has authority over the development, coordination and monitoring of Mauritania's fisheries policy. This includes the promotion of research as well as the development and implementation of laws and regulations concerning fisheries. It is also involved in the conservation of the marine environment and development and the implementation of laws and regulations relating to water pollution.

Artisanal and Coastal Fisheries Department (DPAC)

The *Direction des pêches artisanales et côtières* (DPAC) is responsible for the implementation of the policy on access to resources and the management of small scale and coastal fisheries in accordance with fishing plans and resources management measures. It is also involved in the monitoring of the activities and the management of artisanal fishing boats and coastal fishing vessels.

Industrial Fishing Department (DPI)

The *Direction de la pêche industrielle* (DPI) is responsible for the implementation of the policy on access to resources and the management of the exploitation for industrial fishing, in accordance with fishing plans and resources management measures. They are also involved in the monitoring and management of industrial fisheries activities.

Resources Management and Oceanography Department (DARO)

The *Direction de l'aménagement des ressources et de l'océanographie* (DARO) develops databases and information systems on fisheries in order to develop fisheries and maritime resources.

Mauritanian Research Institute on Oceanography and Fisheries (IMROP)

The *Institut Mauritanien de Recherches Océanographiques et des Pêches* (IMROP) provides to the government and the maritime resources users the scientific knowledge and technical analysis necessary to sustainable management of the maritime resources and marine environment.

Delegation to the Fisheries Monitoring and Control at Sea (DSPCM)

The *Délégation à la surveillance des pêches et au contrôle en mer* (DSPCM), is responsible for the monitoring, control and surveillance operations of the Mauritanian maritime area and activities related to fishing.

2.2.4 *Navigation and Shipping Authorities*

Commercial Shipping Department (DMM)

The *Direction de la marine marchande* (DMM), under the Ministry of Fisheries and Maritime Economy (MPEM), is responsible for the development and implementation of policies and legislation relating to national marine management. It is responsible for the integration of International Maritime Organization (IMO) conventions in the national legal framework. It consists of four departments, including :

- the Department of Marine Environment and Maritime Public Domain Protection (*Service de la Préservation du Milieu Marin et du Domaine Public Maritime*) which is responsible for implementation of MARPOL requirements in the oil industry and the monitoring of the International fund for compensation for damaged caused by oil pollution; and

- the Department of Maritime Transportation and Ports (*Service du Transport Maritime et des Ports*) which is responsible for the development and enforcement of legislation relating to maritime transportation and ports and the monitoring of the maritime traffic.

Port of Nouakchott

The *Port Autonome de Nouakchott*, also known as *Port de l'Amitié* (PANPA) is a public institution under the Ministry of Equipment and Transportation's authority. This public company is responsible for operating, maintenance and development of the Port, its domain and the wharf.

2.2.5 *Local Administration Authorities*

These authorities are concerned with *Wali* (*Wilaya* level), *Hakem*/Head of District (*Moughataa* level/ District) and the Mayor (Commune level) level. In the specific context of the Project, the following authorities are stakeholders:

- *wilayas* of Nouadhibou, Trarza and Nouakchott;
- *moughataas* of Keur Massene, Mederdra, Ouad Naga, Nouadhibou, El Mina, Sebkha and Tevragh-Zeina;
- districts of Tiguent and Nouamghar; and
- communes of Mbalal, Tiguent, El Arya, Mouamghar, El Mina, Sebkha and Tevragh-Zeina. (1)

2.3 ENVIRONMENTAL POLICY IN MAURITANIA

Two texts adopted in 2006 have shaped current Mauritanian environmental policies. These are:

- the *Stratégie Nationale de Développement Durable* [National Strategy for Sustainable Development] (SNDD) ; and
- the *Plan d'Action National pour l'Environnement* [National Action Plan for the Environment] (PANE).

These texts marked the country's commitment to strengthening the integration of environmental matters and public policy.

The PANE (and, more specifically, its definition of Area of Strategic Focus 3: Promoting integrated management and efficient use of natural resources) gives particular importance to the exploration and extraction of hydrocarbons and defines objectives with the aim of making these activities compatible with good practice in the management of coastal and marine environments.

(1) Nouakchott is composed of nine *moughataas*: Arafat, Dar Naim, El Mina, Ksar, Riad, Sebkha, Tevragh-Zeina, Teyarett and Toujounine. Only El Mina, Sebkha and Tevragh Zeina have access to the shore.

2.4 NATIONAL LEGISLATION

2.4.1 Environmental Impact Assessment Legislation

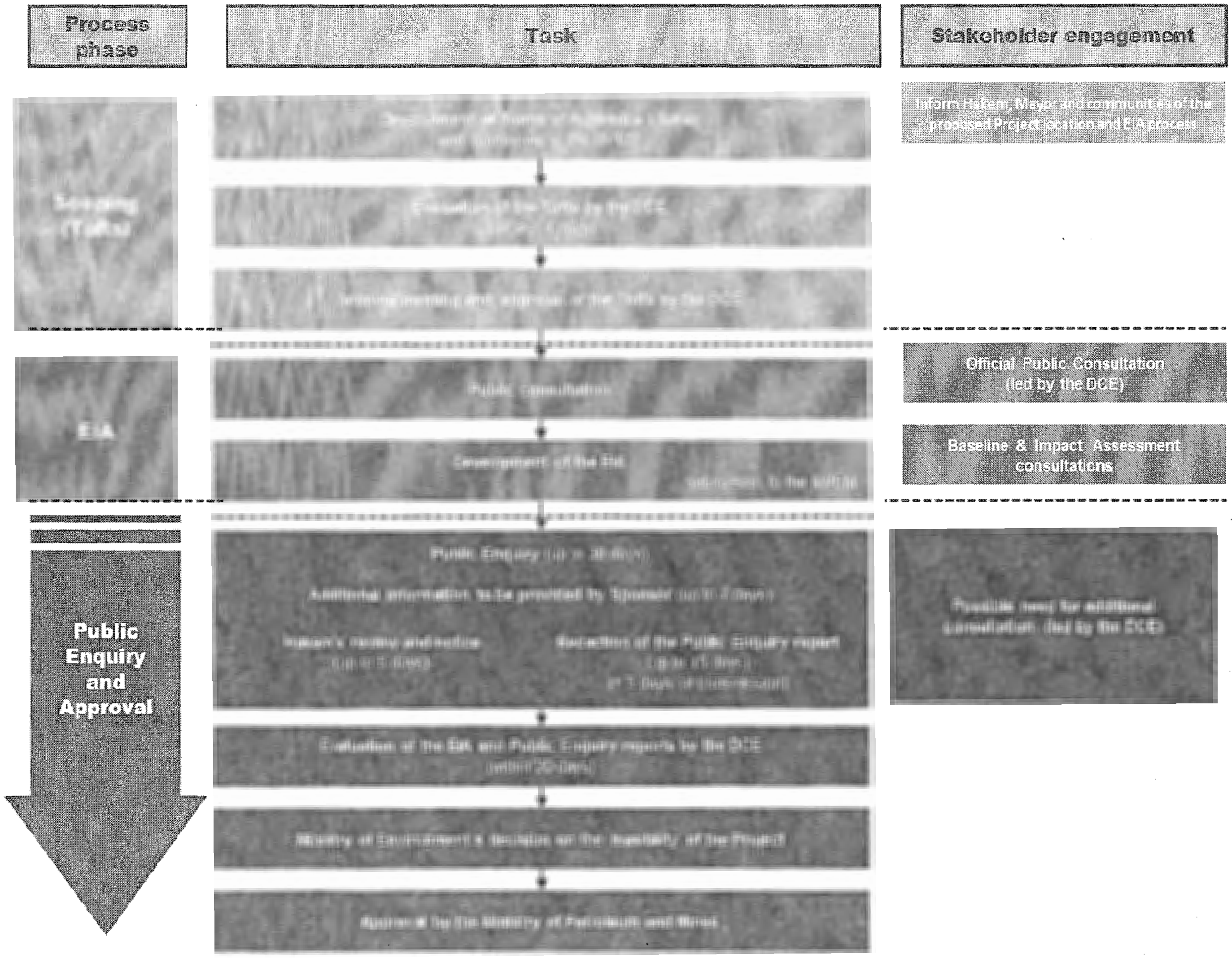
The EIA process in Mauritania is defined by Decree n°2004-094 dated 4 November 2004 relating to Impact Assessments, modified and supplemented by Decree n°2007-105 dated 13 April 2007, completing and modifying certain provisions of Decree n°2004-094.

Article 4 and Annex 1 of Decree n°2004-094 provides a list of projects that are subject to an EIA. This includes oil and gas production and processing, as well as hydrocarbons transportation by pipeline.

Decree n°2004-094 requires that the EIA report be compiled in French and presented in accordance with the model set out in Annex 2 of the Decree. This Decree also specifies the content of the EIA.

The process for executing and implementing an EIA in compliance with Decree n°2004-094 amended and supplemented by Decree n°2007 - 105 is set out in *Figure 2.1*. It includes an initial scoping phase, during which the terms of reference (TOR) of the EIA should be drawn up in relation to the environmental and social aspects of the project and the environmental sensitivities that are considered significant. These terms of reference should be submitted to the Ministry in charge of the Environment for validation. The process also includes a public enquiry phase prior to the issue of any recommendations on the project's feasibility.

Figure 2.1 Procedure for the Development, Implementation and Regulatory Approval of EIAs in Mauritania



2.4.2 *Other Environmental, Maritime and Petroleum Legislation*

The project will be undertaken in compliance with Mauritanian environmental, maritime and petroleum legislation. A summary of applicable legislation is presented in *Table 2.1.*

Table 2.1 Mauritanian Legislation Applicable to the Project

Laws	Description
Environmental Law	
Framework Law (Law n°2000-045 of 26th July 2000)	Establishes Mauritania's Environmental Code, and establishes the general principles to underpin the national policy on environmental matters. It also provides a foundation for the integration of ecological and sustainable socio-economic development requirements.
Order regarding the coastline (Order n°2007-037 of 17th April 2007)	Provides regulations for the protection, management and development of the coastline. Articles 7 and 42 specify that any activity undertaken on the coastline, especially hydrocarbon exploration, is subject to an EIA and should be carried out in keeping with the protection of the coastline environment in order to avoid sea, soil and water pollution.
Vegetation protection (Law n°2000-042 of 15th November 2000)	Defines the rules relating to the protection of vegetation in national territory as well as the import and export of living plants and seeds. Key principles include: prohibiting the import of any damaging organisms or any vegetables or plants without prior authorization by the Minister in charge of agriculture.
Protection of Certain Plant Species (Decree n°83-159 bis of 4th July 1983)	Sets outs the conditions for the protection of certain plant species. Prohibits the removal of the plant species *Aristida Pungens* and *Panicum Turgidum*, the contravention of which may lead to fines and/or prison sentences.
Hunting and nature Protection Code (Law n° 97-006 of 20th January 1997)	Describes the Mauritanian hunting regulation and defines the rules relating to the protection of fauna and natural features. Article 9 details different kinds of protected species.
Forestry Code (Law n°97-007 of 20th January 1997)	Sets out rules for the protection of forests and other vegetated areas. Removal of forests and vegetation is subject to approval and strictly prohibited in certain protected zones: dune protection zones, road sides, state and/or protected forests.
Pastoral Code (Law n°2000-044 of 26th July 2000)	Defines as pastoral lands, those containing pastoral resources as well as any movement corridors allowing animals to access those resources. Development cannot take place on these lands if it will affect the vital interests of shepherds or reduce their access to pastoral resources. In particular water resources and soils are of public interest and should be protected.
Prevention and fight against marine pollution (Law n°2011-022 of 8th March 2011)	Applies to water under the jurisdiction and sovereignty of the Mauritania. It describes the law enforcement and criminal penalties in case of non-compliance.

Laws	Description
Maritime Law	
Fishing Code (Law n°2000-025 of 24th January 2000)	Sets out the rules applicable to fishing in Mauritanian waters. Article 3 indicates that fishery resources in waters under Mauritanian jurisdiction constitute a national heritage that the State has an obligation to manage in the national interest.
Commercial Shipping Code (Law n°95-009 of 31st January 1995)	Provides regulations applicable to maritime shipping and the public maritime domain.
Decree regarding the conditions for the exertion of maritime professions (Decree n°99-05 of 9th July 1999)	Sets out the conditions to be met by any person or entity under Mauritanian law exercising a maritime profession.
Decree relating to seafarers (Decree n°99-146 of 30th January 2000)	Lays down the regulations relating to work on board ships (personnel, pay, organisation of work, etc).
Decree on maritime traffic regulations (Decree n°84-163 B of 16th July 1984)	Establishes the regulation of maritime traffic and creates the Mauritanian Board of Shippers, a Council in charge of monitoring it.
Petroleum Law	
Unrefined hydrocarbons Code (Law n°2010-033 of 20th July 2010 modified and completed by law n°2011-044 of 25th October 2011)	Establishes the regulatory provisions to which hydrocarbon exploration and exploitation are subject. This text repeals and replaces Order n°88-151 on the legal and fiscal regime for the exploration and exploitation of hydrocarbons.
Fiscal regime for the Oil & Gas industry (Law n°2004-029 of 15th July 2004)	Sets out a simplified fiscal regime for foreign companies conducting services on behalf of Oil and Gas companies. Technical terms, conditions and modalities of this fiscal regime to which the company is subject are described.
Cultural Heritage Law	
Framework Law relating to the protection of tangible cultural heritage (Law n°2005-046 of 25th July 2005)	Defines tangible cultural heritage as any tangible human constructions, or product of the interactions between human and nature, which have a historical, archaeological, scientific, artistic or aesthetic value which justifies its preservation and transmission to future generations. Partial or total destruction of cultural heritage is strictly forbidden, and any modifications to such protected sites require the prior authorization of the Ministry of Culture. With particular regard to archaeological finds, the archaeological sub-soil is state property. Archeological surveys require the prior authorization of the Ministry of Culture. If intrusive works reveal the presence of any sites or items of archaeological interest, the author of such works must immediately notify the Ministry of Culture.

2.4.3 *Legislation under Preparation*

Decree on Safety and Environmental Plans of Offshore Drilling Platforms (Draft)

The Decree sets out the requirements for safety and environmental plans on offshore platforms. According to the Article 103 of the Environmental Code, those safety and environmental plans should be approved by the Ministry in charge of the commercial shipping after consulting the Ministry of Mines.

Title II of this Decree describes the content of the safety plan (Article 19 to Article 27) and the measures to be implemented in case of emergency.

Title III of the Decree defines the environmental evaluation (Article 35 to Article 39) and the strategy for the implementation of the environmental plan (Article 40 and Article 41).

Draft Decree on Drilling Fluids

The Decree defines environmental management requirements for drilling activities. It stipulates that Water-Based Fluids (WBF) should be used if feasible. Should the use of Non-Aqueous Drilling Fluid (NADF) be required a technical justification must be submitted to the Ministry in charge of the commercial shipping and to the Ministry of Mines and the negative impacts of their discharge to the environment should be minimised. The Decree sets out discharge limit values for NADF and Improved Synthetic Base Mud (SBM). The Decree also defines minimum water depth and distance from the coast where the discharge will be authorised.

2.5 *RELEVANT INTERNATIONAL CONVENTIONS AND AGREEMENTS*

2.5.1 *United Nations Convention on the Laws of the Sea*

Mauritania is signatory to the United Nations Convention on the Laws of the Sea (UNCLOS). Under this convention Mauritania claims rights within 12 nautical miles (nm) of territorial water and a 200 nm Exclusive Economic Zone (EEZ). Clearance for project vessels travelling into the territorial waters (*eg* to and from the onshore base) must be obtained from the Mauritanian authorities.

2.5.2 *International Maritime Organisation Conventions*

Mauritania is a signatory to a number of IMO Conventions. Of particular relevant is the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78).

The MARPOL Convention contains a number of the provisions relevant to the project. These include general requirements regarding the control of waste oil, engine oil discharges as well as grey and black waste water discharges. *Table*

2.2 provides a list of MARPOL provisions relevant to oil and gas developments.

Table 2.2 ***MARPOL 1973/1978 Provisions Relevant to Oil and Gas Exploration***

Environmental Aspect	Provisions of MARPOL 1973/1978	Annex
Drainage water	Ship must be proceeding en route, not within a 'special area' and oil must not exceed 15 parts per million (ppm) (without dilution). Vessel must be equipped with an oil filtering system, automatic cut-off and an oil retention system.	I
Accidental oil discharge	Shipboard Oil Pollution Emergency Plan (SOPEP) is required.	I
Bulked chemicals	Prohibits the discharge of noxious liquid substances, pollution hazard substances and associated tank washings. Vessels require periodic inspections to ensure compliance. All vessels must carry a Procedures and Arrangements Manual and Cargo Record Book.	II
Sewage discharge	Discharge of sewage is permitted only if the ship has approved sewage treatment facilities, the test result of the facilities are documented, and the effluent will not produce visible floating solids nor cause discoloration of the surrounding water.	IV
Garbage	Disposal of garbage from ships and fixed or floating platforms is prohibited. Ships must carry a garbage management plan and shall be provided with a Garbage Record Book.	V
Food waste	Discharge of food waste ground to pass through a 25-mm mesh is permitted for facilities more than 12 nm from land.	V
Air pollutant emissions	Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances including halons and chlorofluorocarbons. Sets limits on emissions of nitrogen oxides from diesel engines. Prohibits the incineration of certain products on board such as contaminated packaging materials and polychlorinated biphenyls.	VI

2.5.3 *Other Conventions and Agreements*

In addition to compliance with Mauritanian regulatory requirements, the project will also take into account the international conventions ratified by Mauritania and outlined in *Table* 2.3.

Table 2.3 *List of the International Conventions Ratified by Mauritania*

Name of the convention	Date of ratification	Description
General Conventions		
Stockholm Convention on Persistent Organic Pollutants (2001)	2005	Aims to protect human health and the environment against effects of chemical products of long life (remaining in the environment for long periods). The Convention allows the prohibition of the commercialization and utilization of the most harmful Persistent Organic Pollutants (POPs).
Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Montréal, 2000)	2005	Constitutes an instrument enabling Member States to establish legal means to prevent actual potential "biotechnological risks".
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)	Not ratified, Accepted in 2005	Promotes shared responsibility and cooperation among Parties in the domain of international commerce of certain dangerous chemical products. This, in the aim of protecting health and the environment. It promotes as well an ecologically rational utilization of these products.
United Nations Convention to Combat Desertification (Paris, 1994)	1998	Addresses countries gravely affected by drought and/ or desertification, especially in Africa. The phenomenon of desertification is in numerous countries a major concern, in terms of environmental protection and combatting poverty.
Convention on the Conservation of Migratory Species (Bonn Convention, 1979)	1997	Ensures the conservation of land, sea and air migratory species throughout their areas of distribution. Mauritania has signed the following three memoranda of understanding (MOU) associated to this Convention: • MOU concerning Conservation Measures for the Eastern Atlantic Populations of the Mediterranean Monk Seal; • MOU concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa; and • MOU concerning the Conservation of the Manatee and Small Cetaceans of Western Africa and Macaronesia. In addition, Mauritania ratified the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) - *L'Accord sur les Oiseaux d'eau Migrateurs d'Afrique Eurasie* in 2012.

Name of the convention	Date of ratification	Description
Basel Convention on the control of transboundary movements of hazardous wastes and their disposal (Basel, 1989)	1996	Establishes an international framework for the protection of human health and the environment against dangerous waste. Especially, the convention allows the regulation of the industrial sector and answers to the problems caused to the toxic waste imported from abroad.
The Convention on Biological Diversity (Rio, 1992)	1996	Promotes the conservation of biological diversity; the sustainable use of the components of biological diversity; and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. This convention constitutes the very first international agreement that considers biological diversity as a resource.
Vienna Convention on the Protection of the Ozone Layer (1985) and related Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	1994	Aims at structuring at the international scale, a legal, scientific and technical framework to ensure the protection of the environment against activities that modify the Ozone layer. Associated to this Convention, the Protocol of Montreal ensures the control of the production and utilisation of substances commercialized implying a major risk of modifying the Ozone layer.
Convention on the Ban of the Import into Africa and the Control of Transboundary Movements and Management of Hazardous Wastes within Africa (Bamako, 1991)	1991	Constitutes an important stage of the construction is a treaty in terms of environmental protection. In line with the Basle Convention, its principal objective is to limit the circulation of dangerous wastes on the African territory. Mauritania, as Member of the African Union, is party of the Convention
Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973)	1989	Establishes conditions for the importation, export, re-export and in general terms, the movement of endangered species of wild fauna and flora. The annexes of the Convention present a list of endangered species concerned.
Convention on Wetlands of International Importance – (Ramsar,1971)	1982	Aims to maintain the ecological character of wetlands of international importance, and the planning and sustainable use of these areas. Currently there are four Ramsar sites in Mauritania: *Banc d'Arguin, Chat Tboul, Lac Gabou* and *Diawling National Park.*
Convention for the Protection of the World Cultural and Natural Heritage (Paris, 1972)	1981	Establishes the list of Wold Heritage protected areas. Its principal objective is to promote international cooperation for the conservation of the wold common natural and cultural heritage, and the valorisation of its universal character. Mauritania has a natural area classified, the Banc d'Arguin National Park

Name of the convention	Date of ratification	Description
African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968)	1968	Aims to establish a framework of reference for environmental protection in Africa. It promotes actions regarding conservation, responsible use and development of natural resources (land, fauna, flora, water…) for the present and future generations
Offshore specific		
Convention on Cooperation for the Protection, Management and Development of Marine and Coastal Environment (Abidjan Convention), 1981	2012	Provides national and regional cooperative actions for the protection and enhancement of marine and coastal areas of Western and Central Africa.
International Convention on Standards of Training, Certification, and Watch keeping for Seafarers (STCW), 1978	2011	Establishes basic requirements on training, certification and watch keeping for seafarers on an international level.
Convention on Oil Pollution Preparedness, Response and Co-operation in matters of pollution by hydrocarbons (OPRC), 1990	2000	Specifies that States should establish a response mechanism to oil spills and any other oil accident; that they should adopt texts requiring ships flying flags to have an emergency plan; and requiring ships' masters to report without delay to the closest coastal States, an event on the ship involving an oil spill or the risk of an oil spill.
International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1960	1998	Requires member States to take all necessary measures on the high seas to prevent, remove or mitigate any serious and imminent danger that may arise for their coastlines as a result of pollution by hydrocarbons.
International Convention for the Safety of Life at Sea (SOLAS), and the SOLAS Protocol, 1974 and 1978	1998	The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships.
Convention on Civil Liability for Bunker Oil Pollution Damage (IMO)	1996	Establishes a regime for liability and compensation for damage caused by pollution due to propulsion fuel. Before the adoption of this convention, only pollution caused by oil tankers (cargo) was subject to compensation (CLC and FIPOL Conventions).
Convention on the International Regulations for Preventing Collisions at Sea (COLREGs, 1972)	1995	Establishes navigation rules to be followed by ships and other vessels at sea in order to prevent collisions between two or more vessels.

2.6 *TULLOW EHS POLICIES AND GUIDANCE*

Tullow EHS Policy (TO-EHS-POL-001-Rev9)

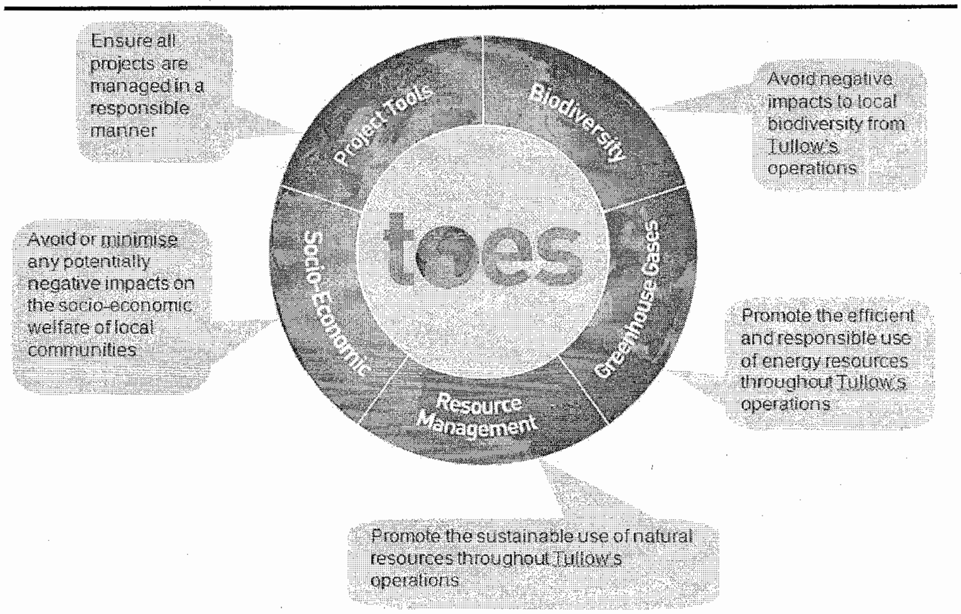
All facilities will be designed, developed and operated in conformance the Tullow EHS Policy (TO-EHS-POL-001-Rev9) (*Figure 2.2*).

Tullow Oil Environmental Standards (toes) (T-EHS-STD-0008)

Tullow has developed Tullow Oil Environmental Standards (*toes*). These srtandards are applicable to all its operations and revolve round the following four key areas with a set of project tools to support their delivery: biodiversity, greenhouse gases, resource management and social-economic aspects. A diagram summarising the *toes* is provided in *Figure 2.2*.

Tullow always ensures compliance with national labour laws (including the "Code du Travail") and the IFC Performance Standard 2. Standards and policies are reviewed on an on-going basis during projects, to ensure that these are always updated and remain compliant with the defined standards.

Figure 2.2 ***Tullow Oil Environmental Standards***



Tullow's Safety Rules (T-EHS-STD-002)

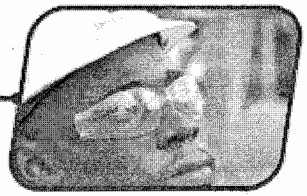
Tullow's Safety Rules are a set of requirements designed to manage high risk activities that have the potential for negative impacts on their staff, the environment and the surrounding communities. The effective implementation of these rules will lead to reduced risk to the workers, the environment and the surrounding communities during the operations.

Tullow's Drills Cuttings and Fluids Disposals Guidelines (T-WEL-GUD-0002)

Tullow's Drills Cuttings and Fluids Disposals Guidelines are applicable to the disposal of drill fluids and cuttings for both onshore and offshore drilling programmes where Tullow is the operator. The guidelines set minimum requirements to be considered during the planning stages of well construction, well testing and well intervention activities. Where local legislation dictates more stringent requirements, these shall be followed.

Figure 2.3 Tullow's Corporate EHS Policy

Think Environment
Think Health
Think Safety
Think Forward



TULLOW OIL plc

Environment, Health and Safety Policy

At Tullow Oil, we expect everyone to *Think* about their role in managing Environmental Health and Safety (EHS) risks that exist in our business and, in particular, within their own area of responsibility and influence.

To help us manage these risks we require everyone connected with our activities to:

- **Respect** our stakeholders and our values
- **Reflect** on lessons learned and their actions
- **Protect** the environment and each other

By following these principles and ***Thinking Forward*** we will ensure that EHS risk management forms an integral part of our day-to-day working practices and alignment with the EHS Vision.

To achieve this, we commit to:

- Proactively manage EHS risks and plan our operations taking those risks into account;
- Comply with the requirements of all applicable EHS laws and regulations, and apply industry best practice where legislation is lacking;
- Invest in building a competent and capable organisation to deliver consistently high levels of operational and EHS performance, supported by strong visible EHS leadership;
- Prevent pollution and minimise other adverse impacts on the environment and the local communities where we operate;
- Maintain a safe working environment by implementing safe systems and taking responsibility for the health and wellbeing of our staff and contractors;
- Ensure those working on our behalf adopt similar high standards of EHS;
- Monitor our progress against strong EHS objectives and targets to continually improve our performance.

In adhering to this Policy, everyone in Tullow or working on our behalf is empowered to stop any activity they regard as irresponsible or unsafe.

Aidan J Heavey

Aidan J Heavey
Chief Executive Officer, Tullow Oil plc
May 2012

T-EHS-POL-0001 Rev9

Tullow's Community Disturbance Philosophy (T-EHS-PHL-002)

The philosophy is based on a commitment that Tullow will prevent community disturbance through eliminating or reducing disruption to an acceptable level. It is Tullow's intent to ensure minimum community disturbance in order to foster and maintain good relations with local stakeholders. To avoid or reduce the potential for disturbance complaints the following principles apply:

- *Mitigation by design*: focus on planning and minimising the key risks relating to community disturbance through the evaluation of technical solutions and adoption of internationally recognised good practice and standards, and national legislation, in operational design.

- *Intervention*: mitigation actions should be undertaken where a disturbance is observed to exceed established thresholds (as set through the EIA, regulators and regulations or recognised international standards.

This philosophy applies also to all those activities associated with a project being undertaken, such as surveys, vehicle movements, ground works, construction camps and any operational activities which may have a potential to interact and disturb the local communities.

2.7 *INTERNATIONAL AND INDUSTRY GOOD PRACTICE AND GUIDANCE*

2.7.1 *International Finance Corporation (IFC) Performance Standards*

The International Finance Corporation (IFC) is a subsidiary of the World Bank Group dedicated to supporting private sector growth in developing countries. The IFC's Sustainability Framework (updated 1 January 2012), is widely considered as one of the most complete sets of standards for environmental and social management.

The IFC Performance Standards are a central element of this framework. The set of eight thematic standards establishes the principles for integrating environmental, health and safety considerations into projects. They were designed to assist project developers to avoid, mitigate and manage risks and impacts so that they develop their activities in a sustainable manner.

Where relevant, Tullow proposes to develop the project with consideration of the IFC PSs, as outlined in *Table 2.4*.

Table 2.4 IFC Performance Standards Considered in Developing the Project

PS	Title	Scope
1	Social and Environmental Assessment and Management Systems	Defines requirements for ensuring appropriate E&S management, policy implementation and accountability, including through an Environmental and Social Impact Assessment for which the IFC PS 1 defines requirements.
2	Labour and Working Conditions	Defines requirements for ensuring that the workers are treated fairly and are provided with safe and healthy working conditions.
3	Pollution Prevention and Abatement	Defines requirements for ensuring an appropriate level of pollution prevention and abatement.
4	Community Health, Safety and Security	Defines requirements for ensuring that adverse impacts from the project on the receiving community are managed and controlled.
5	Land Acquisition and Involuntary Resettlement	Defines requirements to minimize adverse social and economic impacts from involuntary resettlement, land acquisition, or restrictions on land use.
6	Biodiversity Conservation and Sustainable Natural Resource Management	Defines requirements for ensuring that the project's impacts on nature, ecosystems, habitats and biodiversity are appropriately managed.
7	Indigenous People	Defines requirements for the protection of Indigenous people (not applicable to the Banda Gas project, as there are no Indigenous people as defined by IFC PS7 in the Project area).
8	Cultural Heritage	Defines requirements to protect cultural heritage from the adverse impacts of project activities, to support its preservation and to promote the equitable sharing of benefits from the use of cultural heritage.

IFC EHS Guidelines

The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of projects. They are designed to provide relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility.

The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

The general EHS Guidelines contain information on environmental, health, and safety issues potentially applicable to all industry sectors and should be used together with the relevant IFC industry sector guidelines. For the Banda Gas development, the relevant EHS Guidelines that would apply are:

- EHS General Guidelines (IFC 2007a);
- EHS Guidelines for Offshore Oil and Gas Development (IFC 2007b);
- EHS Guidelines for Onshore Oil and Gas Development (IFC 2007c);
- EHS Guidelines for Shipping (IFC 2007d); and
- EHS Guidelines for Ports, Harbors, and Terminals (IFC 2007e).

2.7.2 *Oil and Gas Industry Exploration and Production Forum*

The International Association of Oil & Gas Producers (OGP) (former E&P Forum) was formed in 1974 and is the international association of oil companies and petroleum industry organisations. The OGP is concerned with all exploration and production operations and has sought to establish industry positions on environmental protection and personnel safety. The guidance listed below is of relevance to the project and has been adopted by the project as industry good practice standards for environmental assessment and management.

Table 2.5 ***Oil Industry Exploration and Production Forum Guidelines***

Document	Key Element
E&P Forum Guideline n°196: Exploration and Production Waste Management Guidelines	Provides a general description of waste management principles, an identification and overview of E&P activities and associated wastes and options for waste reduction, recycling, treatment and responsible disposal.
Joint E&P Forum and Nations Environment Programme (UNEP) technical report n°37: Environmental Management in Oil and Gas exploration and Production	Provides an overview of environmental issues and management approaches in oil and gas exploration and production operations. It defines the framework for environmental management against a background of existing information developed by industry, the United Nations Environmental Programme, and a variety of non-governmental organisations. It gives a brief overview of the oil and gas exploration and production process and examines potential environmental effects or impacts and discusses environmental protection measures. Section 6 describes how impacts can be avoided or minimised.
OGP Guideline n°265: Principles for Impact Assessment - the Environmental and Social Dimension	Focuses on increasing the coverage of social and community impacts in EIA, together with such factors as public consultation and access to local knowledge.
OGP Guideline n°389: Environmental-Social-Health Risk and Impact Management Process	Provides guidance to operators on delivering oil and gas projects that are integrated with the Environmental, Social and Health (ESH) appraisal process of identifying and mitigating environmental, social and health impacts.

Document	Key Element
OGP Guideline n°423: HSE Management Guidelines for Working Together in a Contract Environment	Aims at improving the company and contractor health, safety and environmental performcace regarding exploration and production activities. The guidelines is designed to improve workplaece safety, health and environmental performance by assisitng the company and contractor in administaring and effective HSE programme for the contract.
OGP Guideline n°457: Offshore Environmental Monitoring for the Oil and Gas Industry	Provides guidance to exploration and production companies on the design of offshore environmental monitoring studies.

2.7.3 *Industry Good Practice Standards for Offshore Effluent Discharges*

Table 2.6 provides industry good practice standards applied to effluent levels from offshore oil and gas exploration and production. These are based on MARPOL, IFC and OSPAR standards.

Table 2.6 ***Industry Good Practice Standards for Effluent Discharges***

Source	Industry Good Practice Standards
Completion Fluids	Discharge to sea if oil and grease do not to exceed 40 mgl^{-1}daily maximum and 29 mgl^{-1} monthly average. Any spent acids will be neutralised (to attain a pH of 5 or more).
Cooling Water	The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from point of discharge as per IFC EHS Guidelines.
Produced water	Oil and grease not to exceed 40 mg/l daily max and 29 mg/l monthly average as per IFC EHS Guidelines.
Oil on Cuttings	Western Gulf of Mexico. Discharge allowed subject to the following restrictions: • 9.4% for ester or equivalent (based on toxicity and biodegradation standards). • 6.9% for fluid with equivalent environmental performance to C16-C18 IOs. • Limit on Hg/Cd in barite (1/3$mgkg^{-1}$) and no free oil IFC EHS Guidelines require NADF cutting to be treated to an oil concentration lower than 1% by weight on dry cuttings where reinjection or ship to shore is not feasible. Limits on Hg is max 1 $mgkg^{-1}$ and Cd is max 3 $mgkg^{-1}$ dry weight in stock barite. Cuttings should be discharge via a caisson at least 15 m below sea surface.
Sewage	Treat with approved marine sanitation unit (achieves no floating solids, no discolouration of surrounding water) as per MARPOL Annex IV requirements. Minimum residual chlorine of 1 mgl^{-1}as per IFC EHS Guidelines.

Source	Industry Good Practice Standards
Food Waste	Macerate to acceptable levels and discharge in compliance with MARPOL 73/78 Annex V requirements.
Bilge Water	Treat to 15 ppm oil concentration as per MARPOL 73/78 Annex I requirements.
Ballast Water	Compliance with the International Convention for the Control and Management of Ship's Ballast Water and Sediments
Deck Drainage	Treat to 15 ppm oil concentration as per MARPOL 73/78 Annex I requirements.
Desalination brine	Mix with other discharge streams if feasible.

Note: MARPOL 1973/1978 = International Convention for the Prevention of Pollution from Ships. PPM = parts per million ≈ 1 mgl^{-1}

2.7.4 *Environmental Noise Standards and Guidelines*

Applicable National Requirements

Mauritania currently does not have any specific national standards and procedures for the regulation of noise. The Environmental Code states that "*The prohibition of noise [...] above the legal thresholds and in a way which may harm human health or cause nuisance to local communities*" (Chapter 3, Art. 69 of the code). However, no legal thresholds exist at the time of drafting this EIA.

Therefore the International Finance Corporation (IFC) and World Health Organisation (WHO) criteria have been applied for this Project. For additional reference, the South African National Standards (SANS) (that were developed based on the requirements of the WHO and IFC), have also been considered in developing the noise impact assessment presented in this ESIA (these standards are detailed in Annex B-3).

IFC Guidelines for Ambient Noise Levels

Table 2.7 details the IFC guideline applicable to community ambient noise levels. In industrial areas, the guideline prescribes an ambient noise threshold of 70 dB(A). In residential areas, the prescribed threshold is 55 dB(A) during daytime and 45 dB(A) during night time. These values make reference to noise from facilities and stationary noise sources, and are commonly applied as design standards for industrial facilities, and whilst this may imply they relate to some threshold of noise effects in a general sense, the IFC has indicated that they are not directly applicable to transport or mobile noise sources. Measurements are to be taken at noise receptors located outside the project property boundary.

In residential environments where the ambient noise levels already exceed a level of 55 dB(A) daytime and/or 45 dB(A) night time the IFC includes a guideline stating that noise emissions should not cause the ambient noise level in a residential area to rise by 3 dBA or more, determined during the noisiest hour of a 24 hour period.

Table 2.7 ***IFC Guidelines for Ambient Noise Levels***

Receptor	Maximum Ambient Noise Level 1-hour Leq (dBA)	
	Daytime 06:00-22:00	Night time 22:00-06:00
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

Note: No noise levels for rural/desert areas are stipulated

Referring to noise measurements, the IFC specifies the following requirements applicable to noise monitoring:

- typical monitoring periods should be sufficient for statistical analysis and cover an appropriate time period according to noise variation (24h, hourly or more frequently); and
- monitoring devices should be located approximately 1,5 m above ground and not closed to reflecting surface.

2.7.5 *Air Quality Standards and Guidelines*

Applicable National Requirements

As for noise, Mauritania currently does not have any specific national standards and procedures for the regulation of air quality. The Environmental Code states the requirement to avoid or minimise gaseous pollutant emissions, if susceptible of harming persons or goods (Chapter 1, Art. 31).

A new Decree regarding minimization of gaseous pollutants is currently being drafted by the authorities. This decree will specify the activities that will be regulated and for which pollutant emissions must be avoided / minimised.

However, there are no adopted legal thresholds at the time of drafting this EIA. Therefore the International Finance Corporation (IFC) and World Health Organisation (WHO) criteria have been applied for this Project.

World Health Organisation and International Finance Corporation Guidelines

Table 2.8 presents in force air quality standards, set by the IFC EHS Guidelines which refers to the WHO Air Quality Guidelines.

Table 2.8 ***Air Quality Standards set by the IFC Guidelines for Air Emissions and Ambient Air Quality***

Pollutant	Parameter	WHO AQ Guidelines [µg/m³]
NO_2	Annual average	40
	Maximum hourly concentration	200
CO	8h moving average	10000(*)(**)
PM10	Annual average	35
	Daily average	50

(*) WHO Air Quality Guidelines for Europe
(**)The maximum daily eight-hour mean concentration will be selected by examining eight-hour running averages, calculated from hourly data and updated each hour. Each eight-hour average calculated will be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on that day.

2.7.6 *Liquid effluents and onshore discharges*

In Mauritanian law, the Water Code *(Law n°2005-030 of 2nd February 2005)* determines the juridical regime for the planning, use and preservation of all types of water (except sea water). The code recognizes water resources access as a common right and state that the Mauritanian government must guarantee the access of drinking water to all its population, in the respect of natural environment. However, no national guidelines exist for wastewater and liquid effluents quality.Therefore the International Finance Corporation (IFC) criteria have to be considered for this Project.

Two main options are evaluated to reuse or discharge produced water:

- reusing the produced water as water for industrial usage at the neighbouring power plant, to reduce the water needs of the plant; and
- re-use as irrigation water for planted areas at the processing facility.

Points of discharge, rate of discharge, chemical use, dispersion and environmental risk should be considered in a disposal plan. In addition, discharges should be planned away from environmentally sensitive areas, with specific attention to high water tables, vulnerable aquifers, wetlands, and community receptors, including water wells and intakes.

The IFC-EHS Guideline - Onshore Oil & Gas Development proposes quantitative guidance for effluent discharges to surface waters or to land as indicated in *Table 2.8.*

Table 2.9 IFC guidelines for discharge to surface waters or to land

Parameter	Value
Total hydrocarbon content (THC)	10 mg.l^{-1}
pH	6-9
Biological Oxygen Demand (BOD)	25 mg.l^{-1}
Chemical Oxygen Demand (COD)	125 mg.l^{-1}
Total Suspended Solids (TSS)	35 mg.l^{-1}
Phenols	0.5 mg.l^{-1}
Sulphides	1 mg.l^{-1}
Heavy metals (total)	5 mg.l^{-1}
Chlorides	600 mg.l^{-1} (average), 1,200 mg.l^{-1} (maximum)

Source: IFC EHS Guideline - Onshore Oil & Gas Development (2007)

3 *PROJECT DESCRIPTION*

3.1 *Introduction*

3.1.1 *Purpose of this Chapter*

This chapter provides a description of the proposed Banda Gas facilities, equipment, main project activities, and associated emissions and discharges. Information on project personnel and an overview of the project health and safety provisions are also provided.

3.1.2 *Overview of the Banda Gas Development*

The development will involve the drilling and completion of two new subsea gas production wells in the Banda field, offshore Mauritania. The Banda field is located approximately 20 km east of the neighbouring Chinguetti field and, at its closest point, is located approximately 55 km off the Mauritanian coast (*Figure 3.1*). Water depths at the field range between 200 and 325 m.

The Banda field was first discovered in 2002. It is located entirely within Petroleum Sharing Contact Area A (PSCA). It will be developed under a Joint Venture agreement between Tullow, Petronas, Kufpec and Premier, with Tullow as Operator.

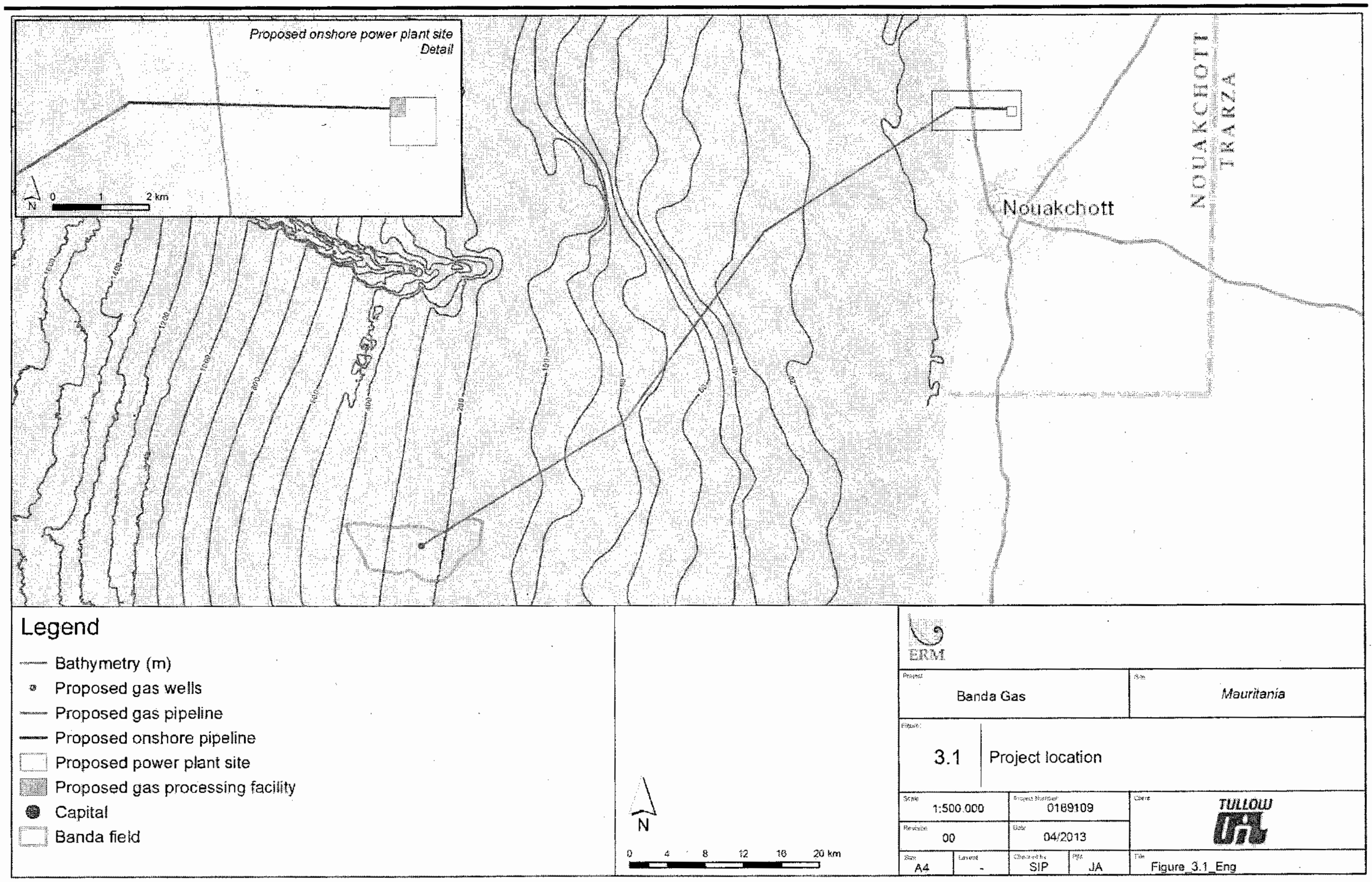
The gas produced from the Banda field will be flowed via a new 10" subsea pipeline to a new onshore plant, where the gas will be separated from water and condensate. Once processed to commercial specifications, the gas will then be flowed to an adjacent proposed power station, to be developed, owned and operated by a separate entity, the *Société de Production d'Electricité à partir du Gaz* (SPEG). The SPEG power plant is not covered by the scope of this EIA. However, this associated facility [(1)] has been considered in this EIA regarding potential cumulative impacts.

The stabilised condensate will be exported by road-tanker to storage facilities at Nouakchott port for onwards export to out of country refinery.

Future provision will be made for the tie-in of a third gas production well if required to meet demand or improve reservoir performance, however, this is outside the scope of this EIA.

(1)The IFC PS1 defines associated facilities as facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

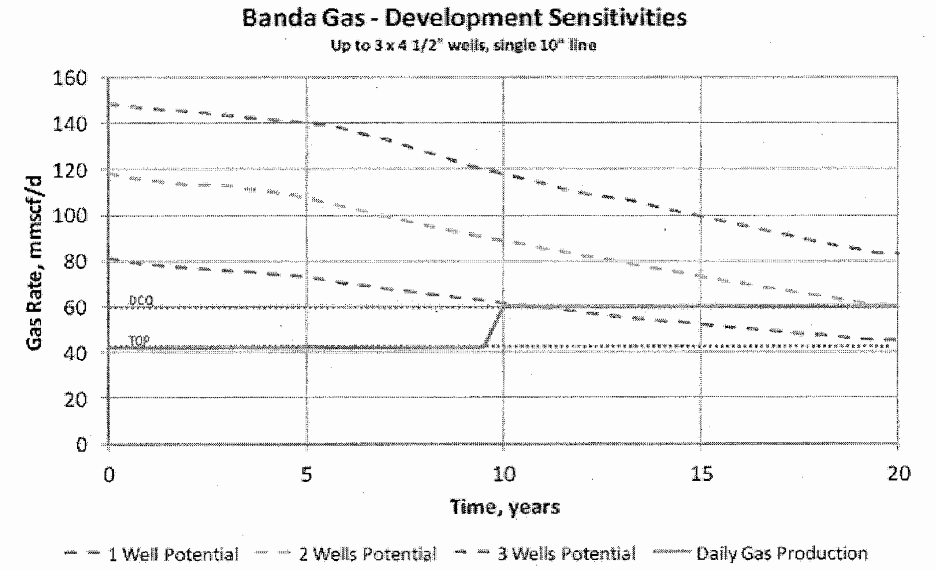
Figure 3.1 Project Location



3.1.3 *Production Forecast*

The Banda gas reserves are estimated at approximately 1 trillion cubic feet (tcf) of gas. Gas recovery for the project will be managed in accordance with market demand. Studies to-date indicate that production of up to 100 million standard cubic feet per day (MMscfd) for 20 years is feasible. The production profile for Banda is presented in *Figure 3.2*, where DCQ (Daily Contract Quantity) refers to the quantity of gas that Tullow have contracted to deliver.

Figure 3.2 ***Base Case Production Profile***



DCQ: Daily Contract Quantity. Multiplied by 365 it provides an annual ceiling for seller's obligation to deliver
TOP : Take or Pay. Buyer's obligation to pay a minimum equivalent to the ToP even if actual nominations are lower

3.1.4 *Schedule*

Table 3.1 presents the proposed Project schedule. The activities listed within this schedule are discussed in more detail the following sections. The drilling programme is planned to commence in the third quarter (Q3) of 2015, with upstream facilities ready to produce first gas early Q1 2016. The schedule may change, depending on the duration of the project approval process, fabrication times of various elements, and the availability of drilling and specialist construction vessels.

Table 3.1 ***Proposed Project Schedule***

Activity	2013				2014				2015				2016			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project approval			▼													
Subsea equipment																
Subsea installation																
Gas plant site works																
Drilling & completions																
First gas													▼			

3.1.5 *Project Activities*

The Banda Gas development project will be undertaken in the following phases:

- **Offshore Drilling and completion** will involve drilling the two wells to their total depth, installation of the sandface completions and production Xmas trees, and the preparation of the wells for production.

- **Subsea installation** will involve the installation on the seabed of the manifold, the tree and manifold protection structures, jumper spools, and the laying of the pipeline and umbilical to shore.

- **Onshore construction** will involve site clearance, materials transfer, construction activities for the gas plant and the laying of the onshore sections of the pipeline and umbilical.

- **Commissioning** activities will involve cleaning, checking, testing installed equipment to verify functionality prior to start of production.

- **Operation** will include processing and production of hydrocarbon products for export to end users.

- **Decommissioning** activities will be undertaken at the end of the field life.

Each of these activities is described in greater detail in the following sections.

3.2 *DRILLING AND COMPLETIONS*

3.2.1 *Well Locations*

The two Banda gas production wells will be drilled from a single drill centre. The nominal locations of the Banda gas wells and production manifold are provided in *Table* 3.2. The final spud locations may deviate from the proposed well locations as part of ongoing detailed engineering studies. The wells are located in water depths of approximately 230 m.

Table 3.2 ***Proposed Well Locations***

Name	Coordinates (UTM) WGS84 Zone 28 N	
	Northings (m)	Eastings (m)
Manifold	1 965 000 N	334 700 E
Well BG1	1 965 051 N	334 703 E
Well BG2	1 964 963 N	334 736 E

3.2.2 *Drilling Vessel*

A moored semi-submersible Mobile Offshore Drilling Unit (MODU) will be used to drill and complete the planned two wells from a single drill centre. Moored MODUs are typically secured to the seabed using eight anchors and ballasted to a predetermined depth to maintain stability. *Figure 3.3* shows a typical moored MODU, the Byford Dolphin. The MODU will be surrounded by a 500 m temporary safety exclusion zone.

Additional services will also be provided such as cementing and pumping with dedicated bulk and fluid storage. The MODU will also be equipped with tanks for drill water, potable water, fuel and machinery oil storage. The main deck will be sufficient to provide racked stowage for drilling pipe and casing as well as providing an area for pre-checks of subsea Christmas trees and an area for a well clean-up package. The MODU will also include personnel accommodation.

Figure 3.3 *Typical third generation MODU, Byford Dolphin*

Source: Dolphin Drilling

3.2.3 *Schedule*

Drilling is expected to take place in Q3 and Q4 2015. It is assumed that it will take up to approximately 45 days to drill and complete each well. Mobilisation of the MODU is expected to take 10 days; however, the timing may change depending on the vessel location at time of hire. Demobilisation of the drilling vessel may take up to approximately 10 days.

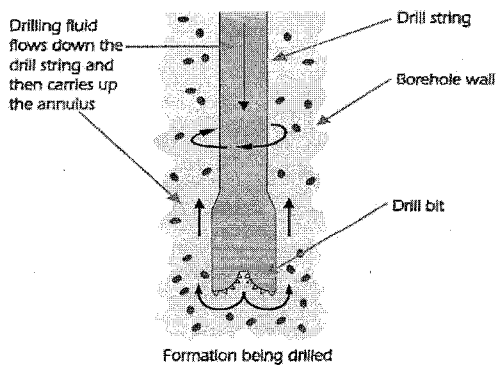
3.2.4 *Drilling Process Description*

Drilling for oil and gas uses a rotating drill bit attached to the end of a drill pipe (the 'drill string') to bore into the subsurface to reach trapped oil and/or gas. The first stage of drilling is to drill the well top hole, following which a conductor casing is lowered into the hole and cemented into place. The second well section, known as the surface section, is then drilled using a smaller drill bit and the surface casing lowered and cemented into place.

At this stage a Blow-Out Preventer (BOP) and marine riser are installed onto the well. The marine riser connects the well to the MODU forming a closed loop system. Once in place, drilling continues using a series of progressively smaller diameter drill bits and casings as the well is drilled deeper. The casings are lowered down the hole through the previous larger diameter casing section and cemented into place.

The rotating drill bit breaks off small pieces of rock (called drilling cuttings) as it penetrates rock strata. The cuttings typically range in size from clay to coarse gravel, and their composition will vary depending on the types of sedimentary rock penetrated by the drill bit. Drilling fluid, also known as drilling mud, is pumped down inside the drill string to lift the cuttings from the bottom of the well to the surface (see *Figure 3.4*). Additionally, the purpose of the drilling fluid is to maintain positive pressure in the well, to cool and lubricate the drill bit and to protect and support the exposed formations in the well. More information on drill cuttings and fluid is provided in *Section 3.2.6*.

Figure 3.4 ***Circulation of Fluid during Drilling***



Source: OGP 2003

3.2.5 *Well Design*

The two Banda Gas wells will be simple 'slant' wells of similar design and will be drilled from within 100 m of a single drill centre. A preliminary well design schematic is shown in *Figure 3.5*. The depth and section lengths for both of the gas wells are presented in *Table 3.3*.

Figure 3.5 *Well Schematic Diagram*

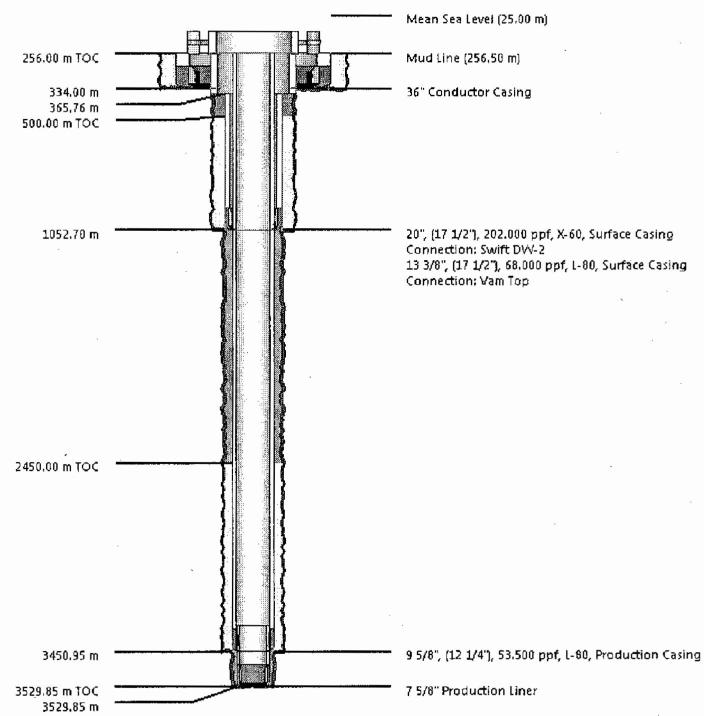


Table 3.3 ***Proposed Designs of the Banda Gas Wells***

Diameter (inches)	Casing	Well BG1		Well BG2	
		Depth (m TVD)	Section length (m)	Depth (m TVD)	Section length (m)
Jet in	36″ conductor	334	78	334	78
17½	13⅜″ casing	1,052	718	1,052	718
12¼	9⅝″ casing	3,426	2,374	3,055	2,003
8½″	7⅝″ production liner	3,529	103	3,077	22

3.2.6 *Drilling Fluids and Cuttings*

The first two sections will be drilled 'riserless' (ie without circulating drilling fluids from the MODU to the well), using seawater and 'sweep pills' (1). Cuttings from these sections will be discharged to the seabed. For the subsequent sections, a marine riser will be installed, allowing the fluids and cuttings to be returned to the MODU. At this stage, drilling will continue with

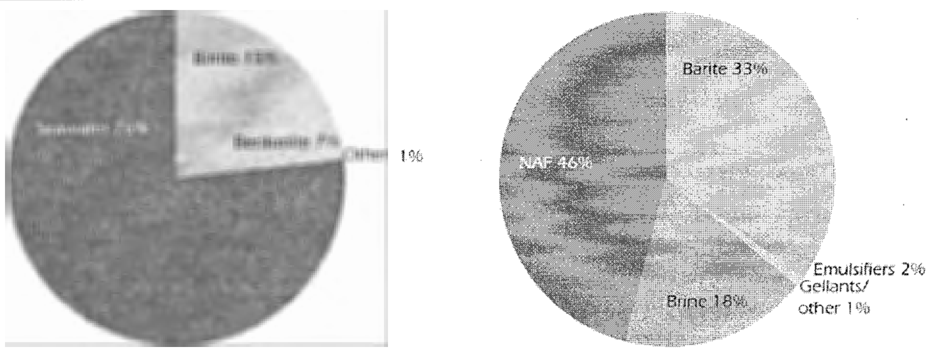
(1) A relatively small volume of viscous fluid, typically a carrier gel, that is circulated to sweep, or remove, debris or residual fluids from the circulation system.

either water based mud (WBM) or an improved synthetic based mud (SBM) for the remaining well sections.

Fluids and cuttings returned to the MODU will be separated and cleaned using shale shakers. Shale shakers typically consist of large, flat sheets of wire mesh screens of various mesh sizes that shake cuttings across and off the screens as the drilling fluid flows through them and back into the drilling fluid system.

For both types of drilling fluids (WBM and improved SBM), a variety of chemicals are added to the water or non-aqueous liquid to modify the properties of the fluid. Additives include clays and barite to control density and viscosity and polymers such as starch and cellulose to control filtration. The proportion of typical components in drilling fluids is shown in *Figure 3.6*. The type of drilling fluid used for a particular well or drilling programme will depend largely on the technical requirements of the well, local availability of the products and the contracted drilling fluid supplier.

Figure 3.6 ***Typical Additives in Drilling Fluids***



(a) Water based muds (a) Improved synthetic based muds

Source: OGP 2003
NAF : Non Aqueous Fluid

Improved SBMs are often required for particular well sections as they offer better well stability (particularly when drilling through water-sensitive formations such as shales). They also offer better lubricity and high temperature stability and reduce the formation of gas hydrates. In addition, using improved SBM results in more efficient drilling, fewer drilling problems and requirement for remedial work, thereby reducing the potential for health and safety risks. If improved SBM are used, Tullow is purposing the use of TOTAL Special Fluids EDC 99-DW, which is categorised as Group III on the OGP categorisation system having an aromatic content of 0.00005% and PAH content of 0%.

Cleaned cuttings will be discharged overboard while the drilling fluid will be recycled and ultimately returned to the supplier. However, a portion of the drilling fluid usually adheres to the cuttings discharged to sea. The amount will depend on the equipment used, but is generally in the region of 5% to 10% by weight.

Estimated drilling wastes (discharged fluids and cuttings) for both gas wells are presented in *Table 3.4*.

Table 3.4 ***Estimated Drilling Wastes***

Well Section	Well BG1			Well BG2		
	Cuttings Generated (MT)	Mud Discharge (MT)	Volume of Discharge (m^3)	Cuttings Generated (MT)	Mud Discharge (MT)	Volume of Discharge (m^3)
36"	-	-	-	-	-	-
17 ½"	262.7	0.0	0.0	262.7	0.0	0.0
12 ¼"	425.7	21.3	15.5	359.1	18.0	13.0
8 ½"	8.9	0.4	0.3	1.9	0.1	0.1
Total	**697.3**	**21.7**	**15.8**	**623.7**	**18.1**	**13.1**

3.2.7 *Cement and Cement Chemicals*

Well casings will be cemented into place to provide structural integrity of the well and also to aid the drilling process. Cement slurries will be used to fill the annulus between the outer face of the casing and the wall of the formation. This is achieved by pumping the slurry down the drill string to the bottom of the section casing which then passes back up through the annulus between the casing and the formation. The cement slurry remaining within the casing is displaced with drilling fluid. After the cement within the casing is displaced the pumping stops and the slurry is allowed to set.

To ensure the annulus is filled with quality cement it is common to pump down 100% excess for the first two sections with the excess discharged to the seabed. Following the installation of the riser the cement slurry will be circulated between the well and MODU. It is estimated that approximately 120 m^3 of cement slurry will be discharged to sea for each well. The slurry will consist primarily of cement and freshwater with small quantities of chemicals to accelerate or delay the setting time, adjust the viscosity and minimise foaming.

3.2.8 *Well Completions*

Once the well has been drilled and cemented, a process known as 'well completion' is undertaken to prepare the well for its operational function (*ie* gas production). The well completion consists of two parts: the lower completion and the upper completion.

The lower completion refers to the portion of the well across the reservoir. For Banda Gas the plan is to complete this section using gravel pack to prevent sand flowing with the gas during production. The upper completion is the tubing that is set above the reservoir through which gas and condensate flow from the reservoir and up to the production tree at seabed. The tubing will have a safety valve to shut-off production in case of failure of the production tree. Heavy fluids will be used to prevent the inflow of gas and /or condensate into the well during well completion.

3.2.9 *Well Clean-up and Flaring*

Prior to production start-up, the drilling and completion fluids within the well must first be removed. This is referred to as well clean-up. Well clean-up is typically achieved by injecting nitrogen gas at the bottom of the well to lift the heavy fluids out of the well and thereby initiating an inflow of gas and condensate from the reservoir. As part of this process the returned fluids from the well flow back to the MODU where any gas and condensate are diverted to a disposal flare.

Well testing and clean-up is estimated to last for up to approximately 24 hours /well. Once a stable production rate is achieved, the clean-up operation is ended. A well might be tested further during well shut-in.

There will be no flaring of gas production effluents other than for well clean-up and testing.

3.2.10 *Support Operations*

An estimated two supply vessels runs per week will be used to transfer materials (mud, casings, tools and water) from the onshore supply base to the MODU.

Tullow will use an existing onshore support base located at the Port of Nouakchott, located at approximately 62 km northeast of the Banda field (*Figure 3.7*). The base has been in operation since 1986 and its lease has been transferred from its former contracting party (Petronas) to Tullow.

Figure 3.7 *Aerial View of Port of Nouakchott*

The facilities are located at a new quay at the Port of Nouakchott: Area 1 and Area 2 on *Figure 3.7*. Area 1 encompasses three warehouses with a total storage capacity of 3,425 m^3, an office unit, a yard and a chemical decanting area. Area 2 encompasses a storage yard, a mud plant chemical storage shed, and concreted laydown areas. Pictures of the facilities at the Port of Nouakchott before Tullow's works are presented in *Figure 3.8*.

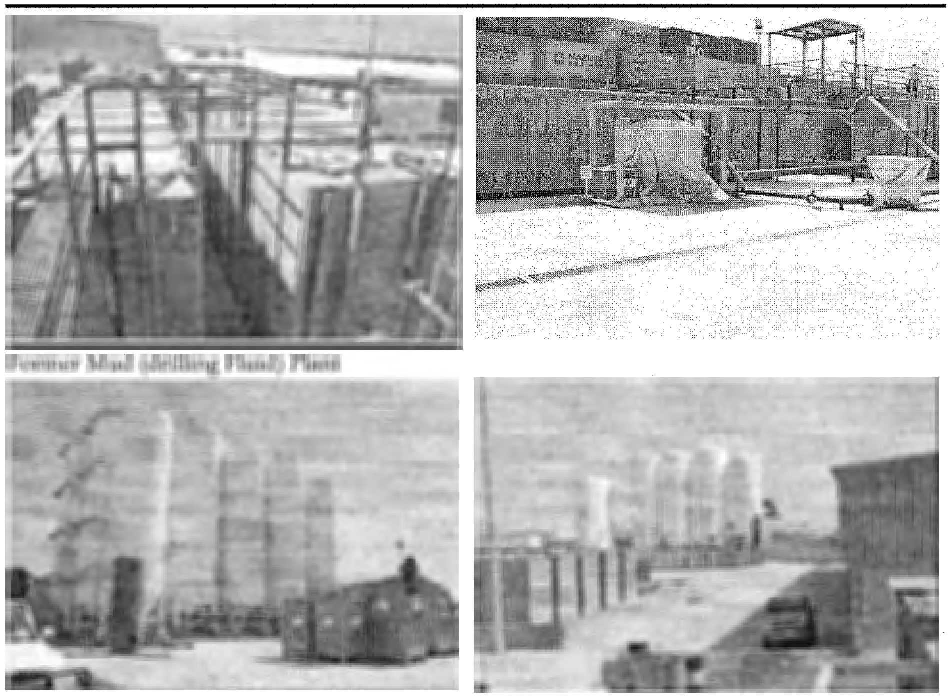
Staff transfers between Nouakchott and the Banda field will be via helicopter. A typical offshore support helicopter is shown in *Figure 3.9*. It is estimated that up to two helicopter trips a day will be required during the drilling phase.

3.2.11 *Personnel*

The number of personnel on the MODU will fluctuate between 60 and 110 depending on its operation (*eg* mobilisation, drilling, etc.), with approximately 95 during drilling, ramping up to 110 during completion operations.

The onshore support base will be manned by about 10 dedicated personnel and a further 20 personnel will be required for logistical operations. The percentage of locally employed workforce will be approximately 5% for the MODU, 90% for the support base, and 25% for the logistics operations.

Figure 3.8 ***Tullow's Facilities at Port of Nouakchott***



Former Cement Plant

Figure 3.9 *Typical Support Helicopters*

3.3 *SUBSEA INSTALLATION*

3.3.1 *Development Overview*

The subsea field configuration is shown in *Figure 3.10*. The two gas-producing wells will be connected by jumpers to a single manifold. Production from the wells will be transported from the manifold to the onshore gas plant via a gas pipeline. Definitions of subsea equipment terminology are provided in *Box 3.1*. The production manifold, jumpers, PLET, pipeline and umbilical will be designed to international standards.

Box 3.1 *Subsea Equipment: Definition of Terms*

Production manifolds
Production manifolds are subsea equipment installed on the seabed, comprised of valves and pipes, which act as a gathering point for the produced fluids/gas from individual production wells.

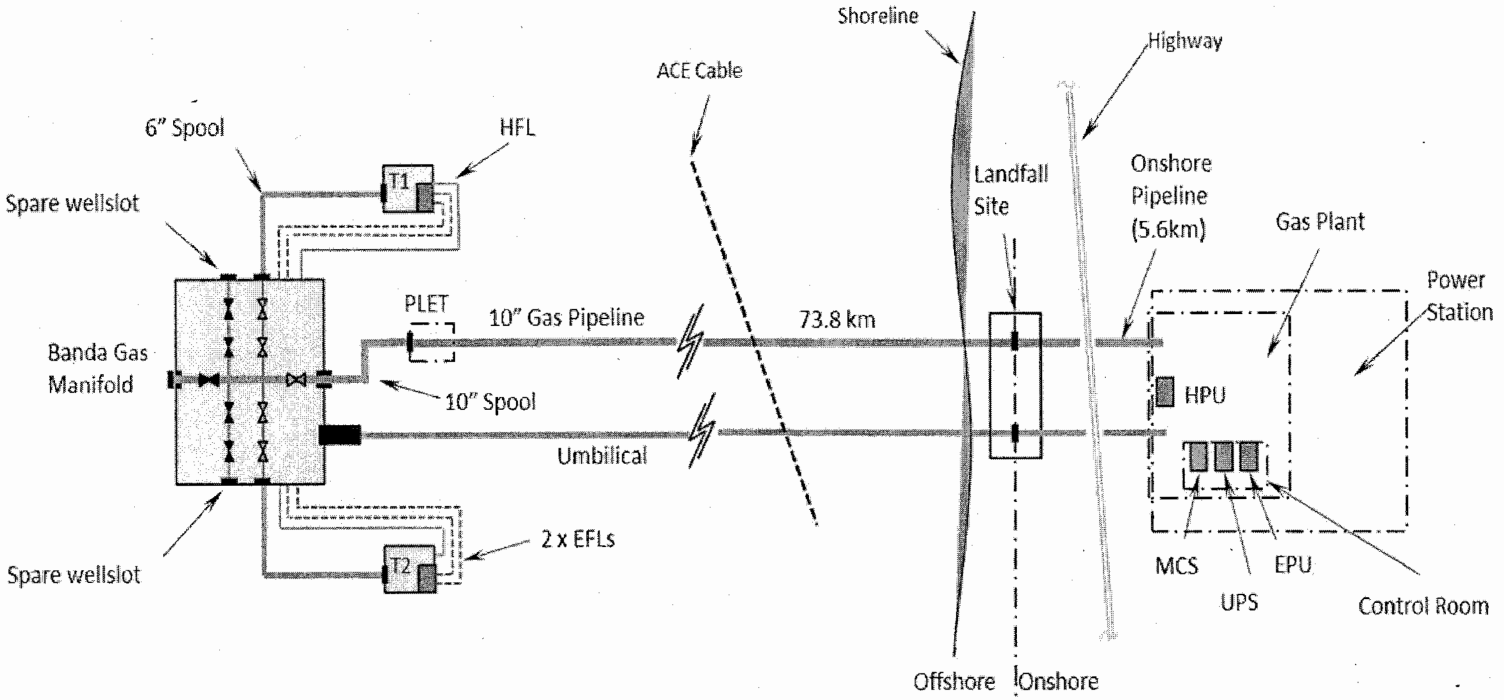
Production trees
Production trees are comprised of a set of control valves that are installed on production wellheads to control production fluids/gas.

Jumpers
Jumpers are rigid and flexible pipes that connect trees to manifolds.

Umbilicals
Umbilicals are used to convey chemicals, data (control system information, pressure and temperature), electrical power and high pressure hydraulic fluid supply to allow manipulation of subsea infrastructure, subsurface safety valves and flow chokes.

Pipeline End Termination (PLET)
A PLET is a subsea component that includes a flange and makes it possible to connect a rigid pipe to another structure such as a manifold or a tree by means of a jumper.

Figure 3.10 *Proposed Subsea Configuration*



Abbreviations:

EFL: Electrical Flying Leads;
HFL: Hydraulic Flying Leads;
PLET: Pipeline End Termination;

3.3.2 *Manifold*

A new 4-slot manifold will be installed in the field to serve as a gathering point for produced gas and distribution point for well services. Initially only two slots will be required for the project requirements, two spare slots will provide for future tie-ins. All the production valves on the manifold will be operated by a Remote Operated Vehicle (ROV) with only a single hydraulic valve controlling the injection of corrosion inhibitor.

The manifold will be constructed using corrosion resistant piping and installed on a permanent foundation structure in order to provide a stable base. A protective structure will also be installed over the manifold to protect it from fishing activities and dropped objects. The protective structure will be designed to be "over-trawlable", such that it provides the optimal protection from trawling nets to the manifold, whilst presenting minimum risk to fishing activities in the area.

The Banda Gas manifold will be installed by a multi-purpose support vessel (MSV) equipped with a suitable crane and remotely operated vehicle (ROV) facilities. The manifold base will be lowered to the seabed first and secured using suction piles. The manifold module will then be lowered onto the base frame and secured to the manifold base.

3.3.3 *Production Wells*

A subsea production tree (commonly termed 'Christmas tree') will be installed on to each of the two wellheads. Each tree will carry control and monitoring equipment including a choke and a Subsea Control Module (SCM) for the operation and control of gas flow from the well. The trees will connect to the manifold with flexible jumpers. The trees will be installed from the MODU during the drilling and completions phase.

3.3.4 *Jumpers and Flying Leads*

Flexible jumpers will be used to connect the subsea production trees to the manifold, and the manifold to the PLET. The jumpers and control flying leads will be installed by the MSV. They will be lowered to the seabed in a basket and the connections at each end will be pulled into place by a Remotely Operated Vehicle (ROV). All connections made subsea will be leak tested.

3.3.5 *Pipeline*

Produced gas will be exported to shore via a 75 km long, 10 inch (25.4 cm) subsea pipeline and a further 5.6 km by an onshore pipeline to the gas plant. The pipeline will be trenched, or protected by rock-dump for sections where trenching is not possible. The Banda field end of the pipeline will be terminated by a Pipeline End Termination (PLET).

The nearshore section will be trenched using back-hoe dredgers or other specialist trenching equipment and the offshore section will be trenched using a specialist trenching vessel to limit the risk of damage to fishing vessels.

The pipeline will be installed by two pipe-laying vessels supported by a survey vessel. The shallow water pipe laying vessel will start at the shore end and lay the nearshore section (approximately 15 km). The deepwater pipe laying vessel will then continue to lay the pipeline from the nearshore section to the PLET (approximately 60 km).

Rock dumping may be required for the approximately 12 km length of pipeline where trenching may not be possible as a result of hard substrate and/or rocky outcrops. Installation of the rock will be either by the single-pass or multi-pass method using a dynamically positioned flexible fallpipe vessel. A pre-lay and post installation survey will also be undertaken to confirm position and target of the rock dump and to verify successful completion of work. The surveys and fallpipe positioning during the installation will be by a remote operated vehicle (ROV) attached to the lower end of the flexible fallpipe. It is envisaged that the rock material will be trans-shipped from Europe to Las Palmas, Canary Islands.

3.3.6 *Subsea Control System*

The system will be controlled by a subsea control system operated from the onshore control room in the gas plant via a subsea umbilical.

A new 75 km umbilical will be installed from the onshore umbilical connection to the manifold, where services are distributed to the wells using individual flying leads. The umbilical will provide electrical power and communications and hydraulic control fluids to the control modules on the subsea trees: it will also supply methanol, MEG and corrosion inhibitors to the wells. The umbilical will either be trenched or laid into in the same trench as the pipeline. Any untrenched sections will be protected using concrete mattressing.

The umbilical will be laid alongside the gas pipeline either in its own trench or within the same trench as the pipeline using similar installation methods.

The subsea control system will operate safety valves installed downhole in the wells, safety and control valves on the tree, and will also gather data on gas flow, pressure and temperature The control system utilises dual redundancy to maximise reliability and will be fully integrated into the gas plant control and safety system.

3.3.7 *Seafloor Footprint*

The area of seafloor directly concerned by the installation of the subsea infrastructure will be approximately 750,600 m^2. Seafloor disturbance will be caused by the installation of subsea production facilities, such as the manifold, Christmas trees, umbilical and pipeline. The largest disturbance will be as a result of the trenching and rock-dumping operations. A summary of the subsea facilities and its expected footprint on the seafloor is provided in *Table 3.5*.

Table 3.5 ***Estimated Seafloor Footprint of the Banda Gas Development***

Facility	Dimensions (m)	Total Seafloor Affected (m^2)
Production Trees (2)	4.5 m x 4.5 m	41
Manifolds (1)	6.0 m x 6.0 m	36
PLET (1)	11.0 m x 5.0 m	55
Production Jumpers (2)	30 m of 6" (0.152 m) jumpers	5
PLET Jumper (1)	200 m of 10" (0.254 m) jumper	500
Trench: • Pipeline (1) • Umbilical (1)	75,000 m of 10 m (disturbed area)	750,000
	Total	**750,637**

3.3.8 *Vessel Requirements and Support Operations*

Tullow's onshore base at Nouakchott, used during the drilling and completions phase, may be retained for use by installation contractor during subsea installation. A summary of the vessels required and their purpose for the installation phase of the project is provided in *Table 3.6*.

Table 3.6 ***Vessels Required for the Installation Phase***

Type	Personnel	Purpose	Duration (days)
Mutli-Purpose Support Vessel (MSV)	40	Installation of manifold, pipeline and Xmas tree tie-in, support testing and commissioning	41
Trenching/Pipelay Support Vessel	60	Trench pipeline, back-fill trench	71
Pipelay Vessel	120	Lay offshore pipeline	30
Rock Dumping Vessel	30	Rock dumping onto un-trenched pipeline sections	45
Umbilical Installation Vessel	60	Lay umbilical into pipeline trench	25
Shallow Water Pipelay/Umbilical Vessel	100	Lay nearshore sections (15 km) of pipeline and umbilical	52
Nearshore Dredging Vessel	100	Dredging the nearshore trench sections (15 km)	115

All construction and support vessels used by the project will be operated in compliance with their classification standards. Specialist vessels with experienced crews will be required for the installation of the infrastructure. Staff transfers will continue to be by helicopter.

3.3.9 *Personnel Requirements*

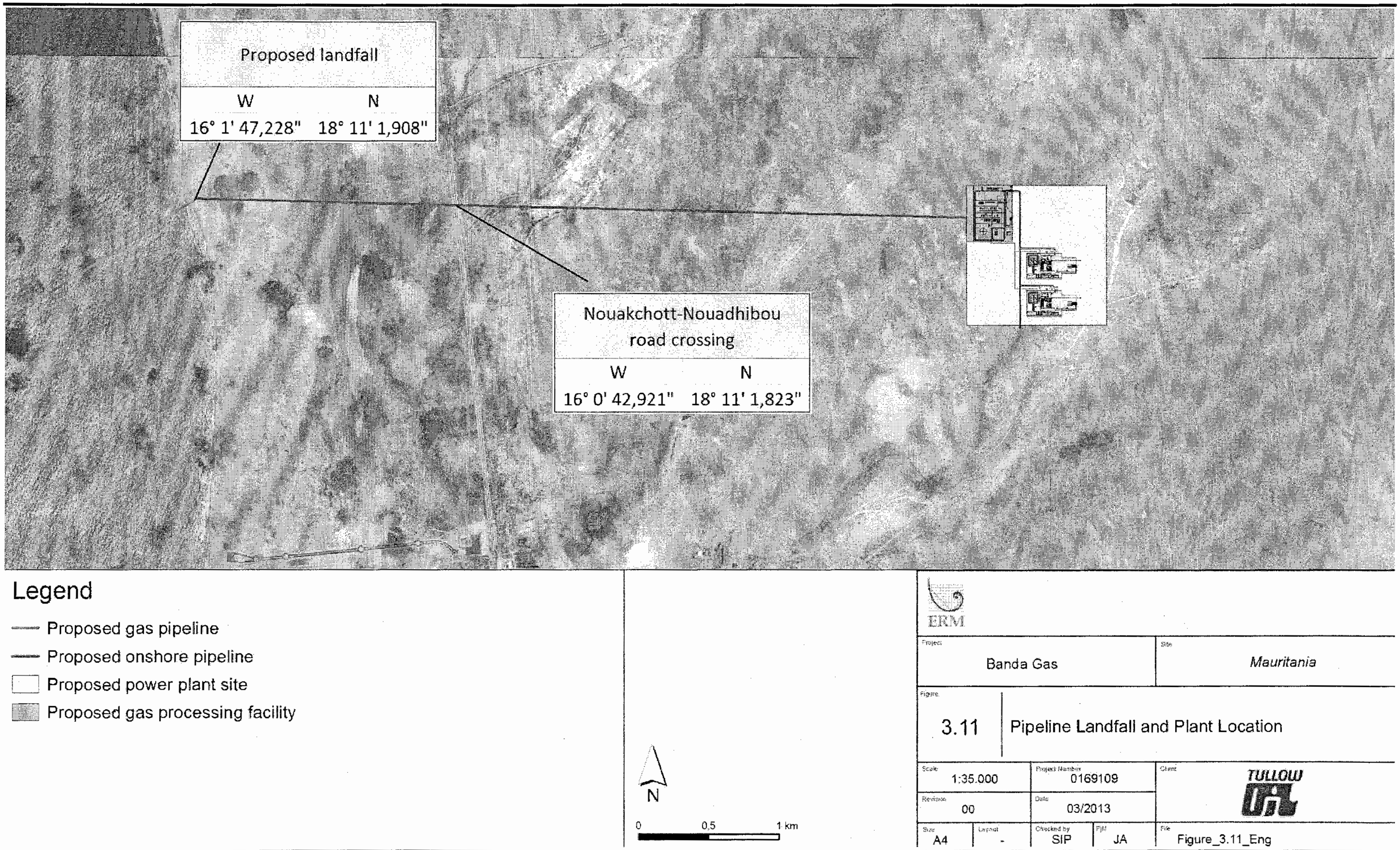
The installation vessels will be manned as indicated in *Table 3.6*, giving a total number of offshore personnel of 510. The onshore support base and logistically operations will be the same as during the drilling and completions phase (10 and 20, respectively). It is envisaged that most offshore personnel will be expatriate workers.

3.4 *ONSHORE INSTALLATION*

3.4.1 *Overview*

An onshore gas plant will be constructed to process the produced gas from the Banda field. The onshore gas plant will be located approximately 9 km north of Nouakchott and approximately 6 km inland. Onshore land take is likely to be in the order of 400 m x 325 m for the terminal within a 1 km x 1 km plot which includes the adjacent power plant. Location of the proposed onshore gas terminal is shown in the figure below.

Figure 3.11   Pipeline landfall and plant location



3.4.2 *Onshore Pipeline and Umbilical*

A 10-inch carbon steel with polyethylene coating pipeline will transport gas for 5.6 km from the offshore pipeline landfall to the onshore gas plant.

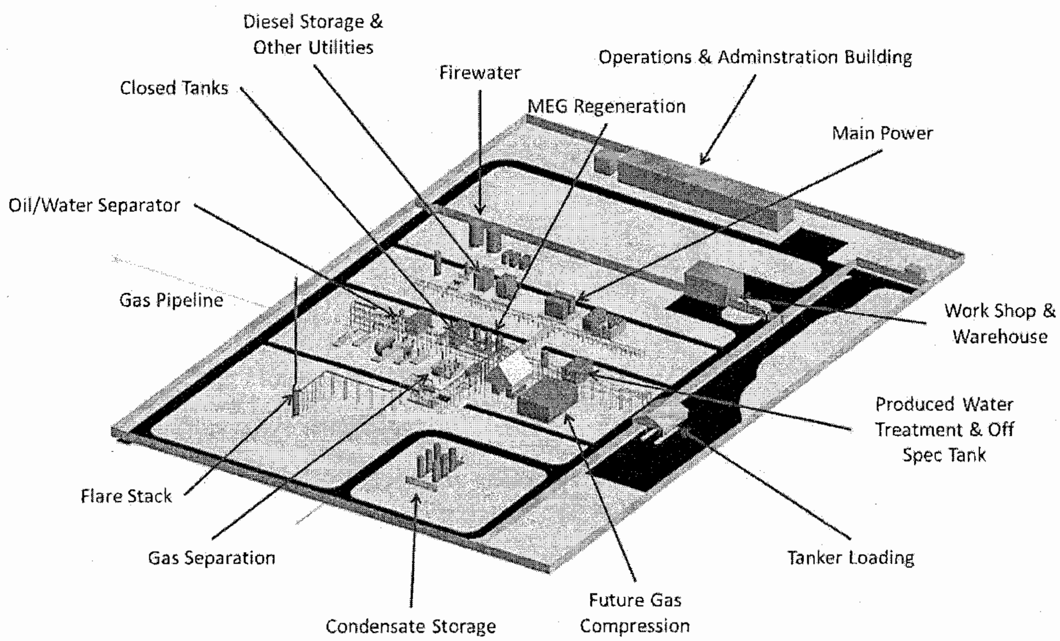
An umbilical will be laid alongside the gas pipeline within the same trench. Once the umbilical has been laid the trench will then be backfilled.

The pipeline and umbilical will cross under the Nouakchott -Nouadhibou road at 16°0'42,921"W 18°11'1,823"N which corresponds approximately to PK 9 on the Nouakchott -Nouadhibou road.

3.4.3 *Gas Plant Facilities*

Figure 3.12 presents the provisional plan of the onshore gas plant. The plant will be designed to condition 65 MMscfd gas to provide fuel gas to an adjacent power station (operated by SPEG). The plant will include a three stage separation process (high pressure, medium pressure and low pressure) with direct gas export and export of stabilised condensate via tankers from a tanker loading area. Treated water discharge will be used for irrigation or may be exported to the adjacent power plant. The plant process description is provided in *Section 3.5.1*.

Figure 3.12 Provisional 3D Site Plan



In addition to the main processing facilities, the plant will provide utilities to support its operation, including LP fuel gas, flare system, instrument air, nitrogen, chemical injection, methanol, MEG regeneration, produced water treatment, service water and power generation. The subsea control system will also be based at the gas plant. Key plant utilities are further described in *Table 3.7*.

Table 3.7 ***Main Gas Plant Utilities***

Utilities	Description and Function
LP Fuel Gas	A small proportion of the treated gas will be used for onsite power generation, the HP/LP flare pilots and purges, and as blanket gas for the glycol flash drum.
HP / LP Flare	High pressure (HP) and low pressure (LP) will be used for the safe disposal of hydrocarbon gases released from the processing facilities during operation or under emergency conditions. The HP flare system will collect discharges from equipment with pressure >10 barg and the LP flare system from equipment with pressure <10 barg.
Instrument Air	The instrument air system provides a supply of compressed, atmospheric dry air to various control and ESD valves. A fraction is used for nitrogen generation for blanketing / inerting and plant air for operating air-driven power tools.
Nitrogen	Nitrogen system provides nitrogen for tank blanketing and equipment/piping purging and inerting during maintenance and start-up.
Closed and Open Drains	The closed drains are used to gravity drain any hydrocarbon or hazardous drains from equipment during maintenance and is hard piped. The open drains system is provided to collect potentially contaminated run-off and rain/wash water from curbed and paved areas of the site via gravity flow. Open drains are collected in gullies and sent to unit swales. Non-hazardous open drains (oil-free) are sent directly to the evaporation ponds. Hazardous open drains (containing oil) are sent to an Oily Water Treatment Unit for oil removal prior to disposal to the ponds.
Chemical Injection System	System includes corrosion inhibitor which is injected continuously into the subsea pipeline at the manifold to minimise the rate of corrosion.
Methanol	Methanol will be pumped down the umbilical and injected subsea at the trees for hydrate inhibition (during start-up only) and remediation (breakup).
MEG Regeneration	The Monoethylene Glycol (MEG) system will provide lean glycol for injection into the subsea production system for the gas producing wells. The primary purpose for MEG injection is to suppress hydrate and ice formation during low temperature conditions. The MEG tank will be blanketed with nitrogen to prevent air ingress. MEG is returned along with the production gas and regenerated in the gas plant.
Produced Water Treatment	System collects and treats water from the MEG regeneration package to a quality suitable for its end user. The package will contain a secondary or tertiary treatment process with a settling tank, induced gas flotation unit, and possibly filtration to further reduce the oil content (see *Section 3.7.2*).
Irrigation Scheme	Treated water will either be disposed of in an irrigation scheme or will be exported for use in the adjacent power plant.
Service Water / Firewater	The water is used for plant services and not for human consumption. The firewater (and foam generators) is used in case of fire. The water will be delivered via road tanker on an intermittent basis to the Service Water Tank.

Utilities	Description and Function
Power Generation	Two gas engine generators with one normally running on LP fuel gas will supply the plant with electrical power. An emergency diesel generator will also be present for black starts and power during shutdowns.
Subsea Utilities (via Umbilical)	Various utilities are supplied from the onshore plant to subsea via an umbilical containing a number of cores: • Corrosion Inhibitor; • Methanol; • Mono ethylene glycol (MEG); • Fibre Optic (communications); • Electrical Power; • High pressure hydraulic fluid; and • Low pressure hydraulic fluid.

3.4.4 *Onshore footprint*

The onshore infrastructures footprint will be 41.1 ha. Ground disturbance will be caused by the installation of the gas plant facilities and the pipeline and umbilical. A summary of the onshore facilities and their expected footprint is provided in *Table 3.5*.

Table 3.8 ***Estimated Onshore Footprint of the Banda Gas Development***

Facility	Dimensions (m)	Footprint (ha)
Gas plant facilities	400 m x 325 m	13
Pipeline & Umbilical: • Pipeline • Umbilical	5,621 m x 50 m (disturbed area)	28.1
	Total	**41.1**

3.4.5 *Construction Activities*

Schedule

Construction of the gas plant is expected to begin in Q4 2014 and last for approximately 15 months. *Table 3.9* provides a breakdown of anticipated construction activities per month.

Table 3.9 ***Construction Schedule***

Activities	Persons on site	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Grading	20	■	■													
Roads	20			■	■											
Foundations	20				■	■										
Other civil works	20					■	■									
Skid installation	20							■	■							
Buildings	30								■	■						
Piping	30									■	■	■				
Electrical	30									■	■	■				
Mechanical completion	40												■			
Commissioning	30													■	■	■

Temporary Construction Landtake

During construction, temporary land will be needed for worker's accommodation, access roads and site access, laydown areas and temporary infrastructure (*eg* administration buildings, concrete plant, etc). Once the construction phase is over, all sites will be restored to their original condition.

Site Preparation

The site preparation phase includes all works necessary to establish the site for the subsequent construction phase including land excavation. During this phase construction infrastructure will be established, such as site access roads, site security fencing and equipment laydown areas. Key works during this phase include site clearance, excavation of the topsoil and surface layers to a depth sufficient to provide firm foundations for construction, installation of drainage works and foundations for the gas plant, developing suitable power and water supplies for the subsequent construction phase, confirming waste management and disposal options and establishing the site perimeter.

Gas Plant Construction

Construction of the gas plant will be a straightforward operation whereby the plant and associated facilities will be established at the site. Following site preparation, foundations will be prepared using concrete from an onsite batching plant. The base case is for the gas plant modules to be fabricated outside of Mauritania and transported to site by road for onsite assembly. Cranes will be used to lift above ground superstructure in place. Excavated material will be used, where possible, for onsite landscaping/re-profiling.

Pipeline and Umbilical

The onshore section of pipeline will be trenched along its entire length from the beach tie-in through to the gas plant. Prior to laying the pipeline, the right-of-way will first be graded utilising a combination of hydraulic excavators and dozers (indicative vehicles shown in *Figure 3.13*). Once grading is complete the pipe joints will be laid out adjacent to the right-of-way using a crawler crane (*Figure 3.13*). At the same time the pipeline trench will be excavated to depth using hydraulic excavators with the excavated material stored on the opposite side of the right-of-way to the pipe joints. The pipe joints are then welded together to form pipe strings of appropriate length and lowered into the trench using side boomers working in tandem (*Figure 3.13*). Once complete the pipeline will be inspected, pigged and hydrotested. The onshore umbilical will be laid in the pipeline trench for its entire length and the excavated material will then be used as back-fill to bury both the pipeline and umbilical.

3.4.6 *Equipment and Utilities*

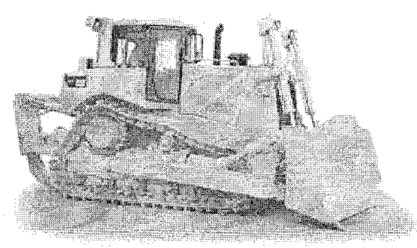
A summary of the equipment required for the construction of the onshore gas plant is included in *Table 3.10*. Photos of indicative pipeline installation vehicles are presented in *Figure 3.13*.

Table 3.10 ***Construction Equipment***

Activity	Medium Excavator	Small Excavator	Dozer	Compactor	Dump Truck	Drill Rig	Concrete Mixer	Large Crane	Small Crane	Mini Bus	Car
Grading	1	1	1	1	2					2	2
Roads			1		2		1			2	2
Foundations		1			1	1	1			2	2
Other civil works		1			1					2	2
Skid installation		1						1	1	2	2
Buildings		1							1	2	2
Piping		1							1	4	4
Electrical										4	4
Mechanical completion										4	4
Commissioning										4	4

Figure 3.13 ***Indicative Onshore Pipeline Installation Vehicles***

(a) CAT 374D Hydraulic Excavator



(b) CAT D8T Dozer

(c) CAT TL83 Side Boomer

(d) Liebherr HS825HD Crawler Crane

3.4.7 *Construction Personnel*

The number of personnel on site during the onshore construction phases is presented in *Table 3.9*. It is anticipated that a maximum of 90 workers will be onsite at any one time. For the majority of the construction phase the numbers of workers will fluctuate between 20 and 40, with 5-50% local content.

3.5 *OPERATIONS*

3.5.1 *Well Control*

The subsea system will be controlled from and integrated with the Integrated Control and Safety System (ICSS) of the gas plant. The system will continuously monitored to detect abnormal conditions. The system will be monitored utilising sensors downhole, on the Christmas Trees and in the gas plant. Pressures, temperatures, valve positions and sand production data from the tree will be used to monitor well performance and ensure that production rates from each of the wells are optimised to meet the demand. Sensor outputs will be displayed in the ICSS. Alarms will be triggered should the flow become abnormal.

The umbilical will provide electrical power and communications and hydraulic control fluids to the control modules on the subsea trees: it will also supply methanol, MEG and corrosion inhibitors to the wells.

3.5.2 *Gas Plant Process Description*

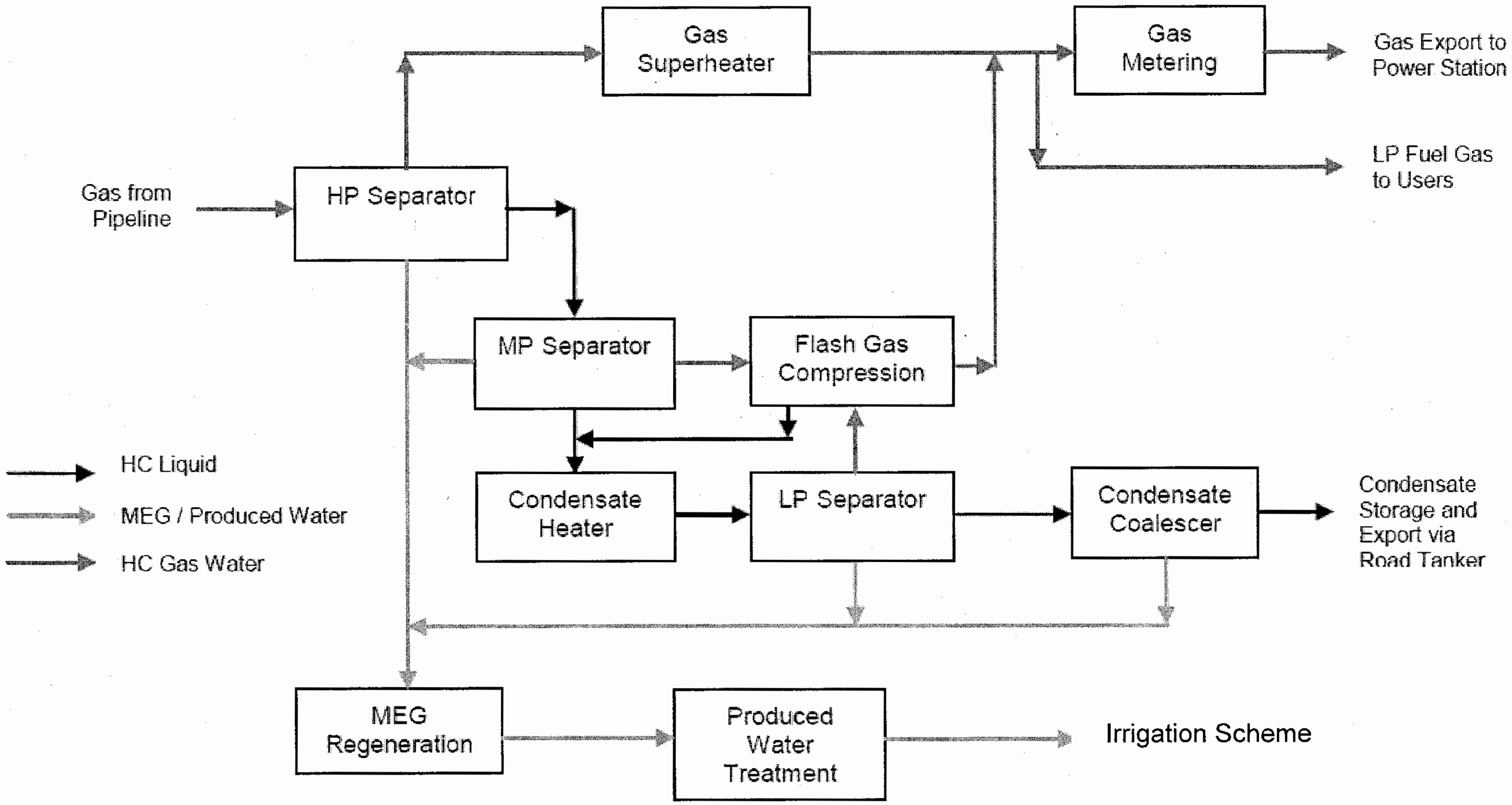
Figure 3.14 shows a process diagram for the proposed gas plant. Produced gas will enter the facility and be flashed off in the high pressure (HP) separator, superheated, filtered and exported to the power station.

The recovered condensate from the HP separator will be partially stabilised in the medium pressure (MP) separator, heated by an electrical condensate heater and further stabilised in the low pressure (LP) separator. The stabilised product will then be treated in the condensate coalescer to remove any remaining water, cooled and sent to storage. The processed condensate (upto approximately 800 barrels per day [bbl/d]) will be exported on a batch basis by road tankers.

Any flashed off-gas from the MP and LP separators will be recovered in the flash gas compressor, and fed back to the produced gas stream.

Associated water will be recovered in the HP and LP separators and sent for treatment. Injection chemicals (including MEG and methanol) are removed during water treatment, prior to the treated water been sent to a local irrigation scheme. MEG will be recovered from the associated water in a regeneration unit, and recycled for use.

Figure 3.14 Typical Process Flow Diagram for the Onshore Gas Plant



3.5.3 *Personnel Requirements*

The gas plant is designed to be operated by a limited number of staff. It is envisaged that up to 35 people will work at the plant, this includes rotational positions such as Plant Operators and Control Room Operators.

3.6 *DECOMMISSIONING*

The Banda reservoir is expected to produce for approximately 20 years, through to 2035. The production facilities will have a 25 year design life. The project will be decommissioned at the end of the field life of the Banda reservoir assuming no future development takes place.

After cessation of production from Banda (and other future fields producing via the gas plant), it is anticipated that decommissioning will process as follows.

- The pipeline will be cleaned and flooded. The tie-in spools will be removed. Pipeline and umbilical sections crossing existing pipelines or cables will be cut and removed. The remaining pipeline and umbilical sections below seabed level will remain in situ.
- Well tie-in jumpers will be removed.
- Following the recovery of the well completions, the wells will be plugged and abandoned leaving the conductor casings below seabed level.
- Fishing protection structures will be removed
- The gas manifold and foundation will be removed.
- The onshore gas plant will be removed.

3.7 *EMISSIONS, DISCHARGES, WASTES AND NOISE*

3.7.1 *Emissions to Atmosphere*

The Banda Gas development will generate varying amounts of air pollutants and greenhouse gas emissions from combustion sources such as generators and thrusters on the MODU, diesel engines on the support and installation vessels and flare emissions from the gas plant.

Table 3.11 to *Table 3.13* provide estimated emissions for the Project:

- *Table 3.11* – emissions during offshore activities;
- *Table 3.12* – emissions during onshore construction; and
- *Table 3.13* – annual emissions during operations.

Table 3.11 Estimated Offshore Emissions During Construction Phase

Period	Equipment	Rated Power (HP)	Runtime		Estimated Emissions (tonnes)							
			h/d	days	PM10	SOx	NOx	VOC	CO	CO_2	CH_4	CO_2e
Drilling and Completions	MODU	6.00	24	82	5	116	172	5	40	8,332	0	8,342
	Vessels (work 1)	8,500	24	82	5	112	132	5	27	8,944	0	8,946
	Vessels (work 2)	8,500	24	82	2	100	165	2	14	8,133	0	8,134
	Tug (tow vessel)	7,000	24	10	0	10	17	0	1	817	0	817
	Helicopter	2,800	2	82	0	3	5	0	1	242	0	242
	Flaring (fluid)	N/A	24	4	-	-	1	4	3	516	4	609
	Total				**13**	**342**	**491**	**17**	**86**	**26,983**	**5**	**27,090**
Subsea Installation	Pipeline Installation Vessel	20,000	24	30	4	97	114	4	24	7,699	0	7,701
	Multi-purpose Support Vessel (MSV)	15,000	24	41	4	99	117	4	24	7,892	0	7,894
	Rock Dumping Vessel	14,000	24	45	5	101	120	5	25	8,084	0	8,086
	Umbilical Installation Vessel	20,000	24	25	4	81	95	4	20	6,416	0	6,418
	Trenching / Pipelay Support Vessel	20,000	24	71	10	229	-	10	56	18,222	0	18,226
	Shallow Water Pipelay Vessel	20,000	24	52	7	168	-	7	41	13,346	0	13,349
	Back-Hoe Dredging Spread	8,000	24	115	7	148	-	7	36	11,806	0	11,809
	Total				**40**	**922**	**445**	**41**	**225**	**73,464**	**1**	**73,483**
			TOTAL		**53**	**1,264**	**936**	**58**	**312**	**100,448**	**5**	**100,574**

Notes: Because the exact vessels to be used for drilling and subsea connects have not yet been contracted, for the sake of this emission inventory, assumed engine sizes have been used based on similar Tullow operations elsewhere.
Runtime is based on provisional schedule provided by Tullow.
Emissions factors source: Oil&Gas UK.
Figures have been rounded to integer.
CO_2e = Carbon dioxide equivalent

Table 3.12 ***Estimated Emissions from Gas Plant Construction Phase***

Activities	Emissions (in tonnes, except otherwise stated)						
	VOC	CO	NOx	SOx (kg)	PMx	CO_2	CH_4 (kg)
Grading	0.4	1.8	3.1	5.0	0.1	479.8	39.2
Roads	0.4	1.6	2.8	4.4	0.1	418.0	33.7
Foundations	0.3	1.3	1.8	3.9	0.1	371.5	23.8
Other civil works	0.2	1.0	1.4	2.4	0.1	224.6	18.6
Skid installation	0.2	1.0	1.4	2.2	0.1	204.0	18.5
Buildings	0.2	0.8	1.0	1.5	0.1	133.6	13.6
Piping	0.4	2.3	2.6	4.2	0.2	374.7	36.2
Electrical	0.4	2.1	2.4	3.9	0.1	348.5	31.6
Mechanical completion	0.1	0.7	0.8	1.3	0.0	116.2	10.5
Commissioning	0.4	2.1	2.4	3.9	0.1	348.5	31.6
Total	**2.9**	**14.8**	**19.7**	**32.8**	**1.0**	**3,019.5**	**257.5**

Notes: Emission factor taken from AQMD, Air Quality Analysis Guidance Handbook, Off-Road - OFFROAD Model Mobile Source Emission Factors

Table 3.13 ***Estimated Annual Emissions from Gas Plant Operation***

Flare System	Emissions (in tonnes/year)			
	CO	NOx	PMx	CO_2
HP flare	17.0	3.2	8.8	685.9
LP flare	17.0	3.2	8.8	685.9
Total	**34.1**	**6.3**	**17.7**	**1,371.9**

Notes: CO and NOx emissions factors: EPA_AP42_13.5 Industrial Flares
PM emission factor: Flare Research Project, Final Report November 1996
All the fuel burned has been assumed as CH_4.

3.7.2 *Liquid Wastes*

Offshore

Discharges to water that will arise from the Banda Gas development, along with estimated volumes and treatment systems, are discussed below and summarised in *Table 3.14*. Offshore discharges will result from the following activities:

- **Drilling.** MODU and support vessel operations during the drilling phase will result in routine discharges to sea (see *Box 3.2*). In addition, non-routine discharges will include drill cuttings and fluid. WBM will be used for the two top sections and drilling fluid and cuttings will be discharged to the seabed. The lower well sections will be drilled using either WBM or improved SBM. The MODU will use solid control equipment to treat cuttings prior to disposal. For the purposes of this EIA it is assumed that improved SBM will be used.

- **Completions**. MODU and support vessels operations during well completions will result in routine discharges and non-routine discharges including returned completion fluids. Completion fluids will include completion brine, earth filter aid, surfactant and surfactant boosters.

- **Installation and Commissioning.** Installation vessels will make routine discharges during operations. In addition, commissioning fluid will be discharged when the pipeline is dewatered (*ie* water is pumped out) and the umbilical is commissioned.

- **Operations**. Offshore operational discharges are likely to be limited to hydraulic fluid associated with subsea valve operation.

Box 3.2 *Expected Routine Discharges from Offshore Operations*

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Table 3.14 *Expected Liquid Discharges during Offshore Drilling and Installation*

Discharge	Treatment	Volume	Limit	Standard
Routine Discharges from Offshore Activities				
Black water	Treat with approved marine sanitation unit. Maceration and chlorination.	Variable depending on number of people on vessels. Estimated 100 l per person per day. Drilling and completions: 11,000 l/d Subsea installation: 45,000 l/d	• No discolouration of surrounding water • < 1 mg/l chlorine concentration	MARPOL Annex IV
Grey water	Remove floating solids	Variable depending on number of people on vessels. Estimated 220 l per person per day. Drilling and completions: 24,000 l/d Subsea installation: 99,000 l/d	• No visible floating solids or discolouration of surrounding water	MARPOL Annex IV
Food waste	Macerate	Variable depending on number of people on vessels. Estimated 1 kg per person per day. Drilling and completions: 110 personnel, 110 kg/d Subsea installation: 450 personnel, 450 kg/d	• Ground to pass through a 25-mm mesh • Discharge more than 12 nautical miles from land	MARPOL 73/78 Annex V
Bilge water	Oil-water separation	Bilge water generation variable, depending upon facility and vessel characteristics, discharge volume variable. MODU: 32 m^3 per week Support vessels: 110 bbl/d (estimated)	• 15 mg/l of oil concentration and 20 mg/l (monthly weighted average) oil water threshold	MARPOL 73/78 Annex I
Ballast water	Oil-water separation	Variable depending on vessel and need for storage displacement. MODU: Estimated 620 bbl per day	• No free oil • 15 mg/l of oil concentration and 20 mg/l (monthly weighted average) oil water threshold • Ballast exchange at least 200 nm from nearest land in > 200 m water.	MARPOL 73/78 Annex I
Deck drainage	Oil-water separation	Deck drainage water generation variable depending on facility and vessel characteristics and rainfall amounts; discharge volumes variable.	• • 15 mg/l of oil concentration instantaneous reading oil water threshold • 20 mg/l (monthly weighted average) oil water threshold.	MARPOL 73/78 Annex I

<table>
<tr><th>Discharge</th><th>Treatment</th><th>Volume</th><th>Limit</th><th>Standard</th></tr>
<tr><td colspan="5">Drilling and Completions</td></tr>
<tr><td>Drill cuttings and fluid</td><td>WBF: No treatment – discharge to seafloor. Unused fluid will be returned to supplier

Improved SBM: Recycle using solid control equipment. Unused retuned to supplier</td><td><table>
<tr><th>Well Section</th><th>Cuttings Generated Per Section (MT)</th><th>Weight Of Mud Discharged (MT)</th><th>Volume Of Mud Discharged (m³)</th></tr>
<tr><td>36"</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>17 1/2"</td><td>262.7</td><td>0.0</td><td>0.0</td></tr>
<tr><td>12 1/4"</td><td>425.7</td><td>21.3</td><td>15.5</td></tr>
<tr><td>8 1/2"</td><td>8.9</td><td>0.4</td><td>0.3</td></tr>
<tr><td>Total</td><td>697.3</td><td>21.7</td><td>15.8</td></tr>
</table>Volumes based on BG1.Volumes for BG2 will differ.</td><td>• Use of low toxicity (Group III) improved SBM
• Less than 5 to 10% oil on improved SBM cuttings.
• Discharge of improved SBM cuttings 15 m below water surface via caisson.
• No free oil
• Hg 1 $mg.kg^{-1}$ dry wt in stock barite
• Cd 3 $mg.kg^{-1}$ dry wt in stock barite</td><td>Tullow</td></tr>
<tr><td>Completion fluids</td><td>Oil-water separation. Any acids used will be neutralised to pH5-7 by addition of soda ash prior to discharge</td><td>Estimated volume per well:
• Calcium chloride ($CaCl_2$) 845 tonnes
• CELITE 545 (Diatomaceous earth filler aid) 5.3 tonnes
• Tetraclean-105 (surfactant) 5.9 tonnes
• Tetraclean-106 (surfactant booster) 3.3 tonnes</td><td>• Maximum one day oil and grease discharge should not exceed 42 mg/l; 30 day average should not exceed 29 mg/l.
• Any spent acids will be neutralised (to attain a pH of 5-7) before testing and disposal.</td><td>IFC (2007)</td></tr>
<tr><td colspan="5">Subsea Installation</td></tr>
<tr><td>Riser, umbilical and pipeline commissioning</td><td>None</td><td>Commissioning fluid including corrosion inhibitor, oxygen scavenger, biocide and dye.</td><td>No free oil</td><td>USEPA, 2007</td></tr>
<tr><td colspan="5">Operation</td></tr>
<tr><td>Hydraulic fluid</td><td>None</td><td>264 litres per year assuming the valves on two Xmas trees. 544 litres in the first year.</td><td>-</td><td>-</td></tr>
</table>

Onshore

Liquid wastes produced during the operation of the project will include produced water from the Banda field (up to approximately 8.7 m^3/d) and waste oils from maintenance activities. Produced water will be removed during the three stage separation and be treated in the produced water treatment system. The produced water treatment system will be designed to remove:

- entrained free oil to allow for safe disposal;
- soluble hydrocarbons, including volatile aromatics - benzene, toluene, ethyl benzene and xylenes (BTEX); and
- MEG and chemicals to reduce biological and chemical oxygen demand prevent biomass accumulation.

The system is expected to include either a settling tank or induced gas floatation cell for free oil removal, an activated carbon bed for soluble oil removal, and biological treatment such as Moving Bed Biological Reactor (MBBR) or reed beds. A schematic of the options under consideration is presented in *Figure 3.15.*

The produced water system will be designed to meet the IFC standards on Environmental, Health and Safety Guidelines for Onshore Oil and Gas Development. The required produced water specification for discharge to surface waters is provided in *Table 3.15* below.

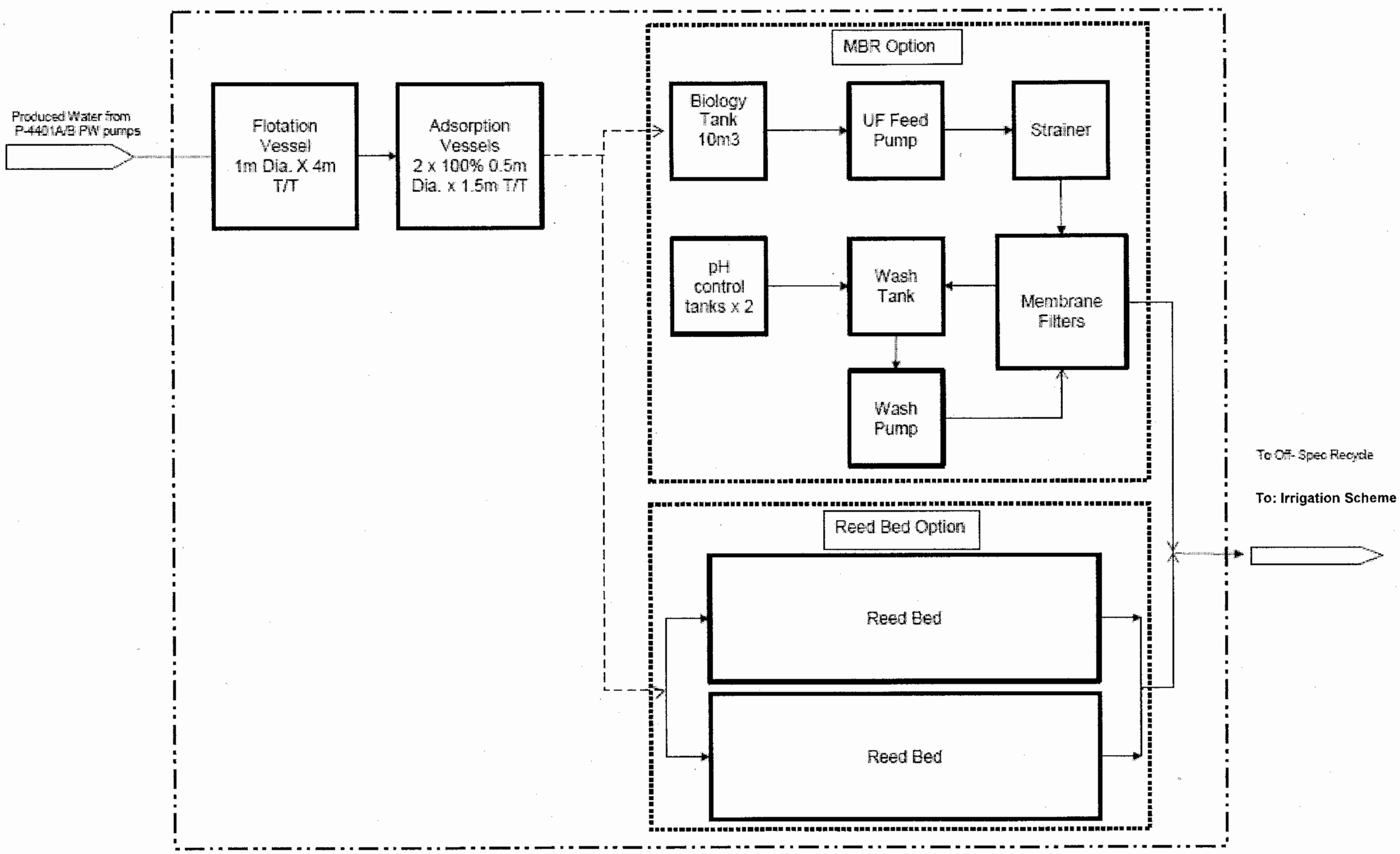
Table 3.15 ***Produced Water Discharge Specification***

Parameter	Value
Total hydrocarbon content (THC)	10 mgl^{-1}
pH	6-9
Biological Oxygen Demand (BOD)	25 mgl^{-1}
Chemical Oxygen Demand (COD)	125 mgl^{-1}
Total Suspended Solids (TSS)	35 mgl^{-1}
Phenols	0.5 mgl^{-1}
Sulphides	1 mgl^{-1}
Heavy metals (total)	5 mgl^{-1}
Chlorides	600 mgl^{-1} (average), 1,200 mgl^{-1} (maximum)

Source: IFC

Following treatment, the treated produced water will be used in one of two ways:
- in the power plant as process water to reduce its water demand; or
- for gardening irrigation.

Figure 3.15 Schematics of Proposed Produced Water Treatment System



3.7.3 *Solid Wastes*

Non-Hazardous Wastes

The types of non-hazardous and hazardous solid waste that would be expected to be generated as part of the project include the following:

- general domestic waste - from the galley and living quarters;
- food waste - from meal preparation and left-overs in the galley;
- plastic - including drinks bottles;
- paper and cardboard;
- scrap metal - empty drums and cables; and
- wood – pallets and crates.

Hazardous Wastes

The types of hazardous solid waste that would be expected to be generated as part of the project include the following:

- batteries - including large lead-acid type;
- chemical residues;
- clinical/medical wastes;
- oil filters;
- oily rags and absorbents;
- used oil - from engine maintenance; and
- oily water – slops and contaminated water.

The general estimated quantities of non-hazardous and hazardous waste that will be produced by the Banda Gas development are presented in *Table 3.16*.

Table 3.16 Estimated Waste Types and Estimated Generation Rates

Category	Waste Type	Units	Estimated Quantity Range		
			MODU	Vessels (various)	Onshore Base
Non-hazardous	General domestic waste	m^3/month	60 – 160	40 - 80	10 - 30
	Wood	m^3/month	10 – 45	0 - 5	0 - 2.5
	Plastic	m^3/month	0 – 2	0	0 - 0.25
	Scrap metal	m^3/month	5 – 19	0	0 - 0.5
Hazardous	Oily rags and oil filters	m^3/month	0.3 - 8	0.5 - 2.5	0 - 0.25
	Used oil	m^3/month	5 - 8	20 - 55	0 - 20
	Batteries	Tonnes/month	0 - 1.3	0 - 0.2	0 - 0.2
	Clinical waste	kg/month	0 – 5	0 - 10	0 - 10
	Oily water (slops)	m^3/month	30 - 300	0 - 100	0
	Filter cartridges	No. units	0 – 10	0	0
	Drums (with residues)	No. drums	50 – 125	0 - 25	0 - 20
	Other various wastes	m^3/month	0 – 3	0 - 0.5	0

Source: *TGL, 2012*

The solid waste generated offshore on board the drilling or support vessels will be shipped back to the Port of Nouakchott where it will be reused or recycled where possible or disposed of. Onshore wastes will be collected and disposed of by an appropriate waste contractor. If a suitable contractor cannot be identified in Mauritania, the wastes will be transported to a neighbouring country for appropriate disposal.

All waste will be managed to the project's waste management plan.

3.7.4 *Noise*

Offshore

The main sources of underwater sound associated with the drilling and completions phase can be categorised as follows.

- **Drilling noise.** Blackwell *et al* (2004) found broadband (10 Hz - 10 kHz) levels reaching a maximum of 124 dB re 1 µPa at 1 km, mainly at 700 Hz - 1.4 kHz from well drilling operations. Noise from a caisson during drilling in the Beaufort Sea was approximately 150 dB re 1 µPa at 1 m at 30 - 40 Hz (Richardson *et al* 1995).

- **Propeller** and **Thrusters (where fitted).** Noise from propellers and thrusters is predominantly caused by cavitation around the blades whilst transiting at speed or operating thrusters under load in order to maintain a vessel's position. Noise produced is typically broadband noise, with some low tonal peaks.

- **Machinery Noise.** Machinery noise is often of low frequency, and often becomes dominant for vessels when stationary or moving at low speeds. The source of this type of noise is from large machinery, such as large power generation units (diesel engines or gas turbines), compressors and fluid pumps. Sound is transmitted through different paths, *ie* structural (machine to hull to water) and airborne (machine to air to hull to water), or a mixture of both. The nature of sound is dependent on a number of variables, *eg* number and size of machinery operating, coupling between machinery and deck. Machinery noise is typically tonal in nature.

- **Equipment in Water.** Noise is produced from equipment such as drill string and caisson, and during pipeline and umbilical installation.

Onshore

Onshore noise will be associated with both the construction and operations phases. A short description of sources of noise during these phases is provided below.

- **Construction Noise.** Noise associated with construction of the gas treatment plant will be variable in nature and will depend on the particular activities being undertaken as well as the equipment in operation. Significant noise will be generated during the site preparation phase, including from activities requiring heavy construction vehicles and equipment such as land clearance, and also from civil works and plant utilities construction, including installation of concrete foundations and assembly of the plant.

- **Noise during Operation.** Noise will be generated during operation from engine generators, compressors and processing pumps. Noise will also be generated from the flare stack when in it is in operation. Noise generated during operating will be continuous (with exception of flaring) as the plant will operate 24 hours a day, seven days a week. Traffic noise between the gas plant and Nouakchott will also be present during operation.

3.8 *REVIEW OF PROJECT ALTERNATIVES CONSIDERED BY TULLOW*

This section presents an overview of the main alternatives considered by Tullow for the Banda Gas development. The aim of considering alternatives is to establish whether there are reasonable options which could be pursued to develop the Project whilst maintaining an acceptable balance between technical and commercial feasibility and the costs of environmental and social mitigation.

The main alternatives that were considered for the Banda Gas development relate to:

- routing of the offshore gas pipeline;
- the condensate export scheme;
- flash-gas recovery versus venting;
- methods of umbilical protection;
- well design; and
- drill cuttings management.

The alternatives for each project component are described in the following sections.

3.8.1 *Pipeline Routing*

There are a number of natural features which influenced the pipeline route including a marine ridge occurring approximate 20 km offshore and the presence of a coastal sand dune system. The base case is for the pipeline to be routed around this offshore ridge, directly to the coast and through the coastal dune system. Both decisions have been made on the basis of technical feasibility and constructability. Installing the pipeline over the ridge would be more complicated and carry a greater level of technical risk.

3.8.2 *Condensate Export Scheme*

The project will produce an average plateau production off 800 barrels per day of condensate (approximately 130 m^3). Four options were evaluated by Tullow based on their technical feasibility/ robustness; health, safety and environmental (HSE) criteria; cost; reliability, availability and maintainability; and operational and construction simplicity:

- **1a** Export via road tankers to Nouakchott Port;
- **1b** Export via pipeline to Nouakchott Port;
- **2** Export via road tankers to a refinery in Senegal;
- **3** Export via road tankers to a new topping plant; and
- **4** Export via road tankers to a new blending plant.

The environmental implications of the options were largely similar, with the worst case environmental impact resulting from a spill event. The absolute worst case would occur from the pipeline given the larger volume of hydrocarbons. However, this should have been mitigated by the very low frequency of spills from a pipeline.

Ultimately, option 1a (trucking to the port of Nouakchott) was selected as the base case, largely considering its technical and commercial feasibility. This will entail an average of 5 to 6 trucks per day travelling between the Banda Gas processing facility to the port of Nouakchott.

Table 3.17 *Ranking of Condensate Export Alternatives*

Options	Criteria ranking					Overall rank
	Technical feasibility, robustness	HSE	Cost	Reliability, availability, maintainability	Simplicity	
1a	1	1	2	1	1	1
1b	3	2	4	2	3	3
2	2	3	1	3	2	2
3	4	4	3	4	4	4
4	5	4	3	4	4	5

3.8.3 *Flash Gas Venting or Recovery*

Flash-gas results from the evaporation of natural gas from the condensate in the low-pressure separators. Tullow considered two alternatives for removing flash-gas, namely venting to atmosphere and recovery. Venting would be a simpler option, but resulting in increased greenhouse gas emissions from the plant. However, to maximise gas recovery, Tullow opted for the recovery of flash gas in a flash-gas compressor unit.

3.8.4 *Umbilical Protection*

The umbilical will follow the same route as the gas export pipeline from the Banda field manifold to the gas plant. Tullow considered whether to install the umbilical within the pipeline trench or in a separate trench. The current base case is for installation within the pipeline trench. This is considered the best environmental option as it reduces seabed disturbance and the time the installation fleet operates offshore, which in turn reduces vessel emissions and disturbance to marine fauna from vessel presence and underwater noise. The base case is also the less expensive of the two alternatives.

3.8.5 *Well Design*

Tullow considered various alternatives for the Banda wells including the number of wells, whether slant or vertical, re-using existing wells, casing configuration, tubing diameters and sand screen configurations.

The main factor of environmental impacts is the number of production wells to be drilled (in terms of drilling process intensity, installed equipment on the seabed, and duration of offshore operations).

In terms of technical and commercial feasibility, design studies indicated that two wells are effectively required to offer greater than 98% recovery of gas from the reservoir. The base case for the development is therefore two wells. The fact that these two wells will be drilled from a single drilling centre will reduce the extent of seabed affected by the drilling operations. It will also allow reducing the duration of offshore operations compared to drilling from two separate locations.

3.8.6 *Drill cuttings management.*

Drill cuttings will be returned to the MODU, separated and cleaned using shale shakers, and then discharged overboard via a caisson below the water surface. Tullow considered the alternative of storing the cuttings on-board and returning them back to shore. However, Mauritania does not possess treatment and disposal facilities for contaminated cuttings, especially for the volumes involved (estimated 1484.6 tons of cuttings). Also, the impact of cuttings discharge offshore was assessed as Minor significance via modelling of total suspended solids (TSS) concentration, and depositional thickness (Section 5.5.1):

- The elevated TSS concentrations are expected to be localised, short term and dissipate rapidly as a result of the dispersion capacity of the local marine environment (small magnitude). Additionally, the good existing water quality and low to medium sensitivity of biological receptors leads us to conclude that the impact to the water column is of Minor significance.
- A depositional thickness of more than 50 mm (the threshold at which smothering and/or mortality can be expected) is anticipated for approximately 2.1 km2 of seabed. This represents approximately 3.4% of the Banda field area (small to medium magnitude). Also, the benthic fauna in the Banda field is homogenous and dominated by low value burrowing species which have a high tolerance to burial (low sensitivity). Therefore, the impact to the seabed is assessed as being of Minor significance.

Solid control equipment will be used to reduce the oil on cuttings to a target concentration below 10% in weight, depending on the equipment available on board the rig. Tullow considered reducing this target of oil on cuttings but this percentage depends on the technology on board. With mechanical solid control equipment on the rig, the lowest average achievable weight on cuttings will be 5%. There are existing technologies that can reach smaller oil on cuttings percentages but the environmental benefits are outweighed by the costs.

4 ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE

4.1 INTRODUCTION

This chapter provides a description of the existing environmental and socio-economic conditions against which the potential impacts of the Banda Gas development are assessed in this ESIA.

The baseline description draws on a number of primary and secondary sources, in particular:

- *Metocean criteria study for Banda field offshore, Mauritania (FugroGeos, 2012).* Tullow appointed Fugro Geos Ltd to conduct a study of metocean conditions off the Mauritanian coast in March and August 2012.

- *Meteorological statistics at Nouakchott, Mauritania (FugroGeos, 2012).* Tullow appointed Fugro Geos Ltd to conduct a study of meteorological conditions for the onshore gas processing plant of the Project in September 2012.

- *Environmental Baseline Survey* (*Gardline, 2012*). This Environmental Baseline Survey commissioned by Tullow aimed to characterize water and sediment quality in the Project area. The offshore (depth greater than 10 metres) part of the survey was completed at the end of August 2012 and the nearshore (water depths less than 10 metres) part during September/October 2012.

- *Geotechnical Survey (SMSC-LABOSOL, 2012).* Tullow appointed SMSC-LABOSOL for a G0 Mission (consisting of drilling, testing and geotechnical measurements) as per NF P 94 500 norm. As part of this mission, onsite drilling and pressuremeter tests as well as laboratory analyses were performed at the proposed locations of the gas processing plant and the arrival of the submarine pipeline on the coast.

- *Marine Mammal and Turtle Observations* (*RPS, 2011; RPS, 2012*). Tullow appointed RPS Ltd to record marine mammal and turtle sightings data during seismic surveys undertaken in June-July 2011, May-June 2012 and September-October 2012 from Block 2, 120 km to the south of the Banda development. Given this proximity, the sightings from Block 2 represent a recent record of the species likely to be present within the vicinity of the Banda development.

- *Collision Risk Assessment* (Anatec, 2012). This study was commissioned to identify shipping routes passing the Banda licence area, calculate collision frequencies and review mitigation measures.

- Internationally recognised published sources and databases such as the Food and Agriculture Organisation (FAO), the International Union for the

Conservation of Nature and its Resources (IUCN), and the online fish database, Fishbase.

This data has been completed by field visits of the onshore area of the Project:

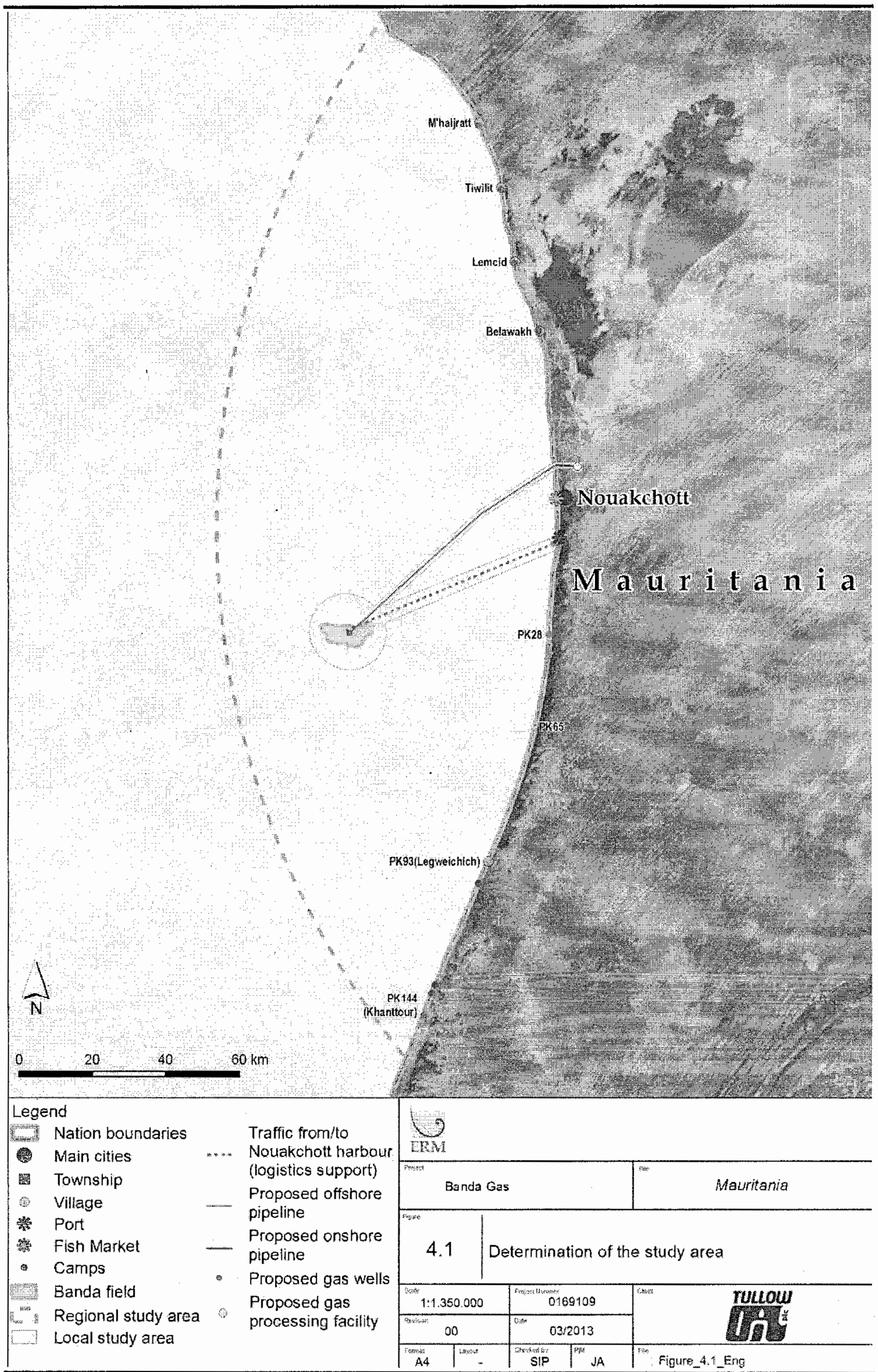
- Scoping visit, to identify the main issues related to the Project, 9-13 July 2012.
- Biodiversity survey, from 9-13 July 2012 and from 6-9 November 2012.
- Noise measurements, from 6-9 November 2012.
- Consultations with stakeholders, from July 2012 to March 2013, as detailed in *Annex A, ESIA Consultation Records*.

4.2 *BASELINE STUDY AREA*

The environmental and social baseline has been assessed within the global study area of the Project, whom the determination is based on the Area of Influence of the Project illustrated in *Figure 4.1:*

- **Project footprint** (cf. *Chapters 3.3.7* and *3.4.4*).
- **Local Area of Influence** corresponding to the direct footprint of the Project. This area includes the wells and a 10 km buffer (to take into account the extent of potential effects during the drilling phase), the offshore and onshore pipeline route with 1 km buffer and the onshore gas facilities site with a 1 km buffer (to take into account the extent of potential effects during the construction phase). A channel between Banda and the Nouakchott port that will serve as a logistics base for the Project is also taken into account for the determination of the local area.
- **Regional Area of Influence** to account for possible indirect effect for the potential environmental and social receptors outside the local study area. This large scale area is defined as the coastline extending from Mamghar to M'Balal (to target fishing communities likely to be concerned) plus a 5 km buffer around the onshore facilities (to include the human activities potentially affected by indirect impacts of the Project).

Figure 4.1 Determination of the Study Area



4.3 *PHYSICAL ENVIRONMENT*

4.3.1 *Climate and Meteorology*

Climate and Seasons

Specific climate and weather information for the Banda field was drawn from the meteocean study and from the meteorological analysis commissioned by Tullow (*FugroGeos, 2012*). This data covers the onshore and offshore parts of the study area.

Mauritania is strongly influenced by the trade winds and is characterised by an upwelling system offshore ("upwelling" refers to a phenomenon when cold, nutrient-rich water is forced up from ocean depth, and rises to shallower coastal water or to the surface.). Both of these phenomena are dictated by the influence of the high pressure originating from the Azores, the Azores High, and its seasonal variation. The Azores High is a large semi-permanent anticyclone located over the Atlantic Ocean, centred in the area of the Azores archipelago. The High tends to move north towards the Iberian Peninsula in summer, and south of the Azores at the onset of winter (*Figure 4.2*).

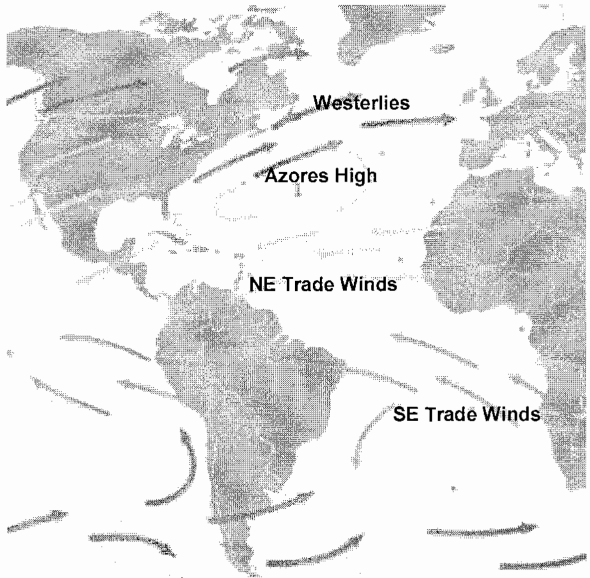
The West African coast is subjected to sudden squalls, an exception to the relatively benign meteorological environment usually experienced. The regional climate is also influenced by the Inter Tropical Convergence Zone (ITCZ). Two air masses, one over the Sahara (tropical continental) and the other over the Atlantic Ocean (maritime) converge at the ITCZ, resulting in an area of low pressure where hot and dry continental air meets moist oceanic air and produces heavy rainfall. The ITCZ migrates northwards up to 20°N to 25°N with the Saharan depression from January to August.

The Mauritanian climate can be divided into three seasons (*Soule, 2003*):

- a rainy season from June to October;
- a cool dry season from October to March; and
- a hot dry season from March to June.

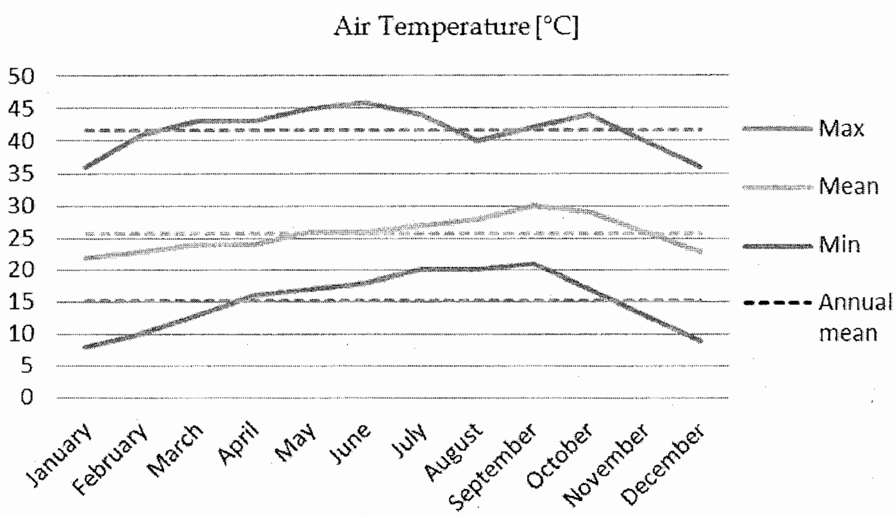
Relative humidity is low (down to 30% at times), but can reach up to 70% during the rainy season. The average weather conditions in Nouakchott are illustrated in *Figure 4.3*, *Figure 4.4* and *Figure 4.5*.

Figure 4.2 *Prevailing Winds in the Atlantic Ocean*



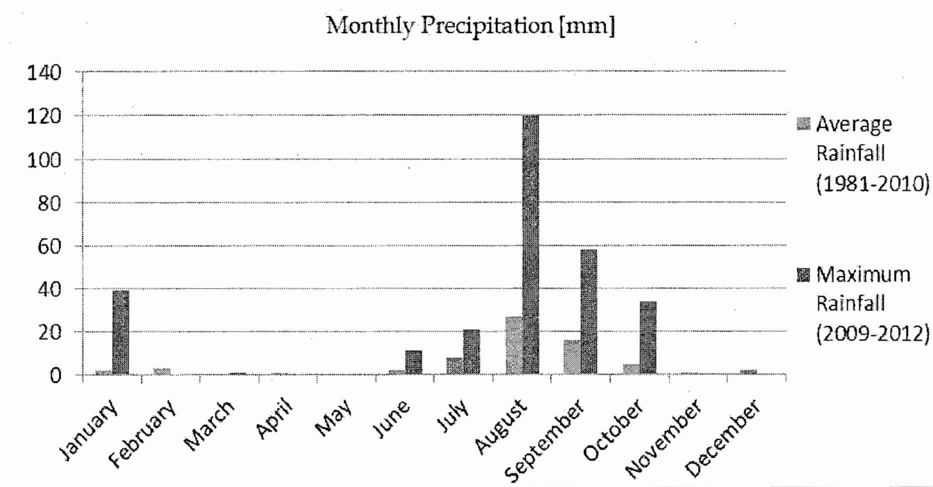
Source: FugroGeos, 2012.

Figure 4.3 *Air Temperature Statistics in Nouakchott, 2007-2012*



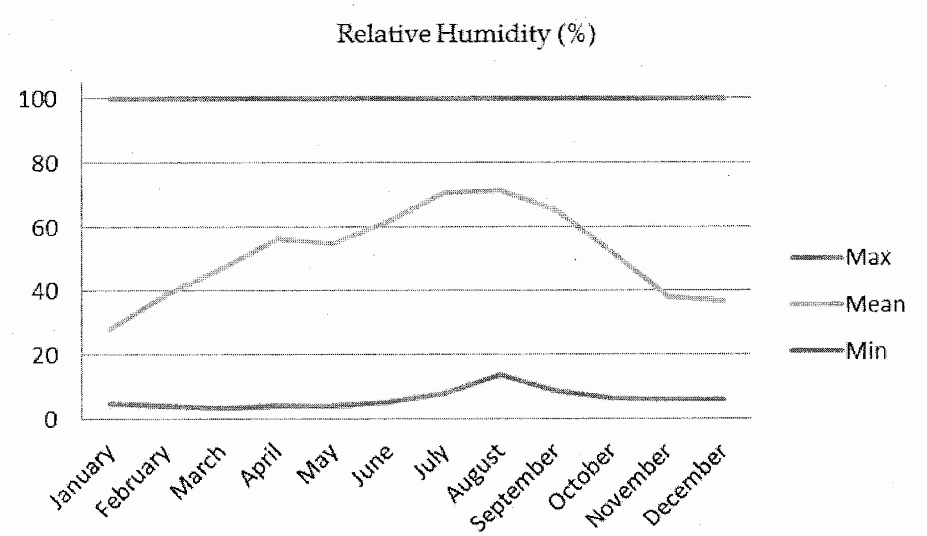
Source: *ERM (interpretation of FugroGeos, 2012)*

Figure 4.4 ***Monthly Precipitation in Nouakchott, 1981-2012***



Source: *ERM (interpretation of MétéoFrance, 2012 and FugroGeos, 2012)*

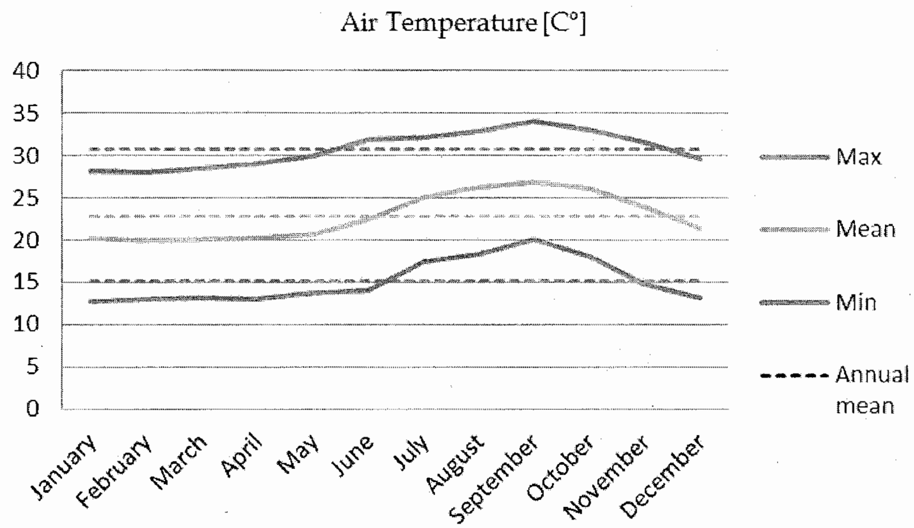
Figure 4.5 ***Relative Humidity in Nouakchott, 2007-2012***



Source: *ERM (interpretation of FugroGeos, 2012)*

The offshore climate at Banda location is influenced by the sea; temperatures are lower than the onshore ones, as shown in *Figure 4.6*.

Figure 4.6 ***Air Temperature Statistics at Banda***



Source: *ERM (interpretation of FugroGeos, 2012)*

Offshore winds

The Azores anticyclone drives the north-eastern Atlantic trade winds which blow over Mauritania year-round. The trade winds band varies seasonally, being located further north (35°N to 20°N) in the summer, shifting south (30°N to 12°N) during the winter in response to the southwards shift of the Azores High (*FugroGeos, 2012*).

The southwards shift of the Azores anticyclone in April and May results in an accentuation of pressure gradients, which may give rise to high intensity winds. In August and September, the anticyclone takes its most northerly position, considerably reducing the pressure gradients and, consequently, reducing the speed of the trade winds. As a result, the climate in winter is characterised by light winds (*Ould Taleb Sidi, 2005*). The drying effect of the trade winds in winter is enhanced by the Harmattan, a hot and dry wind that arises from the Saharan depression and blows from the north-east or east. In the summer, the Harmattan is undercut by the cooler rain-bearing winds of the south-west monsoon that blow in from the ocean (*FugroGeos, 2012*).

Wind data were acquired (*FugroGeos, 2012*) for the Banda field location (17.77° N, 16.57° W). Winds in the Project area blow predominantly from the north at average speeds of 6 to 8 $m.s^{-1}$ (*Figure 4.7*), with slight seasonal variations: in December and January, winds blow mainly from the northeast whereas in June through September, they blow from the northwest.

Figure 4.7 ***Joint Frequency Table of Wind Speed and Direction at Banda field***

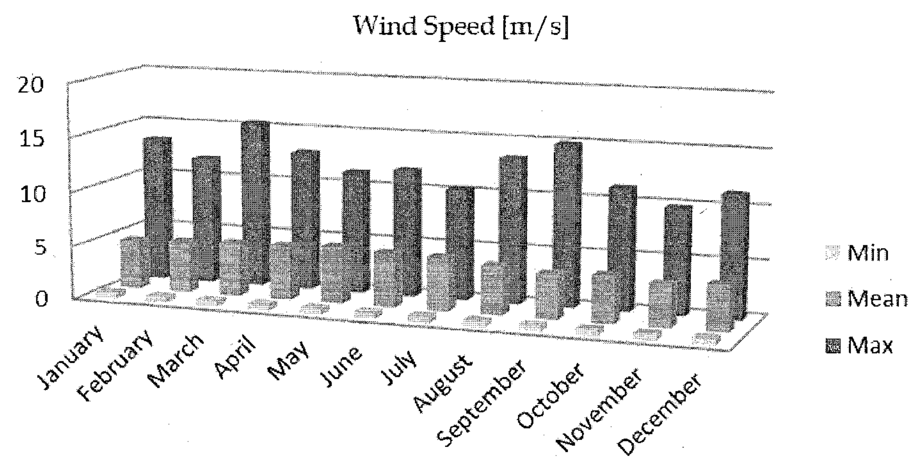
10min Wind Speed at 10m (m/s)	N	NE	E	SE	S	SW	W	NW	Total %	Exceed %
16–				<0.01					<0.01	
15–16	<0.01								<0.01	
14–15	0.01	<0.01	<0.01	<0.01				<0.01	0.02	0.02
13–14	0.04	<0.01		<0.01				0.02	0.07	0.08
12–13	0.15	0.03	<0.01	<0.01		<0.01		0.08	0.27	0.35
11–12	0.47	0.06	0.02	<0.01	<0.01			0.31	0.87	1.22
10–11	1.49	0.22	0.09	<0.01		<0.01	<0.01	0.86	2.68	3.90
9–10	3.70	0.57	0.14	<0.01	<0.01	<0.01	0.04	2.19	6.65	10.55
8–9	6.66	1.30	0.27	<0.01	<0.01	0.05	0.15	4.26	12.72	23.28
7–8	8.43	2.21	0.35	<0.01	0.01	0.17	0.55	6.15	17.88	41.16
6–7	7.95	3.19	0.44	<0.01	0.02	0.27	1.28	6.99	20.16	61.32
5–6	5.82	3.27	0.38	0.01	0.03	0.37	1.97	5.69	17.54	78.85
4–5	3.48	2.30	0.31	0.02	0.05	0.32	1.78	3.26	11.51	90.36
3–4	1.69	1.17	0.17	0.02	0.04	0.23	1.00	1.60	5.94	96.29
2–3	0.66	0.44	0.11	0.03	0.05	0.15	0.44	0.65	2.53	98.83
1–2	0.18	0.16	0.06	0.04	0.06	0.07	0.15	0.22	0.94	99.77
0–1	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.05	0.23	
Total	40.78	14.95	2.38	0.18	0.31	1.68	7.39	32.34	100.00	

Source: *FugroGeos, 2012*

Onshore winds

The average wind on the onshore area of the Project is stable, and is about 5 m/s, but can vary from 0.5 m/s to 15.4 m/s in March (*FugroGeos, 2012*); seasonal variations are illustrated in *Figure 4.8*.

Figure 4.8 ***Wind speed statistics in Nouakchott, 2007-2012***



Source: *ERM (from FugroGeos, 2012)*

4.3.2 *Hydrography and Oceanography*

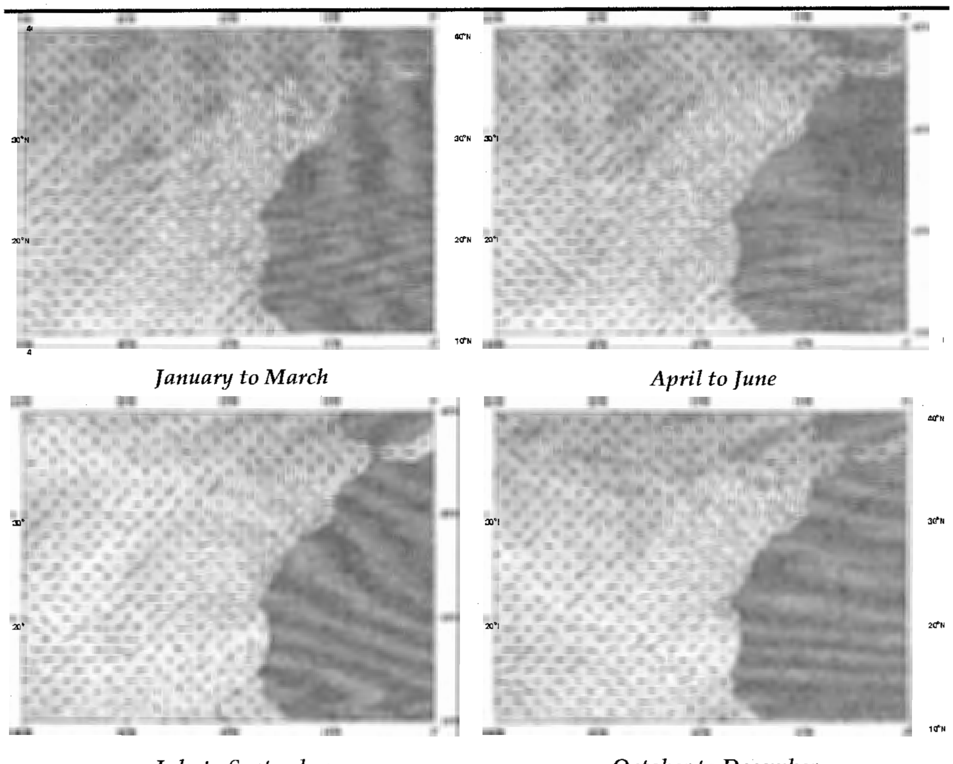
Currents

Four main currents influence Mauritanian waters: the Canary Current, the Azores Current the North Equatorial Current and the Equatorial Counter Current. During periods of well-established trade winds, coastal currents flow southwards with speeds of 25 cm.s^{-1} to 50 cm.s^{-1} at the surface. Tidal currents are usually weak over the whole of northwest Africa, with speeds of about 5 cm.s^{-1} to 10 cm.s^{-1}. In the Project area, average surface current speed ranges from 15 cm.s^{-1} in December to 22 cm.s^{-1} in June and July (*Fugro, 2012*).

From December to May, the Canary Current, the dominant surface current of the region, flows southward along the Mauritanian coast between 30°N and 10°N and is fed by the Azores Current. Counter-currents in the surface layer are a typical feature offshore along the continental slope (between 17°N and 23°N) and flow at speeds of between 5 cm.s^{-1} and 15 cm.s^{-1} (*FugroGeos, 2012*).

In summer, the trade wind band moves to its northernmost limit. This, coupled with the intensification of the North Equatorial Counter Current and the presence of the south-west monsoon at low latitudes, brings about a northward compensation flow along the West African coast (*Figure 4.9*). During the winter, the southwards shift of the trade wind band results in the creation of a southward surface current along the continental shelf as well as the emergence of coastal upwelling (*Fugro, 2012*). The upwelling is driven by prevailing winds which cause this displacement of warmer shallow coastal water by the nutrient-rich deep water. There is an area of almost permanent upwelling off the Banc d'Arguin with seasonal upwelling further south. One of these areas of seasonal upwelling is near and to the south of Cap Blanc and occurs from December to March.

Figure 4.9 ***Circulation of Currents off the Coast of West Africa***



January to March *April to June*

July to September *October to December*

Source: *Mittelstaedt, 1991*

Currents are also influenced by the depth, and they increase when the depth decrease (cf. *Figure 4.10*).

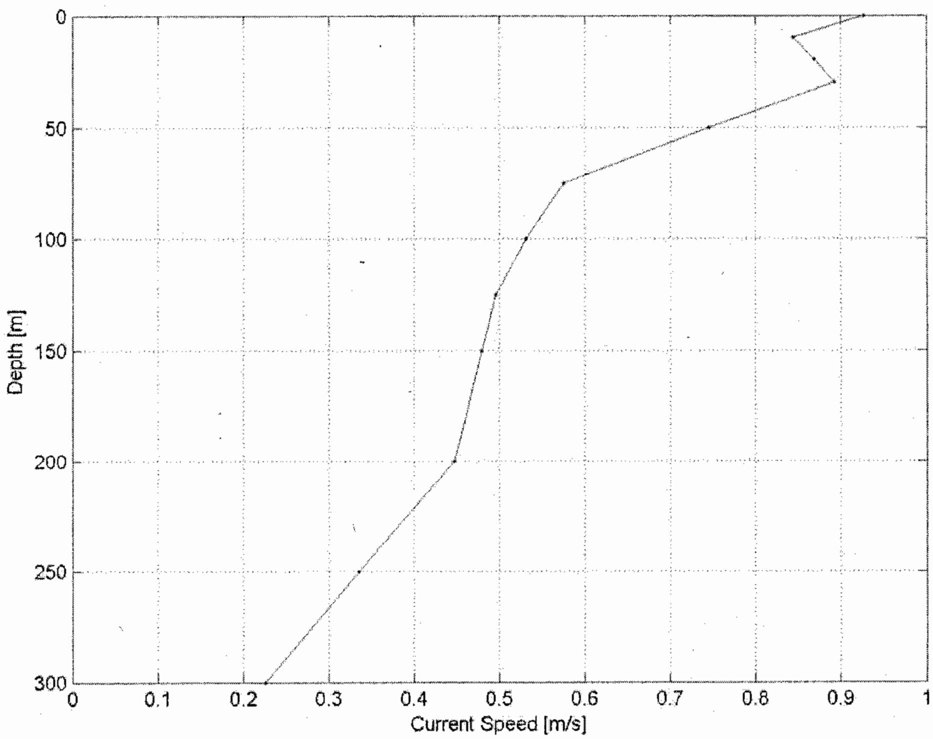
Tides and Waves

Tides offshore Mauritania are relatively weak, semi-diurnal, with an average tidal range of 1.44 m (*PANPA, 2012*).

The wave regime is characterised by relatively low significant wave heights. During the summer, waves measure an average of 1.5 m, with maximum heights of less than 3 m. During the winter, maximum wave height can reach 5 m. *Figure 4.11* illustrates significant wave height and direction in the Project area.

Long-period swell dominates in the region which originate from North Atlantic storms and the Southern Ocean: low frequency swell waves with low significant wave heights originate in the Southern Ocean, whereas low frequency swell waves with a higher significant height originate from North Atlantic storms (*FugroGeos, 2012*).

Figure 4.10 ***Current profile of maximum current speed***



Source: *FugroGeos, 2012*

Figure 4.11 ***Total Significant Wave Height and Direction in Banda Area***

All-Year

Significant Wave Height (m)	N	NE	E	SE	S	SW	W	NW	Total %	Exceed %
Total	30.20	1.00	0.02	0.02	0.06	1.55	8.43	58.72	100.00	
5.25										
5.00								<0.01	<0.01	
4.75								0.01	0.01	0.01
4.50								0.01	0.01	0.03
4.25	<0.01							0.02	0.02	0.05
4.00	0.02							0.04	0.06	0.11
3.75	0.02			<0.01				0.12	0.14	0.25
3.50	0.04			<0.01				0.18	0.22	0.47
3.25	0.08			<0.01	<0.01			0.35	0.44	0.91
3.00	0.13				<0.01			0.60	0.73	1.64
2.75	0.58				<0.01			1.14	1.72	3.36
2.50	1.43	<0.01			<0.01			1.94	3.30	6.73
2.25	2.54	0.05	<0.01		<0.01		0.01	3.54	6.15	12.88
2.00	4.84	0.12	<0.01		<0.01	0.02	0.05	5.85	10.89	23.77
1.75	7.14	0.24	<0.01	<0.01	<0.01	0.06	0.30	9.55	17.30	41.07
1.50	7.02	0.27	<0.01		<0.01	0.19	1.10	12.46	21.05	62.12
1.25	4.54	0.21	<0.01		0.01	0.34	2.52	12.26	19.89	82.00
1.00	1.52	0.09			0.01	0.51	2.63	8.44	13.20	95.21
0.75	0.25	0.01		<0.01	0.01	0.41	1.64	2.11	4.44	99.65
0.50	0.04					0.03	0.18	0.11	0.35	100.00
0.25										
0.00										

Source: *FugroGeos, 2012*

4.3.3 *Morphology*

Marine Bathymetry

The Mauritanian continental shelf extends parallel to the coast from 21°N to 16°N up to 50 km from shore over a surface area of approximately 39,000 km^2. The seabed is relatively flat, with water depths decreasing regularly to the 100 m isobaths approximately 40 km off Nouakchott, except for a few submarine troughs reaching depths of up to 600 m. These troughs are thought to encourage the phenomenon of upwelling, channelling the upwelling of deep water along the continental margin. To the north of the Banda field, there is a deeply incised submarine canyon (>20 km north). There is also a large area of landslides southwest of the Banda field that transport sediment downslope to the West, towards the Abyssal Plain (*Colman et al, 2005*). Lastly, there are several carbonate mud mounds along the 450-550 m depth contour along the coast, to the north and south of the Banda field. These mounds are inhabited by cold-water corals, further discussed in *Section.4.4.2.*

The Banda Field is located approximately 50 km from the coast in water depths of between 200 and 325 m. The pipeline route from the manifold to the shore is presented on *Figure 4.12*. The bathymetric profile of the pipeline route is presented on *Figure 4.13*.

Figure 4.12 Pipeline Route and Bathymetry

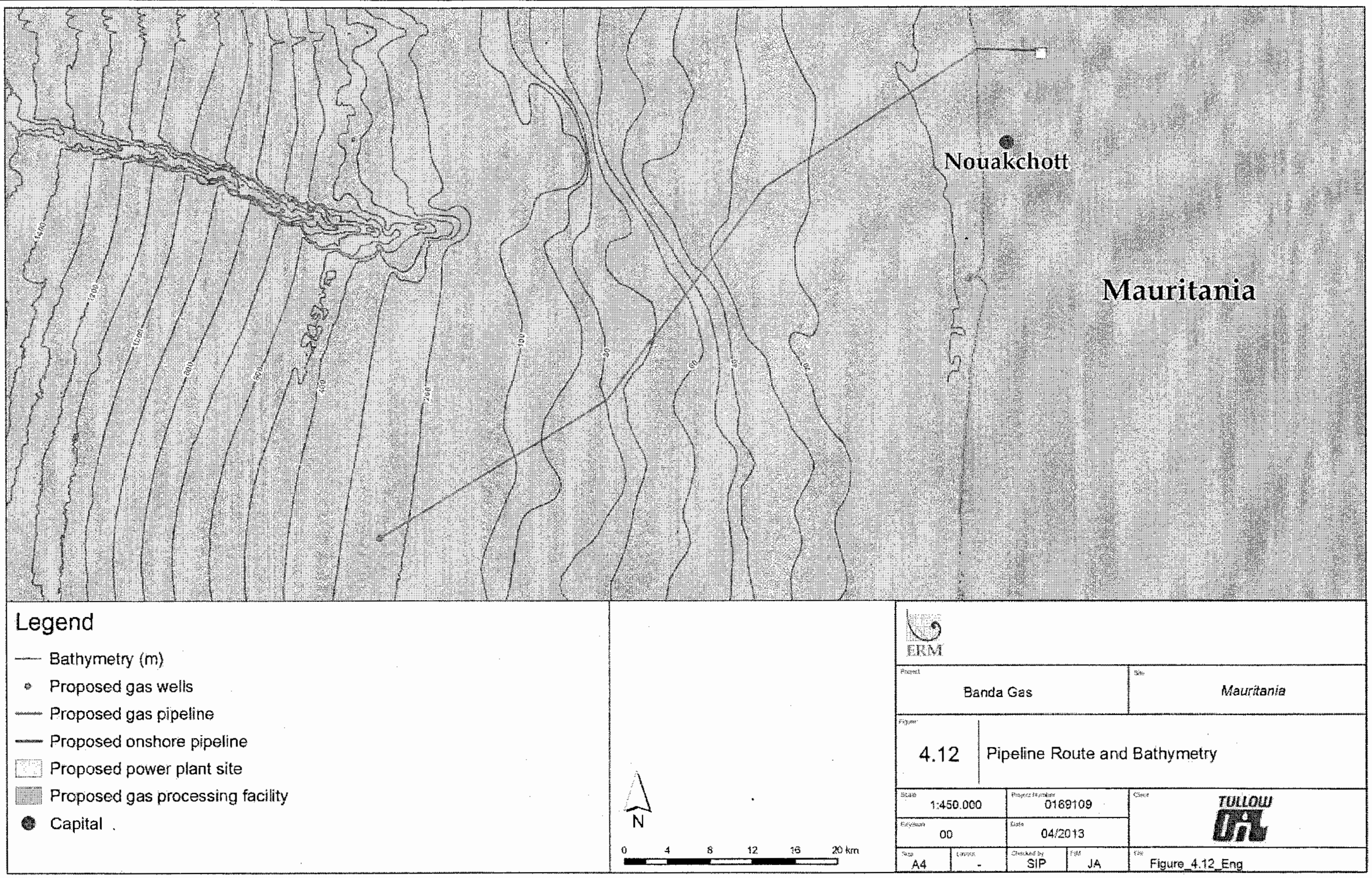
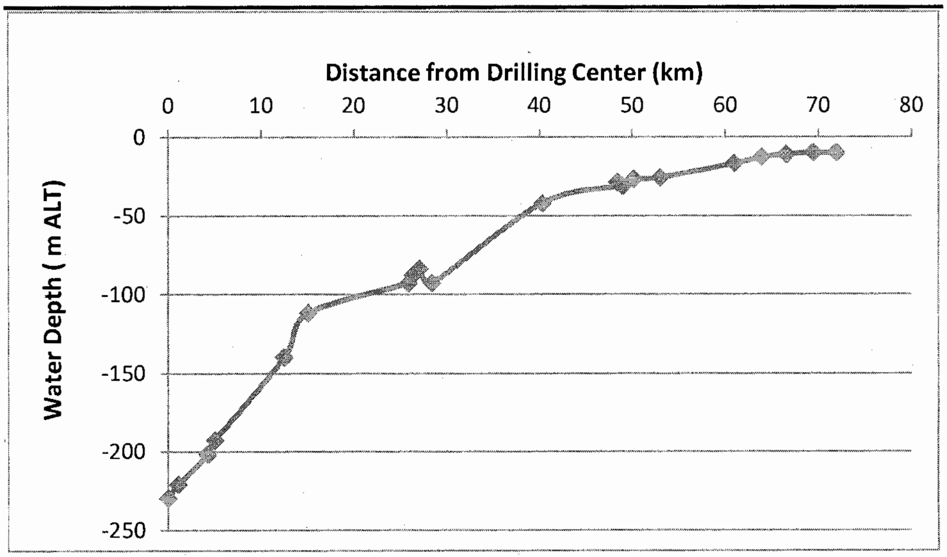


Figure 4.13 Bathymetric Profile of the Pipeline Route



Source: *ERM (from Gardline, 2012)*

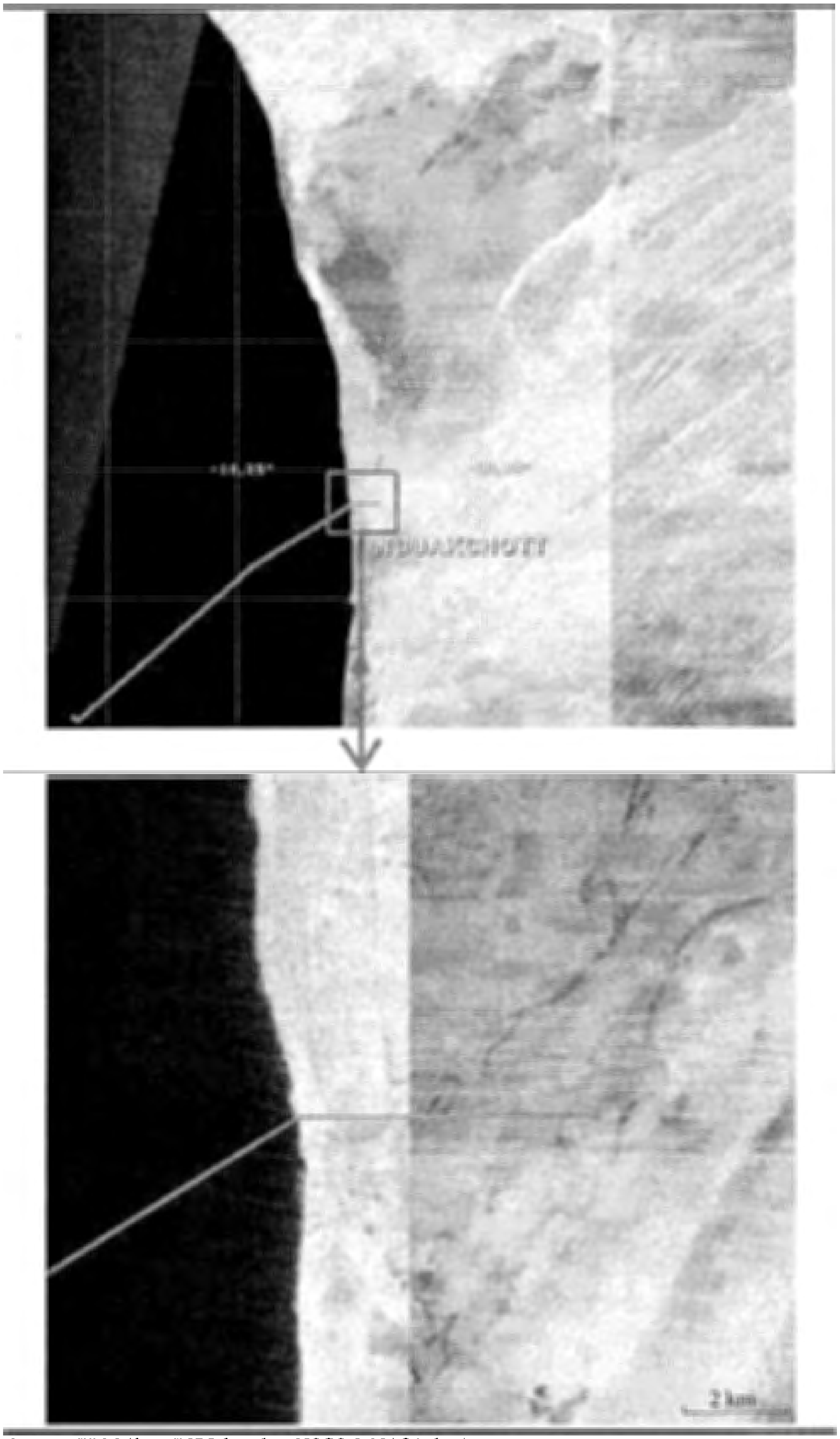
Morphology of the Onshore Area

The geomorphology of the Mauritanian coastline is characterized by narrow beaches and shifting sand dunes that follow seasonal conditions. Further back from the coastline, semi-fixed dunes precede some depression areas of salty clay called "sebkha" (*Faye, 2010*). Sebkhas can be flooded during the rainy season, between August and September (*Figure 4.38*).

The Great Sebkha of Ndramcha, located about 15 kilometres north of the proposed onshore gas plant location, presents some very low altitude (down to -4 m). The use of Short Wave InfraRed (SWRI) satellite images permits to distinguish the location of the Great Sebkha (in cyan blue on *Figure 4.14*). On the onshore study area, the floods are not such as important as more on North; however, SWRI imagery shows some temporary flooded areas (in cyan blue on *Figure 4.14*).

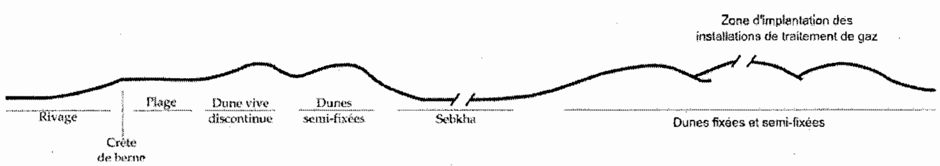
The typical geomorphology of the north of Nouakchott coastline (based on the scoping visit conducted from 9th to 13th July 2012) is presented on *Figure 4.15*.

Figure 4.14 ***Flooded Areas around the Proposed Location of the Project's Onshore Component***



Source: *ERM (from ESRI, based on USGS & NASA data)*

Figure 4.15 ***Schematic Geomorphology of the Mauritanian Coastline (North of Nouakchott)***



Source: *ERM*

Glossary: Rivage: shore – *Plage:* beach – *Dune vive discontinue*: discontinuous shifting dune – *Dunes semi-fixées*: semi-fixed dunes – *Dunes fixées et semi-fixées*: fixed and semi-fixed dunes – *Zone d'implantation des installations de traitement de gaz* : Location of the gas treatment facilities

4.3.4 *Geology and Sedimentology*

Sedimentology

Particle size distributions of sediments in the marine environment are to a large extent determined by hydrodynamic energy at the sediment water interface. Strong currents tend to scour the seabed thereby suspending fine particles and any material associated with them, whilst the finest sediments predominate in areas with the least hydrodynamic energy.

Sediment particle size is also a critical measurement for the categorization of habitat type since this parameter controls to a large extent which organisms are capable of living within sediments. Most benthic infaunal organisms exhibit preferences for sediment with particular grain size characteristics. Many organisms live in tubes or burrows constructed from sediment particles; each organism's ability to do this may be limited by the range of particle size available. The distribution and abundance of free-living mobile organisms, i.e. those that do not construct tubes or burrows, are also affected by particle sizes, which influence their ability to move within the sediment.

A specific Environmental Baseline Survey (EBS) was conducted by Gardline (*Gardline, 2012*) at the proposed Banda Drilling Center and along the Pipeline Route. The main results and conclusions related to sediment characteristics are the following:

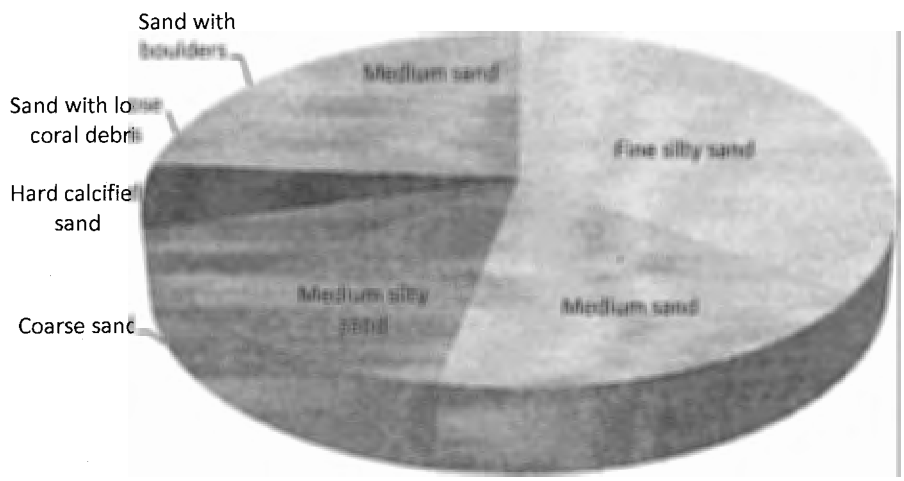
- At the drilling center, the sediments were homogenous with no indication of a change in sediment type across the sampling stations. Sediments were described as fine silty sand with occasional shell fragments.

- The 14 first set of sampling stations along the pipeline route presented sandy seabed with shell fragments but different types of sediments were observed. These are presented on *Figure 4.16*.

- The second set of four near-shore sampling stations from the EBS presented: sand with loosely cemented coral debris and shell fragments closest to the shore, then sand with boulders and coral patches, and finally only sand for the last two stations that were the furthest from shore (*Gardline, 2012*). The sediment types are also presented on *Figure 4.16*.

Figure 4.16 ***Type of Sediments along the Pipeline Route***

Type of sediments:



Source: *ERM (interpretation from Gardline 2012)*

The general sedimentology of the area is shown in *Figure 4.17*. This figure confirms that the offshore pipeline route will cross several different types of seabed, including rocky banks, discontinuous rocky areas and sandy seabed.

Sediment Quality

The role of sediment in the transport and retention of chemical pollutants is tied to both particle size and to the amount of organic carbon associated with the sediment. The chemically active fraction of sediment is usually cited as the organic component and also as the finest size fractions (smaller than 63μm, silt, clay). The sediment, in particular the organic carbon and finer fractions, acts as a sink for many of the persistent compounds, including metals, hydrocarbons and chlorinated compounds. Many of these persistent substances are also inherently bio accumulative and toxic. The concentrations of many parameters are typically positively correlated with the proportion of fines found in the sediment as a result of fine particles possessing a relatively large surface area. Fine sediment particles are relatively easily suspended by waves and currents, and may be transported, along with the materials sorbed to them, over large distances, finally being deposited in areas of lower hydrodynamic energy.

Generally speaking, sands and coarser grained materials are often organically deficient. Strong currents have a tendency to suspend fine materials and their associated organic matter. Therefore, in an environment that is not nutrient enriched due to anthropogenic discharges, both total organic matter and total organic carbon will normally be lowest at sites with coarse-grained sediment, where currents are often strongest.

During the EBS undertaken by Gardline, the levels of pollutants (hydrocarbon and metals concentrations) were measured at the sampling stations (DC and pipe route). The main results were that:

- Hydrocarbon concentrations were lower than the levels that might be considered to cause a toxicological effect, and are consistent with historical and ongoing oil and gas related activity in the area.

- Overall the results of the metals analysis indicate that the sediments within the Banda DC were free from any notable contamination: the levels of heavy metals did not exceed any of the apparent effects thresholds (AETs) defined by *Buchman* (2008), which were obtained by establishing relationships between sediment metal concentrations and benthic community toxicological impacts.

Terrestrial Geology

The maritime zone in the coastal area belongs to the large sedimentary basin that extends from Mauritania to Guinea-Bissau. The Mauritanian coast belongs to the secondary-tertiary sedimentary Senegalo-Mauritanian basin, with an area of approximately 340,000 km^2 (*Mohamed Lemine Ould Aboye, 2003*).

This basin lies at a depth increasing rapidly approaching the coast (5000 m near Nouakchott) on the ancient basement that outcrops in the East with Mauritanides chain. Four stages have been identified for marine Quaternary in Mauritania, corresponding to transgressive levels; Nouakchott and the onshore study area belong to *Nouakchottian* (7,000 to 4,000 BP).

The Quaternary cover is often recent and outcrops over much of the coastal zone. It results from a bustling history characterized by alternative invasions and withdrawals from the ocean. These are represented by local important changes (Ndramcha sebkha, Senegal Delta) of shoreline and varied deposits, added to climatic episodes which are arid or wetter, with their dune systems and the introduction of an extensive cover of wind sands.

As part of the environmental baseline, Tullow commissioned a geotechnical survey at the proposed locations of the gas processing plant and the submarine pipeline landfall.

The 25m depth core drilling undertaken during the geotechnical survey mandated by Tullow at the proposed location of the gas treatment plant identified the following layers:

- a layer of sand with a thickness of 4 to 6m;
- a transition layer of sand cockle;
- a layer of consolidated shells compact 8-9 m to 16-17 m depth;
- another transition layer shell silt; and
- a final layer of gray silt from 18-19 m depth.

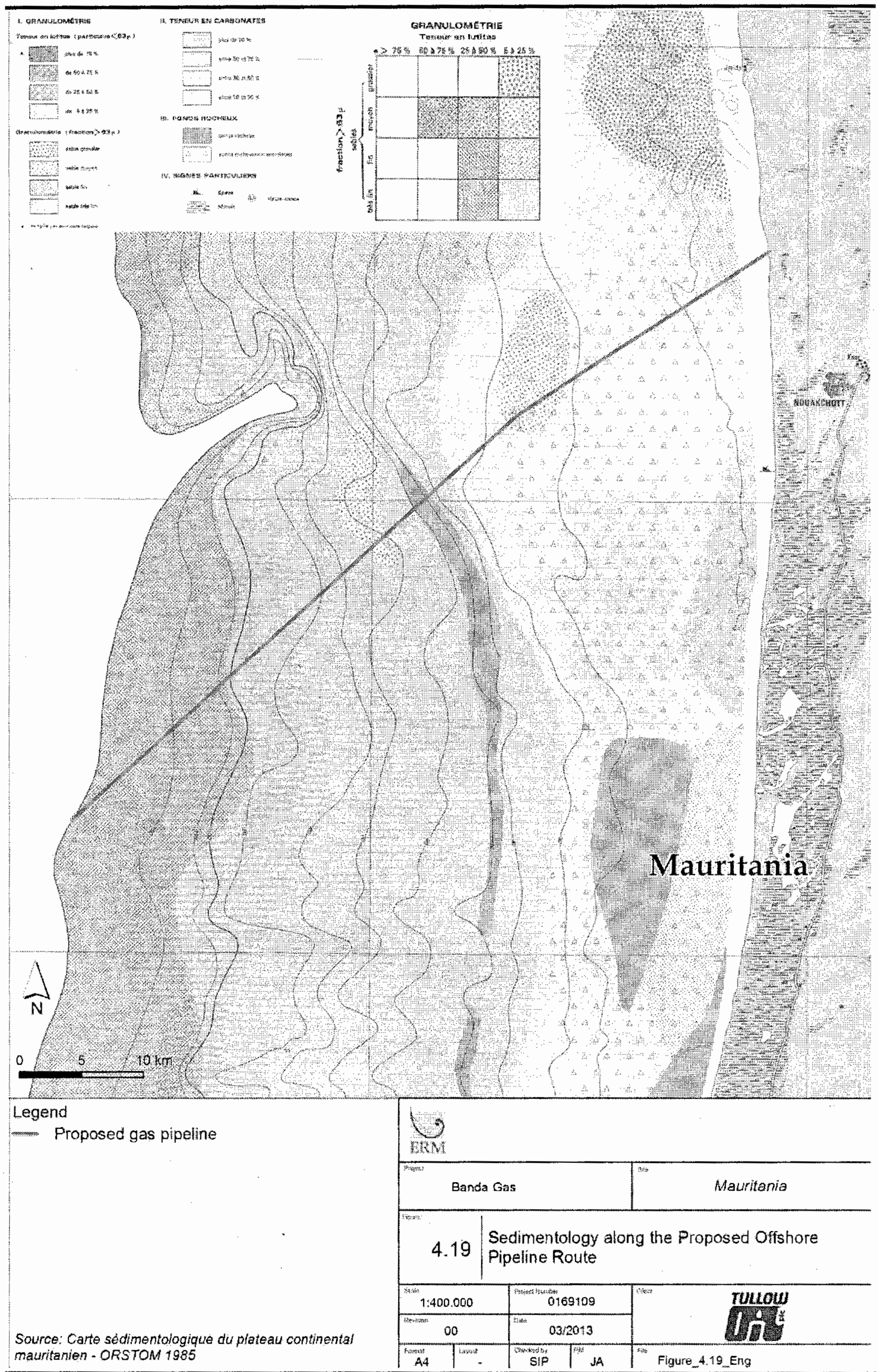
The water levels recorded at the location of the proposed gas treatment plant were 5.1 m and 7 m above the natural ground. However, the existence of movement and / or water infiltration is possible during and after intense or prolonged rainfall events.

The following layers were identified by the core holes of 15m depth made at the proposed location of the submarine pipeline landfall :

- a layer of sand slightly cockle 12 to 14m thick, and then
- a layer of compact consolidated shells.

The water levels recorded beneath the proposed gas processing facility were 1 m and 1.5 m above the natural ground.

Figure 4.17 Sedimentology along the Offshore Pipeline Route



Glossary: *Fonds rocheux*: rocky bed - *Bancs rocheux*: rocky banks - *Sable*: sand – *Epave*: wreck.

4.3.5 *Water Quality*

Water Temperature

Surface water temperature off the coast of Mauritania is relatively low due to coastal upwelling, but varies seasonally as a result of the mixing of cold masses of water from the north (Canary Current) and warm masses of water from the south (a combination of tropical waters and monsoon rains) (*Ould Taleb Sidi, 2005*). In the Project area (between 16°N and 18°N), surface sea temperatures vary between 19°C in February and 28°C in September (cf. *Figure 4.18*) (*Ould Taleb Sidi, 2005*).

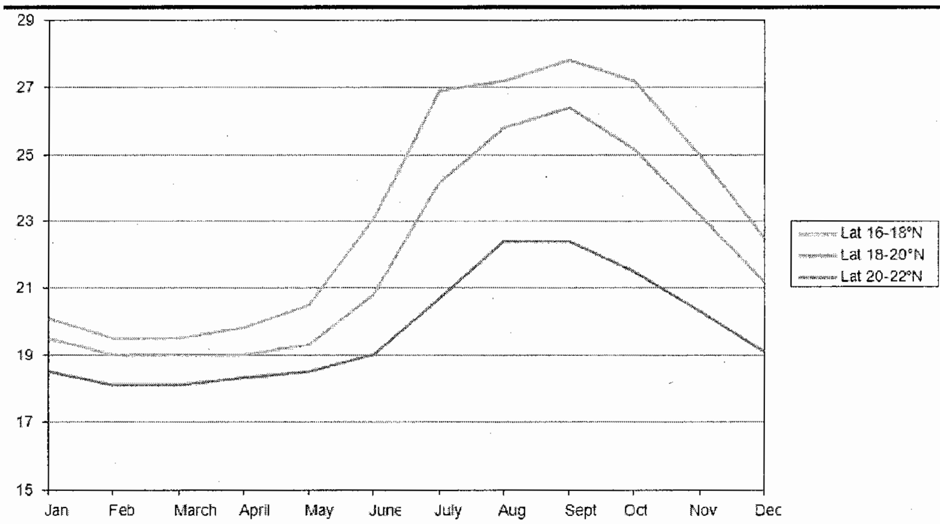
The near bed conditions for the Banda field are not so influenced by the seasons, and the mean temperatures vary between 11.7°C and 12.1°C (cf. *Figure 4.19*).

Finally, temperatures are also influenced by depth (*Gardline, 2012*):

- within the first forty meters, the temperature is quite stable and similar to the surface (around 28 °C);
- from forty to ninety meters depth, it decreases about 15 °C; and
- from ninety meters to the seabed (215 m), the temperature decrease very slowly until 12°C.

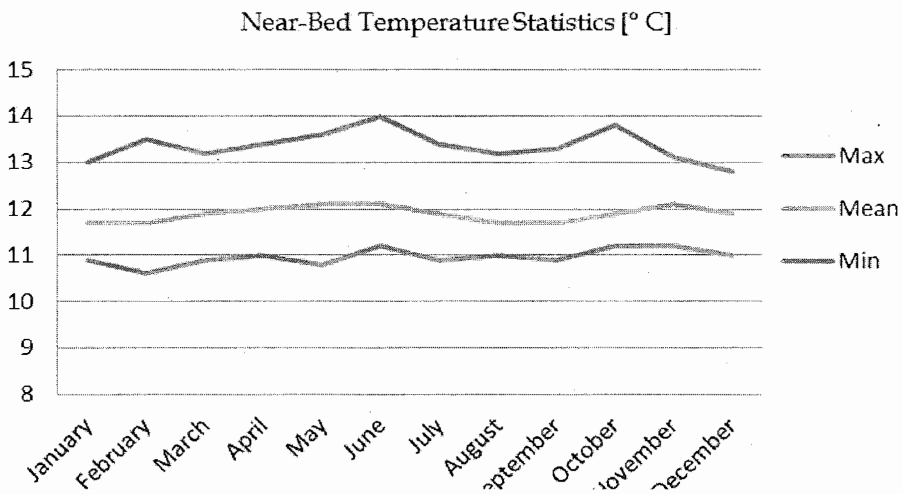
These variations are presented on the *Figure 4.20*.

Figure 4.18 ***Monthly Mean Surface Water Temperature***



Source: *ERM (from Ould Taleb Sidi, 2005)*

Figure 4.19 ***Monthly Near-seabed Temperature in the Banda Field***



Source: *ERM (interpretation of FugroGeos, 2012)*

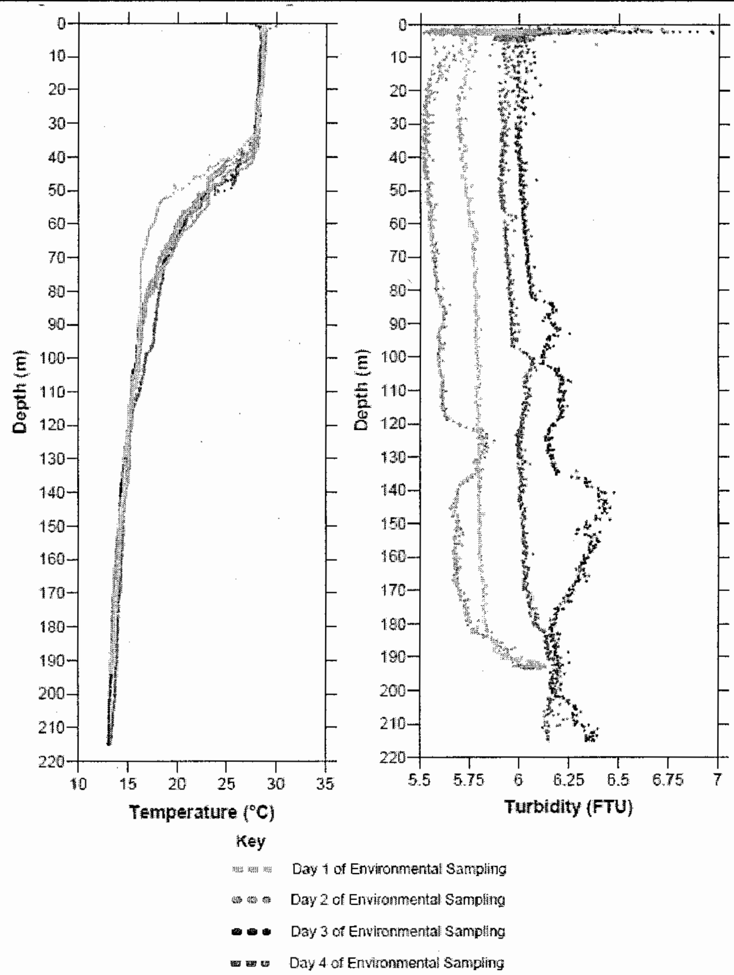
Turbidity

Turbidity profiles collected at the drilling centre indicate that the surface waters can be very turbid (>7 FTU) down to approximately 7m below sea level. Between 10m and 30m the turbidity averages around 6 FTU. The values measured varied by 1 FTU between the sampling days (4 different measures). Still, turbidity increased slightly with depth on all profiles. The spikes on day two to four are most likely caused by objects particles or animal in the water column (See *Figure 4.22*) (*Gardline, 2012*).

Salinity

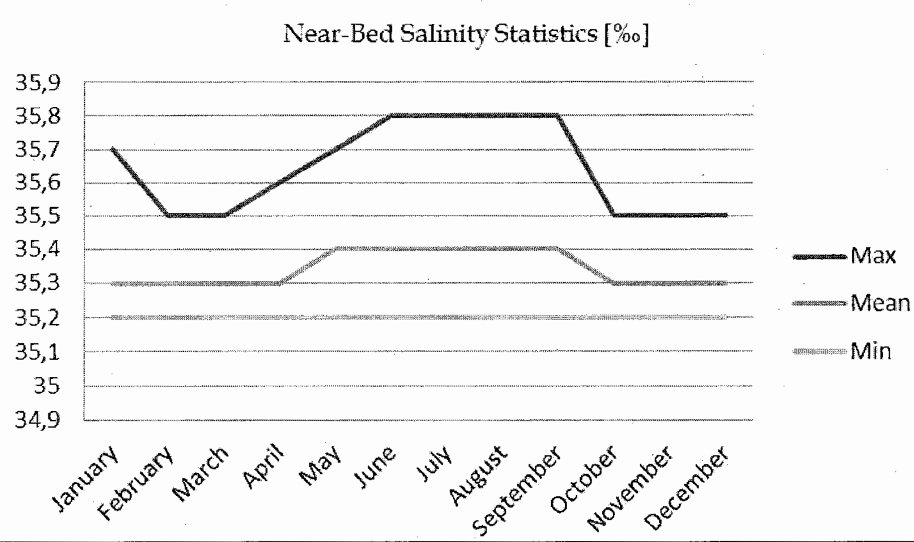
In the absence of fresh water inflow from rivers, the salinity of surface water off the coast of Mauritania is stable at around 36‰ year-round (*Ould Taleb Sidi, 2005*). In the Project area, some low variations between 35.2 ‰ and 35.8 ‰ (from June to September) are anticipated (*FugroGeos, 2012*).

Figure 4.20 ***Water Temperature and Turbidity Profiles in the Banda Field***



Source : *Gardline 2012.*
FTU : Formazin Turbidity Unit

Figure 4.21 ***Monthly Near-seabed Salinity in the Banda Field***



Source: *ERM (interpretation of FugroGeos, 2012)*

4.3.6 *Noise*

Introduction

An important part of the noise assessment is the quantification and understanding of the existing acoustic environment including the identification baseline noise levels at potentially affected noise sensitive receptors. The baseline environment can be defined as the conditions that would prevail in the absence of the Project; it is intended to describe the spatial planning and the status of the noise climate in the area surrounding the Project site, setting the scene for the assessment of the potential noise impacts created by the Project.

Acoustic Characteristics of the Project Site

Based on a desktop analysis, it was anticipated that due to the desert nature of the proposed area, the acoustic environment will have low ambient noise levels which will not vary considerably across the Project area. In fact, specific noise emissions have not been detected during the site inspection. The Project study area consists mainly of a sparsely populated desert environment and the whistling wind is the main source of noise.

The Project site is located about 9 km north of the city of Nouakchott. It is characterized by fixed and semi-fixed dunes , alternating with some depression areas of salty clay called "*sebkha*". The site and its wider environment are used by shepherds for the grazing of herds of camels and goats and crossings to remote places.

Along the pipeline and in proximity of the gas plant the nearest identified buildings are:

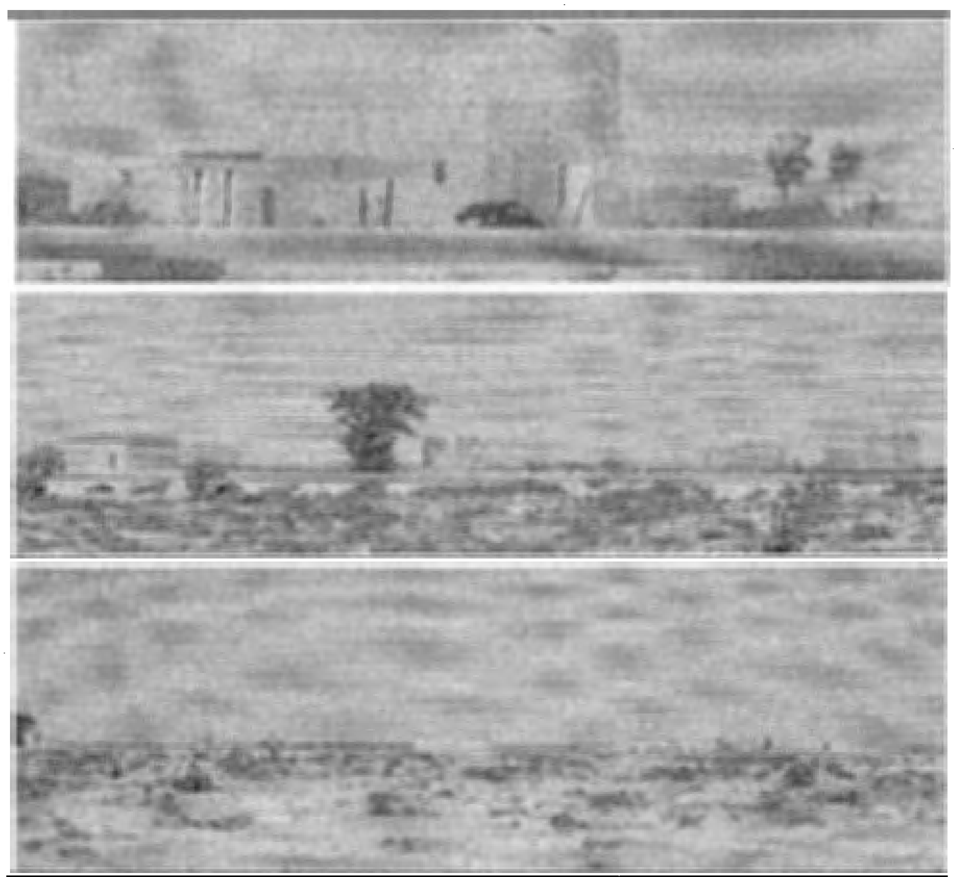
- the new University of Nouakchott located 2.7 km south/southwest of the proposed gas processing facility, still under construction (see *Figure 4.22*);
- scattered residential buildings 3.8 km west-northwest of the proposed processing facility site, including also some tented camps (*Figure 4.23*).

These receptors have been identified previously by a desktop analysis of the local cartography or satellite images and confirmed by means of site visit to verify the state of the buildings and the presence of inhabitants.

In addition to the future noise sources related to the Project, in the study area the only noise emissions derives from Nouakchott-Nouadhibou road traffic, even if no relevant noteworthy infrastructure affects the area.

Figure 4.22 *Pictures of the University of Nouakchott Construction Site (November 2012)*

Figure *Permanent Residential Buildings Located 3.8 km West of the Site*



Noise Baseline Measurements

Ambient (background) noise levels for the Project area were measured by undertaking a series of attended short-term measurements during the day over the period 6-7 November 2012. The noise baseline survey report, including methodology and detailed results is presented in *Annex B-3*.

Figure 4.23 ***Noise Measurement Locations***

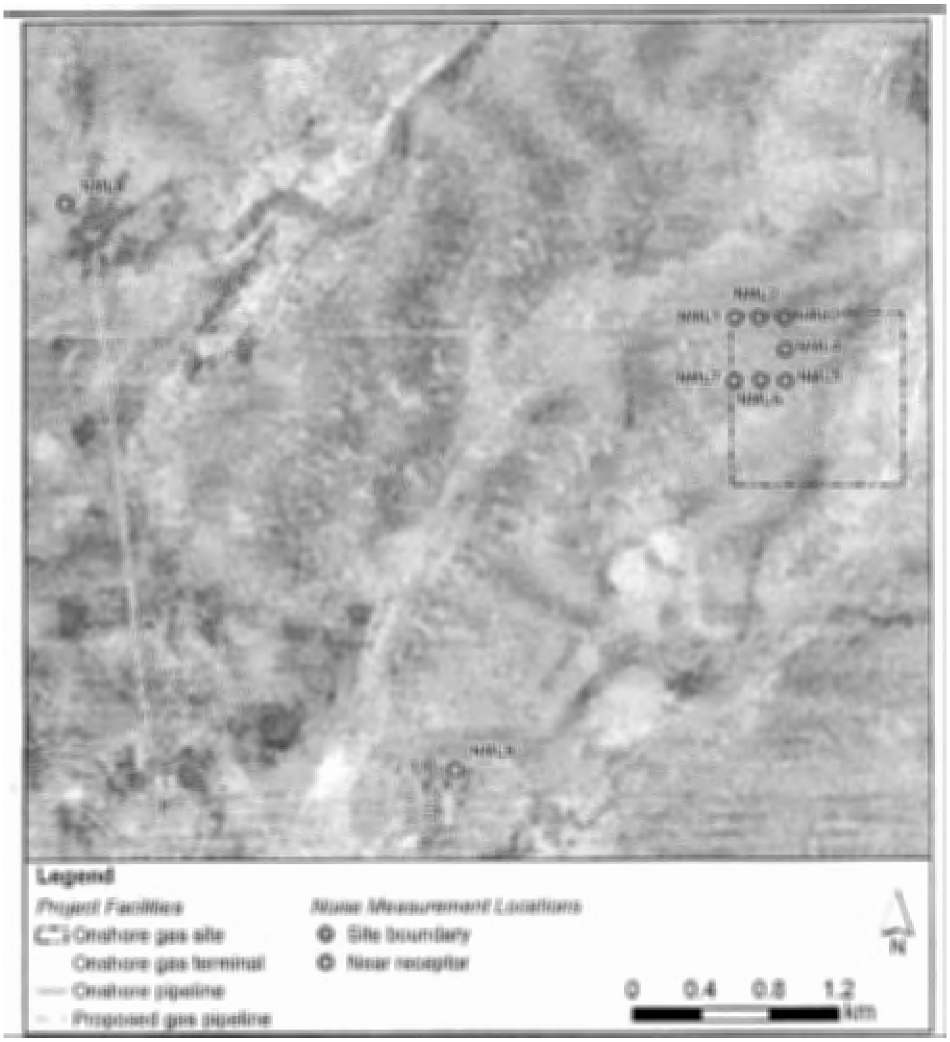


Table 4.1 summarizes the daytime ambient noise levels at each of the measurement on the site boundary.

Table 4.2 summarizes the daytime ambient noise levels at the identified nearest receptors.

Table 4.1 ***Results of Monitoring Measurements. Site Boundary***

Location	Coordinates (1)		L_{Aeq} [dBA]	L_{A90} [dBA]	L_{A5} [dBA]	$L_{A,min}$ [dBA]	$L_{A,max}$ [dBA]
	X [m]	Y [m]					
NML1	396661.01	2010941.59	34.1	29.3	31.3	29.2	58.5
NML2	396804.68	2010942.38	35.0	29.3	34.1	29.2	59.4
NML3	396953.11	2010942.38	32.0	29.5	32.2	29.4	52.3
NML4	396954.70	2010755.85	31.4	29.4	31.6	29.3	50.4
NML5	396956.29	2010573.29	40.3	29.4	35.3	29.3	66.4
NML6	396815.00	2010574.08	33.7	32.0	36.4	31.1	45.8
NML7	396657.04	2010573.29	38.4	31.3	42.2	30.8	57.2

Note:
(1) Coordinate System: WGS 84 UTM 28N

Table 4.2 ***Results of Monitoring Measurements near Identified Noise Sensitive Receptors***

Location		Coordinates (1)		L_{Aeq} [dBA]	L_{A90} [dBA]	L_{A5} [dBA]	$L_{A,min}$ [dBA]	$L_{A,max}$ [dBA]
		X [m]	Y [m]					
NML8	Settlement near Nouakchott-Nouadhibou road (3.8km northwest of the Project site)	392757.87	2011623.77	47.0	36.1	52.2	30.6	75.2
NML9	University (2.7km southwest of the Project site)	395021.29	2008307.89	30.8	29.3	32.0	29.2	50.1

Note:
(1) Coordinate System: WGS 84 UTM 28N

Conclusions

From observations made and measurements recorded during the site visit it may be concluded that the areas set within and surrounding the Project site are typical of undeveloped area sufficiently far from city centre and infrastructures, with low background noise levels throughout the day time period, and consequently throughout the night time period.

No particular sensitive receptor has been identified in the immediate vicinity of the Project area. The nearest receptors being the new University of Nouakchott located 2.7 km south/southwest of the proposed gas processing facility and rare permanent residential buildings located 3.8 km west /northwest of the proposed gas processing facility.

4.4 *MARINE BIOLOGICAL ENVIRONMENT*

4.4.1 *Plankton*

Information on plankton (phytoplankton and zooplankton) was sourced from available published sources (eg *AtlantNIRO, 2009*). Phytoplankton and zooplankton form a fundamental link in the food chain. The composition of plankton communities and their abundance is variable and depends upon water circulation into and around the coast of Mauritania, the time of year, nutrient availability, depth and temperature stratification.

Phytoplankton

Phytoplankton, grouped as diatoms, dinoflagellates and coccolithophores, are microscopic and range between 30 mm and 60 mm in size. Primary production is linked to the amount of inorganic carbon assimilated by phytoplankton via the process of photosynthesis. Primary production determined for the Mauritanian Exclusive Economic Zone (EEZ) is 2,549 mg cm^{-3} per day (*Seas Around Us Project*, 2012). Typically, productivity in the offshore ecosystems (100 to 200 m water depth) range from 10 to 100 mg cm^{-3} per day. Thus, the values obtained within the nearshore areas indicate a system of relatively high productivity. This is not unexpected since the coastal ecosystem of the area undergoes seasonal upwelling, bringing nutrients to the surface which makes phytoplankton especially abundant from March to May and from July to October.

Organisms encountered are large diatoms including *Chaetoceros* (*C. tortissimum, C. laciniosum, C. didymum*), *Rhizosolenia* (*R. stolterfothii, R. delicatula, R. calcar -opinion, R. setigera*), the common coastal diatom *Skeletonema castatum* and *Asterionella japonica, Talassionema nitzschioides, Nitzschia closterium, Thalassiothrix frauenfeldii* and *Ditylum Brightwell*. All of these species can occur in proliferations of up to several hundred thousand cells per litre.

During the warmer months of the year, dinoflagellates can grow in abundance (up to 900,000 cells per litre). Occasionally, in the right conditions, particular species can occur in very high densities creating 'red tides'. In Mauritania, several cases have been observed both in inshore waters and several miles offshore, mostly in calm weather. The main species of dinoflagellates that cause red tides mostly belong to the genera *Gonyolax, Gyymnodinuim, Amphydinuim, Cochlodinium* and *Noctiluca*.

During the EBS conducted by Gardline on behalf of Tullow, concentrations of chlorophyll-a were used as an estimate of phytoplankton biomass within the water column. Concentrations recorded on all environmental sampling days were all below the limit of detection of $<10\mu g.L^{-1}$ both at the Banda Drilling centre and on the pipeline route (Gardline, 2012).

Zooplankton

There is no comprehensive inventory of zooplankton species for Mauritania, however in common with other offshore areas, zooplankton assemblages are likely to be dominated by Copepods, followed by Ostracods, Appendicularians and Chaetognaths. From the studies that have been undertaken copepods include Oncaea spp, Oithona spp and *Parvocalus scotti.* In the Bay of Greyhound, *Sagitta hispida* is found whilst in Banc d'Arguin *Sagitta friderici* is more abundant. Among non-native species are *Calanoides carinatus* and *Galanus helgolandicus*. Concentrations of both zooplankton and phytoplankton are found at sites where upwellings occur, bringing nutrient rich cold waters to the surface.

4.4.2 *Benthic Communities*

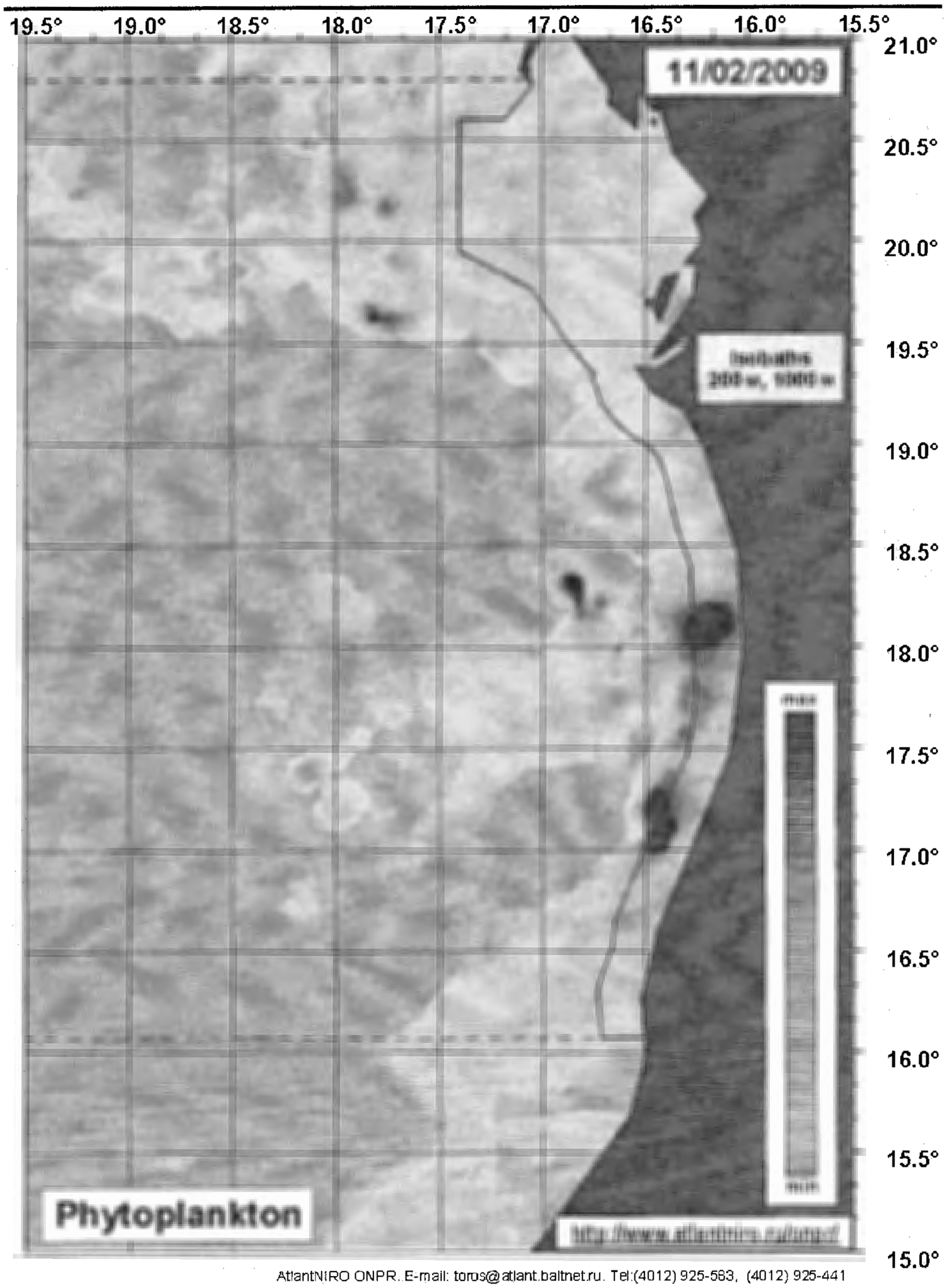
Benthic fauna form an important part of the marine ecosystem, providing a food source for other invertebrates and fish as well as cycling nutrients and materials between the water column and underlying sediments. Different species of benthic fauna exhibit different tolerances to stress, making them useful indicators of environmental conditions. The Mauritanian marine environment has not been extensively studied for its marine benthic communities, particularly in deeper waters.

During the EBS undertaken by Gardline in 2012 on behalf of Tullow, faunal samples were collected from each sampling stations. The study revealed a taxonomically diverse and species rich benthic community. To quantitatively assess the population, the data set was divided into four gross taxonomic groups: Annelida (Polychaeta), Arthropoda (Crustacea), Mollusca and Other taxa, comprising solely of Nemertea (ribbon worms). The gross number of individuals and number of different taxa were evaluated.

At the drilling centre, the faunal community was dominated by polychaete annelids, which contributed between 93% and 99% of the total individuals at each sampling station and between 71% and 93% of total taxa. This shows that the benthic fauna is rather homogenous and subject to little spatial variability around the drilling centre. Therefore, the average abundance and average proportional contribution in terms of individuals and taxa is relevant to describe the benthic fauna. These parameters are shown in *Table 4.3*.

This domination of Annelida at the drilling centre is partly due to a relatively high abundance of the polychaete *Prionospio ehlersi,* the most abundant species in the survey around the drilling centre, with 1,216 individuals accounting for 58% of the total individuals recorded (*Gardline, 2012*).

Figure 4.24 ***Indicative Primary Productivity (mg Cm^{-3} per day) Offshore Mauritania in February***



Source: *Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO, 2009)*

On the pipeline route, the benthic fauna community was found to be dominated by polychaete annelids and crustacean arthropods. Polychaetes contributed between 3% and 95% of the total individuals and between 32% and 81% of the total taxa depending on the station. This highlights a variable faunal community along the proposed route. At the stations where polychaetes contributed a higher proportion of the total individuals, it was partly due to a relatively high abundance of the polychaete *Prionospio ehlersi*, which was the second most abundant species in the survey, with 1,127 individuals and accounting for 11% of the total number of individuals recorded.

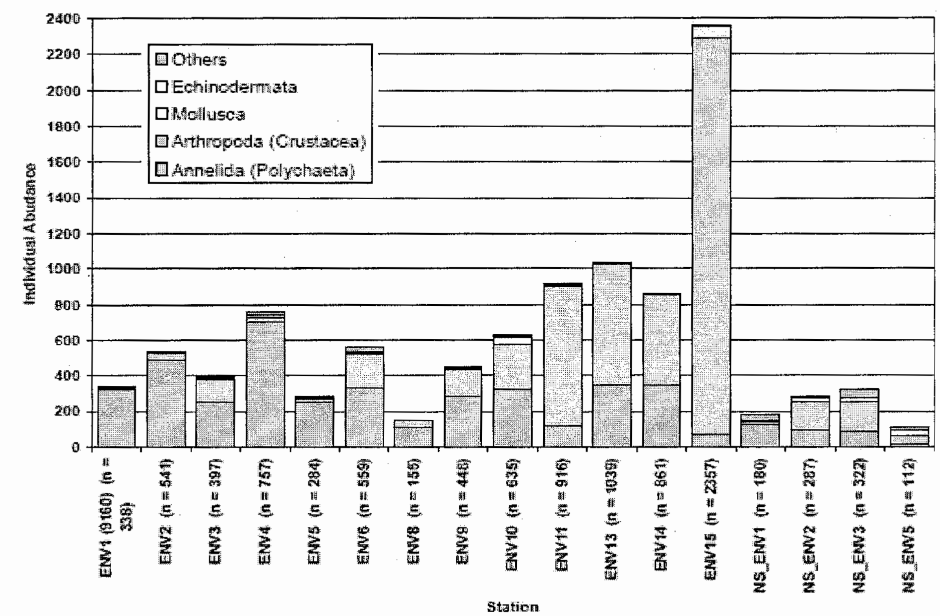
Crustaceans contributed between 3% and 94% of the total individuals and between 11% and 49% of the total taxa depending on the station. The crustaceans *Ampelisca* spp. was the most abundant species in the survey, with 2,052 individuals accounting for 20% of the total number of individuals recorded. *Figure 4.25* and *Figure 4.26* represent this distribution by showing the abundance of individuals and taxa at each sampling station (near-shore included).

Table 4.3 ***Contribution of the Gross Taxonomic Groups at the Drilling Centre***

Group	Individuals		Taxa	
	Abundance	Proportional contribution (%)	Abundance	Proportional contribution (%)
Annelida (Polychaeta)	2001	95.7	55	79.7
Arthropoda (Crustacea)	76	3.6	8	11.6
Molusca	8	0.4	5	7.2
Nemerta	7	0.3	1	1.4

Source: *Gardline, 2012*

Figure 4.25 ***Individual Abundance at the Sampling Stations on the Pipeline Route***

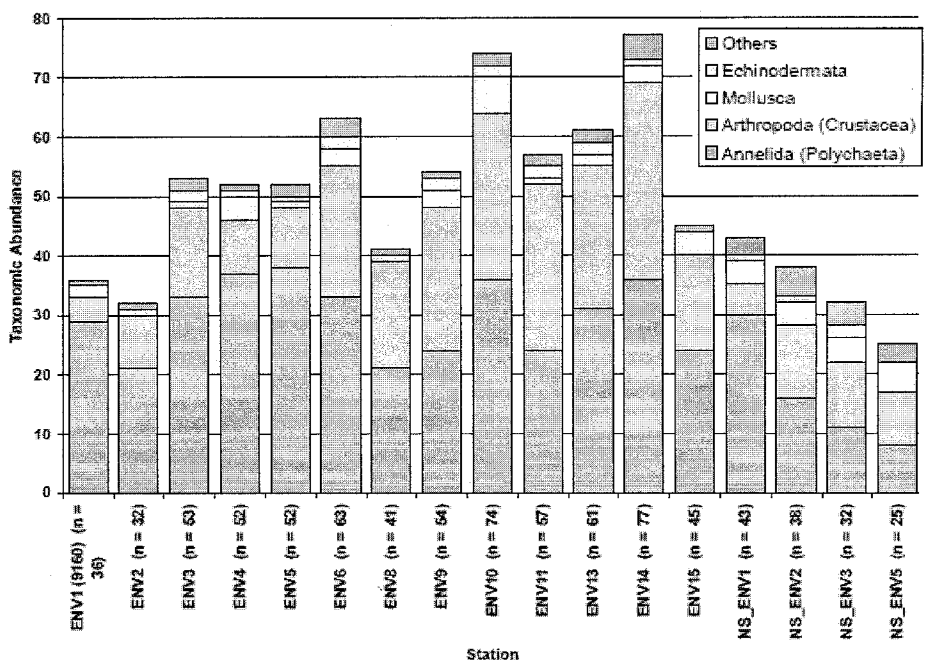


Source: *Gardline, 2012*

The IUCN Red List of Threatened Species identifies 18 species from these four taxonomic groups in Mauritania that are all of Least Concern or Data Deficient. None of these species were observed during the EBS.

In 2005, carbonate mud mounds have been recorded approximately 15 km from the drilling centre (*Colman et al, 2005*), at the approximate depth contours of 450 to 550 m, approximately 60 km from shore (*Figure 4.27*). In the past these mounds were inhabited by dense communities of cold-water corals including *Lophelia pertusa*. However, Colman's survey in 2005 found the coverage by live coral was greatly reduced in comparison to previous surveys. He postulated that this decline could be caused by trawling by fishermen in the area or the result of natural decline as a result in a change in oceanographic conditions such as a change in water temperature, currents (affecting food supply and/or sedimentation rates). This rare habitat was not observed by Gardline in the vicinity of the drilling center , nor on the Pipeline route during the EBS (*Gardline, 2012*).

Figure 4.26 ***Abundance of Taxa at the Sampling Stations on the Pipeline Route***



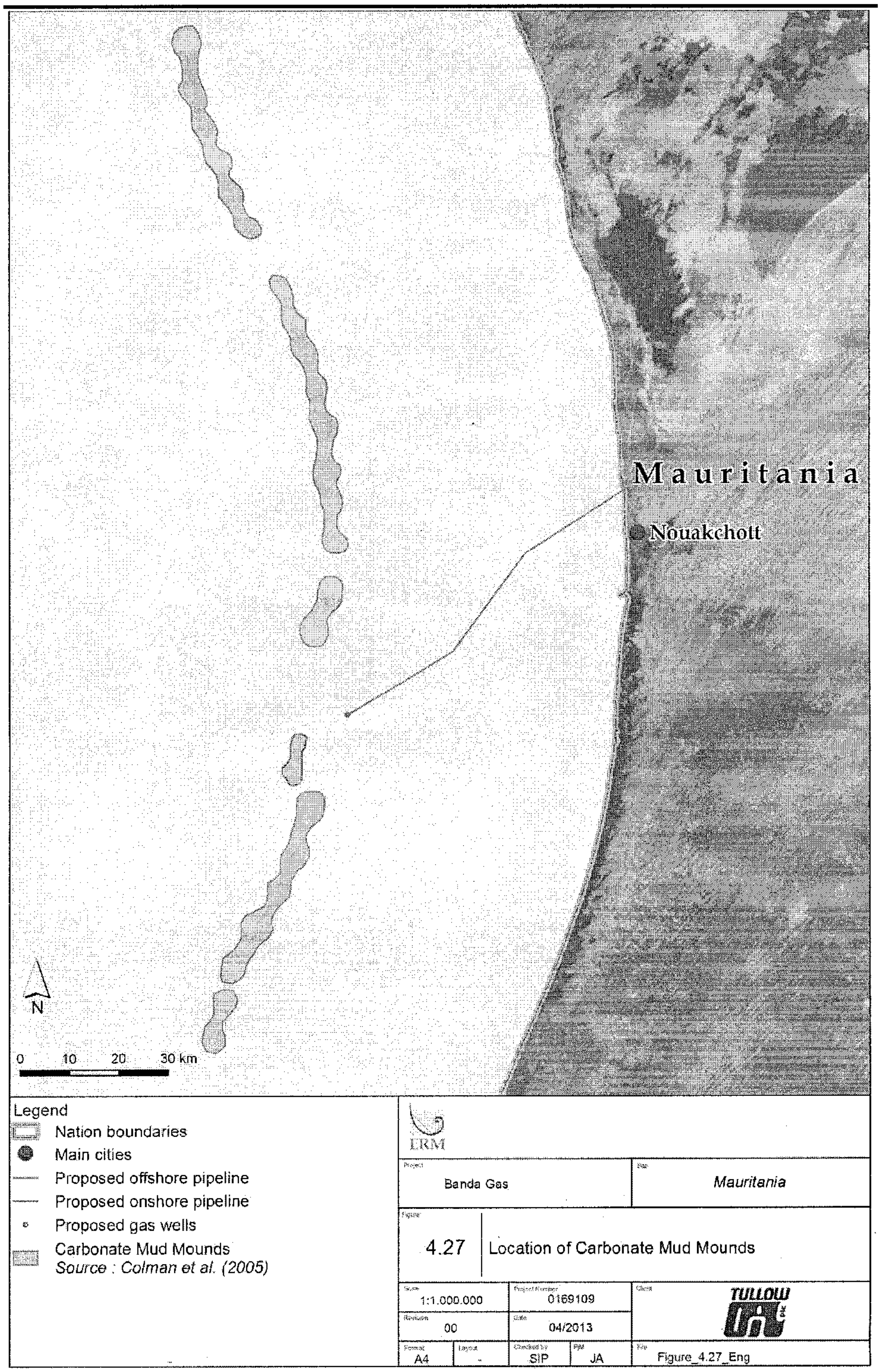
Source: *Gardline, 2012*

The Gardline EBS survey concludes that there was no indication of any sensitive habitats, nor was there any evidence of threatened and/or declining species such as those listed under the IUCN Global Red List of Threatened Species and those on the OSPAR (2008) list of threatened and/or declining species and habitats (*Gardline, 2012*).

4.4.3 *Fish*

The fish communities present on the offshore Project area are described in *Section 4.7*. This section also describes the fisheries and the economic activities linked to the fish.

Figure 4.27 Location of Carbonate Mud Mounds (Colman et al, 2005)



Source: *Colman et al, 2005.*

4.4.4 *Marine Mammals*

Cetaceans

About twenty species of cetaceans have been identified in Mauritania (*Perrin, 2007*). Most are not threatened with extinction according to the IUCN Red List (*UICN, 2011*). Only the Atlantic humpback dolphin (*Sousa teuszii*) is listed as vulnerable (VU). The fin whale (*Balaenoptera physalus*) and blue whale (*Balaenoptera musculus*) are listed as endangered (EN).

The upwelling of high-productivity cold water explains the presence of species that are normally found in the temperate and cold waters of the North Atlantic (*Robineau, 1998*).

The observations made during the seismic surveys carried out in Block C2, about 120 km south west of the proposed Project area have been used to compile this description of the baseline environment.

Observers on board the vessel for the 2D seismic survey carried out by Tullow in June-July 2011 identified 8 specimens of baleen whales in the survey zone and 1,825 specimens of toothed whales (over a total observation time of 332 hours) (*RPS, 2011*).

65 sightings of marine mammals comprising a total of 5,622 individuals were made by the observers on board the vessel for the 3D seismic survey carried out by Tullow during the first phase in May-June 2012 (over a total observation time of 392 hours) (*RPS, 2012)*. A total of 9 marine mammal species were positively identified: blue whale, humpback whale, sperm whale, short-finned pilot whale, bottlenose dolphin, Risso's dolphin, atlantic spotted dolphin, (short-beaked) common dolphin and rough-toothed dolphin. Marine mammals not identified to species level were described as unidentified dolphins, small whales and rorqual whale species (*RPS, 2012).*

150 sightings of marine mammals comprising a total of 4,825 individuals were made by the observers on board the vessel for the 3D seismic survey carried out by Tullow during the second phase in September-October 2012 (over a total observation time of 280 hours) (*RPS, 2012)*. In addition to species already identified during the previous surveys, sightings of killer whales (*Orcinus orca)* and pantropical spotted dolphin (*Stenella attenuata)* were reported during this survey.

The sensitivity of cetaceans to noise is addressed in *Chapter 5.*

Baleen Whales

The West African coast is located on a whale migration route: in the summer they find their food in the North Atlantic, which they leave in the winter to travel to breeding sites located close to the equator. This phenomenon is particularly marked for the humpback whale (*Megaptera novaeangliae*), listed as of Least Concern on the IUCN Red List. Peak times for the gathering of these animals are observed in February-March at breeding sites in the south and between June and August in the north (*Rosenbaum, 2006*); migrating individuals are likely to be present in the Project area between those two periods.

The fin whale (*Balaenoptera physalus*) is also likely to be found within the Project area. Classified as endangered by the IUCN Red List, very little information exists regarding the abundance of this species in Mauritanian waters.

Whale species likely to live or migrate in the Project area are shown in *Table 4.4*.

Observers on board the seismic vessel for the 2D seismic survey carried out by Tullow in June-July 2011 observed 5 individuals of the genus *Balaenoptera* (*edeni* or *borealis*) and 3 individuals of the *Balaenopteridae* family. Observations were not sufficiently close to enable identification of the species and particularly to identify whether the five individuals of the *Balaenoptera* genus were Bryde's whales (*Balaenoptera edeni*) or Sei whales (*Balaenoptera borealis*). The latter species (classified as Endangered by the IUCN) is not mentioned in literature as being present in Mauritanian or Senegalese waters. It is therefore more likely that the individuals observed were Bryde's whales (*RPS, 2011*).

During the first phase of the 3D seismic survey carried out in May-June 2012, one single blue whale (*Balaenoptera musculus)* was visually detected (*RPS, 2012)*.

Three humpback whales (*Megaptera novaeangliae*) were visually detected on one occasion during the first phase of the 3D seismic survey carried out in May-June 2012 (*RPS, 2012)*.

Toothed Whales

In October 2008, Mauritania signed a Memorandum of Understanding on the conservation of manatees and the small cetaceans (all toothed whales, with the exception of the sperm whale (*Physeter macrocephalus*)) of Western Africa and Macaronesia, within the framework of the Convention on Migratory Species (CMS) of the UNEP, which includes signing up to action plans for the conservation of these two species. These Action Plans aim to reduce or eliminate any threat to these species and thus ensure their conservation. With the exception of the harbour porpoise (*Phocoena phocoena*), several species of toothed whales identified in Mauritanian waters are likely to be found in the Project area.

The most sensitive of these species is the Atlantic humpback dolphin (*Souza teuszii*), in view of its endangered population and its restricted and fragmented range of action. It is endemic to the coastal waters of tropical and subtropical West Africa. This species figures amongst the threatened species listed in Annex I of the CITES and is classified as vulnerable (VU) on the IUCN Red List. It is found in coastal or estuary waters and rarely more than 1km from the coast or at depths of more than 20m. According to *Robineau & Vely (1998)*, this species is found most commonly within the boundaries of the Banc d'Arguin National Park and occasionally around Nouamghar. This study reported 15 strandings and 15 sightings between Cap Timiris (inside the park) and Grand Plage just south of Nouamghar. Similarly, *Maigret (1980)* identified two hotspots inside the Park based on 18 sightings. The Banc d'Arguin National Park being located approximately 150 km north of the Banda Field, the probability of finding an Atlantic humpback dolphin within the local Project area is low.

No observation of Atlantic humpback dolphins was reported by the observers on board the seismic vessel during the 2D seismic survey carried out in June-July 2011 or during the two phases of the 3D seismic survey carried out in May-June 2012 and September-October 2012.

Sperm whale (*Physeter macrocephalus*) is classified as vulnerable (VU) on the IUCN Red List (*IUCN, 2011*). It is important to note that the cause of the population reduction in this species (commercial whaling) is reversible, understood, and is not currently in operation. The species has a wide geographic range and a global population size in the 100,000's (*IUCN, 2011*) and can potentially be encountered in the Project area.

Sperm whales were observed on one occasion during the first phase of the 3D seismic survey carried out in May-June 2012. This sighting took place in deep waters of just under 2,000 m and comprised 5 animals remaining in close proximity to each other, blowing and travelling briefly at the surface (*RPS, 2012)*.

Sirenians

The West African manatee (*Trichechus senegalensis*) is classified as vulnerable (VU) on the IUCN Red List. It lives in inshore, estuary and riverine areas such as estuary lagoons and mangroves and should therefore not be found in the sea in the local Project area. No sirenians were observed by observers on board the seismic vessel during the 2D seismic study carried out by Tullow in June-July 2011 or the 3D seismic study carried out by Tullow in May-June 2012 in the nearby Block 2.

Pinnipeds

The northern Mauritanian coasts are home to colonies of monk seals (*Monachus monachus*) around the rocky coast of Cap Blanc, a species classified as in critical danger of extinction (CR) on the IUCN Red List. This highly sensitive species should not be found in the Banda licence area which is located more than 300 km to the south of identified colonies.

No pinnipeds were observed by observers on board the seismic vessel during the 2D seismic study carried out by Tullow in June-July 2011 or the 3D seismic study carried out by Tullow in May-June 2012 in the nearby Block 2.

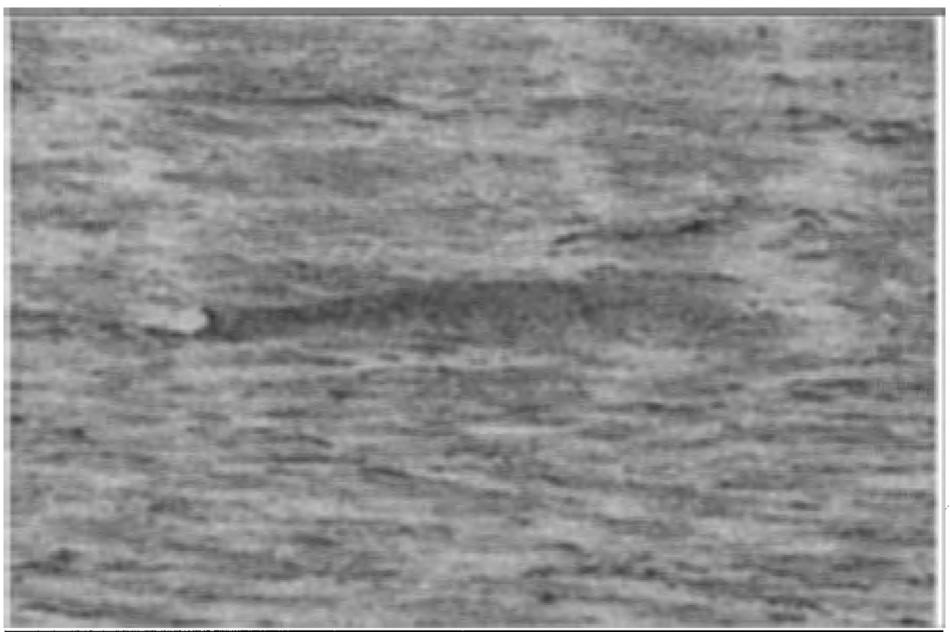
Summary

The marine mammal species identified in Mauritanian waters, their conservation status, the number of sightings during the 2D seismic survey carried out in June-July 2011 and the two phases of the 3D seismic survey carried out in May-June 2012 and September-October 2012, as well as a qualitative assessment of their probability of presence within the Project area are summarized in *Table 4.4*.

Several other marine mammals have been mentioned in the literature, but data concerning their abundance is rare and it has not been possible to confirm their presence. The following species could be encountered within the Project area, but their presence is not considered very likely:

- dwarf sperm whale (*Kogia sima*);
- long-finned pilot whale (*Globicephala melas*); and
- minke whale (*Balaenoptera acutorostrata*).

Figure 4.28 Blue Whale Recorded during the 3D Seismic Study of nearby Block 2



Source: *RPS (2012)*

Table 4.4 ***Marine Mammals Species Identified in the Project Area – Sightings Recorded during Seismic Surveys in Nearby Block C2***

Classification on the IUCN Red List	Species	Common name	2D survey		Ph1 - 3D survey		Ph2 - 3D survey		Presence within the Project area
			Sightings	Animals	Sightings	Animals	Sightings	Animals	
BALEEN WHALES									
Endangered	*Balaenoptera physalus*	Fin whale							Possible
	Balaenoptera musculus	Blue whale			1	1			Possible
Least concern	*Megaptera novaeangliae*	Humpback whale			1	3	1	1	Possible
Insufficient data	*Balaenoptera edeni*	Bryde's whale	3	5	1	1	3	3	Possible
TOOTHED WHALES									
Vulnerable	*Sousa teuszii*	Atlantic humpback dolphin							Unlikely
	Physeter macrocephalus	Sperm whale			1	5			Possible
Least concern	*Tursiops truncates*	Common bottlenose dolphin	3	38	6	187	17	185	Possible
	Delphinus delphis	Short-beaked common dolphin			1	60			Possible
	Stenella coeruleoalba	Striped dolphin							Possible
	Peponocephala electra	Melon-headed whale							Possible
	Steno bredanensis	Rough-toothed dolphin			2	65			Possible
	Phocoena phocoena	Harbour porpoise							Unlikely
	Ziphius cavirostris	Cuvier's beaked whale							Possible
	Grampus griseus	Risso's dolphin			5	110	8	69	Possible
	Stenella attenuata	Pantropical spotted dolphin					2	12	Possible
Insufficient data	*Globicephala macrorhynchus*	Short-finned pilot whale	1[1]	35	16	400	49	1043	Possible
	Mesoplodon densirostris	Blainville's beaked whale							Possible
	Mesoplodon europaeus	Gervais' beaked whale							Possible
	Stenella clymene	Clymene dolphin	1	30			3	105	Possible
	Stenella frontalis	Atlantic spotted dolphin	3	247	2	52	5	380	Possible
	Lagenodelphis hosei	Fraser's dolphin							Possible
	Stenella longirostris	Spinner dolphin	1	40			7	840	Possible
	Delphinus capensis	Common dolphin	13	376	10	4110	6	1170	Possible
	Orcinus orca	Killer Whale					1	4	Possible
SIRENIANS									
Vulnerable	*Trichechus senegalensis*	African Manatee							Unlikely

Source: *ERM interpretation of UICN, 2011 ; Perrin, 2007 ; RPS Energy, 2011 and RPS, 2012.*

[1] Pilot whales were observed on 22 occasions, including 4 sightings of mixed species. During these events, positive species identification as short-finned pilot whales was only possible during one sighting.

Figure 4.29 *Common Dolphin Recorded during 3D Seismic Study of the Nearby Block 2*

Source: *RPS (2012)*

4.4.5 *Marine Turtles*

The Mauritanian coast and the north of the Senegalese coast are home to marine turtle nesting sites (*Fretey, 2001*). Amongst them are notably the presence of loggerhead sea turtles (*Caretta caretta*) and green sea turtles (*Chelonia mydas*), which are both classified as endangered species (EN) by the IUCN. Hawksbill sea turtles (*Eretmochelys imbricata*) and leatherback sea turtles (*Dermochelys coriacea*), are also reported and are classified as critically endangered (CR). The potential presence of olive ridley sea turtles (*Lepidochelys olivacea*), classified as a vulnerable species (VU), is also noted.

The observations made during the seismic surveys carried out in Block C2, about 120 km south west of the proposed Project area have been used to compile this description of the baseline environment.

Observers on board the seismic vessel during the 2D seismic study carried out by Tullow in June-July 2011 in the nearby Block 2 identified 17 loggerhead turtles and 6 olive ridley turtles (over a total observation time of 332 hours) in the survey area. 41 other observations of turtles were made, the species of which could not be identified (*RPS, 2011*).

A total of 11 turtle sightings (all single individuals) were made by the on board observers during the first phase of the 3D seismic survey carried out by Tullow in May-June 2012 (over a total observation time of 392 hours). Two turtle species were positively identified: the loggerhead turtle and the olive ridley turtle. Turtles not identified to species level were hard-shelled turtles (i.e. not leatherbacks), briefly seen at surface, or seen sub-surface (*RPS, 2012)*.

A total of six turtle sightings (all single individuals) were made by the on board observers during the second phase of the 3D seismic survey carried out by Tullow in September-October 2012 (over a total observation time of 280 hours). One loggerhead turtle was positively identified. Turtles not identified to species level were hard-shelled turtles (i.e. not leatherbacks), briefly seen at surface, or seen sub-surface (*RPS, 2012)*.

The five species of marine turtles identified in Mauritanian waters, their conservation status, the number of sightings during the 2D seismic survey carried out in June-July 2011 and the two phases of the 3D seismic survey carried out in May-June 2012 and September-October 2012, as well as a qualitative assessment of the probability of their presence within the Project area are summarized in *Table 4.5*.

In the nesting season, major turtle migrations can be observed. Knowledge of the beaches, and above all of the nesting seasons, is essential in order to take into account the sensitivity of these species. The known nesting locations of species which breed in Mauritania and the distances to the Banda field and the proposed landfall are discussed and assessed in the following species specific sections.

Green Turtle

Green turtle (*Chelonia mydas)* is the most abundant turtle species in Mauritania. Its breeding period would appear to be centred on the months of July-August (*Maigret, 1977*) and, more specifically, during the last two weeks of July and the first two weeks of August for the beaches in the Langue de Barbarie National Park (*Maigret 1978*). Archives held by this National Park do indicate, however, an egg-laying season of June-July (*Fretey, 2001*). Further south in Senegal a second egg-laying season has been reported (*Maigret 1977)*, which has caused some authors to refer to a double breeding period from January to March and then from July to October (*Dupuy, 1986)*. In the north of Mauritania, fishermen have reported observations of mating in June-July in the Banc d'Arguin and nesting on the beaches of the Banc d'Arguin and on the Baie du Lévrier (*Maigret, 1983*).

Juveniles are omnivorous in their first year of life but sub-adults and adults are herbivorous, feeding mainly in coastal seagrass meadows. In Mauritanian waters the large seagrass beds at Banc d'Arguin provide an important feeding area for individuals from breeding colonies both in Mauritania as well as in other West African countries. The known distribution in West Africa is shown in *Figure 4.30*.

The Banc d'Arguin and the Langue de Barbarie National Parks are located approximately 160 and 170 km away from the Banda Field respectively. Similarly the proposed pipeline landfall is located more than 130 km from the boundaries of the Banc d'Arguin and 250 km from the Langue de Barbarie in Senegal. In consequence, the Project should not have an impact on the major nesting sites of Green Turtles.

Loggerhead Turtle

The loggerhead turtle (*Caretta caretta)* is relatively abundant in Mauritanian waters. Its breeding period corresponds to the rainy season and lasts from July to October (*Dupuy, 1986)*. The same author reports observation of nesting in the Langue de Barbarie National Park in January 1982 (approximately 160 km from the Banda Field). This observation is not confirmed, however, in the National Park archives (*Fretey, 1990)*. Fretey states that laying "*appeared to be very rare and took place indifferently in January, March, June, August or September and not from July to October as stated by Dupuy*" (*Fretey, 1990*). Observers on board the seismic vessel during the 2D seismic survey carried out by Tullow in June-July 2011 identified 17 loggerhead sea turtles.

During the first phase of the 3D seismic survey carried out by Tullow in May-June 2012, loggerhead turtles were seen on 2 occasions, both times in water depths of ~1,500 m and both being detected at approximately 25 m from the beam of the vessel (*RPS, 2012*). There are also reports of loggerhead turtle nests in the Bay of Tanit, from observations made in 1994 (*Arvy et al, 2000*). The bay of Tanit is located approximately 65 km from Nouakchott and 55 km from the proposed pipeline landfall.

Loggerhead turtles are carnivorous, with adults largely feeding on benthic species and juveniles and sub-adults feeding on pelagic species. Known distribution in West Africa is shown in *Figure 4.30.*

Major nesting areas of loggerhead turtles are more than 55km from the proposed Project location and proposed pipeline landfall and should not be impacted by the Project activities.

Hawksbill sea turtle

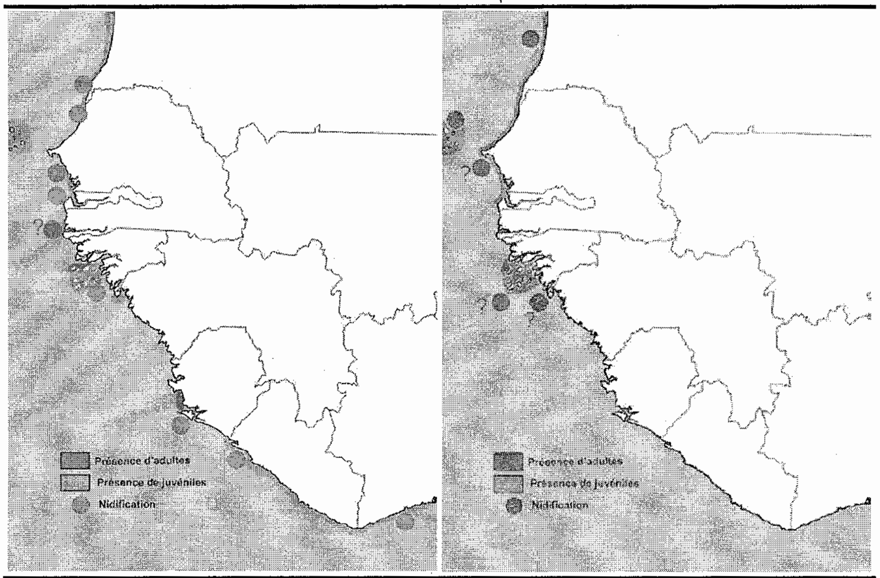
The Hawksbill sea turtle *(Eretmochelys imbricate)* is rare on the Mauritanian coast. It is unlikely that this turtle would breed in this location (*Fretey, 1987).*

Leatherback Turtle

Dermochelys coriacea is rare in the study area. Numerous observations at sea were reported in the north of Mauritania in the seventies (*Maigret, 1983*). Very little is known about its nesting habits in the region, but the leatherback turtle has been recorded in Mauritania (*Fretey, 1987*). Some studies have identified individuals in Mauritanian waters that nest in America (*Eckert, 1989*). Fishermen have reported that this species lays eggs in August and September (*Fretey, 1990*). Sporadic egg-laying has been reported in the Langue de Barbarie National Park and north of the Banc d'Arguin in the Baie du Lévrier (*Fretey, 1991*).

Adults feed almost exclusively on jellyfish, traveling to cold waters after breeding where prey species are more abundant. Very little is known about the distribution of juveniles, although they are likely to remain in relatively coastal waters until they mature into sub-adults.

Figure 4.30 ***Known Presence of Green Turtles and Loggerhead Turtles in West Africa***



Green Turtle | Loggerhead Turtle

Source: *Fretey, 2012*

Olive Ridley Turtle

There are reports of Olive ridley turtles (*Lepidochelys olivacea)* being observed in the 1950s in Nouadhibou; however it is probable that Senegal constitutes the northern limit for the breeding range of this species (*Maigret, 1983*). Records of shells beached in Mauritania confirm that the species is present in Mauritanian waters.

Six observations of olive ridley turtles were reported by observers on board the seismic vessel during the 2D seismic study carried out by Tullow in June-July 2011. During the 3D seismic study carried out in May-June 2012 a single olive ridley turtle was recorded.

Kemp's Ridley Turtle

Kemp's ridley turtle breeds in the Gulf of Mexico and its core range is within the Gulf of Mexico and the south eastern coast of the USA. However vagrant individuals are sometimes found on the shores of the Atlantic Ocean. The presence of this species in Mauritanian waters is confirmed by sporadic findings of shells.

Table 4.5 Marine Turtle Species Identified in the Project Area - Sightings Recorded during Seismic Surveys in Nearby Block C2

Classification on the IUCN Red List	Species	Common name	2D survey		Ph1 - 3D survey		Ph2 - 3D survey		Presence within the Project area
			Sightings	Animals	Sightings	Animals	Sightings	Animals	
Critically Endangered	*Dermochelys coriacea*	Leatherback sea turtle							Possible
	Eretmochelys imbricate	Hawksbill sea turtle							Unlikely
Endangered	*Chelonia mydas*	Green sea turtle							Possible
	Caretta caretta	Loggerhead sea turtle	15	17	2	2	1	1	Possible
Vulnerable	*Lepidochelys olivacea*	Olive ridley sea turtle	6	6	1	1			Possible
		Unidentified species observed by MMOs	*38*	*41*	*8*	*8*	*5*	*5*	

Source: *ERM interpretation of IUCN, 2011; RPS Energy, 2011 and RPS, 2012.*

Summary

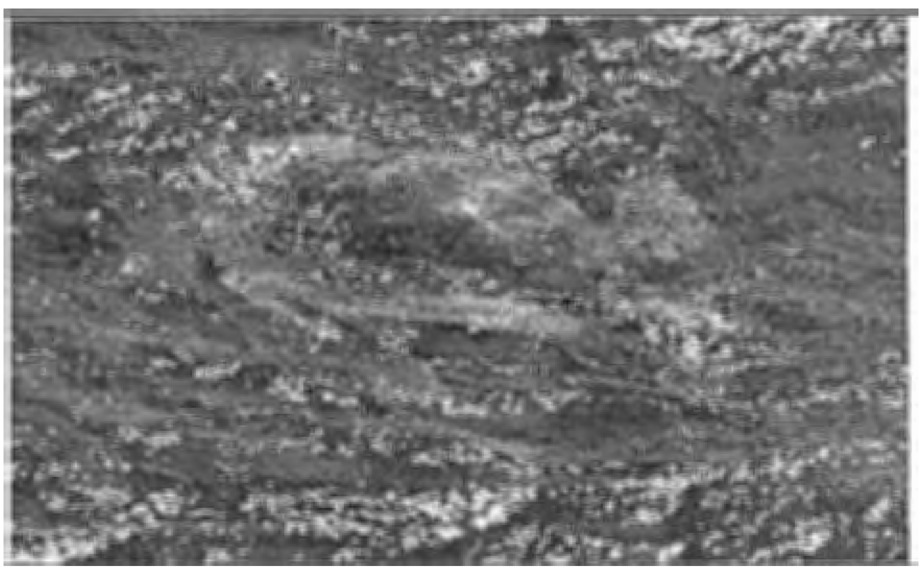
It is important to note that the rainy season, which extends from June to October is the most sensitive time for marine turtles. The months of July and August in particular correspond to peak nesting times

Major nesting areas of loggerhead and green turtles are located more than 55 km away from the proposed landfall and should not be impacted by the Project activities.

Figure 4.31 ***Green Turtle Recorded within the Licence Area during the 3D Seismic Study of Nearby Block 2***

Source: *RPS (2012)*

Figure 4.32 ***Olive Ridley Turtle Recorded within the Licence Area During the 3D Seismic Study of Nearby Block 2***



Source: *RPS, 2012*

4.5 *TERRESTRIAL ECOLOGY*

4.5.1 *Methodology and Sources of Data*

Considering the limited data available, the terrestrial ecology baseline is mainly based on data collected during two visits undertaken by ERM:

- one initial scoping site visit (including fauna and flora investigations on 9-13 July 2012);
- a biodiversity survey undertaken on 6-9 November 2012.

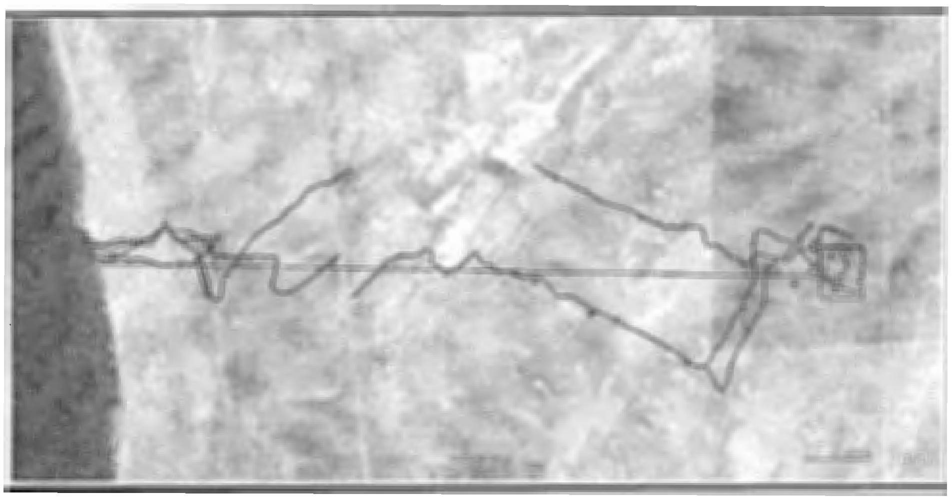
During these two surveys, most of the proposed pipeline route, the gas plant location and the surrounding environment have been covered, allowing to present a representative assessment of the issues related with fauna and flora.

In addition, this study includes a compilation of the results of an avifauna inventory, undertaken during the 3D seismic study of the nearby Block 2 in May-June 2012 (*RPS, 2012*). Even though the Project is not directly located within Block 2, the species inventoried during this survey have been taken into account, as all these pelagic species are considered to be potentially located into Project area because of their migratory status.
The assessment of onshore natural habitats was based on a preliminary analysis of satellite imagery; this pre-mapping has been verified during the field visits, in order to obtain a precise land cover map and a good description of the representative vegetation of each habitat.

The assessment of flora took place over 30 vegetation plots (*Figure 4.33*), representative of the various natural habitats encountered within and around the Project footprint. Flora species have been identified on the field or brought back for further identification.

The assessment of the fauna has been realized on the same time that habitats and vegetation; every animal encountered during the field visits has been recorded; the identification has been done directly on the field (most of the species) or latter using photographic logs. With regards to seabirds, the beach area has been monitored during the breading season (July field visit) and the migration season (November field visit).

Figure 4.33 ***Monitoring Tracks and Vegetation Plots***



4.5.2 *Natural Habitats*

General Context

The terrestrial study area presents different abiotic characteristics influencing the characteristics of natural habitats, in particular:

- soil salinity and exposure to sea-spray; and
- the mobility of the soil substract.

The biodiversity surveys has allowed to identify seven different habitats within the onshore study area. The localisation of these habitats on for the local study area (1 km buffer) and the regional study area (5 km buffer) is presented on the *Figure 4.34* and *Figure 4.35*and. The *Table 4.6* below presents the cover surface of each habitat into the 1 km and 5 km study areas.

Table 4.6 ***Land Cover Surface***

Type of habitat	Cover surface (ha) – Project footprint	Cover surface (ha) – 1 km study area	Cover surface (ha) – 5 km study area
Foreshore	0,3	11,2	50,3
Coastal shifting dunes	3,6	135,0	732,5
Temporarily flooded area (excepted Sebkha)	1,5	176,1	512,4
Sebkha	4,2	73,0	101,8
Bare soil with Zygophyllum	9,0	440,9	4335,9
Open low shrubs with Euphorbia	11,8	395,0	1235,7
Inland dunes	10,6	160,5	3090,8
Roads	0,2	8,6	43,8
Other anthropized areas	-	-	132,2

Figure 4.34 Land Cover in the Local Study Area (1 km)

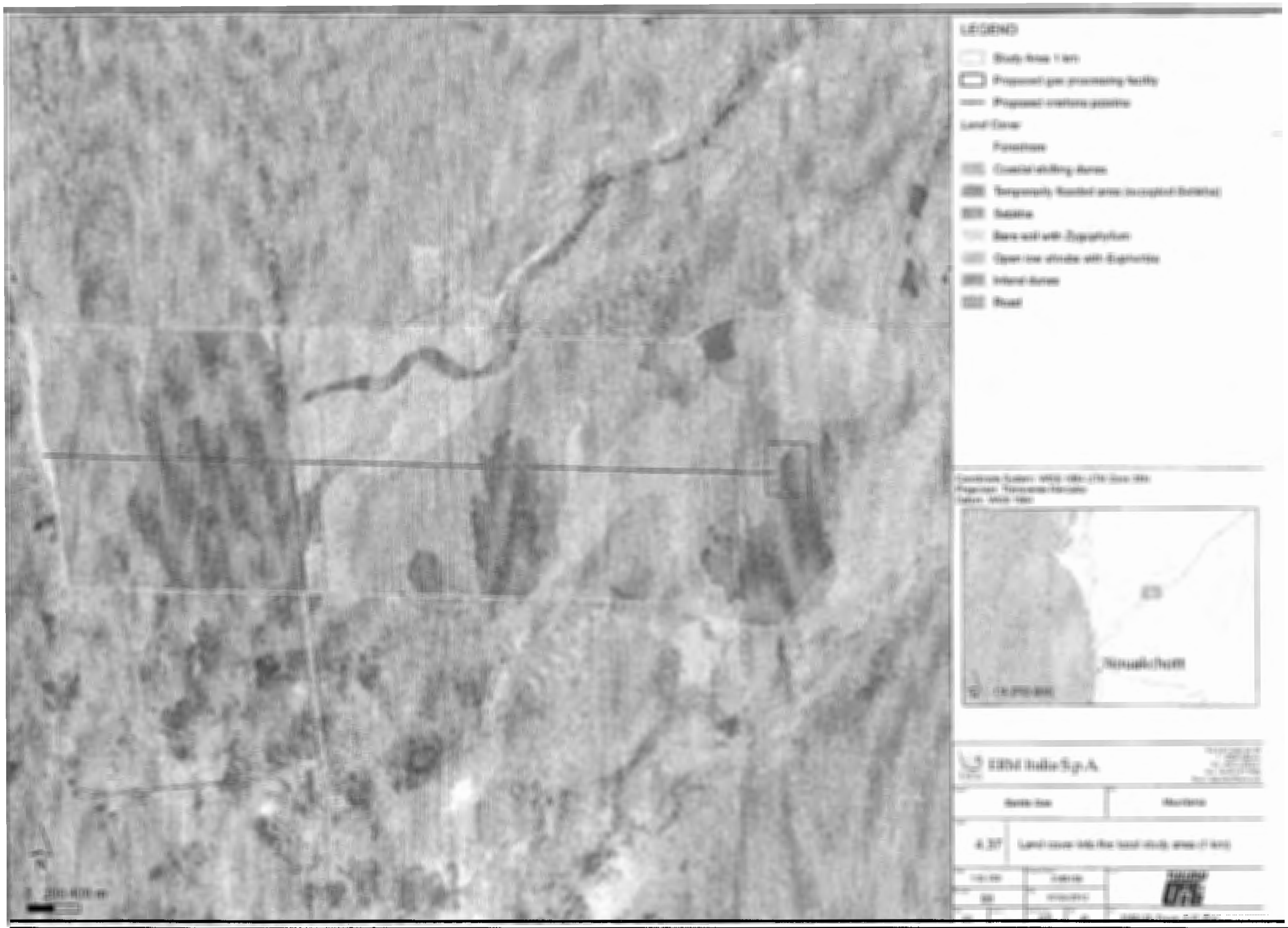
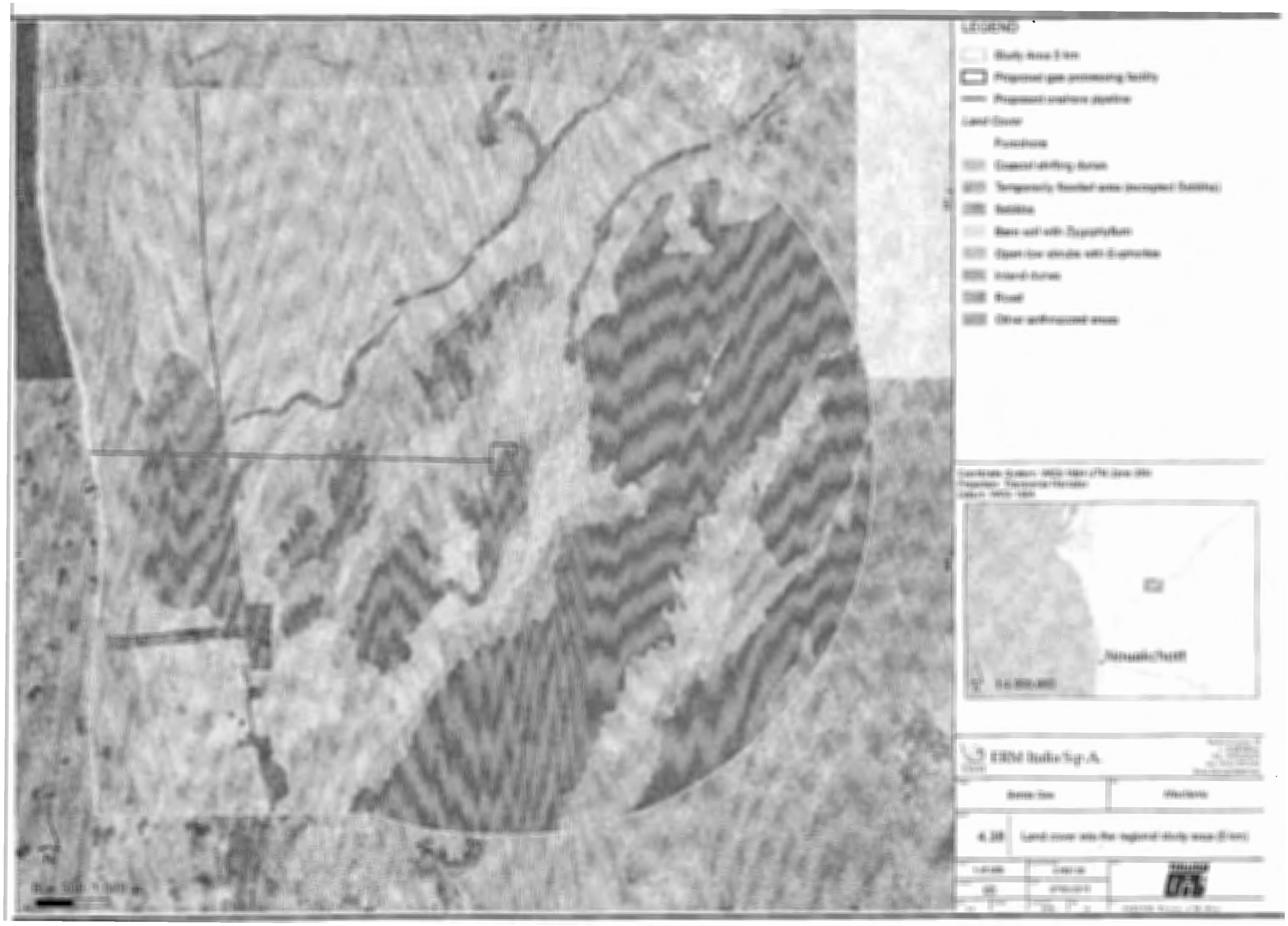


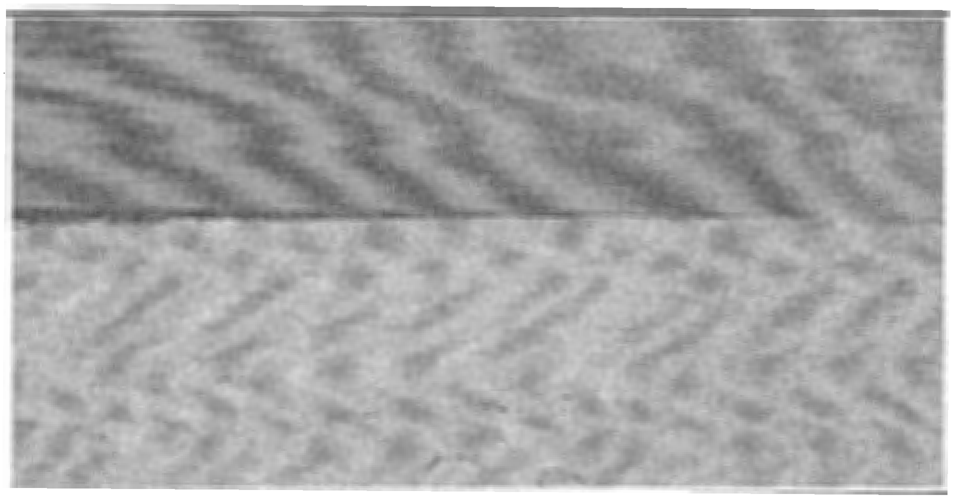
Figure 4.35 Land Cover in the Regional Study Area (5 km)



Foreshore

The beach corresponds to the area delimitated by the highest tides; there is very scarce vegetation, and the main living species using this habitats are seabirds, some molluscs and some small mammals (rodents and small carnivores).

Figure 4.36 Foreshore from the Landfall Site



Coastal Shifting Dunes

This habitat directly subject to sea spray is mainly populated by salt-tolerant species, such as *Zygophyllum fontanesii and Calotropis procera* (*Figure 4.37*). The substratum is loose and mobile, and exposed to sea spray.

Sebkha

The sebkha, behind the dunes, becomes seasonally flooded with salty water in August-September (depending on rainfalls) , and the substratum presents high salinity and humidity. In these conditions the flora is poorly developed, and is mainly represented by herbaceous plants resisting to high salt-conditions (*Figure 4.38*).

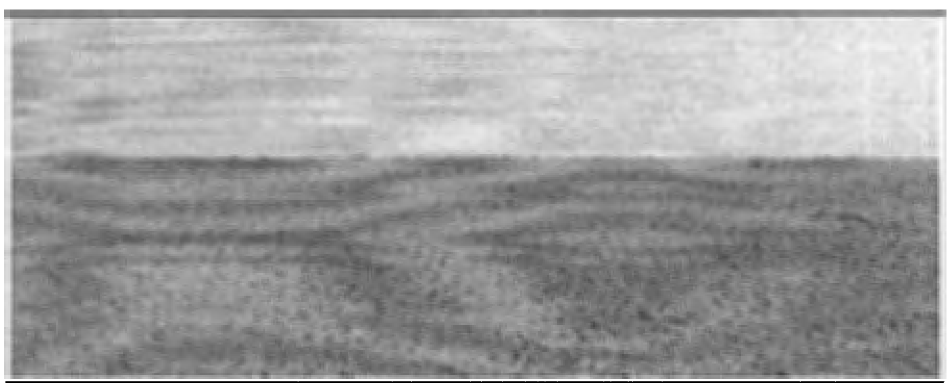
In the study area, the main sebkha is located on the South close to the pipeline route; historically, it communicated with the Great Sebkha of Ndramcha, but the construction of the main sealed road between Nouakchott and Nouadhibou seems to disrupt the flows between these two areas.

Figure 4.37 ***Coastal Dune with Zygophyllum fontanesii and Calotropis procera***

Zygophyllum fontanesii

Calotropis procera

Figure 4.38 ***Sebkha***



Temporarily Flooded Area (except Sebkha)

Some areas around the sebkha are only very temporarily flooded seasonally, and present some significant differences with the sebkha, essentially:

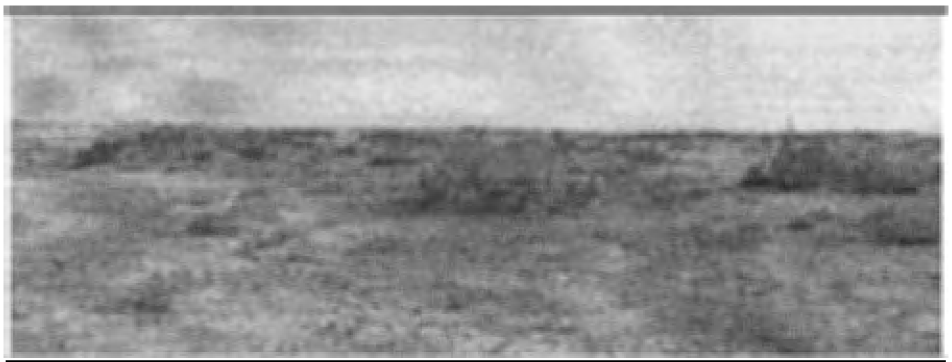
- transitions areas with the dunes and/or open shrubs habitats around the sebkha; or

- temporar flow stream in direction of the Great Sebkha of Ndramcha.

The second configuration can be visualized on the *Figure 4.35*, where the temporarily flooded areas (excepted sebkha) are orientated from South-west to North-east.

The vegetation is composed by the same species that the ones encountered on the sebkhas and on the dunes and is mainly represented by salt-tolerant and water-tolerant species, including *Zygophyllum fontanesii* and species such as *Nitraria retusa,* mainly found in the slightly higher areas, where soil salinity and humidity levels are more favourable (*Figure 4.39*).

Figure 4.39 ***Temporarily Flooded Area***



Bare Soil with Zygophyllum

This natural habitat is mainly developed on a calcareous substratum with high drainage capacity; the sparse vegetation is mainly composed by *Zygophyllum fontanesii*; some acacias (*Acacia sp.*) are also present. In the areas close to the road, this natural habitat is in a poor state of conservation, due to the local gravel mining activities for construction (*Figure 4.40*).

Figure 4.40 ***Bare Soil with Zygophyllum***

Open Low Shrubs with Euphorbia

This habitat is mainly composed by fixed back dunes, and is developed on compacted sand associated with shells. The soil of the areas covered by shells is more compact and hosts burrows of small mammals. The flora is mainly represented by *Euphorbia balsamifera* (cf. *Figure 4.41*), as well as by some shrubs of *Acacia sp.* and *Salvadora persica*.

Figure 4.41 **Dune with *Euphorbia balsamifera***

Inland Dunes

The back dunes, fixed and farther from the sea, present a loose substrate explaining a low vegetation cover; flora is mainly represented by *Calotropis procera* and *Euphorbia balsamifera* (*Figure 4.42*); a very limited number of herbaceous plants like *Cyperus conglomeratus* were observed.

Figure 4.42 ***Inland Dune***

Shrubs

Some shrubs are occasionally found into the Project area. The trees of this habitat are used by an important number of birds during breeding season for nesting. This habitat is considered as of moderate sensitivity into the study area.

This habitat has not been mapped because of its much reduced size.

Reforestation Project

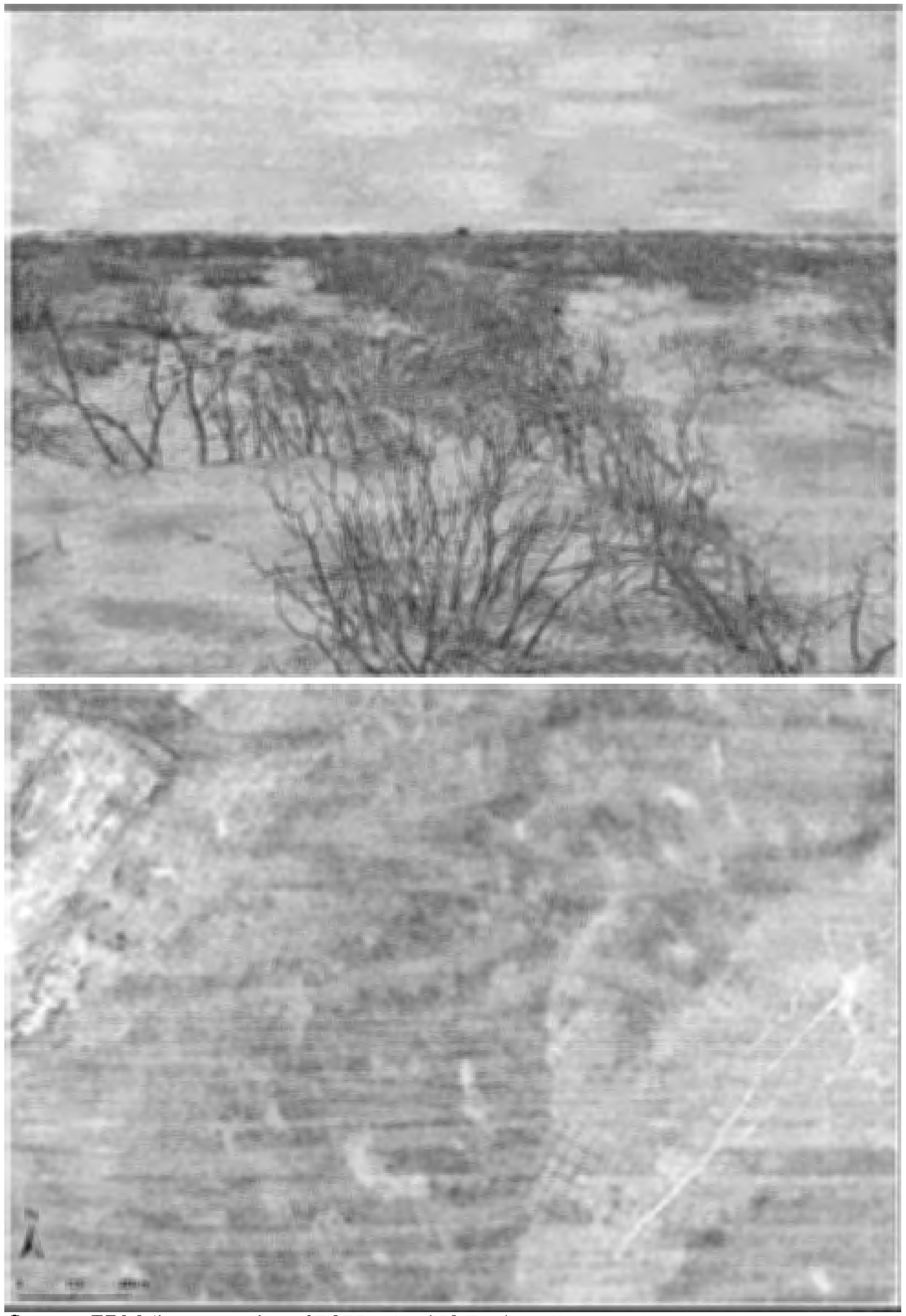
Two of these habitats are concerned by a reforestation project; this project is managed by the Mauritanian Authorities and concerns an area of 334.8 ha and of 725 ha into the 1 km and 5 km study areas. This project consists in planting a red of hedges of *Euphorbia balsamifera* (*Figure 4.43*) in order to fix the dunes; the planted areas are fenced.

The *Figure 4.44* shows the location of the concerned areas, and the detail of the surfaces of habitats concerned by the reforestation is presented on *Table 4.7*.

Table 4.7 Habitats Concerned by the Reforestation Project in the Study Area

	Within the Project footprint	Within a 1 km radius	Within a 5 km radius
Reforested areas	23,2 ha	334,8 ha	725,0 ha

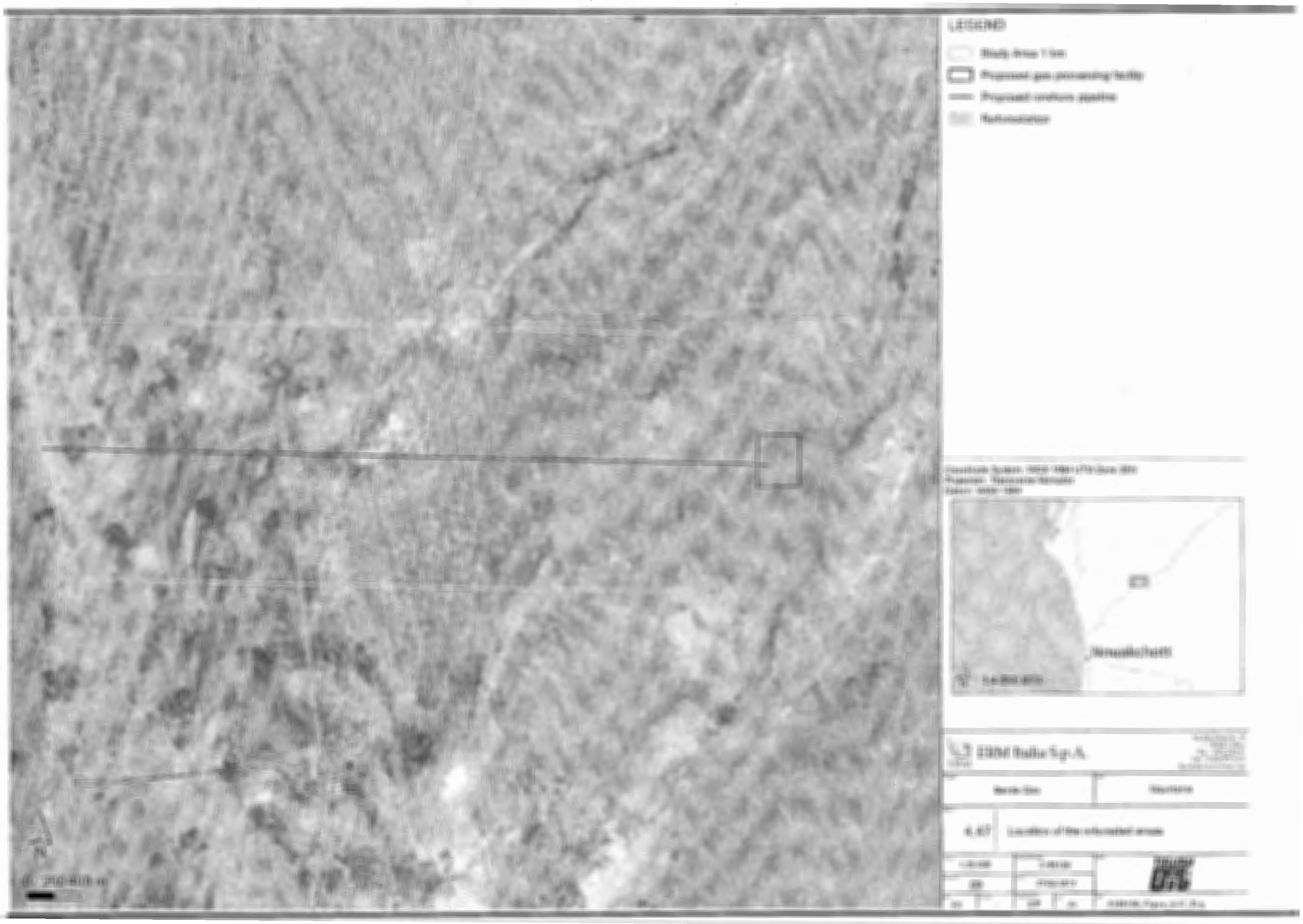
Figure 4.43 Example of Hedges of Euphorbia balsamifera and Satellite View of the Hedges



Source: *ERM (interpretation of ESRI – ArcGIS Explorer Basemaps)*

Note: green doted lines were added on the pictures to highlight the structure of the hedges.

Figure 4.44 Location of the reforested areas



4.5.3 *Terrestrial Flora*

The location of the vegetation is influenced by three main parameters: water, temperature and light. On the desert areas, the high temperatures associated can explain the low diversity of flora (compared to the other kind of climates and biogeographic regions); in Mauritania, about 360 different species have been inventoried (*Ozenda, 1991*). In the local study area, 14 species from 10 different families were identified (*Table 4.8*).

Table 4.8 ***Results of the Flora Survey***

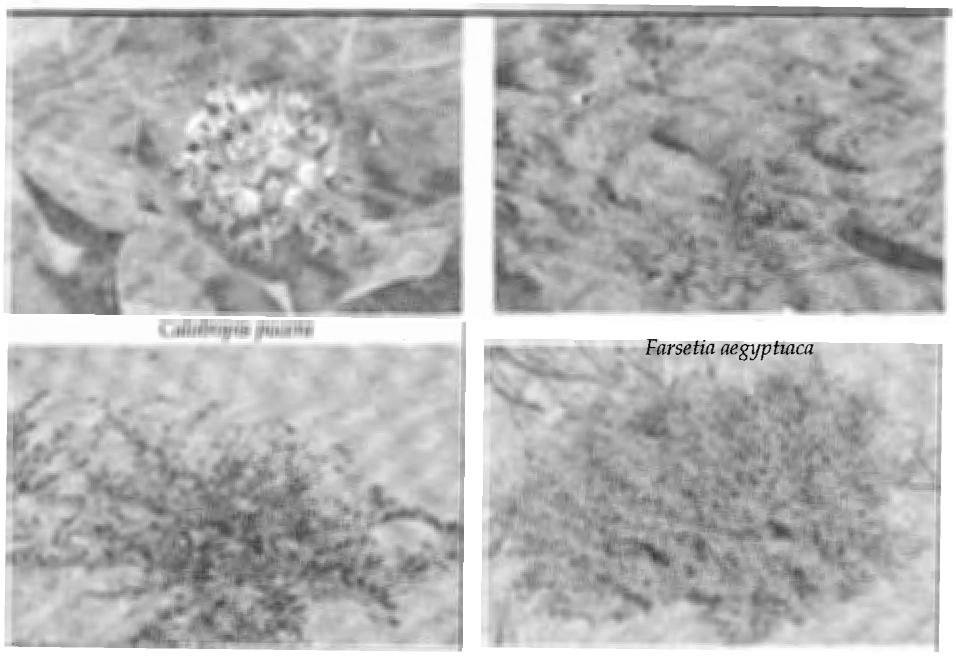
Family	Scientific name	Common name	Particularities	IUCN status	Protected species (1)
Asclepiadaceae	Calotropis procera	Apple of Sodom	-	NA	-
Asparagaceae	Asparagus altissimus Munby	Asparagus	Only on the coastal dunes	NA	-
Asteraceae	Filago spathulata	Broad-leaved Cudweed	-	NA	-
Boraginaceae	Heliotropium ramosissimum	-	-	NA	-
Brassicaceae	Farsetia aegyptiaca	-	-	NA	-
	Morettia canescens	-	-	NA	-
Cyperaceae	Cyperus conglomeratus	-	Mainly in dunes and sandy habitats	LC	-
Fabaceae	Acacia sp.	-	-	NA	-
	Acacia tortilis	Umbrella Thorn Acacia	-	NA	
Graminacaea	Chloris prieurii	-	-	NA	-
Salvadoraceae	Salvadora persica	Mustard tree	-	NA	-
Zygophyllaceae	Nitraria retusa	-	Salt-tolerant	NA	-
	Zygophyllum fontanesii	-	-	NA	
	Zygophyllum simplex	-	-	NA	-

IUCN status: LC = Least concern; NA = Not assessed by the IUCN Red List

None of the flora species are protected by the Mauritanian legislation, and 14 of the species are not assessed by the IUCN; the only assessed specie is considered as "least concerned".

(1) Décret n° 83-159 bis portant protection de certaines espèces herbacées.

Figure 4.45 ***Flora Inventoried in the Study Area***



Farsetia aegyptiaca

Heliotropium ramosissimum *Zygophyllum simplex*

4.5.4 *Terrestrial Fauna*

Birds (including Seabirds)

More than 500 species of birds are present in Mauritania, including about 150 breeding species. The study area is located into the transition zone between the Palearctic and the Afrotropics, and birds from both zones are able to breed around the Project area (*Isenmann, 2010*).

The west coast of Africa forms an important section of the East Atlantic Flyway, an internationally important migration route for a range of bird species, especially shore birds and seabirds (*Boere et al, 2006; Flegg, 2004*). A number of species that breed in higher northern latitudes winter along the West African coast and many fly along the coast on migration. Seabirds known to follow this migration route include a number of tern species (*Sterna spp*), skuas (*Stercorarius* and *Catharacta spp*) and petrels (Hydrobatidae).

The distance of the migration routes of these species from the shore depends on prey distribution and availability, such as the abundance and distribution of shoals of anchovies or sardines (*Flegg, 2004*). The highest concentrations of seabirds are experienced during the spring and autumn migrations, around March and April, and September and October. Waders are present during the winter months between October and March. Species of waders known to migrate along the flyway include sanderling (*Calidris alba*) and knott (*Calidris canuta*).

The coastal areas of Mauritania, and particularly the Senegal delta, hosts a very large number of seasonally migrating birds. The protected areas An Important Bird Area (IBA), identified by Birdlife International has been identified 11 km south of the proposed gas processing facility (see *Section 4.6*).

Three species of bird, known to live or stay during the course of their migration in the Mauritanian marine environment, are considered as Near Threatened (NT) according to the IUCN Red List. These are the Audouin's gull (*Ichthyaetus audouinii*), the black-tailed godwit (*Limosa limosa*) and the lesser flamingo (*Phoeniconaias minor*). These three species are mainly found on the Mauritanian coast between October and March, but have not been monitored during the November biodiversity survey on the terrestrial part of the study area.

In addition to coastal birds, the study area supports a number of migratory pelagic seabirds. A number of bird species were recorded during the 3D seismic study of the nearby Block 2 during May-June 2012 (*RPS 2012 - Table 4.9)*.

Seabirds have also been monitored on the shore and on the beach during the terrestrial biodiversity surveys. Most of the species have been monitored during the July site visit, and there seem to use the coast as resting area and feeding area; no nesting or feeding youth have been observed while the scoping visit, and we can assume there is no breeding colony of seabirds within the study area. During the November visit, the seabirds inventoried were mostly migratory birds.

Desert birds, such as *Alaemon alaudipes* and *Eremopterix nigriceps*, have been identified on the dunes and the sandy areas; these species are common within the study area.

Other species non-specific of deserts and arid areas have also been identified, mainly on bushes and dense shrubs. These species are for example the *Merops persicus*, which presence is due to small sand quarries localised around the study area and which present favourable habitats for the specie. These species are presented in *Table 4.9*.

Table 4.9 ***Seabird Species Recorded During the 3D Seismic Survey of the Nearby Block 2 in May-June 2012***

Scientific name	English name	Habitat/ localization	Status on the study area	Protected species	IUCN Status
Alaemon alaudipes	Greater Hoopoe-lark	Dunes	Resident	No	LC
Calidris alba	Sanderling	Foreshore and seaside	Migratory/wintering	No	LC
Calonectris diomedea	Cory's shearwater	Offshore area (pelagic bird)	Migratory	No	LC
Caprimulgus eximius	Golden Nightjar	Onshore habitats	Wintering	No	LC

Scientific name	English name	Habitat/ localization	Status on the study area	Protected species	IUCN Status
Chlidonias niger	Black tern	Offshore area (pelagic bird) Foreshore and seaside	Migratory/wintering Feeding/resting area	No	LC
Corvus ruficollis	Brown-necked Raven	All	Resident	No	LC
Eremopterix nigriceps	Black-crowned Sparrow-lark	All, particularly shrubs	Resident or breeding	No	LC
Gelochelidon nilotica	Gull-billed Tern	Foreshore and seaside	Feeding/resting area	No	LC
Hydrobates pelagicus	European storm petrel	Offshore area (pelagic bird)	Migratory	No	LC
Hydroprogne caspia	Caspian Tern	Foreshore and seaside	Migratory/wintering Feeding/resting area	No	LC
Lanius excubitor	Great Grey Shrike	Onshore habitats	Resident	No	LC
Lanius senator	Woodchat Shrike	Onshore habitats	Migratory	No	LC
Merops persicus	Blue-cheeked Bee-eater	All	Resident or breeding	No	LC
Morus bassanus	Northern gannet	Offshore area (pelagic bird)	Migratory	No	LC
Oceanites oceanicus	Wilson's storm petrel	Offshore area (pelagic bird)	Migratory	No	LC
Oceanodroma castro	Maderian storm petrel	Offshore area (pelagic bird)	Migratory	No	LC
Oena capensis	Namaqua Dove	All, particularly shrubs	Resident or breeding	No	LC
Passer luteus	Sudan Golden Sparrow	Shrubs	Resident	No	LC
Pelacanus onocrotalus	Great white pelican	Offshore area (pelagic bird) Seaside	Migratory	No	LC
Puffinus griseus	Sooty shearwater	Offshore area (pelagic bird)	Migratory	No	NT
Stercorarius parasiticus	Arctic skua	Offshore area (pelagic bird)	Migratory	No	LC
Stercorarius pomarinus	Pomerine skua	Offshore area (pelagic bird)	Migratory	No	LC
Stercorarius skua	Great skua	Offshore area (pelagic bird)	Migratory	No	LC
Sterna albifrons	Little tern	Offshore area (pelagic bird)	Migratory	No	LC
Sterna hirundo	Common tern	Offshore area (pelagic bird)	Migratory	No	LC
Sterna maxima	Royal tern	Offshore area (pelagic bird) Foreshore and seaside	Migratory Feeding/resting area	No	LC
Sterna paradisaea	Arctic tern	Offshore area (pelagic bird) Foreshore and seaside	Migratory Feeding/resting area	No	LC
Sterna sandvicensis	Sandwich Tern	Foreshore and seaside	Migratory/Wintering Feeding/resting area	No	LC
Sterna sp.	Tern sp.	Offshore area (pelagic bird)	Migratory	No	-
Streptopelia	Laughing	All, particularly shrubs	Resident	Partially	LC

Scientific name	English name	Habitat/ localization	Status on the study area	Protected species	IUCN Status
senegalensis	Dove				
Urocolius macrourus	Blue-naped Mousebird	Shrubs	Breeding	No	LC
Xema sabini	Sabine's gull	Offshore area (pelagic bird)	Migratory	No	LC

IUCN status: LC=Least Concern; NT=Near Theatened; "-"=Not assessed

Almost all of the birds recorded were species categorised as Least Concern by IUCN. The only species with a higher conservation status recorded during the study was sooty shearwater, categorised as Near Threatened by IUCN.

These species have different status into the study area:

- Migratory species: birds (for ex: great white pelican -*Figure 4.46*) only present during the migratory periods (between March and April, and September and October) on the study area.

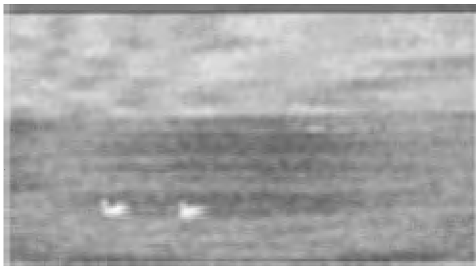
- Feeding/resting: species (e.g. Caspian tern - *Figure 4.46*) using the seaside and the beach area to feed and rest, during summer (no reproduction). An overview of the characteristics of the study area did not show any particularity, and we can consider that these species are also present on other parts of the Mauritanian seaside and that the study area does not represent important feeding/resting area for the conservation of these species.

- Wintering species: regarding the period of the biodiversity survey (November), it is sometimes not possible to determine if some species are migratory or wintering (for ex: Golden Nightjar - cf. *Figure 4.46*). In both cases, the area does not present specific characteristics, and we can consider that these species are also present on other parts of the Mauritanian seaside and that the study area does not represent important wintering area for the conservation of these species.

- Breeding and resident species: these species (for ex: Blue-cheeked Bee-eater, Blue-naped Mousebird or Namaqua Dove - cf. *Figure 4.46*) are mainly onshore bird and there are not specific to the onshore habitats present into the study area; these habitats do not represent important area for the conservation of these species; however, the shrubs are used by an important diversity of birds, and represent an interest for the biodiversity into the study area.

There are 24 Important Bird Areas (IBAs) identified by Birdlife International within Mauritania (*Birdlife International, 2012*). The coastal IBAs are described in *Section 4.6*.

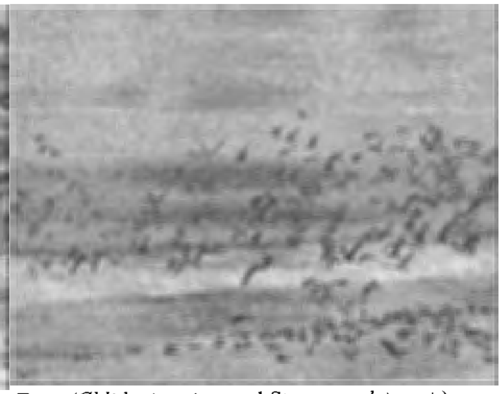
Figure 4.46 ***Birds Observed during the Biodiversity Survey***



Pelecanus onocrotalus

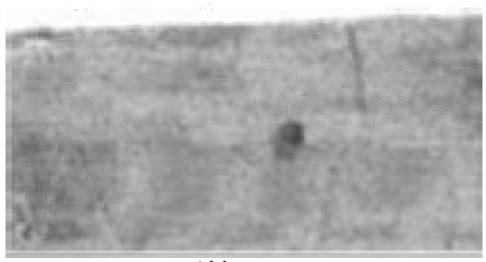
Hydroprogne caspia

Caprimulgus eximius



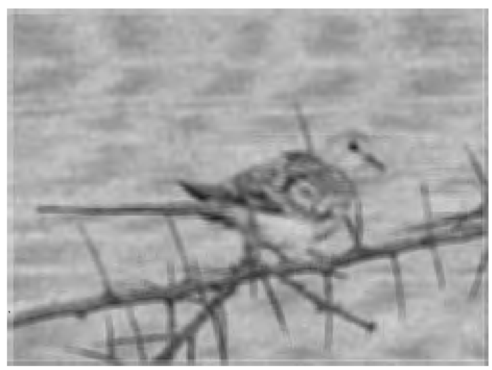
Terns (*Chlidonias niger* and *Sterna sandvicensis*)

Merops persicus (couple)



Nest of *Merops persicus*

Urocolius macrourus



Oena capensis

Reptiles

This class is mainly represented by lizards; signs of snakes have also been identified during the biodiversity surveys without any possibility to define what species it was. The reptiles are essentially present within the dunes and the highest points of the sebkha. The list of the species identified into the local study area (1 km) and their protected status and vulnerability (IUCN status) are presented at *Table 4.10*. Four different species of *Acanthodactylus* (*Figure 4.47*) have been surveyed; none of these species have been assessed by the IUCN. A track of Varanus sp. has also been encountered, but it has not been possible to identify the species. The IUCN distribution data also mentions the potential localization of three other species of reptiles; their vulnerability status from IUCN is least concern.

Table 4.10 Reptiles Identified in the Study Area

Scientific Name	Status on site	Protected species	IUCN Status
Acanthodactylus aureus	Present	No	-
Acanthodactylus boskianus asper	Present	No	-
Acanthodactylus longipes	Present	No	-
Acanthodactylus senegalensis	Present	No	-
Agama boueti	Potential	No	LC
Cerastes vipera	Potential	No	LC
Chalcides sphenopsiformis	Potential	No	LC
Varanus sp.	Present	No	-

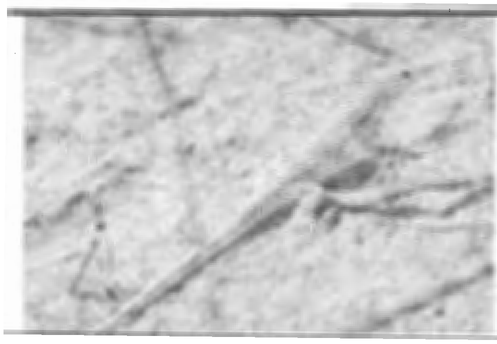
IUCN status: LC=Least Concern; "-"=Not assessed

Mammals

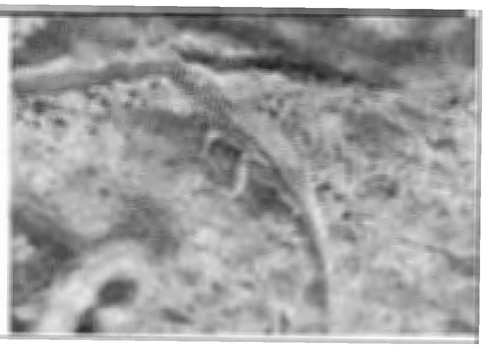
The mammals typical of desert areas are discreet and most of the species are nocturnal; their observation is difficult, and the best way for identification is to look at the tracks.

The biodiversity survey permitted to identify the species of mammals using the Project area as habitat; a list is presented at the *Table 4.11*. This table also presents the potential threatened mammals based on the distribution data from IUCN, to define the potential species localized into the study area; 24 species have been identified as potentially present, and three of these species have been identified during the biodiversity survey. Only one species is considered as near threatened by IUCN, but the probability of presence in the study area is consider as very low.

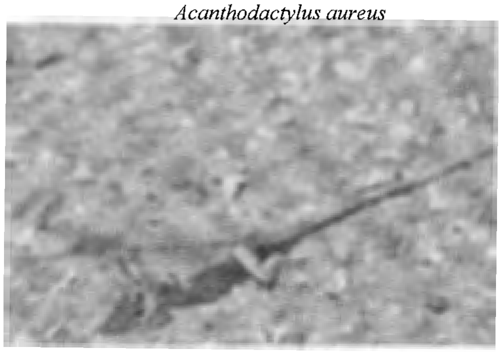
Figure 4.47 Species of Acanthodactylus Obersved in the Study Area



Acanthodactylus aureus



Acanthodactylus boskianus asper



Acanthodactylus longipes

Acanthodactylus senegalensis

Table 4.11 Mammals Identified in the Study Area

Scientific name	Common Name	Status on site	Protected status	IUCN status
Asellia tridens	Geoffroy's Trident Leaf-nosed Bat	Potential	No	LC
Canis aureus	Golden Jackal	Present	No	LC
Crocidura lusitania	Mauritanian Shrew	Potential	No	LC
Crocidura viaria	Savanna Path Shrew	Potential	No	LC
Desmodilliscus braueri	Pouched Gerbil	Potential	No	LC
Felis silvestris	Wild Cat	Potential	No	LC
Genetta genetta	Common Genet	Present	No	LC
Gerbillus gerbillus	Lesser Egyptian Gerbil	Potential	No	LC
Gerbillus nanus	Dwarf Gerbil	Potential	No	LC
Gerbillus nigeriae	Nigerian Gerbil	Potential	No	LC
Gerbillus tarabuli	Tarabul's Gerbil	Potential	No	LC
Hyaena hyaena	Striped Hyena	Potential	No	NT
Ictonyx libyca	Libyan Striped Weasel	Potential	No	LC
Lepus capensis	Arabian hare	Present	Partially Protected	LC
Lepus microtis	African Savanna Hare	Potential	Partially Protected	LC
Mellivora capensis	Honey Badger	Potential	No	LC
Procavia capensis	Rock Hyrax	Potential	No	LC
Psammomys obesus	Fat Sand Rat	Potential	No	LC

Scientific name	Common Name	Status on site	Protected status	IUCN status
Rhinopoma microphyllum	Greater Mouse-tailed Bat	Potential	No	LC
Taterillus arenarius	Robbins's Tateril	Potential	No	LC
Vulpes pallida	Pale Fox	Potential	No	LC
Vulpes rueppellii	Rüppel's Fox	Potential	No	LC
Vulpes zerda	Fennec fox	Potential	No	LC
Xerus erythropus	Striped Ground Squirrel	Potential	No	LC

IUCN status: LC=Least Concern; NT=Near Threatened; "-"=Not assessed

Figure 4.48 *Arabian Hare*

Domestic species such as camels are also present.

Figure 4.49 *Dromedaries*

4.6 *PROTECTED AREAS FOR NATURE CONSERVATION*

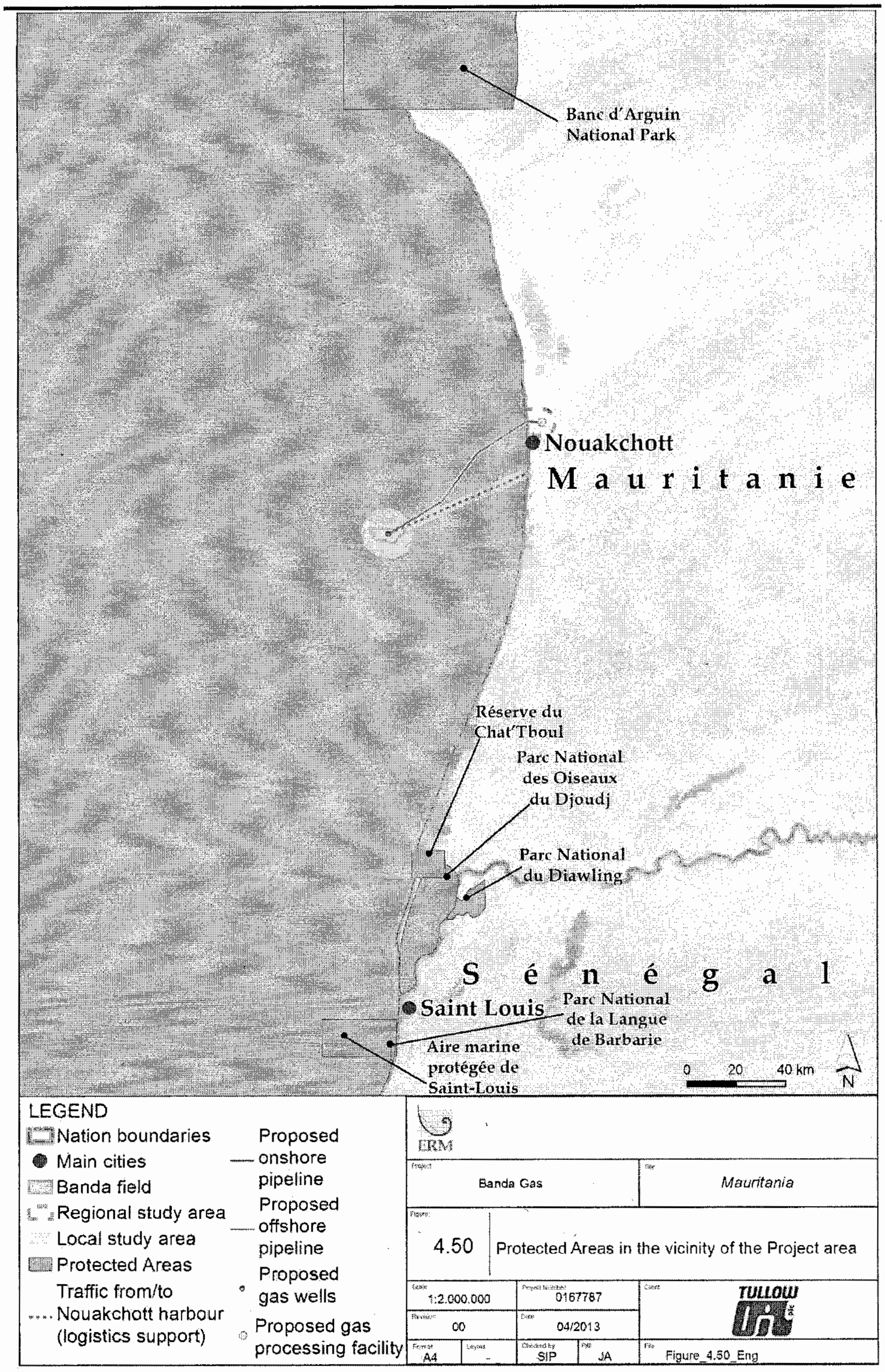
No protected areas are present within a 100 km radius around the Project footprint.

Further away, the following protected areas have been identified and shown on *Figure 4.50*:

- the Chat'Tboul Nature Reserve (Biosphere Reserve, Ramsar Site, Important Bird Area) located approximately 180 km to the south of the proposed gas processing facility;
- the Diawling National Park (Biosphere Reserve, Ramsar Site, Important Bird Area) located approximately 185 km to the south of the proposed gas processing facility; and
- the Banc d'Arguin National Park (World Heritage, Ramsar Site, Important Bird Area) located 130 km to the north of the proposed gas processing facility.

An Important Bird Area (IBA) classified by the NGO Birdlife, is located 11 km south of the proposed gas processing facility. This IBA named "Aftout es Saheli" is a narrow coastal lagoon that extends from just south of Nouakchott for 165 km to finish some 60 km north of St Louis in Senegal. This Important Bird Area has no Protected Area status on a national level.

Figure 4.50 Protected Areas in the Vicinity of the Project Area



4.7 *FISH AND FISHERIES*

4.7.1 *Introduction*

This section provides a baseline description of fish and fisheries in Mauritania and in the Project area. It describes the species classified as threatened by the IUCN Red List and information on the industrial, artisanal and coastal fishing fleets and supporting infrastructure as well as fish landing data for Mauritania.

It has been documented with international and national literature along with the results of the field survey which was conducted from 9 to 19 July 2012 and is further described in *Section4.9*

4.7.2 *Fish*

699 species of marine fish are listed for Mauritania by FishBase (*Fishbase, 2011*); 38 of these species are classified as threatened on the IUCN Red List (IUCN, 2012) and are presented in *Table 4.12*. Six have a critical status (CR), 10 are endangered (EN) and 22 are vulnerable (VU). 315 species are potentially fished commercially (*Fishbase, 2011*).

4.7.3 *Overview of Mauritanian Fishing Sector*

Economic Importance

Mauritania has an Exclusive Economic Zone (EEZ) of 234,000 km^2 and its coastal waters are among the richest fishing areas in the world. The fishing sector is one of the key economic sectors of Mauritania and represents about 6 to 10% of the Gross Internal Product (GIP) and 16% of the exports. 16 to 21% of the State's revenue is generated by this sector. 40,000 jobs are directly or indirectly related to the fishing industry, which is approximately 36% of employment in the country (*BID, 2011*).

Despite its economic importance in Mauritania, fishing is not fully developed yet due to historical and traditional reasons but also due to logistics reasons: there is only one harbour suitably equipped to accommodate industrial fishing, Nouadhibou, but its economic development has been hampered due to its remoteness from Nouakchott. Nonetheless, the industry has been developing since the 1980s. The fisheries sector is one of the key strategic development areas of the Mauritanian government.

Industrial and Artisanal Fishing

The Mauritanian fishing fleet is subdivided into two sub-sectors: the industrial fleet and the artisanal and coastal fleet as described in Law 2000-025 of 24th of July 2000 (Article 5) pertaining to the Maritime Fishing Code, modified by Ordinance 2007-022 of 9th of April 2007 and its Application Decree 2002-073 of 1st of October 2002.

Table 4.12 ***Fish Species Listed for Mauritania and Listed on the IUCN Red List***

IUCN Red List Status	Species	Common name	Habitat	Likelihood of presence in the Project area
In critical danger of extinction	*Anguilla anguilla*	European Eel	All types of benthic habitat.	Possible
	Dipturus batis	Blue skate	On the ocean floor between coastal waters and 200 m depth, but in some cases down to 600 m.	Possible
	Pristis pristis	Common sawfish	Species found in moderately deep coastal waters.	Possible
	Squatina aculeata	Sawback angel shark	On muddy ocean floors at depths of between 30 and 500m.	Possible
	Squatina oculata	Smoothback angel shark	On muddy ocean floors at depths of between 50 and 100 m.	Possible
	Pristis pectinata	Smalltooth sawfish	Coastal and intertidal species which sometimes crosses ocean floors to reach islands out at sea.	Possible
Endangered	*Rostroraja alba*	White skate	Lives in sandy and detritus-filled coastal seabeds at depths of between 40 and 400 m.	Possible
	Sphyrna lewini	Scalloped hammerhead shark	Semi-pelagic coastal species living at depths of up to 275 m.	Possible
	Raja undulata	Undulate ray	Lives on sandy and muddy ocean floors, generally in relatively shallow water in the intertidal zone, down to depths of 200 m.	Possible
	Mobula mobular	Devil fish	Epipelagic waters over continental shelves and near oceanic islands.	Possible
	Dasyatis margarita	Daisy stingray	Marine and estuary habitats down to a depth of 60 m.	Possible
	Epinephelus marginatus	Dusky grouper	Rocky ocean floors at depths down to 50m.	Possible on the rocky floors on the pipeline route
	Pagrus pagrus	Red porgy	Commonly found at depths of between 10 and 80 m but sometimes down to 250 m.	Possible
	Rhinobatos cemiculus	Blackchin guitarfish	Lives on sandy and muddy ocean floors, generally in relatively shallow water, down to 100 m.	Possible
	Rhinobatos rhinobatos	Common guitarfish	Lives on sandy and muddy ocean floors, generally in relatively shallow water in the intertidal zone, down to 100 m.	Possible
	Rhynchobatus luebberti	African wedgefish	Lives on sandy and muddy ocean floors, generally in relatively shallow water in the intertidal zone, down to 75 m.	Possible
Vulnerable	*Alopias vulpinus*	Thresher shark	Pelagic species living at depths down to 366 m, mainly out at sea, 40 to 50 miles from the coast.	Unlikely
	Balistes vetula	Queen triggerfish	Species living in rocky or coral reefs, down to depths of 275 m, and generally between 0 and 30 m.	Possible on the rocky floors on the pipeline route
	Carcharhinus longimanus	Oceanic whitetip shark	Species living on the ocean floor at depths of more than 200 m.	Possible in the vicinity of the Drilling Centre

IUCN Red List Status	Species	Common name	Habitat	Likelihood of presence in the Project area
	Carcharhinus plumbeus	Sandbar shark	Coastal species found on sandy and muddy ocean floors, generally in relatively shallow water, down to 280 m. Also found on banks and round islands.	Possible
	Carcharias taurus	Sand tiger shark	Species living in rocky or coral reefs, down to depths of 200 m, and generally between 0 and 25 m.	Possible on the rocky floors on the pipeline route
	Carcharodon carcharias	Great white shark	Pelagic oceanic species that can live at depths down to 1,280 m.	Possible
	Centrophorus granulosus	Gulper shark	Deep sea species found on continental shelves and upper margins, generally at depths of between 200 and 600 m.	Possible in the vicinity of the Drilling Centre
	Centrophorus lusitanicus	Lowfin gulper shark	Deep sea species found on continental shelves and upper margins, generally at depths of between 300 and 600 m and down to 1,400 m.	Unlikely
	Centrophorus squamosus	Leafscale gulper shark	Benthopelagic species found close to the base of continental margins and in the first 1,250 m of depth.	Unlikely
	Galeorhinus galeus	Tope shark	Demersal species living on continental shelves, insular bases and upper margins down to depths of 1,100 m.	Possible
	Gymnura altavela	Spiny butterfly ray	Lives in sea water and brackish water at depths of between 5 and 100 m.	Possible
	Isurus oxyrinchus	Shortfin mako shark	Coastal species living at depths of down to 500 m.	Possible
	Isurus paucus	Longfin mako shark	Epipelagic species living at depths down to 200 m.	Possible
	Mobula rochebrunei	Lesser Guinean devil ray	Species living either on the surface or close to the bottom. Depth preference unknown.	Possible
	Mustelus mustelus	Common smoothhound shark	Coastal demersal species found on continental shelves and upper margins, generally at depths of between 5 and 50 m on sandy or muddy ocean floors and down to 350 m.	Possible
	Oxynotus centrina	Angular rough shark	Lives on external continental shelves and on margins, at depths of between 60 and 660 m.	Possible
	Rhincodon typus	Whale shark	Species migrating between oceanic basins and the coast, at depths of between 0 and 700 m.	Possible
	Rhinobatos albomaculatus	Whitespotted guitarfish	Coastal species living in relatively shallow water down to depths of up to 35 m.	Possible
	Rhinobatos irvinei	Spineback guitarfish	Coastal species living in relatively shallow water down to depths of up to 30 m.	Possible
	Sphyrna zygaena	Smooth hammerhead shark	Pelagic species generally living at depths of between 0 and 20 m and down to 200 m.	Possible
	Thunnus obesus	Bigeye tuna	Pelagic species that migrates extensively and found at depths of between 0 and 250 m.	Possible
	Urogymnus asperrimus	Porcupine ray	Demersal species of the continental shelf, living on the sand and close to reefs.	Possible

Source: *IUCN, 2011; Fishbase, 2011.*

Industrial Fishing

Industrial fishing represents about 80% of the production of the country in quantity and value. 95% of the production is exported and only 10% of the exported production is processed (*EU, 2010*).

Small pelagic species make more than 90% of the catches made by the Mauritanian industrial fishing fleet.

Pelagic industrial fishing is mainly operated by foreign vessels ruled by EU/Mauritania fishing agreements (*Table 4.13*). Mauritania has agreements with EU fishing vessels for pelagic trawling (Lithuania, Latvia, Netherlands, Poland, UK) tuna and crustacean fishing (mostly Spanish vessels). Demersal fishing agreements are used by Spain, mainly for Senegalese hake (*Merluccius senegalensis*).

Table 4.13 ***Number of Recorded Industrial Fishing Vessels Operating in the Mauritanian EEZ***

Nationality	2007	2008	2009	2010
Mauritania	193	116	133	101
Foreign	175	104	156	145
Total	368	220	189	246

Source: *ONS 2010/DEARH/MPEM*

Mauritania also has established fishing agreements with Japan (tuna and octopus), China (mostly small pelagics), the Russian Federation (pelagics), Ukraine and Senegal (the latter for coastal fishing only).

The coastal area is restricted to artisanal and coastal fisheries which generally fish at a maximum depth of 30 m and distance of 6 nautical miles from shore. According to DSPCM (*Délégation à la Surveillance des Pêches et au Contrôle Maritime*), the Marine Authority in charge of fisheries surveillance and sea control and according to the fishing code, the restrictions for industrial fishing are as follows :

- prawn fishing vessels cannot operate within 3 nautical miles of the Mean Low Water level;
- cephalopods fishing vessels cannot operate within 6 nautical miles of the Mean Low Water level; and
- pelagic fishing vessels cannot operate within 12 nautical miles of the Mean Low Water level.

These zones have been moved away from the coast in order to allow the development of artisanal and coastal fishing.

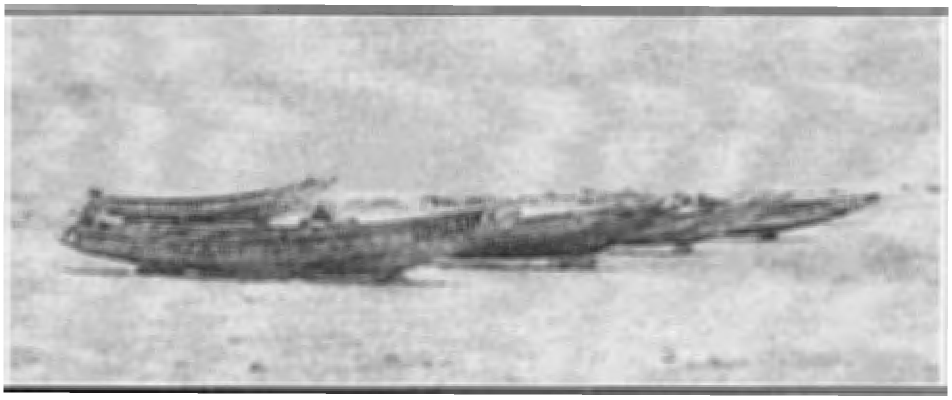
Fishing techniques used by the industrial fishing industry are varied and adapted to the targeted species: prawn trawls, bottom lines ("*palangre*"), angling, purse seine, Danish seine, pelagic trawl and bottom trawl. Trawls are forbidden in all zones with a depth of less than 20 m in order to protect spawning and nursery grounds.

Artisanal and Coastal Fishing

Article 13 of the application Decree 2002-073 of 1st of October defines artisanal fishing as "all fishing activities achieved by foot or with an open boat, motorized or not, with an overall length of 14 metres or less. Fishing activities must use manual devices expect for purse seines that are allowed" In addition, the boats must be made out of wood, aluminium or plastic.

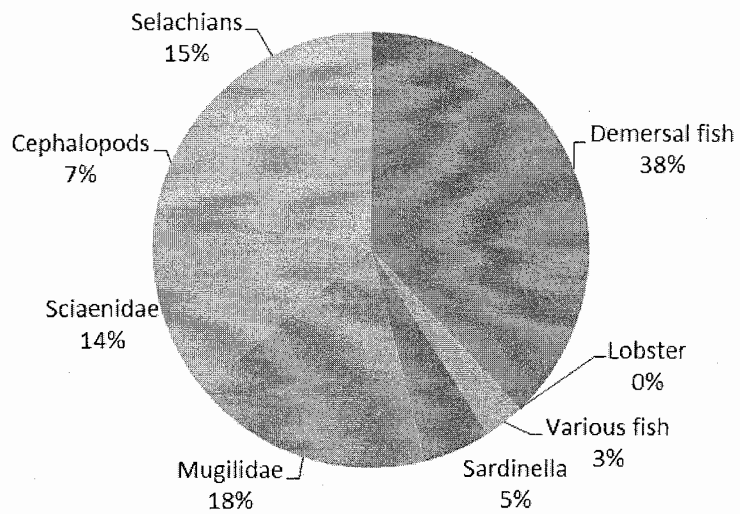
The artisanal fleet is expanding and estimated to represent about 5,600 boats including 4,300 that are currently active in Mauritania (*IMROP, July 2012*). Mauritania signed a convention with Senegal for 300 fishing licences for pelagic fishing with an obligation to land 15% of the captures at Nouakchott.

Figure 4.51 ***Typical Artisanal Fishing Fleet***



Artisanal and coastal fishing are authorised to operate within six nautical miles from the coast. Nevertheless during consultation, artisanal fishermen mentioned conflicts with industrial vessels which did not respect the different fishing zones (see *Annex A, ESIA Consultation Records* for details).

Figure 4.52 Targeted Species for Artisanal Fishing



Source: *Profil des pêches de la Mauritanie, FAO, 2004*

Fishing Zones

The Mauritanian EEZ is divided into 3 sub-zones :

- Northern zone: Nouadhibou and Lagouiera with 62% of the landings (in tons).
- Central zone: Parc du Banc d'Arguin with 2% of the landings.
- Southern zone: M'heijratt to Ndiago with 35% of the landings and which corresponds to the project study area.

80% of the artisanal production lands at Nouadhibou and on the fish market of Nouakchott. There is no other fishing port in the area south of Nouakchott. The area south of Nouakchott consists of mobile and seasonal fishermen camps which are almost exclusively foreign fishermen (Senegalese and Malians) despite the recent efforts of the government to create development centres between Belawakh and Ndiago.

Infrastructure

Nouadhibou is the main fishing port of Mauritania and has better commercial fishing infrastructure than Nouakchott. It hosts well-developed fishery activities, and operates a restricted marine area dedicated to artisanal fisheries.

In Nouakchott, fishing activities are predominantly artisanal, and fish landings are concentrated at the sea-side fish market.

Figure 4.53 *Nouakchott Fish Market*

There are about 80 sites for fish processing in Mauritania, mostly freezing facilities but also fish meal production (*EU, 2010*). The EU estimates that only 50 of these facilities are operational and compliant with international sanitary standards. (*EU, 2010*)

At a national level, the daily capacity for freezing fish is 700 tons from which only 30% is used (*EU, 2010*)

There are nine fish meal factories in the country, seven of them being located in Nouadhibou and two near Nouakchott. The total capacity is 35,000 tons in 2010, equivalent to 175,000 tons of fresh fish.

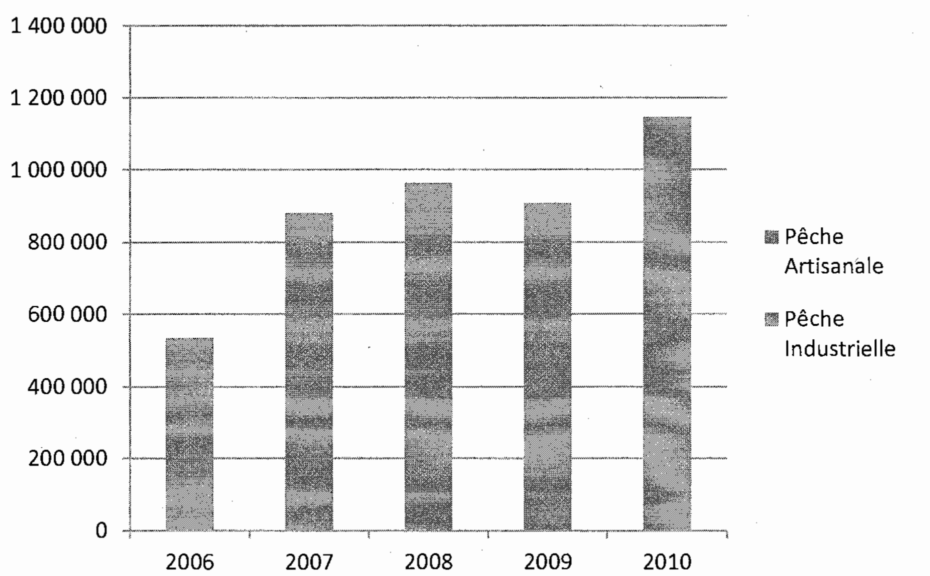
Figure 4.54 ***Fish Meal Factory at PK28, South of Nouakchott***

Fishing Resources

The fish resource potential of Mauritania is estimated at 1,500,000 tons per year and around 880,000 tons per year were landed on average between 2006 and 2010 artisanal and industrial fishing combined according to the National Office for Statistics (*ONS, 2010*) and the Institut Mauritanien de Recherche Océanographiques et des Pêches (*IMROP, 2012*).

Industrial fishing represents the largest proportion of the landings compared to artisanal fishing. *Figure 4.56* presents the proportion of industrial and artisanal fishing landings between 2006 and 2010.

Figure 4.55 ***Industrial and Artisanal Fish Landings (in Tons)***



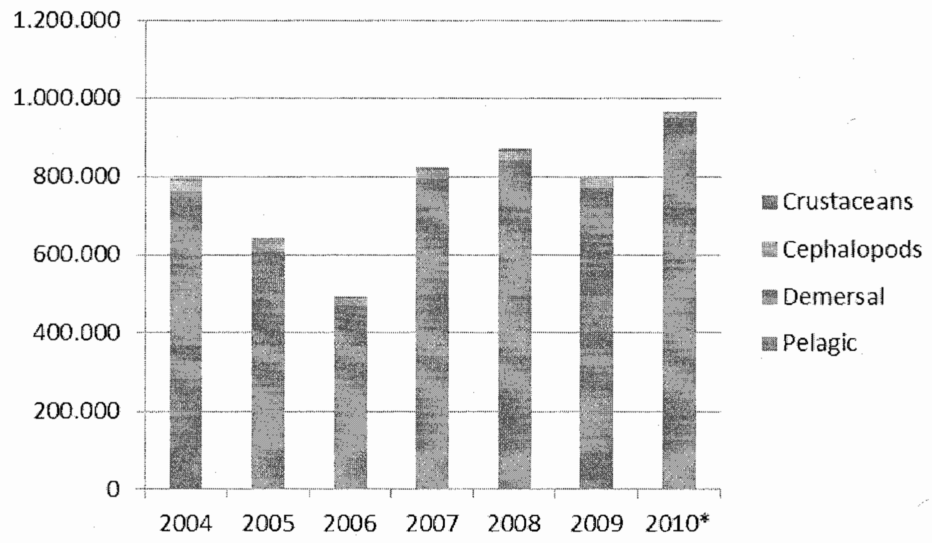
Source: *ONS, 2010 for industrial fishing; IMROP, 2012 for artisanal fishing*

For industrial fishing, small pelagic fish represent about 90% of the catch landed but only 40% of the economic value of landings is retained in Mauritania. Demersal species make about 20% of the fish landings, cephalopods about 30% and crustacean about 10% (*EU, 2010*). *Figure 4.56* shows the proportion of the species landed by industrial fishing.

Fish resources in the coastal zone are relatively abundant and the artisanal fishing sector has developed in the last few years. Since there is limited fishing experience in Mauritania, the sector used foreign experience and work force to develop several profitable fishing fields with high potential for export and added value.

The most common species to be found in the fish landings from industrial and artisanal fisheries are presented in the *Table* 4.14 overleaf.

Figure 4.56 ***Industrial Fish Landings in Tons per Category of Species***



Source: *ONS, 2010*

Fish is not commonly consumed in Mauritania, as a result of cultural habits and despite diminution of livestock production, droughts and rural depopulation toward coastal areas. The average consumption of fish is estimated to be 4.3 kg/year/capita (*Sustainable Fisheries Livelihoods Programme, FAO/DFID, 2005*).

Table 4.14 ***Most Common Species in Fish Landings***

Species	English Common Name	French Common Name
Octopus Vulgaris	Common octopus	Poulpe
Sepia officinalis	Common cuttlefish	Seiche
Loligo vulgaris	European squid	Calamar
Epinephelus aeneus	White grouper	Thiof
Epinnephelus marginatus	Dusky grouper	Mérou Noir
Plectropomus laevis	Blacksaddled coral grouper	Mérou jaune
Epinephelus alexandrinus	Blacktip grouper	Badèche
Dentex angolensis	Angolan dentex	Dorade rose
Sparus aurata	Gilthead seabream	Dorade royale
Argyrosomus regius	Meagre	Courbine
Lachnolaimus maximus	Hogfish	Capitaine
Solea senegalensis	Senegalese sole	Sole de roche
Cynoglossus cynoglossus	Bengal tongue sole	Sole langue
Synaptura cadenati	Guinean sole	Sole tigrée
Psetta maxima	Turbot	Turbot
Liza aurata	Golden grey mullet	Mulet jaune
Chelon labrosus	Thicklip grey mullet	Mulet noir
Panulirus regius	Royal spiny lobster	Langouste verte
Palinurus mauritanicus	Mauritanian lobster	Langouste rose
Diplodus Sargus	White seabream	Sar
Caranx ignobilis	Giant trevally	Carangue
Sciaenops ocellatus	Red drum	Ombrine
Rachycentron canadum	Cobia	Cobia
Salmo trutta	Sea trout	Truite de mer
Sarda sarda	Atlantic bonito	Bonite

Species	English Common Name	French Common Name
Pomadasys incisus	Bastard grunt	Grondeur
Pseudotolithus senegalensis	Cassava croaker	Otolithe Sénégalais
Sardinella aurita	Round sardinella	Sardinelle ronde
Sardinella maderensis	Madeiran sardinella	Sardinelle Plate
Trachurus trachurus	Atlantic horse mackerel	Chinchard
Scomber japonicus	Chub mackerel	Maquereau
Sardina pilchardus	European pilchard	Sardines
Engraulis encrasicolus	European anchovy	Anchois
Thunnus sp.	Tuna	Thons
Xiphias gladius	Swordfish	Espadons
Squalus acanthias	Picked dogfish	Chiens de mer
Chaceon maritae	West African geryon	Crabe profond
Venus verrucosa	Warty venus	Praires
Ostrea sp.	Oyster	Huîtres

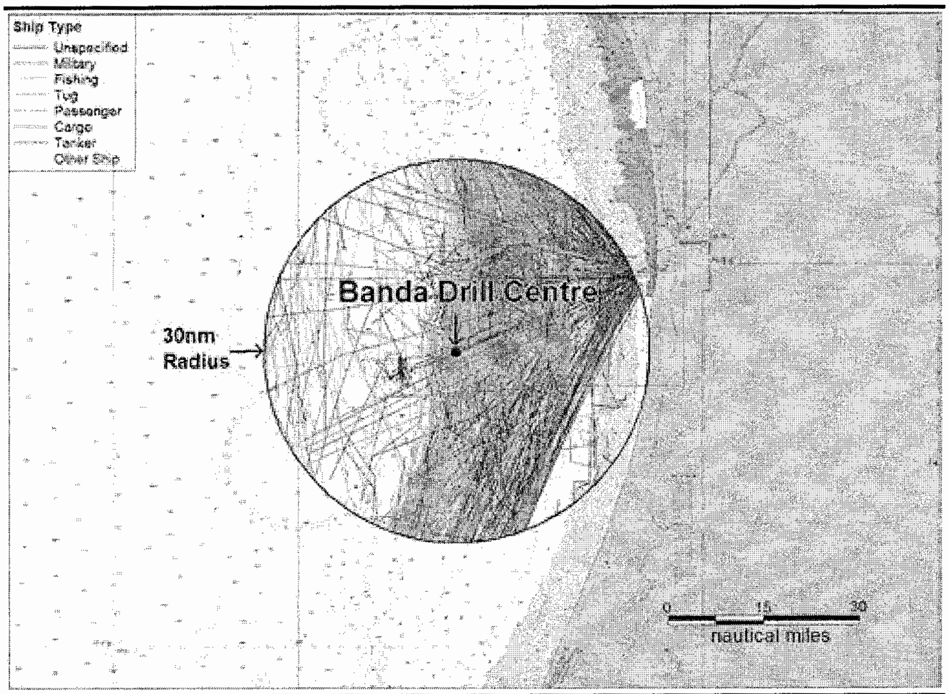
Source : *FAO/Fishbase*

4.7.4 *Fishing within the Study Area*

Fishing Traffic

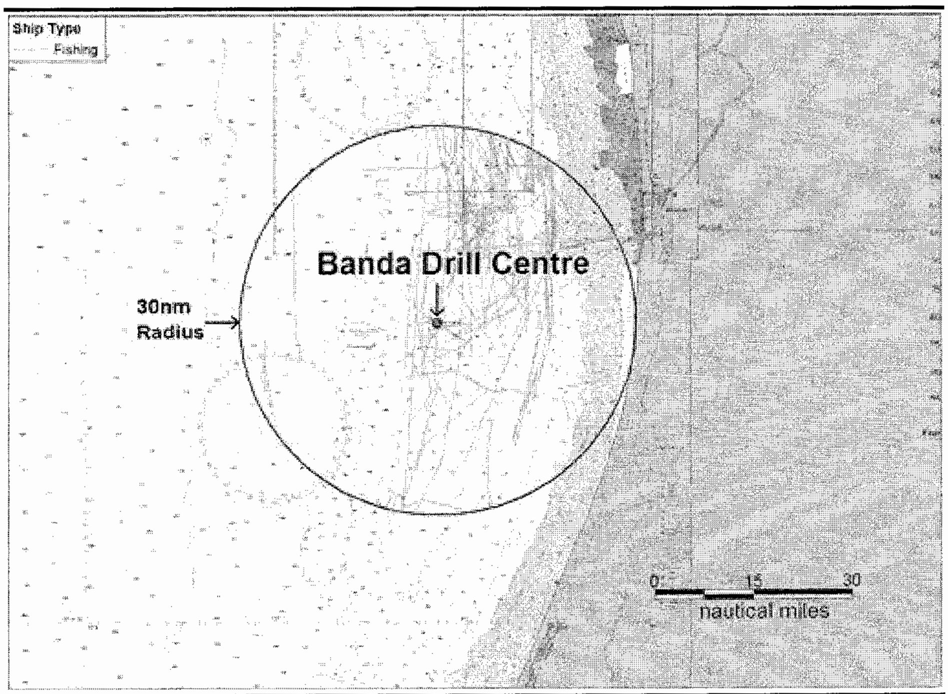
The reports from the stakeholder engagement survey were that only artisanal and coastal fisheries are present within the study area. However, the Collision Risk Assessment conducted by Anatec (*Annex C*) found that 67% of all vessels within the 30 nm around the Banda drilling centre were fishing vessels, and of these 80% were large industrial sized stern trawlers (*Figure 4.57*). It appears that the majority of the fishing vessels pass through the 30 nm around the Banda drilling centre at a speed of over 4 knots (approximately 91%) and can be assumed to be passing through the area and not actively fishing. The remaining fishing vessels travelling under 4 knots may have been fishing in the area. The path of these vessels is shown in *Figure 4.58*.

Figure 4.57 *Fishing Vessel Traffic within the Vicinity of the Banda Field*



Source : *Anatec, 2011.*

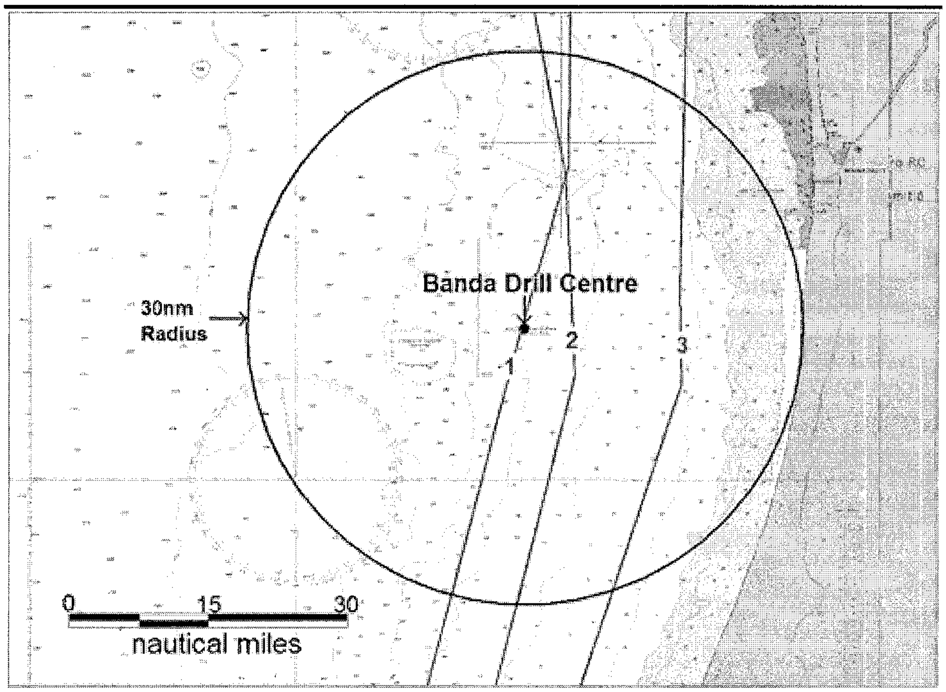
Figure 4.58 *Fishing Vessels Travelling under 4 Knots*



Source: *Anatec, 2011.*

There are three main shipping routes, used by approximately 480 fishing vessels a year, within 30 nautical miles of the Banda field. This corresponds to an average maritime traffic of one or two vessels a day. These shipping routes are shown in *Figure 4.59*.

Figure 4.59 *Shipping Routes within 30 Nautical Miles of the Banda Field*



Source: *Anatec, 2011.*

Organisation of the Artisanal Fisheries Sector in Mauritania

The artisanal fisheries sector in Mauritania is organised as follows:

- Some fishermen are employees of a chief fisherman who is basically an investor and frequently not a fisher himself. Fishermen are a seasonal labour force recruited from southern Mauritania or often from Senegal or Mali (especially for octopus fishing). The materials (boats, nets and sometimes the onshore camps) belong to the investor who cooperates with a pirogue captain who brings the expertise and is paid by the tonnage landed. Generally the price is fixed by the investor prior to the beginning of the season as well as apportionment of the earnings. The investor generally organises the fish landings and selling. The labour force is mobile along the coastal area depending on season and available fish resources. This kind of investor is often member of the *Fédération Nationale de Pêche* (FNP) - artisanal section.

- Some fishermen are migratory fishermen who own their own boat and materials. These fishermen mostly originate from southern Mauritania (Ndiago) and are members of *Fédération Libre de la Pêche Artisanale* (FLPA). Most are seasonal migratory and work in different settlements depending on the season and available fish resources. Most sell their catch to intermediaries (fish traders or "*mareyeurs*") who organise the transfer to fish market, factories or export.

- Others are non-mobile fishermen, which is the case of the Imraguen tribes and some of the fishermen originating from southern Mauritania and settled in camps or in Nouakchott. They partly work for themselves and partly in cooperation with Mauritanian investors who contract them by pre-financing material and sometimes labour force.

Figure 4.60 ***Pirogue Captain and his Team***

Fishing Patterns and Techniques

Most artisanal fishermen fish by day, the daily hours depending on the targeted species. Senegalese fishermen are most likely to practice "tide fishing" meaning sailing for several days until the ice they carry on-board is out of stock however this practice is a minor component of the artisanal fishing sector.

Imraguen fishermen traditionally used to fish by foot from the shore but due to the decrease in coastal fish resources this technique has been abandoned for more than 20 years.

Artisanal fishermen use traps (pot fishing), seine nets (with two boats), simple nets (cast nets) and drifting nets, depending on the prey. Fishing lines (angling) are also used to target tuna and groupers.

Figure 4.61 Traps for Cephalopod Fishing

Figure 4.62 Artisanal Fishermen Landing

In all of these cases, artisanal fisheries remain within the limit of approximately six nautical miles from the coast. They do not therefore venture as far off as into the proposed Banda development area.

Targetted Fish Species

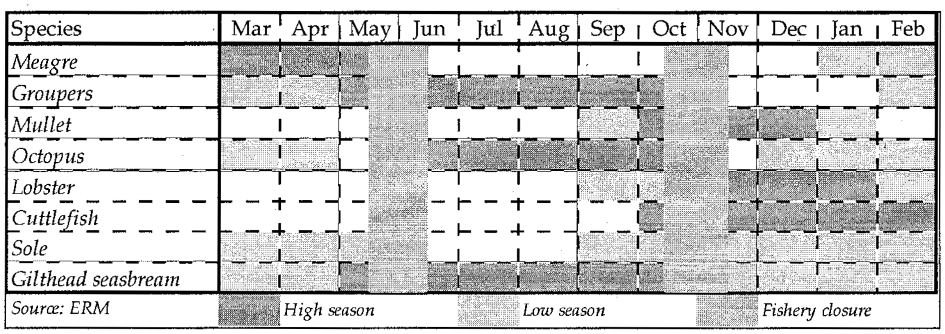
According to the fishermen communities consulted during the survey, the most common species targeted by the artisanal fishing are: common octopus, white grouper, gilthead seabream, meagre, Senegalese sole, golden grey mullet, thicklip grey mullet, Mauritanian lobster, and common cuttlefish.

Other fished species with minor significance are tuna, sharks, conger eels snails and skates.

Figure 4.63 ***Octopuses Caught by Artisanal Fishermen***

These species are fished during specific periods of time. The fishery is seasonally closed to protect the octopus reproductive seasons (1) from mid-May to mid-June and mid-October until mid-November. The *Figure 4.64* below presents a seasonal calendar per species based on the statements of the fishermen gathered during the consultations carried out for this ESIA (see *Annex A, ESIA Consultation Records*).

Figure 4.64 ***Seasonal Calendar of Artisanal Fishing by Species***



(1) Diop, H. & Kazmierczak, Jr., R.F. 1996. *Technology and Management in Mauritanian Cephalopod Fisheries. Marine Resource Economics*, 11: 71-84.

4.8 NON FISHING MARINE USERS

4.8.1 *Non-fishing Maritime Traffic*

An important consideration of the local socio-economic conditions is the maritime traffic occurring in the Study Area, although no interaction with maritime traffic has been declared as problematic by the local communities.

Table 4.15 ***Maritime traffic at Nouakchott Port de l'Amitié***

	2009	2010	2011
Vessels entered	495	471	467
Landings (metric ton)	2,448,000	2,495,000	2,624,000
Loadings (metric ton)	283,000	278,000	357,000

Source: *ONS/PANPA, 2011*

Table 4.16 ***Maritime traffic at Port Autonome de Nouadhibou***

	2008	2009	2010
Vessels entered	2,206	2,361	3,288

Source: *ONS/PAN, 2011*

A maritime traffic survey has been undertaken by Anatec as part of the Banda Oil Project and is attached in *Annex C*. The main results of this study are as follows:

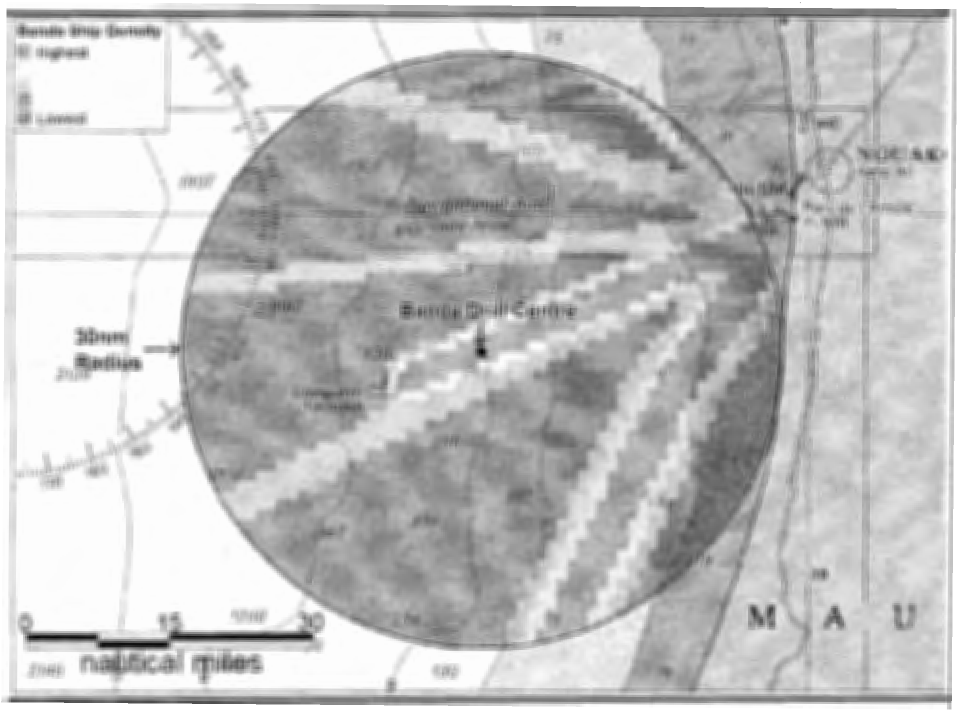
- there are five shipping routes that pass within 30 nautical miles of the Banda field;
- an estimated 588 ships per year or 1-2 ships a day pass within 30 nautical miles of the Banda field; and
- half of all ship traffic are cargo vessels; tankers and offshore support vessels make up the majority of the rest of the traffic with a smaller number of industrial sized fishing trawlers.

Anatec's ship density model was used to calculate the density of shipping based on the ship routeing database. A thematic map showing the estimated variation in shipping density around the local study area is presented in *Figure 4.4*.

Higher density routes include one route heading south out of Nouakchott, as well as traffic associated with the petroleum activities supporting the Berge Helene FPSO on the operating Chinguetti field. In general the traffic levels are relatively low in the surrounding area.

The risk of collision with vessels is discussed as part of the impact assessment within *Chapter 5*.

Figure 4.65 Shipping Density Grid in the vicinity of the Banda Oil Drilling Centre



Source: *Anatec*

4.8.2 *Submarine communication cables*

One existing submarine communication cable was identified in the Project area.

The Africa Coast to Europe (ACE) fibre optic cable links Europe to the West Coast of Africa. It was initiated by France Télécom-Orange and administered by a consortium of 16 operators. It was inaugurated in December 2012.

The proposed pipeline and umbilical will cross over the existing ACE fibre optic cable around 18° 6.6"N 16° 10.1"W in 15m of water. In this area the ACE cable is buried in coarse sand at around 0.8 m depth.

Another submarine communication cable, the GLO 1 cable owned by the Nigerian operator Globacom Ltd, was identified as having a capability to connect Nouakchott through a branching unit. However at the time of drafting this EIA this branching unit was not installed.

4.9 *SOCIO-ECONOMIC BASELINE*

4.9.1 *Introduction*

The data used for this report has been compiled from published literature as well as from the results of a field survey carried out from 9 to 19 July 2012 in order to gather more accurate and specific primary data. During the same period stakeholder engagement activities were undertaken, and the methodology and outcomes of this consultation study are described in *Annex A* of this report.

The consultation survey area was agreed with the DCE as the communities located along the stretch of coastline between PK 144 (which belongs to the commune of M'Balal) in the south to Nouamghar in the north (*Figure 4.66*). The purpose of the survey was to gather qualitative rather than quantitative data in order to gain an understanding of the overall area; therefore not all settlements have been surveyed.

4.9.2 *Administrative Context*

Mauritania has a four level administrative structure which consists of:

- 13 Wilayas (Governorates) including the District of Nouakchott which encompasses the whole of the consultation survey area. Wilayas are led by Walis (Governor) named by the state.
- 53 Moughataas (Districts) which are led by nominated Hakems (Préfet).
- 31 Arrondissements which are subdivisions of Districts covering certain parts of the country only. Officially abolished in 1990 but no decree was ever signed to this effect.
- 216 Communes (Municipalities) including nine in Nouakchott. They are led by mayors (Maires) elected at municipal level.

Settlements have been identified within the consultation study area of coastal communities and are listed in *Table 4.17* below as well as the administrative divisions they belong to. *Figure 4.66* presents the location of the surveyed settlements.

Table 4.17 Administrative Framework of Surveyed Settlements

Wilaya	Moughataa	Arrondissement	Commune	Surveyed Settlement
Nouadhibou	Nouadhibou	Nouamghar	Nouamghar	M'haijratt
Nouadhibou	Nouadhibou	Nouamghar	Nouamghar	Tiwilit
Nouadhibou	Nouadhibou	Nouamghar	Nouamghar	Lemcid
Nouadhibou	Nouadhibou	Nouamghar	Nouamghar	Belawakh
Nouakchott	Nouakchott	-	Sebkha	Fish Market
Trarza	Ouad Naga	-	El Arya	PK 28
Trarza	Mederda	Tiguent	Tiguent	PK93 (Legweichich)
Trarza	Keur Macene	-	M'Balal	PK144 (Khanttour)

Source: *ERM/Ministère de l'Intérieur et de la Décentralisation, 2009*

Traditional authorities (village chiefs) are not present all over the country. Within the consultation study area, village chiefs exists in Imraguen villages, north of Nouakchott, whereas no traditional authorities were found in the settlements visited in the south of Nouakchott.

The Imraguen village chief is elected among the elderlies and his duties are to provide advice, solve conflicts and manage daily life issues.

4.9.3 *Demographics*

According to the estimates by the National Office of Statistics, the total population of the three relevant Wilayas for this survey is 1,457,863 people in 2012, largely concentrated along the coastline.

The last census is dated from 2000 and population's forecast has been calculated per municipality which gives a total population of the surveyed municipalities of 1,008,000 as shown in *Table 4.18*.

Figure 4.66 *Location of Surveyed Settlements*

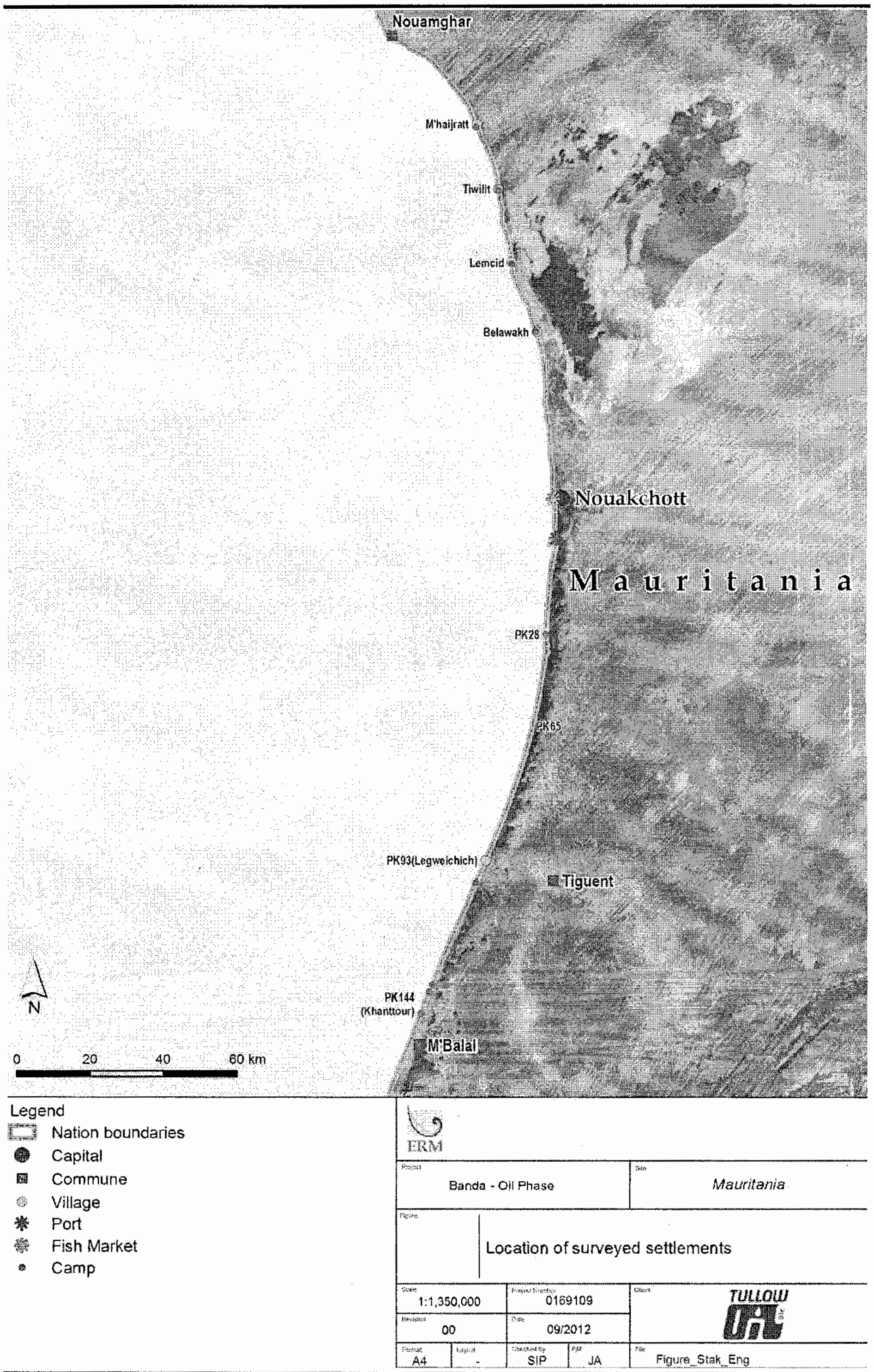


Table 4.18 ***Population per Municipality in the Study Area***

Commune	Wilaya	Population in 2000	Population in 2012 (forecast)
Nouamghar	Dakhlet Nouadhibou	4,151	5,500
Nouakchott	Nouakchott	558,197	957,600
El Arya	Trarza	7,496	9,900
M'Balal	Trarza	14,129	18,800
Tinguent	Trarza	12,170	16,200
Total Project Area		**596,143**	**1,008,000**

Source: *ERM/ Office National de la Statistique de Mauritanie, 2008*

No official statistics are available at village level. The data presented in *Table 4.19* has been gathered through statements of stakeholders during the field surveys and should be taken as qualitative rather than quantitative. It is important to note that "seasonal" residents work in several of these locations, with figures indicated for seasonal workers being high-level indications given by local village representatives.

Table 4.19 ***Population per Surveyed Settlement (Approximate Estimate)***

Settlement	Permanent residents	"Seasonal" residents (generally moving from one village to another, periodically)
PK 144	120	1,000
PK 93	400	400
PK 28	100	1,200
Belawakh	1,500	1,500
Lemcid	500	1,000
Tiwilit	1,000	200
M'haijratt	150	700

Source: *ERM based on interviews carried out in July 2012*

4.9.4 *Fishermen Settlements - Structure and Local Services*

Regional Study Area

With the exception of the Urban Community of Nouakchott which is an important centre of fishing but also processing, trade and export of fisheries products, the survey area can be separated into two distinct areas, north of Nouakchott (Imraguen villages) and south of Nouakchott.

North of Nouakchott – Imraguen Villages

The settlements north of Nouakchott up to Nouamghar are Imraguen villages. The Imraguen are an ethnic group originating from a mix of Arabic, Berber and Sub-saharan Africans tribes. They are one of the rare groups of Saharan inhabitants with a livelihood based on sea fishing. They have settled in the coastal villages of this area since the Sixteenth Century, from Belawakh up to Agadir in the current Banc d'Arguin National Park (PNBA) in the North.

Although this is the oldest fishermen community in Mauritania, it currently makes up only 9% of the artisanal fishermen.

The Imraguen villages are made of concrete buildings and are located directly on the coast, along the former Nouadhibou-Nouakchott trade route. When the Nouadhibou-Nouakchott road was built around 5 km inland some villagers moved to the main paved road in order to seek economic opportunities. For example in M'haijratt only 30 households still live on the shore whereas 240 households migrated toward the main road. Nevertheless the settlements along the road remain connected to the settlements on the coast as families usually live in both settlements and use the proximity of the road to sell some of their catch.

The poor quality of groundwater resources is also a motivation for leaving the coastal village. Fresh water has to be brought from Nouakchott by truck and costs between 7 € and 10 € per cubic meter, which is prohibitive for average income earners. A pilot seawater desalting plant was installed in Belawakh but is not operational.

Figure 4.67 *View of the Imraguen Village of M'haijratt*

Access to electricity is very limited, except on an individual basis for individuals who can afford a power generator.

The field surveyor visited the four main settlements in the study area: Belawakh, Lemcid, Tiwilit and M'haijratt. All these villages are administratively managed by the municipality of Nouamghar.

Next to the Imraguen villages, there are camps which have been built by Mauritanian investors for housing seasonal migrants coming from south of Mauritania or neighbouring countries (Mali or Senegal) and working as seasonal fishermen. Most of these camps are owned by the investors, but some are owned by individual fishermen from the southern region. These camps have been built next to the village in order to take advantage of existing infrastructures. Past conflicts caused by competition for occupation of land have been reported during consultation.

South of Nouakchott - PKs

The coastal settlements located between Nouakchott and Ndiago are dedicated to fishing activities (They are named PK, which stands for "Point Kilométrique", referring to the distance between Nouakchott and the junction at the main road). They are located at an average of 25 km west of the main road, along the coastline to the coast.

The temporary camps of PK 28, PK 93 and PK 144 have been built around the facilities of the fishing training centre CASAMPAC (*Centre d'Apprentissage et de Soutien Aux Métiers de la Pêche Artisanale et Côtière*) built in 2009. These facilities include housing for students and teachers, training facilities as well as a fishermen housing village in PK28.

The CASAMPAC centres are vocational training centres for the artisanal and coastal fishing sector. They are used for the theoretical training of students for 6 month sessions before the students are sent to practise traineeships in the field. There is also an initiative by the Mauritanian authorities to create development centres in these villages in order to keep populations in the region and to curb rural depopulation.

Some partly nomadic families originating in the region (Tenghda tribes) have settled in the coastal area when the CASAMPAC facilities were built, hoping for employment opportunities. A limited number of jobs have been created (primarily security guards) but to-date no important economic development has yet been triggered by the implementation of the centres. These families also interact with fishermen by supplying them with salt exchanged with fish. This economic activity is nevertheless seasonally and geographically very restricted.

The fishermen settlements are temporary (tents, recycled material) or semi temporary with wooden barracks covered with a tent roof; respectively seen to the right and to the left of the photograph shown on *Figure 4.68*.

Figure 4.68 ***View of Fishermen Encampment at PK 28***

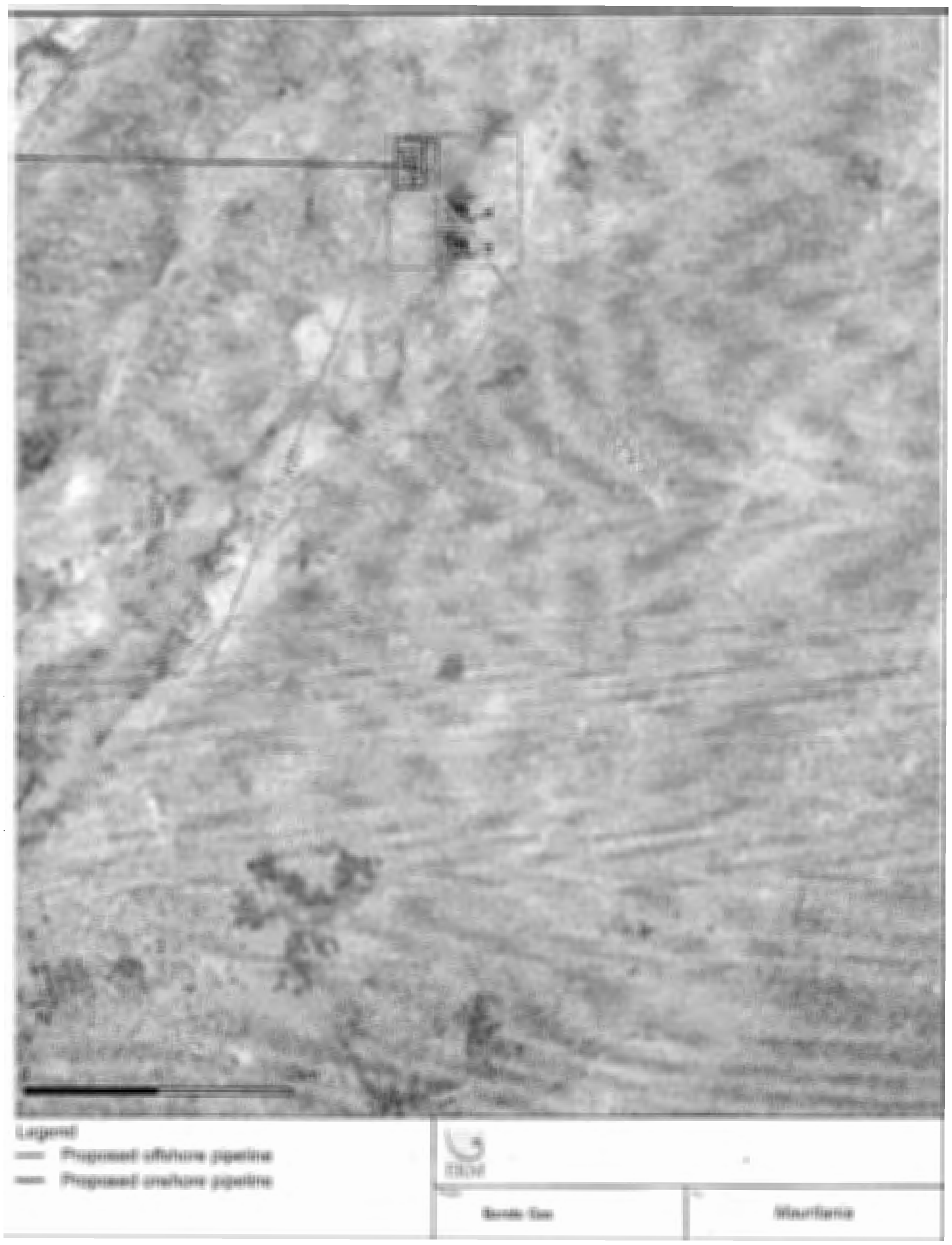
As in the area North of Nouakchott, this area also has limited access to fresh water and electricity. An alternative source of water is the artisanal wells but the water is highly saline and only used by local populations for cattle.

Project Footprint and Surrounding Area

In February 2013, the residential areas nearest to the Project site are located more than 5 km away, to the South. They correspond to the Nouakchott outer neighbourhoods of Tevragh Zeina and Teyarett.

Some isolated residential constructions have been identified in the vicinity of the Project footprint (see details in *Section 4.8.6.*)

Figure 4.69 Nearest Residential Areas to Project Site



4.9.5 *Development Indicators*

Poverty Rates

For the purpose of this study we have used the threshold values defined in 2008 by the International Monetary Fund (*IMF, 2011*). Poverty was described in Mauritania as an income lower than 129,000 Mauritanian Ouguiya (MRO)[1] per year per capita , whilst 96,000 MRO [2] was the threshold for extreme poverty.

The Wilayas of Nouakchott and Nouadhibou, are the main economic centres of the country and have the lowest poverty rate which is below 30% of the population. The poverty rate of the wilaya of Trarza varies from 30% to 50%, according to the Strategic Framework for Poverty Reduction, whereas the national average is 42%.

During the survey, about 75% of the communities declared income classifying them below the poverty rate in the southern area (60% in the northern area). Nevertheless it is important to note that interviewees do not consider the value of the livestock (which is used as money savings and can reach an important level), but rather the daily availability of cash.

Education

According to the Department for Statistics, literacy rates are respectively of 76.2% and 66.4%in the Wilayas of Nouadhibou and Trarza. According to the village authorities met during the field survey, primary school classes are available at all villages visited, including PKs. Nevertheless, a high rate of teacher absenteeism is reported from most primary schools, and there is reluctance among the villagers to send children to school. Religious education is delivered by local imams at all the settlements visited.

Health

Community health centres are theoretically available in all surveyed locations but no trained staff is available and the stations are therefore not functional. The nearest available health facilities can be found at municipal centres (M'Balal, El Arya, Tiguent and Nouamghar).

4.9.6 *Land Tenure in the Study Area*

General Context

Land rights in Mauritania are regulated by Ordinance N°. 83-127 of 23 June 1983 and its implementation decrees, the latter being the Decree N°2000-089 dated 17 July 2000. Chapter IX of this decree establishes the rules regarding urban concessions.

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(1) 432.5 USD based on October 2012 exchange rate
(2) 322 USD based on October 2012 exchange rate

A concession is a temporary authorization of use with an engagement of sale if the title holder fulfils conditions such as fencing its land within two years and developing it within five years. With a total of 2,757 concessions north of PK7, this is the most common type of tenure in the Northern part of the city.

Informal land tenure is also relatively common in the area with an estimation of 820 land users (locally refered to as *gazras*) who have no recognizable legal right or claim to the land or assets they occupy or use.

Licences delivered by the Ministry of Tourism constitute a third type of land right in the area. These licences do not constitute secure land titles.

According to the Ministry of Urbanism, the area north of PK7 has been allotted on both sides of the road. However, only very limited signs of land occupation were observed during the baseline survey conducted in January 2013. Between PK7 and PK20, only small scale houses and sheds constructions have been reported. 30 small houses or sheds were located on the eastern side of the Nouakchott-Nouadhibou road and only seven on the other side.

Local study area

Small houses and sheds are present in the immediate vicinity of the proposed pipeline route at the Nouackhott-Nouadhibou highway crossing (see *Figure 4.70*). Only one small shed is included in the proposed exclusion zone (60 m on both sides of the proposed pipeline route), 35 m away from the proposed pipeline route.

One villa is present 350 m south of the proposed pipeline landfall (see *Figure 4.71*)

No other signs of occupation have been recorded on the proposed Project footprint.

Tullow has initiated a request with the Ministry of Urbanism to access Nouakchott's land title register in order to confirm land tenure on the Project footprint and identify land owners and users potentially affected by Project-related land acquisition and restrictions on land use.

Figure 4.70 Proposed pipeline route and exclusion zone at the highway crossing

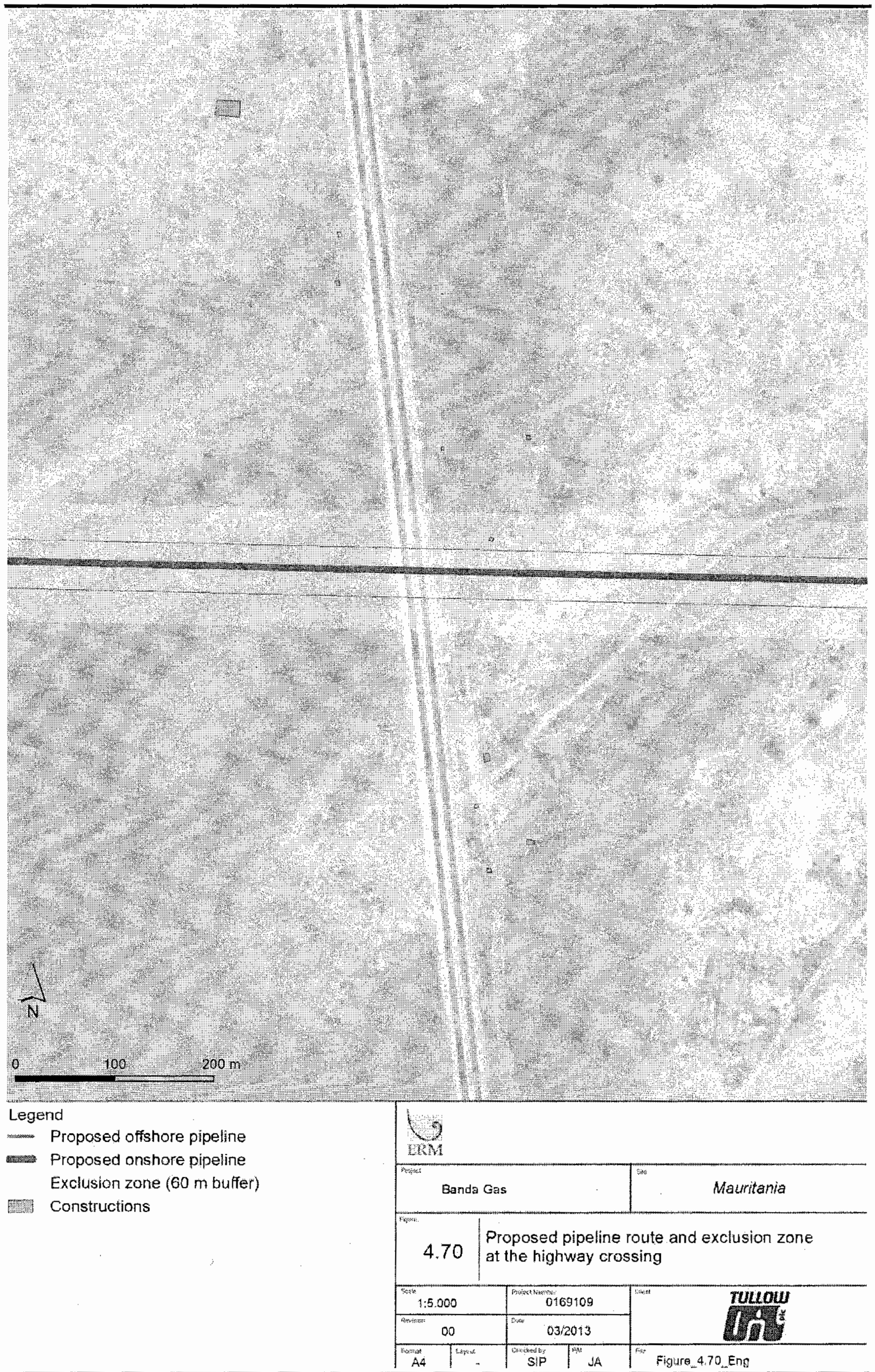
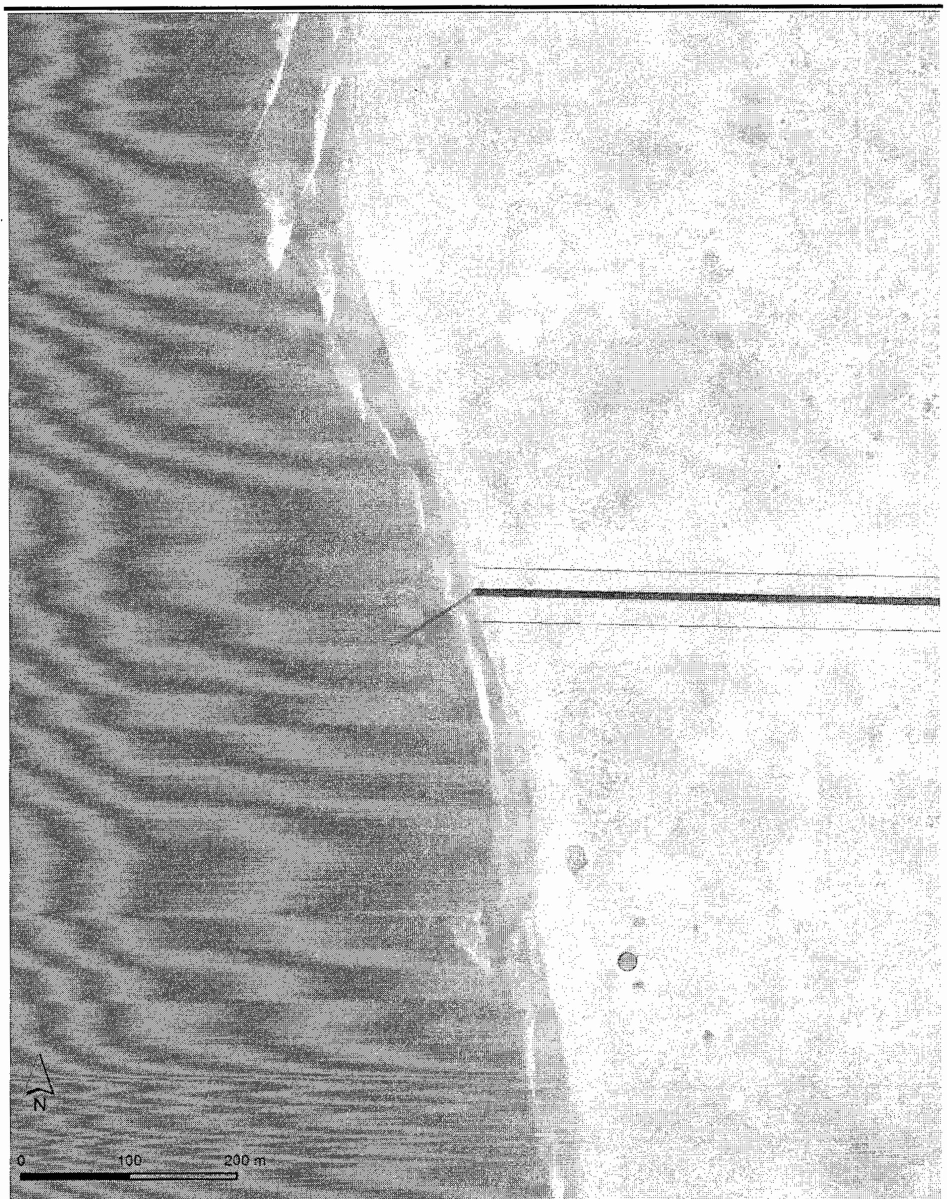


Figure 4.71 ***Proposed pipeline route and exclusion zone at landfall***



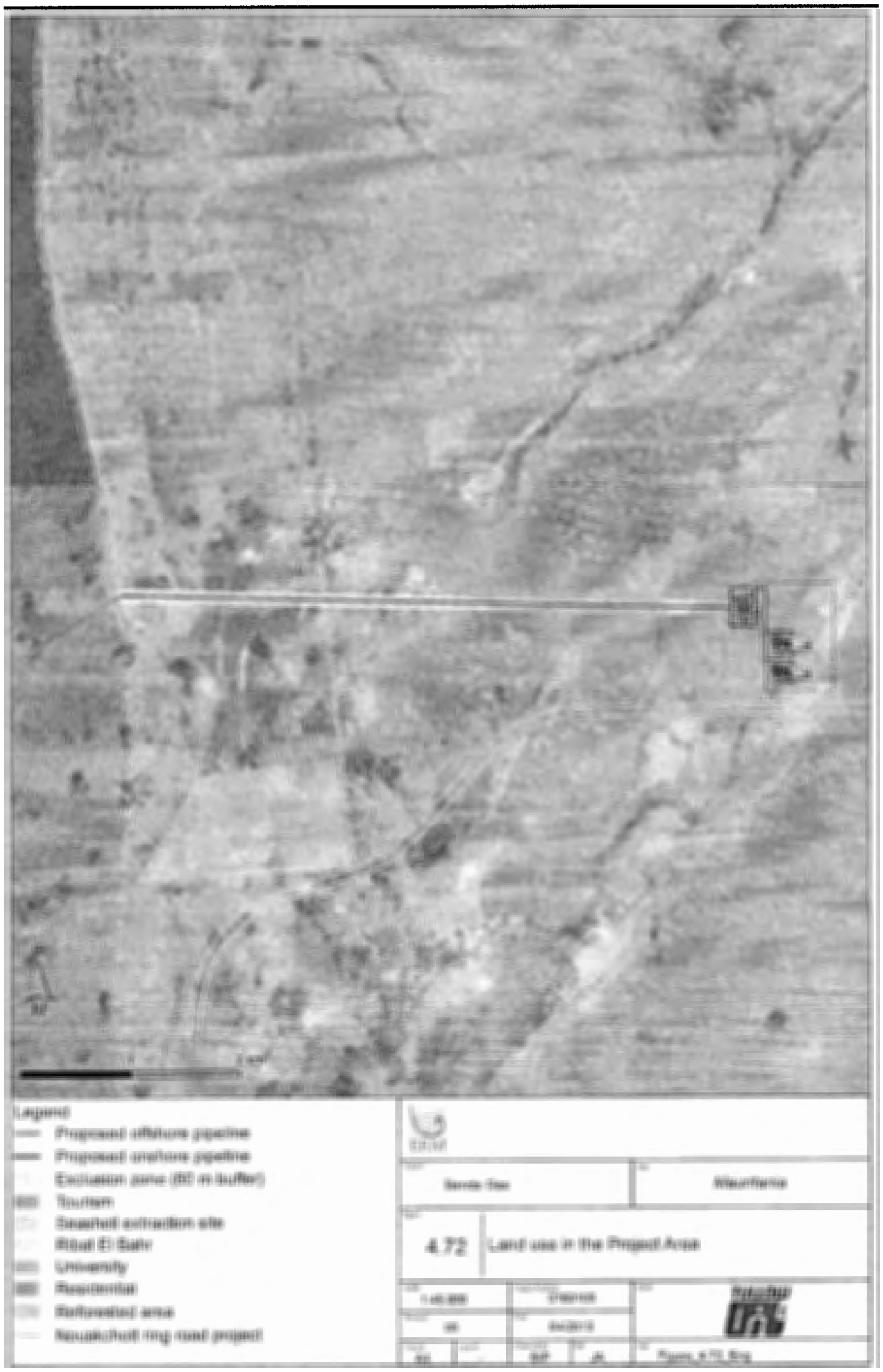
Legend
Proposed offshore pipeline
Proposed onshore pipeline
Exclusion zone (60 m buffer)
Constructions

ERM

Project: Banda Gas		Site: Mauritania	
Figure: 4.71	Proposed pipeline route and exclusion zone at landfall		
Scale: 1:5,000	Project Number: 0169109	Client: TULLOW	
Revision: 00	Date: 03/2013		
Format: A4 / Layout: -	Checked by: SIP / Ppd: JA	File: Figure_4.71_Eng	

Figure 4.72 presents the other types of land use identified in the Project Area. These are described in the Local Study Area headings of *Sections 4.9.7 to 4.9.10.*

Figure 4.72 ***Land use in the Project Area***



4.9.7 *Trade and Livelihoods*

Regional Study Area

Some small scale trade for daily commodities (canned food, sweets, cigarettes, cooking oil, sugar, tea etc) has been observed in the Imraguen villages. The fishermen organise the commerce of the fish by themselves. About two thirds of their catch is sold to intermediaries, the remaining third being sold by their families to intermediaries at the village or along the main road for the Imraguen villages. In the latter case, community women process the fish (artisanal drying and production of mullet oil) before selling it.

Local populations settled around the fishermen camps in the southern area operate small scale and occasional salt trade with fishermen.

Local Study Area

Seashell extraction

Seashell extraction is the main economic activity in the Project area. Seashells are the only aggregate available within a few hundred kilometers from Nouakchott (*Theunynck and Widmer, 1988*) and are one the basic building materials in the area.

There are several sites for seashells extraction North of Nouakchott. The most important are located at PK40 and PK 45. The nearest to the Project area is located 2.7 km north-west of the proposed gas processing facility, 1.2 km north of the proposed onshore pipeline route and covers a surface area of 0.15 km^2.

According to the *Fédération des Transports de Nouakchott*, two types of shells extraction occurs North of Nouakchott near the Nouackhott-Nouadhibou highway. The first one, referred to as raw extraction (*prélèvement brut*) is used for residential construction and represents a fleet of 40 trucks. The second one, referred to as refined extraction (*prélèvement raffiné*) is used by the local cement industry (Mauritano-Française de Ciment -MAFCI, Ciment de Mauritanie) and since recently for the construction of the new airport's runway and represents a fleet of 18 trucks. Each truck collects 7 to 23 tons of shells per rotation and makes 2-3 rotations a day.

Other activities

The Project area and its wider environment are also used by shepherds for the grazing of herds of camels and goats. However this activity has been restricted on the location of the proposed gas processing facility since the installation of the reforestation project (see *Section 4.5.2*).

The area is also located within a wider area of passage crossed by herders coming from further afield to the city of Nouakchott, to sell milk.

No other economic activities have been identified in the Project area.

4.9.8 *Livestock*

Regional Study Area

Livestock is a common way of saving in Mauritania. Some people living in the surveyed location own a small number of animals as savings but few rely on livestock production as main income source, for example people attracted to the coast by the construction of CASAMPAC centres that do not receive an income from fishing.

In the south of the Survey Area, there are very limited interactions between the populations earning a living from fishing and the nomadic or semi-nomadic pastoral communities.

Local Study Area

Before the development of the Nouakchott-Nouadhibou highway, breeding camels was the only economic activity in the area. It remains the first activity in terms of number of people who practice it. Most livestock owners are based in Nouakchott.

4.9.9 *Agriculture*

Although agriculture is a dynamic sector at national level despite an unfavourable environment, no activities related to agriculture have been mentioned nor witnessed in the visited areas. Therefore this economic sector should be considered as negligible within the Study area both at regional and local level.

4.9.10 *Tourism and Recreation*

Regional Study Area

International tourism is not very well developed in the Regional Study Area. Only the protected areas of Diawling and Banc d'Arguin attract a small number of foreign tourists. In recent years, the tourism industry in Mauritania has suffered as foreign embassies have issued travel security warnings in relation to radical Islamist activism in the Sahara and the Sahel.

There are a few signs of development of a local tourism industry with the presence of hotel facilities ("campements") nearby but not directly located on the beach at PK 28 and at PK 93. According to a note from the National Tourism Authority in 2008, hotel capacity includes 344 beds in the Wilaya of Nouhadibou and 25 beds in the wilaya of Trarza.

There is also a recent phenomenon of development of holiday homes along the coast (*FIBA, 2007*) but this is still a very uncommon phenomenon.

Finally, the beach in immediate proximity of Nouakchott is used for recreational purpose (bathing, recreational fishing, kite surfing) by national and foreign residents of Nouakchott but this remains economically insignificant with only small scale business related to this usage.

Local Study Area

There are several signs indicating guest-houses along the Nouakchott-Nouadhibou highway. Some of the facilities have disappeared mostly because of a lack of demand. Presently, there are three functional campsites that are developing, one of which is on the road and the other two are located on the beach.

- Campsite Badr, located on the road at PK 12 is composed of seven bungalows.

- Campsite les Sultanes, founded in 2006, is composed of a restaurant and six tents located on the beach 3.8 km of the proposed pipeline landfall. It receives about 60 persons per weekend.

- Campsite Océanides, founded in 2009, is located on the beach next to the campsite les Sultanes. It has a dining room, 3 bungalows and 8 tents. It hosts approximately 100-120 persons per weekend.

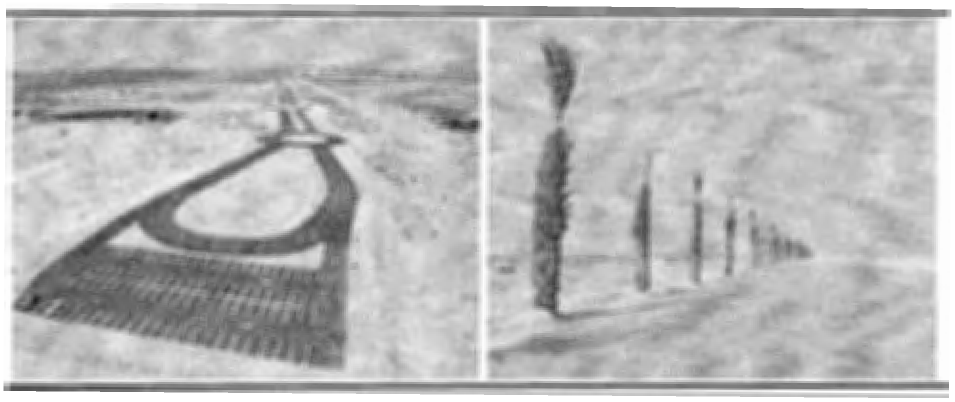
In addition to these small-scale tourism and recreation facilities, a major fully integrated real estate and recreation project is being developed approximately 4 km south west of the proposed gas processing facility.

The *Ribat Albahr* project is being developed by the Mauritanian Investment Group (MMI). Its first phase will include the development of:

- a 1 km^2 residential district;
- a shopping centre;
- a beach front hotel; and
- a recreational walkway that will stretch from the shopping centre to the beach.

Preliminary construction works started in 2010. Grading activities have been performed on the walkway area in order to level the 1,700m-long and 100m-width land prepare it for hosting several facilities. This included planting palm trees along the walkway and the construction of a car park.

Figure 4.73 *Ribat Albahr Preliminary Construction Works*



Source : *Ribat Albahr*

4.10 CULTURAL HERITAGE

4.10.1 *Introduction*

A significant amount of information exists about the earliest populations in Mauritania. The earliest confirmed hominid presence dates to the Early Stone Age. It is believed that *Homo ergaster* first entered Mauritania around 1 million years ago. The most common artifact found at Early Stone Age sites are Acheulean hand-axes; large chipped stone tools used for both crushing and scraping. Sites dating to this period exist within now desolate regions in Mauritania where paleo-lakes existed before the Sahara began turning to desert in the mid fourth millennium BP. *Homo ergaster* populations probably did not regularly hunt but obtained a significant portion of their diet through scavenging.

4.10.2 *Regional Context*

Aterien microliths found across the northern half of the country suggest presence of *Homo sapiens* by around 100,000 years ago. These microliths, belonging to the Middle Stone Age, are small, chipped stone projectile points, which indicate an increase in hunting over scavenging activities. Middle Stone Age sites are not known to extend further south than the Adrar Mountains which contain multiple rock art sites depicting hunting and ritual scenes.

Late Stone Age sites exist in larger numbers than previous periods. Most known Late Stone Age sites are clustered around the Dhar Cliffs, the Hodh Depression, the Adrar Mountains and the Atlantic costal region. By around 5000 BP, the Late Stone Age populations began domesticating animals and plants. Ceramic vessels also come into use about this time. The earliest known stonewalled settlements in sub-Sahara Africa belong to this period in Mauritania. These settlements sit upon easily defensible topographic features such as cliffs and natural rises. Stone tool technology largely shifts from microliths to ground stone axes. Harpoons fashioned from animal bone are also found in high quantities along the shores of now-desiccated lakes that likely hosted large numbers of ancient fishing groups.

Beginning around 2 500 BP, much of West Africa, including Mauritania, entered the Iron Age. It is during this prehistoric period that populations abandon many of the older Late Stone Age settlements. Other settlements begin to develop and eventually take on urban characteristics. The highest densities of Iron Age sites are located within the southern one-third of the country, especially within the Hodh Depression and along the Senegal River. Iron tools and weapons replace stone tools and extensive trading networks begin moving gold, slaves, salt and other commodities across much of West Africa and possibly to the Mediterranean coast. The increase in economic activity eventually led to the origins of the Ghana Empire around year 800, which likely controlled an area between southeastern Mauritania and western Mali. While considered sub-Sahara Africa's first empire, the rise of Ghana also ushers in a suit of major social and political changes that placed Mauritania and the rest of West Africa within a more global position. Most notably, and soon after the rise of Ghana, an Islamic and ethnically Berber group known as the Almoravids established a short-lived empire between 1040 and 1147 that covered an area between southern Spain and Mauritania down to Ancient Ghana. The Almoravid expansion is considered the first of multiple *jihads* that took place in West Africa, which initiated sustained contact and complex cultural connections between white Berber and black sub-Saharan ethnic groups.

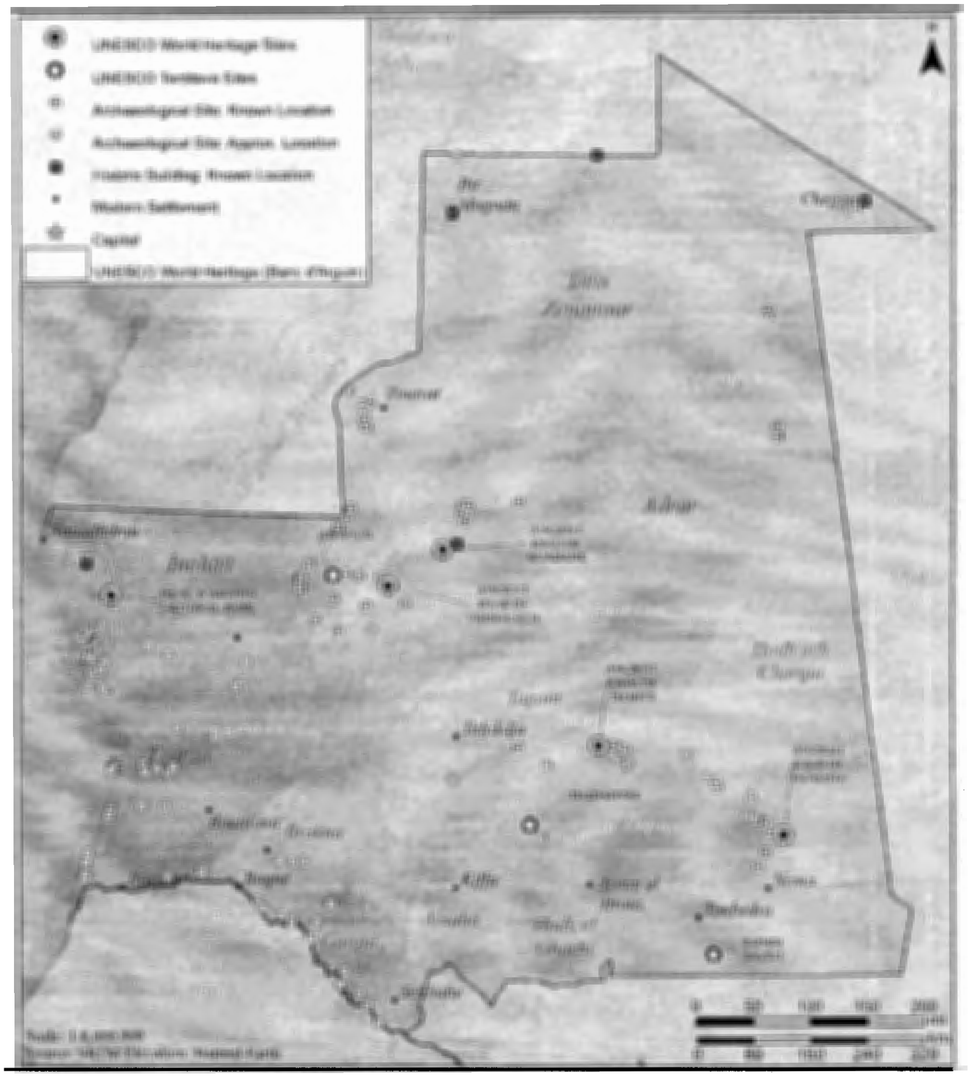
The Medieval Period in Mauritania, and elsewhere in West Africa, begins with the Mali Empire in 1230 and the military conquest of Sundiata Keita. The Malian kings ruled over an area that covered southern Mauritania, Senegal, Guinea and modern Mali. It is during the Mali Empire that trade with Europe and the Near East became well established. Gold and slaves were traded north through the Sahara via camel caravans in exchange for salt and other goods brought down south from the desert interior and North Africa. Additionally, a number of important trading centers in both Mauritania and Mali established world-renowned libraries and universities that received visitors and students from as far away as the Middle East.

Ancient Mali's fall occurred soon before the rise of the Songhai Empire in the late 15th century with the military conquest of Sonni Ali. However, by the time the Songhai Empire established itself as the new political entity in West Africa it had failed to incorporate the important trading centers within Mauritania. The Songhai Empire fell in 1591 with the military conquest of the Saadi Dynasty that sent an army across the Sahara from Morocco. The invasion succeeded in capturing the cities of Timbuktu, Jenne, and Gao. Soon after the Saadi invasion West Africa entered into a period of Balkanization devolving into a number of small and competing political areas. Economic patterns also shifted by the early seventeenth century with the establishment of Portuguese trading colonies along West Africa's Atlantic coast which greatly diminished the importance of the earlier trans-Saharan caravan routes.

European exploration of Mauritania was slower to start than other areas in West Africa. While Portuguese sailors had mapped the coast by the early sixteenth century, it was difficult to enter into the country's interior due to a lack of navigable rivers and the presence of hostile groups. French colonial cartographers eventually began mapping Mauritania's interior in 1859 and discovered large deposits of copper and iron in the Adrar Mountains. Throughout the Colonial Period Mauritania remained under nominal French rule, although colonial administrators did not directly control most of the area above the Senegal River. Colonial settlements in southern Mauritania remained under regular threat from northern raiders until 1934 when France managed to pacify most of Mauritania with the defeat of warring nomadic groups through a campaign of military fort construction at strategic locations.

During the Colonial Period, Nouakchott was a small military camp and Saint Louis served as the regional capital city. However, after independence Saint Louis became part of Senegal and it was decided to make Nouakchott Mauritania's new capital city due to its central location in the country. Starting off with approximately 500 habitants in the late 1950's, Nouakchott has become a major center for trade and commerce in West Africa.

Figure 4.74 Previously Identified Archaeological Sites in Mauritania



4.10.3 Local Study Area

From a costal perspective, Mauritania has a rich and long tradition in maritime resource extraction. Originating in the Neolithic period, small and temporary fishing villages served as a seasonal subsistence activity where nomadic groups would travel to Mauritania's costal shores and extract shellfish and fish for consumption. Archaeologically, these ancient fishing villages left behind shell middens of varying size with associated stone and bone artefacts. Because the Project is primarily influencing a portion of Mauritania's costal area, it is likely that Neolithic temporary fishing villages are primary archaeological resource of concern. This observation is reflected in the local cultural heritage baseline context presented below.

Artefacts were observed within the footprint of the proposed gas treatment plant by ERM consultants during the scoping visit held in July 2012. Preliminary analysis of pictures taken of the sites and of artefacts identified suggested the presence of Late Stone Age Sites within the footprint of the proposed gas treatment plant.

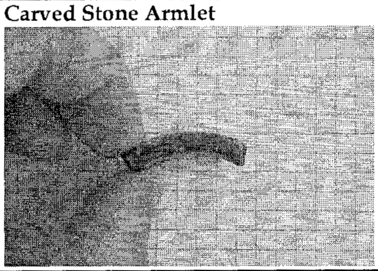
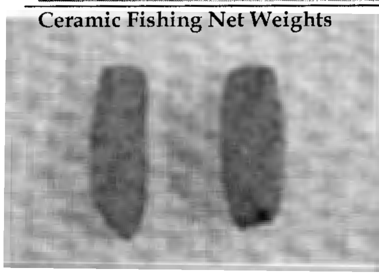
An independent Mauritanian archaeologist was then contracted to undertake a site reconnaissance study in order to confirm the cultural heritage value of the site and suggest recommendations on measures to be implemented in order to be compliant with Mauritanian regulations in terms of cultural heritage. His report is summarized in this baseline.

The site reconnaissance confirmed the presence of Late Stone Age cultural heritage within the proposed footprint. Recorded locations within the Project footprint are reported on *Figure 4.75*

The artefacts observed include pottery fragments, stone tools, bones and ostrich egg shells. The variety of pottery techniques and patterns suggest the presence of seven or eight different human groups during the Late Stone Age period.

No evidence for graves has been identified and the shell middens have been reported to be relatively superficial. However this does not exclude the risk to encounter underground ancient burials during ground disturbing activities.

Table 4.20 Analysis of Artefacts Found within Project Footprint

Object	Comments
Shell-Midden 	These types of shell-middens are typical of several important Late Stone Age cultures in costal Mauritania: 1: La culture de Foum Arguin (~5500 - 3500 BC) 2: La culture de Tintan (~4000 - 2000 BC 3: La culture de Nouakchott (~3000 BC) 4: La culture de Dhraina (~2000 - 1400 BC) 5: La culture de Tin Mahham (~ 400 BC - AD 500) Note: It is common to find burials benieth prehistoric shell middens.
Carved Stone Armlet 	Stone armlets are common in West Africa during the Late Stone Age and Iron Age.
Ceramic Fishing Net Weights 	These are likely fishing-net weights, which are common to many ancient West African costal populations from the Late Stone Age on, and provide preliminary evidence for aquatic resource exploitation aside from shellfish.

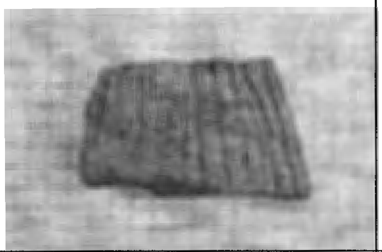
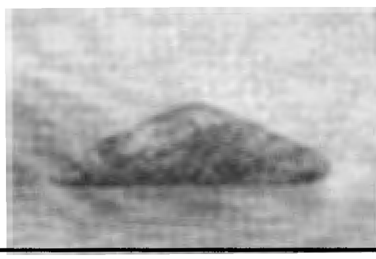
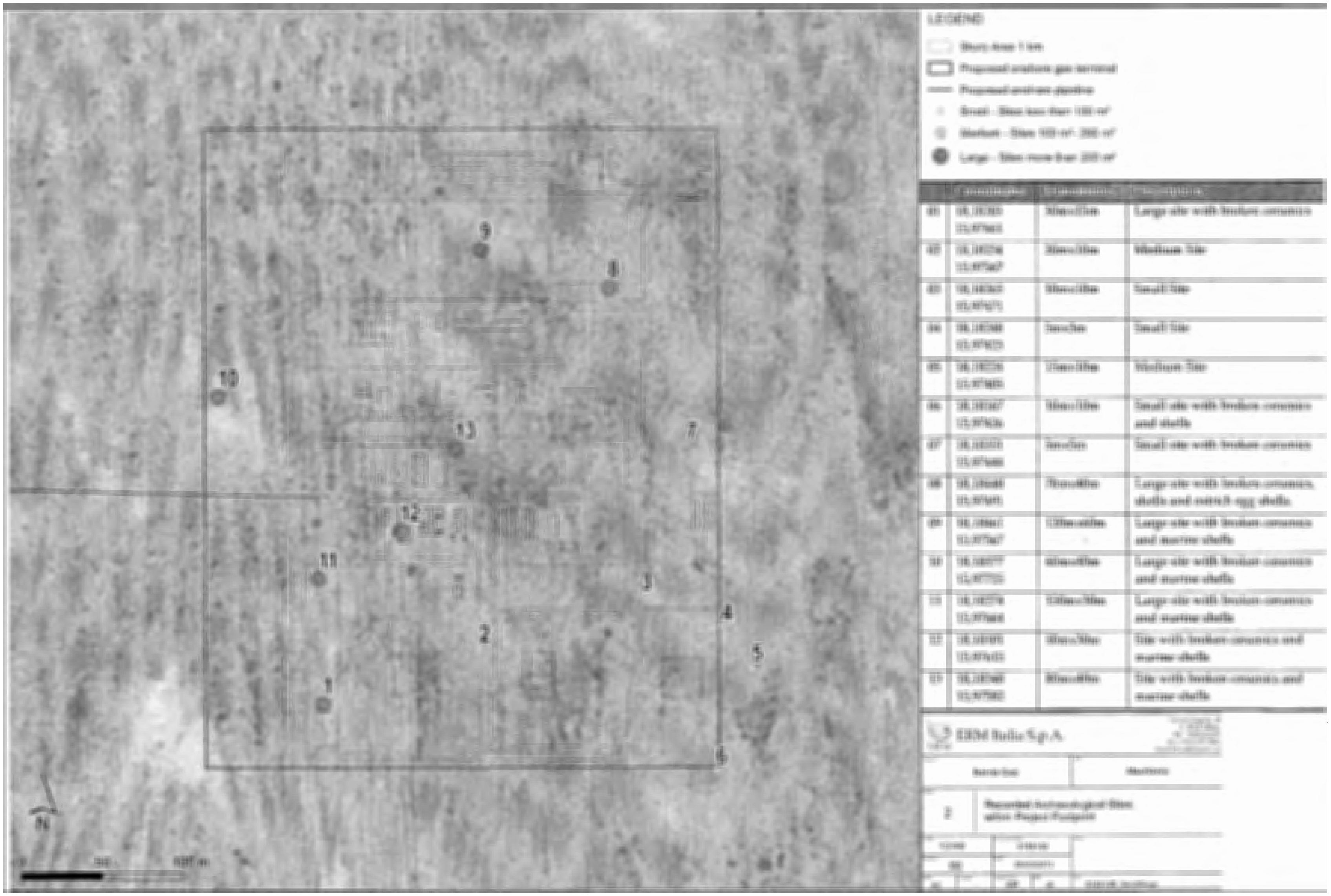
Late Stone Age Ceramic Sherd 	Coil built ceramics are common to both the Late Stone Age and Iron Age in Mauritania. However, here the coil lines are left for aesthetic purposes, which suggest it is Late Stone Age in date.
Possible Nouakchott Culture Ceramic Sherd 	These types of ceramics vessels - large, thick with a restricted neck - are common to several prehistoric cultures. However, this one seem to match with the Nouakchott culture fairly well.
Ground Stone Axe 	This is a ground stone axe. Production of ground stone tools abruptly stops across much of West Africa with the introduction of iron smelting around 500 BC. Following this logic, this tool is estimated to be between 2500 and 5000 years old.
Grinding Stone 	This is a grinding stone. They are common across all West Africa and are used as far back as 30,000 BC right up to the modern period.

Figure 4.75 Locations of Cultural Heritage Recorded within the Project Footprint



5 *IMPACT IDENTIFICATION AND ASSESSMENT*

5.1 *APPROACH TO THIS ASSESSMENT*

This assessment of the potential environment impacts associated with the proposed Banda Gas development is developed as follows:

- *Section 5.2* presents the impact assessment methodology ;
- this is followed by an identification of impacts that may potentially arise (*Section 5.3*), and a preliminary assessment of their significance (*Section 5.4*); and
- impacts found to be significant are then assessed in further detail in *Section 5.5 to 5.7.*

5.2 *IMPACT ASSESSMENT METHODOLOGY*

The purpose of the impact assessment is to identify and evaluate the significance of potential impacts on identified receptors and resources; to develop and describe mitigation measures that will be taken to avoid or minimise any potential adverse effects and enhance potential benefits; and to report the significance of the residual impacts that remain following mitigation.

5.2.1 *Predicting the Magnitude of Impacts*

The term 'magnitude' covers all the dimensions of the predicted impact to the natural and social environment including:

- the nature of the change (what resource or receptor is affected and how);
- the spatial extent of the area impacted or proportion of the population or community affected;
- its temporal extent (*ie* duration, frequency, reversibility); and
- where relevant, the probability of the impact occurring as a result of accidental or unplanned events.

Table 5.1 provides definitions for the impact characteristics used in this assessment.

Table 5.1 *Impact Characteristic Terminology*

Impact Magnitude	
Type	**Direct** – impacts that result from a direct interaction between the project and resource/receptor. **Indirect** – impacts that follow on from direct interactions between the project and its environment as a result of subsequent interactions. **Induced** – impacts that result from other activities that happen as a consequence of the project.
Extent	**Local** – impacts that are limited to the Banda development area or Nouakchott onshore base and the surrounding area. **Regional** – impacts that are experienced beyond the local areas to the wider region, eg Dakhlet Nouahibou or Block C10. **International** – impacts that are experienced at an international scale ie affecting another country.
Duration	**Temporary** – predicted to last less than the project duration. **Short-term** - predicted to last only for the duration of the drilling or construction operations (ie up to approximately two years). **Medium-term** - predicted to last from two years to the end of the project life (ie 20 years). **Long-term** - predicted to continue beyond the project life but will cease in time. **Permanent** – impacts that cause a permanent change in the affected receptor or resource that endures substantially beyond the project lifetime.
Frequency	**Continuous** – impacts that occur continuously or frequently. **Intermittent** – impacts that are occasional or occur only under specific circumstances
Likelihood*	**Unlikely** – the event is unlikely but may occur during the project. **Possible** – the event is likely to occur at some point during the project. **Likely** – the event will occur during the project (ie it is inevitable).

* For unplanned events only.

Magnitude describes the actual change that is predicted to occur in the resource or receptor (*eg* the area and duration over which disturbance of the seabed will occur; the degree of impact on the livelihoods of a local community; the probability and consequences in terms of accidental events). An assessment of the overall magnitude of an impact is, therefore, provided that takes into account all the dimensions of the impact described above to determine whether an impact is of small, medium or large magnitude.

5.2.2 *Sensitivity/Vulnerability/Importance of Resources and Receptors*

The significance of the impacts resulting from an impact of a given magnitude will depend on the characteristics of resources and receptors to that impact in terms of their sensitivity, vulnerability and importance.

The quality or importance of a resource will be judged taking into account, for example, it's national or international designation, its importance to the local or wider community, its ecosystem function or its economic value. The assessment of the sensitivity of human receptors, for example a fishing community or wider social group, will consider their likely response to the change and their ability to adapt to and manage the effects of the impact.

Where required, specific criteria for assessing sensitivity are presented under the relevant impact assessment sections.

5.2.3 *Assessing and Reporting Impact Significance*

All human activity imposes some level of change to the natural and social environment, because of physical interactions with natural systems or other human activities. To provide information to decision makers and other stakeholders on the importance of different project impacts, the EIA team makes an evaluation of the significance of each such change.

There is no statutory definition of significance. Therefore, in the EIA, the evaluation of significance is inherently subjective. It is based on the professional judgement of the EIA team, informed by legal standards, national and regional government policy, current industry good practice and the views of stakeholders. Where specific standards are either not available or provide insufficient information on their own to allow grading of significance, evaluation of significance will take into account the magnitude of the impact and the quality, importance or sensitivity of the affected resource or receptor.

Magnitude and receptor quality/importance/sensitivity are assessed in combination to evaluate whether an impact is, or is not, significant and if so its degree of significance (defined in terms of *Minor, Moderate* or *Major).* Impacts ranked as *Negligible* include those that are slight or transitory, and those that are within the range of natural environmental and social change. This principle is illustrated schematically in *Table 5.2*.

5.2.4 *Mitigation Measures*

One of the key objectives of an EIA is to identify and define socially and environmentally acceptable, technically feasible and cost-effective mitigation measures. Mitigation measures are developed to avoid, reduce, remedy or compensate for the significant negative impacts identified during the EIA process, and to create or enhance positive impacts such as environmental and social benefits. In this context the term mitigation measures includes operational controls as well as management actions.

Where a significant impact is identified, a hierarchy of options for mitigation is explored as shown in *Box 5.2*.

Table 5.2 ***Significance Matrix***

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

Box 5.1 ***Context of Impact Significances***

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

For impacts that are initially assessed during the EIA process to be of *Major* significance, a change in design is usually required to avoid, reduce or minimise these, followed by a reassessment of significance. For impacts assessed during the EIA process to be of *Moderate* significance, where appropriate the discussion explains the mitigation measures that have been considered, the one selected and the reasons (*eg* in terms of technical feasibility and cost-effectiveness) for that selection. Impacts assessed to be of *Minor* significance are usually managed through good industry practice, operational plans and procedures.

The EIA is intended to help decisions on projects to be made in full knowledge of their likely impacts on the environment and society. As noted below, the residual impacts and their significance reported in this report are based on the proposed Banda Gas development as described, *ie* inclusive of all proposed mitigation.

Box 5.2 ***Hierarchy of Options for Mitigation***

- **Avoid at Source** – avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working areas or changing the time of the activity).
- **Abate on Site** – add something to the design to abate the impact (eg pollution control equipment, traffic controls, perimeter screening and landscaping).
- **Abate at Receptor** – if an impact cannot be abated on-site then control measures can be implemented off-site (eg noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site).
- **Repair or Remedy** – some impacts involve unavoidable damage to a resource (eg agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind** – where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

5.2.5 *Reporting Residual Impacts Significance*

The degree of significance attributed to residual impacts indicates the level importance that should be associated with each impact, in the decision-making process on the Project.

Box 5.3 ***Weight of Residual Impacts in the Decision-making Process***

Impacts of *Major* significance, whether positive or negative, are considered to warrant substantial weight, when compared with other environmental, social or economic costs and benefits; conditions will be expected to be imposed to control and, if necessary, monitor adverse impacts and deliver benefits.

Impacts of *Moderate* significance are considered to be of reducing importance to making decisions, but still warranting careful attention to conditions regarding mitigation and monitoring, to ensure the most appropriate (technically feasible and cost-effective) mitigation measures are used and to ensure benefits are delivered.

Impacts of *Minor* significance are brought to the attention of decision-makers but will be identified as warranting little if any weight in their decision; mitigation will be achieved using normal good practice and monitoring may be required to confirm that impacts are as predicted.

5.2.6 *Uncertainty*

Even with a final Project description and an unchanging environment, predictions of impacts and their effects on resources and receptors can be uncertain. Predictions can be made using varying means ranging from qualitative assessment and expert judgement through to quantitative techniques (*eg* air quality modelling). The accuracy of predictions depends on the methods used and the quality of the input data for the Project and the environment. Where uncertainty affects the assessment of impacts a conservative (*ie* reasonable worst case) approach to assessing the likely residual impacts is adopted with mitigation measures developed accordingly. To verify predictions and to address areas of uncertainty, monitoring plans are proposed.

5.3 *SCREENING / PRELIMINARY IDENTIFICATION OF IMPACTS*

The initial stage of the assessment process is the screening of potential impacts. This was conducted during the scoping phase based on a preliminary Project description and involved the production of a high level, matrix of potential interactions between the proposed activities and the surrounding environment. The preliminary interaction matrix for the Banda Gas development is included as *Table 5.3*.

Table 5.3 Impacts Screening Matrix for the Banda Gas Project

Project Phases and Activities	Physical					Biological		Socio-Economic								
	Air Quality	Marine Water Quality	Landscape	Terrestrial Water Quality	Seabed	Marine Ecology	Terrestrial Ecology	Artisanal Fishing	Industrial fishing	Maritime navigation	Coastal resources	Road users/transportation	Community Health	Cultural Heritage	Local activities/economy	Population/employment
Drilling and Completions, Subsea Installation, Pipeline installation																
Physical presence of the MODU, installation and support vessels						■		■	■	■	■					
Onshore supply base and logistical operations												■				■
Emissions to atmosphere from vessels and flaring	■															
Operational discharges (including black, grey, bilge waters, etc.)		■			■	■		■	■		■		■			
Noise (including underwater noise and noise from helicopters)						■										
Discharge of drilling cuttings		■			■	■										
Pipeline and umbilical installation		■		■	■	■	■	■	■	■	■	■		■	■	■
Unplanned events (oil and chemical spills, well blowouts, etc.)	■	■			■	■		■	■	■	■		■		■	■
Construction of Onshore Gas Plant																
Physical presence of workers, equipment, materials and construction works							■							■	■	■
Logistic operations (transportation of workers and equipment, storage, etc.)												■	■		■	
Waste generation and management				■							■	■	■		■	
Noise emissions from construction equipment, workforce							■						■			
Emissions to atmosphere from vehicles, dust generation	■						■						■			
Unplanned events (spills, road accidents, etc.)	■			■			■				■	■	■			
Project Operations																
Physical presence and maintenance operations of all subsea infrastructure					■	■		■	■	■	■					
Physical presence of gas plant and associated infrastructure (pipeline)			■													
Operational emissions to atmosphere (eg flaring)	■						■						■			
Noise emissions from gas plant and traffic							■						■			
Liquid effluents and waste water treatment from gas plant				■			■									
Project related traffic to and from the gas plant												■				
Waste generation, management and disposal				■									■			
Employment & Procurement															■	■
Unplanned events (spills, road accidents, explosions, etc.)	■	■		■	■	■	■	■	■	■	■	■	■		■	■

5.4 *PRELIMINARY ASSESSMENT OF IMPACTS*

From the information provided in the screening matrix, a more detailed preliminary assessment was performed.

The Banda Gas development project phases were divided into a list of individual activities, termed 'aspects' which are listed down the left hand of the table. These aspects also include potential accidental events. Once identified, the interactions are assessed to determine whether they are significant or not, based on the magnitude of impacts and the quality, importance or sensitivity of the receiving the environment. It is noted that the mitigation measures change the magnitude of the effects which in turn can change the significance of the impact.

- *Table 5.4* presents the preliminary assessment of the impacts associated with the offshore construction phase of the Project.
- *Table 5.5* presents the preliminary assessment of the impacts associated with the onshore construction phase of the Project.
- *Table 5.6* presents the preliminary assessment of the impacts associated with the operational phase of the Project.

Table 5.4 ***Preliminary Assessment – Offshore Construction Phase***

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
DRILLING AND COMPLETIONS					
Physical Presence					
Presence and navigation of MODU during rig move	• Interference with shipping and navigation of other sea users as a result of the MODU.	• Provide advanced notice to marine authorities. • Notice to Mariners. • Navigational marks and lights on the MODU. • The MODU will maintain radio contact with other users of the sea to mitigate the risk of collisions.	**Small** – limited additional vessel movements are anticipated in the short-term. Collision risk is considered in *Section 5.5.3*.	**Medium** – located on higher density shipping route out of Nouakchott. There is a high density of fishing vessels in the area.	**Minor**
	• Noise disturbance to marine mammals resulting in behavioural avoidance.	• No mitigation required.	**Small** – localised effect on marine fauna from continuous or near continuous low energy underwater sound.	**Small** – marine mammal species and individuals differ in sound threshold level and sensitivity to sound characteristics. Species likely accustomed to some degree of vessel movement and noise. Mobile species can avoid adverse sound levels.	**Negligible**
Presence of MODU at drilling location, and 500 m exclusion zone	• Interference with shipping and navigation due to the presence exclusion zone.	• Provide advanced notice to marine authorities. • Navigational marks and lights on the MODU. • Liaison with relevant stakeholders before start of drilling. • The MODU will maintain radio contact with other users of the sea to mitigate the risk of collisions.	**Small** – relatively small area (0.79 km^2) to be excluded in the short term. Collision risk is considered in *Section 5.5.3*.	**Medium** – located on higher density shipping route out of Nouakchott en route to the Berge Helene FPSO. There is a high density of fishing vessels in the area.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Loss-of access to fishing grounds due to exclusion zone.	• Liaison with relevant stakeholders before start of drilling. Safety zone will be monitored for the safety of the facility and fishermen.	**Small** – relatively small area (0.79 km^2) will be unavailable for fishing in the short term.	**Low** – the Banda field is not considered to be an important area for artisanal or industrial fishing. Artisanal and coastal fishing activities are expected to remain within the limit of 6 nm off the coast. The area is used for industrial fishing (pelagic and demersal trawlers) and is used as a transit route by fishing vessels along the coast.	**Negligible**
	• Potential disturbance to migrating birds from artificial lighting onboard the MODU.	• No mitigation required.	**Small** – temporary operation located ~55 km from shore. Any impact from artificial lighting will be short term, lasting only until MODU demobilisation.	**Medium** – important Bird Areas in the coastal areas of Mauritania, and particularly the Senegal delta, support migrating birds along the East Atlantic Flyway.	**Minor**
Drilling Operations					
Discharge of drill cuttings and fluids	• Physical smothering of seabed. • Water and sediment contamination from drilling chemicals. • Exposure of marine fauna to chemicals in drilling fluids chemicals.	• Well top holes and surface sections will be drilled using seawater and sweep pills. • Use solid control equipment to achieve 5-10% oil on cuttings when using either WBM or improved SBM. • Discharge from MODU via caisson 5 m below the water surface to facilitate dilution and dispersion. • Selection and use of drilling fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. . • Use of low toxicity improved SBM if SBMs is required in light of technical / geological constraints	**Medium** – cuttings discharged from the top and surface sections will result in smothering impacts of a small area of seabed. Improved SBM will also have some small toxic and organic enrichment effects. Discharge from the surface will increase suspended sediments. Discharge of drill cuttings and fluid is considered further in *Section 5.5.1.*	**Low** – generally featureless benthic habitat and homogenous benthic fauna at the well sites. No evidence of sensitive habitats in the Banda field. Dominant fauna generally not sensitive to smothering and expected to recovery in the short term. Good existing water quality.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
Well Completion					
Well completion	• Discharges of commissioning fluids can impact on water quality and marine fauna.	• Selection and use of completion fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. • Compliance with IFC requirements with regards to oil in water contents (Maximum one day oil and grease discharge should not exceed 42 mg/L; 30 day average should not exceed 29 mg/L). • Acidic solutions will be neutralised (to attain a pH of 5-7) before testing and disposal.	**Small** – discharges of completion fluid will be occasional and in the short term which may have a localised effect on water quality.	**Low-Medium** – good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. Low to high value species supported.	**Negligible**
Flaring during well testing	• Upper completion and well flowback fluids will be flared off after use. Release of gaseous emissions (PM_{10}, SOx, NOx, VOC, CO, CO_2, CH_4) – with potential effects on air quality and contribute to global warming. • Hydrocarbon flaring during testing.	• Minimise volume of completion and flowback fluid to be flared to the extent practical. • Minimise well test durations to the extent practical • Use efficient test flare burner head equipped with an appropriate combustion enhancement system to minimise incomplete combustion, black smoke and hydrocarbon fallout to the sea.	**Medium** – small quantities of VOC and CO_2 will be emitted in the short-term, resulting in a localised and short term impact on air quality due to the highly dispersive nature of the environment of the offshore location	**Low** - emissions from the offshore activities are unlikely to have significant direct impacts given the absence of sensitive receptors.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
SUBSEA INSTALLATION AND COMMISSIONING					
Physical Presence					
Presence of installation vessels (pipelay, MSV, etc.)	• Interference with shipping and navigation of other sea users as a result of the presence of installation vessels.	• Provide advanced notice to marine authorities. • Presence of Fishing Liaison Officers on-board selected installation vessels. • The installation vessels will maintain radio contact with other users of the sea to mitigate the risk of collisions.	**Small** – limited additional vessel movements are anticipated in the short-term. Collision risk is considered in *Section 5.5.3*.	**Medium** – located on higher density shipping route out of Nouakchott. There is a high density of fishing vessels in the area.	**Minor**
	• Noise disturbance to marine mammals resulting in behavioural avoidance.	• No mitigation required.	**Small** – localised effect on marine fauna from continuous or near continuous low energy underwater sound.	**Small** – marine mammal species and individuals differ in sound threshold level and sensitivity to sound characteristics. Species likely accustomed to some degree of vessel movement and noise. Mobile species can avoid adverse sound levels.	**Negligible**
Installation Operations					
Installation operations	• Physical impact on the seabed and benthic fauna through placement and presence of subsea infrastructure.	• Pre-installation survey. • Post-installation survey. • Provision of data for inclusion of nautical charts.	**Small**– long term but very localised impact to the seabed and benthic fauna. Small additional seabed footprint (640 m^2).	**Medium** - generally featureless benthic habitat and homogeneous benthic fauna dominated by polychaete worms. No evidence of sensitive habitats within the Banda field.	**Minor**
	• Impacts on marine fauna due to underwater sound from installation activities.	• No mitigation required.	**Small** – localised effect on marine fauna from continuous or near continuous low energy underwater sound in the short term.	**Medium** – low to high value marine mammal species. Species and individuals differ in sound threshold level and sensitivity to sound characteristics. Mobile species can avoid adverse sound levels.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
Pipeline and umbilical installation	• Physical impact on the seabed and benthic communities as a result of installation the pipeline and umbilical (offshore)	• Pre-installation survey. • Micro-routing the pipeline to avoid sensitive habitats. • Post-installation survey. • Provision of data for inclusion in nautical charts.	**Medium** - localised disturbance to the seabed and benthic fauna along the offshore pipeline route between the Banda field and the nearshore. Installation is expected to directly affect up to 10 m width along the entire length (~60 km). The trench will be backfilled and the seabed is expected to recover in the short term. Rock dumping may be required for ~12 km of the pipeline length.	**Low** – generally featureless benthic habitat and homogenous fauna in the Banda field (dominated by polychaetes). More diverse along the pipeline route, however, still dominated by low value polychaetes and crustaceans. No evidence of potentially sensitive habitat in the Banda field or along the pipeline route.	**Minor**
	• Physical impact on the seabed and fauna as a result of installation the pipeline and umbilical (nearshore)	• Pre-installation survey. • Beach inspection at the pipeline landfall before ground disturbing activities in order to identify any potential turtle nest. • Micro-routing the pipeline to avoid sensitive habitats. • Post-installation survey.	**Medium** - localised disturbance to seabed and fauna at the nearshore section of pipeline (15 km) and the landfall site. The trench will be backfilled and seabed/fauna is expected to recover in the short term.	**Low** – nearshore dominated by low value benthic fauna (polychaetes and crustaceans). No vegetation recorded on the nearshore area, occupied only by some seabirds, molluscs and small mammal species (rodents and small carnivores). There is no evidence of potentially sensitive habitat along the nearshore section.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Crossing over the existing ACE cable in approx. 15m of water.	• Liaison with the cable operator and development of a crossing agreement. • Physical separation between the pipeline and the ACE fibre optic cable. • Protection of the section of pipeline lying on the seabed by rock dumping or flexible concrete mats.	**Small** – The crossing will be constructed in a conventional manner providing physical separation between the pipeline and the ACE fibre optic cable	**Medium** – Dialogue with the cable operator has commenced and a crossing agreement will ensure the protection of the cable.	**Minor**
Testing and Pre-Commissioning Operations					
Testing and pre-commissioning operations	• Chemically treated hydrotest waters will be discharged and can have a detrimental impact on water quality and marine fauna.	• Dewater pipeline from onshore so that discharge is offshore ensuring good dilution. • Select low toxicity chemicals.	**Small** – hydrotest waters will only be discharged during installation and commissioning.	**Low** – good baseline water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion.	**Negligible**
SUPPORT VESSELS / HELICOPTER SUPPORT : DRILLING, COMPLETIONS, INSTALLATION AND COMMISSIONING					
Physical Presence					
Movement and physical presence of support vessels	• Interference with shipping and navigation due to the presence of support vessels and associated collision risk.	• Provide advanced notice to marine authorities. • The support vessels will maintain radio contact with other users of the sea to mitigate the risk of collisions. Navigational marks and lights on the MODU. • Vessel transit route will be communicated to fishermen through the CLOs.	**Small** – limited additional vessel movements are anticipated in the short-term	**Medium** – located on higher density shipping route out of Nouakchott en route to the Berge Helene FPSO. There is a high density of fishing vessels in the area.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Disturbance through movement and noise to marine mammals.	• Prevent excessive speeds and rapid change of direction for vessels when operating in the field to reduce risks of collisions.	**Small** - limited additional vessel traffic between the Banda Area and the Port of Nouakchott in the short term.	**Medium** – low to high value marine mammal species, however, marine mammals are mobile species and can avoid oncoming marine traffic. Species likely accustomed to some degree of vessel movement and noise given baseline marine traffic.	**Minor**
Helicopter movements	• Disturbance of important bird habitats.	• Helicopters will normally not have to fly over IBAs during normal operation. Helicopters flying over IBAs must maintain a minimum altitude of 2,300 ft (710 m) to minimise disturbance.	**Small** – limited helicopter traffic (4 round trips per day) for the duration of the drilling operations. Helicopters fly at height until they reach the Banda field.	**Medium** – important Bird Areas in the coastal areas of Mauritania, and particularly the Senegal delta, support migrating birds along the East Atlantic Flyway.	**Minor**
OTHER EMISSIONS AND DISCHARGES: DRILLING, COMPLETIONS, INSTALLATION AND COMMISSIONING					
Discharges of operational effluents: MODU, support vessels, installation vessels	• Discharge of black and grey water will introduce material with a Biological Oxygen Demand (BOD) to seawater. Potential for organic enrichment and oxygen depletion in vicinity of the discharge location.	• Compliance with MARPOL requirements and good industry practice.	**Small** – discharge of small volumes of black water and grey water is expected to have a localised impact.	**Low-Medium** – good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. Low to high value species supported.	**Minor**
	• Discharges from Project vessel contaminated with traces of hydrocarbons can affect water quality with secondary impacts on marine fauna.	• Compliance with MARPOL requirements and good industry practice.	**Small** – frequent but localised impact of small volumes in the short term.	**Low-Medium** – good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. Low to high value species supported.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Discharge of ballast waters (from MODU and other vessels) can impact on water quality and marine fauna. Risk of introduction of invasive species.	• Compliance with MARPOL requirements. • Ballast water management measures. • Compliance with *International Convention for the Control and Management of Ships Ballast Water & Sediments* to minimise the transfer of organisms.	**Very Small** – occasional discharges of ballast water may have a localised effect on water quality.	**Low-Medium** – good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. Low to high value species supported.	**Negligible**
Drilling, completions, installation and commissioning GHG emissions	• Contribution to global warming	• Best practice and good operation management will be applied to enhance efficiency and where possible minimize CO_2 emissions	**Small** - GHG emissions in Mauritania represented 8.9 Mt/y of CO_2-equivalent in 2005. The offshore construction phase emissions are estimated to be approximately 100 000 tonnes of CO_2 equivalent. (see Chapter 3 for the Emissions inventory). The Construction phase emissions will represent 1.1% of the country's yearly GHG emissions.	**NA**	**Minor**
Power generation and engine exhaust emissions	• Release of gaseous emissions (PM_{10}, SOx, NOx, VOC, CO, CO_2, CH4) - with potential effects on air quality.	• Compliance with MARPOL Annex VI, which sets limits on sulphur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances. • Routine inspection and maintenance of engines, generators and other equipment to minimise air emission.	**Medium** – quantities of VOC and NOx will be emitted resulting in a localised and short term impact on air quality due to the highly dispersive nature of the environment of the offshore location.	**Low** - Emissions from the offshore activities are unlikely to have significant direct impacts given the absence of sensitive receptors.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
Solid waste generation	• Discharge to the water column of food waste from galley. • Waste generated on the MODU and Project vessels will be segregated offshore for storage/ disposal onshore.	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained, and suitable vehicles or vessels and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	**Low to Medium** – impact could occur at a local level and in the long term but volumes of wastes will be small. Limited currently available facilities for waste handling and disposal.	**Medium-High** depending on the sensitivity/ vulnerability of soils and groundwater resources at disposal sites and the proximity and access of communities to the disposal site.	**Minor**
EMPLOYMENT AND PROCUREMENT: DRILLING, COMPLETIONS, INSTALLATION AND COMMISSIONING					
Employment and training	Direct employment by the Project and indirect employment through contractors and suppliers will have a positive impact on those people employed, their families and their local communities from wages and other benefits.	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors, will employ and train nationals where it is practical to do so.	**Small** - few additional employment and training opportunities will be created but could have a positive direct effect at the local level in the short term.	**Medium** - high level of expectations and direct benefits to the population at a local level.	**Positive**
Procurement of goods and services	Socio-economic opportunities generated through procurement of goods and services associated with Project activities.	• Implement Tullow's local content policy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so.	**Small** - most good and services will be sourced internationally. Some good and services will sourced from Mauritanian companies in order to support national economy and to create employment opportunities.	**Medium** - high level of expectations and direct benefits to the population at a local level.	**Positive**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
UNPLANNED / ACCIDENTAL EVENTS: DRILLING, COMPLETIONS, INSTALLATION AND COMMISSIONING					
Accidental fuel oil (diesel) spill	Impacts to marine and coastal habitats and species (seabirds, marine mammals, marine turtles, fish) and temporary impacts to artisanal and industrial fisheries, and tourism.	• MODU and marine vessels will be designed, operated and maintained in accordance with international standards such that the risk of accidental spills will be minimised. • Oil spill prevention equipment, measures and procedures. • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill.	**Medium** – large diesel spills (*eg* loss of the MODU's fuel inventory through collision) are unlikely during the life-time of the Project. In the event of an incident the extent of impacts would be directly related to the duration and volume of the oil release. Coastal impacts may occur.	**Medium** - good existing water quality, marine and coastal habitats and species are of high value and sensitivity both ecologically and commercially.	**Moderate**

Table 5.5 ***Preliminary Assessment – Onshore Construction Phase***

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
SECURING LAND TENURE					
Project-related land acquisition and restrictions on land use	• Current studies suggest that no physical displacement will be required.	• Should the Project configuration change in such a way that some physical displacement is required, Tullow will manage displacement in line with IFC-PS 5.	**Minor** – only one small scale construction has been identified within the exclusion zone, 35 m away from the proposed onshore pipeline route.	**Moderate** - land users identified in the Project footprint are temporary users and do not rely on land for permanent residence or livelihoods.	**Minor**
	• Economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood)	• The proposed onshore pipeline will be trenched and will not prevent movement across the proposed route or cause any severance.	**Negligible** – no economic displacement is anticipated as a result of project-related land acquisition and/or restrictions on land use.	**Moderate** - land users identified in the Project footprint are temporary users and do not rely on land for livelihoods.	**Negligible**
PLANT CONSTRUCTION ACTIVITIES					
Site Preparation	• Surface drainage disturbance • Soil erosion • Ground disturbance	• Areas of ground disturbance will be clearly defined; ground disturbance outside these areas will be avoided. • Top soils removed will be stored and reused. • Excavated material will be used, where possible, for onsite landscaping/re-profiling.	**Small** – erosion due to rainwater will be non-significant considering rainfall. Wind erosion is likely to be low. Affected area will be local scale.	**Medium** – receptor sensitivity is medium considering the homogeneity of natural habitats at a regional scale.	**Minor**
Ground Disturbing Activities	• Potential impact to cultural heritage (archaeological sites)	• A surface artefacts collection will be organized before the ground disturbing activities under the supervision of the Mauritanian Institute for Scientific Research (Institut Mauritanien de Recherche Scientifique - IMRS). • Basic archaeological training in site detection should be provided to project staff and construction workers. • An archaeological chance finds protocol should be developed to manage unexpected finds.	**Small** – ground disturbing activities are localized and any impacts can be managed through proper archaeological mitigation measures.	**Medium** – receptor's sensitivity is medium considering that all archaeological sites are unique and irreplaceable but that the type of site found within the Project footprint is relatively common at a regional level.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Destruction of fauna and flora habitats	• The site layout has been optimized to minimize the size of the footprint during construction activities (13 ha). • Areas of required ground disturbance will be clearly defined and ground disturbance outside these areas will be avoided. • Any vegetation cut on the gas processing facilities location will be offset.	**Small** – destruction of natural habitats will be limited due to the small footprint of the plant.	**Low** - the natural habitats within the plant layout do not present important biological values; habitats sensitivity is low considering their homogeneity at a regional scale. No protected or vulnerable species of fauna and flora have been recorded. Three partially protected species (*Streptopelia senegalensis* and two species of hare) has been recorded; their conservation status within the study areas is good, and these species present low sensitivity to the disappearance of a very small part of their habitats.	**Negligible**
Civil Works and Plant Utilities Construction	• Waste generation	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	**Low to Medium** – impact could occur at a local level and in the long term but volumes of wastes will be small. Limited currently available facilities for waste handling and disposal.	**Medium-High** – depending on the sensitivity/ vulnerability of soils and groundwater resources at disposal sites and the proximity and access of communities to the disposal site.	**Minor**
Both plant construction phases	• Release of gaseous emissions (PM_{10}, SOx, NOx, VOC, CO, CO_2, CH4) – with potential effects on air quality	• Routine inspection and maintenance of engines, generators and other equipment to minimise air emission. Use of low-sulphur diesel if locally available.	**Small** – emission sources are transient, mobile, and very limited in terms of quantities emitted. The emissions inventory is detailed in chapter 3.	**Low** - emissions from the construction works are unlikely to have significant direct impacts given the distance to the nearest sensitive receptors.	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Noise disturbance to fauna	• No mitigation required. Best practice and good operation management will be applied.	**Medium**- noise levels are likely to be almost similar during the two stages of plant construction activities. The model prediction shows that noise levels should not exceed applicable standards. However, the size of the area of disturbance could induce an impact of medium magnitude.	**Low**-. fauna living or passing by noise or vibrations sources can be frightened, and temporarily leave the plant area and its surroundings. The area around the disturbed zone represents sinilar habitats for the fauna potentially concerned, so this temporarily avoidance will not induce modification of the conservation status of the species.	**Minor**
	• Noise disturbance to local community	• No mitigation required. Best practice and good operation management will be applied.	**Small**- noise levels are likely to be almost similar during the two stages of plant construction activities. The model prediction shows that noise levels should not exceed applicable standards.	**Low**- the nearest receptor is located 2.7 km from the site and the predicted noise levels should not exceed applicable standards.	**Negligible**
Road traffic	• Impact on traffic safety	• Application of the company's road safety policy to operator and contractor vehicles.	**Small** – the construction fleet will be relatively small (2 dump trucks, 4 mini buses and 4 cars) and comply with the company's road safety policy	**Medium**- the Project related fleet will contribute to traffic on a busy area with relatively sensitive spots such as the new university.	**Minor**
ONSHORE PIPELAY ACTIVITIES (1)					
Grading and Trenching	• Ground Disturbance	• Areas of required ground disturbance will be clearly defined and ground disturbance outside these areas will be avoided. • Prior to works, access road to the working sites will be determined.	**Small** - the onshore pipeline will length 5.6 km. Long term but very localised impact to soil.	**Medium**- potential sensitive habitats could be affected by earthworks.	**Minor**

(1) Impacts associated with pipeline landfall are assessed with offshore activities.

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Release of gaseous emissions (PM_{10}, SOx, NOx, VOC, CO, CO_2, CH4) - with potential effects on air quality	• Routine inspection and maintenance of engines, generators and other equipment to minimise air emission. Use of low-sulphur diesel if locally available.	**Small –** emission sources are transient, mobile, and very limited in terms of quantities emitted. The emissions inventory is detailed in chapter 3.	**Low** - emissions from the construction works are unlikely to have significant direct impacts given the distance to the nearest sensitive receptors.	**Negligible**
	• Potential impact to cultural heritage (archaeological sites)	• The footprint of the Onshore Pipelay route should be surveyed by an archaeologist for any sites that may potentially be impacted by associated ground disturbing activities. • A surface artefacts collection will be organized before the ground disturbing activities under the supervision of the Mauritanian Institute for Scientific Research (*Institut Mauritanien de Recherche Scientifique - IMRS*). • Basic archaeological training in site detection should be provided to project staff and construction workers. • An archaeological chance finds protocol should be developed to manage unexpected finds.	**Small –** ground disturbing activities are localized and any impacts can be managed through proper archaeological mitigation measures.	**Medium –** receptor's sensitivity is medium considering that all archaeological sites are unique and irreplaceable but that the type of site found within the Project footprint is relatively common at a regional level.	**Minor**
	• Destruction of fauna and flora habitats	• Avoid sensitive habitats such as shrubs if possible. • The pipeline route will be reinstated.	**Small -** the pipeline will be trenched, and the final footprint will be reduced to its minimal. The pipeline route will not create any corridor effect disturbing the movements of fauna.	**Low -** the most sensitive habitats (shrubs) will be preserved as far as possible.	**Negligible**
	• Noise disturbance to fauna	• No specific mitigation required. • Best practice and good operation management will be applied. • Beach inspection at the pipeline	**Medium**- noise levels are likely to be almost similar during the two stages of plant construction activities. The model prediction shows that	**Low**-. fauna living or passing by noise or vibrations sources can be frightened, and temporarily leave the pipeline route and its surroundings.	**Minor**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
		landfall before the ground disturbing activities in order to identify any potential turtle nest.	noise levels should not exceed applicable standards. However, the size of the area of disturbance could induce an impact of medium magnitude.	The area around the disturbed zone represents similar habitats for the fauna potentially concerned, so this temporarily avoidance will not induce modification of the conservation status of the species.	
	• Noise disturbance to local community	• No mitigation required	**Small**- noise levels are likely to be almost similar during the two stages of plant construction activities. The model prediction shows that noise levels should not exceed applicable standards.	**Low**- the nearest receptor is located 2.7 km from Site and the predicted noise levels do not exceed applicable standards.	**Negligible**
Highway crossing	• Disturbance of road traffic	• Safety process for highway crossing will be established in liaison with the road traffic authorities. Only one lane will be closed at a time.	**Small** – important impact but very short term and localised.	**Medium** - interruption of the highway on one lane will affect users.	**Minor**
Traffic Safety					
Road traffic	• Impact on traffic safety	• Application of the company's road safety policy to operator and contractor vehicles.	**Small** – the construction fleet will be relatively small (2 dump trucks, 4 mini buses and 4 cars) and comply with the company's road safety policy	**Medium**- the Project related fleet will contribute to traffic on a busy area with relatively sensitive spots such as the new university.	**Minor**
Waste Generation					
	• Domestic Waste	• Operational controls contained in Waste Management Plan. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous	**Small** – limited amounts of wastes predicted; no significant generation of hazardous wastes.	**Low** – limited habitat sensitivity and no environmental amenity identified near the proposed plant site.	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
		operation and monitoring of the disposal facility.			
	• Industrial Waste	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	**Small** – limited amounts of wastes predicted; no significant generation of hazardous wastes.	**Low** – limited habitat sensitivity and no environmental amenity identified near the proposed plant site.	**Negligible**
EMPLOYMENT AND PROCUREMENT					
Workforce					
Employment and training	• Direct employment by the Project and indirect employment through contractors and suppliers will have a positive impact on those people employed, their families and their local communities from wages and other benefits.	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors, will employ and train nationals where it is practical to do so. •	**Small** – few additional employment training opportunities will be created but could have a positive direct effect at the local level in the short term.	**Medium**- high level of expectations and direct benefits to the population at a local level.	**Positive**
Procurement of goods and services	• Socio-economic opportunities generated through procurement of goods and services associated with Project activities.	• Implement Tullow's local content policy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so.	**Small** – most goods and services will be sourced internationally. Some goods and services will sourced from Mauritanian companies in order to support national economy and to create employment opportunities.	**Medium**- high level of expectations and direct benefits to the population at a local level.	**Positive**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
In-migration	• In-migration of speculative jobseekers to the Project vicinity, leading to land take over public or private land, pressure on the environment and public infrastructure, potential conflict with resident community etc.	• Publicly advertise Tullow's in-country recruitment procedure. • No "at the gate" recruitment. • Discourage potential settlers through proactive communication by Tullow Mauritania's stakeholder engagement team.	**Small-** The Project is located in the immediate vicinity of Nouakchott which is the largest urban centre in Mauritania, and speculative jobseekers are likely to live in Nouakchott already.	**Low –** The project is located in a periurban area with low environmental sensitivity. Local communities are essentially composed of residential areas of the periphery of Nouakchott.	**Negligible**
Accommodation					
Temporary infrastructures installation	• Footprint	• After use, temporary sites will be cleared of any structure and wastes and re-profiled.	**Small-** installation predicted to last only for the duration of construction operations	**Low –** temporary infrastructures will be sited in such a way as to limit footprint over land used by other stakeholders.	**Negligible**
Domestic wastewater					
Physical presence of 100 workers	• Black and grey water generation	• Waste water will be treated via an onsite waste water treatment system.	**Medium-** construction works will last 2 years. Workforce accommodation will be in existing facilities in Nouakchott, ie there will be no generation of wastewater from worker accommodation at or around the site.	**Low –** no receptors should be affected.	**Minor**
PLANT COMMISSIONING ACTIVITIES					
Waste Generation					
Cleaning, checking and testing installed equipment	• Liquid effluents	• Selection and use of chemicals taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. • Ensure minimal quantity of chemicals is used.	**Small –** the water used for these operations will be recovered and treated for hydrocarbon removal.	**Low –** no receptors should be affected.	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
Noise emissions					
Flare testing	• Noise disturbance to fauna	• No mitigation required	**Small –** localised and temporary effects. Limited noise levels.	**Low-** low ecological value within the plant and the pipeline's area.	**Negligible**
	• Noise disturbance to local community	• No mitigation required	**Small-** localised and temporary effects. Limited noise levels generated by construction activities.	**Low-** the nearest receptor is located 2.7 km from Site.	**Negligible**
Atmospheric emissions					
Flare testing	• Release of gaseous emissions (PM_{10}, NOx, CO, CO_2, CH4)	• No mitigation required	**Medium** - localised and temporary.	**Low** – very limited number of nearby receptors.	**Minor**
Road traffic	• Release of gaseous emissions (PM_{10}, SOx, NOx, VOC, CO, CO_2, CH4)	• No mitigation required	**Negligible –** approximately Eight vehicles will be needed during the commissioning stage.	**Low –** very limited number of nearby receptors.	**Negligible**
OTHER EMISSIONS AND DISCHARGES: ONSHORE AND ONSHORE CONSTRUCTION PHASE					
Construction phase GHG emissions	• Contribution to global warming	• Best practice and good operation management will be applied to enhance efficiency and where possible minimize CO_2 emissions	**Negligible** - GHG emissions in Mauritania represented 8.9 Mt/y of CO_2-equivalent in 2005. The onshore construction phase emissions are estimated to be less than 10 000 tonnes of CO_2 equivalent. (see *Chapter* 3 for the Emissions inventory). The Construction phase emissions will represent less than 0.1% of the country's yearly GHG emissions.	**NA**	**Negligible**
UNPLANNED / ACCIDENTAL EVENTS: ONSHORE CONSTRUCTION PHASE					
Loss of containment	• Soil contamination • Impacts to groundwater	• Oil and chemicals spill prevention equipment, measures and procedures.	**Small -** small oil spills and leaks (*ie* diesel spillages	**Medium** – no sensitive habitats and very limited	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	quality • Impacts to fauna and flora	• Maintenance of vehicles • Management plan of dangerous products • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill	during bunkering) are a possibility during the life-time of the Project but these are generally localised and impacts are of short duration.	sensitive users identified within or around the Project onshore footprint.	

Table 5.6 ***Preliminary Assessment – Operational phase***

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
PLANT AND TERRESTRIAL PIPELINE OPERATION					
Noise emissions					
Plant operations	• Noise emissions from flue gas system and cooler	• No particular mitigation required. • Use of best practice and good operation management.	**Small -** the model prediction shows that noise levels should not exceed the IFC Guidelines thresholds.	**Low**- the nearest receptor is located 2.7 km from the site and the predicted noise levels are predicted to not exceed the international threshold values (IFC Guidelines) there.	**Negligible**
Air emissions					
Flaring	• Release of gaseous emissions (PM_{10}, NOx CO, CO_2, CH_4) – with potential effects on ambient air quality	• Limited emission sources. • Compliance with Air Emissions and Ambient Air Quality IFC Standards. • Routine inspection and maintenance of engines, generators and other equipment to minimise air emission.	**Small** - the model prediction shows that pollutant concentrations at groundlevel should not exceed the IFC Guidelines thresholds.	**Low**- the nearest receptor is located 2.7 km from the site and the predicted noise levels are predicted to not exceed the international threshold values (IFC Guidelines) there.	**Negligible**
Waste Treatment and Disposal					
Waste generation	• Domestic waste	• Operational controls contained in Waste Management Plan. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	**Small** – limited number of employees on site; no accommodation on site.	**Low** – limited habitat sensitivity and no environmental amenity identified near the proposed plant site.	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
	• Industrial waste	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	**Small** – limited amounts of wastes predicted; no significant generation of hazardous wastes.	**Low** – limited habitat sensitivity and no environmental amenity identified near the proposed plant site.	**Negligible**
Liquid Effluents					
Liquid effluents production	• Produced water from the Banda field (8.7 m^3/d) • Waste oils	• Water will be a product of the three stage separation and will be treated in the produced water treatment system to remove: • entrained free oil to allow for safe disposal; • soluble hydrocarbons, including volatile aromatics – benzene, toluene, ethyl benzene and xylenes (BTEX). • MEG and chemicals to reduce biological and chemical oxygen demand prevent biomass accumulation. • Treated produced water will be used in the power plant as process water to reduce its water demand or local irrigation	**Small** – very limited amounts of wastewater (up to approx. 8 m^3/d); on-site treatment, no untreated environmental discharge.	**Low** – no sensitive habitats and very limited sensitive users identified within or around the Project onshore footprint.	**Negligible**

Aspect	Potential Impact	Mitigation & Management Measures	Impact Magnitude	Receptor Quality, Importance or Sensitivity	Residual Significance
Naturally occurring radioactive material (NORM)	Disposal of NORM from periodic pipeline cleaning operations (scale removal)	Containment and disposal as hazardous material.	**Negligible** – At Banda NORMS are not expected because there is a low probability of formation water production and hence low risk of scaling	**Low-** the material would be contained and disposed of as hazardous material.	**Negligible**
Condensate export					
Condensate export / Road traffic	• Impact on traffic safety	• Application of the company's road safety policy to operator and contractor vehicles.	**Small –** the processed condensate (~800 barrels per day) will be exported on a batch basis by road tankers. This will require 2 to 6 trucks a day and constitute the main impact source on road traffic.	**Medium-** the Project related fleet will contribute to traffic on a busy area with relatively sensitive spots such as the new university.	**Minor**
Physical presence of the gas plant and associated operations					
Physical presence of the gas plant and associated operations	• Disturbance to fauna	• No mitigation required. Best practice and good operation management will be applied.	**Small-** activities associated to the presence of the plant will potentially disturb the fauna; however, the habituation of the species to the gas plant operations (and the associated decrease of the disturbance) will induce an impact of small magnitude.	**Low-** no protected or vulnerable species of fauna and flora have been recorded. Three partially protected species (*Streptopelia senegalensis* and two species of hare) has been recorded; their conservation status within the study areas is good, and these species present low sensitivity to the disturbance due to the physical presence of the plant.	**Negligible**

PHYSICAL PRESENCE OF ONSHORE PIPELINE					
Physical presence of the onshore pipeline	• Physical presence of the pipeline	• The pipeline and umbilical will be trenched. • Only pipeline markers will be visible above ground. • Periodic monitoring of the onshore part of the pipeline to reduce the likelihood of any intentional damage to it.	**Small** – the physical presence of the pipeline will not prevent movement across the Project area. Pipeline markers will be the only structure visible above ground	**Low**- no sensitive resources that could be impacted by the physical presence of the pipeline have been identified along the pipeline route	**Negligible**
Exclusion zone	• Restriction on permanent infrastructure within 60 m on both sides of the pipeline	• Coordination with Ministry of Urbanism to take into account the Project in land planning scheme.	**Medium** – the exclusion zone of the pipeline will prevent the construction of any permanent infrastructure during Project operation	**Medium** The exclusion zone does not affect any significant existing construction (only one shed has been identified within the exclusion zone). However it creates an additional constraint in a suburban area that will have to be taken into account in land planning.	**Moderate**
OFFSHORE OPERATION					
Operation of subsea control system	• Valves on the subsea equipment will discharge hydraulic control fluid to the marine environment.	• No mitigation required.	**Negligible**– an estimated 264 litres of hydraulic fluid will be discharged every year (544 litres in the first year). Intermittent discharges will be small volume every 3 to 6 months. The fluid is likely to be a waterbased glycol which is low toxicity, readily biodegradable and non-bioaccumulative.	**Low/Medium** - good existing water quality, water depth, distance offshore and hydrography in area provides a high level of dilution and dispersion. Low to high value species supported.	**Negligible**

Subsea production structures	• Physical presence of subsea production structures.	• Liaison with other users of the sea to make them aware of the subsea production structures • 500 metres fishing exclusion zone around well heads and manifold. • The subsea production structures and exclusion zone will be marked on navigation charts.	**Small** - relatively small area (0.79 km^2) will be unavailable for fishing	**Low** - the Banda field is not considered to be an important area for artisanal or industrial fishing. Artisanal and coastal fishing activities are expected to remain within the limit of 6 nm off the coast. The area is used for industrial fishing (pelagic and demersal trawlers) and is used as a transit route by fishing vessels along the coast.	**Negligible**
Pipeline, umbilical and rock dumps	• Physical presence of pipeline, unbilical and rock dumps.	• Liaison with other users of the sea to make them aware of the pipeline and umbilical • The pipeline and umbilical will be trenched along most of its length to provide stability and to prevent damage from fishing gear. • Where soil conditions obviate trenching, the pipeline and umbilical will be protected by rock dumping or flexible concrete mats. • The pipeline and umbilical route will be marked on navigation charts.	**Negligible** -The physical presence of the pipeline, umbilical and rock dumps is unlikely to impact other sea users. There will be no exclusion zone along the route and all the structures will be overtrawable.	**Medium** - traffic and fishing activities are relatively important on the nearshore section of the pipeline route.	**Negligible**
EMPLOYMENT AND PROCUREMENT					
Employment and training	• Direct employment by the Project and indirect employment through contractors and suppliers will have a positive impact on people employed, their families and their local communities from wages and other benefits.	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors, will employ and train nationals where it is practical to do so.	**Small** - some limited additional employment opportunities will be created but could have a positive direct effect at the local level in the short term.	**Low**- high level of expectations and direct benefits to the population at a local level.	**Positive**

Procurement of goods and services	• Socio-economic opportunities generated through procurement of goods and services associated with Project activities.	• Implement Tullow's local content strategy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so..	**Small -** most goods and services will be sourced internationally. Some goods and services will sourced from Mauritanian companies in order to support national economy and to create employment opportunities.	**Low-** high level of expectations and direct benefits to the population at a local level.	**Positive**
In-migration	In-migration of speculative jobseekers to the Project vicinity, leading to land take over public or private land, pressure on the environment and public infrastructure, potential conflict with resident community etc.	• Publicly advertise Tullow's in-country recruitment procedure. • No "at the gate" recruitment. Discourage potential settlers through proactive communication by Tullow Mauritania's stakeholder engagement team.	**Small-** The Project is located in the immediate vicinity of Nouakchott which is the largest urban centre in Mauritania, and speculative jobseekers are likely to live in Nouakchott already.	**Low -** The project is located in a periurban area with low environmental sensitivity. Local communities are essentially composed of residential areas of the periphery of Nouakchott.	**Negligible**
UNPLANNED / ACCIDENTAL EVENTS					
Spills					
Loss of containment	• Soil contamination • Impacts to groundwater quality • Impacts to fauna and flora	• Oil and chemicals spill prevention equipment, measures and procedures • Install secondary containment around tanks to contain accidental releases. • Maintenance of vehicles • Management plan of dangerous products • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill	**Small -** small oil spills and leaks (*ie* diesel spillages during bunkering) are a possibility during the life-time of the Project but these are generally localised and impacts are of short duration.	**Low** – no sensitive habitats and very limited sensitive users identified within or around the Project onshore footprint.	**Negligible**

Fire&Explosion					
Fire and explosion	• Impacts on people's health and safety • Impacts on assets • Impacts on workforce health and safety	• Active fire protection system • Gas leak detection devices • Development of a fire and life safety plan for workforce • Coordination with local authorities for external emergency response. • Markers will be provided to prevent accidental excavation damage to the pipeline and umbilical • 300 m exclusion zone with no permanent infrastructure around the processing plant boundary. • 60 m exclusion zone with no permanent infrastructure on both sides of the pipeline. • Periodic monitoring of the onshore part of the pipeline to reduce the likelihood of any intentional damage to it.	**Medium** – impacts prevention through design and operations, supported by risk assessments.	**Low** - very limited presence of stakeholders. There are no dwellings in the vicinity of the proposed processing plant site, and a 60 m exclusion zone will be established on both sides of the pipeline, and a 300m exclusion zone around the processing plant boundary.	**Minor**

OTHER EMISSIONS AND DISCHARGES: OPERATIONAL PHASE					
Operations GHG emissions	• Contribution to global warming	• Greenhouse gas reduction strategy with focus on optimisation of overall energy efficiency and reduction in flaring and venting. • Minimization of gas leaks by maintenance programme • Flash gas recovery system in plant • Best practice and good operation management will be applied to enhance efficiency and where possible minimize CO_2 emissions	**Negligible** - GHG emissions in Mauritania represented 8.9 Mt/y of CO_2-equivalent in 2005. The operational phase emissions are estimated to be less than 1 400 tonnes/year of CO_2 equivalent. (see Chapter 3 for the Emissions inventory). The estimated annual emissions from the gas processing facility operation will represent less than 0.02% of the country's yearly GHG emissions.	-	**Negligible**

5.5 *KEY IMPACTS IDENTIFIED – OFFSHORE DRILLING AND INSTALLATION PHASE*

The majority of aspects of the proposed offshore construction phase have been identified to be *Negligible* or *Minor* significance (*Section 5.4*). Of those impacts identified as significant, only hydrocarbon spills are assessed as *Moderate* significance and warrant a more detailed assessment and a more comprehensive discussion of the mitigation measures adopted.

In addition, quantitative assessments have been used to confirm the conclusions of the preliminary impact assessment in regards to discharge of drill cuttings and navigation and collision risk. The results of these assessments are summarised in this section. This also includes the conclusions of the navigation and collision risk assessment was originally conducted as part of preliminary assessment work developed on the Banda Oil phase development project.

5.5.1 *Drilling Discharges*

Introduction

To quantify the magnitude of potential impacts from the discharge of drill cuttings and associated drilling fluids on the marine environment drill cuttings dispersion modelling was undertaken (see *Annex B-1*). The study methodology and results are also summarised below.

Modelling Approach

Drilling discharges were simulated using a numerical model, GEMSS (Generalised Environmental Modelling System for Surfacewaters) and its drill cuttings and fluid discharges module GIFT (Generalised Integrated Fate and Transport). GIFT simulates the transport, dispersion and bottom deposition of dissolved and particulate material discharged into a water body.

The modelling approach is based on a single event, deterministic mode of simulation. In this scenario, the start date, current speed and current direction at each time step are selected from a database of properties for the selected period. The model was based upon expected metocean conditions for the period between June and August. These months were selected due to the absence of any strong net directional currents thus having the highest potential for depositional thickness and sedimentary rates. The environmental data used by the model includes spatially varying bathymetric data and time varying wind, current, temperature and salinity data. The bathymetric data was obtained from GEBCO (2012). The depth-varying, six-hour average wind, current, temperature and salinity data for the period between December 1995 and March 2001 were obtained from the National Centres for Environmental Prediction (NCEP), using oceanographic output from their Climate Forecast System Reanalysis (CFSR) program (NCEP 2012).

The drilling programme that was modelled consisted of four sections using seawater and sweep pills for the two top sections (the top hole and surface section) and either WBM or improved SBM for the two bottom sections. The top (conductor hole) will be jetted in rather than drilled. The drilling fluids used to drill the top sections (prior to installing the riser) will be released to the seabed together with the cuttings and associated pumped seawater. Once the riser is installed, cuttings and either WBM or improved SBM will be returned to the MODU where it will be treated and discharged overboard. *Table 5.4* provides volumes of drill cuttings and fluid that were modelled for each well.

Table 5.4 ***Drill Cuttings and Drilling Fluid Volumes (Per Well)***

Well Section	Cuttings Discharged (Tonnes)	Muds Discharged (Tonnes)	Volume Of Mud Discharged (m^3)	Release Depth
Banda Gas 1				
36"	81.8*	0	0	Seafloor
26"	262.7	0	0	Seafloor
17 ½ "	425.7	21.3	15.45	Surface
8 ½"	8.9	0.4	0.34	Surface
	779.1	**21.7**	**15.79**	
Banda Gas 2				
36"	81.8*	0	0	Seafloor
26"	262.7	0	0	Seafloor
17 ½ "	359.1	18	13.66	Surface
8 ½"	1.9	0.1	0.07	Surface
	705.5	**18.1**	**13.73**	

* jetted

The drilling unit will be fitted to each well using anchors via a single drilling centre. In this study, it was considered that muds and cuttings will be discharged at the surface from the drilling centre.

- Northing: 1965000 m, Easting: 334700 m, UTM WGS 1984, Zone 28 N

The top hole discharges are located at the well sites located approximately 50 m apart:

- Banda Gas 1. Northing: 1965000 m, Easting: 334675 m, UTM WGS 1984, Zone 28 N; and
- Banda Gas 2. Northing: 1965000 m, Easting: 334725 m, UTM WGS 1984, Zone 28 N.

This surface discharge was considered to be continuous. It will take approximately 10 days to drill each well and therefore a total duration of 20 days has been assumed for drilling the two wells. Other input data considered in the model included drill cuttings and fluid particle size distribution and material densities.

Modelling Results

The results of the modelling are illustrated in the following sections as contour plots. The plots presented indicate the location of the drill cuttings release point, taken as the drill centre. The results are presented for the following parameters:

- bottom thickness in mm;
- total suspended solids measured in parts per million (ppm); and
- sedimentation rate.

Bottom Deposition

The cuttings discharged at the seabed are deposited directly adjacent to each of the well sites, resulting in the thickest layers of deposition. The cuttings discharged at the sea surface disperse over a much larger area with smaller particles travelling distances exceeding 5 km from the discharge location.

Figure 5.1 shows the expected thickness of the mud and cuttings layer on the seabed as a result of the drilling activities at the end of the model simulation. The maximum thickness predicted by the model was 209 mm, located in the vicinity surrounding the second well [(1)]. *Figure 5.2* shows this peak from a 3D perspective. Approximately 66.2 km^2 of seabed is expected to be covered by more than 1 mm of deposition and approximately 5.3 km^2 of seabed is expected to be covered by more than 10 mm deposition.

(1) Well Head #1 and Well Head #2 refers to Banda Gas 1 and Banda Gas 2, respectively.

Figure 5.1 *Bottom Deposition Thickness*

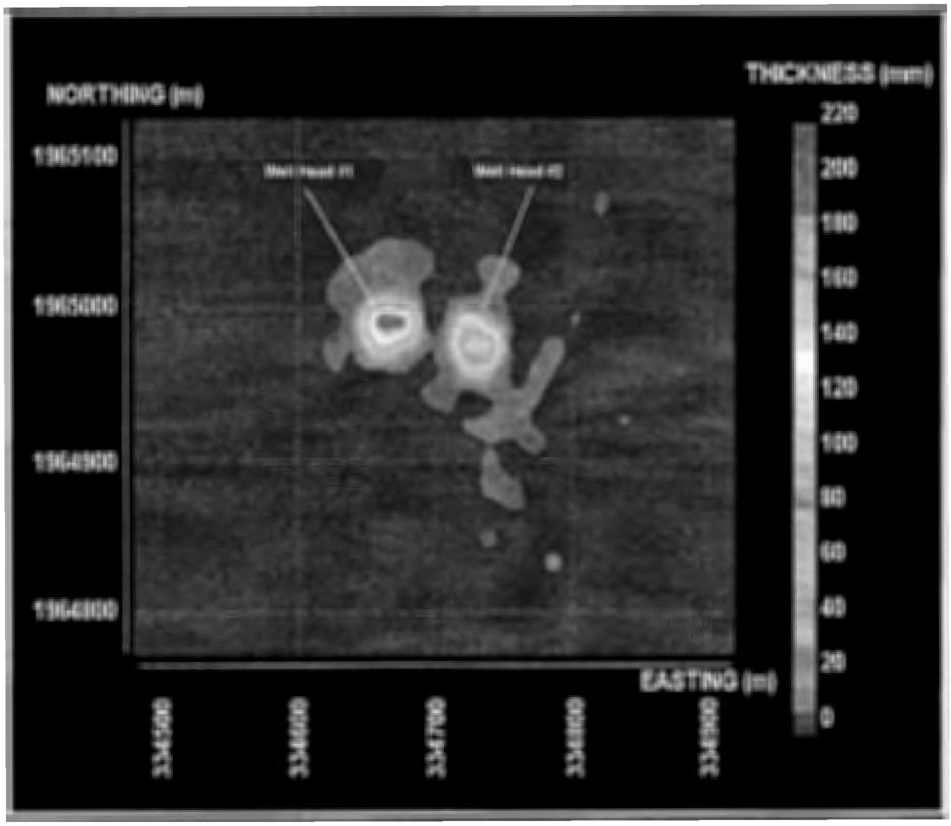
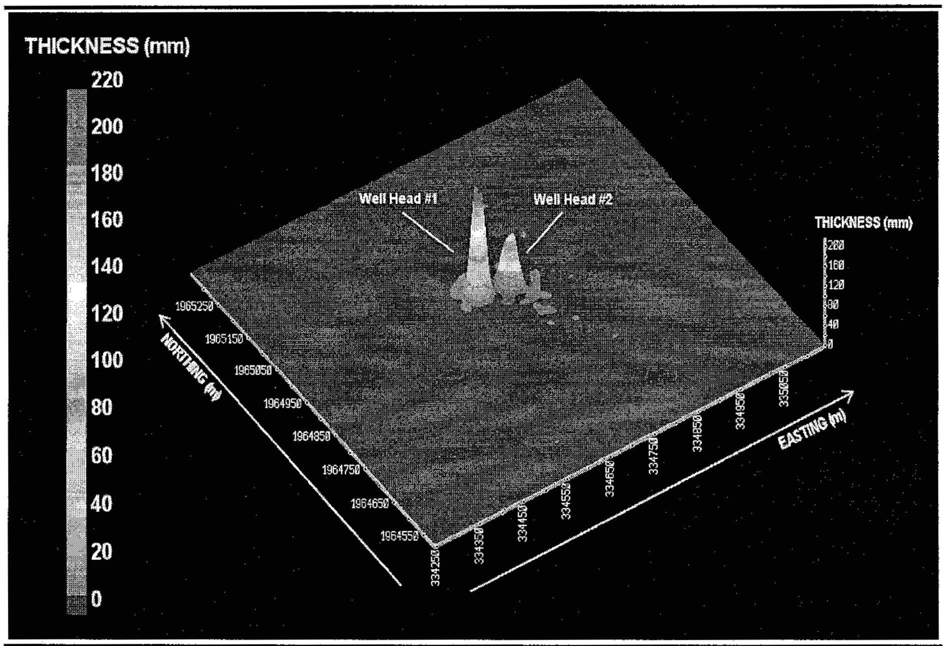


Figure 5.2 *Bottom Deposition Thickness – 3D Perspective*



Note: This figure has been vertically exaggerated.

Total Suspended Solids

Concentrations of Total Suspended Solids (TSS) exceeding background levels are known to decline quickly with increasing distance from the discharge location due to dilution of the plume and rapid settling of larger particles. For this reason, relatively high concentrations are expected in the immediate vicinity of the well site with a sharp reduction at increasing distance from the discharge location.

Figure 5.3 shows the maximum TSS exceeding background levels. The modelling results show excess concentrations of TSS between 10 and 60 mgl^{-1} during surface discharge of cuttings with a maximum of 447 mgl^{-1}. The range is a result of currents mixing the dispersion plume. At the seabed deposition from the top hole is estimated to increase TSS by 270 mgl^{-1}. Typical values at the seabed range between 20 and 90 mgl^{-1}. Although the volume of cuttings at the seabed is much higher, the maximum TSS concentration is estimated to be lower than that at the surface because particles quickly rapidly settle onto the seabed and have less opportunity to recirculate in the water column. *Figure 5.4* shows the TSS concentrations during the first top hole release.

Figure 5.3 ***Maximum TSS Concentration Exceeding Background Levels***

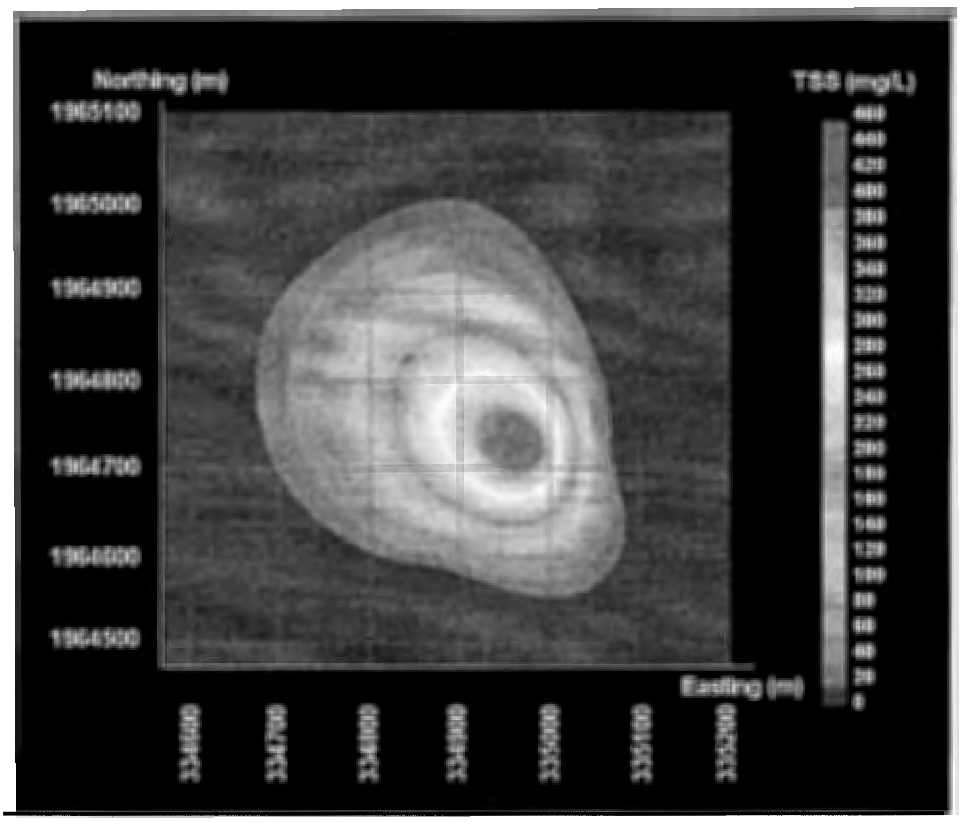
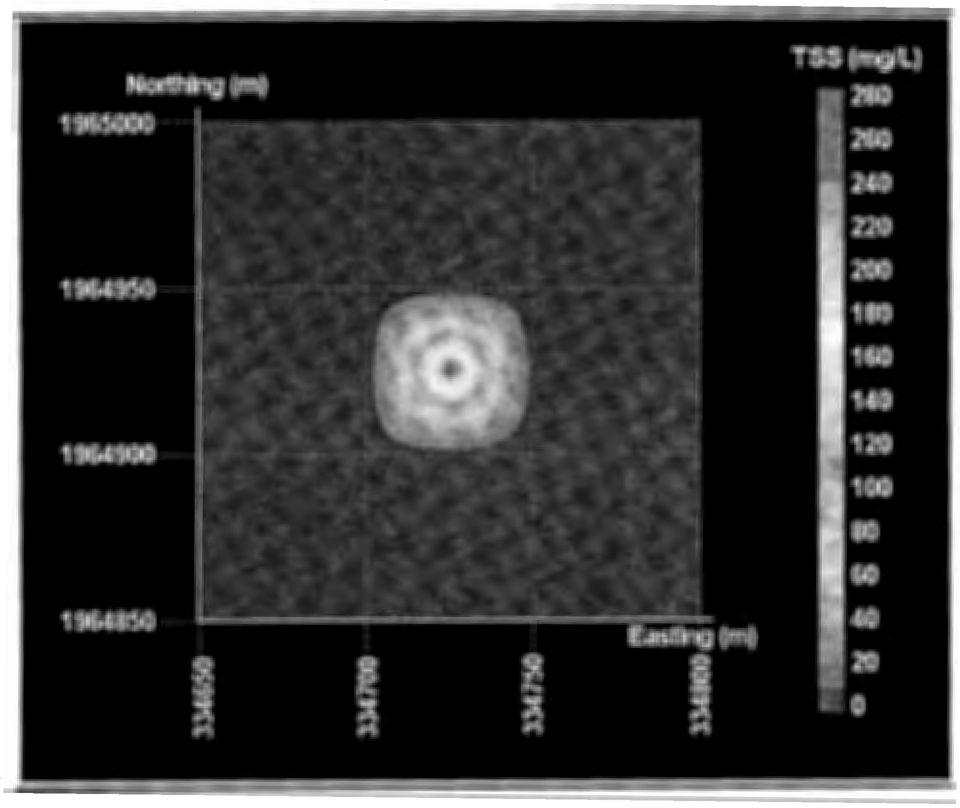


Figure 5.4 *TSS Concentration Exceeding Background Levels from Top Hole Release*



Sedimentation Rate

The maximum modelled sedimentation rate peaks at around 170,000 mg cm^{-2} per day at the seabed. This rate is experienced during drilling the top well sections (*Figure 5.5*). The rate decreases by an order of magnitude within a day and decreases spatially by an order of magnitude after 30 m from the discharge location, and again after 60 m. Beyond this region, scatter locations have deposition rates above 10 mg cm^{-2} per day. The sedimentation rate decreases to approximately 1,800 mg cm^{-2} per day a month after the initial release. *Figure 5.6* shows the maximum sedimentation rate decreasing over time.

Figure 5.5 ***Maximum Sedimentation Rate at the Seabed***

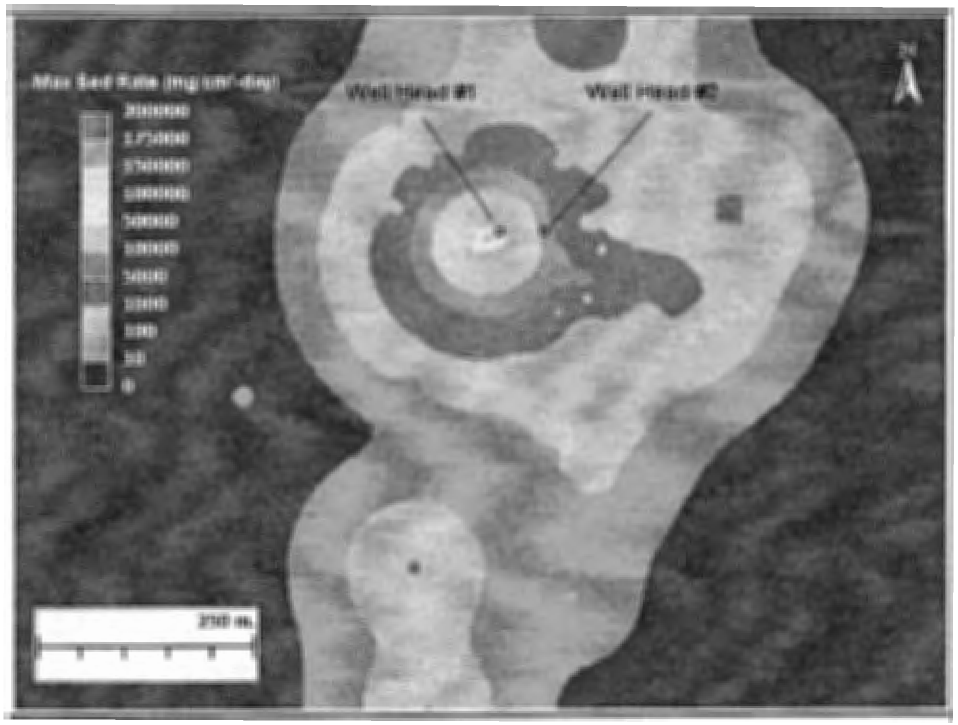
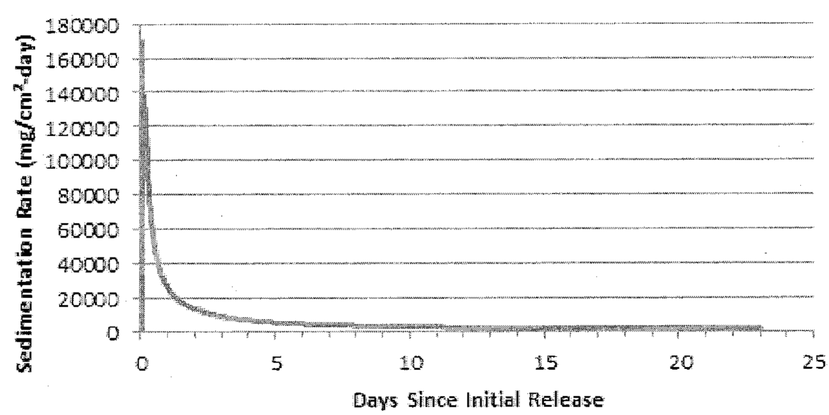


Figure 5.6 ***Maximum Sedimentation Rate over Time***



Description of Potential Impacts

As described in *Chapter 3* a total of two wells are required for the development. Discharges of drill cuttings to the environment have the potential to impact the water column and seabed. The extent of the impact will to varying degrees be predominantly dependent on the following.

- Point of discharge, *eg* discharge at the sea surface or release on the seabed, and the volume and rate of discharge.

- The physical and chemical properties of the cuttings and base fluids (*eg* water based or improved synthetic based), which may include particle size distribution and particle cohesion, and its chemical characteristics.

- The extent of mixing and dispersion, which can be influenced by the currents present and the water depth in which the cuttings pass; and the presence and sensitivity of pelagic, demersal and benthic communities.

The impacts to marine organisms (which assume the stated discharges and releases) will arise from the following two types of cuttings and mode of discharge.

- Cuttings generated from the top sections drilled with seawater and sweep pills, which are released at the seabed from the well.

- Cuttings generated from the lower well sections will be drilled with either WBM or improved SBM, which are treated reduce oil retention on cuttings and discharged from the MODU at approximately 5 m below the sea surface. As a realistic 'worst case' it is assumed that an improved will be used.

Receptor Sensitivity

The effects of the disposal of drill cuttings are well documented from previous studies and the impacts from drill cuttings discharges depend largely on the quantity and nature of the discharged material, the area affected and the sensitivity of the receiving environment (*eg* the habitat/species potentially affected). The benthic fauna expected is informed by an environmental baseline survey of the Banda field area.

The habitat has been assessed as relatively low value given the homogeneous nature of the substrate and types of species it supports (primarily polychaete worms). The environmental baseline survey for the project reported no evidence of sensitive habitats within the Banda field (see *Chapter 4*).

Mitigation Measures

The following mitigation measures to minimise the impact of drill cuttings and fluid discharge on the marine environment will be adopted.

- Solids control systems will be used, including dryers, to treat oil on cuttings to between 5 and 10% as a weighted average.

- Measures will be taken to comply with project effluent guidelines, including use of low toxicity (Group III) improved SBM, no free oil, and limits on mercury and cadmium concentrations. Water based muds may be used instead if feasible.

Impact Assessment

Biological Impacts to the Water Column

Following the discharge of cuttings at the sea surface, cuttings will pass down through the water column (*ie* water depths of approximately 250 m) and gradually be dispersed before settling on the seabed. During this time, marine life, such as pelagic fish, may become exposed to suspended solids (*eg* fine particles that may interfere with respiration) or toxic substances (such as certain metals or organic compounds) associated with the suspended solids or dissolved in the surrounding water. An oxygen demand may also be exerted on the water. However, these impacts on the water quality are unlikely to represent a concern as cuttings do not disperse readily in seawater and tend to settle rapidly through the water column and onto the seabed. In addition, most pelagic species are sufficiently mobile to avoid being exposed periods of time that could potentially be harmful.

Model-predicted TSS concentrations in the water column are primarily due to drilling fluid solids, since these particles have lower settling velocities and remain suspended in the water column for longer periods of time. In contrast, discharged cuttings settle to the seabed very quickly.

Predicted TSS concentration for the drilling discharges will predominantly occur when the bottom sections of each well are drilled. The elevated TSS concentrations are expected to be localised, short term and dissipate rapid as a result of the dispersion capacity of the local marine environment. The overall impact is considered of small magnitude and given the good existing water quality and low to medium sensitivity of biological receptors, the impact to water column is assessed as *Minor* significance.

The effects of discharges of drill cuttings and associated improved SBM into the marine environment are, therefore, primarily on the seabed sediments and associated fauna since there is little effect on water quality.

Biological Impacts to Seabed

As cuttings and WBM used to drill the upper sections of each well will be released from the well at the seabed, the large or heavy cutting particles accumulate in the immediate vicinity of the well. The finer particles released at the seabed during drilling of the top two well sections are likely to form a dense plume which may interfere with the respiration of benthic and demersal communities downstream of the release point. However, the plume is expected to occur over a relatively short duration whilst the top sections of the wells are drilled and effects are likely to be local to the well.

Thereafter improved SBM cuttings released at the surface will spread over a wider area subject to currents, however, the majority of cuttings will still settle on the seabed within the local vicinity of the well. Sedimentation rates are expected to be around 170,000 mg/cm^2 during day one of drilling, decreasing exponentially over time to approximately 1,800 mg/cm^2-day after 20 days. The maximum model-predicted thickness of the deposited material on the seabed is 209 mm. Deposits of more than 1 mm thick are expected to occur within a region approximately 66.2 km^2 around the vicinity of the two wells, while depositional areas over 10 mm are estimated to be 5,300 m^2.

Last *et al* (2012) assessed the tolerance of different benthic species to burial in fine sand against a benchmark of 50 mm burial depth. The study found that tolerance to burial varies considerably between benthic species. In general, burrowing species such as polychaetes had a high tolerance to burial, while encrusting species such as ascidians and bivalves have a lower tolerance. The EBS of the Banda field showed that benthic communities are dominated by burrowing species (primarily polychaetes). Therefore, the communities are assumed to have a lower sensitivity to smothering effects. The modelling results predict that approximately 2.1 km^2 of seabed will be exposed to depositional thicknesses greater than 50 mm, therefore smothering impacts and/or mortality of benthic fauna is likely to occur for a small area around each well (see *Figure 5.1*).

Other effects from improved SBM cuttings could include organic enrichment of sediments through organic carbon loading and toxicity from organic enrichment and the drilling fluids (including bioaccumulation and bio-magnification through the food chain). These effects are related to the degree of accumulation of drill cuttings on the seabed and the toxicity of the drilling fluids. The type of NADF (EDC 99 DW or similar) that will be used for the mid and lower sections of each well does not contain any aromatics and is readily biodegradable in aerobic conditions. Anaerobic conditions slow down the rate of biodegradation and increase toxicity of the sediments. Solid control equipment will be used to reduce the oil on cuttings to a target concentration of between 5 and 10%.

The biological impact of drilling discharges on the seabed could occur as a result of smothering effects and biochemical effects. The modelling results predict a maximum depositional thickness on the seabed of 209 mm, and a thickness of over 1 mm for an area of 66.2 km^2. Approximately 2.1 km^2 of seabed is expected to be exposed to depositional thickness of more than 50 mm, the threshold at which smothering and/or mortality can be expected; approximately 3.4% of the Banda field area. Therefore, the magnitude of seabed impacts is considered small to medium. Benthic fauna in the Banda field is homogenous and dominated by low value burrowing species which have a high tolerance to burial (low sensitivity). Therefore, the impact to the seabed is assessed as being of *Minor* significance.

5.5.2 *Hydrocarbon Spills*

Introduction

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

Considering that the Banda Gas development wells are only targeting gas bearing formations, not oil bearing formations, the assessment does not consider modelling for spills resulting from accidental well blowouts.

Assessment Methodology

An oil spill model was set up and a diesel spill scenario modelled using GEMSS (Generalised Environmental Modelling System for Surfacewaters) and its oil spill module COSIM (Chemical/Oil Spill Impact Module). The modelling results have been attached as *Annex B-4.*

The GEMSS application requires both spatial data and temporal data. Spatial input data includes the shoreline and bathymetry. Temporal data includes time-varying boundary data defining tidal elevation, inflow rate and temperature, inflow constituent concentration, outflow rate and meteorological data.

Oil Spill Modelling

Introduction

Oil spill modelling has been used to predict the consequence of a diesel spill from the MODU. The modelling considers the nature of the diesel spilled, the location and duration of the spill, the behaviour of oil in the marine environment, and the transport from the spill site to other marine and coastal areas. The information used in the model allows the likely fate of the diesel spill to be assessed and illustrated. This aids the assessment of potential environmental impacts of an oil spill on sensitive receptors (eg coastal habitats).

Modelling Inputs

The diesel spill scenario that was simulated is presented in *Table 5.5*. It represents a hypothetical loss of diesel containment on the MODU resulting in a discharge of 1,200 m^3 of diesel over a three-hour period at the surface level. The spill location is at the drilling centre.

Table 5.5 ***Oil Spill Simulation Scenarios***

Description	Oil Type	Spill Depth (m)	Volume Spilled (m^3)	Duration of Release
Diesel spill at the surface	Diesel	0	1 200	3 hours

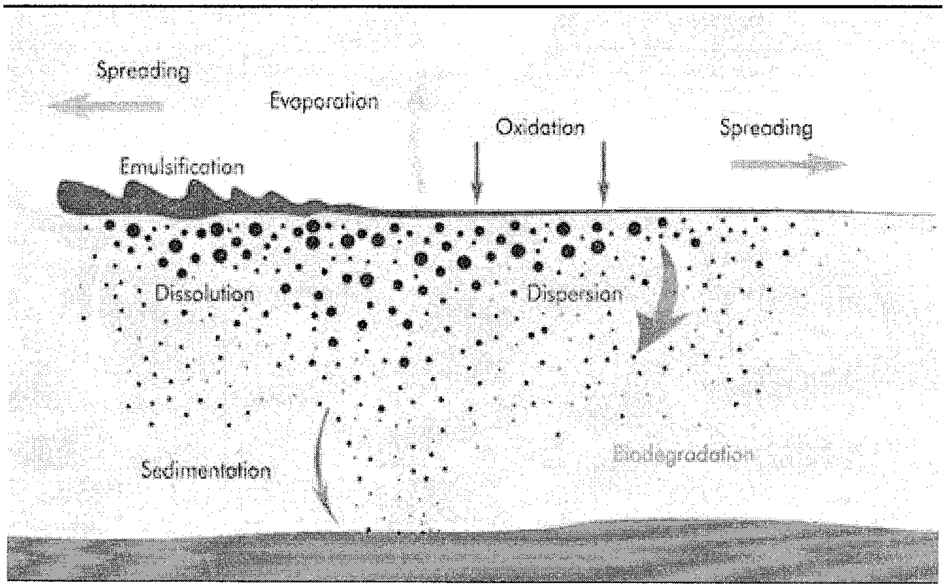
The diesel release volume is conservative and is considered to have a low likelihood of occurrence.

Data on wind and currents that represent conditions at the Banda field were obtained and used in the modelling study. Winds are represented stochastically and the currents are represented deterministically. The currents in the Banda field region are mostly directed towards the southwest, away from the shoreline. There is no month when currents predominantly travel towards the shore. The months with the lowest frequency of currents directed away from the shoreline were in July and August. Considering also the months of June, July and August have the highest frequency of winds directed towards the shore, these months were selected as the analysis period. These three months represent the time of the year with the greatest risk for shoreline oiling, providing the shortest response time.

Oil Behaviour

The physical and chemical change that spilled oil undergoes is collectively known as 'weathering' (*Figure 5.7*). Knowledge of these processes and how they interact to alter the nature and composition of the oil with time is essential in identifying the best oil spill response strategies, choosing appropriate equipment and developing effective contingency plans. A short description of the fate process is provided in *Figure 5.8*.

Figure 5.7 ***Weathering Processes for Oil at Sea***



Source: ITOPF (2012)

Figure 5.8 Oil Weathering Process

Modelling Results

The modelling results present a worst case that could result from a diesel spill, assuming that no oil spill response measures were deployed. The remainder of this section summarises the results of the modelling.

<u>Stochastic Modelling Results</u>

The COSIM stochastic model was applied to predict the probability of sea surface oiling as a result of the modelled diesel spill. The stochastic simulations indicate the probable behaviour of potential spills under the specific metocean conditions expected to occur in the Banda field. The stochastic model simulations showed the predominant transport of spilled oil is to the south-east under worst case oceanographic conditions.

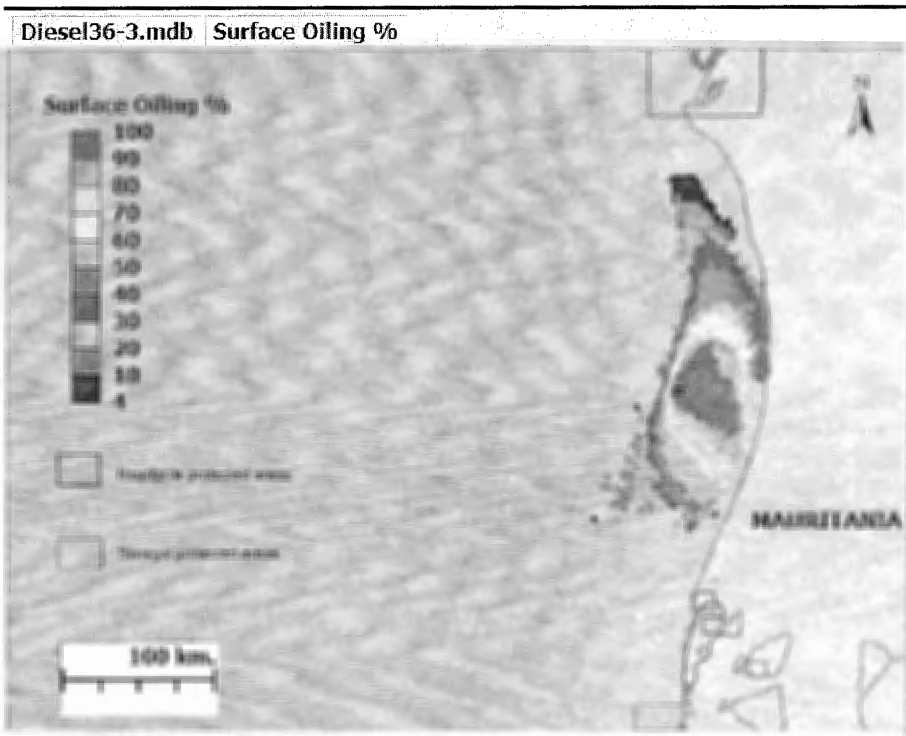
For the modelled scenario, a 200 km stretch of coastline, located 35 km to the north and 165 km to the south of Nouakchott, has a greater than 4% probability of being impacted. A relatively small volume of diesel (on average

14 m³) is expected to beach. The model predicts that the spill would not impact the more sensitive habitats to the north of Nouakchott, for example Banc d'Arguin, or the wetland areas around the Senegal River Delta. The following figures depict the modelling results.

- *Figure 5.9* presents the surface probability of oiling;
- *Figure 5.10* presents the thickness of the diesel slick at the surface;
- *Figure 5.11* presents probability of shoreline oiling; while *Figure 5.12* shows the maximum volume of shoreline oiling; and
- *Figure 5.13* presents the travel time of the diesel spill to shore.

It is noted that these figures represent composite results from a number of simulation runs and present the overall results under varying meteocean conditions rather than the extent of a single spill.

Figure 5.9 ***Probability of Visible Surface Oiling from Diesel Spill***



A minimum threshold thickness value has been chosen at 0.1 μm, translated into units of mass per surface area as 0.08 g/m². Model output is presented for those locations with surface diesel mass per unit area equal to or above this threshold, and presented in terms of the color classifications. *Table 5-6* summarizes these descriptors.

Table 5-6 *Oil thickness descriptors*

Color	Thickness µm	Diesel $g\ m^{-2}$
Silver sheen	0.1	0.080
Rainbow	0.3	0.24
Metallic	5	4.0
Transitional dark	50	40.0
Dark / true color	200	160.0
Black oil	>200	>160.0

Figure 5.10 *Diesel Spill: Maximum Oil Thickness*

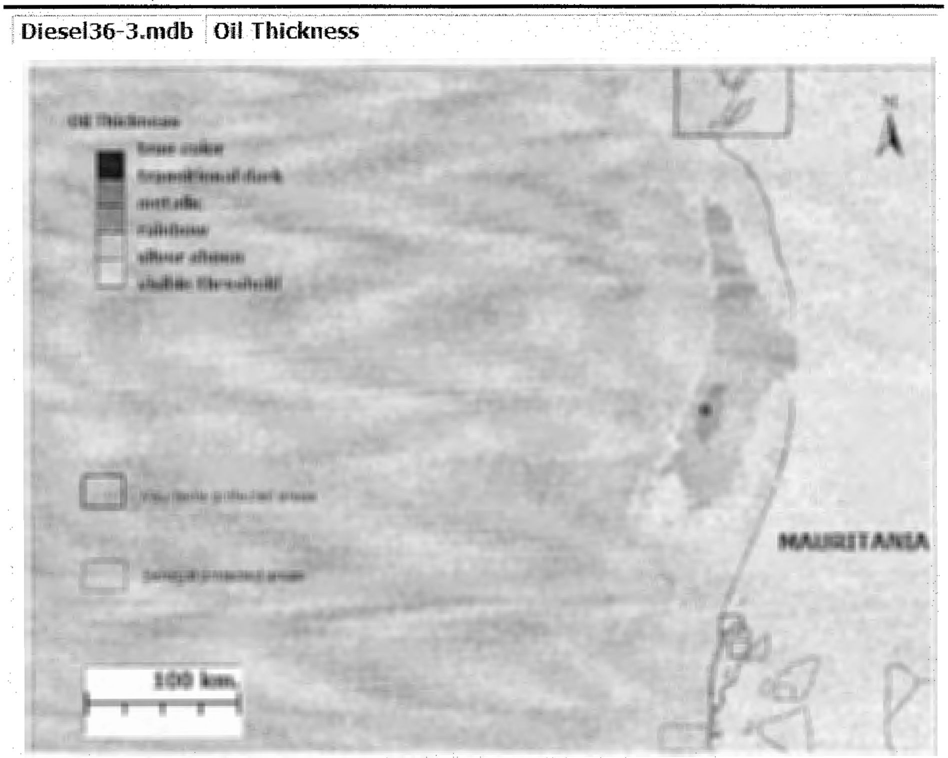


Figure 5.11 Probability of Shoreline Oiling from Diesel Spill

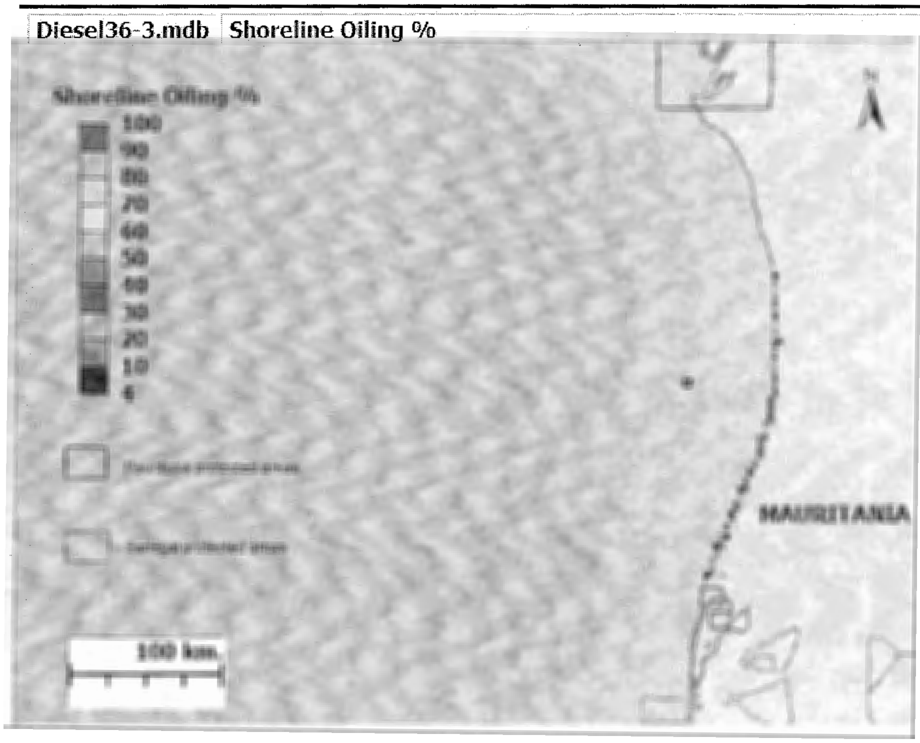


Figure 5.12 Diesel spill: Maximum Shoreline Oiling Volume

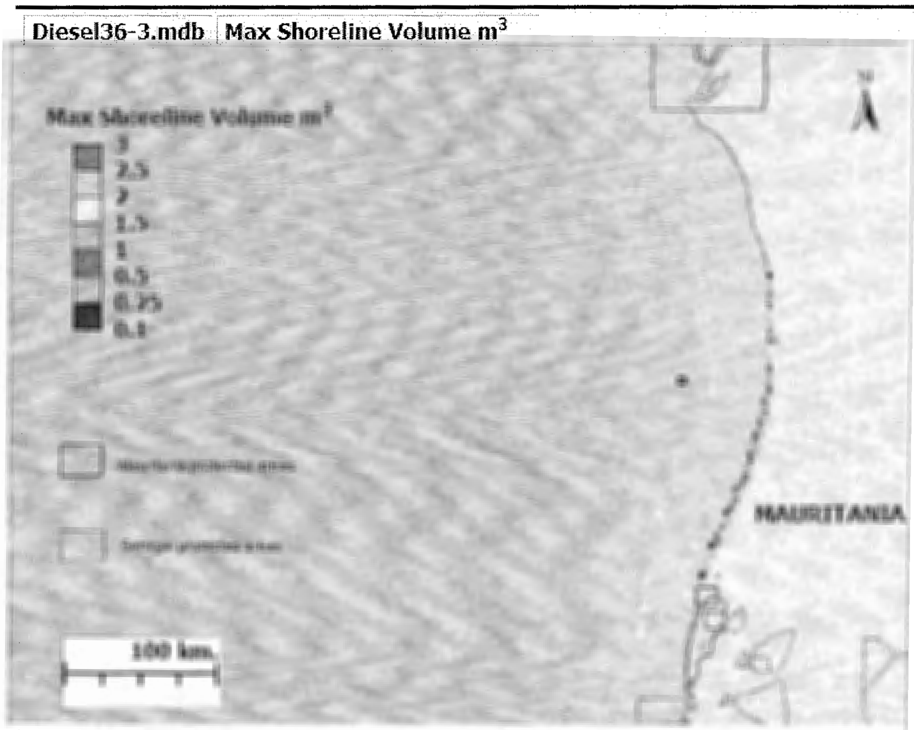
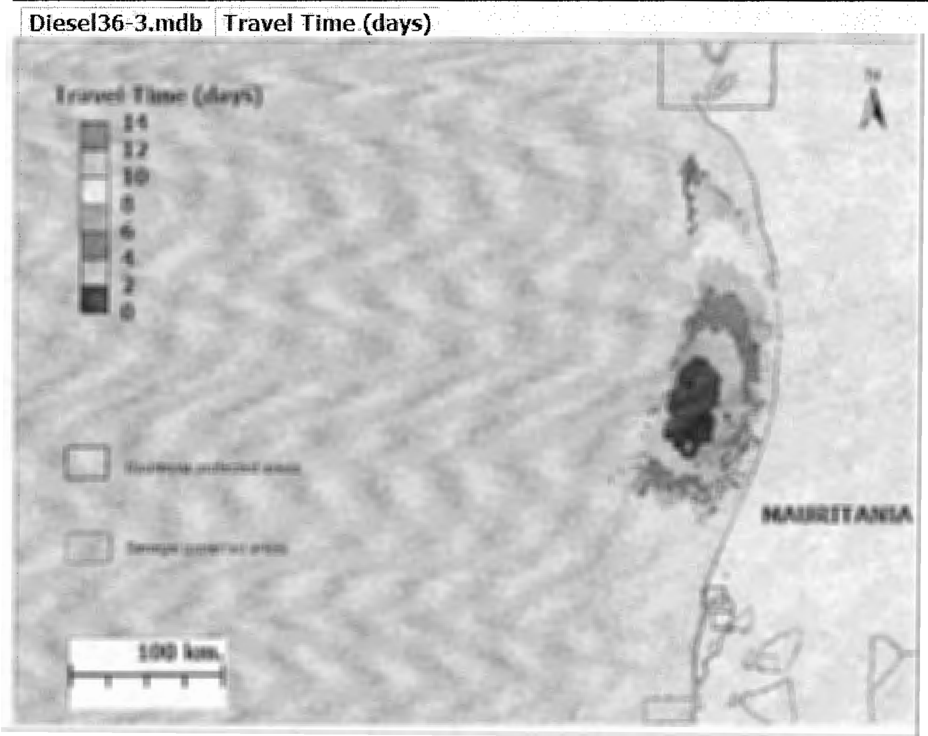


Figure 5.13 *Travel of Time of Diesel Slick*

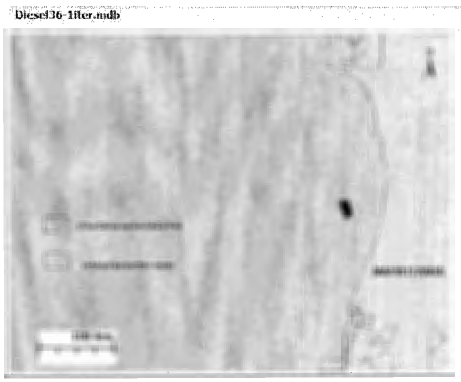


Deterministic Modelling Results

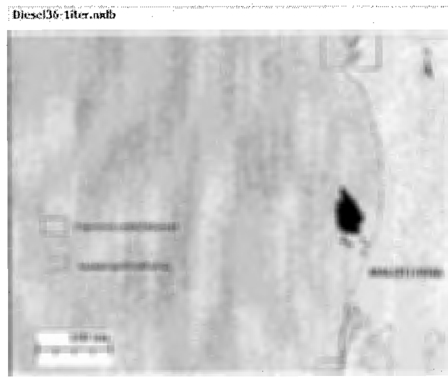
The deterministic (trajectory/fate) modelling simulations represent the fate of an oil spill release under specific meteorological conditions (*ie* one particular wind direction and strength). Deterministic model simulations provide a time history of oil weathering over the duration of the simulation, expressed as the percentage of spilled oil on the water surface, on the shore, evaporated, and naturally dispersed in the water column.

Figure 5.14 presents the evolution of a diesel spill event by showing snapshots of the spill at different times. The mass balance for the spill is illustrated in *Figure 5.15*.

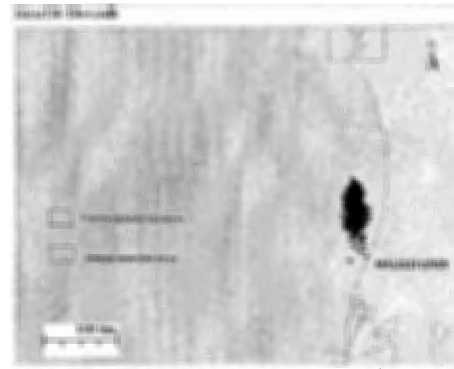
Figure 5.14 *Example of the Evolution of a 1,200 m³ Diesel Spill during 2 Weeks*



1 day after spill

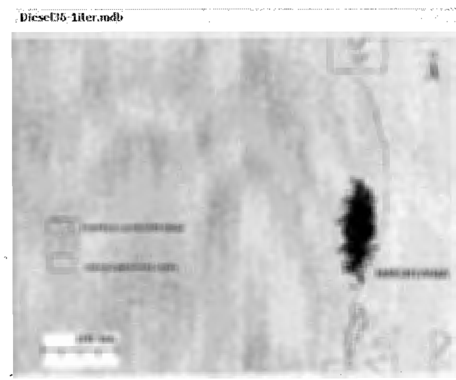


4 days after spill

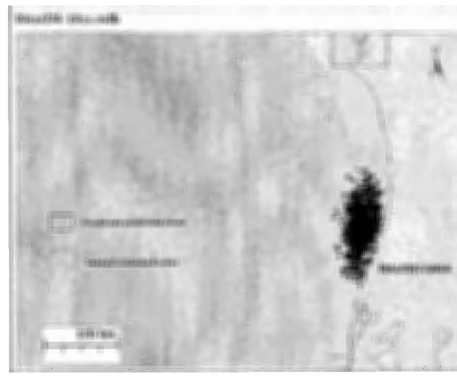


6 days after spill

8 days after spill

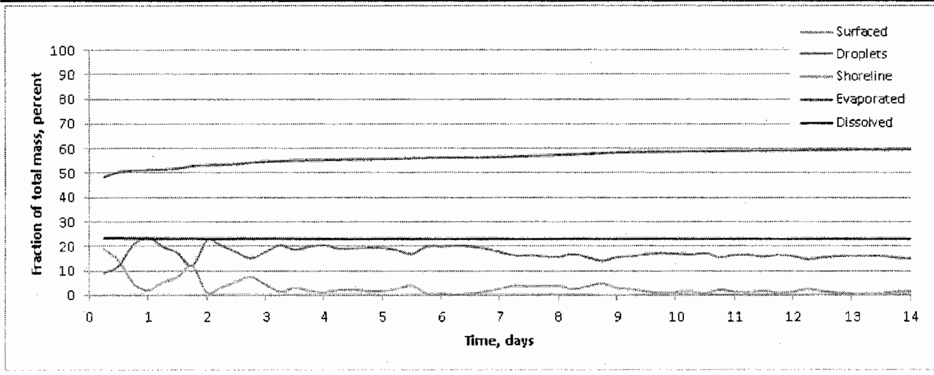


12 days after spill



14 day after spill

Figure 5.15 Mass Balance Plot: Diesel Spill



Diesel is expected to weather rapidly, with 50% of the light fractions quickly evaporating at the start of the simulation due to the high proportion of short chain hydrocarbons present in diesel. In the first 14 days approximately 60% of the initial mass has evaporated.

The diesel that does not evaporate stays on the surface and a proportion of this diesel dissolves as the winds and waves entrain the diesel into the water column. As a result of this process a significant percentage of the oil (approximately 22%) dissolves in water rapidly.

A small fraction of diesel may contact the shoreline approximately 6 days after the release. After two weeks, approximately 1% of the total mass may be on the shorelines (6 tons out of the total 960 tons comprising the 1200 m^3 volume released).

Description of Potential Impacts

In the event of a diesel spill the most sensitive components of the ecosystem in the marine environment are seabirds, marine mammals and turtles, due to their close association with the sea surface. In the event of spilled diesel reaching the coast notable sensitive receptors include coastal habitats such as wetlands, lagoons and turtle nesting beaches, fish and fishing activities and people whose livelihoods depend on coastal resources.

This section summarises the potential impacts on the most sensitive receptors. However, it should be noted that this assumes a 'worst case' spill that reaches the coastline and is subject to no response efforts.

Mitigation Measures

Mitigation of oil spills takes two forms: spill prevention and spill response.

Spill Prevention

To minimise the risk of potential spills a range of inherent measures aimed at reducing the risk of oil spill have been included in the project design. Spill prevention is achieved through both operational controls and technology applications.

- Adoption of formal and systematic hazard identification and operational procedures

- Use of competent crews, trained and certified in well management and well control procedures.

- A system of wells and pipeline and umbilical, designed to international process codes and with alarm and shutdown systems to maintain the system within its design criteria at all times. The system will be tested, inspected and maintained to ensure performance standards.

- Use of drilling fluids for hydrostatic control in the event of sudden or unexpected changes in well bore pressure.

- Installation and regular testing of industry standard safety valves (blowout preventers) on subsea well heads.

- Protection of subsea equipment, such as by installation of overtrawlable protection structures, trenching to reduce the risk of damage (and subsequent leaks/spills) to wellheads, manifolds, pipeline and umbilical from trawling activities.

Spill Preparedness and Response

Despite the prevention measures and management procedures built into the design of the project there is always a risk that an oil spill can occur. In response to such an event, an Oil Spill Contingency Plan (OSCP) will be developed which will have procedures which set out the strategy and specific actions that will be taken in the event of an oil spill.

The actions that will be required for the OSCP in the event of an oil spill vary according to the size and type of the spill. Oil spills are defined according to three 'Tiers'. This classification is in alignment with the International Petroleum Industry Environmental Conservation Association (IPECA) which advocates a response to oil spills such that the planned response engages resources commensurate with the severity of the spill with the higher the Tier the higher the level of response required.

The OSCP will be informed by the oil spill modelling study so that the response strategy and location of equipment takes into account the areas most at risk and the response times required to mobilise resources and equipment in the event of a spill.

The OSCP interfaces closely with the Mauritanian National Oil Spill Contingency Plan. The resources available to provide a suitable response to any oil spill from the project, and the responsibility for leading spill response, are set out in the OSCP as follows for each Tier of spill.

- **Tier 1:** The response to all Tier 1 spills will remain the responsibility of Tullow. Tullow will hold the appropriate level of Tier 1 oil spill response equipment and trained personnel so as to facilitate an immediate response in the event of a Tier 1 spill and to assist with Tier 2 spill events.

- **Tier 2:** In the event of a Tier 2 spill event the initial response would be the responsibility of Tullow. However, if the magnitude of spill warrants a further response it would engage mutual aid resources which may be provided by industry partners within Mauritania and the Oil Spill Response Limited (1) (OSRL) West and Central Africa surveillance and spraying aircraft.

- **Tier 3:** In the event of a spill situation which is clearly beyond Tullow's immediate response capability, both mutual aid resources which may be provided by industry partners within Mauritania and the OSR call-out guarantee from the Oil Spill Response Base in Southampton, UK.

It is important to note that, in Tier 2 and 3 spill situations, the response strategy set out in the OSCP is intended to align with the Mauritanian National Oil Spill Contingency Plan and comply with its requirements. The intention is that in any major spill situation there is cooperation between Tullow, other offshore oil and gas operators and the Government of Mauritania in order to ensure a coordinated and effective response to a spill.

Impact Assessment

Seabirds and Coastal Birds

Several protected areas have been identified as being possibly impacted by a spill, including the following: the Chat T'boul Reserve, the Diawling National Park and the Saint-Louis Ramsar site..

Unprotected areas along the coast are also important bird habitats. These include the wetlands and swamps in inter-dunal depressions along the Aftout es Saheli area, a proposed Ramsar site with up to 50,000 waterbirds recorded and globally threatened and biome-restricted species present, between Nouakchott and St Louis. In addition, two proposed marine IBAs are located

(1) Oil Spill Response Limited (OSRL) is a Global Tier 3 Oil Spill Response Organization, owned by its oil industry member shareholders, for the benefit of its members. OSRL provides immediate response to a Tier 3 oil spill from Southampton, UK. Regional Tier 2 response can be provided with access to an aircraft based in Sao Tome which can both spray dispersant and detect and quantify oil at sea using specialist remote sensing cameras.

offshore Mauritania, namely the Aftout es Saheli which includes inshore marine areas between Nouakchott and St Louis and the Atlantic Eastern Central 4 marine IBA located further offshore and covering an area of approximately 68,000 km^2.

Direct mortality of birds is often the most widely perceived risk of an oil spill, however, birds can also affected by diesel pollution in the following ways.

- 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; and
- indirect effects resulting from destruction of bird habitats or food resources.

Taking into account the international significance of the habitat, including threatened and biome-restricted species, coastal bird species and habitats in Mauritania are considered highly sensitive to potential impacts resulting from an oil spill that reaches the coastline.

Marine Mammals

Marine mammals are generally less sensitive to oil spills than seabirds as they will tend to detect the area around a surface oil slick and avoid any breaching or feeding behaviours that may bring them into direct contact with oil. However, marine mammals are still sensitive to impacts from oil spills, and in particular from the hydrocarbons and chemicals that evaporate from the oil, particularly in the first few days following a spill event. Although it is likely that certain species of marine mammals occur in the area offshore Mauritania, it is considered that as mobile species they would generally avoid any areas affected by oil spills, minimising the potential for heavy oiling though there is potential for ingestion and eye and skin damage from oil contact.

Marine Turtles

In Mauritanian waters the large seagrass beds at Banc d'Arguin provide an important feeding area for individuals from green turtle breeding colonies both in Mauritania as well as in other West African countries. Juveniles and sub-adults of other species which are less well understood, such as the Leatherback, are also likely to use this relatively sheltered area for foraging prior to migration as adults. However, based on the modelling study, diesel is not expected to impact this area.

Turtles are sensitive to the effects of oil spills at all life stages: eggs, post hatchlings, juveniles and adults. Several aspects of sea turtle biology place them at particular risk. These include a lack of avoidance behaviour, indiscriminate feeding around the sea surface and large pre-dive inhalations at the sea surface. Potential direct impacts to sea turtles include:

- increased egg mortality and developmental defects;
- direct mortality due to oiling in hatchlings, juveniles and adults; and
- negative impacts to skin, blood, immune systems and salt glands.

In addition, sea turtles are sensitive to potential secondary and longer term impacts, which are generally less obvious than the short term impacts immediately following a spill. In the event of a diesel spill reaching the coastline between Nouakchott and Cap Vert sea turtle populations may be highly sensitive to impacts assuming that nesting beaches are present.

Coastal Habitats

The coasts that are predicted to be most at risk of being oiled are 200 km in length, located 35 km to the north and 165 km to the south of Nouakchott. This stretch of coast is made up entirely of sandy beach habitat which is considered to have a low to moderate sensitivity to oil spills depending on its grain size. The model predicts that the spill would not impact the more sensitive habitats to the north of Nouakchott, for example Banc d'Arguin, or the wetland areas around the Senegal River Delta. The shoreline at risk of oiling ends 7 km North of the Chat'Boul Reserve.

Fish Stocks

The offshore and coastal waters in Mauritania support significant numbers of fish species many of which are targeted by the artisanal and coastal fishing and industrial fleets. Most commercial species occur in coastal waters from close inshore to the edge of the continental shelf. Fish species that occur in the shallow coastal habitat are also important as these areas act as vital nursery grounds and assist with sustaining fish stocks in coastal waters.

Typically, fish are not considered highly sensitive to impacts from oil spills. Adults are mobile and generally able to detect heavily contaminated areas or areas of low water quality. Oil contamination in open waters below an oil slick is generally low (only a few ppm or below) (IPIECA 2000) and there is no evidence to suggest that fish are significantly affected by oil in open water.

Non-lethal negative effects are more usual and fish can be affected in the long term in some circumstances, especially when oil spills into shallow or confined waters. Fish exposed to elevated concentrations of hydrocarbons absorb contaminants though their gills, accumulating it within their internal organs which can lead to long-term, sub-lethal effects.

In addition, spilled oil in confined and shallow waters, such as intertidal mudflats and remnant mangroves, poses a threat to fish eggs and larvae which cannot actively avoid or escape a pollution event.

In terms of the vulnerability of fish stocks to impacts from a diesel spill, while fish in open waters are not particularly sensitive, the species found in shallow coastal habitats are highly sensitive.

Fisheries

There is no other fishing port in the area south of Nouakchott. The area south of Nouakchott consists of mobile and seasonal fishermen camps which are almost exclusively foreign fishermen. Coastal lagoons and estuaries are also important sources of fish and shellfish for both subsistence and commercial purposes.

In the event of an oil spill that reaches either coastal waters, or beaches within coastal lagoons, fisheries may be suspended by the regulatory authorities to avoid contamination of fish being lifted through the slick on the surface waters and to prevent gear contamination. Fishing is difficult or impossible in areas directly affected by a spill. Vessels and gear will be smeared in oil and the catch might be spoiled. The fishermen might for a period be forced to stop or temporarily move to other fishing grounds nearby free of oil slicks. These fisheries closures will directly affect fishing communities along the coastline by preventing them from maintaining their livelihood during the period of closure, resulting in a reduction in both food and economic resources.

In addition, tainting of fish from contamination with hydrocarbons can impact fisheries affected by oil spills. Tainting of fish will reduce the quality of the fish landed and sold to traders. As a result these fish may fetch a lower price than others unaffected by tainting.

Given the importance of the artisanal fishing industry along the coastline and the presence of particularly sensitive fisheries such as lagoons, fisheries are considered highly sensitive to impacts resulting from a diesel spill that reaches coastal waters.

Impact Significance

The metocean conditions in the area during the summer months, and in particular the strong winds blowing from the North-West tend to move spilled hydrocarbons towards the Mauritanian coast. It should be noted that this assumes that no oil spill response measures are taken.

The majority of the shoreline which would most likely to be impacted is sandy beach which is considered to have a low to moderate sensitivity depending on grain size. This coastline and inshore marine zone habitats between Nouakchott and Senegal are important bird areas and would be sensitive to the effects of an oil spill. Wetland areas are highly sensitive to oil spills as these habitats support significant bird populations and act as fish nursery grounds, turtle nesting sites and artisanal fishing grounds. These receptors would be adversely impacted in the event of an oil spill that reaches the coastline. These shorelines at risk of oiling are 7 km from the nearest of the protected areas.

> A large diesel spill is considered unlikely to occur[1], and should one occur, the proposed oil spill response measures would likely prevent the majority of diesel reaching the shoreline given the relatively small volume of diesel, weathering processes, distance to shore, and the time afforded to the response effort (3 days minimum and 4.6 days on average). If diesel does reach the shore receptors are likely be exposed to medium term adverse impacts of local to regional extent, therefore a diesel spill is considered of medium magnitude. The stretch of coastline most likely to be affected is considered of low to medium sensitivity and value given both the shoreline type (sandy beaches) and its importance to avifauna. A spill is not expected to reach the more sensitive wetland locations around the Banc d'Arguin and the Senegal River Delta. Therefore, while the residual risk of spills from the Project remains, the overall impact of a large diesel spill is considered to be of *Moderate* significance.

5.5.3 *Navigation Risk and Collision*

Introduction

A collision risk assessment was undertaken by Anatec Limited (Anatec) for the Banda Oil phase development project. The assessment identifies the shipping routes passing the Banda field, calculates passing powered/drifting and infield collision frequencies and reviews risk mitigation measures. Navigation risk and collision impacts are assessed for the Banda Gas project in this section using the results of the Anatec study. Information on shipping routes, volumes and traffic is reported in *Chapter 4*. A copy of the collision risk assessment report is provided in *Annex C*.

Collision Risk Assessment

Risk modelling was undertaken to assess collision risk at the Banda field location. Numerical modelling software namely COLLRISK was used. COLLRISK is recognised as industry-leading software for collision risk assessment. Traffic volumes were assessed for each route passing the Banda field location to determine the number of ships interacting with the MODU. The following location-specific influencing factors were considered in the model.

- Emergency Response and Rescue Vessel (ERRV) coverage and specification (*eg* radar type).
- Visibility.

[1] From 784 oil spills above 1 bbl, documented by the US Bureau of Ocean Management (BOEM) from 1964 to 2011 from oil and gas related activities within the US federal outer continental shelf area , 95.0% of the spills were less than 1000 bbl in size; 98.3% of the spills were less than 5000 bbl and 99.2% less than 10000 bbl (BOEM, 2012).

- Wave height.
- Vessel speed distribution.
- Shipping data (traffic density, type and size).
- Installation dimensions and orientation.

The total number of interaction that can be expected formed the basis for calculating the collision frequency.

COLLRISK was then used to assess the likely impact energies that will be generated in the event of ship collision. Impact energy was calculated using likely vessel velocity (ms^{-1}) and displacement (tonnes).

Modelling Results

Table 5.7 presents the ship collision frequencies distributed by impact energy for fours collision scenarios, namely collision from:

- a powered passing vessel;
- a drifting passing vessel
- an in-field vessel; or
- a fishing vessel.

Results are presented on an annual basis.

Passing Powered Vessels

The passing powered ship collision risk modelling took into account the collision risk reduction that will be provided by a supply vessel acting as an ERRV equipped with Automatic Radar Plotting Aid (ARPA). The annual ship collision frequency for passing powered vessel at Banda is estimated to be $8.6\text{x}10^{-4}$, corresponding to a collision return period of approximately 1,150 years. The full collision frequency versus impact energy exceedence spectrum for passing powered ship collisions is presented in *Figure 5.16*.

Passing Drifting Vessels

Drifting vessel collision risks at Banda were based on breakdown of a passing vessel in the proximity of the MODU, the course and speed of the vessel and the probability of the vessel repairing itself before reaching the Banda drilling location. The overall drifting ship collision frequency for the Banda location is very low (

Figure 5.17). This frequency corresponds to a collision return period of approximately 4 million years.

Infield Vessels

Collision from in field vessels was assessed based on estimated exposure to supply vessels. The estimated collision return period for an infield vessel colliding with the MODU at the Banda field is 57 years. The majority of vessel collisions predicted at the Banda location have estimated total impact energies below 10 Mega Joules (MJ). The full collision frequency versus impact energy exceedence spectrum for infield vessel collisions for the Banda location is presented in *Figure 5.18*.

Fishing

The collision risk assessment considered collision from a fishing vessel due to the significant number of large industrial fishing trawlers passing the Banda field location. The annual collision frequency for a fishing vessel colliding with the MODU in the Banda field is estimated to be 2.0×10^{-04}, corresponding to a collision return period of 4,900 years. The full collision frequency versus impact energy exceedence spectrum for passing powered ship collisions is presented in *Figure 5.19*.

Table 5.7 ***Infield Vessel Collision Frequency Results for the Banda Field***

Impact Energy (MJ)	Annual Collision Frequency	Percentage
Passing Powered Collision Frequencies		
0 - 20	Negligible	0
20 - 50	3.8E-04	44
50 - 100	3.8E-04	44
100 - 200	9.5E-05	11
≥ 200	1.2E-05	1
Total	**8.6E-04**	**100**
Passing Drifting Collision Frequencies		
0 - 20	3.7E-08	14
20 - 50	7.2E-08	28
50 - 100	7.5E-08	30
100 - 200	6.4E-08	26
≥ 200	4.9E-09	2
Total	**2.5E-07**	**100**
Infield Vessel Collision Frequency		
0 - 1	9.3E-03	53
1 - 4	6.6E-03	37
4 - 10	1.5E-03	9
10 - 50	1.9E-04	1
≥ 50	Negligible	0
Total	**1.8E-02**	**100**
Passing Fishing Vessel		
0 - 20	2.3E-05	12
20 - 50	6.8E-05	34
50 - 100	6.8E-05	34
100 - 200	4.5E-05	23
≥ 200	Negligible	0
Total	**2.0E-04**	**100**

Source: *Anatec 2012*

Figure 5.16 Passing Powered Impact Energy Exceedence (from Anatec, 2012)

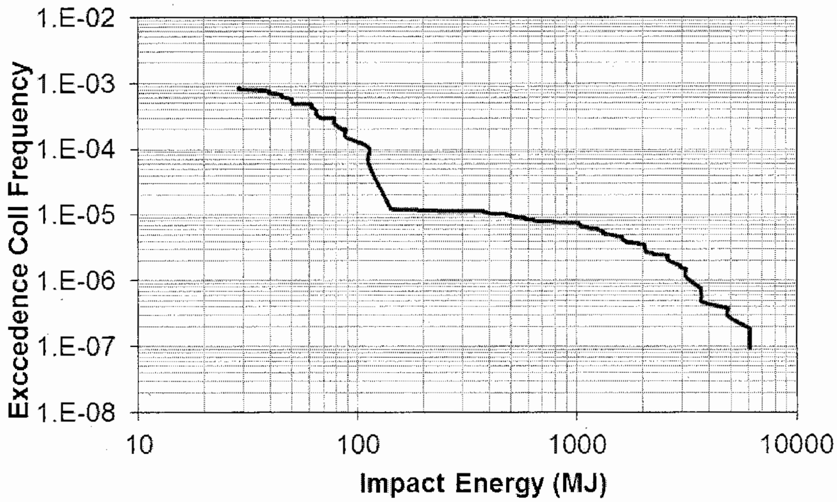


Figure 5.17 Passing Drifting Impact Energy Exceedence (from Anatec, 2012)

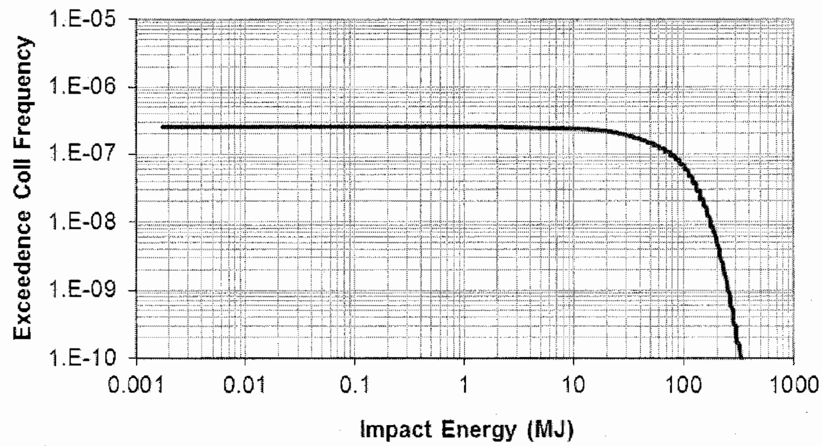


Figure 5.18 Infield Vessel Impact Energy Exceedence (from Anatec, 2012)

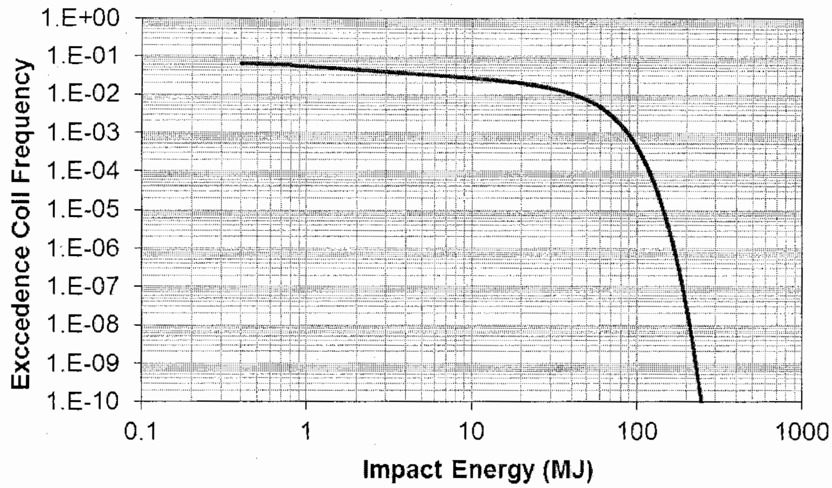
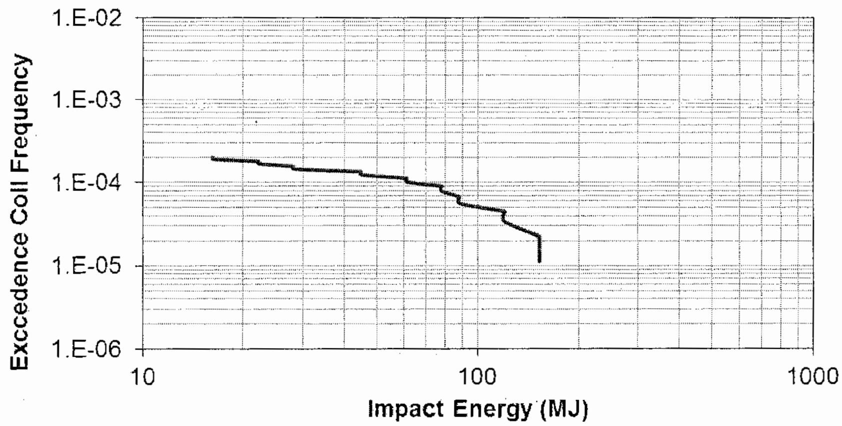


Figure 5.19 Passing Fishing Vessel Impact Energy Exceedence (from Anatec, 2012)



Description of Potential Impacts

The likely impacts on the navigation and shipping of the Project's activity are centred on collision risks and hazards (*ie* associated risks to life, pollution to the environment and emergency dumping of cargo) and can be broadly described as follows.

- Potential for collision between MODU, support or installation vessels, and other vessels (merchant, commercial fisheries, recreational and passenger) during drilling, completion, installation or commissioning activities.
- Displacement of vessels out of the 500 m safety exclusion zone due to presence of MODU or installation vessels.

Mitigation Measures

As a minimum, a 500 m safety exclusion zone will be maintained around the MODU by a supply vessel acting as an ERRV equipped with Automatic Radar Plotting Aid (ARPA). Communication and navigation equipment on the project vessels will comply with requirements of the International Convention for the Safety of Life at Sea, 1974 (SOLAS) and vessel operations will be in accordance with the IMO's International Regulations for Preventing Collisions at Sea 1972 (COLREGS).

The following risk mitigation measures will be implemented to further reduce collision risk for Banda Gas development activities.

- Early notification will be provided to mariners so that they are well aware of the Banda Gas development facilities and activities when undertaking their passage planning or in advance of arriving at the field. Specific notification measures will include providing advanced notice to mariners in the area of the proposed development, issuing a Notice to Mariners and providing data on new facilities for inclusion of nautical charts.

- AIS detection systems will be installed in the field to provide early detection of passing vessels and improved information to aid in the management of this hazard.

- Tullow will consider the use of RAdar and beaCON (RACON) or AIS Aids to Navigation (AtoN) to provide a positive identification of the MODU to passing vessels.

- Industry guidelines (UKOOA 2003) will form the basis of infield vessel management and a full Marine Operations plan will be developed for the field. This should give account to factors including vessel selection and inspection, crewing and competency.

- Collision risk management procedures (preventative and emergency response) will be developed giving account to the traffic patterns and evacuation requirements on the MODU and support vessels.

Impact Assessment

The navigational sensitivity of the area is considered to be medium given that the Banda field is located on a higher density shipping route out of Nouakchott en-route to the Berge Helene FPSO and that a significant number of large industrial fishing trawlers pass the Banda field location.

The intensity of a vessel collision may range from small to large depending on the size of the vessel, travelling speed and subsequent collision impact energy. Lower energy impact collisions are more likely than higher energy collision impact. The magnitude of the consequences of a collision will depend on the collision impact and emergency response procedures. In the event of a high energy collision with the MODU, the consequences may be of large magnitude and result in loss of life, spills of oils and chemicals, and subsequent environmental damage. However, the collision risk assessment showed that the risk frequencies for passing vessels (powered, drifting and fishing vessels) colliding with Banda field facilities is very low ranging from 2.5×10^{-7} to 8.6×10^{-4}, corresponding to return periods of 4 million years to 1,150 years. The collision risk frequency for in-field vessels is higher with a return period of approximately 57 years, however, the majority of these collisions will have low impact energy due to the relatively small tonnages of the vessels and lower impact speed.

The mitigation measures proposed will provide notice and early warning to shipping that may use the area so that, if required, they can adapt their routes to avoid the area. Further navigational aids such as AIS will be implemented and infield procedures developed which would reduce collision risk further.

Given that the Banda Gas operations will comply with standards of international navigation conventions and implement additional navigational aids and infield procedures to further reduce collision risk, this potential impact is assessed to be of *Minor* significance.

5.6 *KEY IDENTIFIED IMPACTS - ONSHORE CONSTRUCTION PHASE*

No onshore construction impacts have been identified as *Moderate* or *Major* in *Section 5.4.*

However, in response to stakeholder concerns regarding noise impacts from the Project on some sensitive receptors identified in the far field, such as the new university of Nouakchott currently being built (please refer to *Annex A* for detailed consultation records), construction noise impacts have been considered to warrant a more detailed assessment and a more comprehensive discussion and have been included in the following section and in the supporting *Annex B-3.*

5.6.1 *Construction Noise*

Assessment Approach

This section presents an assessment of the impacts expected to result from the noise emissions associated with the onshore construction phase of the Banda Gas Project.

A noise modelling has been performed to predict the noise levels for the area surrounding the gas processing plant. The modelling methodology and results are presented in *Annex B-3.*

Noise Sources

Noise associated with the onshore construction phase will be variable in nature and will depend on the particular activities being undertaken as well as the equipment in operation. The construction phase is expected to be approximately 12 months and is anticipated to begin in early 2015.

The overall noise produced during the construction phase comes from several types of equipment and from specific activities. Therefore, the noise impact related to this phase can be variable and it is difficult to accurately predict construction noise emissions throughout the entire construction period.

Hence, to facilitate the noise assessment, two 'worst case' scenarios have been developed:

- **Site Preparation Scenario**: this scenario includes significant noise-producing activities such as vegetation clearance, topsoil removal, earthworks. These activities will require heavy construction vehicles and equipment (excavators, dozers, rollers, dump trucks).

- **Civil Works and Plant Utilities Construction Scenario**: this scenario includes significant noise-producing activities such as installation of concrete and asphalt batch plants, installation of foundation structures and paved areas within the gas treatment facilities, assembly of plant items. These activities will require equipment such as concrete trucks, cranes, side-booms.

Considering that construction activities will extend throughout the Project site, each scenario has been simulated to represent a 'typical' maximum activity with all equipment operating in the area closest to noise sensitive receptors.

The predicted noise levels from the model are based on the assumption that all equipment is operating simultaneously and at full load. The equipment simulated and their acoustic performances for each scenario are detailed in *Annex B-3.*

Construction Phase Noise Magnitude Criteria

There is no relevant national guidance and construction noise is not addressed directly by the IFC EHS guidelines. It is common practice to classify impact magnitude as negligible if the predicted construction noise levels do not exceed the existing ambient noise levels.

In consideration of the construction period, being a period of 12 months, it is considered that the IFC threshold levels of 55 dB(A) for the daytime and 45 dB(A) for the night time would be appropriate for this Project.

Additionally, a LAMax of 85 dBA is a well-accepted action limit for occupational noise management as it is the threshold at which the potential for hearing damage starts to occur. This level has been adopted as the threshold for critical impacts.

The magnitude of construction noise is evaluated by establishing a threshold noise level at which significant impacts start to occur and higher levels for ***medium*** and ***large*** magnitude impacts. Using these standards and guidelines for reference, usually it is appropriate to set significance thresholds for day and night time according to the duration of the noise, on the basis that temporary construction (<1 month) will have lesser impact than short term (1-6 months) or long term (> 6 months).

Table 5.8 presents the magnitude criteria for noise impacts during the construction phase. Given the duration of construction for this Project, a conservative approach has been taken, adopting the most stringent (> 6 months duration) long term criteria.

Table 5.8 Noise Impact Magnitude for Residential Receptors. Construction Phase

Operating Period	Day time Noise Level, dBA			Night time Noise Level, dBA		
Impact Magnitude	Small	Medium	Large	Small	Medium	Large
	Construction LAeq,1hr					
Short exposure < 1 month	< 75	> 75-80	> 80	< 60	> 60-65	> 65
Medium term exposure 1 to 6 months	< 70	> 70-75	> 75	< 55	> 55-60	> 60
Long term exposure >6 months	< 60	> 60-65	> 65	< 50	50-55	> 55

Note: L_{AMax} = 85 dBA is a well-accepted action limit for occupational noise management as it is the threshold at which the potential for hearing damage starts to occur (critical level)

Description of Potential Impacts

This section assesses the likely noise levels and potential impacts at off-site noise sensitive receptors.

Maximum construction noise levels at receptors have been predicted for the scenarios detailed above. The noise values reported refer to the maximum noise level predicted at each receptor where the construction equipment is located at the nearest point of the Project to receptor location and all the equipment work simultaneously. This assumption represents a worst case scenario, considering the worst combination in terms of source level and distance.

Table 5.9 ***Predicted Construction Noise Levels***

Receptor	Predicted Noise Level, from Construction Phase (dBA)		Noise Limit (dBA)	
	Site preparation	Civil works	Day	Night
Site boundary				
NSR 1	68.5	68.5	70	70
NSR 2	66.0	66.0		
NSR 3	62.0	62.0		
NSR 4	63.5	63.0		
NSR 5	61.0	61.0		
NSR 6	64.5	64.0		
NSR 7	66.0	65.5		
Nearest Sensitive Receptors				
NSR 8	29.0	28.5	55	45
NSR 9	32.5	32.0		

For residential receptors (NSR8 and NSR9) a noise limit of 55 dBA for day time and 45 dBA for night time has been assumed. The predicted construction noise levels at both NSRs will comply with the Project's noise construction criteria during both the daytime and night time periods, hence impact magnitude is *Small,* as per criteria reported in *Table 5.8.*

NSR1 to NSR7 are not residential receptors and they are located along the site boundary. In this case the criteria defined in *Table 5.8* cannot be applied, and the noise emissions have been compared to a suitable noise level of 70 dBA, representative of industrial area as per the IFC guidelines. Also for these receptors, the predicted construction noise levels will comply with the Project's noise construction limits during both the daytime and night time periods and the magnitude impact for construction phase, in absence of mitigation, will be *Small.*

Without mitigation, noise impact significance associated with the construction of the Project is expected to be *Negligible,* mainly due to the distance of receptors and the temporary duration of construction activities.

Mitigation Measures

The noise contribution of the construction phase predicted through noise modelling has not identified any significant impacts according to international standards.

Hence no specific mitigation measures will be needed; however, during construction, achievement of Project noise guidelines will be accomplished through good operations management. The management and mitigation measures presented below are considered to be international good practice and are recommended :

- enforcement of appropriate speed limits for heavy vehicles to reduce noise;
- utilisation of modern, well maintained industrial equipment

Impact Assessment

Predicted noise levels for construction are expected to comply with the guidelines presented in *Chapter 2* for all conditions during the daytime and night time period.

Construction noise levels have been predicted for scenarios representing a typical worst-case activity with all equipment operating and the construction noise contribution would be lower than the levels predicted in this study.

Conservatively, the residual impacts are considered equal to potential impacts described above and the overall significance of the residual impacts are assessed as *Negligible* at all the Noise Sensitive Receptors identified.

5.7 *KEY IDENTIFIED IMPACTS – OPERATIONAL PHASE*

Only the presence of exclusion zones with a restriction on permanent infrastructure within 60 m on both sides of the onshore pipeline and within a 300m radius of the gas processing plant was assessed as *Moderate* significance. No other operational impacts have been identified as *Moderate* or *Major* in *Section 5.4.*

However, in response to stakeholder concerns regarding air quality and noise impacts from the Project on some sensitive receptors identified in the far field, such as the new university of Nouakchott (please refer to *Annex A* for detailed consultation records), noise and local air quality impacts have been considered to warrant a more detailed assessment and a more comprehensive discussion which is presented in the following sections and in the supporting *Annexes B-2* and *B-3*.

5.7.1 *Onshore Pipeline Exclusion Zone*

Description of Potential Impacts

The onshore pipeline and umbilical will be trenched and will not cause any severance. However, a restriction on permanent infrastructure within 60 m on both sides of the pipeline will be enforced for safety reasons.

The presence of this 0,68 km^2 exclusion zone creates an additional constraint in a suburban area.

Mitigation Measures

Tullow will have to coordinate with the Ministry of Urbanism so that the exclusion zone is included in the land planning scheme.

Impact Assessment

The exclusion zone of the pipeline will prevent the construction of any permanent infrastructure over a 0,68 km^2 area. This exclusion zone will last for at least 20 years (duration of the Project). The impact magnitude is therefore considered to be *Medium.*

The exclusion zone does not affect any significant existing construction (only one shed has been identified within the exclusion zone). However, it affects an already constraint suburban area of an expanding city. Therefore the resource sensitivity is considered to be *Medium.*

Therefore, the impact of the pipeline exclusion zone is considered to be of *Moderate* significance.

5.7.2 *Gas processing plant exclusion zone*

Description of Potential Impacts

To mitigate potential impacts from accidental operation of the gas processing plant, a restriction area will be established for permanent infrastructure over a distance of 300m around the proposed facility.

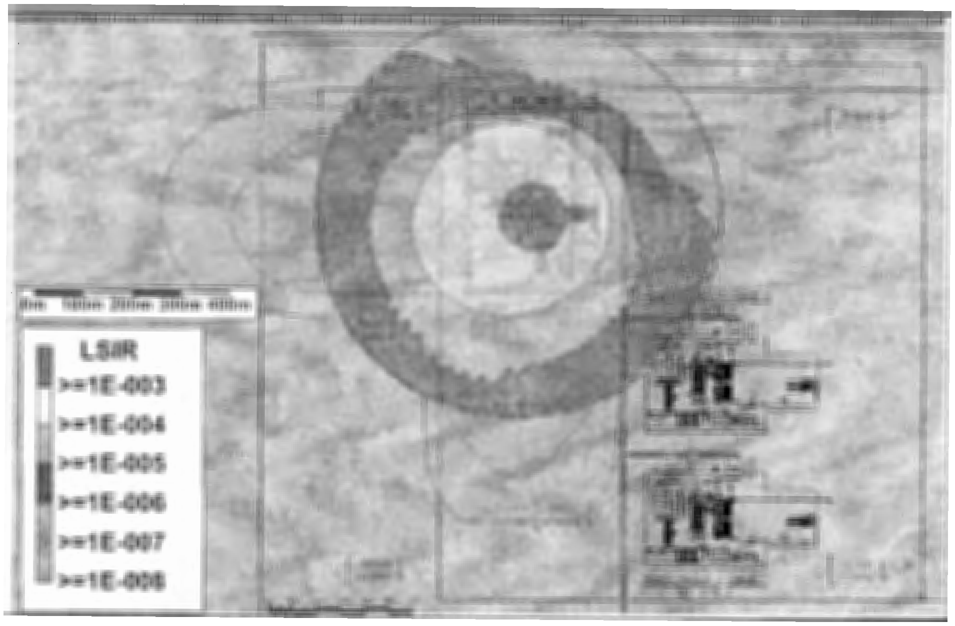
This zone has been defined based on levels of geographical risks identified during a risk assessment and presented in *Figure 5.20.*

This exclusion zone goes beyond the limits of the plot assigned to SOMELEC west and north in an area of 0.31 km ^{2} and creates an additional constraint in a suburban area.

Mitigation Measures

Tullow will have to coordinate with the Ministry of Urbanism so that the exclusion zone will be included in the land planning scheme.

Figure 5.20 ***Geographical Risk Levels used to define the exclusion zone***



Impact Assessment

The exclusion zone of the gas processing plant will prevent the construction of any permanent infrastructure over a 0,31 km² area. This exclusion zone will last for at least 20 years (duration of the Project). The impact magnitude is therefore considered to be *Medium*.

The exclusion zone does not affect any significant existing construction (only one shed has been identified within the exclusion zone). However, it affects a suburban area of an expanding city already subject to constraints. Therefore the resource sensitivity is considered to be *Medium*.

Therefore, the impact of the gas processing plant exclusion zone is considered to be of *Moderate* significance.

5.7.3 *Operational Noise*

Assessment Approach

This section presents an assessment of the impacts expected to result from the noise emissions associated with the operational phase of the Banda Gas Project.

A noise modelling has been performed to predict the noise levels for the area surrounding the gas processing plant. The modelling methodology and results are presented in *Annex B-3*.

Noise Sources

It is anticipated that the operational life of the facility will be 20-25 years and the Plant will run 24 hours a day, 7 days a week and the main noise sources will be located within:

- the gas processing plant and utilities areas, characterized by engine generator, flash gas and processing pumps; and
- the flare area, due to the necessity during normal plant operations to occasionally and intermittently burn unwanted gas from the flare tower. The flare will be 30 meters above ground level.

To predict noise emissions from plant processing operations, a typical worst case activity has been assumed based on the assumption that equipment is operating simultaneously and at full load.

The equipment simulated and their acoustic performances are detailed in *Annex B-3.*

Operational Phase Noise Magnitude Criteria

The IFC EHS guidelines have been considered to set operational phase noise criteria described in *Table 5.10.*

Table 5.10 ***Noise Impact Magnitude for Residential Receptors. Operational Phase***

Operating Period	Daytime Noise Level, dBA			Night time Noise Level, dBA		
Impact Magnitude	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Plant Operation LAeq,1hr	< 55	> 55-60	> 60	< 45	> 45-50	> 50
Amenity Impact Δ LA90	< 10	> 10-15	> 15	< 8	> 8 - 15	> 15

Note: L_{AMax} = 85 dBA is a well-accepted action limit for occupational noise management as it is the threshold at which the potential for hearing damage starts to occur (critical level)

Description of Potential Impacts

Maximum operational noise levels at receptors have been predicted for the operational phase scenarios detailed above.

Figure 5.21 Predicted Noise Levels Generated by the Project – Operation Phase

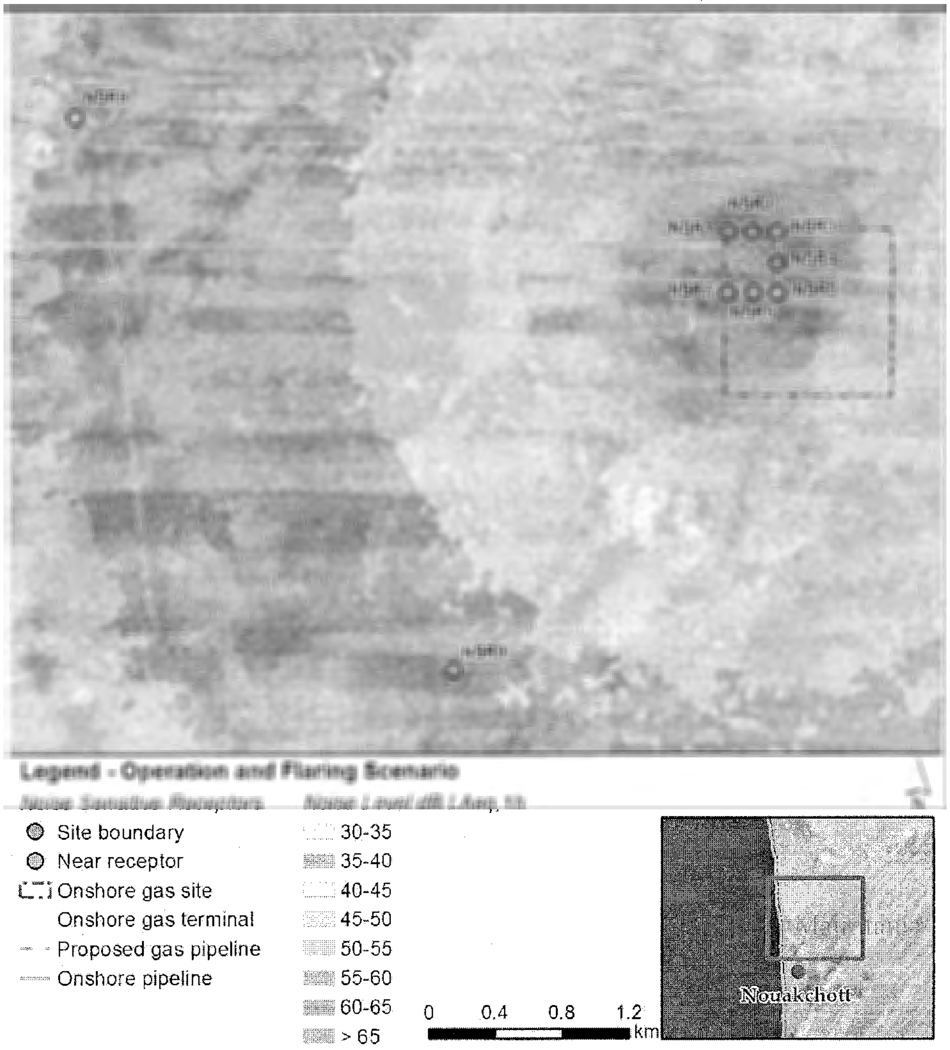


Table 5.11 *Predicted Operational Noise Levels*

Receptor	Predicted Noise Level, Main Operational Phase (dBA)	Noise Limit (dBA)	
		Day	Night
Site boundary			
NSR 1	64.5	70	70
NSR 2	66.0		
NSR 3	63.5		
NSR 4	67.0		
NSR 5	63.5		
NSR 6	68.5		
NSR 7	66.0		
Nearest Sensitive Receptors			
NSR 8	35.0	55	45
NSR 9	38.0		

The noise levels at receptors are influenced predominantly by the fuel gas system and cooler.

The predicted operational noise levels comply with the IFC noise criteria during both daytime and night time periods for all scenarios. Considering the noise assessment criteria reported in *Table 5.10*, the magnitude impact for operational phase is expected to be *Small*.

Predicted noise contours for operational activities, including flaring, are shown in *Figure 5.21*.

Increase in Background Noise Levels during the Operational Phase

The IFC General EHS Guideline states that *[..noise impacts should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site]*. To assess the noise impact generated by the Project on the environmental noise quality, the increase above background required by IFC guidelines has been evaluated.

Noise modelling has allowed calculating $L_{Aeq,\,1\,hour}$ site contributions for direct comparison to the IFC fixed criteria and as such these values must be converted to a background L_{A90} value (15 hour daytime and 9 hour night time) to assess any potential increase in noise level. ERM has assumed that similar activities will occur for the whole duration of each period and has applied a conservative 1 dB reduction [1] to convert from the L_{Aeq} acoustic

(1) As reported in Section 3.2.4 ETSU-R-97 Guidelines states that the LA90 level noise is typically 2 dBA less than the equivalent LAeq,t value. A reduction of only 1 dBA considered in this study guarantees a more conservative approach of the noise assessment.

parameter to the LA90 statistical parameter as the noise emissions from the gas processing plant are considered to be very continuous in nature.

An increase in the background noise level at a noise sensitive receptor location of more than 3dB would be considered as significant.

The predicted change in LA90 noise levels at each NSR during the operational phase has been compared with the background noise levels as reported in *Table 5.12*, which shows the increase above background noise for the assessment locations. Only residential receptors NSR8 and NSR9 have been considered.

Table 5.12 ***Increase in Background Noise Levels - Operational Phase***

Receptor	Existing Background LA90 Noise Level [dBA]	Operational Phase Noise Level, dBA			
		Estimated Plant LA90, [dBA] (a)	Cumulative Noise Level [dBA]	Increase in LA90 Background Noise Level	Comply with IFC significance criteria (< 3 dB)
NSR 8	36.0	34.0 (35.0)	38.1	2.1	Yes
NSR 9	29.5	37.0 (38.0)	37.7	8.2	No

Note:
(a) A reduction of 1 dBA of the equivalent LAeq,t value has been considered to estimate the LA90 plant contribution.

Based on the results reported in *Table* 5.12, the increase above background exceeds the IFC limit of 3 dBA at receptor NSR9. According to the noise criteria reported in *Table 5.10*, the amenity impact magnitude at receptor NSR8 is *Small* and at NSR9 is *Medium*.

It is necessary to underline, however, that the impact at NSR9 is mainly due to low background noise, and it is supposed that once the university facilities have been built the noise background will be higher, comparable to levels monitored at receptor NSR8. Hence it is reasonable to consider also for receptor NSR9 a *Small* amenity impact. However a noise monitoring survey at the beginning of the operations is recommended to verify the compliance with IFC guidelines.

Without mitigation, noise impact significance associated with the operational phase of the Project is expected to be *Negligible*.

Mitigation Measures

The noise contribution of the operational phase predicted through noise modelling has not identified any significant impacts according to international standards.

A medium amenity impact may occur at receptor NSR9, but it's supposed that once the university facilities have been built the noise background will be higher and no significant impacts will be expected.

Hence no specific mitigation measures will be needed; however, during operation, achievement of Project noise guidelines will be accomplished through good operations management. The management and mitigation measures presented below are considered to be international good practice and are recommended :

- enforcement of appropriate speed limits for heavy vehicles to reduce noise;
- utilisation of modern, well maintained industrial equipment and plant with the appropriate noise mufflers in place;
- operational noise monitoring at established permanent monitoring locations (such as NSR9) to ensure compliance with the guidelines; and
- performance of noise modelling in case of modification of the plant, or if ongoing monitoring indicates non compliance with the guidelines.

Impact Assessment

Predicted noise levels for operations are expected to comply with the guidelines presented in *Section 2.2* for all conditions during the daytime and night time period.

Operations noise levels have been predicted for scenarios representing a typical worst-case activity with all equipment operating and the plant noise contribution would be lower than the levels predicted in this study.

Conservatively, the residual impacts are considered equal to potential impacts described above and the overall significance of the residual impacts for normal operations are assessed as *Negligible* at all the Noise Sensitive Receptors identified.

5.7.4 *Impacts on Local Air Quality*

Assessment Approach

This section presents an assessment of the impacts expected to result from the atmospheric emissions associated with the operational phase of the Banda Gas Project.

An air quality modelling has been performed to quantify the atmospheric ground-level concentrations of macro-pollutants. The modelling methodology and results are presented in *Annex B-2.*

The air dispersion modelling study aims to quantify the atmospheric ground-level concentrations of macro-pollutants produced by the atmospheric emissions associated to the operation of the High Pressure (HP) and Low Pressure (LP) flares of the Banda gas processing plant. The main atmospheric emissions arising from the combustion of sulphur-free flue gases at the HP and LP flares are NO_x, CO and PM.

According to the Project characteristics, two simulation scenarios were identified, for operational and emergency conditions.

The atmospheric emissions occurring during the normal operation of the Project are produced by the combustion of purge gas at the HP and LP flares with an emission rate of 250 kg/h.

A worst-case emergency scenario, in terms of gas flowrate, has been chosen for both flares in discussion with Tullow; moreover it was assumed that the HP and LP flares operate in their worst emergency conditions at the same time and continuously during the simulated year with emission rates of respectively 59 546 kg/h and 14 377 kg/h.

The ground concentrations of NO_x (conservatively considered as NO_2), CO and PM (conservatively considered as PM_{10}) have been modelled for both scenarios over a 30 x 30 km domain, roughly centred on the flares' location.

Significance Criteria for Impacts on Local Air Quality

The significance of the predicted impacts is considered in terms of:

- the Process Contribution (PC) which is the impact on air quality arising from the process emissions only; and
- the Predicted Environmental Concentration (PEC) which is the PC added to the existing baseline.

No existing baseline data are available for the Project area thus PEC has not been calculated in the present study. Considering the rural nature of the Project area and the absence of existing atmospheric pollution sources in its proximity, it can reasonably be concluded that background concentrations of airborne pollutants are negligible over the Project area.

On this basis a significance criteria based on the PC has been defined and used in the present study.

The IFC General EHS guidelines (*IFC, 2007*) recommends that projects with significant sources of air emissions, such as the Project flares, should not contribute to the attainment of relevant ambient air quality guidelines or standards for more than 25 % of the applicable air quality standards to allow additional, future sustainable development in the same airshed.

An adjacent proposed electrical power station is to be developed, owned and operated by a separate entity, the *Société de Production d'Electricité à partir du Gaz* (SPEG). The SPEG power plant is being developed as a separate project from the Banda gas development, and is not covered by the scope of this EIA. However, this associated facility (1) will produce atmospheric emissions and potential impacts on local air quality. The significance criteria for air quality impacts have therefore been defined and used in the present study based on the IFC recommendation to allow additional development in the same airshed.

- If the PC <5% of the air quality standard, then impacts are **negligible**.
- If the PC between 5% and 25% of the air quality standard, then impacts are of **minor** significance.
- If the PC between 25% and 50% of the air quality standard, then impacts are of **moderate** significance.
- If the PC >50% of the air quality standard, then impacts are of **major** significance.

Air Quality Receptors

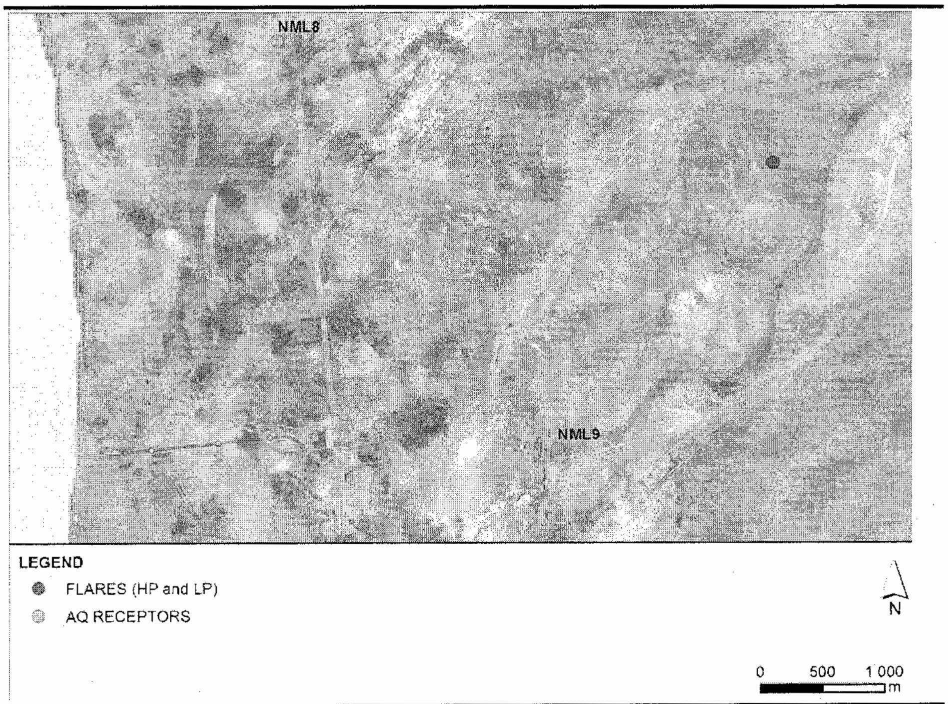
The nearest buildings identified in the vicinity of the proposed gas plant site are:

- the new University of Nouakchott located 2.7 km south/southwest of the proposed gas processing facility, still under construction; and
- some scattered permanent residential buildings located 3.8 km west /northwest of the proposed gas processing facility, including also few temporary tents.

These receptors have been identified by a desktop analysis of the local cartography or satellite images and confirmed by means of site visit to verify the state of the buildings and the presence of inhabitants.

(1)The IFC PS1 defines associated facilities as facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.

Figure 5.22 ***Receptors Identified in the Near Field around the Site***



Description of Potential Impacts

Operational Scenario

Table 5.13 provides a summary of the results of the performed modelling study for the Operational Scenario along with the significance of impacts on local air quality assessed with respect to IFC Air Quality Standards.

It shows that the ambient air concentration of all pollutants modelled for the operational phase comply with IFC air quality standards. In particular modelled concentrations of CO are four orders of magnitude smaller than their respective AQS.

According to the impact significance levels described above, impacts on local air quality due to NO_2, CO and PM_{10} ground level concentrations induced by the combustion of purge gas at the HP and LP flares have been assessed as **Negligible.**

Table 5.13 ***Operational Scenario: Modelled Concentrations of Atmospheric Pollutants and Significance of Impacts on Local Air Quality***

Pollutant	Parameter	Modelled concentrations [µg/m^3]	IFC AQS [µg/m3]	Impact Significance
NO_2	Annual average	0.15	40	Negligible
	Maximum hourly concentration	1.87	200	Negligible
CO	8h moving average(*)(**)	7.62	10000(*)(**)	Negligible
PM_{10}	Annual average	0.42	20	Negligible
	Maximum Daily average	1.41	50	Negligible

(*) WHO Air Quality Guidelines for Europe
(**)The maximum daily eight-hour mean concentration will be selected by examining eight-hour running averages, calculated from hourly data and updated each hour. Each eight-hour average calculated will be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on that day.

Modelled pollutants concentration were spatially localised by mean of iso-concentration maps, for NO_2 and PM_{10}. These contour maps are shown in the following figures:

- *Figure 5.23* *Operational Scenario: Predicted Annual Average Concentration.*
- *Figure 5.24* *Operational Scenario: Maximum Predicted Hourly Concentration.*
- *Figure 5.25* *Operational Scenario: Predicted Annual Average Concentration.*
- *Figure 5.26* *Operational Scenario: Maximum Predicted Daily Concentration.*

The iso-concentration maps shows that concentration maxima are localised downwind, thus south-east of flares; moreover the areas affected by the concentration maxima are confined in the near proximity of the Project atmospheric emission sources.

Figure 5.23 Operational Scenario: Predicted Annual Average Concentration for NO_2

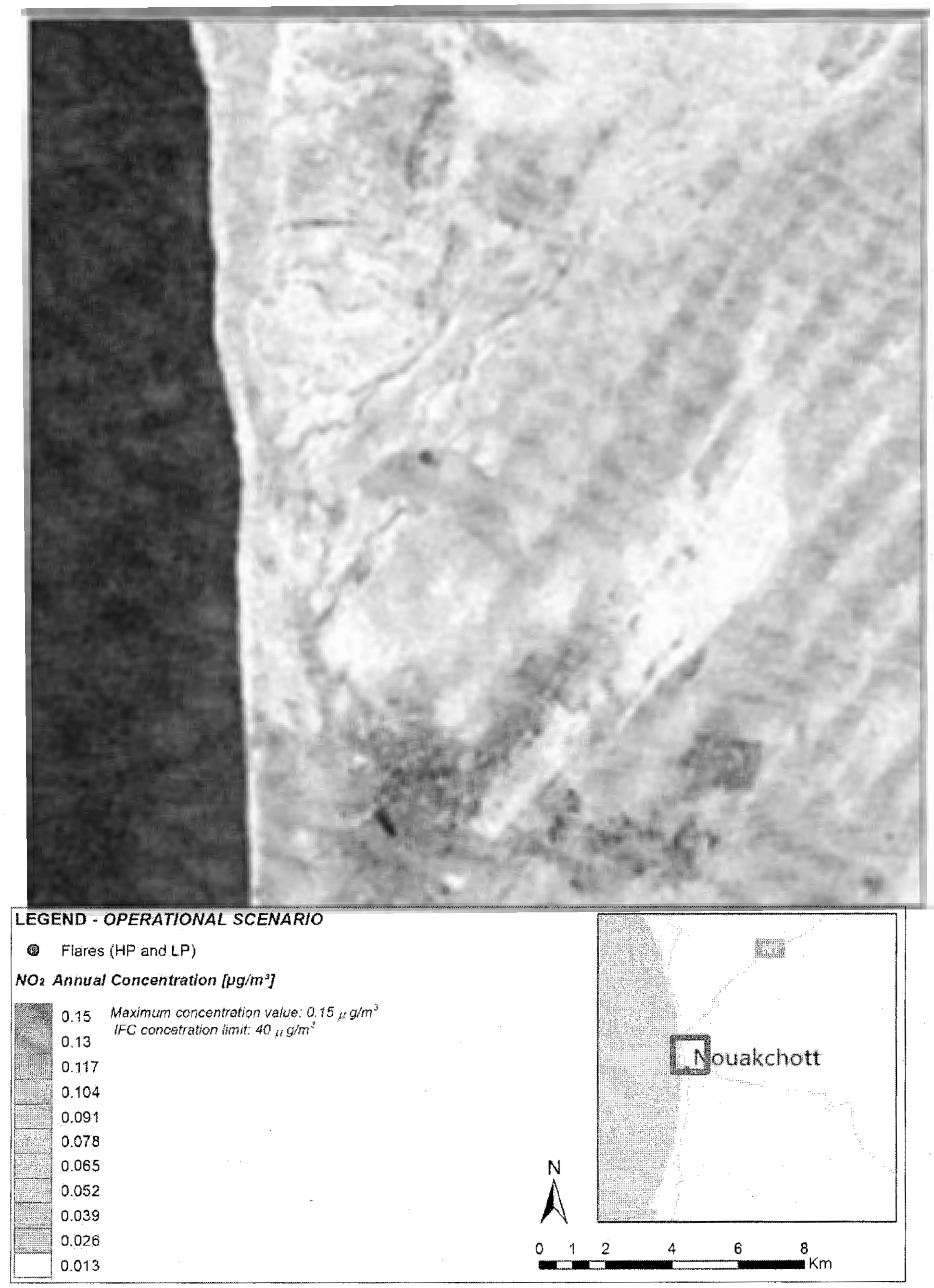


Figure 5.24 ***Operational Scenario: Maximum Predicted Hourly Concentration for NO_2***

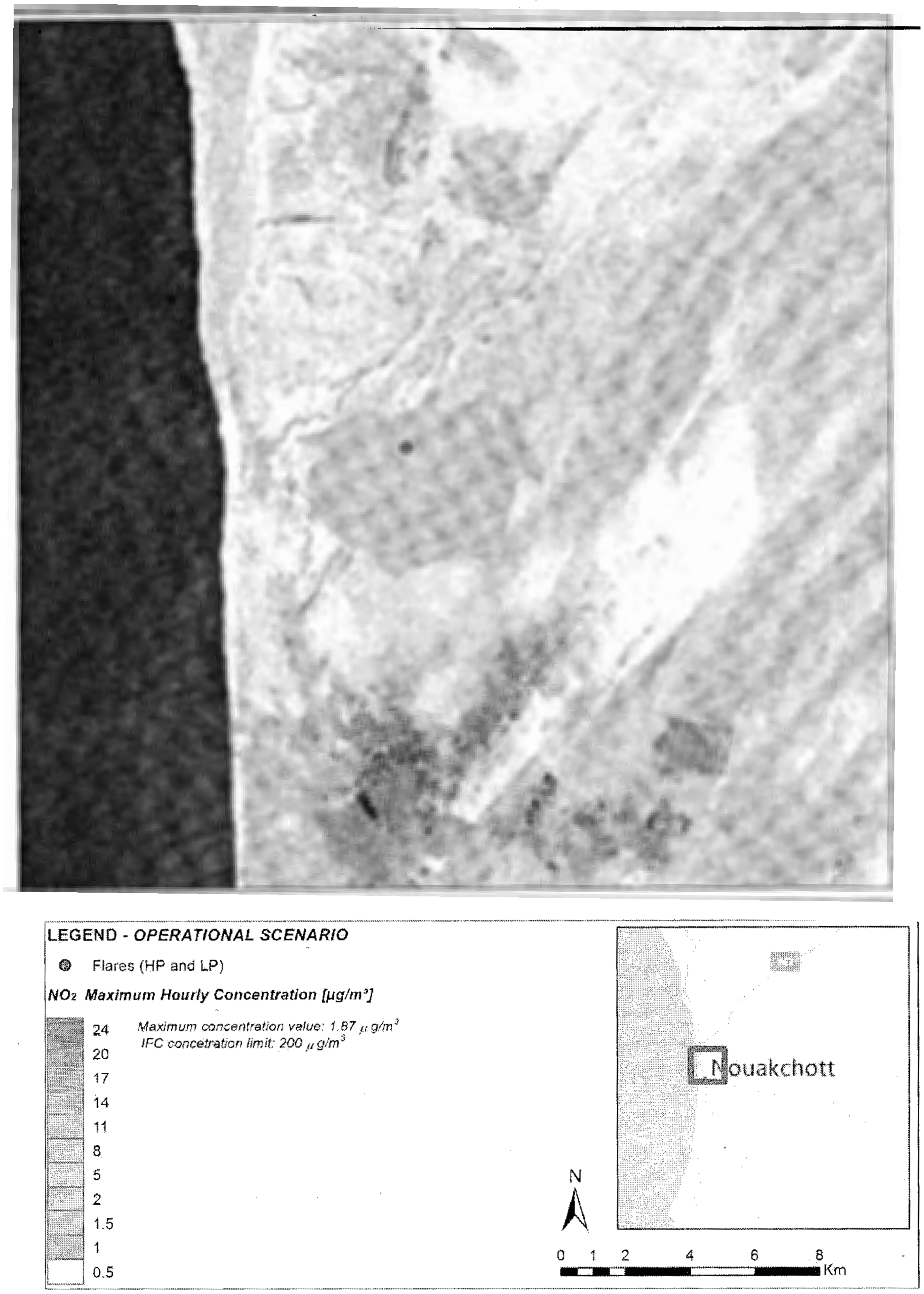


Figure 5.25 Operational Scenario: Predicted Annual Average Concentration for PM_{10}

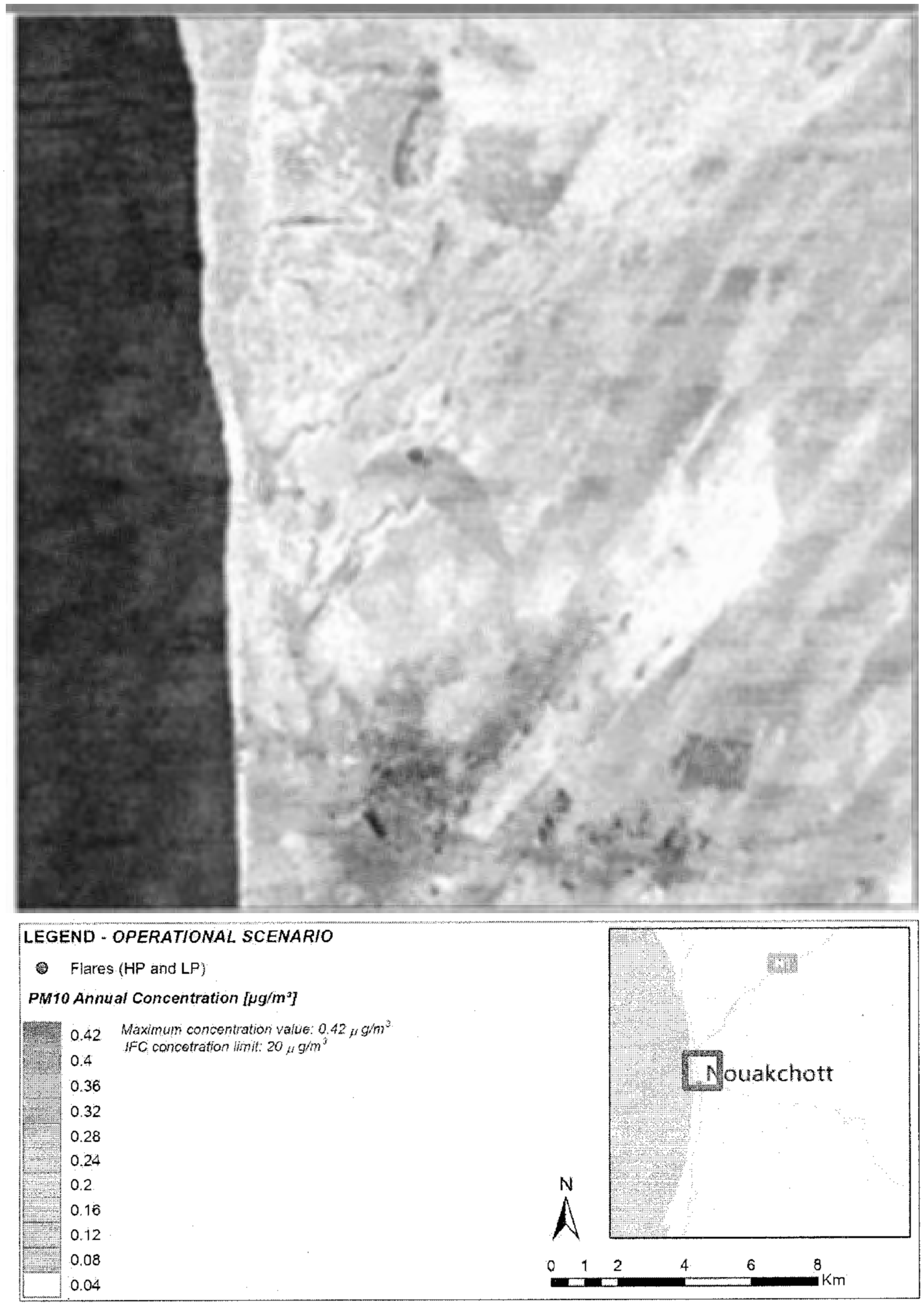
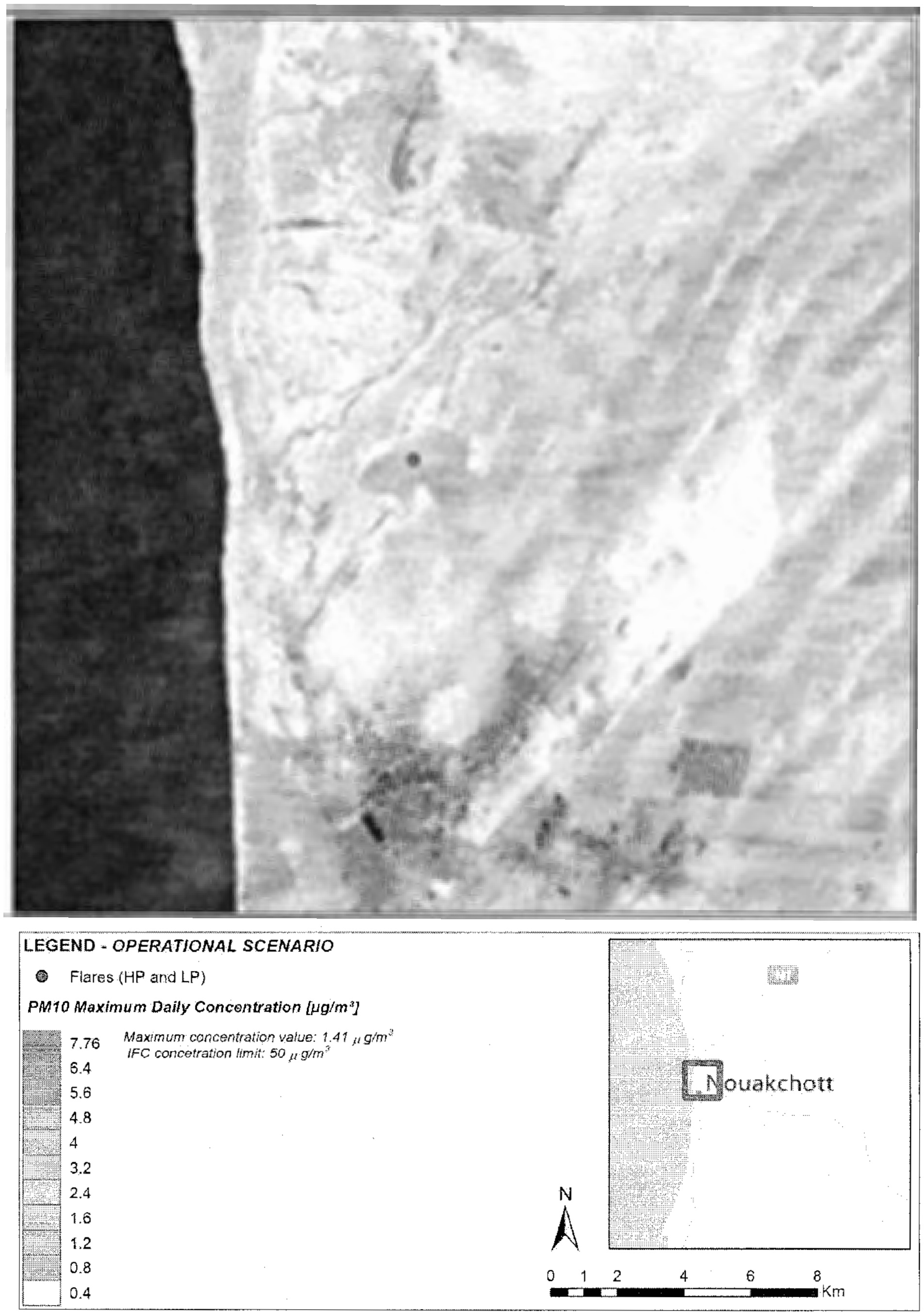


Figure 5.26 ***Operational Scenario: Maximum Predicted Daily Concentration for PM_{10}***



Emergency Scenario

Table 5.14 provides a summary of the results of the performed modelling study along with the significance of short term impacts on local air quality assessed with respect to IFC Air Quality Standards.

Table 5.14 ***Emergency Scenario: Modelled Concentrations of Atmospheric Pollutants and Significance of Impacts on Local Air Quality***

Pollutant	Parameter	Modelled concentrations [µg/m³]	IFC AQS [µg/m3]	Impact Significance
NO_2	Maximum hourly concentration	24.05	200	Minor
CO	8h moving average(*)(**)	43.00	10000(*)(**)	Negligible
PM_{10}	Maximum Daily average	7.76	50	Minor

(*) WHO Air Quality Guidelines for Europe

(**)The maximum daily eight-hour mean concentration will be selected by examining eight-hour running averages, calculated from hourly data and updated each hour. Each eight-hour average calculated will be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on that day.

As clearly apparent from the previous table all pollutants concentrations modelled for the emergency scenario comply with IFC air quality standards. In particular modelled concentrations of CO are three orders of magnitude smaller than their respective AQS.

According to the impact significance levels described above, impacts on local air quality due to CO ground level concentrations induced by the combustion of gas at the HP and LP flares in emergency conditions have been classified as **Negligible;** whereas impacts due to NO_2, and PM_{10} ground level concentrations have been classified as **Minor**.

In comparison with the model results obtained for the operational scenario, short term modelled concentrations obtained for the emergency scenario appears to be higher. This trend was expected considering the higher atmospheric emissions produced in the identified emergency case. However, only **Minor** impacts on local air quality are expected for the emergency scenarios.

Similarly to what is shown in the previous section for the operational scenario, pollutants concentration modelled for the emergency scenario were spatially localised by mean of iso-concentration maps, for NO_2 and PM_{10} short term concentrations. These contour maps are shown in the following figures:

- *Figure 5.27* *Emergency Scenario: Maximum Predicted Hourly Concentration.*
- *Figure 5.28* *Emergency Scenario: Maximum Predicted Daily Concentration.*

In order to enable a comparison between model results obtained for the operational and the emergency scenarios, the same classes of concentration values have been adopted in the iso- concentration maps related to the future and present scenarios.

Figure 5.27 Emergency Scenario: Maximum Predicted Hourly Concentration for NO_2

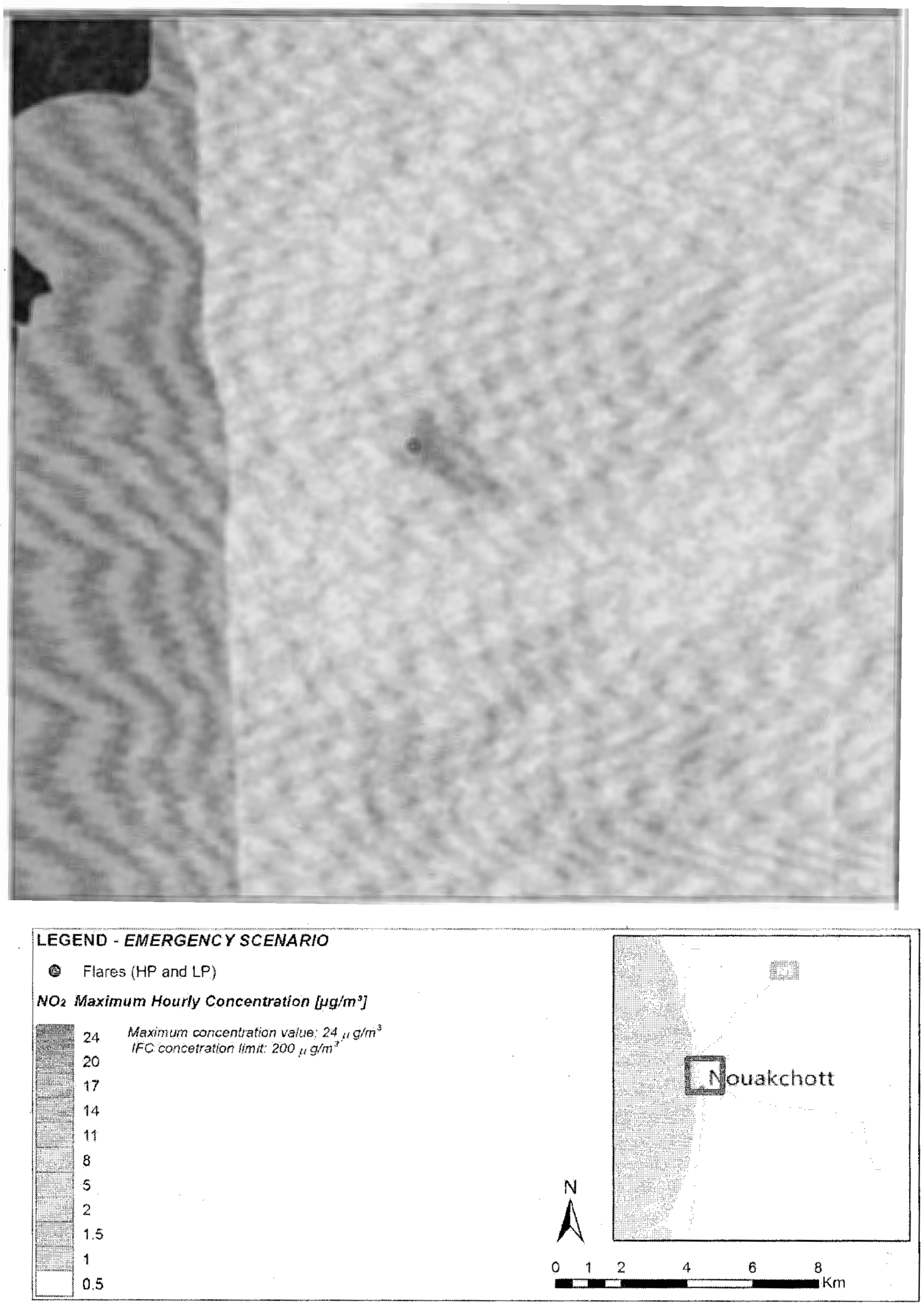
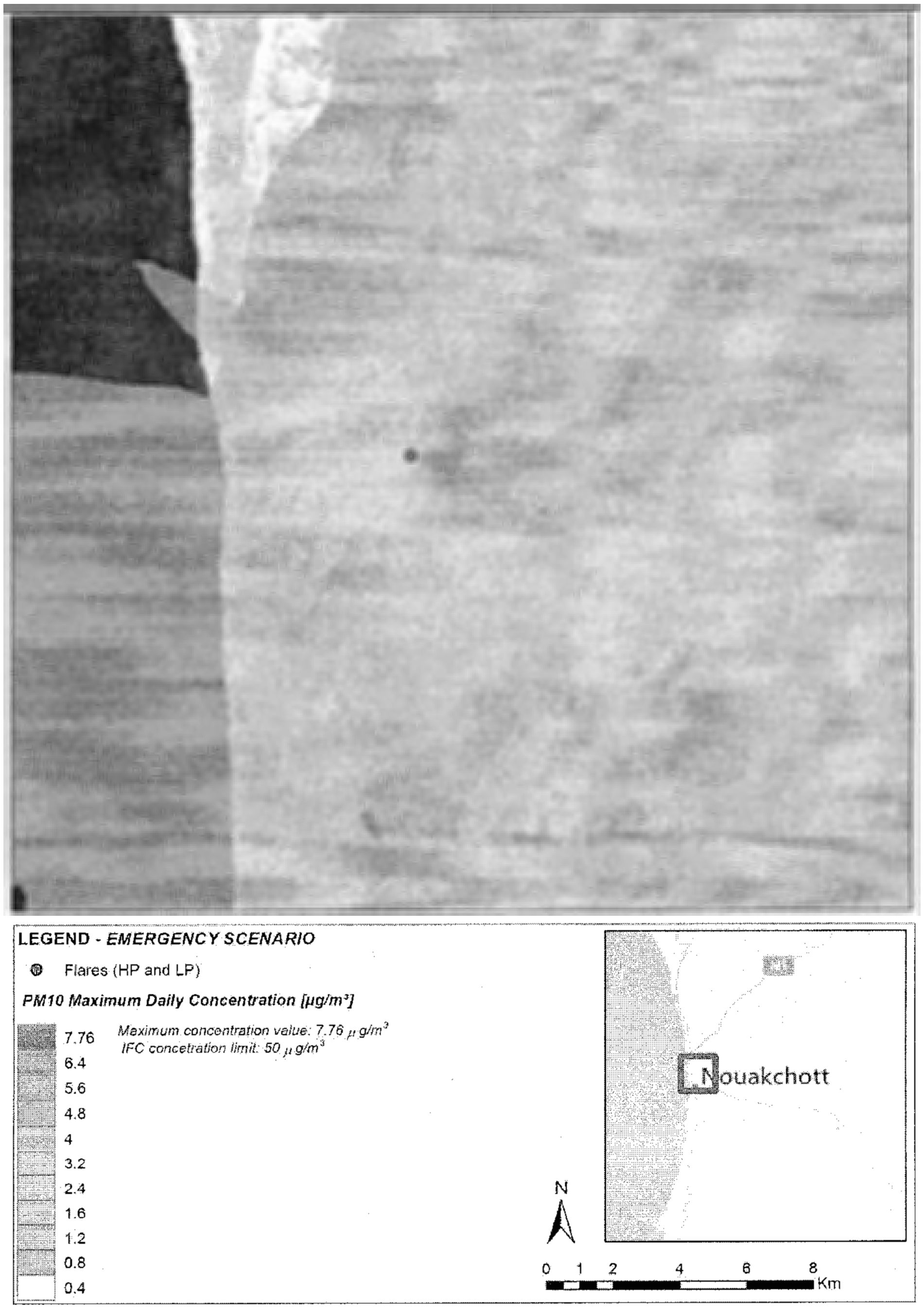


Figure 5.28 Emergency Scenario: Maximum Predicted Daily Concentration for PM_{10}



The map of concentration isopleths show that the concentration maxima are localised downwind, thus east south-east of the flares and the areas affected by the concentration maxima are confined in the proximity of the project atmospheric emission sources.

The maximum value for NO_2 hourly concentrations and PM_{10} daily concentrations occurs at a distance of approximately 33 m and 79 m from the flare, respectively.

Time series extracted at the NML8 and NML9 locations for modelled short term concentrations of NO_2 and PM_{10} are presented in the following Figures:

- *Figure 5.29 Time Series of No2 Hourly Concentrations at Receptor NML8 (Settlement near Nouakchott- Nouadhibou Road).*
- *Figure 5.30 Time Series of NO2 Hourly Concentrations at Receptor NML9 (University).*
- *Figure 5.31 Time Series of PM10 Daily Concentrations at Receptor NML8 (Settlement near Nouakchott- Nouadhibou road).*
- *Figure 5.32 Time Series of PM10 Daily Concentrations at the Receptor NML9 (University).*

Figure 5.29 Time Series of No_2 Hourly Concentrations at Receptor NML8 (Settlement near Nouakchott- Nouadhibou Road)

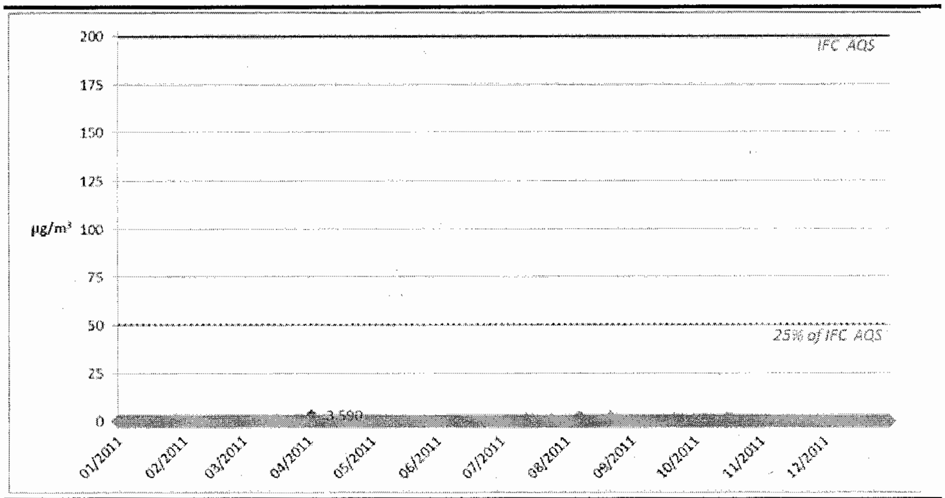


Figure 5.30 Time Series of NO_2 Hourly Concentrations at Receptor NML9 (University)

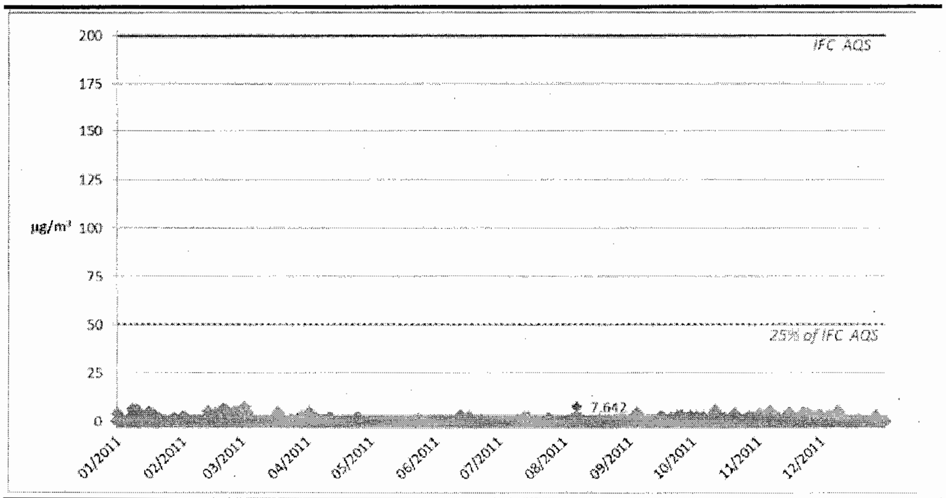


Figure 5.31 ***Time Series of PM_{10} Daily Concentrations at Receptor NML8 (Settlement near Nouakchott- Nouadhibou road)***

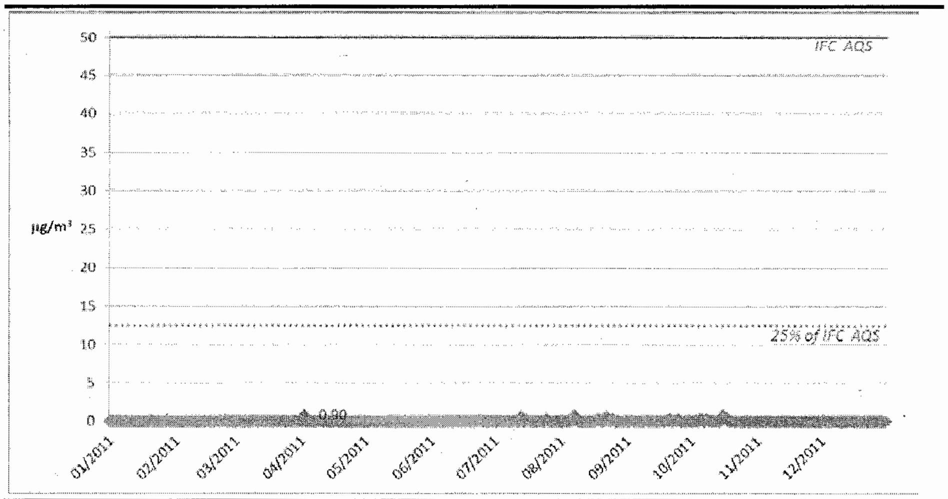
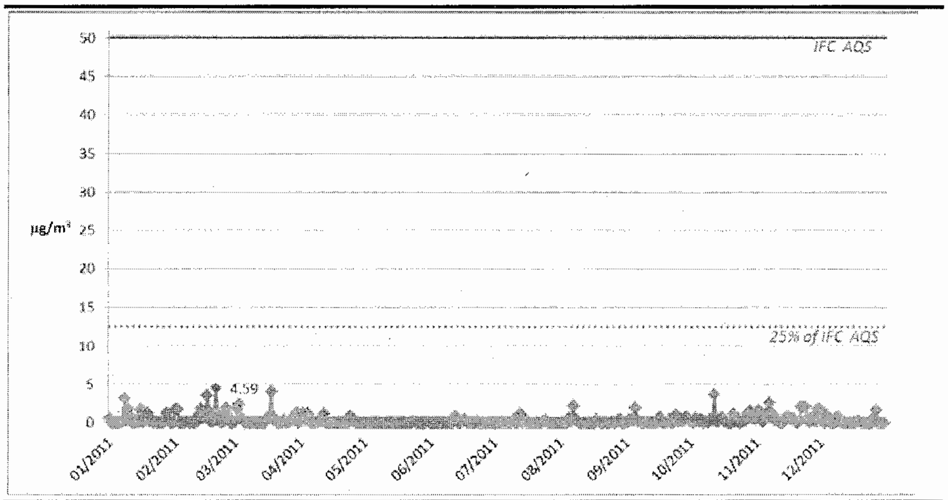


Figure 5.32 ***Time Series of PM_{10} Daily Concentrations at the Receptor NML9 (University)***



As clearly apparent from the previous Figures, short term concentrations of NO_2 and PM_{10} modelled for the emergency scenario are significantly below in force AQS Standards set by the IFC guidelines. In particular, maximum modelled concentrations at receptors accounts for less of the 5% of the regulatory limits, thus even in emergency cases, impacts on local air quality at the closest receptors are classified as **Negligible**.

Mitigation Measures

No specific measures are needed to mitigate the impacts on local air quality.

Impact Assessment

The performed atmospheric dispersion study quantified the atmospheric ground-level concentrations of NO_2, CO and PM_{10} produced by the atmospheric emissions associated to the Banda Gas Project under operational and emergency conditions.

Modelled ground level concentrations enabled the comparison with in force air quality standards, set by the IFC guideline, and subsequently the assessment of the significance of impacts on local air quality. It has to be noted that modelled pollutants ground level concentration obtained for the emergency scenario have only been compared against short term air quality standards, due to the short term nature of emergency events.

The project contribution in terms of induced ground level concentrations of CO, PM and NO_2 is **Negligible** for the operational scenario.

The project contribution in terms of induced ground level concentrations of CO is **Negligible** for the emergency scenario.

The project contribution in terms of induced ground level concentrations of PM and NO_2 is **Minor** for the emergency scenario.

5.8 CUMULATIVE IMPACTS

Cumulative impacts are the result of the combined effect of individual impacts, which may be of no significance when taken individually, but which can have a non-negligible cumulative impact.

The potential for the Project to have cumulative impacts with other activities and with known or committed developments taking place in the area at the same time have been considered. This Section presents the assessment of the cumulative impact risk associated with the main receptors studied in the previous sections.

5.8.1 *Offshore Drilling and Installation Phase*

Activities Considered in Assessing Offshore Cumulative Impacts

Other activities in the vicinity of the offshore component of the Project area have the potential to cause cumulative impacts. These include:

- the operations of the Chinguetti oilfield located approximately 20 km to the west of the Banda field;
- the oil and gas exploration activities in the vicinity of the Project area; and
- the shipping and fishing related traffic in the Project area.

These scattered and intermittent sources are not considered to cause any significant impact.

Interference with Shipping and Navigation of Other Sea Users

The vessels taking part in the Project activities will increase shipping traffic in the area, which could increase the risk of collision between vessels. However, with only 1-2 ships a day pass within 30 nautical miles of the Banda field the baseline traffic is relatively low and no particular mitigation or management measures are required to address this cumulative impact.

Noise Disturbance to Marine Fauna

Cumulative impacts linked to submarine engine noise could be large scale if there was a large amount of shipping traffic in the Project area, or if seismic acquisition surveys were taking place in neighbouring blocks over the same period.

The noise disturbance to marine fauna caused by the Project will be localised and in view of the distance between the various blocks and the relatively low traffic in the Project area, these cumulative impacts are not considered to be significant.

Atmospheric Emissions

Atmospheric emissions result from the combustion of diesel fuel by the various vessels taking part in the Project.. Taken separately, these emissions are small, intermittent and localised and will not constitute any significant deterioration of the air quality in the Project area (see Chapter 3 for the Project's Emissions inventory).

Other possible contributors to air emissions are the other vessels crossing the area. However, the cumulative impact of emissions generated by all shipping traffic in the area should not lead to any significant deterioration of the air quality and no particular mitigation or management measures are required to address this cumulative impact.

The offshore construction phase emissions will represent 1.1% of the country's yearly GHG emissions (see Chapter 3 for the Project's Emissions inventory).

Waste Generation and Effluent Discharge

The Project's waste generation (including both liquid and solid waste, whether hazardous or not) will be localised, of small scale, and limited in time. No other significant waste generators have been identified in the vicinity of the Project area and the cumulative impacts linked to the generation and management of waste by other sea users is considered to be *Negligible*.

5.8.2 *Onshore Construction Phase*

Activities Considered in Assessing Cumulative Impacts from Onshore Construction

Other activities or proposed developments in the vicinity of the onshore component of the Project area have the potential to cause cumulative impacts during the onshore construction phase. These include:

- the construction of the proposed SPEG power plant;
- the construction and operation of the new international airport; and
- the existing road traffic on the Nouakchott-Nouadhibou.

Due to their scale, expected to be larger than the Banda Gas development, the construction of the proposed SPEG power plant and the new international airport have the potential to cause impact of higher significance than the one covered in this EIA.

Noise Disturbance to Local Community

Few receptors are located in the vicinity of the proposed gas processing plant and the cumulative impact risk on Noise has been assessed as *Negligible.* No particular mitigation or management measures are required to address this cumulative impact.

Traffic Safety

The road infrastructure (dual carriage way) in the Project area is considered to have the capacity to accommodate the additional traffic caused by the proposed development without compromising traffic safety.

Therefore the cumulative impact risk on traffic safety has been assessed as *Negligible* and no particular mitigation or management measures are required to address this cumulative impact.

Air Quality

Few receptors located in the vicinity of the roads used by the different developments in the area have been identified and the cumulative impact risk on Air Quality has been assessed as *Minor.* No particular mitigation or management measures are required to address this cumulative impact.

Clearance of Natural Habitats

The natural habitats within the plant layout and the pipeline were not found to be of particular environmental sensitivity at a regional scale. Other proposed development can impact these natural habitats but cumulative impact risk is considered as *Minor.*

5.8.3 *Operational Phase*

Activities Considered in Assessing Operational Cumulative Impacts

Other activities or proposed developments in the vicinity of the onshore component of the Project area have the potential to cause cumulative impacts during the operation phase. These include:

- the operation of the proposed SPEG power plant;
- the operation of the new international airport;
- residential developments (such as the Ribat El Bahr proposed development); and
- road traffic on the Nouakchott-Nouadhibou road and the proposed Nouackhott ringroad .

Due to its scale and nature, the operation of the proposed SPEG power plant will generate higher volumes of atmospheric emissions and discharges than the proposed Banda Gas development.

No offshore activities have been considered as a potential source of cumulative impact as during its operational phase, all the Project infrastructure will be subsea and are not expected to interfere with other activities or proposed developments.

Constraint on Land Planning

The onshore component of the Project is located on mostly undeveloped land, 5 km north of the edge of the city of Nouakchott, which experiences rapid suburban growth. Other proposed developments (such as Nouakchott's proposed ring road or the Ribat El Bahr residential development) in the vicinity of the Project can constitute additional constraints on land planning during the Project operations.

Therefore the cumulative impact on land planning is considered to be *Moderate.*

Tullow will have to coordinate with the Ministry of Urbanism so that the exclusion zone is included in the land planning scheme.

Air Quality

In consideration of the IFC General EHS guidelines (*IFC, 2007*) the significance criteria for air quality impacts used in the present study have been defined to) allow additional development in the same airshed.

The IFC General EHS guidelines recommends that projects with significant sources of air emissions, such as the Project flares, should not contribute to the attainment of relevant ambient air quality guidelines or standards for more than 25 % of the applicable air quality standards.

Maximum modelled concentrations (for NO_2, CO and PM_{10}) at nearest receptors accounts for less of 5% of the regulatory limits and allow other developments in the same airshed. Therefore the cumulative impact risk on Air Quality has been assessed as *Minor*.

Future developments in the vicinity of the Project area, in particular the SPEG power plant which will generate much more significant atmospheric emissions than the Banda Gas processing facility, should consider the Project's atmospheric emissions in their baseline in order to assess actual cumulative impacts on air quality.

Noise Disturbance to Local Community

Few receptors are located in the vicinity of the proposed gas processing plant and the cumulative impact risk on Noise has been assessed as *Negligible*. No particular mitigation or management measures are required to address this cumulative impact.

Traffic Safety

The road infrastructure (dual carriage way) in the Project area is considered to have the capacity to accommodate the additional traffic caused by the proposed development without compromising traffic safety.

Therefore the cumulative impact risk on traffic safety has been assessed as *Negligible* and no particular mitigation or management measures are required.

6 *ENVIRONMENTAL MANAGEMENT PLAN*

6.1 *INTRODUCTION*

The environmental and social impacts expected from the Project, and the measures proposed to mitigate these impacts to an acceptable level, are discussed in *Chapter 5*.

This chapter describes the Environmental Management Plan (EMP) for the Project. This EMP is intended to be used throughout the Project lifecycle as the basis for the detailed design and implementation of environmental mitigation measures to be established by Tullow in coordination with its Contractors.

6.2 *EMP OBJECTIVES*

The EMP should be viewed as a register of the mitigation measures proposed by Tullow in the EIA, to provide guidance for their implementation, as the Project progresses. It is intended as a "live" document, to be periodically reviewed as part of an ongoing improvement process, and adjusted as new circumstances arise during the course of the Project, such as a change in the Project design, the occurrence of unforeseen environmental conditions or any unplanned event.

Its objectives are as follows:

- To ensure compliance of the Project with Mauritanian legislation, international law and international standards, as well as with good practice in the oil and gas industry.
- To help ensure that all the mitigation measures and all the commitments made by Tullow and identified in the EIA report are taken into account during the survey planning and performance phases.
- To establish an environmental surveillance and monitoring programme so that the EMP can be updated and improved as the Project progresses.

6.3 *CONSISTENCE WITH TULLOW EHS MANAGEMENT STANDARDS*

Tullow Oil Plc has adopted an Integrated Management System (IMS), setting out the expectations that operating and support functions are required to meet.

One of the IMS elements is Environment, Health and Safety (EHS) which forms the basis for all underpinning EHS processes and systems, setting out the minimum EHS requirements for business delivery across the group.

The Tullow EHS Management Standards consist of 14 Standards. Each Standard consists of a principle statement to provide the overall intent and mandatory EHS requirements. Each standard states a number of EHS requirements that all operations and activities within the organization must meet:

- Standard 1 Leadership and Accountability.
- Standard 2 Regulatory Compliance & Consultation.
- Standard 3 Risk Management.
- Standard 4 Management of Change.
- Standard 5 Design, Construction & Commissioning.
- Standard 6 Operations, Maintenance & Integrity.
- Standard 7 Contractor Management.
- Standard 8 Asset Protection.
- Standard 9 Environmental & Social Management.
- Standard 10 Health Management.
- Standard 11 Incident Reporting & Investigation.
- Standard 12 Training, Competency & Behaviours.
- Standard 13 Information & Document Management.
- Standard 14 Assessment, Assurance & Improvement.

The Banda Gas Environmental Management Plan will be implemented through the development and application of a set of Project-specific EHS management procedures, which will be developed in line with the Tullow EHS Standards, and adapted to the EHS sensitivities specific to the Banda Gas project.

6.4 *SPECIFIC MANAGEMENT PROCEDURES*

6.4.1 *Introduction*

In addition to the Project's EMP, an EHS plan will be prepared prior to the start of the construction activities, which will include at least the following:

- a vessel emergency oil spill contingency plan;
- an onshore oil and chemical spills prevention and contingency procedure;
- a waste management plan;
- a maritime and fisheries liaison procedure; and
- an archaeological chance finds procedure.

The principles of these procedures are detailed in the following sections.

6.4.2 *Vessel Emergency Oil Spill Contingency Plan*

Despite the prevention measures and management procedures built into the design of the Project there is always a risk that an oil spill can occur. In response to such an event, an Oil Spill Contingency Plan (OSCP) will be developed which has procedures which set out the strategy and specific actions that will be taken in the event of an oil spill.

The actions that will be required for the OSCP in the event of an oil spill vary according to the size of the spill. Oil spills are defined according to three 'Tiers'. This classification is in alignment with the International Petroleum Industry Environmental Conservation Association (IPECA) which advocates a response to oil spills such that the planned response engages resources commensurate with the severity of the spill with the higher the Tier the higher the level of response required.

The OSCP has been informed by the oil spill modelling study so that the response strategy and location of equipment takes into account the areas most at risk and the response times required to mobilise resources and equipment in the event of a spill.

The OSCP interfaces closely with the Mauritanian National Oil Spill Contingency Plan. The resources available to provide a suitable response to any oil spill from the project, and the responsibility for leading spill response, are set out in the OSCP as follows for each Tier of spill.

- **Tier 1:** The response to all Tier 1 spills will remain the responsibility of Tullow. Tullow will hold the appropriate level of Tier 1 oil spill response equipment and trained personnel so as to facilitate an immediate response in the event of a Tier 1 spill and to assist with Tier 2 spill events.

- **Tier 2:** In the event of a Tier 2 spill event the initial response would be the responsibility of Tullow. However, if the magnitude of spill warrants a further response it would engage mutual aid resources which may be provided by industry partners within Mauritania and the Oil Spill Response Limited [(1)] (OSRL) West and Central Africa surveillance and spraying aircraft.

- **Tier 3:** In the event of a spill situation which is clearly beyond Tullow's immediate response capability, both mutual aid resources which may be provided by industry partners within Mauritania and the OSR call-out guarantee from the Oil Spill Response Base in Southampton, UK.

It is important to note that, in Tier 2 and 3 spill situations, the response strategy set out in the OSCP is intended to align with the Mauritanian National Oil Spill Contingency Plan and comply with its requirements. The intention is that in any major spill situation there is cooperation between Tullow, other offshore oil and gas operators and the Government of Mauritania in order to ensure a coordinated and effective response to a spill.

(1) Oil Spill Response Limited (OSRL) is a Global Tier 3 Oil Spill Response Organization, owned by its oil industry member shareholders, for the benefit of its members. OSRL provides immediate response to a Tier 3 oil spill from Southampton, UK. Regional Tier 2 response can be provided with access to an aircraft based in Accra (Ghana) which can both spray dispersant and detect and quantify oil at sea using specialist remote sensing cameras.

6.4.3 *Onshore Oil and Chemical Spills Prevention and Contingency Procedures*

Management procedures to reduce the risk of oil or chemical spill during construction works and operations will include the following measures:

- Vehicles and equipment shall be appropriately maintained to ensure they are free of leaks.
- Drip trays must be provided to capture any drips or spills eg during storage and decanting of hazardous substances including refuelling of bowsers and generators.
- Fuel bowsers and refuelling areas are to be installed on bunded concrete hardstand (rollover vehicle bunds are permitted).
- During refuelling, the fuel dispensing / fill point must be attended at all times to monitor fuel delivery.
- Chemical and hydrocarbon storage facilities must be covered to prevent rainfall ingress into bunded areas.
- Secondary containment (e.g. bunding) must be capable of holding at least 100 per cent of the volume of the largest package plus 25% of the storage capacity.
- Gauges to measure volume must be installed in order to prevent overfilling.
- Fuel and storage areas must be regularly inspected.
- Oil water separators (such as triple interceptors) must be installed and maintained to treat all oily water draining from bunded hydrocarbon storage facilities.

Despite the management procedures built into the design of the Project there is always a risk that an oil or chemical spill can occur during construction works or operations. In response to such an event, onshore oil and chemical spills contingency procedures will be developed to set out the specific actions that will be taken in the event of an onshore oil or chemical spill. These will include at least the following measures:

- Material safety data sheet and spill control equipment will be available at all hazardous material storage and handling locations, and on plant where there is a high risk of spills (including mobile refuelling trucks).
- Spill kits will be available at all refuelling locations regularly inspected and maintained.

- The spill substance is to be identified and the relevant material safety data sheet located immediately to ensure that appropriate corrective actions can be made, and to assist emergency response teams with their preparation and response.

- All hazardous materials spills must be cleaned up as soon as is reasonably practicable to avoid or limit potential environmental impact or health risk.

6.4.4 *Waste Management Plan*

A Banda Gas Development Project detailed Waste Management Plan (WMP) will be developed and implemented for all stages of the Project in accordance with Tullow's requirements and procedures. This WMP will be aligned with the waste management procedures developed for similar Tullow Oil projects and will follow current good practice within the oil and gas industry (1) and IFC requirements. The WMP will include a description of the non-hazardous and hazardous waste streams expected from the various Project activities. The WMP will adopt the principles of the 'waste hierarchy' to ensure that waste generation is reduced and reuse and recycling is maximized. Waste such as scrap metal will be recycled at approved facilities, where possible.

Information on the procedures for handling, storage and treatment and disposal of all project wastes will be included in the WMP. As part of the development of the WMP, Tullow will identify suitable local companies and facilities to receive both non-hazardous and hazardous wastes. All companies receiving Banda Gas Development Project wastes will be approved by the authorities and shall be audited by Project staff prior to receiving any wastes to ensure good practices are in place and companies operate to wholly acceptable standards.

Where suitable facilities do not exist for the onward management of hazardous wastes in-country Tullow will store the wastes as an interim measure until suitable companies have been identified. Where necessary the export of hazardous wastes will be considered as an option to allow the sound management of specific waste streams. Where this is necessary all international conventions shall be followed (see *Chapter 2*)

Tullow recognises that waste traceability is a key issue and that it has a duty to ensure that any waste generated is handled safely and in accordance with legal requirements and good international practice. The WMP will implement a waste tracking system to ensure the management of wastes produced from all operational activities from 'cradle-to-grave'. Waste Transfer Notes (WTNs) will be used to ensure that wastes are transferred from the producer, through the transportation chain to the final disposal point and will provide a record of due diligence across the system.

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(1) OGP (2009) *Guidelines for Waste Management with Special Focus on Areas with Limited Infrastructure*. Oil & Gas Producers Report No. 413. September 2008 (rev1.1, updated March 2009).

The following sections provide an initial framework and waste procedures for offshore vessels and onshore locations for the management of expected wastes. It is envisaged that more detailed procedures will be developed as part of the comprehensive Environmental Management System (EMS) that will be periodically updated and improved to reflect the full scope in-country operations.

6.4.5 *Maritime and Fisheries Liaison Procedure*

Other ships travelling within the Project area and its immediate surroundings must be informed about the Project and its timetable.

The maritime and fisheries liaison procedure will supply the Project contact details to the Mauritanian port authorities and the fishing communities concerned.

Procedures will also be implemented to take account of the presence of fishing boats in the Project area during offshore drilling and installation activities.

Any incidents that may occur will be logged and all relevant details will be entered (time, date, type of incident, etc.).

6.4.6 *Archaeological Chance Finds Procedure*

An archaeological chance finds procedure should be developed to manage unexpected finds resulting from any ground disturbing activity. The goal of this action is to minimize potential impact to subsurface archaeological sites that were not detected by archaeological field survey.

Basic archaeological training should be provided to Project staff and construction workers to help them identify subsurface archaeological resources discovered during ground disturbing activities. This training can be included as part of introduction training and should insist on the fact that unexpected finds must immediately be reported. The goal of this action is to elevate the protection of either known or unknown archaeological resources from potential impacts from ground disturbing activities.

An archaeologist will be deployed to monitor active construction fronts and to guide the recognition of and response to archaeological finds.

Protocols will be established for responding to chance finds, including cessation of work in the vicinity of potential significant finds and notification of the Mauritanian Institute for Scientific Research (*Institut Mauritanien de Recherche Scientifique* - IMRS) and relevant authorities.

Expedited plans will be used for evaluation and rescue of significant chance finds; and an auditable record of monitoring activities will be maintained, including negative findings as well as discoveries. All and any artefacts found must be handed over to the IMRS.

Where sites of importance are identified through the chance finds procedure they will be avoided where practicable.

If a site cannot be avoided it will be evaluated to determine whether it would be considered non-replicable heritage in accordance with IFC PS8. If it is non-replicable then the construction team will work with the IMRS and relevant government authorities to determine an appropriate strategy.

Where sites are considered to be replicable they may be moved to a new location for their protection in consultation with the IMRS.

If a cultural heritage site is damaged it will be treated as an incident, if any features are lost or damaged a mitigation strategy will be further developed under the direction of the Cultural Heritage Working Group.

6.5 *IMPLEMENTING THE EMP*

Tullow will own primary responsibility for implementing the EMP. The Project's contractors will also need to integrate the requirements of the EMP in their operating procedures, and ensure that :

- Roles and responsibilities for EMP implementation and environmental, social, health and safety are clearly defined within the contractor's structure.
- Staff are aware of environmental, social, health and safety procedures.
- Procedures for communication and corrective action are established, to allow for appropriate reaction in case of an environmental, social, health and/or safety incident.
- Periodic auditing and review of the EMP implementation are undertaken.

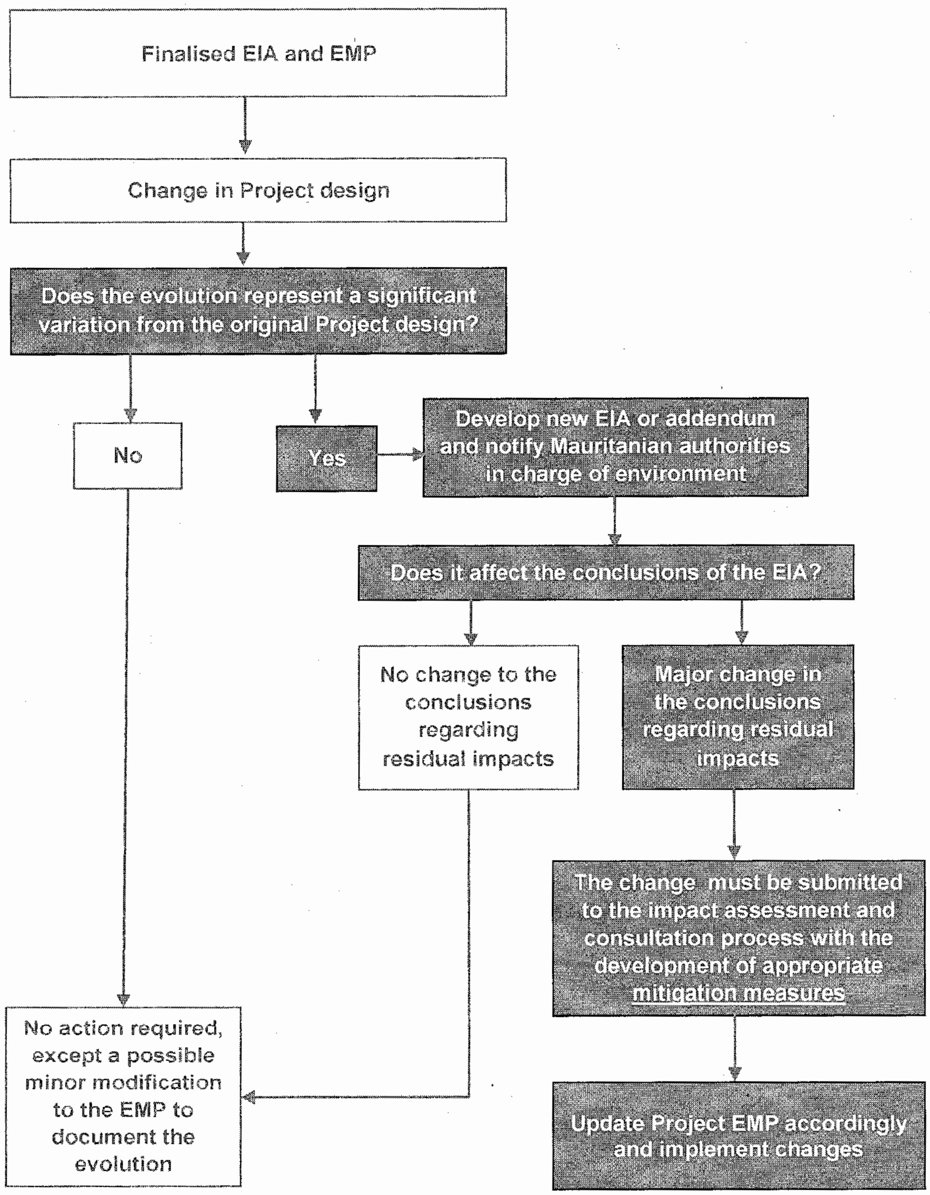
6.6 *MANAGEMENT OF CHANGE*

Gaps and uncertainties inevitably remain in terms of information regarding the proposed Project and the EIA process at the time of writing this report.

As a result, Tullow will implement a clear and transparent Management of Change Procedure, in order to take gaps and uncertainties into account as and when they arise.

Uncertainties remaining about the timetable and logistics for the Project must be addressed in a structured and transparent manner. The procedure that Tullow proposes to implement in order to manage these uncertainties is outlined in *Figure 6.1.*

Figure 6.1 *Process for the management of change relating to the Project*



6.7 DETAILS OF THE EMP

The EMP presented in *Table 6.1* to *Table 6.3* sets out all the specific measures that Tullow proposes to adopt to reduce the impacts identified in this EIA.

This EMP should be viewed as the outcome of the overall Banda Gas EIA. The EIA describes the environmental and social context for the Project, details the Project description on which the assessment was based, and describes the impacts and associated mitigation measures, as well as any residual impacts.

In the following pages:

- *Table 6.1* presents the mitigation measures and commitments register associated with the offshore construction phase of the Project.

- *Table 6.2* presents the mitigation measures and commitments register associated with the onshore construction phase of the Project.

- *Table 6.3* presents the mitigation measures and commitments register associated with the operational phase of the Project.

Note that most costs associated with environmental mitigation are embedded in the construction activities and Project operations, and can therefore be considered to form part of the Project cost, rather than being considered as dedicated environmental mitigation costs.

Table 6.1 Mitigation Measures and Commitments Register - Offshore Drilling and Construction Phase

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Cost of measure
A1	**Physical Presence**						
A1.1	Interference with shipping and navigation from MODU presence	• Provide advanced notice to maritime authorities • Liaison with relevant stakeholders before start of offshore construction. Navigational marks and lights on the MODU • The MODU will maintain radio contact with other users of the sea to mitigate the risk of collisions	*Section 5.5.3*	Duration of offshore construction	FLO	N/A	Included in standard operations
A1.2	Interference with shipping and navigation due to 500 m exclusion zone	• Provide advanced notice to maritime authorities • Liaison with relevant stakeholders before start of offshore construction • Navigational marks and lights on the MODU • The MODU will maintain radio contact with other sea users to mitigate the risk of collisions.	*Section 5.5.3*	During drilling	FLO	N/A	Included in standard operations
A1.3	Temporary interference with artisanal fisheries due to exclusion zone around drilling and pipelay operations	• Essentially during pipelay operations, as artisanal fishermen will not be affected by the drilling exclusion zone which is too far out to sea • Presence of Fishing Liaison Officers (FLOs) on-board selected installation vessels to liaise between fishermen and the Project. The installation vessels will maintain radio contact with other users of the sea to mitigate the risk of collisions. • Exclusion zone will be monitored for the safety of the facility and other users of the area (eg fishermen)	*Section 5.5.3*	During drilling and pipelay operations	FLO	N/A	Cost of FLOs for the work : approx. 20,000 USD.
A1.4	Crossing over the existing ACE cable in approx. 15m of water	• Liaison with the cable operator and development of a crossing agreement. • Physical separation between the pipeline and the ACE fibre optic cable. • Protection of the section of pipeline lying on the seabed by rock dumping or flexible concrete mats.	*Section 5.5.3*	Before pipelay operations During pipelay operations	Pipelay manager	N/A	Cost of matting: up to approx.. 600,000 USD.

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Cost of measure
A2	Drilling Operations (top hole and bottom sections)						
A2.1	Discharge of drill cuttings and fluids casing physical smothering of seabed; water and sediment contamination from chemicals; and impact to marine fauna from exposure to chemicals	• Selection and use of drilling fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. • Seawater and sweep pills used to drill top and surface sections • Use of low toxicity improved SBM, if SBMs is required in light of technical / geological constraints • Use solid control equipment to minimise oil and cuttings(5% to 10%) from WBM and improved SBM sections • Separate cuttings from oil before discharge • Discharge via caisson 5 m below the water surface	*Section 5.5.1*	Top hole drilling	Drilling Manager	5-10% oil on cuttings prior to discharge from MODU	Included in standard operations
A3	Well Completion						
A3.1	Discharge of completion fluids	• Selection and use of completion fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard • Compliance with IFC requirements with regards to oil in water contents (Maximum one day oil and grease discharge should not exceed 42 mg/L; 30 day average should not exceed 29 mg/L). • Any spent acids will be neutralised before testing and disposal	*Section 5.4; Table 5.4*	During completions	Drilling Manager	Oil in water content: - 29 mgl-1 (30 day average) - 42 mgl-1 (maximum) pH range 5 to 7 (prior to discharge)	Included in standard operations
A3.2	Emissions from flaring completion fluids and hydrocarbons during well testing	• Minimise volume of completion and flowback fluid to be flared to the extent practical • Minimise well test durations to the extent practical • Use efficient test flare burner head equipped with an appropriate combustion enhancement system to minimise incomplete combustion, black smoke and hydrocarbon fallout to the sea	*Section 5.4; Table 5.4*	During completions	Drilling Manager	N/A	Included in standard operations
A4	**Subsea Installation and Commissioning**						
A4.1	Physical impact to seabed and benthic fauna from subsea infrastructure	• Pre-installation survey • Post-installation survey • Provision of data for inclusion of nautical charts.	*Section 5.4; Table 5.4*	During subsea installation	Subsea Installations Manager	Recorded baseline conditions	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Cost of measure
A4.2	Physical impact to seabed and benthic fauna from pipeline and umbilicalinstallation	• Pre-installation survey • Post-installation survey • Provision of data for inclusion of nautical chartsMicro-routing the pipeline to avoid sensitive habitats	*Section 5.4; Table 5.4*	During subsea installation	Pipelay Manager	Recorded baseline conditions	Included in standard operations
A4.3	Physical impact to nearshore seabed and benthic fauna, and landfall site.	• Pre-installation survey • Post-installation survey • Beach inspection at the pipeline landfall before ground disturbing activities in order to identify any potential turtle nest • Micro-routing the pipeline to avoid sensitive habitats	*Section 5.4; Table 5.4*	During subsea installation phase	Pipelay Manager	Recorded baseline conditions	Included in standard operations
A5	**Testing and Pre-Commissioning Operations**						
A5.1	Discharge of hydrostat waters, impact on water quality and fauna.	• Dewater pipeline offshore so that discharge is offshore ensuring good dilution. • Selection and use of completion fluids taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard	*Section 5.4; Table 5.4*	During Testing and Pre-Commissioning	Operations Manager	N/A	Included in standard operations
A6	**Employment and Procurement**						
A6.1	Employment and training opportunities	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors, will employ and train nationals where it is practical to do so.	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from CLO)	N/A	Cost of training to be determined as part of labour study.
A6.2	Opportunities from procurement of local goods and services	• Implement Tullow's local content policy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so.	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from CLO)	N/A	Included in standard operations
A7	Support Vessels / Helicopter Support : Drilling, Completions, Installation and Commissioning						
A7.1	Interference with shipping and navigation due to support vessel presence; collision risk	• Provide advanced notice to maritime authorities • Navigational marks and lights on vessels • The support vessels will maintain radio contact with other users of the sea to mitigate the risk of collisions. Vessel transit route will be communicated to fishermen through the CLOs	*Section 5.5.3*	Throughout of offshore construction	Operations Manager (with support from CLO)	N/A	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Cost of measure
A7.2	Disturbance (physical presence and noise) to marine mammals	• Prevent excessive speeds and rapid change of direction for vessels when operating in the field to reduce risks of collisions	*Section 5.4; Table 5.4*	Throughout of offshore construction	Vessel captains	N/A	Included in standard operations
A7.3	Disturbance to important bird habitats by helicopters	• Helicopters will normally not have to fly over IBAs during normal operation. Helicopters flying over IBAs must maintain a minimum altitude of 2,300 ft (710 m) to minimise disturbance	*Section 5.4; Table 5.4*	Throughout of offshore construction	Helicopter pilots	N/A	Included in standard operations
A8	Other Emissions and Discharges : Drilling, Completions, Installation and Commissioning						
A8.1	Discharge of black and grey water (including macerated food wastes)	• Compliance with MARPOL Annex IV requirements and good industry practice including treatment of black water in an IMO compliant sewage treatment facility	*Section 5.4; Table 5.4*	Throughout of offshore construction	Vessel captains	Black water: - no floating solids - residual chlorine at <1 mgl-1. Grey water: - max particle size <25 mm - no floating solids or foam	Included in standard operations
A8.2	Discharges from vessels contaminated with trace hydrocarbons (bilge water, deck drainage)	• Compliance with MARPOL Annex I requirements and good industry practice	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from vessel captains)	15 mgl-1 oil and grease as a maximum limit	Included in standard operations
A8.3	Discharge of ballast water (from MODU and other vessels)	• Compliance with MARPOL requirements • Ballast water management measures • Compliance with International Convention for the Control and Management of Ships Ballast Water & Sediments to minimise the transfer of organisms	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from vessel captains)	Exchanging ballast water at least >200 nm from shore	Included in standard operations
A8.4	Impact to air quality from release of gaseous emissions from power generation and engine exhaust	• Compliance with MARPOL Annex VI, which sets limits on sulphur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances • Routine inspection and maintenance of engines, generators and other equipment to minimise air emission	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from vessel captains)	N/A	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Cost of measure
A8.5	Waste generated on the MODU and Project vessels will be segregated offshore for storage/ disposal onshore.	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste • Safe transport using well maintained and suitable vehicles or vessels and trained operators • Use of Tullow approved waste contractors • Selection of a suitable disposal facility or facilities • Measures to ensure proper continuous operation and monitoring of the disposal facility	*Section 5.4; Table 5.4*	Throughout of offshore construction	Operations Manager (with support from vessel captains)	Zero loss of containments during storage and transport of wastes Maximised recycling of wastes	Included in standard operations
A9	Unplanned / Accidental Events : Drilling, Completions, Installation and Commissioning						
A9.1	Accidental fuel oil (diesel) spill impacting the marine environment	• MODU and marine vessels will be designed, operated and maintained in accordance with international standards such that the risk of accidental spills will be minimised. • Oil spill prevention equipment, measures and procedures • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill	*Section 5.5.2*	*Throughout of offshore construction*	*Operations Manager*	N/A	Included in standard operations

Table 6.2 Mitigation Measures and Commitments Register - Onshore Construction Phase

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
B1	**Securing land tenure**						
B1.1	Physical displacement	• Should the Project configuration change in such a way that some physical displacement is required, Tullow will manage displacement in line with IFC-PS 5.	*Section 5.4; Table 5.5*	Design phase Prior to land acquisition	Tullow's External Affairs Manager	Minimize physical displacement (only one small scale construction has been identified on the proposed exclusion zone)	Included in standard operations
B1.2	Economic displacement	• The proposed onshore pipeline will be trenched and will not prevent movement across the proposed route or cause any severance	*Section 5.4; Table 5.5*	Design phase	Tullow's External Affairs Manager	N/A	Included in standard operations
B2	**Plant Construction Activities**						
B2.1	Ground Disturbance	• Areas of required ground disturbance will be clearly defined and ground disturbance outside these areas will be avoided • Excavated top soils will be stored for future re-use for revegetation • Excavated material will be used, where possible, for onsite landscaping/re-profiling	*Section 5.4; Table 5.5*	Duration of ground disturbance activities	Construction Manager	N/A	Included in standard operations
B2.2	Biodiversity	• Areas where ground disturbance is required will be clearly delineated • Vegetation clearance will be kept to a minimum • Disturbance in sensitive habitats (such as shrubs) will be minimised • Any vegetation cut on the gas processing facilities location will be offset.	*Section 5.4; Table 5.5*	Duration of ground disturbance activities	Construction Manager	N/A	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
B2.3	Noise	• No specific mitigation required. Best practice and good operation management will be applied such as : ◦ enforcement of appropriate speed limits for heavy vehicles to reduce noise ◦ utilisation of silent, well maintained industrial equipment (incorporating noise reduction systems such as capping and mufflers if required) ◦ noise monitoring at established permanent monitoring locations (such as the new university) to ensure compliance with the international standards	*Section 5.6.1*	Duration of works	Construction Manager	LAeq,1hr <55 dB(A) for the daytime and 45 dB(A) for the night time and LAMax < 85 dBA at all permanent monitoring locations.	Included in standard operations
B2.4	Atmospheric Emissions	• Routine inspection and maintenance of engines, generators and other equipment to minimise air emission • Use of low-sulphur diesel if locally available.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	N/A	Included in standard operations
B2.5	Cultural Heritage	• A surface artefacts collection will be organized before the ground disturbing activities under the supervision of the Mauritanian Institute for Scientific Research (Institut Mauritanien de Recherche Scientifique - IMRS). • Basic archaeological training in site detection should be provided to Project staff and construction workers • An archaeological chance finds protocol should be developed to manage unexpected finds	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	N/A	Up to approximately 25,000 USD for pre-construction artefacts collection
B2.6	Road traffic	• Application of the company's road safety policy to operator and contractor vehicles	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	Zero traffic accident	Included in standard operations
B2.7	Liquid Effluent	• Waste water will be treated on site via an onsite waste water treatment system.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	N/A	Included in standard operations
B2.8	Temporary infrastructures installation	• After use, temporary sites will be cleared of any structure and wastes and re-profiled	*Section 5.4; Table 5.5*	Upon completion of construction works	Construction Manager	Recorded baseline conditions	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
B3	**Onshore Pipelay**						
B3.1	Ground disturbance	• Areas where ground disturbance is required will be clearly delineated • Vegetation clearance will be kept to a minimum • For the trenching phase, the excavated material will then be used as back-fill to bury the pipeline • The pipeline route will be reinstated.	*Section 5.4; Table 5.5*	Duration of ground disturbance activities	Construction Manager	N/A	Included in standard operations
B3.2	Biodiversity	• Disturbance in sensitive habitats (such as shrubs) will be minimised • The pipeline route will be reinstated. • Beach inspection at the pipeline landfall before ground disturbing activities in order to identify any potential turtle nest	*Section 5.4; Table 5.5*	Duration of ground disturbance activities	Construction Manager	N/A	Cost of beach inspection approx 1000 USD.
B3.3	Noise	• No specific mitigation required. Best practice and good operation management will be applied such as : • enforcement of appropriate speed limits for heavy vehicles to reduce noise • utilisation of silent, well maintained industrial equipment (incorporating noise reduction systems such as capping and mufflers if required)	*Section 5.6.1*	Duration of works	HSE Manager	N/A	Included in standard operations
B3.4	Atmospheric Emissions	• Routine inspection and maintenance of engines, generators and other equipment to minimise air emission • Use of low-sulphur diesel where possible	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	N/A	Included in standard operations
B3.5	Cultural Heritage	• The footprint of the Onshore Pipeline route should be surveyed by an archaeologist for any sites that may potentially be impacted by associated ground disturbing activities • Basic archaeological training in site detection should be provided to Project staff and construction workers • A surface artefacts collection will be organized before the ground disturbing activities under the supervision of the Mauritanian Institute for Scientific Research (*Institut Mauritanien de Recherche Scientifique - IMRS*) • An archaeological chance finds protocol should be developed to manage unexpected finds	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	N/A	Up to approximately 25,000 USD for pre-construction artefacts collection

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
B3.6	Highway crossing	• Safety process for highway crossing will be established in liaison with the road traffic authorities Only one lane will be closed at a time	*Section 5.4; Table 5.5*	Duration of works	Construction Manager	N/A	Internal time
B3.7	Road traffic	• Application of the company's road safety policy to operator and contractor vehicles.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	Zero traffic accident	Included in standard operations
B4	**Plant Commissioning Activities**						
B4.1	Noise	• No mitigation required. Best practice and good operation management will be applied	*Section 5.4; Table 5.5*	Duration of commissioning activities	HSE Manager	LAeq,1hr <55 dB(A) for the daytime and 45 dB(A) for the night time and LAMax < 85 dBA at all permanent monitoring locations.	Included in standard operations
B4.2	Liquid effluents	• Selection and use of chemicals taking into account its concentration, toxicity, bioavailability and bioaccumulation potential with selection based on least environmental potential hazard. Ensure minimal quantities of chemicals are used.	*Section 5.4; Table 5.5*	Duration of commissioning activities	HSE Manager	N/A	Included in standard operations
B5	**Construction Personnel**						
B5.1	Employment and Training	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors will employ and train nationals where it is practical to do so.	*Section 5.4; Table 5.5*	Duration of works	Tullow's HR Department	N/A	Cost of training to be determined as part of labour study.
B5.2	Procurement of goods and services	• Implement Tullow's local content policy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so.	*Section 5.4; Table 5.5*	Duration of works	Tullow's HR Department	N/A	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
B6	**Waste Management**						
B6.1	Domestic Waste Generation	• Operational controls contained in Waste Management Plan. • Safe transport using well maintained and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	Zero loss of containments during storage and transport of wastes Minimized volume of wastes	Included in standard operations
B6.2	Industrial Waste Generation	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	Zero loss of containments during storage and transport of wastes Maximised recycling of wastes	Included in standard operations
B7	**Unplanned / Accidental Events**						
B7.1	Loss of containment	• Oil spill prevention equipment, measures and procedures. • Maintenance of vehicles. • Management plan of hazardous products. • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill.	*Section 5.4; Table 5.5*	Duration of works	HSE Manager	Zero loss of containment during storage and transport of hazardous products	Included in standard operations

Table 6.3 Mitigation Measures and Commitments Register - Operational Phase

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
C1	**Plant Operations Activities**						
C1.1	Noise	• No specific mitigation required. Best practice and good operation management will be applied such as : • enforcement of appropriate speed limits for heavy vehicles to reduce noise • utilisation of silent, well maintained industrial equipment (incorporating noise reduction systems such as capping and mufflers if required). • periodic (yearly) noise monitoring at established permanent monitoring locations (such as the new university) to ensure compliance with the international standards (note that noise measurements will not only measure the contribution of the Project, but also those of neighbouring projects like the SPEG owned thermal power plant. Noise measures will therefore only provide an indication of possible changes to ambient noise level, but it will not be possible to clearly relate such changes to the Banda gas processing facility)	*Section 5.7.1*	Throughout the Project	HSE Manager	LAeq,1hr <55 dB(A) for the daytime; 45 dB(A) for the night time and LAMax < 85 dBA Δ LA90<8dBA at all monitoring locations.	Up to approx. 25,000 USD for yearly monitoring
C1.2	Atmospheric Emissions	• Routine inspection and maintenance of engines, generators and other equipment to minimise air emission. • Greenhouse gas reduction strategy with focus on optimisation of overall energy efficiency and reduction in flaring and venting. • Air quality monitoring at established permanent monitoring locations (such as the new university) to ensure compliance with the international standards (note that ambient air quality measurements will not only measure the contribution of the Project's atmospheric emissions, but also those of neighbouring projects like the SPEG owned thermal power plant, and more generally the contributions to atmospheric emissions of the city of Nouakchott. Ambient air quality measures will therefore only provide an indication of possible changes to local air quality, but it will not be possible to clearly relate such changes to the Banda gas processing facility).	*Section 5.7.2*	Throughout the Project	HSE Manager	Ambient Air Quality IFC Standards Annual average : NO_2 : 40 µg/m³ PM_{10}: 20 µg/m³ Max 1h : NO_2 : 200 µg/m³ Max daily average : PM_{10}: 50 µg/m³	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
C1.3	Road traffic	• Application of the company's road safety policy to operator and contractor vehicles.	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	Zero traffic accident	Included in standard operations
C2	**Operations Personnel**						
C2.1	Employment and Training	• Implement Tullow's local employment and skills development policies. • Accordingly, Tullow and its contractors will employ and train nationals where it is practical to do so.	*Section 5.4; Table 5.6*	Throughout the Project	Tullow's HR Department	N/A	Cost of training to be determined through yearly review of workforce training needs
C2.2	Procurement of goods and services	• Implement Tullow's local content policy. • Accordingly, Tullow and its contractors will use local products and services where it is practical to do so.	*Section 5.4; Table 5.6*	Throughout the Project	Tullow's HR Department	N/A	Included in standard operations
C2.3.	In-migration of speculative jobseekers	• Publicly advertise Tullow's in-country recruitment procedure. • No "at the gate" recruitment. • Discourage potential settlers through proactive communication by Tullow Mauritania's stakeholder engagement team.	*Table 5.6*	Throughout the Project	Tullow's HR Department	N/A	Included in standard operations
C3	**Liquid Effluents**						
C3.1	Waste Water Generation	• Water will be a product of the three stage separation and will be treated in the produced water treatment system to remove: ◦ entrained free oil to allow for safe disposal ◦ soluble hydrocarbons, including volatile aromatics – benzene, toluene, ethyl benzene and xylenes (BTEX) ◦ MEG and chemicals to reduce biological and chemical oxygen demand prevent biomass accumulation • Treated produced water will be reused in the power plant as process water to reduce its water demand or local irrigation	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	IFC EHS Guideline for discharge to land	Up to approximately 1,500,000 USD for the produced water treatment package

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
C3.2	Naturally occurring radioactive material (NORM)	• At Banda NORMS will be very unlikely because there is a low probability of formation water production and hence low risk of scaling. Still, a possible mitigation measure is containment and disposal as hazardous material.	*Table 5.6*	Throughout the Project	HSE Manager	Zero discharge of NORMS	Included in standard operations
C4	**Waste Management**						
C4.1	Domestic Waste Generation	• Operational controls contained in Waste Management Plan. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	Zero loss of containments during storage and transport of wastes Minimized volume of wastes	Included in standard operations
C4.2	Industrial Waste Generation	• Operational controls contained in Waste Management Plan. • Proper storage of hazardous waste. • Safe transport using well maintained, and suitable vehicles and trained operators. • Use of Tullow approved waste contractors. • Selection of a suitable disposal facility or facilities. • Measures to ensure proper continuous operation and monitoring of the disposal facility.	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	Zero loss of containments during storage and transport of wastes Maximised recycling of wastes	Included in standard operations
C5	**Physical presence of subsea infrastructures**						
C5.1	Physical presence of subsea production structures.	• The subsea production structures and exclusion zone will be marked on navigation charts • Liaison with other users of the sea to make them aware of the subsea production structures • 500 metres fishing exclusion zone around well heads and manifold	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	N/A	Included in standard operations

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
C5.2	Physical presence of pipeline, umbilical and rock dumps.	• The pipeline and umbilical will be trenched along most of its length to provide stability and to prevent damage from fishing gear • Where soil conditions obviate trenching, the pipeline and umbilical will be protected by rock dumping or flexible concrete mats • The pipeline and umbilical route will be marked on navigation charts • Liaison with other users of the sea to make them aware of the pipeline and umbilical	*Section 5.4; Table 5.6*	Pipeline and umbilical installation Throughout the Project	HSE Manager	N/A	Included in standard operations
C6	**Physical presence of the onshore pipeline**						
C6-.1	Physical presence of the onshore pipeline	• The pipeline and umbilical will be trenched. • Only pipeline markers will be visible above ground. • Periodic monitoring of the onshore part of the pipeline to reduce the likelihood of any intentional damage to it.	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	N/A	Included in standard operations
C6.2	Restriction on permanent infrastructure within 60 m on both sides of the pipeline	• Coordination with Ministry of Urbanism to take into account the Project in land planning scheme.	*Section 5.4; Table 5.6*	Design phase Prior to land acquisition	Tullow's External Affairs Manager	N/A	Included in standard operations
C7	**Physical presence of the gas processing plant**						
C7.1	Restriction on permanent infrastructure within a 300m radius around the gas processing plant	• Coordination with Ministry of Urbanism to take into account the Project in land planning scheme.	*Section 5.4; Table 5.6*	Design phase Prior to land acquisition	Tullow's External Affairs Manager	N/A	Included in standard operations
C8	**Non Routine Events**						

Ref.	Potential Impacts	Actions/Mitigation/Monitoring	EIA § Reference	Timing	Responsibility	Targets	Estimated Cost
C8.1	Loss of containment	• Oil and chemicals spill prevention equipment, measures and procedures • Install secondary containment around tanks to contain accidental releases • Maintenance of vehicles • Spill prevention / oil and chemicals management procedure • Oil Spill Contingency Plan (OSCP) which contains detailed procedures that will be followed in the event of an oil spill	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	Zero loss of containments during storage and transport of hazardous products	Cost of OSCP document: up to approx 30.000 USD. Other mitigation measures are included in standard operations
C8.2	Fire and Explosion	• Active fire protection • Gas leak detection devices • Development of a fire and life safety plan for workforce • Coordination with local authorities for external emergency response • 300m exclusion zone without permanent infrastructure (except Project infrastructures) around the gas treatment plant • Markers will be provided to prevent accidental excavation damage to the pipeline and umbilical • 60 m exclusion zone with no permanent infrastructure on both sides of the pipeline. • Periodic monitoring of the onshore part of the pipeline to reduce the likelihood of any intentional damage to it.	*Section 5.4; Table 5.6*	Throughout the Project	HSE Manager	Zero fire event	Cost considered as part of standard provisions for this type of plant

7 PUBLIC CONSULTATION

7.1 REGULATORY FRAMEWORK

7.1.1 *National requirements regarding public consultations*

In Mauritania, in accordance with article 17 of Decree n° 2007-105 modifying and supplementing certain provisions of decree 2004 – 094 of 4th November 2004 relating to the Environmental Impact Assessment, a stage of public consultation and stakeholder engagement must be carried out during the environmental impact assessment process, in collaboration with the authorities within the concerned administrative district.

The public consultation process aims to ensure that stakeholders are informed in advance about the Project and its environmental and social management. It also aims at integrating any comments made by stakeholders into the environmental impact assessment. The objective is to guarantee that the EIA is robust and transparent, demonstrating that public concerns about the Project have been taken into account.

In accordance with article 17 of the Decree n° 2007-105, public consultation involves:

- a meeting to present the Project to local authorities, representatives of the population present in, or close to the Project area, the concerned authorities and any non-governmental organization (NGO) and other associations that may be involved; and
- the opening of a register accessible to the public in which any assessments, observations and/or suggestions made regarding the Project will be entered.

7.1.2 *International good practices*

Stakeholder engagement is an important component of international good practices regarding impact assessments. The IFC standards and, in particular, the performance standard 1 contain recommendations on the participation of the community, the provision of information, and public consultation.

Based on these recommendations, stakeholder engagement activities were undertaken as part of the EIA of the Banda Gas Project. These are described in the following section.

7.2 *PUBLIC CONSULTATION AND STAKEHOLDER ENGAGEMENT FOR THE EIA*

7.2.1 *Scoping phase*

The stakeholder engagement activities started during the scoping phase of the Project and continued throughout the EIA phase. The objective was to ensure the identification of appropriate sources of information, regulatory requirements, and concerns and expectations of stakeholders.

Interviews were conducted in June 2012 during the scoping phase to collect relevant data from stakeholders, such as the Mauritanian representation of the IUCN, and from the Ministry in charge of the Environment. Consultation reports can be found in *Appendix A*.

7.2.2 *Marine component*

During the EIA phase, eighteen stakeholder consultations were carried out in Nouakchott and in coastal communities (three camps south of Nouakchott and four villages north of Nouakchott) during July 2012.

The stakeholders consulted included representatives of the administration, cooperation programs, fishermen's associations, private investors, village representatives, and traditional authorities.

The purpose of these consultations was mainly to exchange information on the Project, to collect baseline data and to understand the concerns of key stakeholders. Consultation reports can be found in *Appendix A*.

The key issues raised during these meetings are summarized in this section.

The development of the oil and gas sector has a direct impact on fishing activities

- "*Since the beginning of oil and gas projects in 2005, fish populations have declined*" (Artisanal fishers).
- "*The population of Cephalopods has declined around the drilling sites*" (Professional Training Centre - CASAMPAC).
- "*Oil and gas projects cause pollution that leads to bad tasting fish*" (Artisanal fishers).

The development of the oil and gas industry leads to a high risk of pollution

- "*Pollution from chemicals used during the drilling phase concerns us*" (Industrial Fisherman).
- "*There are risks associated with drilling waste and solid waste management*" (NGOs).
- "*There is a high risk of major oil spills*" (Industrial Fisherman).
- "*Are the contingency plans in case of an emergency adapted to the threats to the population, fisheries and biodiversity?*" (NGOs).

The oil and gas sector is seen as an opportunity for the development of local communities

- "*The oil and gas industry provides employment opportunities*" (Local authorities).
- "*What kind of infrastructure (paved roads, water supply) can Tullow provide to communities?*" (Professional Training Centre - CASAMPAC).
- "*What kind of support for artisanal fishing can Tullow provide?*" (Artisanal fishers).

Spatial competition with industrial fishing

- "*Will trawling be allowed along the pipeline route?*" (Industrial Fishermen).

In general, the concerns of stakeholders were more questions and speculations based on hearsay rather than concrete and rational questions. Implementation of outreach activities and communication with stakeholders is necessary to ensure a good understanding of the Project.

Artisanal fishermen have always raised concerns about competition with industrial fishing before general concerns about the oil and gas sector.

7.2.3 Land component

Between November 2012 and February 2013, eight consultations took place with stakeholders of the land component of the Project.

The stakeholders consulted included government officials, representatives of the projects planned in the vicinity of the study area, and residents.

The objectives of these consultations were to share information on the Project, collect data, and understand the concerns of key stakeholders for the land component of the Project. Consultation reports can be found in *Appendix A*.

The key issues raised during these consultations are summarized in this section.

Location of the gas treatment plant

- "*The chosen site is too close to the city and sensitive sites such as the new university and the new airport*" (Several authorities and residents).
- "*Studies should assess the risks posed by the gas processing facility on local communities*" (Project coordinator of the new university).
- "*If the impacts (noise, odor) are managed, the location of the gas processing facility is suitable*" (Owners of camping).

Opportunities for the development of local communities

- "*The project can create jobs*" (Resident).

- "*The project can improve access to electricity*" (Resident, owner of camping and administration).

7.3 PUBLIC CONSULTATION MEETING

7.3.1 *Organisation*

On the 20th of March 2013, a public consultation meeting was held at the Sabah hotel in Nouakchott as part of the environmental impact assessment of the Banda Gas Project.

About 60 people attended this meeting. The attendance list is attached in *Appendix A*.

Figure 7.1 ***Public consultation meeting in Nouakchott***

The public consultation followed this agenda:

- opening by the deputy of the Hakem of Tevragh Zeina;
- speech by the representative from the Ministry of Oil;
- presentation of the Project, its environmental impacts and mitigation measures by ERM and Moustapha Ould Taleb (independent consultant);
- questions, debates and discussion;
- opening of a register accessible to the public in which assessments, observations and/or suggestions made with regard to this Project will be entered; and
- closure of the meeting.

The ERM presentation included the following points:

- a presentation of the speakers;
- the location of the Project;
- a description of the Project;
- the applicable regulations;
- the sources of impact assessed in the EIA;
- the receptors considered in the EIA;
- the methodology for impact assessment;
- the main sources of information used in the EIA;
- the estimated Project schedule, and
- the terms for stakeholder engagement in the EIA.

During the presentation, translation into Hassanya was provided for a better understanding and participation of all present.

7.3.2 *Main concerns raised*

The questions and concerns raised by the stakeholders during the meeting were related to:

- the location of the Project and its land component in particular;
- the lifetime of the Project;
- protection zones induced by the Project and their boundaries;
- the expectations of civil society;
- the design of the gas processing plant and pipeline specifications;
- the effects of the Project on fish resources and biodiversity;
- the environmental management plan provided for the Project;
- the monitoring plan for the Project and the devices that will be used for this purpose;
- feedback from similar Projects around the world, and
- the EIA methodology.

The representatives of the DCE, DPHB, Tullow and ERM provided answers to the questions, suggestions and comments raised during the debate.

The detailed list of comments, questions and answers made during the public consultation meeting is attached (in French) in *Appendix A*.

7.4 *ADDRESSING STAKEHOLDER CONCERNS*

Appendix A provides more details of responses made by Tullow to the questions and comments raised by stakeholders in the course of the consultation process. In summary, there were 3 kinds of questions and comments, addressed as follows:

- Requests for technical clarification were met by providing more information on the Project – this applies to questions on schedule, technology used, pollution prevention and control etc.

- Points raised on environmental and social sensitivities (eg the sensitivity of marine biodiversity, fisheries resources, migratory avifauna etc) were considered in developing the environmental and social baseline study (Chapter 4), the assessment of environmental and social impacts and mitigation (Chapter 5), and the environmental management plan, which details the measures that Tullow will implement to address potential environmental impacts and risks.

- Stakeholder expectations in terms of socio-economic benefits from the Project – largely that the Project will foster the employment of local workforce – where duly noted by Tullow and reflected in Tullow's recruitment and procurement policy in Mauritania (which includes a commitment to recruit and procure locally where possible).

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