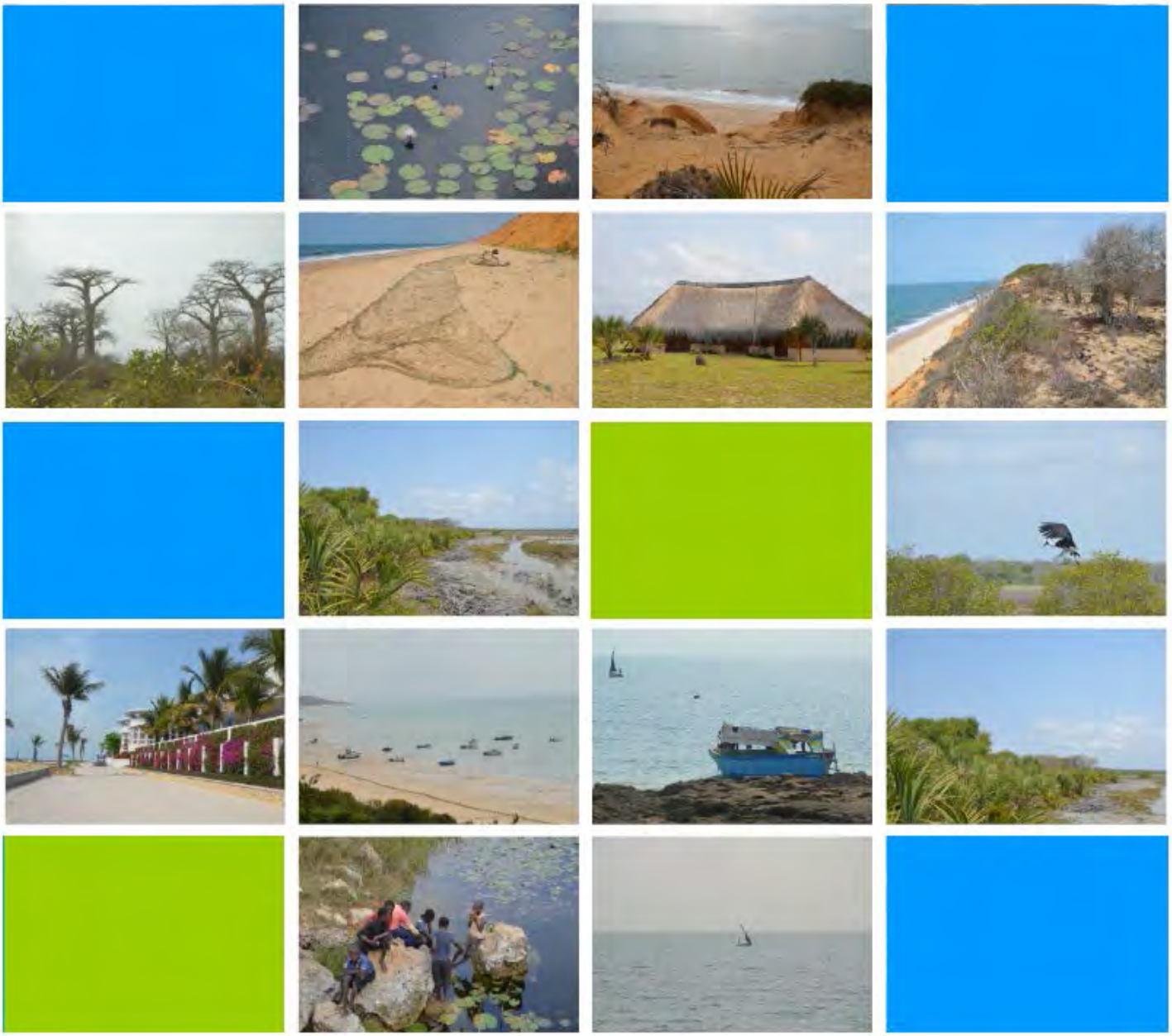

Sasol Petroleum Mozambique

EIA FOR THE PROPOSED PIPELINE FROM THE TEMANE LIQUIDS PROCESSING FACILITY TO A FLOATING, STORAGE, AND OFFLOADING UNIT IN INHAMBANE PROVINCE, MOZAMBIQUE

Environmental Pre-feasibility and Scoping Report (EPDA) and Terms of Reference (ToR)

MSDP1401-ERM-0000-11400-REP-00004

July 2016

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Sasol Petroleum Mozambique)

Environmental Pre-feasibility and Scoping Report (EPDA) and Terms of Reference (ToR)

Project Reference: 0312425

For and on behalf of Environmental Resources Management

Approved by: Ingeborg McNicoll

Signed: 

Senior Partner

Date: July 2016

Non-Technical Summary

EIA FOR THE PROPOSED PIPELINE FROM THE TEMANE LIQUIDS PROCESSING FACILITY TO A FLOATING, STORAGE & OFFLOADING UNIT IN INHAMBANE PROVINCE, MOZAMBIQUE

PURPOSE OF THIS DOCUMENT

This document provides a summary of the Draft Scoping Report for the Sasol Pipeline and FSO Project, which includes a description of the proposed Project and the associated EIA process. It aims to help stakeholders understand the proposed Project and provides guidance on how stakeholders can register and be involved in the EIA Process.

PROJECT BACKGROUND

Sasol Petroleum Mozambique Limitada (Sasol) has obtained approval from the Mozambique Council of Ministers for the Production Sharing Agreement's (PSA) Field Development Plan (FDP) that will see further hydrocarbon resources developed to support the economic growth of Mozambique.

At present, the Central Processing Facility (CPF) in Temane is supplied by 24 onshore production wells, 12 in the Temane Field and 12 in the Pande Field. Production at the CPF is currently around 197 Gigajoules of gas per annum and 250 m^3 per day of condensate of condensate (a low-density mixture of hydrocarbon liquids that are present as gaseous components).

Sasol is committed to the phased evaluation and development of additional oil and gas resources within its concession areas.

In 2014, detailed technical and environmental work on the PSA Development and Liquid Petroleum Gas (LPG) Project was started, which involves the expansion of the CPF and the development of a new Liquids Processing Facility (LPF) adjacent to the CPF, in order to process additional PSA gas, condensate and light oil Figure 1.

What is The Production Sharing Agreement (PSA)?
Sasol Petroleum Mozambique (SPM) has a Production Sharing Agreement (PSA) with the Government of Mozambique and ENH (Empresa Nacional de Hidrocarbonetos). In turn, a Petroleum Production Agreement (PPA) has been entered into between Sasol Petroleum Temane (SPT) and its partners [Companhia Moçambicana de Hidrocarbonetos (CMH) and the International Finance Corporation (IFC)] and the Government of Mozambique which covers the currently- producing assets of the Temane and Pande fields.

The PPA and PSA licences overlap each other in both Pande and Temane. The PPA licence applies to specific hydrocarbon bearing formations within these areas.

The PSA licence covers all other formations in Temane and Pande for which a Field Development Plan has been approved for development, and also includes other fields and prospects where exploration and appraisal wells have been drilled but have not as yet been declared commercial.

The proposed PSA Development and LPG Project will include a facility to produce LPG to replace much of the LPG currently imported at significant cost to Mozambique.

Due to uncertainty about the quantity of light oil that will be produced, Sasol wishes to license two transport options in order to provide flexibility in later planning once liquid volumes are confirmed:

1) Road transport; and

2) Pipeline / offshore storage.

Road transport will be undertaken if the volumes are relatively low. The second transport option suited to larger volumes is to pump the light oil via an onshore and offshore pipeline to an offshore Floating, Storage and Offloading unit (FSO), where it can be collected by shuttle tankers. It is also possible that road transportation would be preferred initially, followed by the pipeline / offshore storage option as volumes start to increase. The latter option, known as *the Sasol Pipeline and FSO Project* for the exportation of stabilised light oil, is the subject of the current Draft Scoping Report.

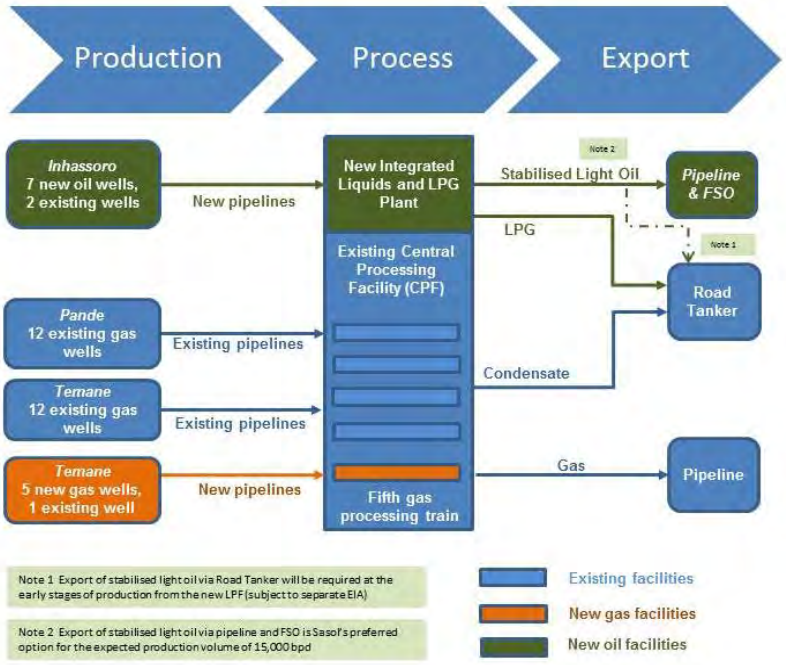


Figure 1 Conceptual Overview of the PSA Development and LPG Project Including Transport Options

PROJECT DESCRIPTION

Sasol is planning to develop a pipeline and offshore FSO in Inhambane Province, subject to the satisfactory outcomes of the initial PSA drilling campaign (in 2016).

The objective of the Project is to export stabilised light oil through a pipeline from the new LPF, which is adjacent to the Temane CPF, to an offshore FSO north of the Bazaruto Archipelago. The FSO will have the capacity to store up to 500 000 barrels of stabilised light oil onboard and to offload 300 000 barrels within 24 hours.

Useful Definitions

FSO - is a permanently moored floating vessel for storage and offloading of stabilised light oil.

Shuttle tanker - is a floating vessel for the exportation of oil.

PIPELINE ROUTE AND FSO LOCATION

The pipeline route and FSO location is shown in *Figure 2.* The onshore pipeline will start at the LPF and will follow the existing Pande trunkline corridor northward, for 32 km. The pipeline then turns north eastward and crosses the EN1 national road and utilities (approximately 8 km from the pipeline turn), before crossing the Govuro River and its floodplain (approximately 10 km from the EN1). Approximately 6 km east of the Govuro River the onshore pipeline terminates at a beach valve station approximately 20 km north of Inhassoro. The proposed offshore pipeline route to the FSO extends approximately 50 km northeast of the shore crossing. The FSO will be located within a 2 x 2 km block, approximately 52 km north east of the Bazaruto Archipelago National Park (BANP), at a water depth of approximately 50 m.

The Project Area will include the Administrative Posts of Inhassoro and Bazaruto, in Inhambane province. The nearest settlements to the onshore pipeline are Temane, Masadge, Catine, Pere, Chinhocane and Chibo, with Temane and Chibo being the closest.

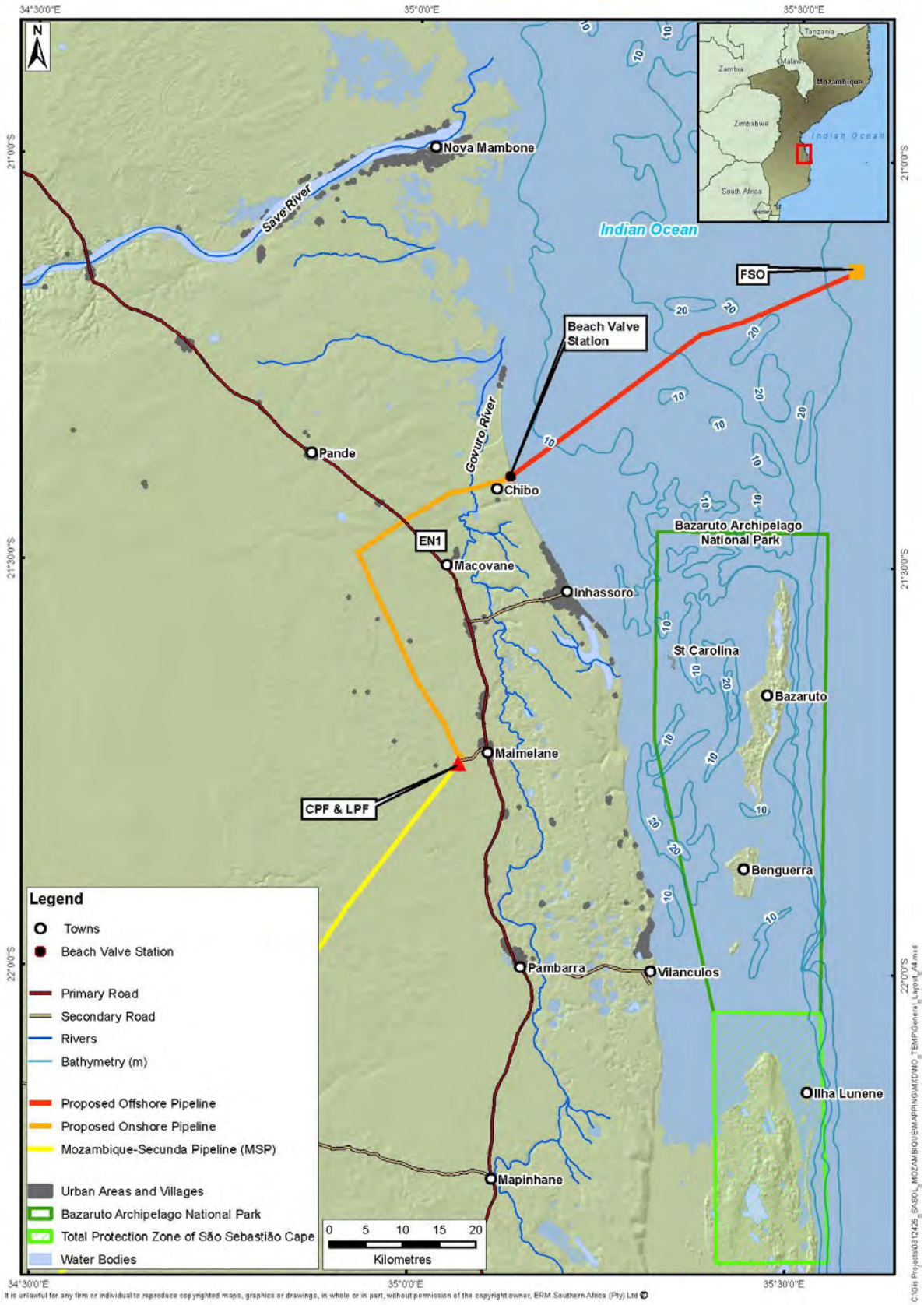


Figure 2: Project Location and Layout

PROJECT INFRASTRUCTURE, FACILITIES AND ACTIVITIES

The key Project features are described below.

Onshore infrastructure

Light oil export facilities (pumps and pipeline servicing infrastructure), located inside the new LPF site.

A buried onshore pipeline, from the LPF to the beach valve station, of approximately 57 km. The pipeline includes safety valves at the Govuro River crossing and a beach valve station in order to safely isolate the pipeline in the event of an oil leak.

The beach valve station will be located on the coast approximately 20 km north of Inhassoro set inland from the shoreline cliffs and occupying a footprint of 30 m x 30 m. It will include pipeline servicing, testing, safety and maintenance systems.

Offshore

An offshore pipeline (buried beneath the seafloor in water depths of up to 10 m) from the beach valve station to approximately 50 km offshore. The offshore pipeline will be designed to allow inspection and cleaning.

Pipeline support structure (riser base, safety valve, riser and umbilical), located on the seabed, approximately 50 km offshore. The riser base and safety valve will connect the pipeline from the shore to the FSO through a flexible pipeline or riser and provide a safety mechanism for isolating the flow of oil to the FSO in the event of an emergency. An umbilical from the riser base will provide hydraulic power and controls to the FSO.

FSO

The FSO will be permanently moored (stationed) for operation in 50 m water depth using a turret mooring system (tower like structure attached to the FSO). The FSO's mooring system will be installed at the forward end while the offloading platform will be installed at the rear end. The FSO will be approximately 234 m long and 42 m wide with an operating draft of 7 to 15 m (below the water line). The FSO will be designed for a 15 year continuous service life without dry docking.

The FSO will accommodate a maximum of 50 personnel allowing for high manning periods such as the initial hook-up and the commissioning phase.

Figure 3: Turret Moored FSO

Beira

The marine supply base will be located at the Port of Beira in Mozambique on previously developed land. The supply base will provide all the supplies, support vessel and services to the FSO.

Support vessels will include supply boats for water and food supplies, waste removal and crew changes, and a vessel to provide operational support to the FSO including emergency response.

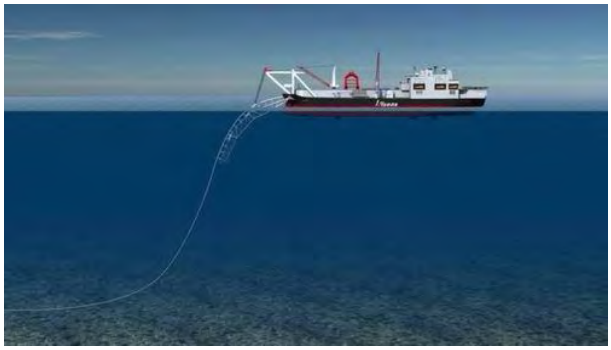


Figure 4: Typical Offshore Pipelay Vessel

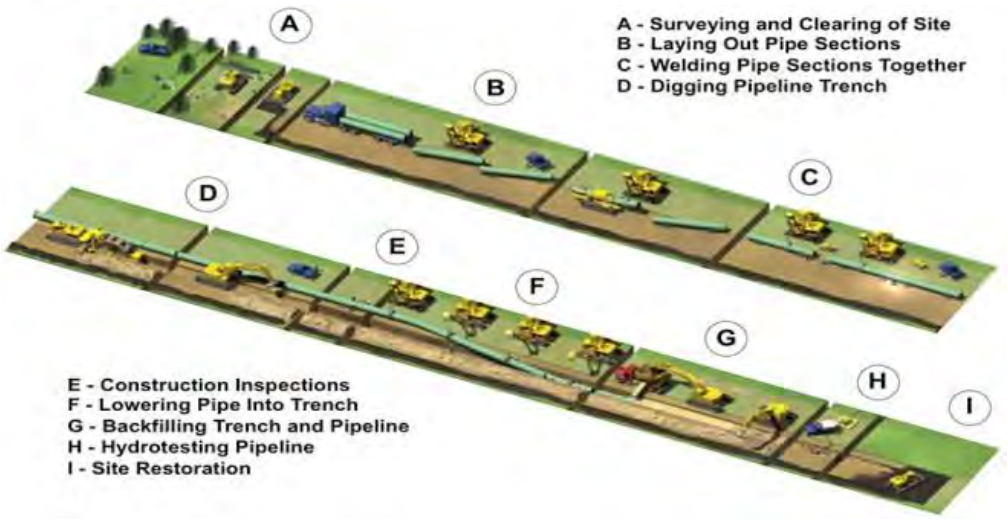


Figure 5: Onshore Pipeline Laying

PROJECT PHASES AND SCHEDULE

Advanced works and construction activities on the project are planned to start in the third quarter of 2019, and be ready for operation in the third quarter of 2021. The planned activities for the Project are summarised as follows:

Phase 1: Advanced Works
- Site preparation
- Camps and lay down areas
- Widening and maintenance of dirt roads and pipeline ROW
- Installation of offshore moorings, umbilical and riser

Phase 2: Construction
- Pipeline / subsea infrastructure construction
- FSO / Turret construction and mechanical completion
- Marine Support Vessel and Supply Base construction works
- Re-instatement of the onshore pipeline route and ROW

Phase 3: Pre-Commissioning and Commissioning
- FSO quayside commissioning and sea trials
- FSO transport, installation and hook-up
- Hydro-testing of pipeline and subsea infrastructure
- FSO and Subsea systems integration
- End to end commissioning (introduction of hydrocarbons)

Phase 4: Operation
- Transfer of light oil, storage and export
- Offloading operations
- Power generation and FSO utilities
- Marine Support Base operations

Phase 5: Decommissioning
- Making safe all infrastructure;
- Removal of the FSO and moorings and subsea infrastructure (except the pipeline);
- Removal of onshore infrastructure no longer in use; and
- Re-use and recycling of equipment.

THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The Project will require an Environmental License from the Ministry of Land, Environment and Rural Development (MITADER), in compliance with the National Environmental Law (*Law No 20/1997*), considering both the Decree regulating Environmental Impact Assessment (*Decree No. 45/2004* amended by *Decree 42/2008*) and the Decree on Environmental Regulation of Oil Operations (*Decree 56/2010*).

Sasol has registered the Project with MITADER as required by the *Decree 45/2004*. The Project has been classified as '*Category A '*, *Reference Number 90/180/DGA/DPTADER/16*. Licensing of *Category A Projects* must be supported by an Environmental Impact Report (EIR), which must include a public participation process in accordance with the Mozambican environmental regulatory requirements.

Environmental Resources Management International Services Ltd (ERM) and Impacto Lda have been appointed by Sasol to undertake the Environmental Impact Assessment (EIA) and public participation process for this Project.

Sasol has committed that its governance of environmental and social issues will comply with relevant Mozambican regulations and laws as well as relevant international good practice, specifically the International Finance Corporation's Performance Standards (IFC PS) and Environmental and Health and Safety (EHS) Guidelines.

The EIA process and stakeholder engagement opportunities for this Project are illustrated in *Figure 7.*

Scoping Phase

Note: New regulations for governing the Environmental Impact Assessment process in Mozambique have been published in *Decree No 54/2015* which took effect on 30 March 2016. However, this Project was registered under *Decree No 45/2004* and will be conducted in accordance with the requirements of this legislation. The applicability of the new requirements on an on-going Project will be discussed with MITADER as part of the submission of this Scoping Report.

The purpose of the Scoping Phase (this phase) of an EIA is to identify possible positive and negative impacts, Project alternatives, and determine the terms of reference for specialist studies to be conducted in the EIA phase. These findings are then shared with stakeholders for their review and input via a Draft Scoping Report (EPDA). The Draft Scoping Report is now available for review and comment and a series of Focus Group and Public Meetings are scheduled to be held in the Project Area and Maputo (see below). As part of the scoping activities the EIA team developed an initial biophysical and socio-economic baseline and identified key issues for further consideration in the EIA as summarised below:

Biophysical Environment	
Climate	• The Mozambican climate can be described as highly variable and is vulnerable to climatic events such as floods, droughts and cyclones as well as climate change. • Mozambique is currently experiencing the effects of climate change manifesting in coastal erosion and extended drought.
Air Quality	• Onshore air quality measured at the boundary of the CPF meets requirements of the CPF Operational EMP and Mozambique and IFC air quality standards. • Onshore air quality in the rural areas is mainly impacted by the seasonal burning of woodland and grassland, as well as localised burning of waste and fuels. • Offshore air quality is generally good as the only source of air pollution is from vessels travelling along shipping lanes, including those involved in oil and gas operations in the area.
Noise	• Onshore industrial noise measured at the boundary of the CPF reach 60 dB(A), which is equivalent to the night time limit in industrial areas for Mozambique. Households nearest to the CPF are not materially affected by noise from the plant. • Onshore rural noise is largely unaffected by noisy activities except traffic noise along transport routes. • Offshore rural noise is influenced largely by ambient natural noise sources (water movement and weather events) with contributions from existing vessel traffic in the shipping lanes (above surface and underwater noise).
Water Quality	• The water quality of the Govuro River is generally good, with the water mainly fresh and clear (low turbidity) and having low but variable salinity levels as the lower reaches of the river exhibits tidal influence. • Groundwater salinity generally increases towards the coast. • The physico-chemical characteristics of the water masses of Bazaruto Bay and the nearshore areas north of the Bay exhibit spatial and temporal variability.
Geology, Soils and Seabed Sediments	• In the coastal areas of Inhassoro District, the soils are variable but are generally sandy and of low arable potential. West of the Govuro River the soils have generally higher agricultural capability. • The seabed sediment characteristics in the Project Area are currently unknown but are expected to be predominantly sandy.
Topography and Seabed Bathymetry	• The terrain along the proposed pipeline route between the CPF and the shore crossing is relatively flat to slightly rolling and intersected by the south to north draining Govuro River and floodplain. • The proposed shore crossing area is characterised by a gently sloping beach leading from the sea up to 10 to 35 m high cliffs. • The offshore pipeline route shows an approximate one meter drop in sea level every kilometer from the nearshore shallow water (average water depth of 10 m) to the proposed FSO location (approximately 50 m deep).

Physical Oceanography	• The circulation of the open ocean adjacent to Bazaruto Archipelago is governed by the Mozambique Channel circulation system which comprises a series of intermittent large-scale eddies drifting southward.
Onshore Biological Environment	• Vegetation along the pipeline corridor comprises a mosaic of woodland and thicket for most of the route and the Govuro River floodplain wetland systems. Mangroves and estuarine habitats occur in the lower Govuro River system north of the pipeline route. • A number of plant species occur, some of which are of conservation concern, either as they are IUCN red listed species with a high risk of extinction or because they are endemic species with localised distribution. Threatened species include a critically endangered subspecies of cycad. • The fauna found in habitats along the onshore pipeline route are expected to be more diverse in the more remote areas where human presence is lower and may include various medium to large mammals and a high diversity of birds. • Sensitive coastal habitats include vegetated sand dunes, sandy beaches, wetlands and pans, estuaries and mangroves.
Offshore Biological Environment	• Marine fauna comprises phytoplankton and zooplankton, large invertebrates, seabirds, marine mammals (whales, dolphins, dugongs and seals), marine turtles and fish. • The marine mammals (dolphins, whales, dugongs and seals) present in the Project Area are considered protected species in Mozambique. • The dugong population present in the Project Area are of conservation importance as they are the last remaining viable population along the Western Indian Ocean coastline and they are on the IUCN list as Vulnerable to extinction. • All sea turtles (green, loggerhead, olive-ridley, leatherback and hawkbill) present in the Project Area are considered protected species in Mozambique and are all on the IUCN list as threatened and therefore are of conservation importance. • Sensitive marine habitats comprise seagrass meadows, coral and coral reefs as well as channels that funnel tidal water moving into and out of the area between the islands and the mainland. • Protected Areas present in the Project Area include Bazaruto Archipelago National Park (BANP) and the Cabo São Sebastião. These areas are important conservation areas for marine specifically dugongs and sea turtles.

Socio-Economic Environment	
Administrative Structure	• The Project is located in the southern region of Mozambique in Inhambane Province. • The onshore pipeline will pass though Inhassoro District and Inhassoro and Bazaruto Administrative Posts. • The nearest settlements to the onshore pipeline are Temane, Masadge, Catine, Pere, Chinhocane and Chibo.
Demographics	• There are 1 402 245 people in Inhambane Province (2011), approximately 6.1 percent of the population of Mozambique. • Inhassoro District comprises 3.8 percent of the Provinces population and is predominantly rural. • The main religions practiced are Catholicism (45.9 percent), Protestant / Evangelical (23 percent) and Zionism (5.4 percent). • The predominant local language is Xitswa.

Economic Activities	• The majority of the population (70.2 percent) of Inhassoro District is engaged in the agriculture, forestry and fisheries sectors. • Fishing is the predominant activity in coastal areas. • Small-scale (artisanal) fishing for subsistence and cash is the predominant type of fishing practiced in the Govuro River estuary and near-shore areas. • The main fishing gear used includes line, seine nets, harpoons, traps and gill nets. Diving (generally for lobster) is also undertaken. • Fish processing and resale is also an important economic activity. • Industrial and semi industrial line fishing is practised east of Bazaruto Archipelago for the supply of fish to national and international markets. • Agriculture is practiced across the District and is mainly 'rain fed, slash and burn' shifting agriculture. • Common crops are sorghum, millet, peanuts, beans, cassava and maize. • Agriculture is mainly practised on small (1.8 ha) plots. • Secondary economic activities include hunting, harvest and sale of non-timber forest products and labouring which also form an essential part of households livelihood strategies
Tourism	• Inhambane Province is one of the main tourism destinations in Mozambique. • The Vilanculos/Bazaruto/Inhassoro cluster is listed as one of the Priority Areas for Tourism Investment (PATI) and is Mozambique's most developed leisure destination. • Tourist attractions include pristine islands, the BANP, marine-based recreational activities including diving and snorkelling, beaches, recreational fishing, and swimming. • The District is well served by a range of tourism facilities, from affordable lodges to high-end hotels and resorts. • Tourism is the largest formal sector employer in the coastal region of Inhassoro District.
Infrastructure	• Education facilities are limited in the District with a third of the population having no formal education. • There is no hospital in Inhassoro District; Rural Health Centres are located in the District Headquarters. The main diseases in 2011 comprised malaria, diarrhoea and dysentery, sexually transmitted diseases (including HIV/AIDS), tuberculosis and pneumonia. • The main sources of energy are wood, charcoal, paraffin and kerosene,. • All District roads are unpaved with the exception of the main EN1.
Cultural Heritage	• Inhassoro District has high archaeological potential due to its strategic setting along the coastal trade routes • Family cemeteries are located near people's residences and cemeteries for local chiefs with access restrictions are located in each Administrative Post. • Cultural sites such as sacred forests, trees and pools have also been identified in Inhassoro District.

POTENTIAL PROJECT IMPACTS ON THE PHYSICAL AND SOCIAL ENVIRONMENT

Onshore

- Loss of habitats and threatened flora due to clearing of the route of the onshore pipeline construction right of way.
- Increased access for harvesting of critically endangered cycads.
- Increased access to remote areas for other natural resources including hardwood harvesting for timber and charcoal, and hunting for bush meat.
- Degradation of the Govuro River and potential loss of aquatic fauna (invertebrates and fish) during and after construction due to increased sedimentation, oil and chemical pollution risks, and altered flow.
- Unplanned events (eg pipeline break / oil spill) impacting on soil, water, the Govuro system, and fish resources.
- Interrupted access, and increased noise and dust affecting nearby residents during construction.
- Loss of land for agriculture and settlements due to the permanent pipeline Right of Way.
- Loss of cultural heritage resources due to clearing of the construction right of way.
- Direct and indirect employment opportunities (positive) during construction and operation.
- Social disruption and health risks caused by presence of construction workers during advanced works and construction activities.
- Increased traffic accidents (both offshore and onshore) during advanced works and construction activities.
- Disruption of tourism activities and tourism potential in the Project Area.

Offshore

- Increased noise, vibration and offshore traffic impacts on dugongs and other marine fauna, and tourism activities (eg fishing, diving).
- Exclusion of fishing activities during advanced works and construction activities with impacts on livelihoods.
- Increased risks of pollution to the marine and coastal environment with impacts on Bazaruto archipelago (eg coral reefs, sea grass) and natural resource-based tourism; and
- Visual impacts of infrastructure and support activities on tourism and residents.

EIA PHASE

The biophysical and socio-economic environment baseline description and the potential impacts identified in the Draft Scoping Report will be updated, based on comments received during the current phase of public participation.

It is proposed that the following specialist studies are undertaken during the EIA in order to address the issues raised in this report:

- ❑ Air Quality;
- ❑ Onshore and Offshore Noise;
- ❑ Hydrology, Surface and Groundwater Quality;
- ❑ Soils and Geology;
- ❑ Terrestrial, Aquatic and Nearshore Ecology;
- ❑ Marine and Coastal Ecology (including dugongs, turtles and marine mammals);
- ❑ Ecosystem Services;
- ❑ Community Health;
- ❑ Social and Socio-Economic;
- ❑ Archaeology and Cultural Heritage;
- ❑ Tourism;
- ❑ Fisheries;
- ❑ Visual Illumination;
- ❑ Onshore and Offshore Traffic; and
- ❑ Qualitative Risk Assessment.

The possible positive and negative impacts identified in the Final Scoping Report will be assessed in the EIR. The EIR will include Environmental Management Programmes, which will detail management measures to minimise negative impacts and enhance positive impacts. ERM has appointed Peter Tarr of South African Institute for Environmental Assessment (SAIEA) to review this Scoping Report, EIR and the associated specialist reporting and to provide technical support to the Stakeholder Forum that will be created for this Project. The SAIEA is a non-profit Environmental Trust, whose mission is to support sustainable development in Southern Africa through promoting the effective and efficient use of Environmental Assessment as a planning tool.

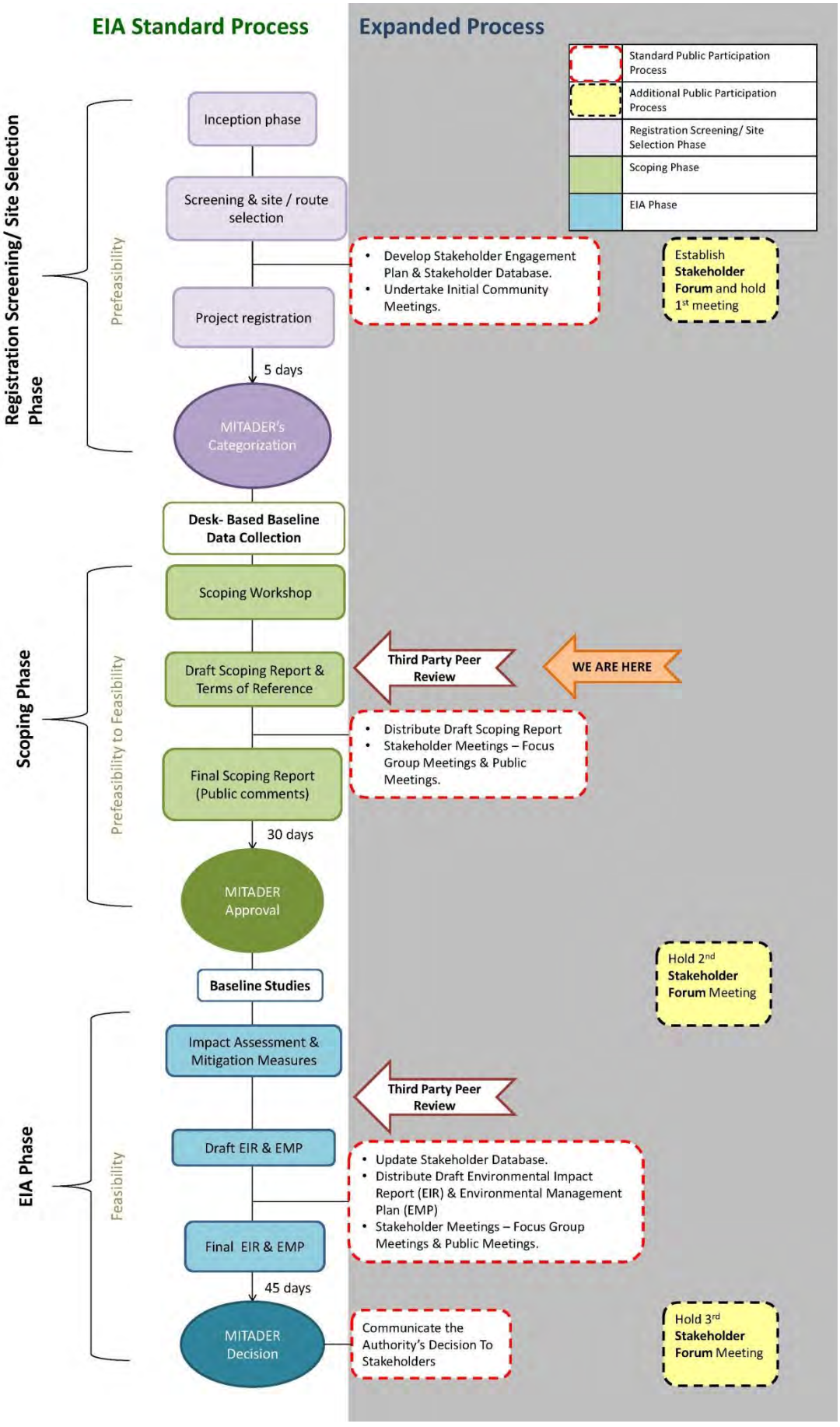
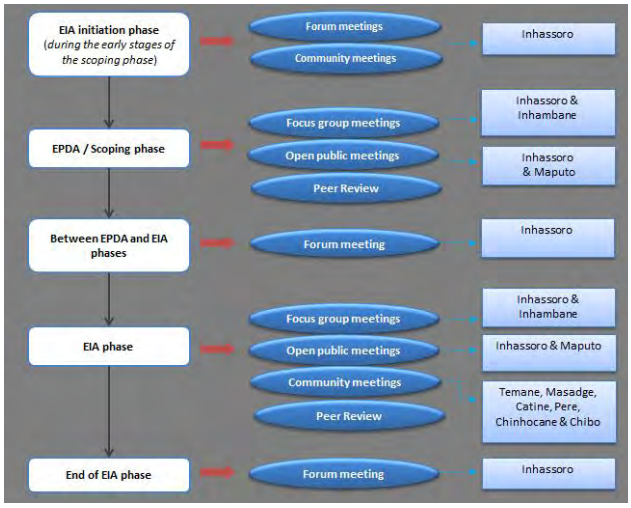


Figure 6: Steps of the Proposed EIA Process for this Category A Project

PUBLIC PARTICIPATION PROCESS

Stakeholders play an important role in the EIA process and we encourage you to register as a stakeholder to enable ERM and Impacto to keep you informed. By registering you will be able to engage in discussions on issues, provide comment on the Draft Scoping Report and comment on various reports that will be produced during the EIA process.

The Public Participation Process (PPP) steps that will be undertaken for this Project are summarised below:



The initial engagement phase was undertaken in February 2016 when the first Stakeholder Forum meeting was held along with a number of community meetings. During these meetings stakeholders were introduced to Sasol, the Project and the EIA Process. The proposed early works, which have since been deferred, were also presented. The stakeholder Forum has been established for the Project to allow for the opportunity for more in depth conversations regarding the EIA Process, technical studies, findings and mitigation measures with nominated representatives of interested and affected parties in the Project Area. This will allow for greater transparency and understanding of the findings.

The stakeholder engagement process and Forum will be peer reviewed by an independent consultant, Magdalena Dray, an environmental consultant with years of relevant experience in Mozambique.

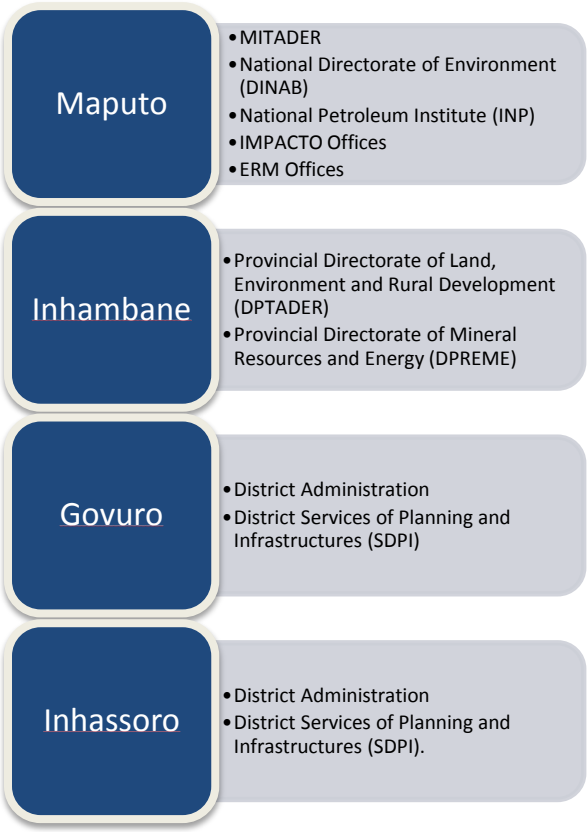
The aim of the peer review is to provide assurance to stakeholders that issues they raise are addressed in the public participation process reports and that their views, opinions and concerns are considered in the development of the EIR.

What's Next?

This Non-Technical Summary forms part of the next steps in the EIA process for this Project; and it is being publicly released as part of the materials for the stakeholder engagement process for the Scoping Phase. During disclosure of the Draft Scoping Report, ERM and Impacto will be visiting various communities in the Project Area. The purpose of the visits will be:

- To provide stakeholders with information about the proposed Project, the baseline environment and the EIA process;
- To gather information from the Project Area that can be used to inform Project planning;
- To assist in the identification of concerns and issues regarding the proposed Project and the EIA process;
- To capture stakeholder comments and suggestions on alternatives;
- To confirm issues identified in the public domain and ensure that where relevant these are investigated further through technical studies; and
- To meet legislative requirements regarding stakeholder engagement.

The Draft Scoping Report will be made available for stakeholder comment at the following locations:



In addition, an electronic version of the Draft Scoping Report and the Non-Technical Summary will be made available on Impacto´s webpage: www.impacto.co.mz and ERM webpage: www.erm.com/Sasol-Pipeline-FSO-Project.

How Can You Be Involved?

If you have any comments or concerns, and would like to register as an interested or affected stakeholder for the proposed Project you can get involved by:

- Attending workshops and public meetings held during the EIA process; or
- Contacting Impacto for further information (see contact details below).

To register as a stakeholder or for any further information please contact Sandra Fernandes of Impacto.

Email: consulta.publica@impacto.co.mz

Tel: +258 21 499 636; Cell: +258 82 304 6650;

Fax: +258 21 493 019

Address: Av. Mártires da Machava, 968 Maputo – Moçambique

Table of Contents

Abbreviations

ABS	American Bureau of Shipping
ADI	Area of Direct Influence
ADNAP	Direcção Nacional de Administração Pesqueira (National Directorate for Fisheries Administration)
AII	Area of Indirect Influence
ALARP	As Low As Reasonably Practicable
ANE	Administração Nacional de Estradas (National Roads Administration)
AoI	Area of Influence
AOPL	Association of Oil Pipelines
API	American Petroleum Institute
AQUA	Agência Nacional para o Controlo da Qualidade Ambiental (National Agency of Environmental Quality)
ASME	American Society of Mechanical Engineers
BNP	Bazaruto National Park
BANP	Bazaruto Archipelago National Park
bbls	Barrel of Oil Unit
BID	Background Information Document
BPD	Barrels per day
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
Ca	Calcium
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CMAS	Competency Assurance Management System
CLF	Community Liaison Forum
CMH	Companhia Moçambicana de Hidrocarbonetos (Mozambican Company of Hydrocarbons)
CO	Carbon Monoxide
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CORDIO	Coral Reef Degradation in Indian Ocean
CPF	Central Processing Facility
CTRG	Mozambique Gas to Power Project Ressano Garcia
CSI	Corporate Social Investment
dB(A)	A weighted decibel
DINAB	Direcção Nacional do Ambiente (National Directorate of Environment)
DPCA	Direcção Provincial para a Coordenação da Acção Ambiental (Provincial Directorate of Environmental Affairs)
DPTADER	Direcção Provincial de Terra, Ambiente e Desenvolvimento Rural (Provincial Directorate of Land, Environmental & Rural Development)
DPREME	Direcção Provincial dos Recursos Minerais e Energia (Provincial Directorate of Mineral Resources and Energy)
DRP	Decommissioning and Rehabilitation Plan
DWT	Dead weight tonnes
EDM	Electricidade de Moçambique
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Plan
c-EMP	Construction Environmental Management Plan
ENSO	El-Niño Southern Oscillation
EP	Equator Principles
EPDA	Environmental Prefeasibility and Scoping Report
EPFI	Equator Principle Financial Institutions
ERM	Environmental Resources Management

ESD	Emergency Shutdown valve
ESMP	Environmental and Social Management Plan
EWT	Endangered Wildlife Trust
F&G	Fire and Gas
FDP	Field Development Plan
FNP	Forum for Nature in Danger
FOC	Fibre Optic Cable
FSO	Floating Storage and Offloading Unit
GIS	Geographic Information System
GoM	Government of Mozambique
GHG	Green House Gas
GJ	Giga Joules
GPS	Global Positioning System
HH	Household
HDD	Horizontal Directional Drilling
HIA	Health Impact Assessment
HP	High Pressure
HVAC	Heating, Ventilation and Air Conditioning
IACS	International Association of Classification Societies
ICRPD	Convention on the Rights of Persons with Disabilities
I&APs	Interested and Affected Parties
IDPPE	Instituto Nacional de Desenvolvimento de Pescas de Pequena Escala (Small Scale Fisheries Development Institute)
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standards
IFI	International Finance Institutions
IIP	Instituto de Investigação Pesqueira (Fisheries Research Institute)
IMO	International Maritime Organization
INAHINA	Instituto Nacional de Hidrografia e Navegação (National Institute of Hydrography and Navigation)
INAMAR	Instituto Nacional da Marinha (Marine National Institute)
INE	Instituto Nacional de Estatística (National Statistics Institute)
INP	Instituto Nacional de Petróleo (National Petroleum Institute)
IPIECA	International Petroleum Industry Environmental Conservation Association
ITCZ	Inter-tropical Convergence Zone
IRR	Issues and Responses Report
IUCN	International Union for Conservation of Nature
L&FS	Life and Fire Safety
LP	Low Pressure
3 LPE	Three-layer Polyethylene
LPF	Liquids Processing Facility
LPG	Liquid Petroleum Gas
LRS	Lloyds Register of Shipping
mamsl	Meters above mean sea level
MAP	Mean Annual Precipitation
MAP	Marine Assurance Plan
MARPOL	International Convention for Prevention of Pollution from Ships
MATIP	Mozambique Anchor Tourism Investment Programme
MBC	Mix-Bury-Cover
MBR	Membrane Bioreactor
MDG	Millennium Development Goals

MdP	Ministério das Pescas (Mozambican Ministry of Fishing)
Mg	Magnesium
MGC	Matola Gas Company
MGO	Marine Gas Oil
MGJ/annum	Million Gigajoule per annum
PJ/a	Petajoules per annum
MGtP	Mozambique Gas to Power
MIREME	Ministério dos Recursos Minerais e Energia (Ministry of Mineral Resources and Energy)
MISAU	Ministério de Saúde (Ministry of Health)
MITADER	Ministério da Terra, Ambiente e Desenvolvimento Rural {Ministry of Land, Environment and Rural Development (previously known as MICOA)}
MITUR	Ministério do Turismo (Ministry of Tourism)
MSP	Mozambique – Secunda Pipeline
MSV	Marine Support Vessel
NGP	Natural Gas Project
NTS	Non-Technical Summary
NaCl	Sodium Chloride
NGO	Non-Governmental Organization
NO_2	Nitrogen dioxide
NOx	Oxides of Nitrogen
OCIMF	Oil Companies International Marine Forum
o-EMP	Operational Environmental Management Plan
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation
OSCP	Oil Spill Contingency Plan
PARPA II	Plano de Acção para a Redução da Pobreza Absoluta (Action Plan for the Reduction of Absolute Poverty)
PATI	Priority Areas for Tourism Investment
PDP II	Plano Director das Pescas (Fisheries Master Plan)
PESPA	Plano Estratégico para o Sector da Pesca Artesanal (Strategic Plan of the Small-Scale Fishing Subsector)
PEDPA	Plano de Desenvolvimento do Pesca de Atum (Strategic Development Plan for Tuna Fisheries)
PIG	Pipeline Inspection Gauge
PEDD	Plano Estratégico de Desenvolvimento Distrital (District Strategic Plan for Development)
POB	Personnel on Board
PPA	Petroleum Production Agreement
PPE	Personal Protective Equipment
PPP	Public Participation Process
PPR	Public Participation Report
PSA	Production Sharing Agreement
PSU	Practical Salinity Unit
PTI	Pande, Temane and Inhassoro
PPZ	Pipeline Protection Zone
QRH	Quick Release Hook
RESA	Regional Environmental and Social Assessment
ROW	Right of Way
SAR	International Convention on Maritime Search and Rescue
SDPI	Serviço Distrital de Planeamento e Infra-estruturas (District Services of Planning and Infrastructures)
SEP	Stakeholder Engagement Plan
SEPI	Sasol Exploration and Production International
SDG	Sustainable Development Goals

SES	Simplified Environmental Study
SHE	Safety, Health and Environmental
SO_2	Sulphur dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOx	Sulphur Oxides
SPM	Sasol Petroleum Mozambique
SPT	Sasol Petroleum Temane
SSIV	Subsea Isolation Valve
SST	Sea Surface Temperatures
TAC	Total Allowable Catch
TDS	Total Dissolved Solids
ToR	Terms of Reference
TMS	Turret Mooring System
TRP	Tactical Response Plan
UNFCCC	United Nations Framework Convention on Climate Change
US-EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
VOS	Voluntary Observing Ship
WHO	World Health Organization
WWF	World Wildlife Fund

Glossary of Terms

Area of Direct Influence	Area that the activity directly affects based on the physical, biotic and socioeconomic characteristics.
Area of Indirect Influence	Area affected by activities or influences not directly linked to the Project but which are triggered by the physical presence of the Project or associated activities
Area of Influence	Area of Influence refers to the spatial or physical scale at which the impact may occur – it does not relate to the potential consequence of the impact
Anchor handler	A vessel that tows the shuttle tanker to its offloading location and anchors it.
Auger bore	Auger bore is a technique for forming a horizontal borehole through the ground by means of a rotating cutting head.
Actuated	To actuate means to cause (a machine or device) to operate.
Beach Station	Beach station is where the offshore and onshore pipeline will connect onshore and it is where pipeline servicing, testing and maintenance will take place.
Brownfield	Previously developed land.
Bunded	A secondary enclosure, typically consisting of a wall or berm, which surrounds a tank or fluid-handling mechanism, intended to contain any spills or leaks.
Buoy	A float placed in water and usually moored, as to mark a location, enable retrieval of a sunken object, or record oceanographic data.
Cathodic protection	An electrochemical technique used to control the corrosion (rusting) of a metal surface. It involves the introduction of a very small electric current onto the metal surface.
Carbon Monoxide	A highly toxic, colourless, odourless, flammable gas produced industrially for use in the manufacture of numerous organic and inorganic chemical products; it is also present in the exhaust gases of internal-combustion engines and furnaces as a result of incomplete combustion of carbon.
Central Processing Facility	The Central Processing Facility (CPF) is Sasol's gas and condensate processing plant supplied by onshore production wells in the Temane gas field.
Cumulative Environmental Impacts	Impact caused by the Project that interacts with an impact from another activity to create an additional impact.
dB(A)	A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale. The scale is A-weighted to approximate the sensitivity of human hearing.
Dynamic Positioning	A computer-controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters.
Environmental Impact Assessment	The process by which the anticipated effects on the environment of a proposed development or Project are measured.
Exclusive Economic Zone	The Exclusive Economic Zone of the Mozambique Republic comprises the sea zone beyond and adjacent to Mozambique's territorial waters that extends up to a distance of 200 nautical miles from the coast, measured from the low tide line.
Environmental Management Plan	A site-specific plan generally developed from recommendations made in an Environmental Impact Assessment to ensure that all necessary impact management measures are identified and implemented, in order to protect the biophysical and social environments and to comply with environmental legislation. The Term is often used interchangeably with 'Environmental and Social Management Plan'
Environmental and Social Management Plan	This term is often used interchangeably with 'Environmental Management Plan'. See definition above.
El-Nino Southern Oscillation	Is a general term used to describe both warm (El Niño) and cool (La Niña) ocean-atmosphere events in the tropical Pacific. The Southern Oscillation is the accompanying atmospheric component, coupled with the sea temperature change.
Equator Principles	Provide a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in Projects, and primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making.

Environmental and Social Management Plan	A site-specific plan to ensure that social and environmental impacts, risks and liabilities are identified. The term is often used interchangeably with 'Environmental Management Plan'.
Exporting Pump	Pump that provides enough pressure to export oil or gas along the pipelines
Fatal flaws/ risks	Environmental and/or social negative and irreversible impacts, of such significance that the implementation of the project or activity in analysis is not of public interest.
Field Development Plan	A plan that provides the best technical solutions for field optimization. FDPs comprise all activities and processes required to develop an oil or gas field: environmental impact, geophysics, geology, reservoir and production engineering, infrastructure, well design and construction, completion design, surface facilities, and economics and risk assessment.
Floating, Storage and Off-Loading Unit	A permanently moored, floating vessel used for the storage and offloading of stabilised light oil.
Forward Shelter	Closed area above deck at the fore part of the FSO near the turret for the purposes of emergency evacuation.
Hawser	Mooring rope between the FSO and the offloading shuttle tanker.
Hermatypic reef formations	Corals which build reefs by depositing hard calcareous material, forming a stony framework of the reef.
Horizontal Directional Drilling	Is a steerable trenchless method of installing underground pipe along a prescribed bore path by using a surface-launched drilling rig, with minimal impact on the surrounding area.
Hydro-testing	Strength testing the pipeline by pressurizing with water.
Inert Gas Vent	An elevated stack or port through which inert gas will be released to atmosphere during loading operations. This vent forms part of the Inert Gas and venting system.
International Finance Corporation	Is an organization that assists developing countries by achieving a greater degree of private investment.
Intelligent Pigs	Sophisticated instruments inserted into a pipeline that include electronics and sensors to collect various data measurements to highlight integrity issues.
Inter-tropical Convergence Zone	Is a belt of low pressure circling the Earth, generally near the equator, where the trade winds of the Northern and Southern Hemispheres come together.
Lowest Astronomical Tide	Is an internationally standardised reference size for measuring the depth of water and to define the coastal line in sea charts.
Liquids Processing Facility	The LPF will process production fluids from oil/gas wells in the Inhassoro Field, store and prepare them for export.
Liquid Petroleum Gas	Gas mainly composed of propane and butane, which has been liquefied at low temperatures and moderate pressures.
MARPOL73/78	MARPOL 73/78 is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. ("MARPOL" is short for marine pollution and "73/78" short for the years 1973 and 1978).
Metering Skid	A special platform on which various devices and instruments are installed.
Metocean	Metocean refers to the syllabic abbreviation of climate, weather and (physical) oceanography.
Manifold	A wide and/or bigger pipe connector into which smaller pipes lead.
Nitrogen Oxides	May refer to a binary compound of oxygen and nitrogen, or a mixture of such compounds: Nitric Oxide, also known as Nitrogen Monoxide (NO), Nitrogen (II) Oxide, Nitrogen Dioxide (NO_2), Nitrogen (IV) Oxide, Nitrous Oxide (N_2O), Nitrogen (−I, III) Oxide.
Operational Environmental Management Plan	An EMP is a site-specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment and comply with environmental legislation. An operational EMP refers to the operational phase of the Project.

Pig Launcher/ Receiver	A device installed on the pipeline to launch/ receive 'pigs'. These pigs perform various operations (eg: cleaning, inspection) in a pipeline without stopping the flow of the product.
Pigging	Refers to the practice of using an inspection gauge called a 'pig' which is inserted into a pipeline to perform various maintenance operations on pipelines. These operations include but are not limited to cleaning and inspecting the pipeline
Pipelay Barge	A maritime vessel used in the construction of subsea infrastructure. It serves to connect oil production platforms with refineries on shore.
Petroleum Production Agreement	**PPA** and PSA licences overlap each other to a large extent in both the Pande and Temane areas. The PPA licence applies to specific hydrocarbon bearing formations within these areas.
Public Participation Process	The process by which an organization consults with interested or affected individuals, organizations and government entities before making a decision.
Production Sharing Agreement	A licence that covers all other formations in the Temane and Pande geographical areas that are currently being considered for development, and also includes other fields and prospects where exploration and appraisal wells have been drilled but have not as yet been declared commercial.
Red Data	The IUCN Red List is a critical indicator of the health of the world's biodiversity
Riser	A flexible pipeline which transfers the light oil from the riser base on the seabed to the surface.
Riser Base	A subsea support structure to tie in the pipeline and connect to the umbilical.
Safety Exclusion Zone	A safety exclusion zone is an area extending from any part of offshore oil and gas installations and is established automatically around all installations, which protrude above the sea at any state of the tide. Subsea installations may also have safety zones, created by statutory instrument, to protect them. Vessels of all nations are required to respect them.
Scoping Report	A report in which key issues are identified from a broad range of potential concerns for inclusion in EIA process. The Scoping Report confirms the level to which identified issues should be studied and the areas affected.
Sulphur Oxides	Refers to all sulphur oxides, the two major ones being sulphur dioxide (SO_2) and sulphur trioxide (SO_3). Sulphur dioxide is a colourless gas with a pungent, irritating odour and taste. It is highly soluble in water forming weakly acidic sulphuric acid.
Subsea Isolation Valve	A valve that creates a safety barrier in case a part of a pipeline needs to be shut down. The main purpose of a Subsea Isolation Valve (SSIV) is to isolate the import of stabilised light oil to the FSO in the event of an emergency.
Tandem Mooring Hawser System	Offloading operation characterised by the relative "tandem" position between the FSO and the shuttle tanker. The bow of the shuttle tanker is connected to the stern of the FSO via a hawser.
Transmissivity	Fluid flow in porous media.
Turret Gantry	Bridge like structure on the deck above the turret.
Turret Mooring	The turret mooring system consists of a turret swivel assembly that is integrated into a vessel and permanently fixed to the seabed by means of a mooring system. This system allows the vessel to rotate around the fixed part of the turret into the direction of oncoming seas when the FSO requires protection from high winds, waves and strong currents.
Umbilical	A flexible hose providing hydraulic power and controls to the FSO.
Volatile Organic Compounds	Known as a large group of carbon-based chemicals that easily evaporate at room temperature. While most people can smell high levels of some VOCs, other VOCs have no odour.

1 INTRODUCTION

1.1 BACKGROUND TO THE PROJECT

Sasol Petroleum Mozambique Limitada (Sasol) has obtained approval from the Mozambique Council of Ministers for the Production Sharing Agreement's (PSA) Field Development Plan (FDP) that will see further hydrocarbon resources developed to support the economic growth of Mozambique.

What is The Production Sharing Agreement (PSA)?

Sasol Petroleum Mozambique (SPM) has a Production Sharing Agreement (PSA) with the Government of Mozambique and ENH (Empresa Nacional de Hidrocarbonetos). In turn, a Petroleum Production Agreement (PPA) has been entered into between Sasol Petroleum Temane (SPT) and its partners [Companhia Moçambicana de Hidrocarbonetos (CMH) and the International Finance Corporation (IFC)] and the Government of Mozambique which covers the currently- producing assets of the Temane and Pande fields.

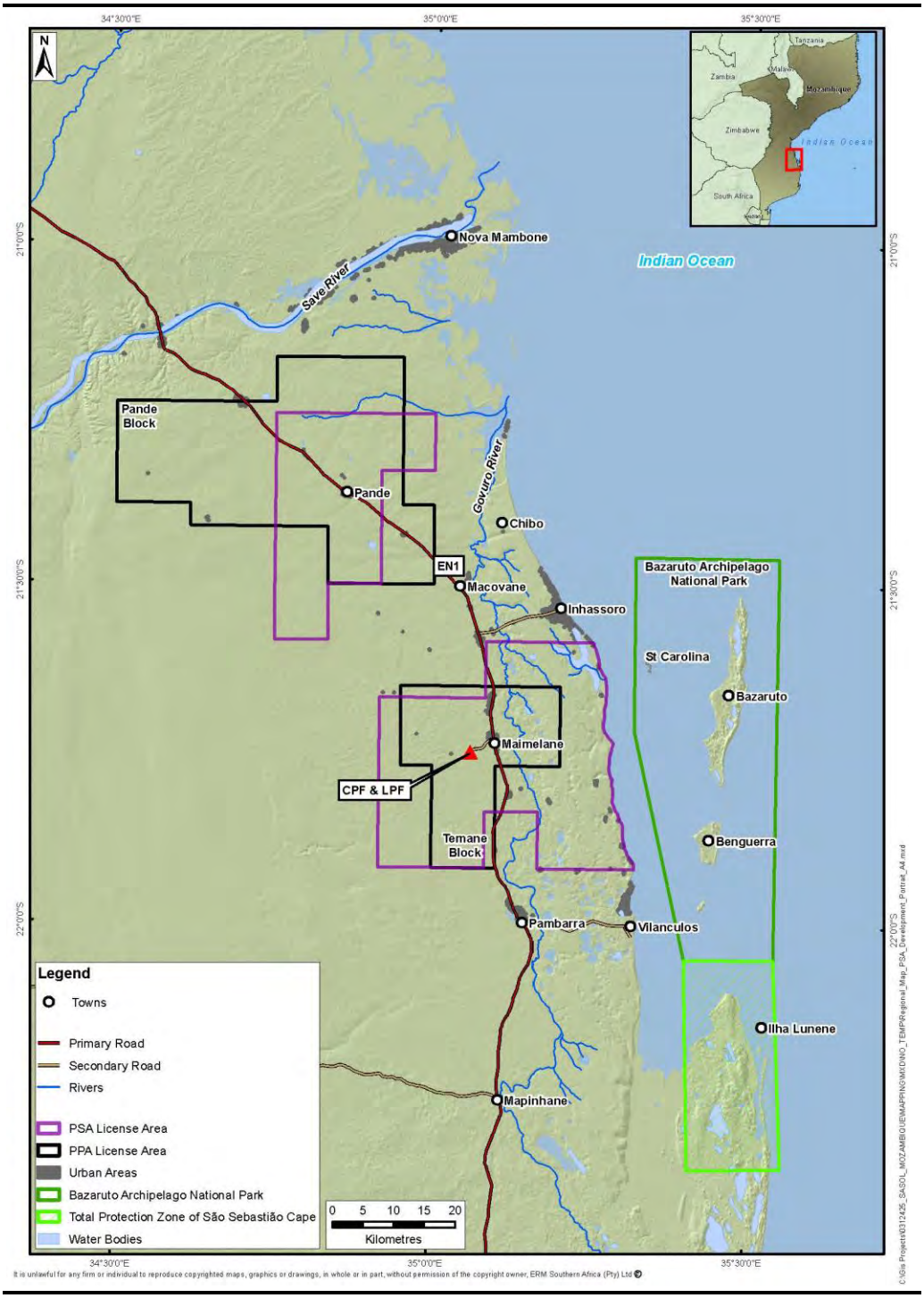
- **The PPA** and PSA licences overlap each other to a large extent in both the Pande and Temane areas. The PPA licence applies to specific hydrocarbon bearing formations within these areas.
- **The PSA licence** covers all other formations in the Temane and Pande geographical areas for which a Field Development Plan has been approved for development, and also includes other fields and prospects where exploration and appraisal wells have been drilled but have not as yet been declared commercial.

The PSA Development comprises various hydrocarbon reservoirs in the Temane, Pande and Inhassoro areas; all of which are located in the Inhamabane province of Mozambique, 40 km north-west of Vilanculos and 560 km north of Maputo (*Figure 1.1*). Under the terms of the PSA license agreement, Sasol holds a 100 percent working interest as Operator.

Sasol's gas processing plant, known as the Temane Central Processing Facility (CPF), is situated in Temane 40 km northwest of Vilanculos. The plant began operation in 2004, supplied by wells situated in the Temane Gas Field. All of the plant's production is delivered as either pipeline gas to South Africa, as condensate by road to Beira for onward shipment, or is used in Mozambique for industrial purposes and power generation. In Inhambane Province, the gas is supplied to the EDM (Electricity of Mozambique) gas-fired power station, which generates electricity for Inhassoro, Vilanculos and surrounding areas.

Since the Natural Gas Project (NGP) was first established, Sasol has brought further gas wells on stream in the Temane and Pande Gas Fields. At present, the CPF is supplied by 24 onshore production wells, 12 in the Temane Field and 12 in the Pande Field. Production at the CPF has been ramped up to process the additional gas and liquids and current production is around 197 GJ of gas per annum and 250 m^3 per day of condensate.

Figure 1.1 Regional Map of the PSA Development Area

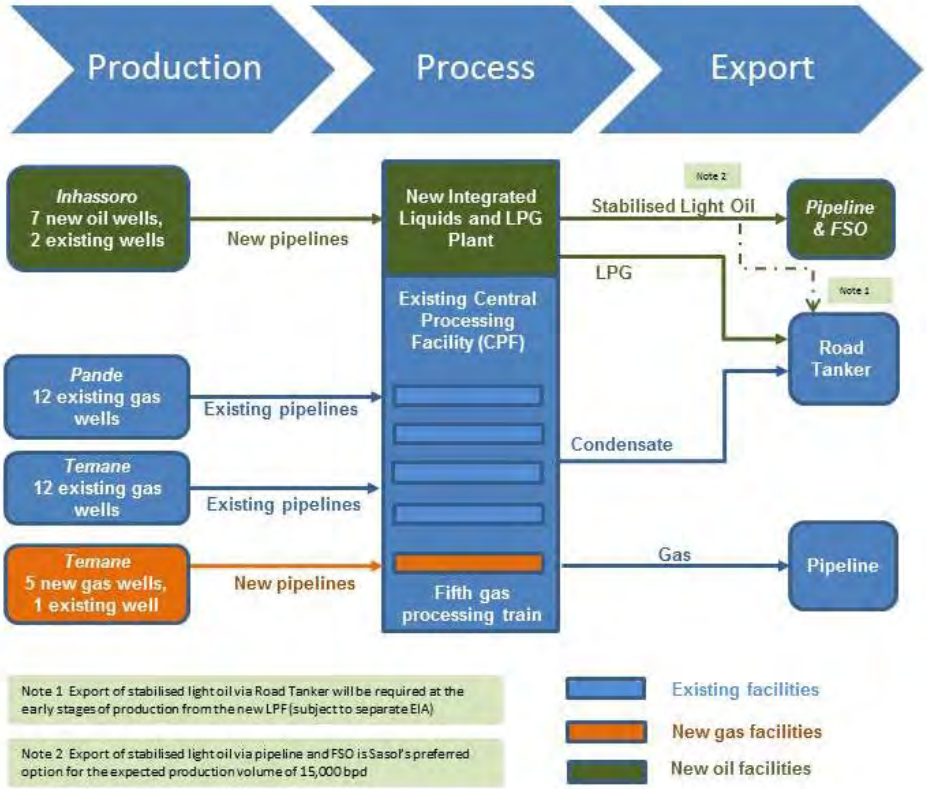


Sasol is committed to the phased evaluation and development of additional oil and gas resources within its concession areas.

In 2014, detailed technical and environmental work on the PSA Development and LPG Project was started, which involves the expansion of the CPF and the development of a new Liquids Processing Facility (LPF) adjacent to the CPF, in order to process additional PSA gas, condensate and light oil from the area defined in the Production Sharing Agreement with the Mozambique Government. The light oil is very similar to the existing condensate, being a straw-coloured liquid with a consistency like paraffin.

The proposed Project will significantly increase Sasol's capability to process gas and liquids, and the LPF will include a facility to produce Liquefied Petroleum Gas (LPG) to replace much of the LPG currently imported at significant cost to Mozambique (*Figure 1.2*). The environmental license for the PSA Development and LPG Project was issued by MITADER in December 2014, following review of the PSA Development and LPG Project EIR (Golder, 2014). The license excluded authorisation of the transportation of the additional hydrocarbon liquids, which will increase from 250 m^3 to 2 500 m^3 per day.

Figure 1.2: Conceptual Overview of the PSA Development Project, Including New Oil and Gas Wells, Flowlines, Production Facilities and Product Transport



There remains some uncertainty about the quantity of light oil that will be produced and an alternative transport option, suited to larger volumes, is to pump it via an onshore and offshore pipeline to an offshore Floating, Storage and Offloading unit (FSO), some 50 km north of Bazaruto island (*Figure 1.3* and *Figure 1.4)*, where it can be collected by shuttle tankers. The pipeline will extend from the LPF along the route of the existing Pande trunkline, turning north-eastward to a landfall some 17 km north of Inhassoro, and from there routed offshore for approximately 50 km in a north easterly direction to the proposed FSO.

It is also possible that road transportation would be preferred initially, followed by the pipeline / offshore storage option as volumes ramp up. Sasol therefore wishes to license both the road and pipeline / offshore storage transport options as a part of the PSA Development Project, in order to provide flexibility in later planning once liquid volumes are confirmed. The latter method, known as the Sasol Pipeline and FSO Project for the exportation of stabilised light oil, is the subject of the current report.

Figure 1.3 *A Map of the Proposed Pipeline and FSO Location*

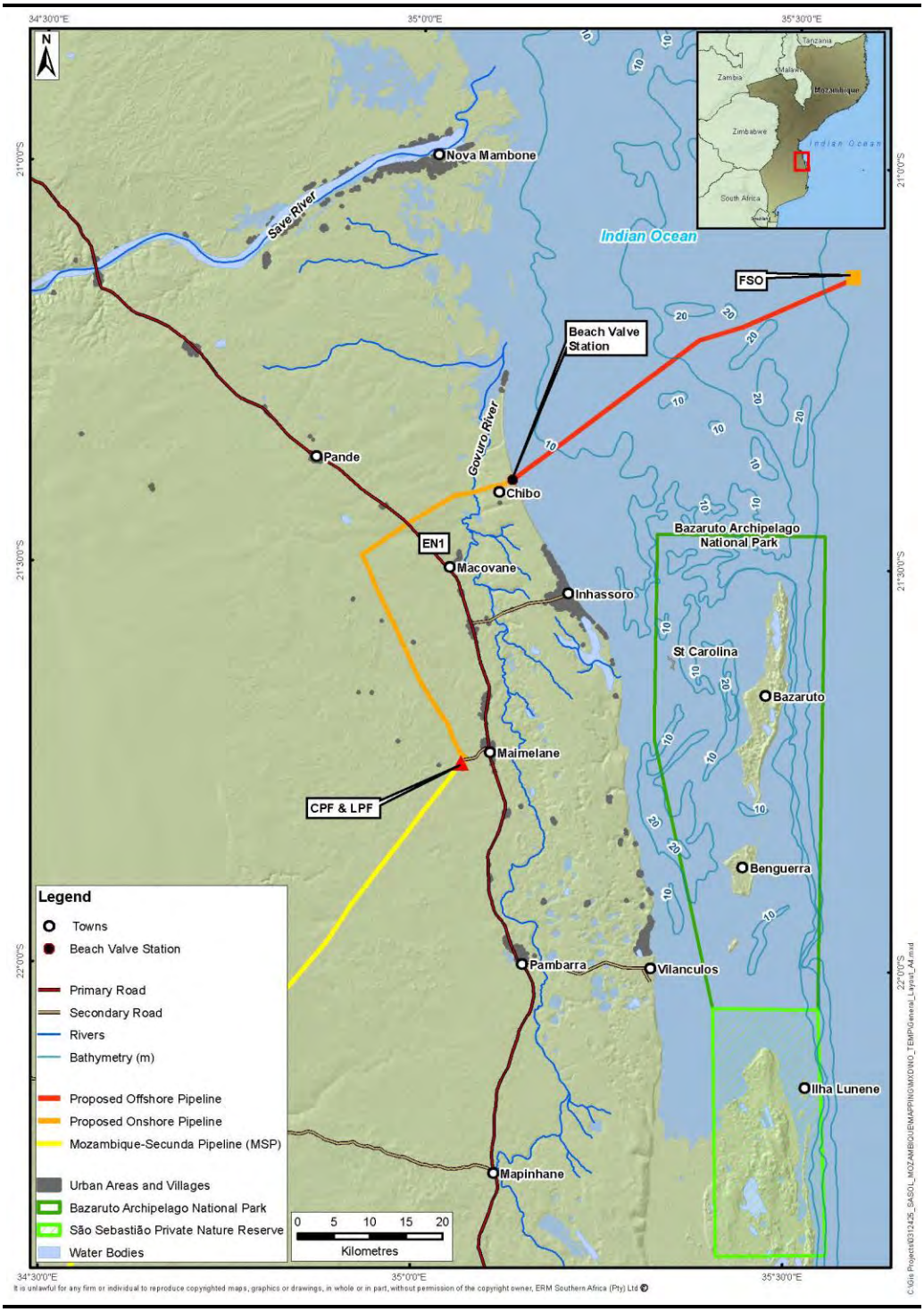
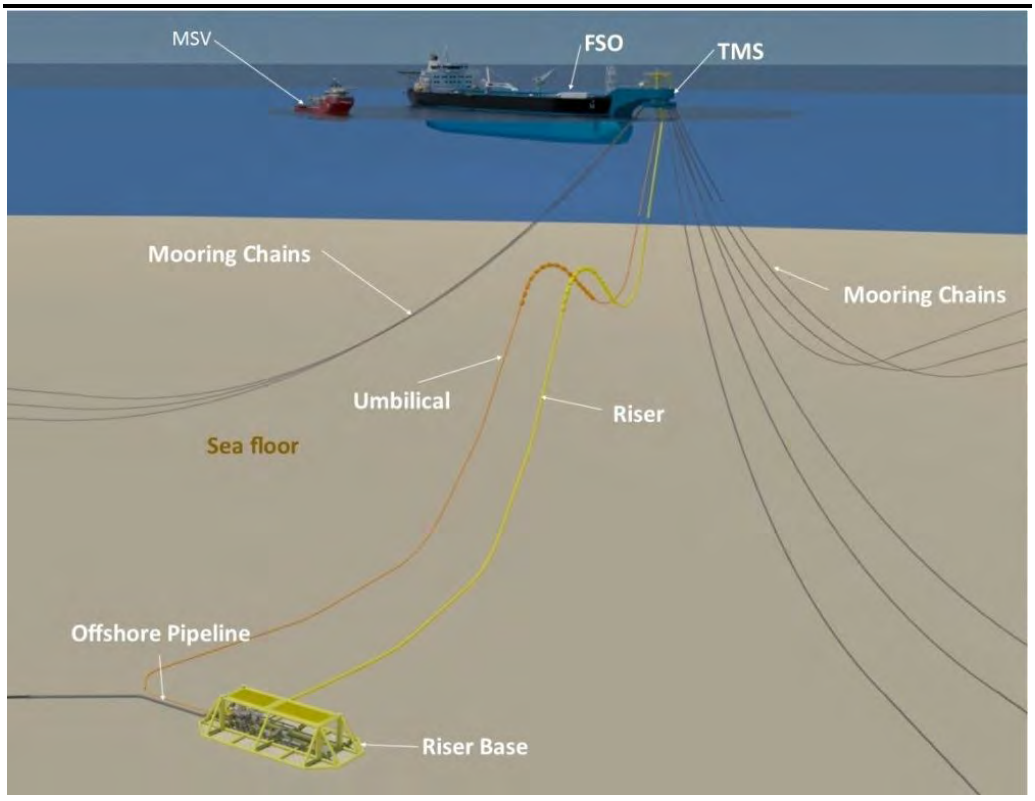


Figure 1.4: Field Layout of FSO, Mooring and Subsea Infrastructure



1.2 PROJECT MOTIVATION

1.2.1 Liquid Pipeline Export

During the Select (Feasibility) Phase of the Project, Sasol evaluated the options available for the export of 15 000 barrels per day of stabilised light oil from the new LPF. Two overall liquid pipeline concepts were studied:

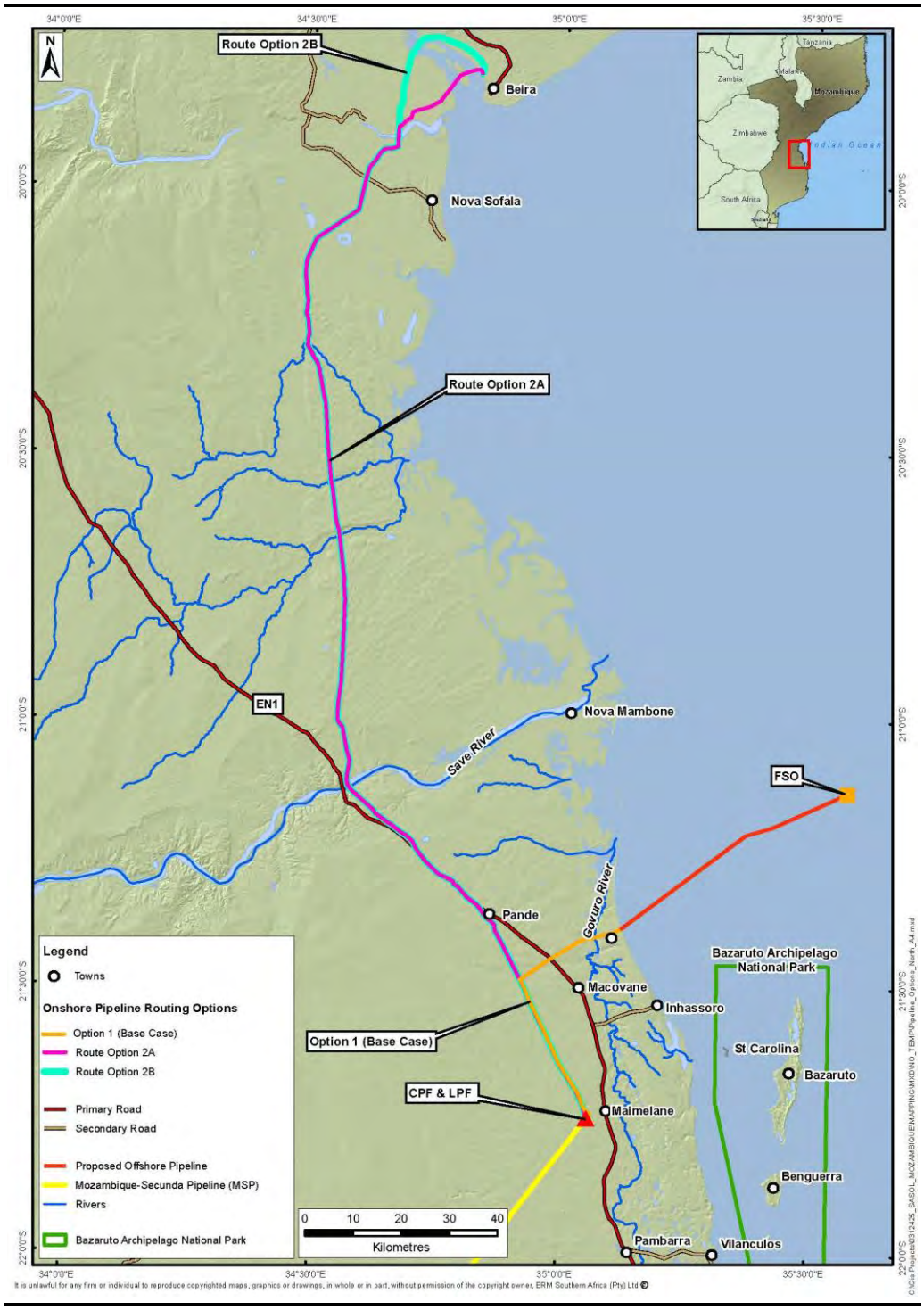
- **Option 1 (base case)**: The construction and commissioning of an pipeline from the new PSA LPF to an offshore FSO north of the Bazaruto Archipelago (*Sasol Pipeline and FSO Project,* refer to *Figure 1.3*).

- **Option 2 (alternative to base case):** The construction and commissioning of an onshore pipeline from the new PSA LPF at Temane to the tank farm at the Beira Offloading Terminal (*Figure 1.5)* and including the following alternatives:

  - **Option 2A**: A 258 km 12 inch pipeline to Beira offloading terminal including a 7.5 km Beira Estuary crossing; and

  - **Option 2B**: A 291 km 12 inch pipeline to Beira offloading terminal including a 33 km re-route avoiding the Beira Estuary crossing.

Figure 1.5: Evaluation of Export Pipeline Concept Options



Option 1 (the *Sasol Pipeline and FSO Project)* was carried forward for further engineering definition as it was considered technically and commercially feasible owing largely to the shorter onshore and offshore pipeline lengths and subsequent terrain to be crossed.

Option 2 was rejected based on cost and the technical constraints surrounding the construction methods for a pipeline crossing of the Pungwe River at the Beira Estuary.

The onshore pipeline to Beira in general was considered to be significantly more challenging than Option 1 in terms of construction, requiring four major river crossings.

1.2.2 Road Tanker Export

An alternative to the liquid pipeline approach is liquid export via road transportation. This is essentially an expansion of an activity already in progress over the past 10 years for the 250m^3 per day of PPA condensate along the same routes (ie the Temane to Beira and Temane to Maputo routes).

The use of a pipeline as an alternative to road transportation of the stabilised light oil is generally determined by the volume to be transported. As volumes increase, the cost of constructing and operating a pipeline becomes attractive, when compared with road – based transport alternatives. The use of a pipeline also presents opportunities to reduce the overall Safety Health and Environmental (SHE) risks associated with road tanker transportation, namely road traffic accidents.

The exact volume of liquids for export will be confirmed during the initial PSA Drilling campaign (in 2016 and 2017). Should the volume of stabilised light oil be lower than anticipated following the results of the PSA Drilling campaign, Sasol may consider the continuation and expansion of the current road tanker liquid export option. However, for the anticipated production volume of 15 000 barrels per day, the liquid pipeline method (the *Sasol Pipeline and FSO Project*) is Sasol's preferred option and will be assessed by this Scoping and EIA process.

1.3 HISTORY OF SASOL IN THE PROJECT AREA

Sasol's presence in this region was established in 1998 when, in partnership with Arco[1], exploration seismic surveys in Pande and Temane were conducted as well as five wells drilled in Temane. This led to the signing of the PSA between Sasol and the Government of Mozambique in October 2000, this agreement served as the basis for Sasol's investment in the Natural Gas Project (NGP). In 2001, as part of the NGP, Sasol commenced the construction of the Central Processing Facility (CPF) and the 865 km Mozambique-Secunda Pipeline (MSP). The NGP became commercial productive in February 2004.

Table 1.1 places the PSA Development and LPG Project in the context of Sasol's activities which have taken place since February 2004 and describes planned future Projects.

[1] Sasol bought Arco's shares in the project in 1999

Table 1.1 Stages of Development of Sasol's Natural Gas Project since 2004

Initial Production Activities (2004)

The first phase of the Sasol Natural Gas Project (NGP) involved the initial extraction, processing, transportation and utilisation of natural gas reserves in the Inhambane Province of Mozambique. The Mozambique component of this consisted of:

- Development of the Temane Gas Field, including the installation of wells and construction of flowlines and access routes between the wells and the Central Processing Facility;
- The establishment of a CPF at Temane, which separates the gas from liquid hydrocarbons and produced water which is present in the well fluids; and
- The construction of an 865 km pipeline between Temane in Mozambique and Ressano Garcia (and then onward to Sasol's gas reticulation network at Secunda in South Africa).

Related to the NGP, the Government of Mozambique (GoM) entered into a gas sales agreement with the Matola Gas Company (MGC) to sell a portion of the Petroleum Production Tax taken in kind (royalty gas). MGC undertook the construction of a 68 km pipeline from the off-take point at Ressano Garcia to Matola, for distribution to industrial clients in Matola and Machava.

Avoidance of large baobabs during the construction of the Mozambique - Secunda Pipeline (MSP).

Livelihood restoration monitored in accordance with Sasol's Resettlement Planning and Implementation Programme for farmers who lost crops.

Other Drilling and Construction Activities (2006-2008)

As part of the 2006-2008 Drilling Campaign to support the CPF expansion project, as described above, a further eight appraisal wells on the eastern side of the Govuro River were drilled and fourteen old wells were permanently plugged and abandoned. In addition, three exploration wells were drilled.

Rehabilitation of an abandoned well site using drilling mud waste

Development of Additional Capacity to Supply Gas (2006-2009)

In order to sustain the CPF expansion, the capacity to produce gas from the Petroleum Production Agreement (PPA) area was increased. This involved the development of the Pande G6 gas reservoir as well as increasing the production capacity of the Temane G9 reservoir. Pande gas is conveyed to the Temane CPF by means of a 48 km long trunkline. The first production from the Pande Field started in July 2009.

Community Pedestrian and Road Safety Programme in Pande, developed by Sasol and the Provincial Roads authorities.

Increasing the Capacity of the MSP Compressor Stations (2007-2010)

In accordance with a long-term strategy to increase gas flow in the Mozambique-South Africa pipeline, Sasol undertook detailed planning of compressor stations at Komatipoort, in South Africa, and at Dindiza, Gaza Province, in Mozambique. The design of the facilities includes above ground infrastructure housing two compressors driven by gas turbines.

Compressor station at Komatipoort

Expansion of the Temane CPF (2007 - 2011)

The Natgas 183 Expansion was designed to increase the production capacity of the plant from 120 PJ/a to 183 million PJ/a.

The project consisted of the installation of additional equipment within the CPF perimeter, designed to process the additional volumes of gas, store increased volumes of by-products, and provide additional capacity to treat and safely dispose of waste products.

MBR sewage treatment plant installed at the CPF to significantly increase treatment capacity as a part of the NATGAS 183 Project.

Onshore PSA Seismic Acquisition Campaign (2009)

In March 2009, Sasol launched its third onshore seismic project in two areas, one between Mabote and Maphinane in the southern section of the Exploration Block and the other north of the PandeGas Field and the Save River. A total of 927 km of seismic lines were de-mined and shot.

Gradual recovery of woodland along an old seismic line cut in 2009

Onshore Drilling Campaign (2010-2011)

The drilling campaign included two exploration wells, one north of the Save River and one south of the Temane Field, a horizontal appraisal well in the Inhassoro District and a second produced water reinjection well at the Temane CPF, designed to provide Sasol with redundancy in the event of reinjection failure at one of the wells. In addition, eight wells were recompleted in both the Temane and Pande Fields in order to improve gas production flows.

Using mixed-bury-cover (MBC) to dispose of drilling waste at Inhassoro well pads

CPF LP Compression and Electrical Expansion Projects (2013-2014)

Following on from the Natgas 183 Expansion commissioned in October 2011, the CPF facilities upgrade includes further infrastructure designed to ensure continued efficient production of gas at the CPF over time. The project entails the construction of additional low pressure (LP) compressors driven by gas turbines and installation of additional gas turbine generators for power supply. Construction of the first two LP compression units began in 2014 and was completed in 2015. Work on the remainder of the project will continue, in phases, until 2022.

Measuring emissions from the plant stacks as a basis for air pollution modelling of cumulative impacts.

Increasing the Capacity of the MSP Loop Line Project – Phase 1 (2013-2015)

The intention to increase the gas value chain to meet expected market demand has necessitated further increases in the capacity of the MSP. The loop line was planned to increase the capacity of the MSP from 170 MGJ/annum to 212 MGJ/annum. The completed loop line will be 254 km long, routed from the Temane CPF to Scraper Trap Station 2 and installed in the same right of way as the MSP. The first (128 km) phase of the loop line became operational in December 2014, routed from the CPF to Scraper Trap Station 1. This phase will increase the MSP's capacity to 188 MGJ/a. Construction of the second phase of the project will start in 2015, with operation expected by January 2017.

Cleaning of earth moving equipment brought into the loop line construction area for invasive plant prevention.

Mozambique Gas to Power Project (CTRG) (2014) In 2014, in-country monetisation of Mozambique's gas resources on a large scale reached a milestone with the commissioning of Central Térmica de Ressano Garcia, known as CTRG. Completed at a cost of US$246 million, CTRG is a 175MW gas-to-power plant that is a joint venture between *Electricidade de Moçambique* – 51 percent and Sasol 49 percent. This, the first permanent, gas-fired power plant in Mozambique, supplies electricity to more than two million Mozambicans, equating to 23 percent of the country's current demand.	 *One of seventeen graves identified for exhumation at the CTRG site, prior to construction. Revision of the site boundaries avoided all but one these exhumations.*
The PSA Development & LPG Project (2014-2020) This Project involves the development of five new gas wells and seven new oil wells in the PSA (plus two existing oil wells), to be delivered to a new LPF built adjacent to the Sasol CPF. The Project is to include increased production of gas, light oil and LPG, which will replace much of the imported product currently imported into Mozambique. *Project licensed by MITADER on 12 December 2014, based on submission of a full EIR and Environmental Management Plans. The license was revised on 16 March 2016 based on an EIA Addendum and revised EMPs.* **Environmental licensing of road transport and the onshore /offshore pipeline and FSO is in progress in separate EIAs.**	 *The Nhangonzo Coastal Stream, a potential 'Critical Habitat' identified during the PSA Development EIA.*
NGP Seismic Acquisition Project (2015-2017) Sasol proposes to conduct further 2D and focussed 3D seismic acquisition over large areas of its PPA and PSA license areas. In the short term, an urgent programme has been scheduled in the Pande and Inhassoro Fields, within the PPA and PSA license area, to support the development of G10 and G6 oil reservoir well drilling plans and the remediation of the Pande 4 well. Both 2D and 3D seismic data will be acquired.	 *Encephalartos ferox identified in the Govuro River floodplain near Nova Mambone during fieldwork for the NGP Seismic EIA Addendum.*

Proposed Mozambique Gas to Power Project (MGtP) (2015 -2020)

To further reduce Mozambique's reliance on foreign power imports, Sasol and the Mozambique state power company, EDM, propose to develop the Mozambique Gas to Power (MGtP) Project, a 400 MW natural gas power plant supplied with PSA gas from the existing Sasol Central Processing Facility. The proposed MGtP site is located in close proximity to the CPF, approximately 500 m south of the existing fence line.

In addition to the plant itself, the MGtP project will include a 25 km long 400 kV power line linking the plant to the national grid, a 13 km long water supply pipeline from the Govuro River, a 3 km long access road and a gas pipeline between the CPF and the power plant. For the construction phase, a temporary beach landing is being considered near Inhassoro, together with some necessary upgrading of roads and bridges between Inhassoro and the CPF.

Example of large equipment being offloaded from a barge - information presented to stakeholders in Inhassoro public meetings.

1.4 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The Project requires an Environmental License from the Ministry of Land, Environment and Rural Development (MITADER), in accordance with the National Environmental Law (Law No 20/1997), considering both the *Decree* regulating Environmental Impact Assessment (*Decree No. 45/2004* amended by *Decree 42/2008)* and the *Environmental Regulation for Oil Operations* (*Decree 56/2010*).

In accordance with *Decree 45/2004*, Sasol has submitted the Project Registration documents to the Ministry of Land, Environment and Rural Development (MITADER) for categorization. As per the *Decree 45/2004*, it has been classified as a '*Category A Project'* (Refer to Appendix 1 of the EIA Regulations), *Reference Number 90/180/DGA/DPTADER/16*, for which a full EIR is required.

In order to obtain an Environmental License, Sasol must prepare an Environmental Impact Report (EIR), in accordance with the Mozambican environmental regulatory requirements. Environmental Resources Management International Services Ltd (ERM) has been appointed by Sasol to manage the EIA process and the submission of the EIR on their behalf.

This document constitutes the Environmental Pre-feasibility and Scoping Report (EPDA) and Terms of Reference (ToR), an essential document in the EIA process, which determines the scope of the EIR itself.

This EPDA Report (hereafter referred to as a Scoping Report) will be presented to Interested and Affected Parties (I&APs) as part of the public participation process, which is mandatory for 'Category A' activities.

1.5 THE PURPOSE OF THIS SCOPING REPORT

This Draft Scoping Report provides the findings and outcomes of (1) the **EIA Pre-assessment Application** and (2) the **Environmental Pre-feasibility and Scoping** stages ***only***. For the purposes of this report, these stages will be termed ***Scoping***.

The main objectives of this report are to:

- Present a description of the proposed Project;
- Present the EIA process, methodology and the relevant legislation that will be adhered to;
- Present an initial description of the physical, biological and socio-economic characteristics of the Project Area;
- Identify the environmental and socio-economic issues related to the proposed Project, in the Project Area on which the EIR will be focused;
- Identify any fatal flaws associated with the proposed Project; and
- Present an outline of the Terms of Reference for the various specialist studies that will assess the identified environmental and social issues.

Note – this Scoping Report **does not** present a full baseline assessment or an assessment of the environmental and socio-economic impacts. Rather it is a Terms of Reference for the EIA process to be followed. Detailed answers will be presented in the Environmental Impact Report.

1.6 APPLICANT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER DETAILS

1.6.1 *Applicant*

The applicant for the proposed Project is Sasol Petroleum Mozambique. The contact details for the applicant are as follows:

SPM - SASOL Petroleum Mozambique
Contact: Ailton Rego
Address: Rua dos Desportistas, No. 833, Prédio Jat V-3, 11º e 12º
Tel: +258 357400
Email: ailton.rego@sasol.com

1.6.2 *Environmental Assessment Practitioner*

ERM is a global environmental consulting firm employing over 5 000 specialists in more than 160 offices in over 40 countries. ERM is one of the largest, totally focused, sustainability consulting firms in the region.
As required by *Decree No. 42/2008*, ERM is registered with MITADER. The contact details for ERM's Mozambique office are as follows:

ERM International Services Limitada
Contact: Paula Gonzalez
Address: Rua dos Desportistas, Vodacom Building No 649, 12th Floor, Maputo, Mozambique
Tel: +258844905586
Email: Paula.gonzalez@erm.com

1.7 DETAILS OF THE EIA PROJECT TEAM

A list of the EIA Team members that will conduct the EIA process on the behalf of Sasol is provided in *Table 1.2*.

Table 1.2 EIA Project Team

Activity	Name	Company and Location
Project Management Team		
Partner in Charge and Technical Lead	Ingeborg McNicoll	ERM – South Africa
Project Manager	Dieter Rodewald	ERM – South Africa
In-Country Project Manager	Uke Overvest	Impacto - Mozambique
In-Country Assistant Project Manager	Ricardo Costa Pereira	ERM - Mozambique
Assistant Project Manager	Vicky Stevens	ERM – South Africa
In Country QA/OC	Paula Gonzalez	ERM - Mozambique
Technical Leads		
Marine Specialist	Vicky Stevens	ERM – South Africa
Terrestrial Technical Lead	Jessica Hughes	ERM – South Africa
Social / Resettlement Technical Lead	Callie Philips	ERM – Kenya
Soils/Hydro/ Geohydrology Technical Lead	Ken King	ERM – South Africa

1.8 STRUCTURE OF THIS REPORT

This report comprises ten chapters, the contents of which are listed below:

Table 1.3 Structure of this Report

Section	Description
	Non-Technical Summary
Chapter 1	Introduction
Chapter 2	Project Description
Chapter 3	Legal Framework and Best Practice Standards
Chapter 4	The EIA Process
Chapter 5	The Public Participation Process
Chapter 6	Description of the Affected Biophysical Environment.
Chapter 7	Description of the Affected Socio-Economic Environment
Chapter 8	Identification of Key Issues
Chapter 9	Terms of Reference for the EIA Studies
Chapter 10	References

1.9 ASSUMPTIONS AND LIMITATIONS

- This report uses secondary data sources that have been reviewed by ERM. The identified gaps in the data will be addressed during the EIA phase; and

- This report has been prepared using a high level description of the Project which is sufficient for the purposes of Scoping. Additional information will be provided in later reports once the engineering design is more advanced and the technical specifications and requirements are defined.

2 PROJECT DESCRIPTION

2.1 INTRODUCTION

This Chapter provides a description of the *Sasol Pipeline and FSO Project* and associated Project phases. This description is preliminary and for information purposes only. Additional information will be made available in the Environmental Impact Report (EIR), once a more detailed project description becomes available.

2.2 BACKGROUND AND PROJECT NEED

Sasol has obtained approval from the Mozambique Council of Ministers for the Production Sharing Agreement's (PSA) Field Development Plan (FDP) that will see further hydrocarbon resources developed to support the economic growth of Mozambique. As discussed in *Chapter 1*, the PSA Development comprises various hydrocarbon reservoirs in the Temane, Pande and Inhassoro areas. In order for Sasol to accommodate the increased requirement for processing, the Temane Central Processing Facility (CPF) will be expanded to process additional gas, condensate and stabilised light oil. Sasol has an approved EIR for the PSA Development and LPG Production Projects.

The PSA Development will be developed in phases. Phase 1 includes an integrated stabilised light oil and Liquid Petroleum Gas (LPG) project adjacent to Sasol and its partners' existing Petroleum Production Agreement (PPA) CPF Plant area.

Subject to the satisfactory outcomes of the initial PSA drilling campaign (in 2016 and 2017), the Liquids Processing Facility (LPF), adjacent to the existing Temane CPF, is expected to process 15 000 barrels of stabilised light oil per day. Sasol intends to export this stabilised light oil through a pipeline from the new LPF, adjacent to the existing Temane CPF, to an offshore Floating, Storage and Offloading unit (FSO) north of the Bazaruto Archipelago (*Figure 1.3)*. The FSO will have the capacity to store up to 500 000 bbl of stabilised light oil onboard and to offload 300 000 bbl within 24 hours.

2.3 PROJECT LOCATION

The Project is located in the southern region of Mozambique's Inhambane Province (*Figure 1.3)*, the capital of which is Inhambane town. The proposed onshore pipeline route from the new LPF to the shore crossing will be approximately 57 km long. The shore crossing is located approximately 20 km north of Inhassoro.

The proposed offshore pipeline route (located within a planned 700 m wide survey corridor) to the FSO extends approximately 50 km in a northeast direction from the shore crossing. The FSO will be installed at a fixed location within a 2 x 2 km block (*Table 2.1* and *Figure 2.1)*, approximately 50 km north east of the Bazaruto Archipelago National Park (BANP), inside the Exclusive Economic Zone (EEZ), at a water depth of approximately 50 m. A detailed survey (prior to construction) will confirm the preferred location of the FSO within the 2 x 2 km block.

Table 2.1 The Coordinates of the FSO Location Block

Latitude (South)	Longitude (East)
21°7'49.37"	35°33'39.94"
21°7'21.81"	35°34'42.82"
21°8'20.82"	35°35'11.98"
21°8'48.09"	35°34'9.41"

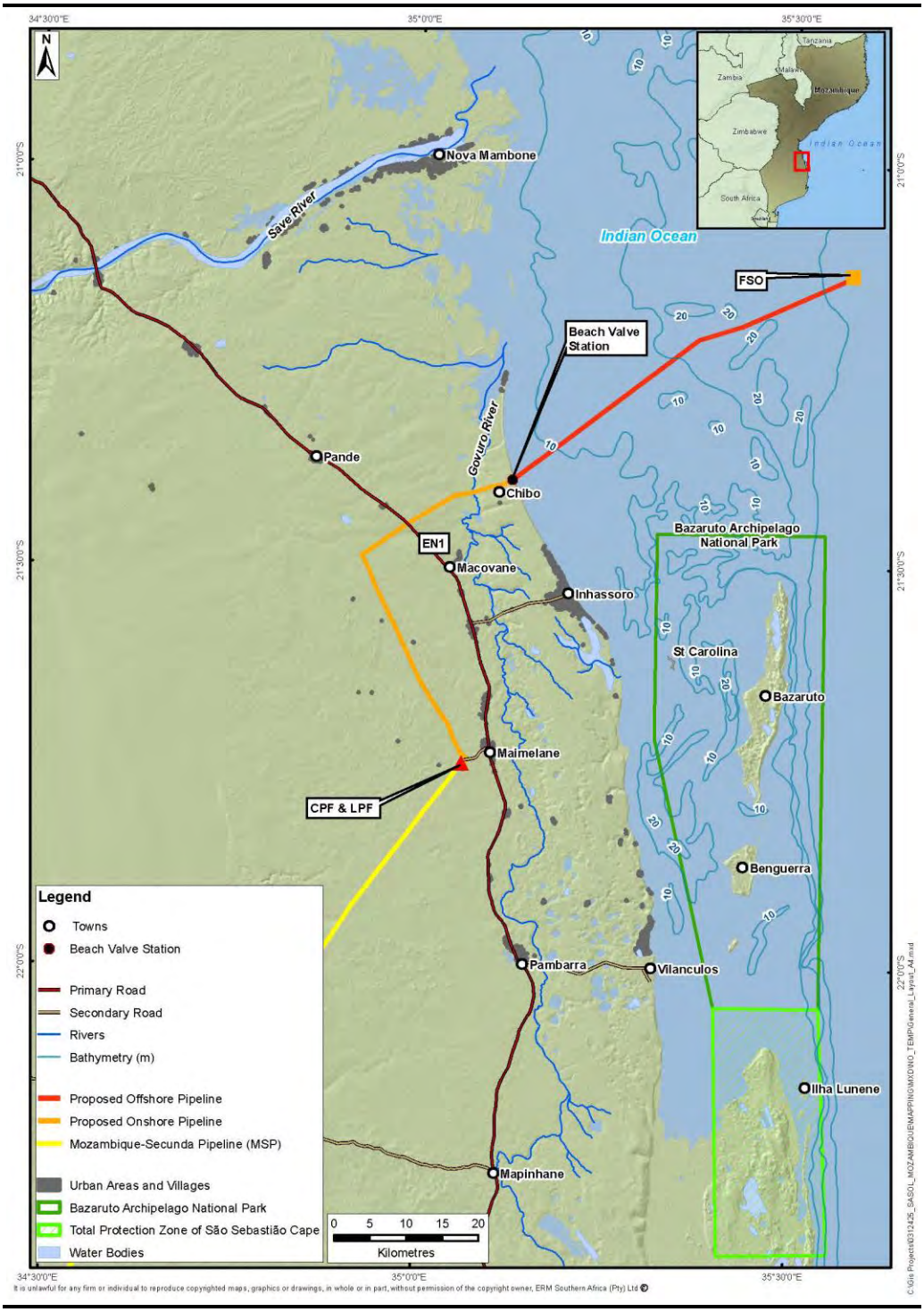
Four different alternatives for the FSO location were assessed during the Screening Phase (*Section 2.5*). A key reason for selection of the preferred FSO location was its greater distance from Bazaruto, the nearest island in the BANP, and the mainland.

2.4 PROJECT AREA

The Project Area comprises the various environmental and socio-economic receptors that may be affected both directly and indirectly by the Project activities described below. The Project Area can be separated into Areas of Direct Influence (ADI) and Areas of Indirect Influence (AII) depending on the source and causes of the impacts and these will vary in extent depending on the type of receptor affected.

The baseline environment of the Project Area is described using available data in *Chapter 5* (biophysical) and *Chapter 6* (socio-economic) as the basis for identifying potential impacts in *Chapter 7*. From the baseline information and identified impacts, a categorisation of ADI and AII for each receptor type is summarised in *Chapter 8* as the basis for defining the study areas for the specialist studies.

Figure 2.1 A Map of the Project Area



2.5 *ALTERNATIVES ASSESSED FOR THE PROJECT*

Following the completion of the feasibility study, the Pipeline and FSO concept was selected for further definition. The Engineering Team has assessed a number of potential location alternatives for the pipeline routes from the LPF to the FSO.

The options were assessed against the following criteria:

- Safety to operations (ie risks to existing infrastructure and potential third party interference);
- Construction and Operational Safety and Health and Environment (SHE);
- Environmental and Social considerations;
- Technical difficulty/ Constructability;
- Schedule; and
- Cost.

2.5.1 Onshore Pipeline Route Alternatives

A pipeline corridor assessment was completed in 2014 (Genesis, 2014) which evaluated a number of potential routes available for the pipeline from the LPF at Temane to the offshore FSO.

As detailed under *Figure 2.2* the following onshore pipeline route options were evaluated:

- Base Case Route: pipeline length of 57 km;
- Route Option A: pipeline length of 48 km;
- Route Option B: pipeline length of 45 km; and
- Route Option C: pipeline length of 146 km

The base case and Options A and B are all routed to the north of the Temane CPF towards a common landfall location which avoids environmentally sensitive wetland/ mangrove areas further north and populated areas around Inhassoro to the south. Route Option C is routed to the south of the CPF towards a landfall location far south of BANP.

The base case was considered to present the most favourable option when taking into account all of the above criteria, which can be summarised as:

- Limited habitat fragmentation by optimising use of existing pipeline corridor;

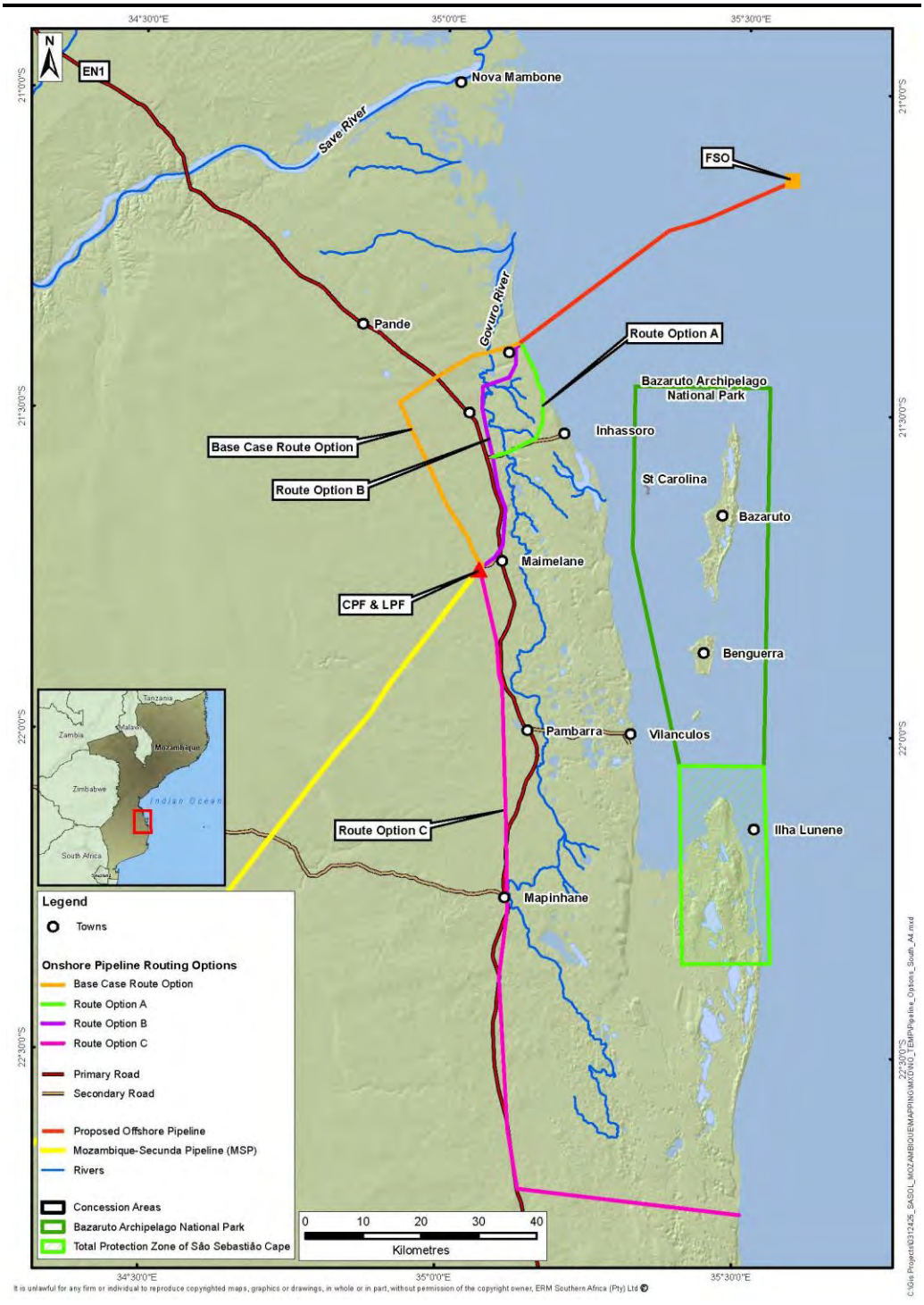
- Minimised routing through flood plain areas (deemed high value catchment area and sensitive environmental receptor);

- Minimising potential disturbance to tourism and recreational development by avoiding a pipeline route along the coastline;

- Reduced risk of third Party interference for section of route following existing Pande trunkline corridor ; and

- Reduced risk of road traffic and pedestrian accidents by avoiding transport construction along EN1 highway.

Figure 2.2 Alternatives Considered for the Onshore Pipeline Routes



2.5.2 *Offshore Pipeline Route and FSO Location Alternatives*

At the feasibility stage, four potential FSO locations were identified at a 50 m water depth contour with the following distances from Bazaruto Island (*Figure 2.3*):

- Location 1 - 52 km;
- Location 2 – 50 km;
- Location 3 – 31 km; and
- Location 4 – 19.5 km.

A 50 m water depth was selected in order to accommodate the riser and mooring system design for the anticipated metocean conditions and to provide sufficient water depth to allow safe shuttle tanker approach and departure.

Location 2 was selected as the preferred FSO location on the basis of:

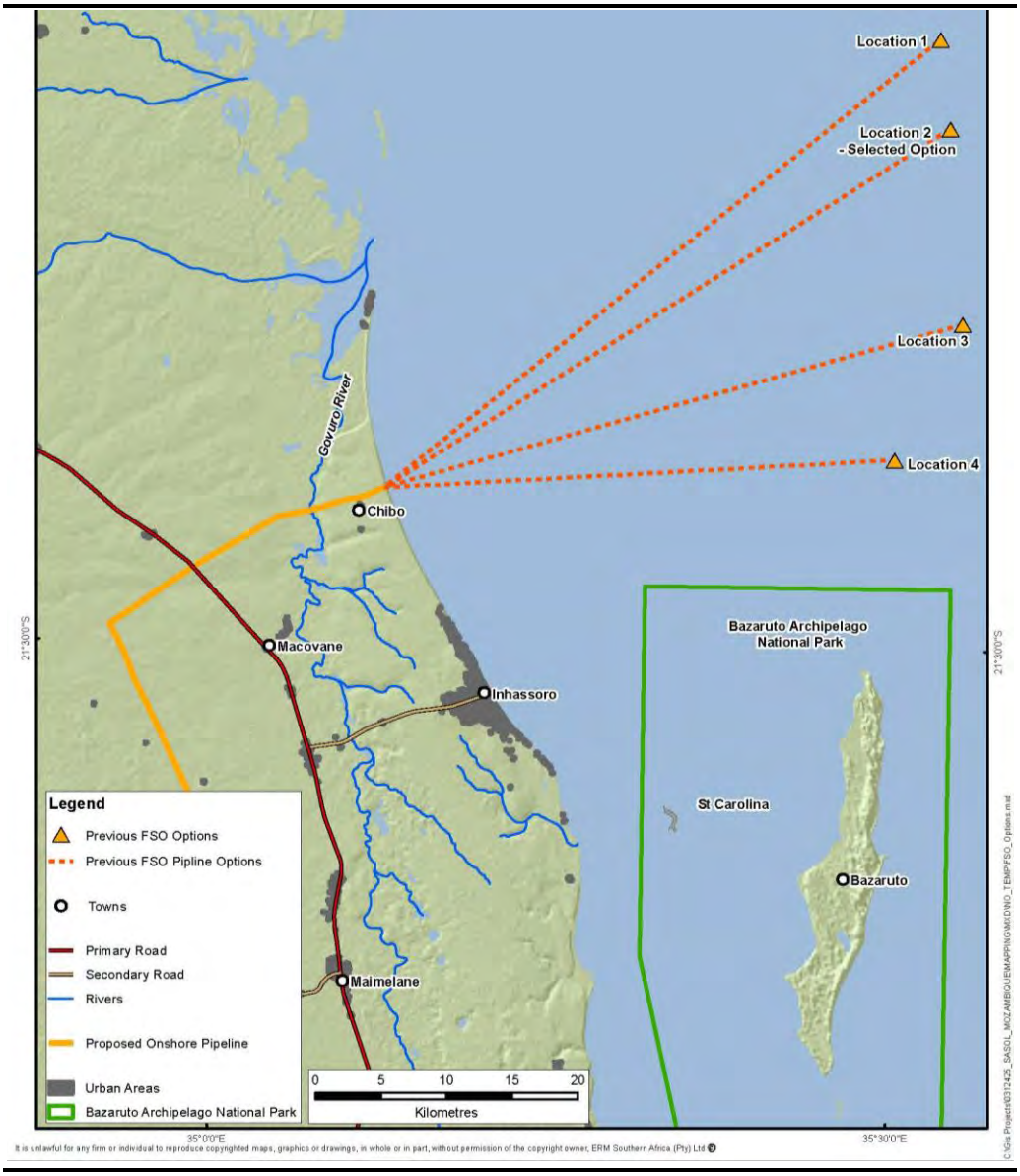
- FSO and shuttle tankers are expected to have no visual impact upon Bazaruto Island (depending on elevation above sea level);
- Provision of sufficient water depth to determine a clear manoeuvring area for the shuttle tanker approach and departure ;
- Minimisation of overall pipeline length compared to FSO location options further north of Bazaruto Island;

The main reason for the selection of the offshore pipeline route is the landfall and FSO location. The following criteria have been used to determine the offshore route:

- Minimum distance between shore crossing and FSO;
- Minimised pipeline length in shallow water to optimise pipeline stability;
- Avoidance of shallow water areas marked on marine charts (eg potential coral outcrops);
- Minimised impacts upon seagrass beds (which are often associated with dugong presence) through selection of nearshore approach through seagrass beds at their narrowest point; and
- Avoidance of existing shipping channels.

A marine survey will be conducted before construction of the pipeline in order to collect information required to confirm the final FSO location and offshore pipeline route.

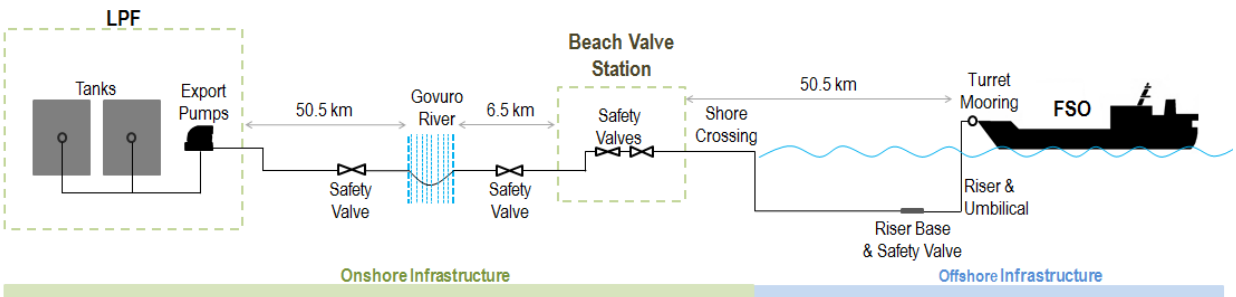
Figure 2.3 FSO Location Alternatives Assessed



2.6 PROJECT FACILITIES AND INFRASTRUCTURE

The Project includes the following facilities and infrastructure, depicted in *Figure 2.4* below. All Project infrastructure and equipment will have a design life of 15 years.

Figure 2.4 Sasol Pipeline and FSO Project Process Illustration



2.6.1 *Onshore Infrastructure*

Light Oil Export Facilities

The stabilised light oil export facilities (pumps and pipeline servicing infrastructure) will be located within the LPF (*Figure 1.3*), located adjacent to the existing Temane CPF. It will comprise a manifold, metering skid, export pumps and a temporary 'pig' (pipeline inspection gauge) launcher and receiver. The export pumps will pump stabilised light oil from four tanks, located inside the LPF site, to the FSO.

- **Export Pump –** a pump that provides enough pressure to transport the light oil along the pipeline.
- **Manifold –**a wide and/or bigger pipe connector into which smaller pipes lead.
- **Metering skid**- a special platform on which various devices and instruments are installed.
- **Pig Launcher / Receiver–** a device installed on the pipeline to launch/ receive 'pigs' (pipeline inspection gauges). These pigs perform various operations (eg: cleaning, inspection) in a pipeline without stopping the flow of the product.

Onshore Pipeline

The onshore pipeline route will start at the LPF and will follow the northward route of the existing Pande trunkline corridor, for a distance of approximately 32 km north of Temane.

The terrain along the Pande trunkline is generally flat comprising a mixture of subsistence agriculture and woodland. This section of the pipeline is aligned along the east side of the existing trunkline Right of Way (ROW) for most of the north-south section of the route in order to minimise the additional bush-clearing required for construction.

The onshore pipeline turns north eastward towards the shore crossing, at a distance of approximately 33 km from the LPF. This section of the route corridor traverses relatively undisturbed habitat. It crosses the EN1 national road and utilities at approximately 8 km from the pipeline turn, and then approximately 10 km from the EN1 it crosses the Govuro River and its floodplain.

Approximately 6 km from the Govuro River the onshore pipeline terminates at the beach valve station approximately 20 km north of Inhassoro. This section of the route traverses an area of scattered rural settlement, subsistence cropping and secondary woodland. The entire onshore pipeline from the LPF to the beach valve station will be below ground.

Figure 2.5 Example of the Construction of a Pipeline and Associated Right of Way

Source: Golder, 2015

Remotely actuated mainline valves will be installed on either side of the Govuro River crossing, which can be closed from the LPF in the event of an emergency, preventing the continued flow of product into the river. The pipeline will be a 10 inch welded carbon steel pipeline that meets the American Petroleum Institute (API) 5L specification.

- **Mainline valve-** a valve that will create a safety barrier, at the Govuro River, in order to minimise the amount of light oil spilled into the river due to a pipeline leak or rupture.
- **API 5L –** is an American Petroleum Institute specification for the welded steel pipeline that is suitable for transporting oil, water and gas.

Two different methods of protection will be implemented to protect the pipeline from corrosion. The first layer of protection comprises a coating of three-layer polyethylene (3 LPE) bonded to the pipeline and the second layer will comprise the introduction of a small electric current onto the pipeline (known as cathodic protection).

Shore Crossing and Beach Valve Station

The shore crossing site, approximately 20 km north of Inhassoro, comprises an approximately 35 m high cliff, leading to a gentle sloping sandy beach *(Figure 2.6)*.

Figure 2.6 ***A Photograph of the Proposed Shore Crossing***

Source: ERM, 2015

The beach valve station (including pipeline servicing, testing, and safety and maintenance systems) will be inland from the top of the cliff and will have a footprint of approximately 30 m x 30 m. The beach valve station will include two connections for a temporary pig launcher/receiver to pig either the onshore or offshore pipeline. The function of the beach valve station is to isolate the onshore and offshore pipelines and provide a facility to aid pigging of either pipeline.

Pigging - refers to the practice of using an inspection gauge called a 'pig' which is inserted into a pipeline for the purposes of displacing or separating fluids, or cleaning or inspecting the pipeline to perform various maintenance operations on pipelines. These operations include but are not limited to cleaning and inspecting the pipeline.

The pipeline will be cleaned using "cleaning pigs" *(Figure 2.7)*; this activity is envisaged to be performed every two years for the duration of the operation. For the purposes of pipeline inspection, maintenance and monitoring, "intelligent pigs" may be used. Intelligent pigs are sophisticated instruments that include electronics and sensors to collect various data measurements along the pipeline to identify and monitor integrity issues.

Figure 2.7 ***Example of a Typical Cleaning Pig***

Source: www.rosen-group.com

Manually actuated isolation valves will also be installed on both the offshore and onshore pipeline at the beach valve station, providing a safety barrier, isolating the onshore and offshore pipeline if and when required. A summary of the onshore pipeline and supporting infrastructure design specifications and safeguards are provided in *Table 2.2* and *Box 2.1.*

Isolation valve- - a valve that will create a safety barrier, at the beach valve station, in order to isolate either the onshore or offshore pipelines in the event of a leak or other emergency.

2.6.2 *Onshore Marine Supply Base in Beira*

The marine supply base will be located within the Port of Beira, on an existing brownfield site (previously developed land) and therefore it is not included in this EIA process. The supply base will provide all the supplies, support vessel and services for the FSO.

In order to support emergency response and operational logistics of the FSO a Marine Support Vessel (MSV) will be stationed permanently outside the FSO 500 m safety exclusion zone (refer to *Section 2.6.3*). This vessel will act as a guard vessel ensuring that other maritime users remain outside of the FSO 500 m safety exclusion zone and provide firefighting and spill response capability in the case of emergency. The MSV will have a core crew of 15 to 18 people. In addition to the MSV, a dual purpose vessel will perform crew changes and supply logistics including waste transfer to and from the Port of Beira.

This vessel will also perform the role as an anchor handler during offloading from the FSO. It is expected that the vessel will remain in the vicinity of the FSO location for approximately 26 days per month and will also be fitted with firefighting equipment on board. The core crew of this vessel will be approximately 10 people.

Anchor handler - a vessel that tows the shuttle tanker to its offloading location and anchors it.

The marine supply base will also receive all wastes from the construction of the onshore pipeline as well as the wastes from the FSO during both construction and operations phases. Licensed waste contractors will be appointed to sort and dispose of the wastes appropriately, in accordance with Mozambique legal requirements.

Table 2.2 Onshore Pipeline and Supporting Infrastructure Design Specifications

Characteristic	Description
Pipeline diameter	10 inches
Pipeline burial	The onshore pipeline will be trenched and buried from the LPF to the beach valve station.
Pipeline depth of cover	Minimum 1m to top of pipe
Pipeline depth below river	Trenchless crossing 3 m below Govuro River bed
Pipeline material and coating	Carbon steel (API 5L x 60) Three-layer polyethylene (3 LPE)
Pipeline corrosion protection (cathodic	Onshore – 3 LPE coating & impressed current

Characteristic	Description
Pipeline diameter	10 inches
protection)	cathodic protection Offshore – 3 LPE coating & cathodic protection
Pipeline permanent surface markers	Onshore pipeline, generally inter-visible along the centreline of the pipeline
Permanent fencing	Permanent fencing around all mainline valves ie above ground installations
Remotely actuated mainline valves	Installed on either side of the Govuro River crossing
Manually actuated isolation valves	Installed on both the offshore and onshore pipeline at the beach valve station
Onshore marine supply base	Located within the Port of Beira, on an existing brownfield site

Box 2.1 Main Design Safeguards for the Onshore Pipeline and the Onshore Supporting Infrastructure

- Entire onshore pipeline will be buried to prevent tampering with the pipeline by third parties;
- Pipeline routing will avoid, if possible, onshore environmental sensitivities;
- Trenchless crossings to minimize construction impacts at the Govuro River and shore crossing;
- Remotely actuated mainline valves located either side of the Govuro River to isolate the crossing in the event of a leak or other emergency;
- Manually actuated isolation valve at the beach valve station to isolate either the onshore or offshore pipeline in the event of a leak or other emergency; and
- Pipeline corrosion protection and leak detection systems.

2.6.3 Offshore Infrastructure

Offshore Pipeline

The offshore pipeline route extends from the beach valve station to approximately 50 km offshore. It is anticipated that the pipeline will be buried where water depths are less than 10 m in order to maintain pipeline stability at shallow water depths. Where possible, the final pipeline route will avoid sensitive areas such as seagrass beds, coral reefs and areas typically used by artisanal and semi-industrial (small-scale) fishermen.

The proposed offshore pipeline will also cross an existing buried subsea fibre optic cable (FOC). Concrete mattresses will be installed on the seabed above the FOC, which the pipeline will then be laid over, in order to spread the load and protect the FOC from damage. There are no requirements for offshore pipeline crossings of any other existing infrastructure. The offshore pipeline will be designed to allow easy inspection and cleaning. To achieve this, the pipeline will be equipped with temporary pig traps, one at the subsea riser base, and one at the beach valve station.

Riser Base, Subsea Isolation Valve, Riser and Umbilical

The riser base will be situated on the seabed, approximately 50 km offshore. The riser base will connect the pipeline to the FSO through a flexible pipeline called a riser together with an umbilical. The riser and umbilical will attach to the turret mooring on the FSO. The riser base includes a Subsea Isolation Valve (SSIV). The SSIV enables the import of stabilised light oil to the FSO to be isolated at the riser base in the event of an emergency. The SSIV is controlled and actuated remotely from the FSO through the umbilical. The SSIV is a fail-safe system ie should the FSO communication with the SSIV fail, it will automatically close.

- **Subsea Isolation Valve (SSIV) -** a valve that will create a safety barrier, at the riser base and FSO, in order to minimise the amount of light oil released into the sea due to leak or rupture on the offshore pipeline and/or riser.
- **Riser -** flexible pipeline which transfers the light oil from the riser base on the seabed to the surface.
- **Riser base -** a subsea support structure to tie in the pipeline and connect to the umbilical**.**
- **Umbilical -** flexible hose providing hydraulic power and controls to the FSO.

A summary of the offshore pipeline and associated infrastructure design specifications and safeguards are provided in *Table 2.3* and *Box 2.2* below.

Table 2.3 Offshore Pipeline and Associated Infrastructure Design Specifications

Characteristic	Description
Pipeline diameter	10 inches
Pipeline burial	Buried where water depths are less than 10 m
Planned survey corridor width	700 m
Safety Exclusion Zone	500 m during construction
FSO and subsea infrastructure	50 m water depth (to be confirmed by Offshore Survey)
Riser base	• Designed to minimise fishing equipment interaction • Subsea Isolation Valve (SSIV) • Retrievable pig trap

Box 2.2 Main Design Safeguards for the Offshore Pipeline and Associated Infrastructure

- Pipeline routing to avoid, where possible, offshore environmental sensitivities;
- 500 m safety exclusion zone during construction;
- Buried where water depths are less than 10 m to provide pipeline stability in shallow water;
- Pipeline designed to enable inline inspection and cleaning;
- Concrete mattresses placed over FOC prior to pipeline installation; and
- SSIV at the riser base to shut off the supply of light oil in the event of an emergency.

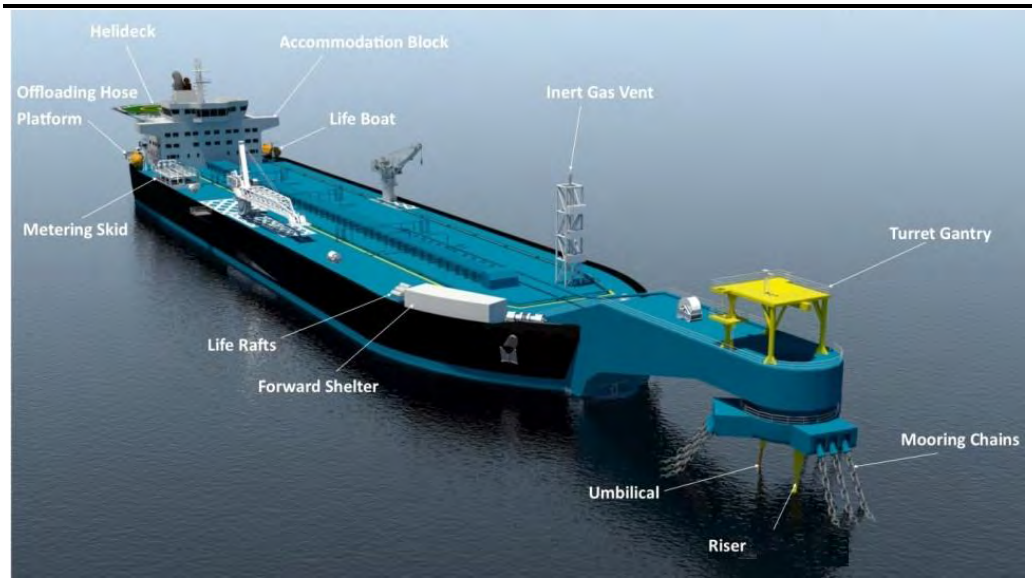
Floating Storage and Offloading Unit (FSO) and Turret Mooring

The FSO (*Figure 2.8*) will be located in the Mozambique Channel north of Bazaruto Island and as such shall be subject to compliance with the Government of Mozambique's rules and regulations as well as international treaties to which Mozambique is a signatory. The FSO is likely to be a converted medium-sized tanker (Aframax) of between 95 000 and 110 000 dead weight tonnes (DWT) that is that is less than ten years old at the time of conversion.

- **FSO -** is a permanently moored, floating vessel used for the storage and offloading of stabilised light oil.
- **Turret Mooring System -** consists of a turret swivel assembly that is integrated into a vessel and permanently fixed to the seabed by means of a mooring system. This system allows the vessel to rotate around the fixed part of the turret into the direction of oncoming seas when the FSO requires protection from high winds, waves and strong currents.

The FSO will measure approximately 234 m in length and 42 m in breadth with an operating draft of 7 to 15 m (below the water line). The hull of the FSO will be double-sided and double-bottomed to protect against any loss of stored hydrocarbons in the event of a collision or impact. The FSO will be designed for a continuous service life of 15 years without dry docking and for operation in 50 m water depth.

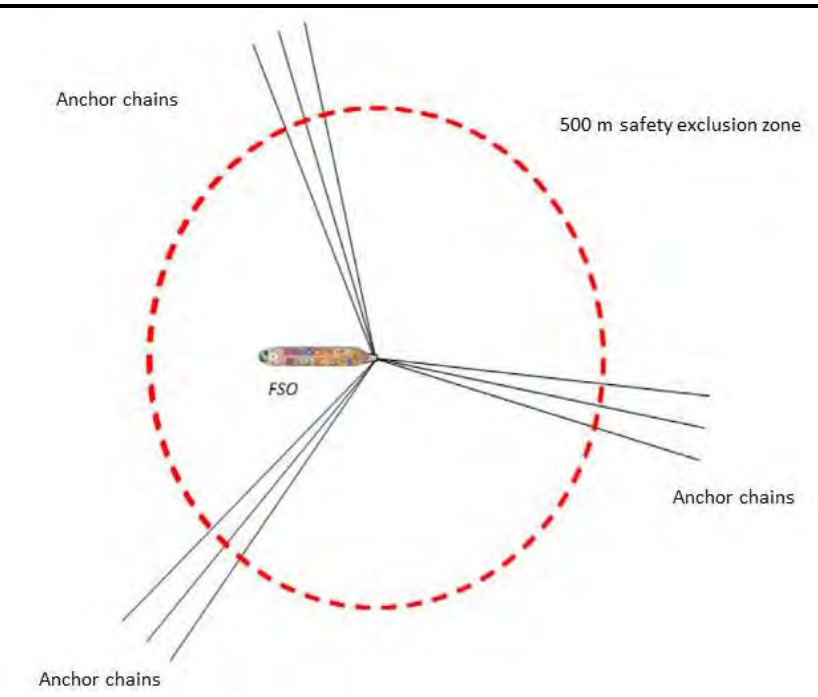
Figure 2.8 Floating Storage and Offloading Unit (FSO)



The FSO will have accommodation for 50 personnel to allow for sufficient crew onboard during high manning periods such as the initial hook-up and commissioning phase. Normal manning levels will require 35 to 38 personnel on board (POB) during operations. The living quarters will be located toward the aft (rear) of the FSO.

The FSO will be permanently moored, inside a 500 m safety exclusion zone (*Figure 2.9*), to the seabed using an external bow mounted Turret Mooring System (*Figure 2.10*), in accordance with the station-keeping requirements of ISO-19007-1. The mooring system will be installed at the forward part of the FSO.

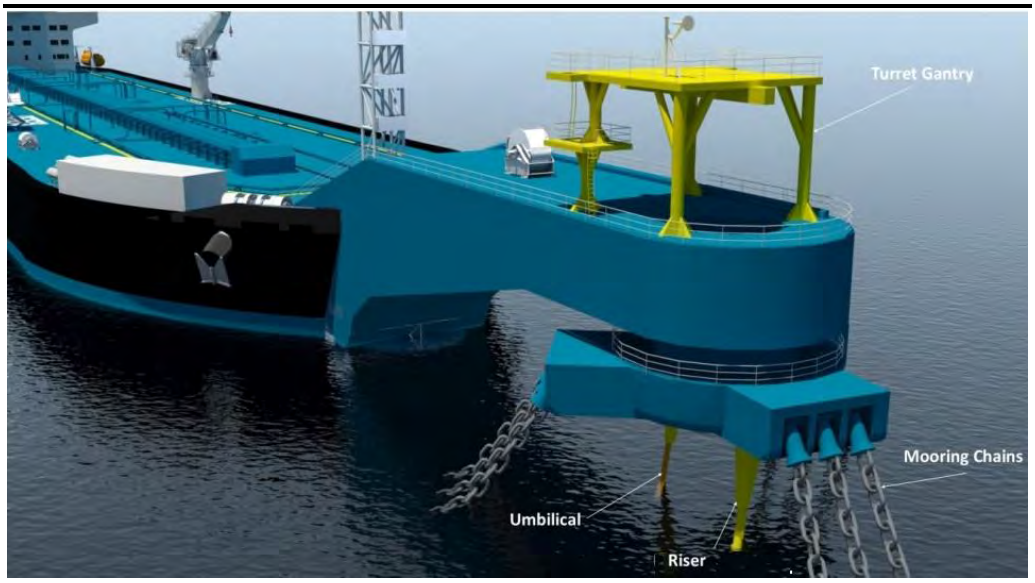
Figure 2.9 Schematic of the 500 m FSO Safety Exclusion Zone



Mooring lines will run from the turret to anchors on the seabed. The FSO turret mooring system will require nine anchor chains arranged in three bundles and nine anchors. The anchors will be located at a radius of approximately 900 m from the turret.

A Tandem Offloading System with an Offloading Hose will be installed at the rear of the FSO. The Offloading Hose will comprise a double carcass designed to contain potential spills from the main carcass should this fail.

Figure 2.10 Turret Mooring System (TMS)



The FSO, including the Turret Mooring System (TMS), will be classed, ie designed in accordance with the requirements of a member of the International Association of Classification Societies (IACS). A classification society is a non-governmental organization that establishes and maintains technical standards for the construction and operation of ships and offshore structures. The society will also validate that construction is according to these standards and carry out surveys every five years to ensure continued compliance.

The FSO will also have a Flag State Authority. The Flag State has the authority and responsibility to enforce regulations over vessels registered under its flag, including those relating to inspection, certification, and safety and pollution prevention. The FSO will comply with all applicable national and international maritime conventions, acts, codes, rules and regulations, including:

- International Convention for the Safety of Life at Sea (SOLAS);
- International Convention on Load Lines;
- International Convention on Tonnage Measurement of Ships;
- International Convention for the Prevention of Pollution from Ships (MARPOL73/78);
- Regulations for Prevention of Collisions at Sea; and
- Regulations for Communications.

Table 2.4 FSO Design Specifications

Characteristic	Description
FSO dimensions	234 m length 42 m breadth Operating draft (7 to 15 m)
Water depth at FSO location	50 m
Hull construction	Double Hull Construction with Double Sided Fuel tanks
Mooring type	Permanent external turret mooring , 9 anchors and chains
Storage Capacity	500 000 barrels
Loading rate	15 000 barrels of stabilised light oil per day
Offloading rate	300 000 barrels over 24 hours
Safety Exclusion Zone	500 m
Persons on Board (POB)	50 (maximum) 35 to 38 (normal operations)
Minimum Age of vessel:	Less than 10 years old at the time of conversion
Service Life	15 Years

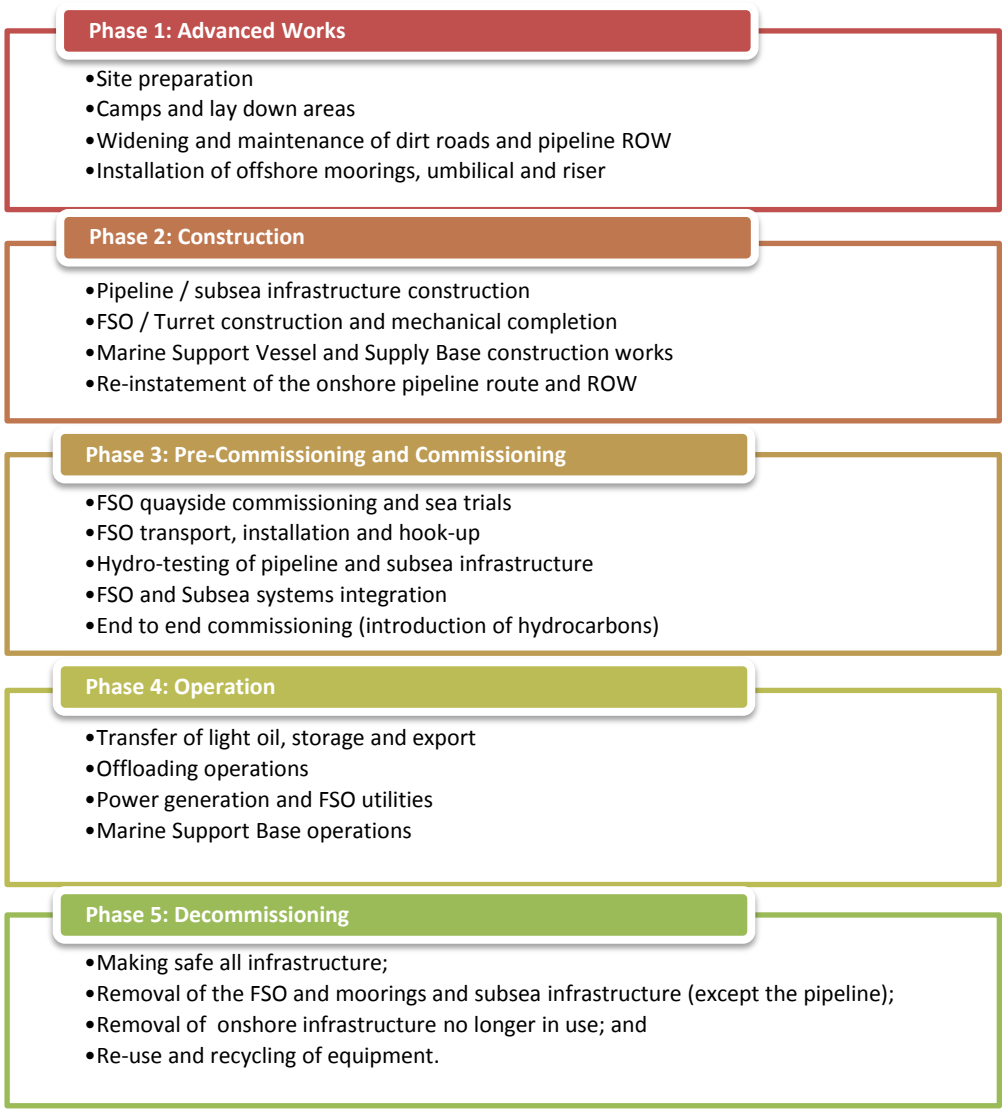
Box 2.3 Main Design Safeguards for the FSO

- Double hull construction to protect against hydrocarbon leaks in the event of an impact or collision;
- Stabilised light oil stored within 12 individual cargo tanks in order to minimise inventory loss in the event of an impact or collision;
- FSO located to minimise its visibility from the mainland and Bazaruto;
- Turret mooring system minimizes seabed footprint;
- A 500 m safety exclusion zone around the FSO and Mooring;
- Turret mooring system allows the FSO to rotate (or weather vane) according to sea state and wind direction and is designed to operate safely in extreme cyclonic weather conditions; and
- Cargo handling system spill prevention measures.

2.7 PROJECT PHASING

The planned activities over the lifespan of the Project are summarised in *Figure 2.11* and described in the text below.

Figure 2.11 Project Phases and Associated Activities



2.7.1 *Phase 1: Advanced Works*

Site Preparation

Site preparation onshore includes demining, vegetation clearance and topsoil removal and storage along the onshore pipeline corridor. There may be some clearing of the coastal vegetation in the vicinity of the beach valve station. This vegetation will be re-instated in line with an amended version of the Infrastructure Construction EMP (Golder, 2014a) for the PSA and LPG Project activities.

For the offshore pipeline route a debris survey will be undertaken prior to the installation of the offshore pipeline, subsea infrastructure and FSO, where any debris and fishing gear found along the offshore pipeline corridor and at the FSO site will be removed or avoided.

Camps and Lay Down Areas

For the duration of construction activities, camps and lay-down areas will be established in the vicinity of the CPF, along the pipeline corridor alignment and near the shore. Sasol intends to use existing camps and lay-down areas in the area subject to their availability during construction. These camps will support the workforce involved in construction activities and provide support services, including offices, clinic, workshops, warehouses, accommodation, kitchens and ablutions and utilities.

Widening and Maintenance of Dirt Roads and Pipeline Right of Way

The existing dirt road from Inhassoro heading north along the coast will be used to provide construction vehicles access to the shore crossing and beach valve station site, and may require additional widening and grading. An access track to and along the pipeline ROW will be established that will be maintained for the life of the operation. There is also a possibility that a temporary bridge across the Govuro River will be installed to minimise the impact of construction traffic on local transport infrastructure. The temporary bridge would be installed at a suitable location in close proximity to the pipeline crossing to enable vehicles to drive on the pipeline ROW and restrict increased road traffic.

Installation of Offshore Moorings, Riser and Umbilical

The turret mooring, anchors and anchor chains, riser and umbilical will be installed offshore using an Anchor Handling Tug and support vessels prior to the arrival of the FSO at its mooring location. The installation techniques will be confirmed and discussed in the EIR.

2.7.2 *Phase 2: Construction Activities*

Pipeline Construction

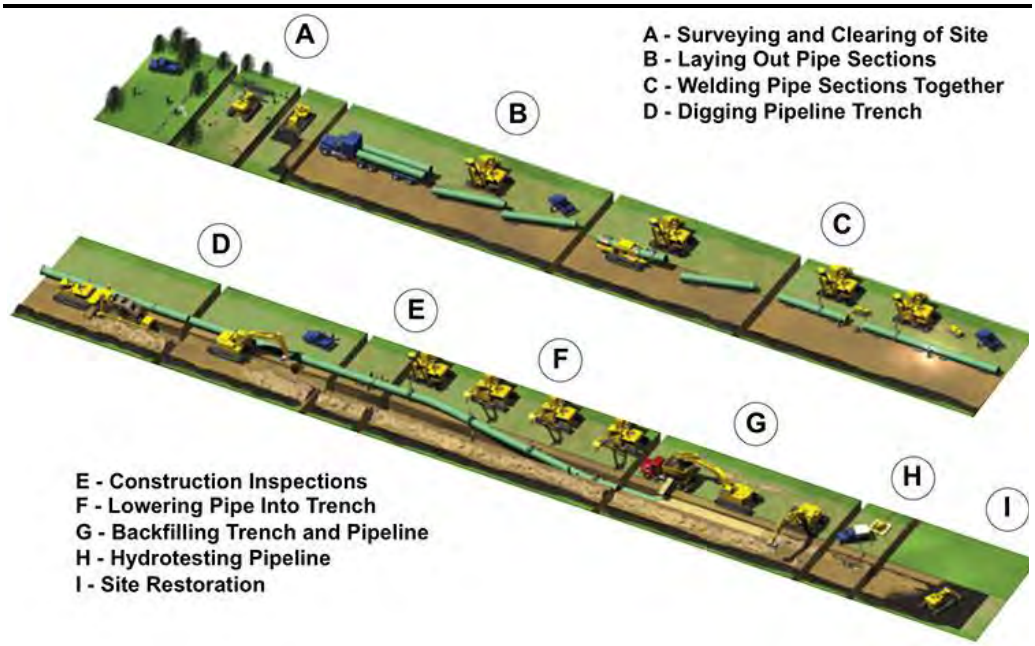
The preferred methodology for the construction of the onshore pipeline from the LPF to the beach valve station is to use standard construction techniques and for the pipeline to be trenched and buried (*Figure 2.12*).

The Pipeline Servitude / Partial Protection Zone (PPZ) is planned to be 50 m or less. The Servitude / PPZ is the land where the pipeline will be located, it requires any other entity wanting to conduct any activity or erect any infrastructure within the pipeline servitude / PPZ to seek prior permission from the certificate holder (Sasol).

In addition to the Pipeline Servitude / PPZ a Safety Zone is planned, this is an additional 50 m on either side of the pipeline servitude; this could be optimised if required. The Safety Zone is an area which housing or other infrastructure development is restricted. The topsoil will be stockpiled along the pipeline route in the pipeline ROW, and then re-instated following the completion of pipeline construction activities.

Auger boring is the preferred construction methodology for the EN1 road crossing and the Govuro River Crossing. The auger boring is expected to be completed within the 50 m wide construction ROW. The depth of the auger boring is determined by the geotechnical conditions encountered and capability of the contractor but will be approximately 3 m below the Govuro River bed. Following pipeline installation, the bore pits will be backfilled to match the original grade and rehabilitated.

Figure 2.12 Cross Section of Typical Trenching and Burial of an Onshore Pipeline



Source: Association of Oil Pipelines (AOPL)

Figure 2.13 Example of Auger Bore Technique for a Road Crossing

Source: US Department of Transportation (Federal Highways Administration)

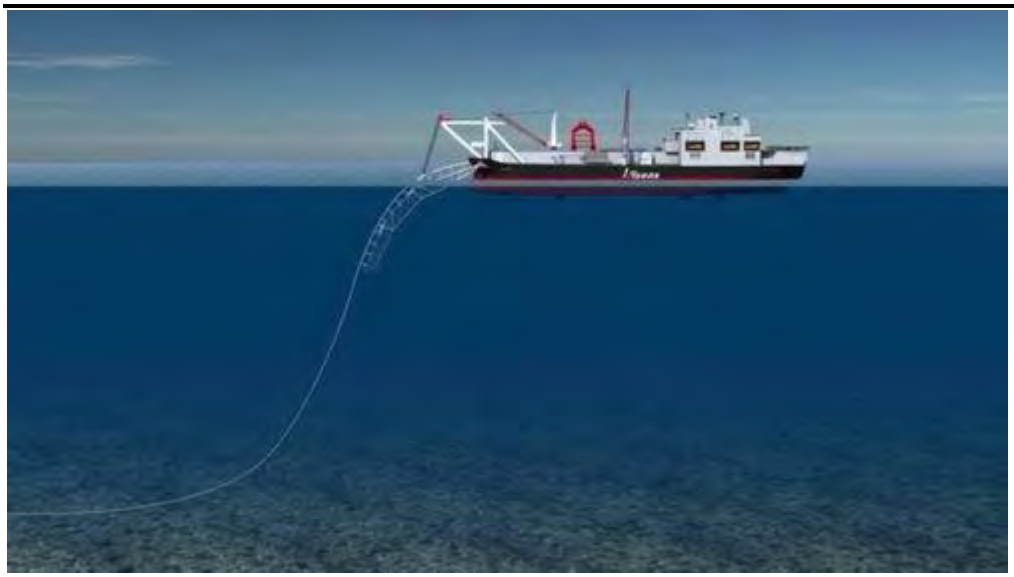
The preferred methodology (subject to nearshore geotechnical assessment) for the construction of the pipeline from the beach valve station to approximately 600 m offshore is using the Horizontal Directional Drilling (HDD) technique. HDD is a guided and trenchless method of installing underground infrastructure that will allow the pipeline to be installed beneath the beach and the immediate shoreline without surface exposure during construction.

The drilling mud and cuttings will be returned back through the hole to the beach valve station and the mud will be separated and reused and the cuttings disposed of in accordance with the Installation Construction EMP.

The rest of the offshore pipeline will be installed using a specialist pipelay barge. The most likely type of pipelay vessel is an anchored S-lay barge, as shown in *Figure 2.14*. Suitable barges are typically 120 to 150 m long, which includes a long support structure protruding from the vessel, called a stinger. The vessel will maintain correct position and speed using anchors. Pipeline sections are delivered to the pipelay barge in 12 m lengths by a separate barge.

The pipelay barge welds sections of pipe together and then applies a field joint coating over the bare steel as part of the corrosion protection system for the pipeline. As the pipeline gets longer the vessel, moves forward to progressively lay the pipe on the seabed. Following completion of the offshore pipelaying, the riser base will be installed at the pipeline spool tie in point. The installation techniques will be confirmed and discussed in the Project Description Chapter of the EIR.

Figure 2.14 Example of a Pipelay Barge for Offshore Pipeline Installation



Source: www.2b1stconsulting.com

FSO/ Turret Construction and Mechanical Completion

The construction and conversion of the FSO including hull fabrication, topsides fabrication, turret integration and shore based commissioning will be completed at a nominated Construction Yard.

The Turret will be fabricated separately at another facility and transported to a nominated yard for integration and commissioning. The Construction will ensure that completed works are tested and the required mechanical completion certification is in place before handing over the systems to the commissioning team.

Mechanical Completion (MC) requires that all construction and installation activities related, but not limited to equipment, piping, electrical services, instrumentation/control and utilities are physically complete and that inspection checks/tests have been performed to a level deemed satisfactory to Sasol. Additional construction works will take place in order to develop the marine supply base at the Port of Beira and the MSV.

Prevention of Access

For onshore construction activities the access to the existing construction camps will not change. However, access to the pipeline corridor during construction, notably at work fronts and open trenches, will be limited to ensure safety of the public. During construction, any impediment to access will be discussed with affected parties and alternative arrangements agreed upon with Sasol.

There will be a temporary 500 m safety exclusion zone around the installation and support vessels during installation of the offshore pipeline and subsea infrastructure including the moorings.

Ships, fishing vessels and other craft will not be allowed to access the safety exclusion zone during the advanced works and construction phases. This safety exclusion zone will be enforced by support vessels operating in the field.

2.7.3 Phase 3: Pre-Commissioning and Commissioning

FSO Quayside Commissioning and Sea Trials

The onshore (quayside) commissioning activities to be completed in the Conversion Yard prior to Sail away of the FSO will ensure that all systems required by Class are satisfactorily handed over to operations. Commissioning will also include a sea trial period for the FSO.

Once the systems are fully commissioned the FSO will be handed over to operations for the duration of the transportation to the installation location in Mozambique.

FSO Transport, Installation and Hook-Up

The FSO will depart from the tanker conversion facility (location to be confirmed) in full compliance with Class and Flag requirements (*Section 2.6.3*) and will be towed or be self-propelled to the FSO location.
Once the FSO arrives in the field, and a suitable weather window is available, a support vessel will pick up the pre-laid mooring lines from the seafloor and connect them to the TMS. After the last mooring line has been connected, the FSO will be classed as an installation. When fully installed, the FSO will be hooked-up to the subsea infrastructure, namely the umbilical and riser.

On completion of the FSO and subsea systems hook-up, both systems can be integrated and end to end commissioning, namely the introduction of hydrocarbons, can commence.

Pre-Commissioning and Commissioning of the Pipeline

Before normal pipeline operations can commence, the pipeline must be strength tested and prepared for the introduction of stabilised light oil. This will require the following steps:

- Initial pipeline cleaning;
- Filling the pipeline with water;
- Hydro-testing (strength testing the pipeline by pressurizing with water);
- Dewatering the pipeline; and
- Filling the pipeline with stabilised light oil (Commissioning).

The pipeline will be pigged to clean and check the pipeline quality is within acceptable limits. The pipeline will then be filled with water for hydro-testing. To fill the onshore section of pipeline, about 3 000 m^3 of freshwater will be required. Existing boreholes currently used by Sasol will be the preferred source and these may be supplemented with new wells if there is insufficient freshwater supply for the testing activities. Freshwater will be extracted at a low flowrate (approximately 0.03 m^3/s) before pumping into the pipeline. Approximately 3 000 m^3 of seawater will also be required for filling of the offshore pipeline, which will be drawn from the sea at the FSO location at a low flowrate and with the use of exclusion screens in order to minimise uptake of marine life. Once filled, the pipeline and subsea equipment will be hydro-tested in order to verify the pipeline's structural integrity and to check for leaks. The onshore and offshore sections of the pipeline will be hydro-tested separately.

The water used for testing the onshore and offshore pipeline sections will be filtered and treated with a package of chemicals designed to minimise corrosion of the pipeline.

The specific chemicals and additives to be used will be selected in accordance with internationally recognised classification systems with the intent to utilise those that are the least environmentally harmful.

Once the hydro-test has been completed for both sections of pipeline, the entire pipeline will be dewatered. Approximately 6 000m^3 of treated water will be discharged from the FSO over a period of around 24 hours. Dewatering will require pigging to displace the water from the pipeline, which will either be driven by compressed air or light oil (ie during pipeline commissioning).

Pipeline commissioning (hydrocarbon product filling) will not begin until the FSO is connected to the pipeline and the entire system is accepted as ready for

commissioning by Sasol. Pipeline commissioning will be performed by filling the pipeline with stabilised light oil from the LPF by displacing a pig first through the onshore pipeline and then the offshore pipeline to the FSO. The filling operation will be tracked by careful measurement of the volume of stabilised light oil introduced to the pipeline.

2.7.4 Phase 4: Operational Activities

Light Oil Storage and Export

The FSO will receive a continuous stream of incoming stabilised light oil from the onshore LPF. The FSO will be provided with an Inert Gas (IG) and venting system, the function of which is to maintain a non-explosive atmosphere at all times in the cargo storage, reception and slop tanks.

Tank venting on the FSO will occur during loading as the stabilised light oil cargo tanks are filled and the gas above the stabilised light oil is displaced. The composition of the vented gas will vary depending on the loading phase. At the beginning of tank filling, inert gas will be mostly vented, whilst a mixture of inert gas and hydrocarbon vapours (volatile organic compounds) will be vented as the tank fills. Most of the residual hydrocarbon vapours in the stabilised light oil will have already been removed via the stabilisation process at the onshore LPF.

A Volatile Organic Compounds (VOC) Management plan for the storage of stabilised light oil onboard the FSO will be developed in accordance with MARPOL Annex VI (Prevention of Air Pollution from Ships) with the objectives of minimising VOC emissions via effective control and maintenance procedures.

The cargo system onboard the FSO will be capable of independently isolating any tank for inspection, maintenance and repair without disrupting the use of any other tank for either loading or unloading.

Offloading Operations

Stabilised light oil stored on the FSO will be periodically offloaded through a double carcass offloading hose to a shuttle tanker positioned behind the FSO ie in tandem (*Figure 2.15*). Dual safety zones (*Figure 2.16*) will be applied during offloading operations with a 500 m safety exclusion zone enforced around both the FSO and the shuttle tanker.

Figure 2.15 Offloading from FSO to Shuttle Tanker

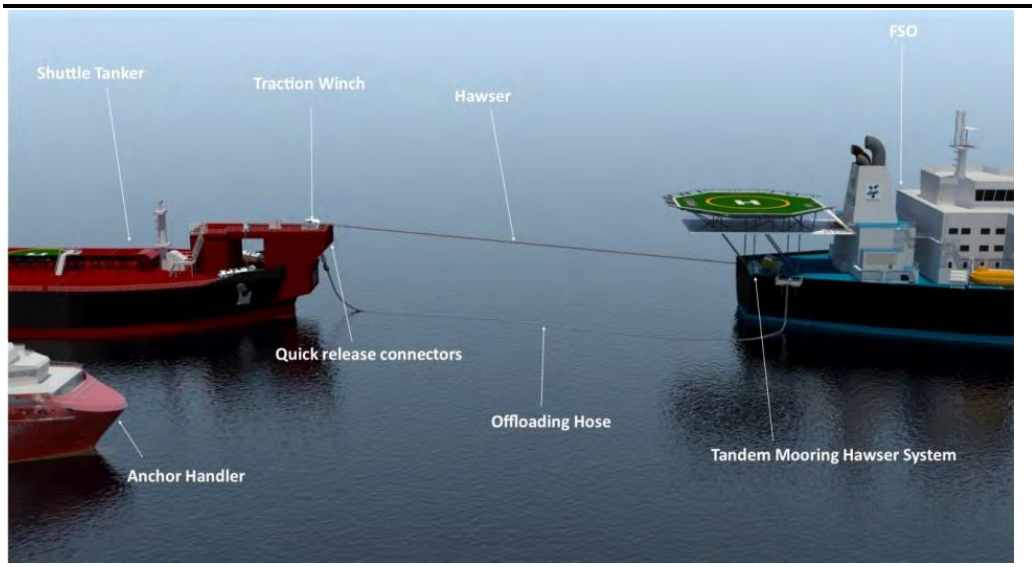
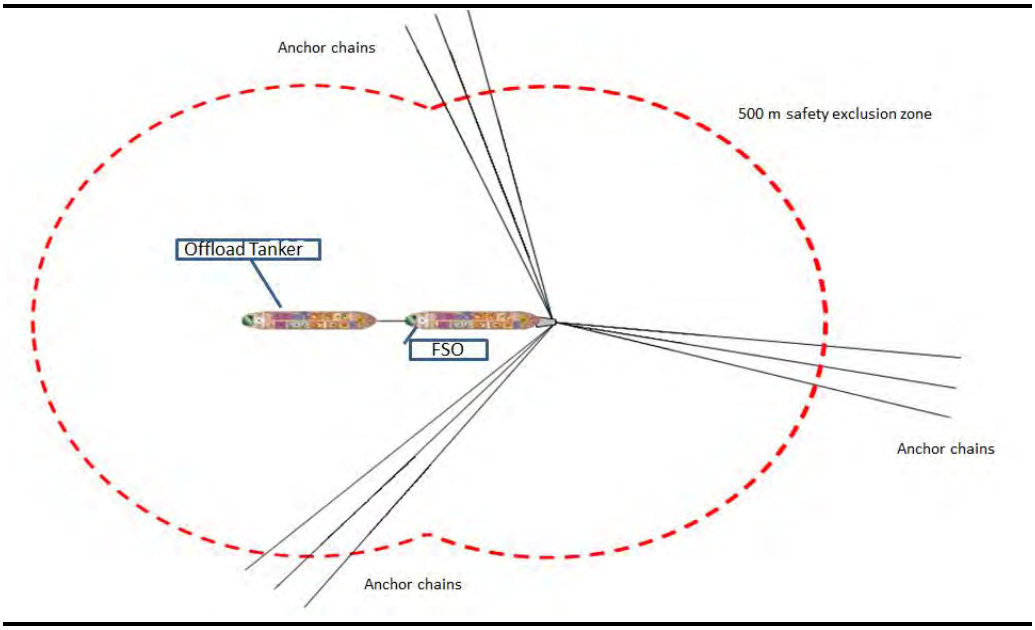


Figure 2.16 Schematic of the Dual Safety Exclusion Zone



Prior to contracts being awarded for export offloading, Sasol will undertake a full review of the suitability of the shuttle tankers for the safe transfer of light oil. Shuttle tankers will be required to conform with the Sasol Marine Assurance Plan (MAP) which will govern offloading requirements. Sasol will develop a MAP for offloading operations which will include the necessary provisions for crew training and competency, vessel maintenance and marine incident emergency response.

In order to be sure that personnel on board the FSO have the competence to carry out their duties, a Competency Assurance Management System (CMAS) will be developed by Sasol as part of the Operational Readiness and Assurance plan for the Project.

The capacity of the FSO export system will be designed to minimise the offloading time. Offloading of a complete cargo package of 300 000 bbls will typically be achieved within 24 hours, including connect and disconnect operations. Offloading of the FSO via shuttle tankers will be carried out every 20 to 28 days. The shuttle tankers mooring systems will be fitted with a Quick Release Hook (QRH).

The QRH assembly will be installed in accordance with Oil Companies International Marine Forum (OCIMF) guidelines, as part of the cargo handling system. The QRH will automatically disconnect if safe working loads are exceeded during cargo offloading.

The cargo system of the FSO will be designed and operated to minimize stabilised light oil spillages following any damage to the hull or cargo handling system. Pollution prevention measures include:

- FSO Double hull construction (ie with two complete layers of watertight hull surface in case the outer hull is damaged and leaks);
- Double carcass offloading hose fitted with a leak-proof, self-sealing breakaway coupling;
- Emergency shut off valve for the Cargo export system;
- Hose flushing into tanks onboard upon completion of offloading; and
- Hose maintenance and inspection procedures.

In addition, the support vessels and the FSO will have facilities for firefighting and spill response equipment, in line with class requirements, onboard in order to respond to operational spills resulting from minor leaks, dropped objects, transfer and storage of diesel fuel, and offloading activity incidents. There will also be an Emergency Shut Down (ESD) and Fire and Gas (F&G) detection system. The riser base will have an SSIV, which is a fail-safe system that enables the flow of stabilised light oil to the FSO to be stopped at the riser base by remote operation from the FSO

Power Generation and FSO Utilities

The main power generation on the FSO will be supplied by diesel generators fuelled by MGO (Marine Gas Oil). Precise specifications will be determined later during the detailed engineering design phase and further defined in the Project Description Chapter of the EIR.

The FSO will include the following marine and utility systems onboard:

- Air Systems (ie systems operated using compressed air);
- Heating, Ventilation and Air Conditioning (HVAC);

- Cooling water systems;
- Freshwater systems;
- Fuel systems;
- Ballast water treatment plant;
- Crude oil washing system for cleaning of cargo tanks;
- Drains systems equipped with oil discharge monitoring equipment; and
- Sewage treatment plant.

The utilities onboard the FSO will be dependent on the vessel that is selected and the capacity of the vessel to provide these utilities. More details about the utilities onboard will be provided in the EIR.

2.7.5 Phase 5: Decommissioning

Equipment and facilities will be decommissioned at the end of the economic life of the Project, which is expected to be 15 years from first stabilised light oil production.

Decommissioning offshore will involve making safe the FSO, offshore pipeline and associated facilities and the removal all the infrastructure except the pipeline. The subsea infrastructure design will allow for removal of subsea architecture in line with international best practice and national legislation, for subsequent possible re-use and recycling onshore. Umbilical and risers will be recovered and disposed of onshore using normal Sasol waste management procedures, prepared as part of the overall Decommissioning Plan, for potentially oil-contaminated equipment.

The FSO will be disconnected from the moorings which will be laid down on the seabed. The FSO will then be towed from its on-station position to a nominated yard. The mooring lines and anchors will be recovered, in much the same way as they were installed. The mooring lines and anchors will be disposed of onshore using normal Sasol waste management procedures. The overall decommissioning strategy for the FSO and Mooring is to ensure minimal permanent impact on the marine environment and other sea users.

Decommissioning onshore would involve making safe all the onshore facilities together with the removal of above ground infrastructure that will no longer be used. The restoration of the onshore pipeline route and ROW will be conducted in accordance with the license and the regulatory requirements.

The overall decommissioning strategy for the Project is to ensure minimal impact on the onshore and offshore environment and other users of the Project Area. Therefore, removal will be performed in such a way as to prevent any significant adverse effects. A framework Decommissioning and Rehabilitation Plan (DRP) will be developed during the EIA Phase and reviewed and updated two years prior to the end of the life of the Project. Decommissioning will be conducted to meet, as a minimum, the regulatory requirements in place at that time.

A DRP is a requirement of Mozambique National legislation (Petroleum Law 21/2014) and best international practice, and is intended to ensure that companies that operate large industrial facilities identify and make sufficient provision for the closure costs of the facility.

2.7.6 Emissions, Discharges and Wastes

Air Emissions

The emissions generated during the advanced works and construction phases will be mainly related to dust as a result of bush clearing and the emissions from the construction vehicles along the pipeline route. During the operational phase there will be no venting from the pipeline. The emissions during the operational phase will be limited to those associated with the export pumps, situated at the LPF, and the loading and offloading of the FSO. The latter emissions will be as a result of power generation, venting of inert gas from the FSO tanks and waste incineration.
These emissions will include carbon monoxide (CO), oxides of nitrogen (NOx) and sulphur (SOx), volatile organic compounds (VOCs) and particulate matter.

Noise

The Project's onshore construction activities and equipment will increase the noise in the local area during the advanced works, construction and operational phases. During commissioning and operation some noise will be produced by the export pumps located at the LPF.

The FSO, installation vessels, shuttle tankers and support vessels will introduce sound into the marine environment whilst they mobilise to site and while they are keeping on station using dynamic positioning. Vessel noise is primarily attributed to propeller cavitation and propulsion engines (ie noise transmitted through the vessel hull).

Dynamic positioning (DP) - is a computer-controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters.

Increased Traffic

There will be increased construction vehicle activity onshore, due to material supply and delivery from Beira and Maputo. Approximately 200 truckloads will be required over a period of nine months. Traffic management measures will be developed and included in an amended Infrastructure Construction EMP.

The construction, installation, commissioning and support vessels will increase the offshore vessel traffic from the Port of Beira to the offshore pipeline corridor and FSO location.

Light

The FSO will be lit for safety and operational purposes at all times and will have similar lighting to that of a tanker. The FSO site has been selected in order to minimise the risk of lighting impacts on the nearest islands and mainland and that this will be verified during the EIA Process.

Disposal of Solid Waste

There will be both hazardous and non-hazardous solid wastes generated during all the phases of the Project, both onshore and offshore. All waste management will be carried out in accordance with the requirements of Mozambique legislation including the Regulations on Solid Waste Management (*Decree 13/2005*). Onshore and offshore construction wastes will be managed by the construction contractors. Onshore construction wastes will be managed in accordance with the existing Infrastructure Construction – EMP. During the EIA Phase a new offshore waste management section will be added to the existing Infrastructure Construction – EMP.
During the operational phase, most of the waste will be generated by the operation of the FSO. These wastes will either be incinerated or shipped back to the marine supply base where they will be reused or recycled, where possible, or disposed of by licensed local waste contractors. The types of wastes that will be generated and potential disposal methods are not yet confirmed.

However, typical waste types and potential disposal methods based on industrial good practice are provided in *Table 2.5*.

Table 2.5: Typical Waste Types and Potential Disposal Routes

Type	**Potential Disposal Method**
Hazardous	
Paints, adhesives, solvents	Incineration - typically partially used tins to be dried out and then incinerated. Metal tins may be recovered and recycled.
Empty drums containing hazardous residues	Other - typically drums are decontaminated at an approved facility, then sent for recycling
Lubricants, engine oil, hydraulic oil, crude oil	Recycling or Incineration
Transformers, capacitors, batteries, aerosols, contaminated filters, oily rags, refrigerants, absorbents	Recycling / incineration/ other -items such as batteries and capacitors should be sent to specialist recycling facilities.
Sludge's / Liquids / Tank Washings: Oil spills, heavy metals, tank washings, pig wax	Recycling or Incineration
Non-Hazardous	
Non-hazardous fluids	Landfill
Empty metal / plastic drums, dried paint cans	Recycling/ landfill
Scrap metal, wire rope, uncontaminated pipe, electric cable	Recycling/ landfill
Aluminium cans, cardboard, paper, wood, rubber, plastics, glass, fluorescent tubes, cooking oil	Recycling/ landfill
Galley waste, accommodation waste, compactor waste	Incineration/ landfill
Non-hazardous tank washings	Incineration

Source: extracted from LMC, 2016

Disposal of Waste Water Onshore

Portable toilets and existing camp facilities will be used to provide ablution facilities for the onshore construction activities. Storm water will be managed at the existing camps in-line with their existing management plans.

Disposal of Waste Water Offshore

The operation of the installation, construction and support vessels will result in routine discharges to sea (ie, sewage, grey water, food waste, bilge water, ballast water and deck drainage).

One-off discharges to sea includes the estimated 6 000 m^3 of hydro-test water from the onshore and offshore pipeline; potentially containing dye, oxygen scavenger and corrosion inhibitor. When pipelines and risers are dewatered (ie flushed) after pressure testing and treatment, these fluids will be pumped through the pipeline to the FSO for overboard discharge.

Routine Project discharges will typically include the following: sewage, grey water, food waste, deck drainage, bilge water, ballast water, brine, and cooling water. Anticipated discharge volumes and treatment methods will be assessed during the EIA process. Discharge streams would be treated to required national and international standards (eg MARPOL 73/78) prior to discharge.

2.7.7 Fresh Water Use

The water for construction personnel and construction activities is likely to be provided by using the existing Sasol groundwater wells near the CPF and the PSA Development well pads, if possible. Prior to construction, Sasol will verify the volume of water required and potential availability from existing boreholes, aquifers and additional sources that may be required.

Bottled drinking water will be provided to the crew on the FSO and all other vessels. All other water required for the supply vessels will be provided by a local water source to be confirmed in the EIR.

2.7.8 Labour, Equipment and Service Supply

Qualified personnel will be required to support both onshore and offshore activities including but not limited to:

- Advanced works and construction activities;
- Marine supply base;
- Camps;
- Logistics operations (eg. land transportation, aviation, marine/quayside operations, material handling, loading and transport);
- FSO operations;
- Installation vessel operations; and
- Support vessels

Personnel requirements will be met via a combination of direct staff employment, third party contractors and consultants as well as third party service providers.

Where qualified Mozambican personnel are available for employment to support Sasol's operations, whether staffed directly or via third party, Sasol will ensure opportunities are provided for their employment as far as reasonably possible.

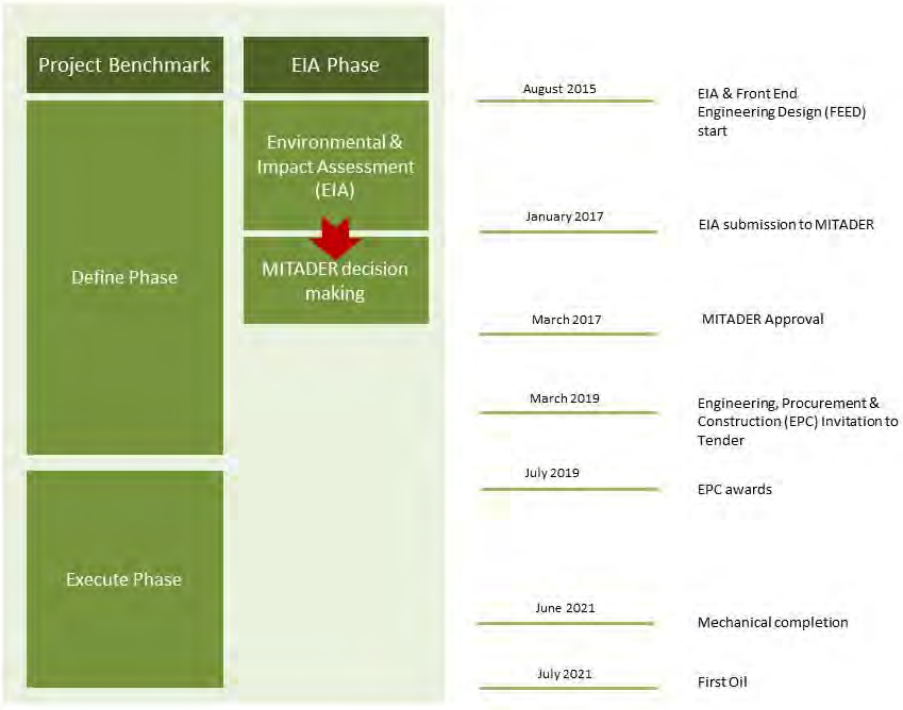
Direct (Sasol employees) and indirect (contracted services) employment requirements will change with each phase of the Project through to production operations.

Attracting, developing and retaining qualified, high-performing professionals will be a key objective. Sasol will continue to promote local labour employment opportunities via the existing Community Liaison Forum (CLF) in Inhassoro and Govuro (Pande). The CLF comprises Sasol, the local governments of Inhassoro and Govuro, and Community Leaders representing around 32 individual communities across both areas.

2.7.9 Project Activities and Schedule

The Project is planned to start in the third quarter of 2019, and be ready for operation in the third quarter of 2021 (*Figure 2.17)*.

Figure 2.17: The Preliminary Project Schedule



2.8 *EMERGENCY RESPONSE PROCEDURES*

Sasol has an existing Emergency Response Plan for all activities in Temane, which will be reviewed and updated during the EIA Phase to include this Project's activities.

The objectives of the emergency response plan are to ensure that all emergencies consider:

- The safety of all SPT and service provider personnel;
- The safety of the CPF;
- The protection of the environment ; and
- The rapid assessment and containment of the emergency.

Sasol has also developed a Tactical Response Plan (TRP), together with the Oil Spill Contingency Plan (OSCP), for the producing assets of the Temane, Pande and Inhassoro fields. These plans will also be reviewed and updated to include this Project's activities.

2.9 *COMPENSATION PROCEDURES*

Sasol has adopted and implemented World Bank Group policies and procedures for compensation and has an existing compensation procedure for both onshore and offshore activities in the region which will be updated to include this Project. Within the framework provided by the policy, procedure and directive, Sasol adopted the following objectives:

- Avoidance of impacts to people and their assets wherever feasible through integrated and iterative planning;

- Where impacts to people and their assets are unavoidable:
  - To minimize the scope and magnitude of the impacts;
  - To treat all affected parties with respect, dignity and fairness;
  - To pay affected parties fair and equitable compensation to the extent that they are affected by project activities;
  - To assist affected parties to adapt to their new environment; and
  - To monitor the effects of project impacts for a period after project completion and to take the necessary actions to address issues that may arise.

Sasol has a comprehensive socio-economic development programme which is centrally managed and operated in terms of which all Sasol's socio-economic development programmes are conducted and, therefore, it does not form part of the compensation procedure.

Sasol has undertaken to route the onshore pipeline so as to minimise the need for economic displacement and resettlement. Sasol will monitor damage to or loss of property or agriculture prior to, during and after key activities and map this against documented data and confirm trends.

Where a potential link is identified between Sasol's activities and damage to or loss of property or agriculture, then claims for compensation will be assessed.

Sasol will monitor fish catch via the Fisheries Development Institute (IDPPE) and map this against documented data and confirm trends. Where a potential link is identified between Sasol's activities and a drop in fish catch, claims for compensation will then be assessed.

Sasol will monitor tourism activities within the Project Area and map this against documented data and confirm trends. Where a potential link is identified between Sasol's activities and a drop in tourism activity, claims for compensation will then be assessed.

3 LEGAL FRAMEWORK AND BEST PRACTICE STANDARDS

3.1 INTRODUCTION

This Chapter details the legislative framework for the EIA process associated with the proposed *Sasol Pipeline and FSO Project*. National (Mozambican) laws deemed relevant for the successful implementation of all components of the Project are presented in this Chapter. Furthermore, Sasol has committed to comply with international guidelines and standards (the Equator Principles, World Bank Group Operational Policies and the International Finance Corporation Performance Standards) where these are more rigorous or detailed than Mozambican National standards or where Mozambique standards do not exist.

3.2 NATIONAL ENVIRONMENTAL LEGISLATION

Environmental management in its entirety, with the EIA process in particular, is regulated by a number of national laws and regulations. These are discussed in the following Section.

3.2.1 *The Constitution of Mozambique*

The Constitution is the supreme law of the land and any act or conduct that is inconsistent with the principles enshrined within the Constitution is considered unlawful. The Constitution provides for the protection of the natural environment and other socio-economic rights under the following articles:

"Article 117 (1): The state shall promote efforts to guarantee the ecological balance and the conservation and preservation of the environment for the betterment of the quality of life of its citizens."

"Article 111: In granting titles for the use and enjoyment of land, the State shall recognize and protect rights acquired through inheritance or occupation, unless there is a legal reservation or the land has been legally attributed to another person or entity."

"Article 112(2): The State shall promote the just distribution of the proceeds of labour."

"Article 90 (1): All citizens shall have the right to live in, and the duty to defend, a balanced natural environment."

3.2.2 The Environmental Law

The *Environmental Law (Decree No 20/1997 of 1 October)* was passed by the Mozambican Parliament in July 1997. The aim of this law is to provide a legal framework for the use and correct management of the environment and its components. Core principles for environmental management in Mozambique include:

- Citizen's quality of life improvement and protection of the country's biodiversity and ecosystems.
- Recognition and valuing of local communities' traditions and knowledge.
- Polluters responsible for environmental degradation will be liable for rehabilitation measures or compensation costs.
- Prohibition of the discharge of any polluting substances into the soil, subsoil, water or atmosphere or any other form of degradation of the environment, which falls outside the limits stipulated by law.
- Prohibition of the importation of dangerous residues or dangerous waste, except as provided for in specific legislation.
- Prioritization of preventative systems against environmental degradation.

With their focus on the EIA process, *Articles 15 to 17* establish that any activity, which by virtue of its location, design or scale, may cause significant environmental impacts will require an Environmental License from the designated authorities. The authorities will only issue a license, in terms of the final decision, based on the findings of an EIA process.

3.2.3 Regulation on the Environmental Impact Assessment Process

The *Regulation on the Environmental Impact Assessment Process approved by Decree No 45/2004 of 29 September* as amended by *Decree No 42/2008 of 4 November*, defines the procedures that must be followed in an EIA process.

Under Article 2, the requirement of this *Decree* applies to all public or private activities which can, directly or indirectly, influence the environment, in accordance with the terms of Article 3 of the Environmental Law.

Under Article 3, the Project must be assessed against activity category lists (Category A, B and C projects) and additional environmental criteria as defined under Articles 6, 7 and 8 to determine the EIA process requirements. The Project has been classified as a '*Category A Project*' by the *Ministry of Land, Environment and Rural Development* (MITADER) and thus will be subject to the development of a full Environmental Impact Report (EIR).

Note: New Regulations governing the Environmental Impact Assessment process in Mozambique have been published in *Decree No 54/2015*, which took effect on 30 March 2016. However, the Sasol Pipeline and FSO Project was registered under Decree *No 45/2004* and will be conducted in accordance with the requirements of this legislation. The applicability of the new requirements on an on-going Project will be discussed with MITADER as part of the submission of this EPDA.

3.2.4 Amendments to the Regulations for the Environmental Impact Assessment Process

The *Amendments to the Regulations for the Environmental Impact Assessment Process (Decree 42/2008 of 4 November)* provide for revisions and changes to certain Articles of *Decree No 45/2004*. The following amendments are of potential significance to this Project:

- Amendment to Article 18 which specifies the timeframes for issuing decisions including the additional provision of timeframes in the review of EMPs.
- Amendments to Article 20 with respect to validity of environmental licenses, and specifically the requirements in terms of renewal of licenses.
- Amendments to Article 25 with respect to an increase in environmental licensing taxes, and taxes related to changes in licenses.

3.2.5 General Directive for Environmental Impact Studies

The *General Directive for Environmental Impact Studies (Ministerial Diploma 126/2006 of 19 July)* establishes the content and information requirements for an EIR. The directive also establishes the minimum requirements of the EIR with respect to information and report structure.

3.2.6 General Directive for the Public Participation Process in the Environmental Impact Assessment Process

The *General Directive for the Public Participation Process in the Environmental Impact Assessment Process (Ministerial Diploma 130/2006 of 19 July)* expands on the procedural requirements for the public participation process, as established in the EIA regulations. This directive establishes the norms and general principles that need to be met in undertaking the public participation process.

3.2.7 Specific Legislation

ERM will also take into consideration the following legislation:

- *Decree 56/2010 – Environmental Regulation for Petroleum Operations* - Sets the EIA process to be implemented for petroleum operations. Defines the project activity categories and the environmental assessment level required for each category.

- *Law 21/2014 – Petroleum Law* – Establishes the system of allocation of rights to conduct petroleum operations and decommissioning in the country and includes aspects relating to Safety and Environmental Protection and the discharge of contaminated water and oil residues.

- *Decree 34/2015 – Regulation for Petroleum Operations* - establishes the operational requirements, including aspects related to safety, health and environmental protection and provides a list of environmental issues to consider while conducting petroleum operations.

3.3 SUPPORTING LEGISLATION RELEVANT TO THE PROJECT

In addition to the primary legislation discussed earlier in this Chapter, supplementary environmental legislation and other relevant legislation are provided in *Table 3.1*:

Table 3.1 List of Supplementary Environmental Legislation and Other Relevant Legislation

Sectors	Law/Decree	Title	Description
ENVIRONMENTAL	*Law 10/99* of 7 July	Law of Forestry and Wildlife	Establishes the principles with respect to the formalisation of protected areas and the management of forestry and wildlife resources. Article 13 establishes the need for protection of places of historical and cultural value to the local communities.
	Decree 12/2002 of 6 June amended by *Decree 11 / 2003* of 25 March	Forestry and Wildlife Regulation	Establishes additional regulations in support of the Forestry and Wildlife Law. This regulation provides the guiding principles associated with the management, protection, use and exploitation of forest and wildlife resources.
	Law 16/2014 of 20 June	Biodiversity Conservation Law	Established basic principles and rules on the protection, conservation, restoration and sustainable use of biological diversity in conservation areas, as well as the framework for the integrated management for sustainable development for the country.
	Decree 25/2011 of 15 June	Regulation on the Process of Environmental Auditing	This Regulation defines environmental auditing as a management tool for the systematic, documented and objective evaluation of the operation and organization of the management system and the environmental protection and control processes.
	Decree 18/2004 of 2 June amended by *Decree 67/2010* of 31 December	Regulation on Environmental Quality Standards and Wastewater Emissions	Regulates and ensures effective control and monitoring on the quality of the environment and natural resources. It establishes specific standards and regulations on water quality, atmospheric emissions and noise. These regulations will be of relevance during the construction phase of the Project and with regard to fuel storage during operations.
	Decree 11/2006 of 15 June	Regulation on Environmental Inspections	Regulates the activities associated with supervision, control and compliance with environmental protection standards at national level.
	Decree 83/2014 of 31 December	Regulation on Hazardous Waste	Establishes the legal framework for hazardous waste management in Mozambique so as to minimise negative impacts on social health and the environment.
	Decree 94/2014 of 31 December	Regulation on Urban Solid Waste Management	Establishes the legal framework for urban solid waste management in Mozambique so as to minimise negative impacts on social health and the environment. This regulation sets out rules for classification of solid waste, the forms of waste segregation, waste collection and transport, waste treatment and waste disposal.

Sectors	Law/Decree	Title	Description
WATER	*Law 16/1991* of 3 August	The Water Law	Establishes the basis for management of water resources and advocates a "user pays" and "polluter pays" policy. This law stipulates, for cases of private water use, that full priority shall be given to water supply to the population (human consumption and heath care needs). Furthermore, it prohibits the private use of water where the provision of such water use will be to the detriment of the environment. Article 18 appoints the Regional Water Administrations as the institutions responsible for the management of surface and underground water resources and assigns management, control and planning competences including approval of bulk water construction works. In this context, the Regional Water Administration of (referred to as ARA-Sul) was created for the management of the River Basin within Mozambique boundaries. Articles 25 and 26 that details private water use and priorities. In the case of private water use, the law stipulates, through Article 26, that water supply must be prioritised for human consumption and fulfilment of sanitary requirements. Furthermore, it mentions that private water use that jeopardises water demands for environmental protection is prohibited. It should be noted that the rights for private water use can be obtained through the provision of a license in the terms of the law and its regulations (Article 25). This includes works with a non-permanent character that do not alter riverbeds or banks, lakes, lagoons or swamps (Article 32).
LAND RIGHTS/ACQUISITION	*Law 19/1997* of 1 October	The Land Law	Establishes as a general principle that, in Mozambique, land is the property of the state. The Land Law and associated regulations establishes land use rights and the means by which individuals or companies may obtain the rights to use land (referred to as DUAT). In addition, other provisions that merit special attention considering the context of the Project for which this law provides legal guidance includes: • The impacts of the Project existing DUATs; • Impacts on zoning and land use planning for social and economic purposes; and • Impacts on agriculture; and • Impacts on public health due to ecological changes.

Sectors	Law/Decree	Title	Description
	Decree 66/98 of 8 December amended by *Decree 1/2003* of 18 November and *Decree 43/2010* of 20 of October	Land Law Regulation	Provides regulations with respect to the Land Law, 19/1997 of 1 October. The regulation presents a series of provisions related to public owned land, land use rights, land title application process, inspection and taxes. Of relevance to the Project would be the provisions included in Article 17, which determines the liability for damages and / or compensation to the land use holder of land intended for other use by a public or private investor. The land law outlines the procedures to be followed during application and acquisition of land use rights (DUAT) and establishes the obligation for payment of land taxes. Articles 22 introduces the procedures for land acquisition and the competent authorities that need to be involved.
	Ministerial Diploma no 29/2000 – A of 17 March	Technical Annex to the Land Law Regulation	Defines the approach and implementation mechanisms associated with the title application process. Furthermore, the technical annex makes provision concerning the rights and duties of the local communities.
TERRITORIAL PLANNING	*Decree 19 of 2007* of 18 July	Territorial Planning Law	Establishes the principles, objectives and legal framework for land planning in Mozambique. This regulation outlines the measures and regulatory procedures required in improving living standards for the people of Mozambique and to sustainable development.
RESETTLEMENT	*Decree 31/2012* of 8 August	Regulations for the Resettlement Process Resulting from Economic Activities	These regulations stipulate the basic rules and principles associated with resettlement, as a result of public or private economic activities, performed by national or foreign, natural or legal persons, with a view to the promotion of the citizens' quality of life and the protection of the environment.
	Ministerial Resolution No. 156/2014	Technical Directive on the Resettlement Plans Preparation and Implementation Process	The Directive aids in: ensuring and verifying compliance with the goals included in resettlement and action plans; assessing the level of satisfaction of the needs of the resettled persons; and Technically assessing and validating the information received from the plan implementation process.

Sectors	Law/Decree	Title	Description
MARINE	*Decree 45/2006* of 30 November	Regulation for Prevention of Pollution on the Marine and Coastal Environment	Provide for the regulation of the marine and coastal environment. Article 5 stipulates that every harbour, harbour installation, platform, emitting installation along the coast as well as its support installations must as an obligation have adequate installations or means for the collection and treatment of the several types of residues and for combatting pollution. Furthermore, the decree stipulates that the discharge in waters of national jurisdiction of harmful or dangerous substances - that in terms of the international norms and of the regulation in force on management of residues, represent a high risk both for human health and aquatic ecosystems, including those temporarily classified as such, such as ballast water, residues from tank washing or other mixtures that contain such substances - is prohibited.
	Law 4/1996 of 4 January	Sea Law	This Law defines the legal context of jurisdictional rights regarding ocean situated along the Mozambique coastline and contains provisions regarding the normative bases for regulating the administration and maritime activities of the country, and it establishes sovereignty rights of the State for purposes of exploration and enjoyment of its natural resources.
	Decree No. 43/2003 of 10 December	General Regulation on Maritime Fishing (REPMAR)	The Minister of Fisheries, based on the comments from the administration of commission of fisheries, will determine the list of aquatic species subject to special protection regime, total or partial, and particular applicable conditions.
	Decree 35/2007 of 14 August	Regulation on Maritime Commercial Transport	Regulates marine transport and related activities in Mozambique. Requires an authorization (issued by the Director General of INAMAR) to perform any maritime commercial activities (it applies also for passengers and cargo) led by vessels within the waters under the Mozambican jurisdiction.
LABOUR	*Law 23/2007* of 1 August	Labour Law	Defines aspects related to the hiring of workers, the rights and responsibilities of workers, including hygiene and health and safety. The law also discusses the labour relations between employers and workers and the laws in terms of national and foreign workers.
CULTURE	*Law 10/1988* of 22 December as amended by *Law 13/2009* of 25 February	Cultural Protection Law	Establishes the legal protection for material and immaterial assets associated with Mozambican cultural heritage (existing or yet to be discovered). With focus on the Project, Article 13 stipulates the need to communicate any findings of buildings, objects or documents that may potentially be classified as assets of cultural heritage.

Sectors	Law/Decree	Title	Description
	Decree 27/1994 of 20 July	Archaeological Heritage Protection Regulation	Establishes the rights and protection of resources that have archaeological and historical value. Article 21 of this regulation prohibits the execution of construction and demolition or any other works that may result in physical changes to the protection zones of archaeological property of high scientific value or that are important to preserve for the future generations. This regulation establishes, *inter alia* that the finding of artefacts shall be reported to the local authorities (District Administration or Municipal Council) within a period of 48 hours.

3.4 CONVENTIONS AND RESOLUTIONS

Mozambique is signatory to a number of international conventions and agreements relating to environmental management and energy, and in certain cases these have influenced the development of policies, guidelines and regulations. The EIA process will need to consider these conventions and agreements and ensure compliance as applicable during the planning, construction and operational phases of the Project.

Mozambique is a signatory to the following international conventions and protocols, which are of relevance to the Project and will be considered in the EIA Phase:

Table 3.2 List of Conventions and Resolutions

Name
Environment: General
Convention on the Conservation of Migratory Species of Wild Animals
Convention on Wetlands of International Importance especially the Water Fowl Habitats of Aquatic Birds (Ramsar Convention) (1975)
United Nations Convention on Biological Diversity (CBD)(1992)
Convention on Tropical Areas of International Importance which serve as Habitats for Aquatic Birds Resolution 45/2003 of 05 November
African Convention of Nature and Natural Resource Conservation Resolution 18/81 of 30 December
Environment: Climate Change
Vienna Convention for the Protection of the Ozone Layer (1985)
Montreal Protocol to Protect the Ozone Layer (including 1990 and 1999 amendments) (1987)
United Nations Framework Convention on Climate Change (UNFCCC) and the 1992 and 1997 Kyoto Protocol (1992 and 1997)
Hazardous Substances
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)
Stockholm Convention on Persistent Organic Pollutants (2002)
Waste
Convention on the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako Convention) (1991)
The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)
Heritage
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)
Marine
United Nations Convention on the Law of the Sea of 10 December 1982
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL73/78), Annexes I-V (Mozambique is not signatory to Annexure VI)
International Convention and Protocol on Civil Responsibility for Hydrocarbon Pollution Resolution 52/2001 of 6 November
International Convention for the Safety of Life at Sea (SOLAS), 1974
Load Lines Convention 66
Tonnage Convention 69
Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

Name
International Convention on Maritime Search and Rescue (SAR)79
International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC) (1990)
Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)
Bunkers Convention 01
East Africa Marine Protection, Management and Development Convention 17/96 of 26 November
Labour
Abolition of Forced Labour Convention, 1957 (No. 105)
Minimum Age Convention, 1973 (No. 138)
Worst Forms of Child Labour Convention, 1999 (No. 182)
Human Rights
Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
International Convention on the Elimination of All Forms of Racial Discrimination :1969
Convention on the Elimination of All Forms of Discrimination against Women :1981 (CEDAW)
Convention on the Rights of the Child :1990
International Convention on the Protection of the Rights of All Migrant Workers and Members of their Families :2003
Convention on the Rights of Persons with Disabilities :2008 (ICRPD)

3.5 *INTERNATIONAL GUIDELINES AND STANDARDS*

The aim of following international guidelines and standards is to ensure all issues are considered and managed in line with international good practice. This section describes the most relevant international guidelines and standards that aim to ensure that all environmental and social issues are considered and managed in line with international good practice. Sasol is committed to best oil industry practice. Where standards and guidelines are absent in Mozambique law, or are less stringent than equivalent industry guidelines, Sasol will, wherever possible, comply with the more stringent industry guideline.

3.5.1 *The Equator Principles*

Sasol is committed to conformance with the Equator Principles and IFC Performance Standards throughout in its Mozambique activities, whether or not any lending institutions are involved (such as the IFC). The Equator Principles (EPs) are a risk management framework which has been adopted by financial institutions for determining, assessing and managing environmental and social risks in projects. They are primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. Equator Principle Financial Institutions (EPFIs) commit to implementing the EPs in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the EPs. In order to facilitate potential access to funding for project development, potential borrowing organisations need to consider the EPs as well as the environmental and social risk management as part of the EIA process.

These EPs, shown in *Box 3.1* (please note that EPs highlighted in **bold** are relevant to the EIA Phase of the Project), require that projects conduct an EIA process in compliance with the IFC Performance Standards (PS) on Environmental and Social Sustainability (IFC PSs). The requirements of the IFC PSs are discussed in *Section 2.4.3.*

Box 3.1 The Equator Principles

1. Review and categorisation
2. Social and environmental assessment
3. Applicable environmental and social standards
4. Environmental and Social Management System and Equator Principles Action Plan
5. Stakeholder Engagement
6. Grievance mechanism
7. Independent review
8. Covenants
9. Independent monitoring and reporting
10. Reporting and Transparency

3.5.2 World Bank Group Operational Policies

World Bank funded projects and activities are governed by Operational Policies designed to ensure that the projects are economically, financially, socially and environmentally sound. For projects that are not seeking financing from the World Bank their policies and procedures serve as relevant standards for international good practice.

The World Bank has ten environmental and social Safeguard Policies that are used to examine the potential environmental and social risks and benefits associated with World Bank lending operations. These safeguard policies include the following (please note that the safeguard policies in **bold** are potentially relevant to the Project):

1. **Environmental Assessment;**
2. **Natural Habitats;**
3. Forestry;
4. Pest Management;
5. **Cultural Property;**
6. Revised Draft Operational Policy 4.10: Indigenous People (replaces operational Directive 4.20 on Indigenous Peoples);
7. **Involuntary Resettlement** (economic and physical displacement);
8. Safety of Dams;
9. Projects in International Waters; and
10. Projects in Disputed Areas.

3.5.3 The International Finance Corporation

IFC Performance Standards

The International Finance Corporation (IFC), a division of the World Bank Group that lends to private investors, has released a Sustainability Policy and a set of Performance Standards on Social and Environmental Sustainability (January 2012).

These Standards replace the prior safeguard policies and are used to evaluate any project seeking funding through the IFC. It should be noted, that even for projects that do not anticipate seeking financing from the IFC, the IFC Performance Standards are typically applied as a benchmark of international good practice.

These standards also include stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of direct investments (including project and corporate finance provided through financial intermediaries), the IFC requires that its clients apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced (IFC, 2012).

The IFC Performance Standards are outlined in *Box 3.2* below (please note that standards highlighted in **bold** are considered relevant to the Project).

Box 3.2 International Finance Corporation (IFC) Performance Standards

Performance Standards:

- **PS 1: Assessment and Management of Environmental and Social Risks and Impacts.**
- **PS 2. Labour and Working Conditions**
- **PS 3. Resources Efficiency and Pollution Prevention**
- **PS 4. Community, Health, Safety and Security**
- **PS 5. Land Acquisition and Involuntary Resettlement**
- **PS 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources**
- PS 7. Indigenous Peoples
- **PS 8. Cultural Heritage**

IFC Environmental, Health and Safety Guidelines

The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. The EHS Guidelines contain the performance levels and measures that are normally acceptable to the IFC and World Bank, and measures that are generally considered to be achievable in new facilities at reasonable costs by existing technology. This information supports actions aimed at avoiding, minimising and controlling EHS impacts during the construction, operation, and decommissioning phases of a project or facility.

When host country (eg: Mozambique) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in the view of specific project circumstances, a full and detailed justification for any proposed alternatives is required. General EHS Guidelines exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to this Project. These are listed in *Box 3.3*.

Box 3.3 IFC General EHS Guidelines

General EHS Guidelines
1. Environmental
1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise
1.8 Contaminated Land
2. Occupational Health and Safety
2.1 General Facility Design and Operation
2.2 Communication and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazard Environments
2.9 Monitoring
3. Community Health and Safety
3.1 Water Quality and Availability
3.2 Structural Safety of Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response
4. Construction and Decommissioning
4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety

In addition to the General EHS Guidelines, sector-specific guidelines have also been developed. Sector specific guidelines deemed applicable to the Project will be considered in the EIA process. The Guidelines of relevance to the Project and the EIA process are:

- Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development, 2007.

- Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development, 2007.

4 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

4.1 INTRODUCTION

This Chapter provides a summary of the EIA process that is being followed for the *Sasol Pipeline and FSO Project*. The process is structured in compliance with the regulatory requirements established in the *Environmental Impact Assessment Regulations approved by Decree No 45/2004 of 29 September* [1]as amended by *Decree No 42/2008 of 4 November* (refer to *Chapter 3* of this document) and *Decree 56/2010 – Environmental Regulation for Petroleum Operations*. The process also takes into account the requirements established in the IFC performance standards which Sasol is committed to.

The overall aim of the EIA is to identify and assess potential environmental and social impacts associated with the phases of the proposed Project, in order to support a decision by MITADER. The EIA process is divided into three distinct stages, namely:

1. **EIA Pre-assessment Application (Screening)** : The proposed project is screened against applicable environmental laws and regulations to determine category of assessment that must be undertaken.

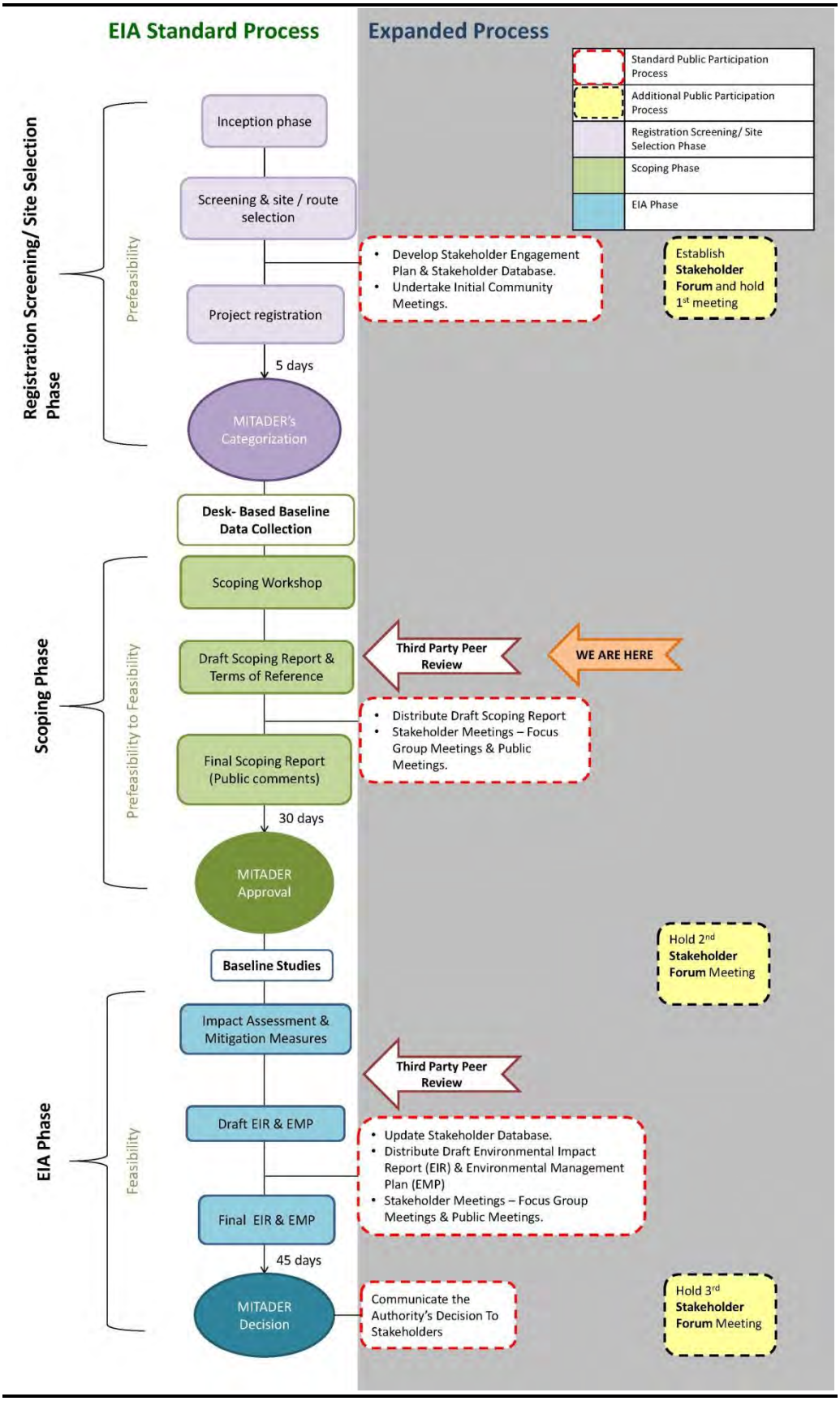
2. **Environmental Pre-Feasibility and Scoping (Scoping): Where projects are categorized as Category A, s**coping is undertaken to identify *potential* impacts, carry out preliminary engagement with interested and affected parties (who may assist in determining the potential impacts) and define the Terms of Reference (ToR) for the EIR.

3. **Environmental Impact Assessment:** The EIA stage comprises a number of steps that collectively assess the manner in which the proposed project will interact with elements of the physical, biological, and socio-economic environments resulting in impacts on resources/receptors. Furthermore, the EIA phase evaluates what mitigation measures are warranted so as to avoid or reduce the magnitude of the impacts associated with the proposed project. Based on a balanced view of the advantages and disadvantages of the Project, the EIA makes a recommendation as to whether the Project should be authorised.

Figure 4.1 illustrates an overview of the EIA process that will be followed for this Project. The process is largely based on regulated steps which can be divided into the three major phases described above, namely Screening, Scoping and the Environmental Impact Assessment Phase, which includes specialist studies and the Environmental Impact Report (EIR). However, it must be noted that this is not a linear process, but one in which several stages may be carried out in parallel and where the assumptions and conclusions are revisited and modified as the EIA progresses. The following sections provide detail on how each stage of the EIA process will be applied to the Project.

[1] Note: New Regulations governing the Environmental Impact Assessment process in Mozambique have been published in *Decree No 54/2015*, which took effect on 30 March 2016. However, the Sasol Pipeline and FSO Project was registered under *Decree No 45/2004* and will be conducted in accordance with the requirements of this legislation. The applicability of the new requirements on an on-going Project will be tested with MITADER as part of the submission of this EPDA.

Figure 4.1 Steps of the Proposed EIA Process for this Category A Project



4.2 EIA PRE-EVALUATION APPLICATION (SCREENING)

All major developments must be screened in order to determine which environmental impact assessment process should be undertaken. Article 3 of the *EIA Regulations* and the associated Annexures I, II and III define this process.

The screening process involves the submission of Project Registration documentation together with an Environmental Application Form to MITADER, specifically at the Provincial Directorate of Environmental Affairs (DPCA) and National Agency of Environmental Quality (AQUAA). Based on this, MITADER determines the category of the project and the environmental impact assessment process to be adopted.

The application was submitted to the national and provincial environmental authorities on 4 December 2015. The environmental impact assessment process was formally classified as a *Category A Project* by MITADER (refer to *Section 3.2.3*) on the 26 January 2016 (reference number *90/180/DGA/DPTADER/16*).

4.3 SCOPING

The purpose of the scoping phase is to identify key sensitivities and those activities with the potential to contribute to, or cause, potentially significant impacts to environmental and socio-economic receptors and resources and to evaluate siting, layout and technology alternatives for the project proposed.

The key objectives of scoping are to:

- Identify the key environmental and social issues;
- Obtain stakeholder views through consultation; and
- Develop the Terms of Reference for the EIA through consultation so as to ensure that the process and output are focused on the key issues.

Subsequent phases of the EIA process focuses on these key issues through the collection of information on existing environmental and social conditions; engagement with stakeholders; understanding the impacts to the physical, biophysical and social environment; and developing the measures to avoid/control and monitor these impacts.

This Scoping Report will be submitted to the Ministry of Land, Environment and Rural Development (*Ministério da Terra, Ambiente e Desenvolvimento Rural* – MITADER) for approval, prior to initiation of the EIA Phase.

4.4 PUBLIC PARTICIPATION PROCESS

The Public Participation Process (PPP) for this Project will be undertaken in accordance with the Mozambican legislation, specifically with the requirements provided in *Article 19, Section III, Chapter II*, of *Decree* 56/2010 of 22 November and in compliance with the Guidelines for the Public Participation Process (Ministerial Diploma No.130/2006 of 19 July).

In addition to aligning with national standards, Sasol has committed to undertaking the engagement process in line with relevant international good practice, specifically the International Finance Corporation's Performance Standards (IFC PS). IFC requirements place an emphasis on broad engagement and disclosure of findings to stakeholders (*Box 4.1*) and require a stakeholder engagement plan to be developed.

As part of a previous EIA process undertaken by Sasol for exploration activities in the offshore Blocks 16 and 19, a Stakeholder Forum was constituted in the Project Area to allow for a group of stakeholder representatives to closely monitor the EIA process through closer engagement with the consultants and Sasol. The previous Forum appointed the Southern African Institute for Environmental Assessment (SAIEA) (represented by Peter Tarr) to provide them with the technical support to review the draft EIR and to provide comfort that Sasol's consultants had been objective in conducting the EIA process. The Forum and the peer review process facilitated a greater degree of transparency and trust in the EIA process for Block 16 and 19 and it is anticipated that this will also be achieved for this Project. Sasol has therefore committed to establishing a Stakeholder Forum for the EIA process (discussed in more detail in *Chapter 5*) for this Project as well as to submit the EIA process to an independent peer review (discussed in more detail in *Section 4.4*).

Box 4.1 Definition of Stakeholders

Stakeholders include those individuals, groups or organisations who themselves could be directly affected by the Project (Project - affected people) and those individuals or organisations who, although not directly affected by the Project , represent those affected or have a regulatory duty, an interest, influence or secondary involvement in the Project (secondary stakeholders).

For this Project, ERM has appointed the SAIEA, represented by Peter Tarr, to support the Forum in the technical review of this Scoping Report, the EIR and specialist studies and to ensure that the scope and EIA process followed for the Project are objective and quality focussed. The SAIEA is a non-profit Environmental Trust, whose mission is to support sustainable development in Southern Africa through promoting the effective and efficient use of Environmental Assessment as a planning tool.

ERM has also appointed Madalena Dray, an environmental consultant with many years of relevant experience in Mozambique, to peer review the stakeholder engagement and the Stakeholder Forum processes. Madalena Dray will provide assurance to stakeholders that issues they raise are addressed in the public participation process reports and that their views, opinions and concerns are considered in the development of the EIR and relevant mitigation measures.

The peer reviewers' comments will be shared with stakeholders to provide reassurance of the quality of the reports and the environmental assessment process followed.

Consultation with stakeholders will be undertaken at a number of stages during the evolution of the Project. An overview of the PPP for this Project is summarised in *Chapter 5* of this document.

4.5 *SPECIALIST STUDIES (BASELINE DATA COLLECTION)*

Issues identified during the Scoping Phase of the EIA process will be assessed, so as to understand what receptors and resources will be *significantly* affected by the Project. Specialist studies will also describe baseline conditions that will influence the assessment of both social and environmental impacts. The description of the baseline will be aimed at providing sufficient detail to meet the following objectives:

- Identify the key conditions and sensitivities in areas potentially affected by the Project ;
- Provide a basis for extrapolation of the current situation and the development of future scenarios without the Project;
- Provide data to aid the prediction and evaluation of possible impacts of the Project;
- Understand stakeholder concerns, perceptions and expectations regarding the Project;
- Facilitate the development of appropriate mitigation measures later in the EIA process; and
- Provide a benchmark against which future changes and the effectiveness of mitigation measures can be assessed.

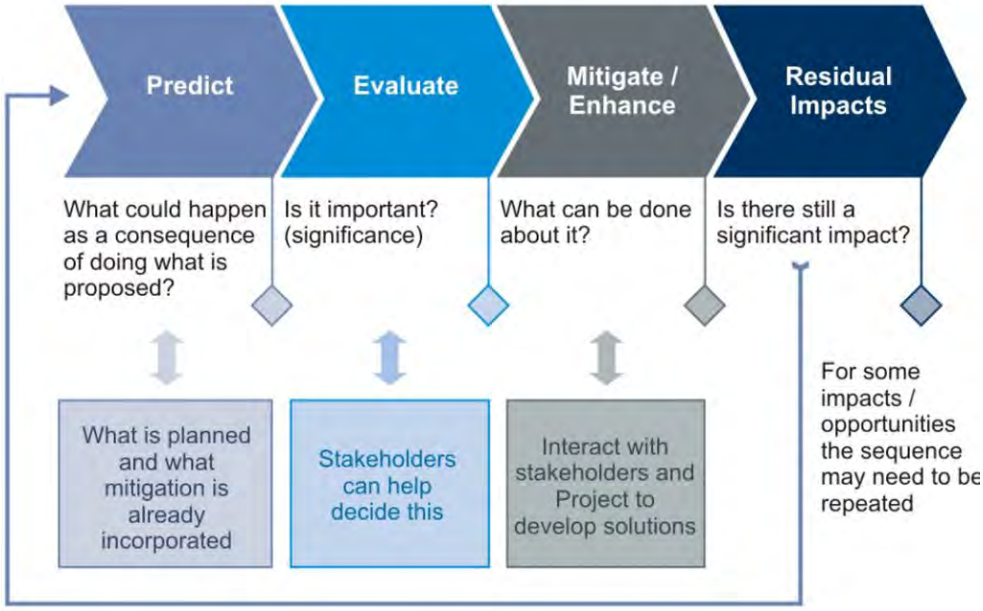
The Terms of Reference for each of the specialist studies required for this Project are described in *Chapter 9*.

4.6 *ASSESSMENT OF IMPACTS AND MITIGATION*

The impact assessment stage comprises a number of steps that collectively assess the manner in which the proposed Project will interact with elements of the physical, biological, cultural or human environment to produce impacts to resources/receptors.

The process of predicting and evaluating impacts and development of mitigation measures is iterative, and informs and runs in parallel with the design of the Project. The process also links in with consultation and stakeholder input regarding the significance of impacts and the suitability of proposed mitigation measures. This process is illustrated in *Figure 4.2*. Following the detailed assessments, the impacts to each social and environmental resource / receptor will be presented in three stages: (i) the potential impact is described; (ii) the mitigation committed to by Sasol is outlined; and (iii) the residual impact (that remaining after mitigation) is described and assigned a significance level.

Figure 4.2 Predictions, Evaluation and Mitigation of Impacts



The steps involved in the prediction, evaluation and mitigation of impacts are described in greater detail below.

4.6.1 Impact Prediction

The impact assessment process describes what will happen by predicting the magnitude of impacts and quantifying these to the extent practicable. The term 'magnitude' is used as shorthand to encompass all the dimensions of the predicted impact including:

- The nature of the change (what is affected and how);
- Its size, scale or intensity;
- Its geographical extent and distribution; and
- Its duration, frequency, reversibility, etc.

Magnitude therefore describes the actual change that is predicted to occur in the resource or receptor (eg the area and duration over which air may become polluted and the level of increase in concentration, and the degree and probability of impact on the health of a local community).

The impact characteristic terminology to be used during the impact assessment is summarised in *Table 4.1*.

Table 4.1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	• Direct • Indirect • Induced
Extent	The "reach" of the impact (eg confined to a small area around the Project Footprint, projected for several kilometres, etc.).	• Local • Regional • International
Duration	The time period over which a resource / receptor is affected.	• Temporary • Short-term • Long-term • Permanent
Scale	The size of the impact (eg the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

When categorising an impact, it is important to note that this process will take into account any control measures that are already part of the project design. Additional mitigation measures aimed at further reducing the significance of impacts will also be proposed where necessary or appropriate.

In the case of *type*, the designations are defined universally (ie the same definitions apply to all resources/receptors and associated impacts). For these universally-defined designations, the definitions are provided in *Table 4.2*.

Table 4.2 Designation Definitions

Designation	Definition
Type	
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (eg between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (eg viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (eg influx of camp followers resulting from the importation of a large Project workforce).
Extent	
Local	Defined on a resource/receptor-specific basis.
Regional	
International	
Duration	
Temporary	Defined on a resource/receptor-specific basis.
Short-term	
Long-term	
Permanent	

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, accidental release of toxic gas, community riot, etc.) is likelihood. The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale, as described in *Table 4.3*.

Table 4.3 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (ie it is essentially inevitable).

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity/vulnerability/importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity/vulnerability/importance of the resource/receptor, which may be physical, biological, cultural or human.

Where the resource is physical (for example, a water body) its quality, sensitivity to change and importance (on a local, national and international scale) are considered. Where the resource/receptor is biological or cultural (for example, the marine environment or a coral reef), its importance (for example, its local, regional, national or international importance) and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

4.6.2 *Evaluating Significance*

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor has been characterised, the significance can be assigned for each input. Impact significance will be determined using the matrix shown in *Table 4.4*. In the case of impacts resulting from unplanned/ accidental events, the same resource/receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor as described in *Table 4.3* is considered, together with the other impact characteristics, when assigning a magnitude designation.

Table 4.4 Impact Significance

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

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor- or impact-specific considerations are factored into the assignment of magnitude and sensitivity designations that enter into the matrix. *Box 4.2* provides a context for what the various impact significance ratings signify.

Box 4.2 Context of Impact Significance

An impact of ***negligible*** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of ***minor*** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of ***moderate*** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

An impact of ***major*** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of impact assessment is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

4.6.3 Mitigation of Impacts

Once the significance of a given impact has been characterised using the above matrix, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the priority in mitigation is to first apply mitigation measures to the source of impact (ie to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensation measures or offsets (ie to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude.

It is important to note that it is not an absolute necessity that all impacts be mitigated to the lowest level of significance; rather in certain cases it may be acceptable to mitigate impacts to an ALARP (As Low As Reasonably Practicable) level.

Once mitigation measures are declared, the next step is to assign residual impact significance. This is essentially a repeat of the impact assessment steps, assuming the implementation of the additional declared mitigation measures.

4.6.4 Dealing with Uncertainty

Even with a final design and an unchanging environment, impacts are difficult to predict with certainty. Where such uncertainties are material to EIA findings, they will be clearly stated and conservatively approached ('the precautionary approach') in order to identify the broadest range of likely residual impacts and necessary mitigation measures.

Potential impacts may be assessed using tools ranging from quantitative techniques such as hydrodynamic modelling to qualitative techniques based on expert judgment and historical information. The accuracy of these assessment tools depends on the quality of the input data and available information and the experience of the study team. Where assumptions have been made, the nature of any uncertainties associated with the assumption is discussed. For qualitative predictions/assessments, some uncertainty is removed through consultation.

4.6.5 Cumulative Impacts

Cumulative impacts are those that arise as a result of an impact from the Project interacting with the impact of another activity to create an additional, larger, impact. The approach for assessing cumulative impacts is influenced by the availability of information about the impact of the other activity, and whether or not it already exists or is only proposed. Any cumulative impacts to which the Project may contribute will be assessed where practical.

4.6.6 Management and Monitoring

Management and monitoring measures need to be defined in order to identify whether:

- Impacts or their associated Project components remain in conformance with applicable standards, and

- Mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing impacts to the extent predicted.

This step may include additional elements, such as identification of the individuals responsible for implementing mitigation measures and assurance mechanisms for use in verifying proper implementation of mitigation measures.

4.6.7 Environmental Impact Report

The results of the specialist studies and the assessment of the impacts of the proposed activities will be integrated into an Environmental Impact Report (EIR). The report will be prepared in accordance with Article 12 of the EIA Regulations.

The EIR will assess the potential impacts associated with the proposed Project, and will provide recommendations on the mitigation of negative impacts and enhancement of positive impacts.

4.6.8 Environmental Management Plans.

As part of the PSA Development and LPG Project Sasol has developed the following EMPs:

- Construction Environmental Management Plan (C-EMP) – CPF Complex.
- Construction Environmental Management Plan (C-EMP) - Infrastructure Construction of the Infrastructure associated with the PSA Development and LPG Project, including Well-sites, Flowlines, Trunklines and Access Roads (excluding Well Drilling) in Inhambane Province, Mozambique.
- Operations Environmental Management Plan (O-EMP) - Operation of the Central Processing Facility, PSA Liquids and LPG Plant, Production Wells, Flowlines and Access Roads Inhambane Province, Mozambique.

These EMPs will be reviewed and updated to include the mitigation measures stipulated in the EIR. Where required, new EMPs will be developed to include the mitigation measures for offshore activities. These mitigation measures will be written as clear practical measures applicable to local conditions in the EMP.

5 PUBLIC PARTICIPATION PROCESS

5.1 INTRODUCTION

This Chapter presents a summary of the stakeholder engagement activities planned as part of the EIA process. It serves as a summary of a more detailed Stakeholder Engagement Plan (SEP), which presents the engagement approach and identifies stakeholders and the mechanisms through which they will be engaged.

The Public Participation Process (PPP) for this Project will be undertaken in accordance with Mozambican legislation, specifically with the requirements provided in Article 19, Section III, Chapter II, of *Decree 56/2010* of 22 November and in compliance with the Guidelines for the Public Participation Process (Ministerial Diploma No.130/2006 of 19 July).

In addition to aligning with national standards, Sasol has committed to undertaking the engagement process in line with relevant international good practice, specifically the International Finance Corporation's Performance Standards (IFC PS). IFC requirements place an emphasis on broad engagement and disclosure of findings to stakeholders and requires a stakeholder engagement plan to be developed.

A Stakeholder Forum and an independent peer review process were constituted as part of a previous EIA process undertaken by Sasol for exploration activities in the offshore Blocks 16 and 19. The aim of the Stakeholder Forum and the peer review process was to keep stakeholders informed about the Project and EIA process and to ensure the EIR was technically sound. The Forum and peer review process were well received and provided a valuable point of engagement with representatives of different interest groups ranging from artisanal and industrial fishing, tourism, conservation and other government representatives. It provided the basis for these representatives to obtain a more detailed understanding of the Project and its findings, and to engage directly with the EIA team and client (Sasol) on issues of concern. It also facilitated a greater degree of transparency and trust in the EIA process for Block 16 and 19 and it is anticipated that the same could be achieved for this Project. Sasol has therefore committed to establishing a Stakeholder Forum and peer review process for this Project. This is further discussed in *Section 5.4*.

5.2 OBJECTIVES OF PUBLIC PARTICIPATION

The objectives of the PPP during the EIA process include:

- **Ensuring Understanding**: An open, inclusive and transparent process of culturally appropriate engagement and communication will be undertaken to ensure that stakeholders are well informed about the Project. Information will be disclosed as early and as comprehensively as possible.
- **Involving Stakeholders in the Assessment**: Stakeholder views and concerns will be considered in the scoping of issues, and will inform the assessment of impacts, the generation of mitigation and management measures and the finalisation of the EIS, in particular through the Stakeholder Forum. Information obtained from stakeholders may also play an important role in providing local knowledge and information in support of the baseline, which will inform the impact assessment.
- **Building Relationships**: Through supporting open dialogue, engagement will help establish and maintain a productive relationship between the EIA team and stakeholders. This will support not only an effective EIA, but will also strengthen the existing positive relationships between Sasol and stakeholders.
- **Engaging Vulnerable Peoples**: An open and inclusive approach to consultation increases the opportunity for stakeholders to provide comments on the Project and to voice their concerns. Some stakeholders, however, need special attention in such a process due to their vulnerability. Special measures, such as focus group meetings, will be considered and implemented to ensure that the perspectives of vulnerable stakeholders are heard.
- **Managing Expectations**: It is important to ensure that the Project does not create or allow unrealistic expectations to develop amongst stakeholders with respect to Project benefits. The engagement process will serve as a mechanism for understanding and managing stakeholder and community expectations, where the latter will be achieved by disseminating accurate information in an accessible way.
- **Ensuring Compliance**: The process is designed to ensure compliance with both local regulatory requirements and international best practice.

One of the key outcomes of engagement should be free, prior and informed consultation of stakeholders, where this can be understood to be:

- **Free**: Engagement free of external manipulation or coercion and intimidation;
- **Prior**: Engagement undertaken in a timely way, for example the timely disclosure of information to allow stakeholders time to review materials, ask questions and receive feedback and for their views to be considered in the EIA; and
- **Informed**: Engagement enabled by relevant, understandable and accessible information, including clear explanations of the approach and findings of technical studies.

Detailed stakeholder engagement starts during the screening phase of the Project and will continue throughout the assessment ensuring that legislative requirements and the Project standards are met. It also ensures that the stakeholder concerns are addressed in the assessment and that sources of existing information and expertise are identified.

5.2.1 Identification of Stakeholders

The stakeholders initially identified for the EIA process for this Project include but are not limited to those organisations presented in *Table 5.1* below.

An initial stakeholder database was compiled before the start of the Scoping public consultation process. This database will act as a 'live document' that will be continually updated throughout the EIA process.

Different issues are likely to concern different stakeholders, and so separate stakeholder groups have been established based on their anticipated interest in the Project. Having an understanding of the concerns of a stakeholder group about the Project will help to identify the key objectives of the engagement activities with any given group.

As the EIA process progresses, further stakeholder identification, mapping and analysis will be conducted during subsequent phases of the EIA. The initial phases of engagement will also identify and confirm stakeholders that are interested or potentially affected by the Project.

Table 5.1 Stakeholders Identified to Date

Stakeholder Group	**Stakeholders**
Decision Makers / Regulators	
Government – National	• Ministry of Land, Environment and Rural Development • Ministry of Mineral Resources and Energy • Ministry of Economy and Finance • Ministry of Agriculture and Food Security • Ministry of Public Works, Housing and Water Resources • Ministry of the Sea, Inland Waters and Fisheries • Ministry of Culture and Tourism • Ministry of Transports and Communications • Ministry of Labour, Employment and Social Security • National Agency for Environment Quality Control (AQUA) • National Directorate of Environment (DINAB) • National Directorate of Territorial Planning and Resettlement • National Directorate of Agrarian Services • National Directorate of Land and Forestry • National Directorate for Conservation Areas • National Directorate of Geology • National Institute of Geology and Mines • National Institute for Disaster Management

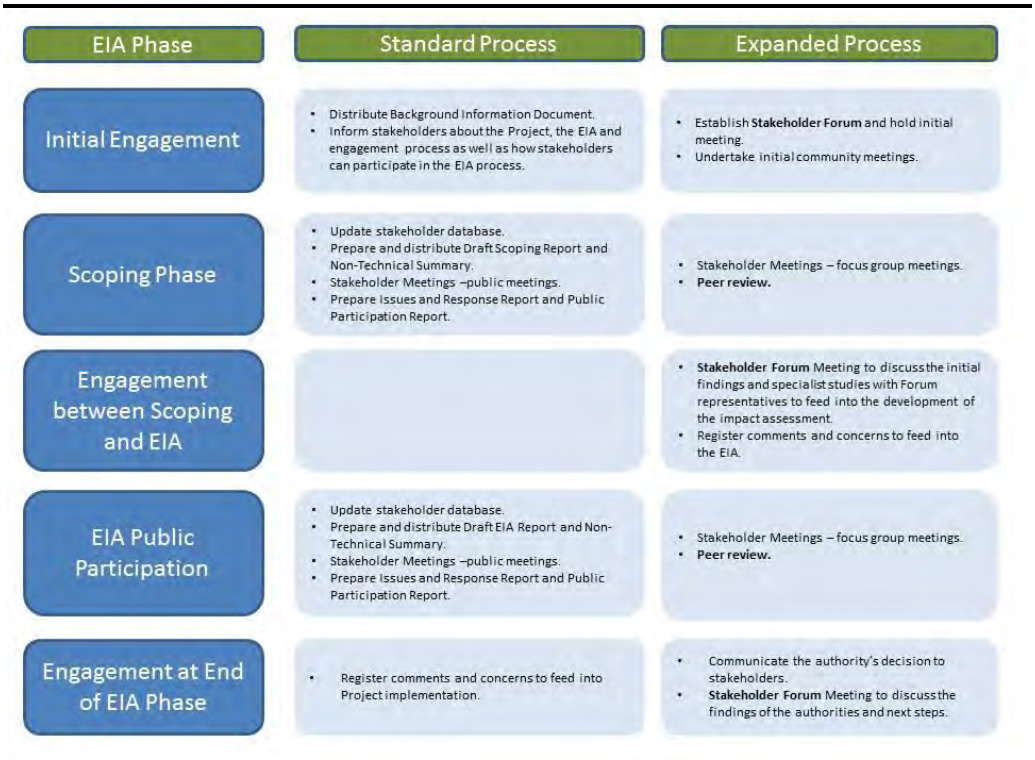
Stakeholder Group	Stakeholders
Inhambane Provincial Government	• Office of the Provincial Governor • Provincial Directorate of Land, Environment and Rural Development • Provincial Directorate of Mineral Resources and Energy • Provincial Directorate of Public Works, Housing and Water Resources • Provincial Directorate of Agriculture and Food Security • Provincial Directorate of Fisheries • Provincial Directorate of Sea, Inland Waters and Fisheries • Fisheries Research Institute- Provincial Delegation • Provincial Directorate of Industry and Commerce • Provincial Directorate of Labour, Job and Social Safe • Provincial Directorate of Transport and Communications • Provincial Directorate of Women and Social Action • Provincial Directorate of Health • Provincial Directorate of Tourism • Maritime Administration
District Level Government	• Inhassoro District Administrator • District Permanent Secretary • District Command of Policy (PRM) • District Services of Economic Activities • District Services of Education, Youth and Technology • District Services of Health, Woman and Social Affair • District Services of Planning and Infrastructures • Administrative Post of Bazaruto • Administrative Post of Inhassoro • Administrative Post of Vilankulo • Maritime Administration from Vilankulo
Interest Groups	
Public, private companies, agencies and financial institutions (national & provincial level)	• ENH • ENH Logistics • Petromoc • Matola Gas Company • World Bank • EDM • National Road Administration (ANE) • ARA-Sul • Beira Port companies Authority (eg. Beira)
Environmental Interest Groups	• IUCN • FNP - Forum for Nature in Danger • WWF Mozambique • EWT (Endangered Wildlife Trust) • National Administration of Conservation Areas (ANAC) • Centro Terra Viva (CTV) • African Parks
Locally affected people	
Local leaders	• Villages leaders appointed by the government • Traditional Authorities, chiefs and leaders • Religious or educational leaders: • Igreja Metodista Unida de Moçambique • Influential people
Affected individuals	• Men, women, children, youth, elderly, and disabled.
Local institutions and service providers in the Project Area of Influence	• Educational and health services
Vulnerable Groups	• Disabled people • Elderly people

Stakeholder Group	Stakeholders
Local business/ companies	• Business owners (onshore, offshore and from Bazaruto Archipelago) • Fisheries Association: Vilanculo
Local NGOs, conservation entities and civil society organisations	• Justiça Ambiental • Livaningo • AMAVIL (Associação dos Amigos de Vilankulo) • Forum Turismo de Vilankulo • Plataforma dos Recursos Naturais e Indústria Extractiva • Associação para Investigação Costeira e Marinha • Associação Tomba Yedo (Ilha de Bazaruto)
Community Based Organisations	• Local organisations representing key interest groups within the community.
Academic / research organisations	
Academic / research organisations	• Institute for the Development of Small Scale Fisheries (IDPPE) • Fisheries National Research Institute (IIP) • Eduardo Mondlane University_ Science Department • Institute of Science and Technology of Mozambique • CDS-Gestão das Zonas Costeiras - Xai-Xai • CIP – Centre for Public Integrity • Natural History Museum • Universidade Católica de Moçambique

5.3 *APPROACH TO PUBLIC PARTICIPATION*

The PPP associated with the EIA process for this Project will be undertaken from the Screening Phase until disclosure of MITADER's decision regarding the EIR. A staged approach will be used in line with the various phases of the EIA process. The PPP steps are summarised in *Figure 5.1*.

Figure 5.1 Public Participation Process



5.3.1 Screening Phase

In January 2016, initial engagement with stakeholders was undertaken during the screening phase of the EIA process. The objective of this engagement was to inform stakeholders about the Project, the EIA process and engagement process and their participation. A Background Information Document (BID) in Portuguese and English was distributed on 5 February 2016 by e-mail and handouts at the initial Forum meeting to 55 stakeholders to support the dissemination of information.

An initial Stakeholder Forum meeting (*Section 5.4*), involving potentially affected stakeholders, was held on 9 February 2016. The aim of this first Forum meeting was to establish a new Forum for this Project and to set its Terms of Reference (ToR).

5.3.2 Scoping Phase

Objectives

Public participation is a legal requirement as part of the Scoping Phase as it allows for an early identification of public expectations and concerns that will need to be considered and addressed as part of the EIA process. The broad activities of the public participation process during the Scoping Phase will involve:

- Updating the stakeholder identification and mapping;
- Notifying stakeholders of the Project and the EIA process through distribution of the Non-Technical Summary (NTS) of the Scoping Report;
- Undertaking focus group meetings with fisheries and tourism operators and public meetings to present the Project, the EIA process and public participation process and gather comments, concerns and queries with respect to the Project and associated EIA process; and
- Provide stakeholders with an opportunity to ask questions and give input on the Project.
- Tabulating comments and responses on the issues raised by stakeholders for inclusion in the Draft Scoping Report.

Dissemination of the Draft Scoping Report

Stakeholders will be notified of the availability of the Draft Scoping Report and the date, time and venue of public meetings through announcements in the local newspaper and radio (in Portuguese and Xitswa) and formal invitations. This notification will be undertaken at least 14 days prior to the public meetings. This is in accordance with the requirements stipulated in the Directive for the General Public Participation Process in the EIA process.

The Non-Technical Summary (NTS) of the Draft Scoping Report, which contains a summary of the Project, the EIA process and associated PPP will be distributed with the formal letters of invitation to all registered stakeholders. The NTS is compiled in Portuguese and will be provided to stakeholders in English upon request. Furthermore, the NTS will include a comments sheet allowing stakeholders to provide initial comments and formally register to participate in the EIA process.

The Draft Scoping Report will be made available for stakeholder comment at the following locations:

In Maputo:
- MITADER;
- National Directorate of Environment (DINAB);
- National Petroleum Institute (INP);
- IMPACTO Offices;
- ERM Offices; and

In Inhambane:
- Provincial Directorate of Land, Environment and Rural Development (DPTADER); and
- Provincial Directorate of Mineral Resources and Energy (DPREME).

In Govuro:
- District Administration; and
- District Services of Planning and Infrastructures (SDPI).

In Inhassoro:
- District Administration; and
- District Services of Planning and Infrastructures (SDPI).

In addition, an electronic version of the Draft Scoping Report and the NTS will be made available on IMPACTO´s webpage: www.impacto.co.mz and ERM webpage: www.erm.com/Sasol-Pipeline-FSO-Project. Comments can be submitted to the EIA team via fax, letter, e-mail and the Impacto website as follows:

To register as a stakeholder or for any further information please contact Sandra Fernades of IMPACTO.
Email: consulta.publica@impacto.co.mz
Tel: +258 21 499 636; Cell: +258 82 304 6650;
Fax: +258 21 493 019
Address: Av. Mártires da Machava, 968 Maputo – Moçambique

For comments to be included in the Final Scoping Report, comments should reach Impacto no later than 9 September 2016 (ie 14 working days after the end of the public consultation meetings). Relevant comments received by this date will be incorporated in the EIR.

Public Participation Report (PPR)

The PPP carried out during the Scoping Phase will be detailed in a Public Participation Report (PPR), which is to be developed following the Scoping Phase PPP and during the finalisation of the Scoping Report. The PPR will be appended to the Final Scoping Report that is to be submitted to MITADER.

The PPR will contain the following:

- The methodology used for PPP;
- Stakeholder Database;
- Issues and Responses Report (IRR); and
- Copies of all relevant documentation such as meeting minutes, attendance registers, advertisements and letters of invitation (including the NTS).

5.3.3 Engagement Undertaken between the Scoping Report and EIA

During this phase a Forum meeting will be held at Inhassoro District. The aim of the Forum meeting in this phase will be to update Forum members on Project activities and the specialist studies that are underway and to gather any additional contributions or concerns to be considered in the Draft EIR.

5.3.4 EIA Public Participation

Engagement methods that will be used during EIA Phase will include:

- Focus group meetings in Inhassoro and Inhambane;
- Focus group meetings in Govuro; and
- Open public meetings in Inhassoro and Maputo; and Community meetings in Govuro, Temane, Matsanze, Catine, Maperepere, Chinhocane/Colonga and Chibo.

The PPP process will provide stakeholders with an insight into the predicted impacts and mitigation and to contribute their knowledge to the assessment and development of mitigation measures. It will also allow stakeholders the opportunity to confirm that their concerns, issues and expectations have been recorded and considered in the specialist investigations and Project design, where possible and appropriate.

This phase of engagement will involve the disclosure of the Draft EIR and associated EMP (in Portuguese) and the NTS with registered stakeholders ahead of formal public consultation meetings. Stakeholders will be given 14 days on completion of the public consultation meetings to review and consider the information provided to them and provide comments or feedback to the EIA team on the EIR. This can involve written and/or verbal feedback. All feedback received from stakeholders will be documented, considered and, where relevant, incorporated into the EIR.

5.3.5 Public Disclosure and Engagement at End of EIA Phase

At the end of the EIA Phase and after MITADER has issued its decision on the approval of the EIR, a Forum meeting in Inhassoro will be held to communicate the authority's decision to stakeholders and close out the consultation process for the EIA.

In addition, registered stakeholders in the stakeholder database will also be informed via email of the authority's decision. There is no regulatory requirement to inform stakeholders of MITADERs decision but it will be undertaken in line with international best practices to keep stakeholders informed and maintain transparency and confidence in the engagement process. If further clarifications are requested the EIA team will provide these at the meeting or reply via e-mail or fax within 15 days.

5.4 STAKEHOLDER FORUM AND PEER REVIEW

5.4.1 Stakeholder Forum

As discussed in *Chapter 4*, as part of a previous EIA process undertaken by Sasol, a Stakeholder Forum was constituted in the Project Area to allow for a group of stakeholder representatives to closely monitor the EIA process through discussions with the consultants and Sasol. The previous Forum comprised approximately 41 members (21 organisations) representing key sectors such as fishing, tourism, communities, conservation and government institutions. The Forum developed an agreed Terms of Reference that defined its scope, mandate, and function. The Forum members were also responsible for sharing information with the key sector groups they represented. .

The Forum was well received and was an important tool for keeping stakeholders up to date with the EIA process and findings. The Forum contributed to the establishment of strong relations between stakeholders and the Project through regular contact and information sharing. As such, a similar Forum is in the process of being established for this Project.

The main aim of the Forum for this Project is to allow for productive, in-depth and effective discussions with Forum representatives, the findings and outcomes of which will feed into the EIA process. The Forum will therefore provide stakeholders with a platform where their specific concerns and suggestions can be discussed in detail, through facilitated group discussions and the best approach for managing issues and concerns can be agreed. Forum members will be invited to discuss and understand data collection methods, findings of studies, mitigation measures and developing solutions to issues as they arise. The Forum members will be responsible for sharing the information and issues raised with their key sector groups.

It is also anticipated that the Forum will also serve to manage expectations regarding the Project. It is hoped that it will contribute to the development of a good relationship between Sasol, its consultants and stakeholders. It is expected, as with the previous Forum, that as a result of these meetings and the independent peer review process that there will be additional confidence in the findings of the EIR.

At the start of the EIA process, the consultant team invited all the previous Forum members and additional relevant stakeholders to attend the first Forum meeting for this Project. The aim of the first Forum meeting, that was held on 9 February 2016, was to inform the stakeholders about the Project, the Forum objectives and ToR, the EIA and consultation processes and to discuss their willingness to participate in the Forum. Two further Forum meetings will be held throughout the EIA process at the following times:

- Stakeholder Forum Meeting 2: between Scoping and EIA Phases; and
- Stakeholder Forum Meeting 3: after the EIA Phase.

If required, an additional Stakeholder Forum Meeting will be undertaken at the appropriate time. The need for this meeting will be determined based on the requirements of the members of the stakeholder Forum.

5.4.2 Peer Review

As stated in Chapter 4, ERM has appointed the SAIEA, represented by Peter Tarr, to support the Forum in the technical review of this Scoping Report, the EIR and specialist studies and to ensure that the scope and EIA process followed for the Project are objective and quality. In addition ERM has appointed Madalena Dray, an environmental consultant with many years of relevant experience in Mozambique, to peer review the stakeholder engagement and Stakeholder Forum processes. Madalena Dray will provide assurance to stakeholders that issues they raise are addressed in the public participation process reports and that their views, opinions and concerns are considered in the development of the EIR and relevant mitigation measures.

6 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

6.1 INTRODUCTION

This Chapter describes the physical and biological environment of the *Sasol Pipeline and FSO Project*. It is important to gain an understanding of the biophysical attributes of the Project Area and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is proposed. This information will be used to inform the baseline, following which the potential impacts of the proposed Project may be assessed.

Since 2001, Sasol has been present in the Project Area and currently has existing operations and ongoing exploration activities in the area. This means that there is considerable information available to describe the baseline environment of the Project Area. Most of this is documented in previous baseline studies and EIAs for Sasol's concession areas and has been used to inform the environmental description for the Project Area in this Chapter. More detailed descriptions of the baseline physical, biophysical and socio-economic environments along the pipeline route will be provided in the Environmental Impact Report (EIR).

Relevant information sources include:

- Mark Wood Consultants & Impacto (2002). Environmental Impact Study for the Temane & Pande Gas Fields – Seismic Exploration and Exploratory Development Drilling. Report on behalf of Sasol Petroleum Temane Limitada.
- Mark Wood Consultants (July 2003). National Gas Project. Regional Environmental and Social Assessment (RESA). Report on behalf of Sasol Technology.
- ERM / Consultec (March, 2008). Environmental Impact Assessment for Sasol's Offshore Exploration Project in Blocks 16 and 19 – Inhambane and Sofala Provinces. Report on behalf of Hidrocarbonetos de Mozambique and Sasol Petroleum Sofala Limitada.
- Golder Associates (2014a). EIA for the Petroleum Sharing Agreement (PSA) Development and Liquefied Petroleum Gas (LPG) Project.
- Golder Associates (2014b). Sasol PSA and LPG Project: Final Environmental Impact Assessment Report (including a number of specialist studies).
- Golder Associates (2015a). Sasol PSA and LPG Project: Final EIA Addendum (including specialist studies).
- Golder Associates (2015b). Baseline Biodiversity Studies for the proposed Pande Wells Expansion Project and associated Seismic Exploration activities (Pande and Temane Blocks).
- Golder Associates (2015c). Biodiversity Sensitivity Map for the proposed seismic exploration within the Pande and Temane areas, Mozambique. Draft Report.
- Golder Associates (2015d). Ecological studies for the Nhangonzo Coastal Stream Critical Habitat Biodiversity Assessment (for Sasol PSA Development and LPG Project Inhambane Province (EIA Addendum). Includes studies on vegetation and flora, terrestrial fauna, wetlands, fish and aquatic habitats, surface water quality, mangroves and estuaries.

6.2 PHYSICAL ENVIRONMENT

6.2.1 Climate and Long Term Climate Trends

The Mozambican climate can be described as semi-arid and subtropical in the south and tropical in the north. The southern part of the country is generally drier than the north and has strong fluctuations in temperature and precipitation, with the heaviest rainfall from October to March (Tadross and Johnston, 2012).

The most important weather systems that determine rainfall amounts and pattern over Mozambique are:

1. The Inter-tropical Convergence Zone (ITCZ);

2. Tropical Cyclones;

3. Thermal lows along the coast as result of the deepening of a semi-permanent trough over the Mozambique Channel; and

4. Incoming African easterly waves that often serve as the "seedling" circulations for a large proportion of tropical cyclones.

The monthly temperature trends from 2010 to 2013 in the Project Area are presented in *Table 6.1*. Average temperatures typically range between 19°C and 27°C, with the highest average temperatures between December and March.

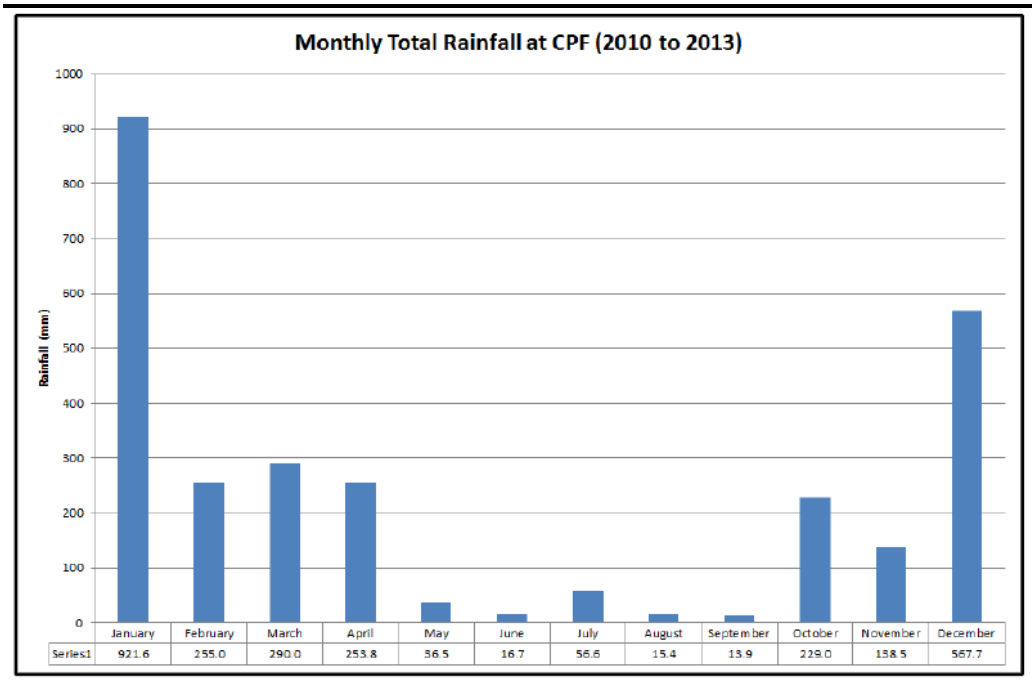
Table 6.1 Minimum, Maximum and Mean Temperatures at CPF Site (2010 to 2013)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum	19.2	19.0	17.9	14.0	10.6	4.9	7.7	8.8	9.7	13.8	14.9	17.2
Average	27.0	26.4	26.2	23.3	21.4	19.9	18.8	20.3	22.9	24.1	25.6	26.6
Maximum	35.0	36.1	35.4	32.9	33.8	32.3	31.0	32.5	37.1	35.3	37.3	35.6

Source: Golder, 2014b

There is a clear seasonal variation in the amount of rainfall in Mozambique with a dry and cooler season from May to September and a rainy and hot season, lasting from October to April. These seasonal variations are associated with the ITCZ and its movement southward over the country. Rainfall in Mozambique is also affected by local variations in altitude, with the higher altitude areas often experiencing more rainfall. Heaviest rainfall is associated with the movement of tropical cyclones which originate from the Indian Ocean and pass along the Mozambique Channel, usually from north to south, and can result in heavy floods (Tadross, 2009). The monthly average rainfall in the Project Area (as measured at the CPF) from 2010 to 2013 is shown in *Figure 6.1* below. Highest rainfall typically occurs between December and March. Rainfall is highly variable in the region.

Figure 6.1 Rainfall Measured at Sasol's Onshore Central Processing Facility: 2010 to 2013



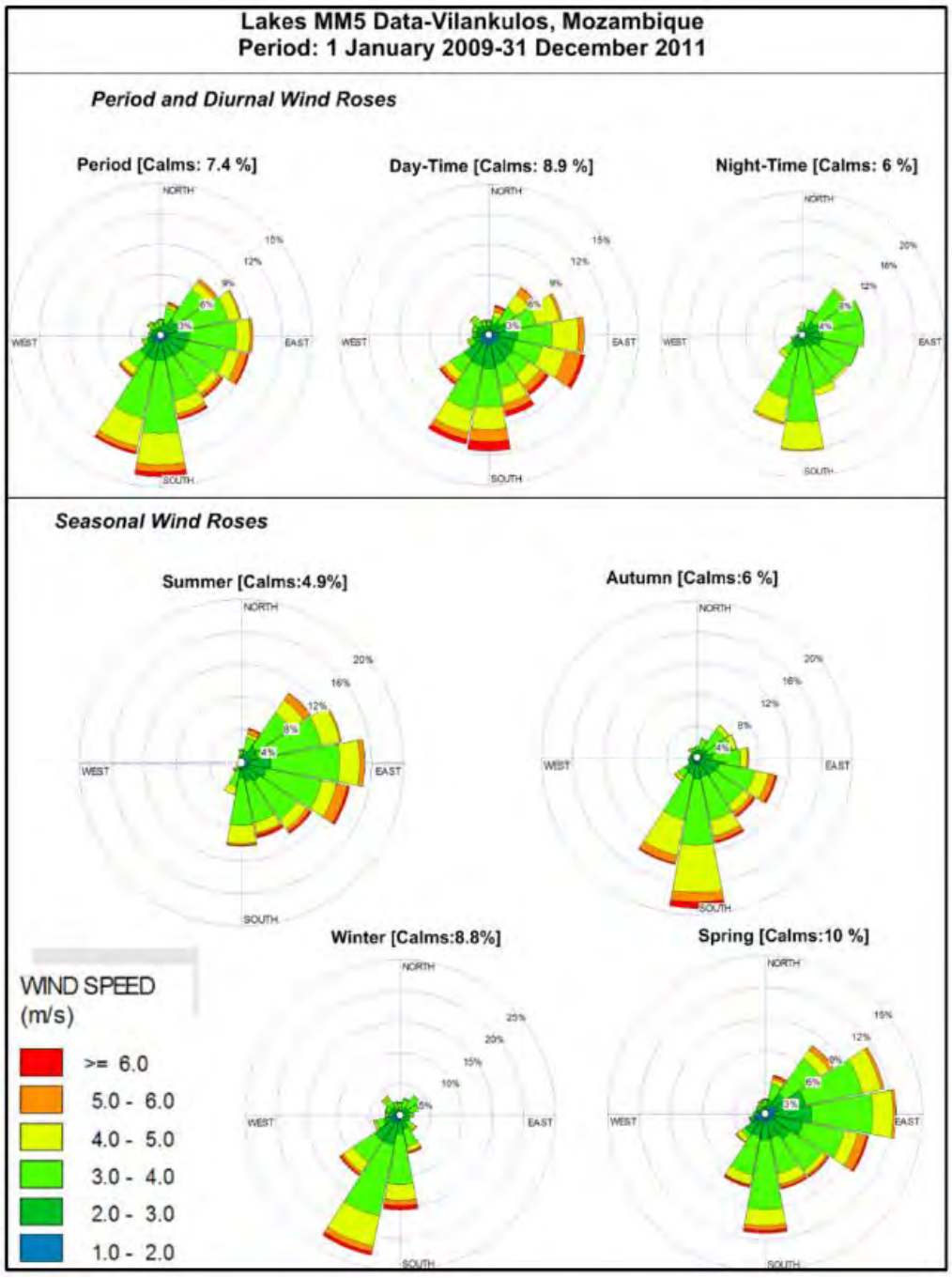
Source: Golder, 2014b

The onshore winds in the Project Area are predominantly from the southeast and strengthen in the afternoon. Prevailing onshore winds are southerly and easterly (*Figure 6.2*). Onshore wind speeds of between 3 and 4 m/s occur for about 43 percent of the time, and speeds exceed 6 m/s for about 5.6 percent of the time[1].

Observations from Voluntary Observing Ships (VOS) for the period 1968 to 1998, indicate that the winds in the offshore region east of the archipelago are predominantly from the south to southeast and are strongest in the summer months (*Figure 6.3*).

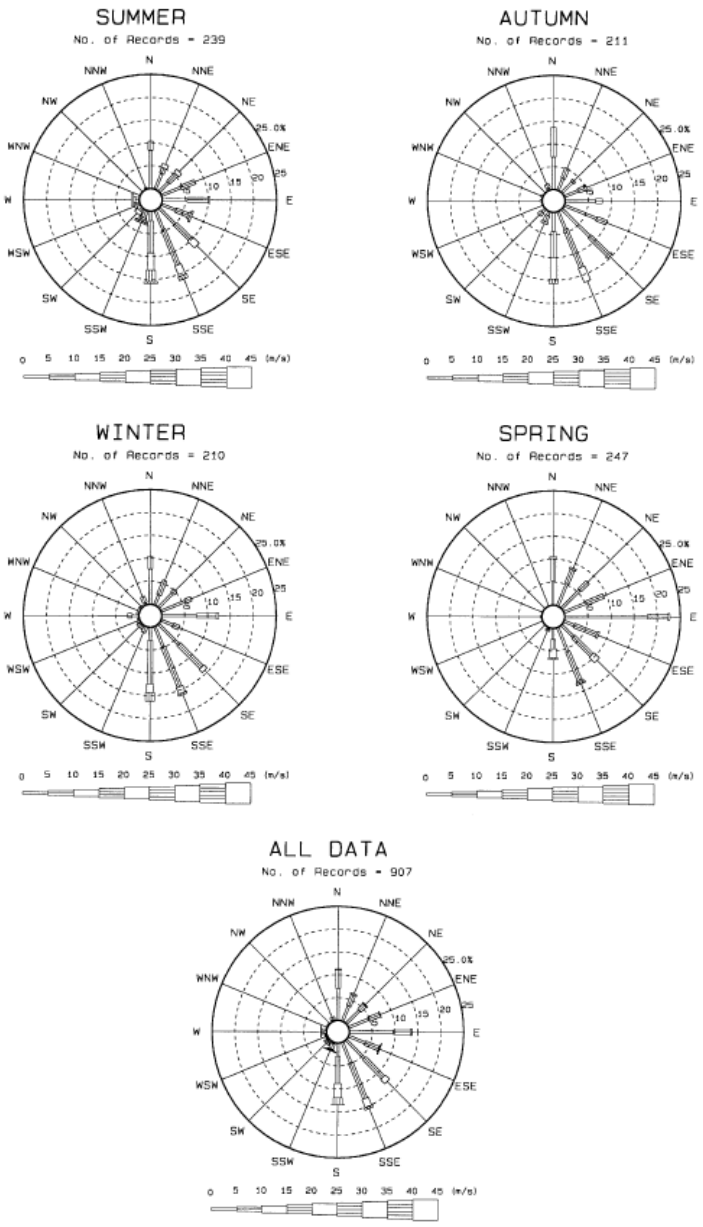
[1] The Lakes MM5 wind data for Vilankulos has been used because it provides upper level winds, which are important in air quality dispersion analysis. Sasol's wind recorder at the CPF does not measure upper level winds. However, the Lakes and Sasol ground level wind data are very similar and the Lakes data can therefore be used with confidence

Figure 6.2 Onshore Period and Diurnal Wind Roses



Source: Golder, 2013

Figure 6.3 Offshore Wind Speed and Direction Occurrences



CSIR, 2006

Mozambique is prone to cyclones with Northern Inhambane classified as having the highest risk of cyclones by the National Institute of Natural Disaster Management. Since 1970 at least nine cyclones have hit the coast of northern Inhambane (*Table 6.2* and *Figure 6.4*), with three having occurred since 2001. The worst cyclone in living memory to strike the coast, Cyclone Favio, occurred in February 2007; a category 4 event which caused delays to Sasol's drilling programme and damaged coastal infrastructure. The cyclone season in this region extends from December to March, peaking in December and January, and causing seasonal flooding and damage to property.

Table 6.2 Cyclone History in Mozambique since 1956

Year	Month	Name
1956	April	Unknown
1994	March	Nadia
1996	January	Bonita
2000	February	Eline
2001	March	Dera
2003	January	Delfina
2003	March	Japhet
2007	February	Favio
2008	March	Jokwe
2012	January	Funso

Source: Grab and Fitchett, 2014

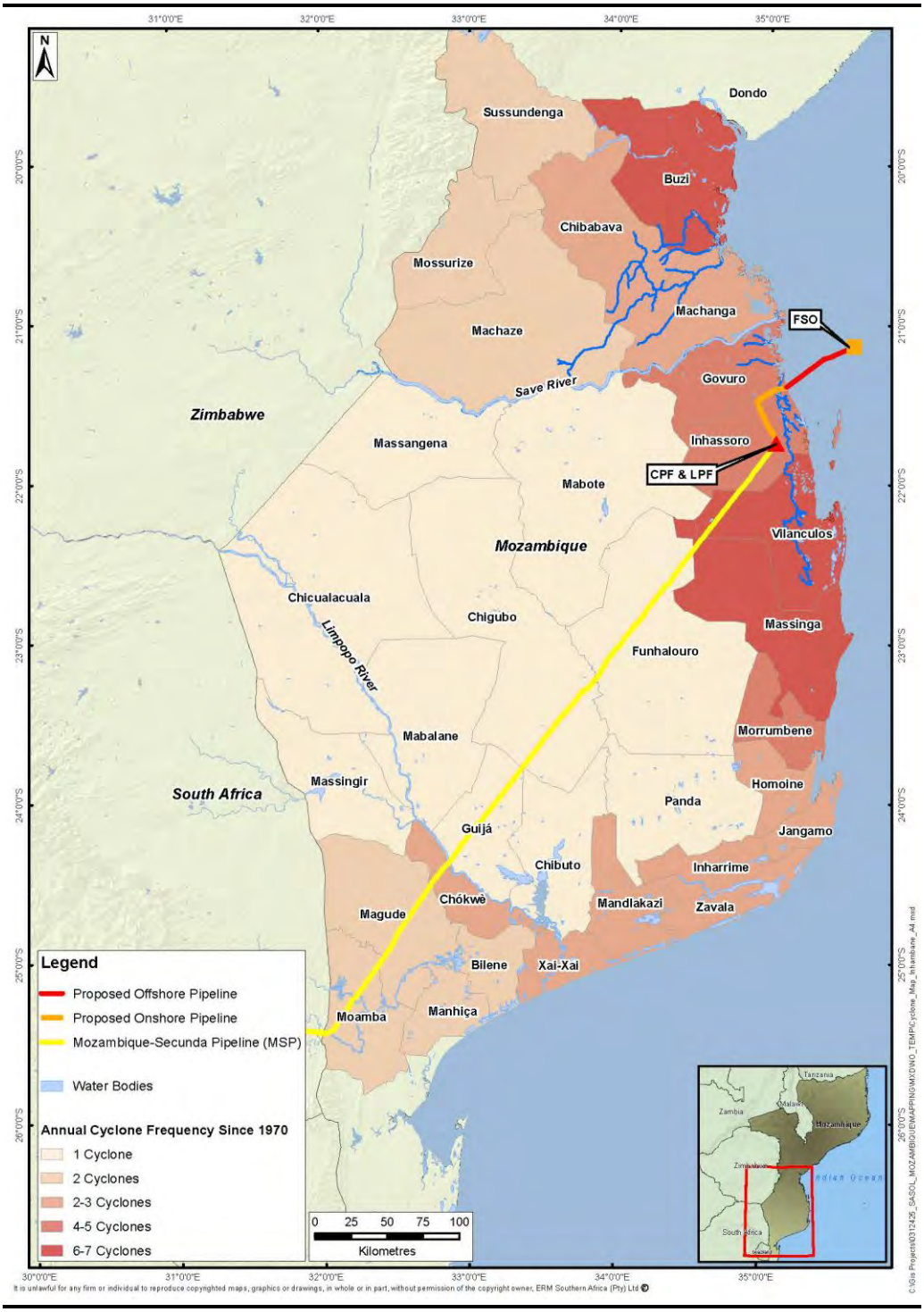
Long Term Climate Trends

The inter-annual variability of the climate of Mozambique is often influenced by large scale global patterns of change such as the El Niño Southern Oscillation (ENSO). Sea Surface Temperatures (SST) in the Indian Ocean (which are at times associated with El Niño) also have a strong influence on the climate of Mozambique. Whilst warm SSTs in the Indian Ocean can lead to drier conditions inland, high SSTs over coastal regions in the Mozambique Channel may result in increased humidity and rainfall.

Mozambique is vulnerable to climatic events such as floods, droughts and cyclones and climate change. Tropical cyclones have become more frequent in recent years leading to major floods events, such as those that occurred in 2008 and 2009. Climate change is expected to lead to greater variability in rainfall and more frequent and intense extreme weather, as well as sea-level rise and temperature increases of up to 3°C (INGC, 2009).

In March 2015, the Inter-tropical Pacific sea surface temperatures were 0.5°C above the average as a result of El Niño. For Southern Africa, El Niño usually means less rain, and as a result of this climatic event Mozambique has been experiencing a drought since 2015 (OCHA, 2015).

Figure 6.4: Occurrence of Tropical Cyclones in Southern Mozambique from 1970



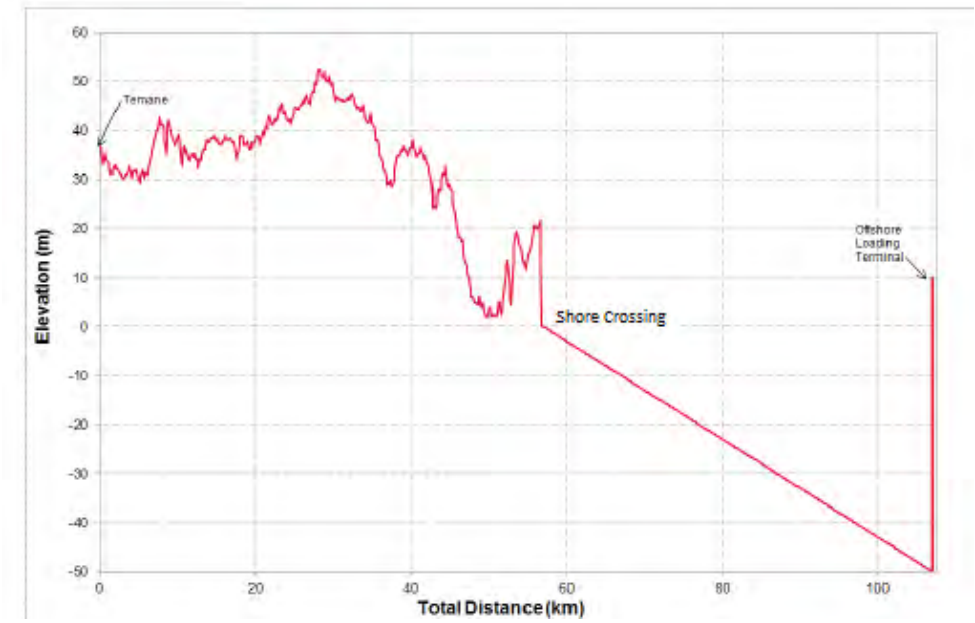
Source: Golder, 2014b

6.2.2 *Topography and Seabed Bathymetry*

The onshore Project Area is situated on the broad southern coastal plain of Mozambique, which rarely exceeds 50 m above sea level (mamsl) (*Figure 6.5*). The terrain along the proposed pipeline route between the CPF and the shore crossing is relatively flat to slightly sloping.

The proposed shore crossing area (*Figure 6.6*) is characterised by a gently sloping beach leading from the sea up to 10 to 35 m high cliffs. The offshore pipeline route shows an approximate one metre drop in sea level every kilometre from the nearshore shallow water (average water depth of 10 m) to the proposed FSO location (approximately 50 m deep).

Figure 6.5 Topography of the Offshore and Onshore Pipeline Routes



Source: Genesis, 2014

Figure 6.6: Proposed Shore Crossing Location

Source: ERM, 2015

6.2.3 *Geology, Soils and Seabed Sediments*

The coastal plain of Mozambique consists of unconsolidated fine to medium textured sands of aeolian (and/or marine) origin that overlay the karstified limestone and calcarenites of the Jofane Formation.

Two types of soils occur in the Project Area: Soil Type A – Clay Loams and Soil Type C - Coastal Sands. Clay loams (Soil Type A) appear to dominate the area to the west of the Govuro River. Coastal sands (Soil Type 'C) dominate the area to the east of the Govuro River, and are quite extensively cropped with maize and groundnuts, but with sufficient trees and shrubs present to limit wind erosion. The coastal soils consist of deep or very deep, grey or very pale yellow-grey sands.

The Bazaruto Archipelago is composed mainly of unconsolidated Quartz sand, with a minor carbonate component from the skeletons of marine organisms (CSIR, 2006), and beachrock. Beachrock formation is an ongoing process which continues to provide the foundation for the continued existence of the islands (ERM, 2006). Additionally, the beachrock outcrops provide the only suitable substrate on which the coral reefs in the area can form (Dutton and Zohla, 1990). There are extensive sand flats present inshore of the islands and to the north and south of the archipelago. These are more intertidal in nature to the south of the islands, and are slightly deeper to the north. The sediments in these areas primarily comprise sand and sandy mud (CSIR, 2006). Further north of the Archipelago, the sediment becomes muddier closer to the Save River Delta due to the silt deposits from the rivers in the region (Pereira *et al,* 2014).

The seabed sediment characteristics in the Project Area are currently unknown but expected to be predominantly sandy. The nature of these sediments will be investigated during the Marine Ecology studies as part of the EIA.

6.2.4 *Surface and Ground Water*

Surface Water

The Govuro River (*Figure 6.7*) is approximately 185 km long and flows roughly parallel to the coastline from south (Cheline) to north (passing Macovane and ending at the Govuro Estuary near the Bartolomeu Dias peninsula. The proposed onshore pipeline crosses the Govuro River approximately 12 km north of Macovane on the western side of the river and near Chibo on the eastern side of the River (*Figure 6.7*). At Nova Mambone, approximately 48 km north of the pipeline shore crossing, the Govuro River and Save River combine to form an extensive coastal estuary, consisting mainly of highly diverse mangrove swamps. The southern margin of this estuary system is approximately 3 to 5 km north of the proposed onshore pipeline, and is protected by a coastal dune system known as the Bartolomeu Dias Peninsula, where several lodges are located.

Extensive seasonal and permanent wetlands are associated with the southern reaches of the Govuro River. In the vicinity of Inhassoro and Vilanculos, a series of coastal lakes occur which vary significantly in size. Most of these contain fresh water and appear to be fed by groundwater but, in some instances, a surface connection to the Govuro floodplain is evident from the satellite imagery. The hydrological drivers supporting these permanent lakes have never been investigated. None of the permanent lakes are located in proximity to the proposed onshore pipeline, the nearest one being approximately 10 km to the south and the majority located over 20 km to the south.

Figure 6.7 The Govuro River

Source: J Hughes 2015

Flow data for the Govuro River suggest an average annual flow of 121 Mm^3 per year (Golder, 2015). Flow varies seasonally and in the lower reaches, as far south as the Inhassoro bridge, it exhibits some degree of tidal influence.

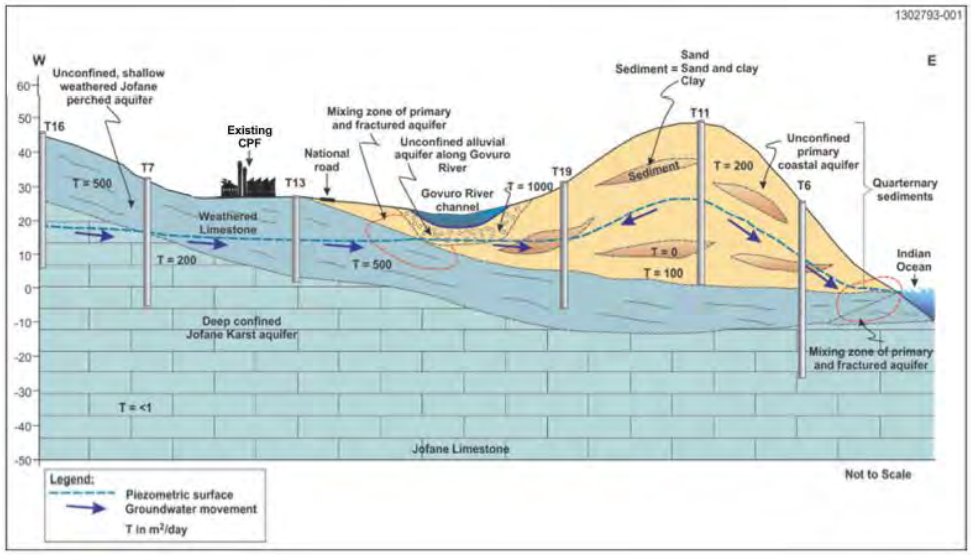
The water quality of the Govuro River is good, with the water being fresh, clear (low turbidity) and having low salinity values. Based on sampling done by Golder (2014) surface water in the Govuro River is more saline and has a higher concentration of Total Dissolved Solids (TDS) in the lower reaches than in the upper reaches. Further north, near the pipeline crossing and increasing towards the estuary, tidal influence results in increased conductivity.

Groundwater Flow

Groundwater flow is controlled by topography, meaning underground water moves from high lying to low lying areas. Groundwater flow in the Inhassoro area largely mimics topography (Golder, 2015), and it is likely to do the same further north in the area of the proposed pipeline. According to the EIA of the PSA Development (Golder, 2014), the Temane area has a general groundwater level elevation of 16 to 25 mamsl and flows towards the Govuro River to the east (*Figure 6.8*).

The areas to the north east towards Inhassoro are characterised by deeper water levels (>31 mamsl), creating a localised water divide between the coastal dunes and the Govuro River. A similar situation occurs towards the southeastern coastal area (Chipongo area). The water table depth decreases closer to the Govuro River. During the rainy season, increased flow in the Govuro River recharges the groundwater system. During low-flow conditions in winter, groundwater feeds the river system, indicating close interaction between the surface and groundwater systems.

Figure 6.8 Conceptual Model of the Hydrogeology of the Project Area



Source: Golder, 2015a

Groundwater Quality

Groundwater quality is controlled by annual recharge of the groundwater system, rock type and flow dynamics within the aquifers, and in some instances, by sources of pollution. Sampling shows that groundwater quality is dominated by calcium and magnesium ions (Ca and Mg) west of Temane and sodium chloride (NaCl) towards the coast. The latter is typical of the saline environment associated with the Jofane Limestone aquifer that occurs in the area and which is the dominant water source for communities in the Temane area. The high concentrations of total dissolved solids, especially sodium and magnesium, result in water tasting brackish (slightly saline). Nearer the coast in the Inhassoro area (and possibly similar in the onshore pipeline area), there is a dune aquifer overlying the Jofane limestones with fresh groundwater due to recharge from rainfall and the Govuro River. Here communities rely on shallow hand dug wells that reach this unconfined aquifer.

Aquifer Parameters

The boreholes tested in the PSA area to the south of the pipeline varied in depth from 20 m to 150 m. The transmissivity of the groundwater (ie rate of horizontal water flow) varies between 541 and 9245 m^2/d (Golder, 2014b), which means that aquifer attributes are not directly related to a deeper lying limestone aquifer, but rather to a mixture of systems. Transmissivity through the limestone aquifer was on average 551 m^2/ day with water in the upper shallow zone moving around 16 m^2/day. The higher transmissivities are likely to be associated with either highly karstified limestone and/or with permeable sand aquifers closer to the coastline.

6.2.5 *Physical Oceanography*

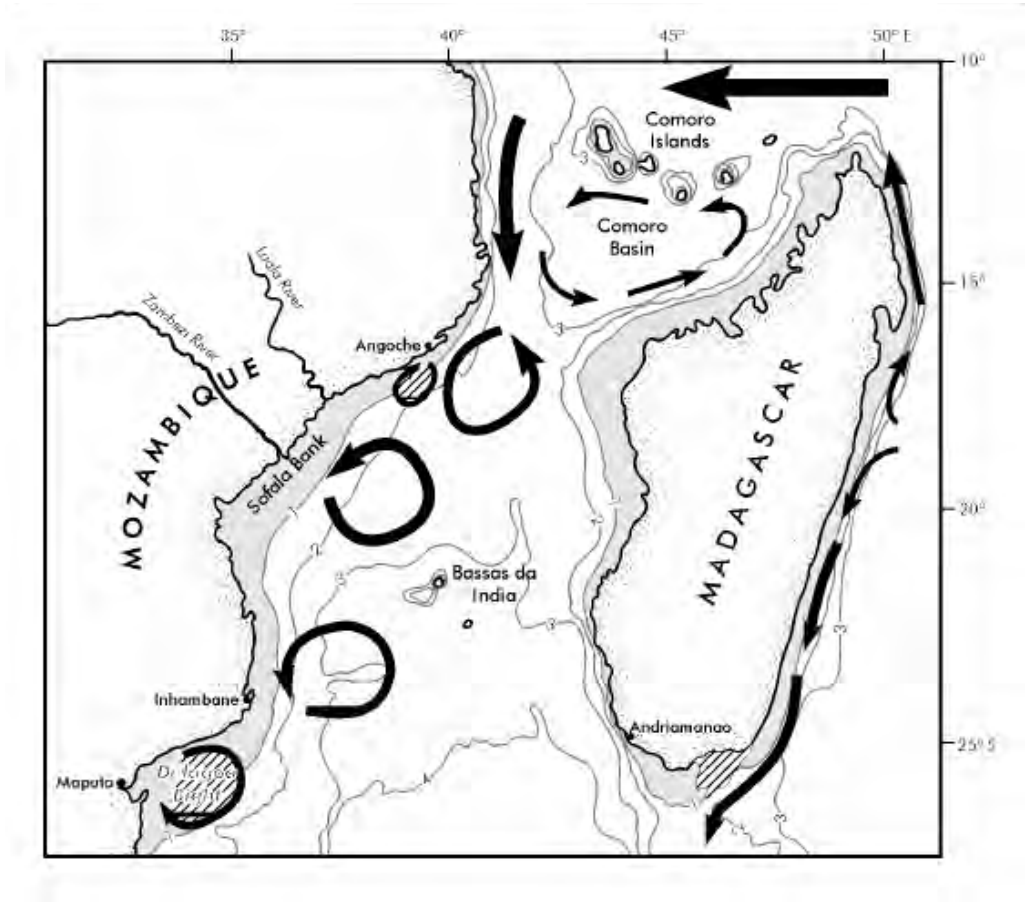
Distinct circulation patterns are recognised for the continental shelf, open ocean and Bazaruto Bay. The circulation of the open ocean adjacent to Bazaruto Archipelago is governed by the Mozambique Channel circulation system which comprises a series of intermittent large-scale eddies drifting southward (*Figure 6.9*). Surface currents associated with this circulation system are known to flow southward throughout the year, with flow speed varying with the seasons. This current is predominantly southwards and is strongest in summer (October to February), attaining speeds of up to 2 m/s during this period and 1.3 m/s at other times during the year (ERM, 2006).

However, for the inshore region of the Archipelago, there is an indication of intermittent inshore counter currents which flow predominantly northward with speeds of approximately 0.8 m/s. These currents are known to be highly variable in both speed and direction and are wave-driven and consistent with the wave patterns of this region. In the bay, the main feature of circulation is the occurrence of strong tidal currents that drive water into the bay during the flood phase of the tides and out of the bay during the ebb tide (ERM, 2006).

Within the Bazaruto Archipelago the water temperature ranges from 23°C in winter to 27 °C in summer and the salinity ranges from 35.4 PSU in winter to 34.7 PSU in summer (Dutton and Zolho, 1990).

The tides are semi-diurnal. The mean spring tidal range is approximately 3 m during normal spring tides, increasing to approximately 4.4 m during equinoctial spring tides. The tidal range at spring highs produces strong tidal currents in the channels between the islands that transport vast quantities of sand to form extensive flood- and ebb-tide deltas. These strong tidal flows also maintain the deep channels on the landward side of the islands and transport sand across the tidal flats (ERM, 2006).

Figure 6.9 ***The Major Circulatory Features in the Mozambique Channel***

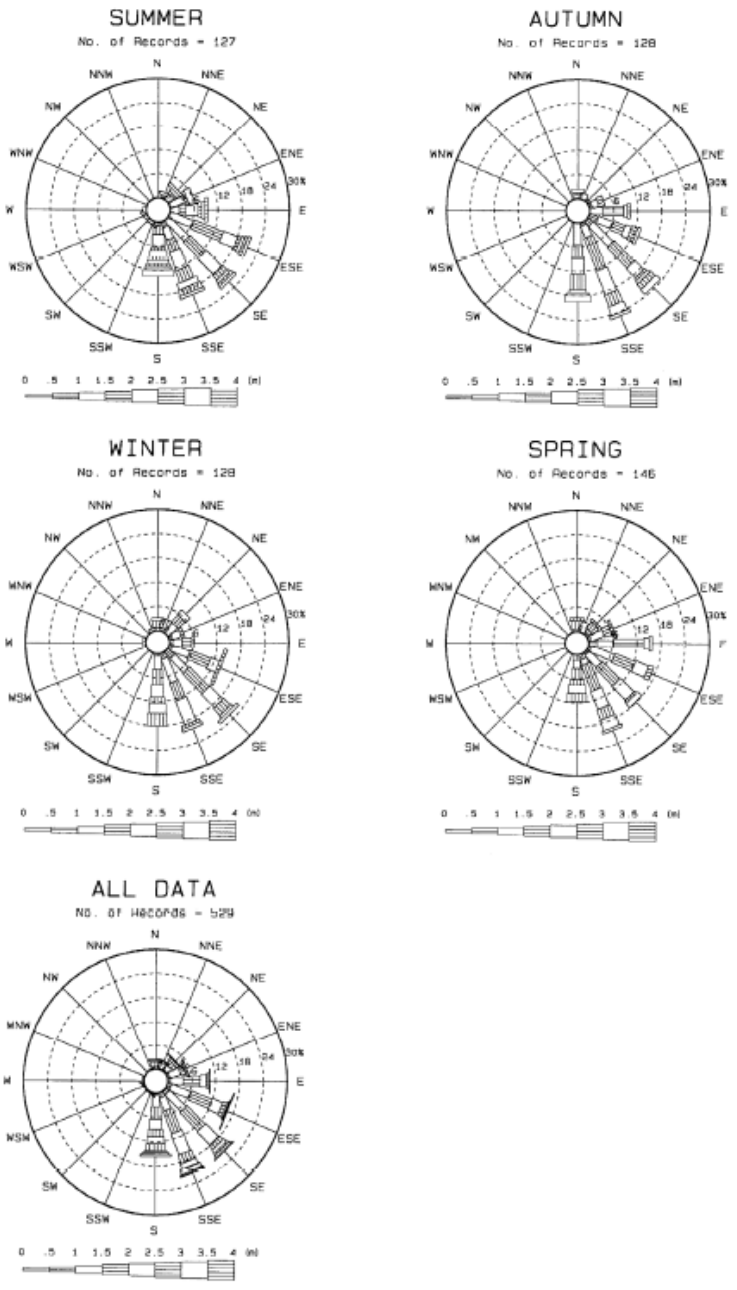


Source: Lutjeharms, 2006

The offshore wave environment is driven by winds and dominated by a south-easterly wave origin (*Figure 6.10*), with the highest waves originating from the south during the summer months (October to February) (ERM, 2006).

Closer inshore, surrounding the islands of the Archipelago and within the Bay, wave action is restricted to the seaward side of the islands, including coastal areas further north of the Archipelago, where the proposed development occurs. The wave action in these areas prevents the formation of extensive intertidal flats, such as those which are present to the south of the Archipelago and inshore of the islands. The leeward side of the islands is sheltered from direct wave energy, and thus have more tranquil conditions, which is dominated more by tidal energy (CSIR, 2001; ERM, 2006; Everett *et al,* 2008).

Figure 6.10 Offshore Wave Height and Direction



CSIR, 2006[2]

[2] observations from voluntary observing ships in a block (21°30′-22°30′S ; 35°-36°E) and for the period 1968 to 1998

6.2.6 *Physico-Chemical Regime of Offshore Water Masses*

The physico-chemical characteristics of the water masses of Bazaruto Bay and the nearshore areas north of the Bay exhibit spatial and temporal variability. Salinity along the coast is seasonally affected, where evaporation and low river runoff increases salinities (to between 35 and 36 PSU) in the dry season and an increase in freshwater inputs decreases salinity (to between 33 and 35 PSU) during the wetter summer months. During the rainy season, spatial variation in salinity occurs across the Bay with higher salinities in the eastern part and lower salinities along the coast in the western part. The western coastal areas are estuarine and in the wet season are increasingly influenced by the freshwater inputs from the Save River outflow (ERM, 2006).

6.2.7 *Air Quality*

Onshore

The onshore pipeline route extends from the northern perimeter of the CPF through rural and largely unsettled areas to the coast. Increased dust during pipeline construction is the primary air quality pollutant likely to be generated by the Project, particularly in areas such as the Govuro floodplain which comprises fine grey dust. Fortunately, there appear to be few settlements in this area apart from Macovane, located at the edge of the floodplain.

Sasol has conducted regular ambient and stack monitoring campaigns at the CPF over the past number of years (Mark Wood Consultants, 2015) to check compliance with the limits specified in the Operational Environmental Management Plan (oEMP). The baseline monitoring programme for the PSA Development EIA (Golder, 2014b) confirmed that the CPF has caused a negligible change in air quality beyond the boundaries of the site over the past 10 years. Ambient concentrations of SO_2, NO_2 and organic pollutants are measured at the boundary of the CPF and remain within the target levels specified in the oEMP. However dust levels have occasionally exceeded target levels due to construction activities at the CPF: high dust levels recorded in 2011 show a decline from 2012 to within target levels coinciding with reduction in earthmoving activities (Airshed, 2015).

Ambient air quality in the rural areas along the pipeline route is mainly impacted by the burning of woodland and grassland for clearing agricultural land and for grazing, hunting and settlement, as well as burning of waste and fuels. Annual burning during the dry winter months preceding the rain season typically results in hazy and dusty conditions.

Offshore

The offshore pipeline and FSO will be located in the marine environment remote from any industries, settlements or other onshore sources of air pollution. The only offshore sources of air pollution are from vessels (eg container and tanker vessels etc) travelling along shipping lanes in proximity to the Project, and vessels (eg shuttle tankers, supply vessels etc) involved in oil and gas operations in the area. The offshore air quality is considered to be essentially unaffected by anthropogenic sources.

6.2.8 Noise

Onshore

The onshore pipeline route is in a quiet rural environment unaffected by road noise or industrial noise sources. At the CPF, noise levels are elevated due to the operation of mechanical equipment and the flare stack, reaching 65dB(A) at the plant boundary, but this quickly decreases to the natural background ambient away from the plant. Where the pipeline crosses the EN1, the sound environment is only influenced by passing traffic, particularly buses and trucks.

Offshore

Anthropogenic noise in the offshore region is minimal due to the lack of industrial and other activities. Current levels of noise and vibration offshore are due to natural sources (water movement and weather events) with contributions from existing vessel traffic.

6.3 ONSHORE BIOLOGICAL ENVIRONMENT

6.3.1 Introduction

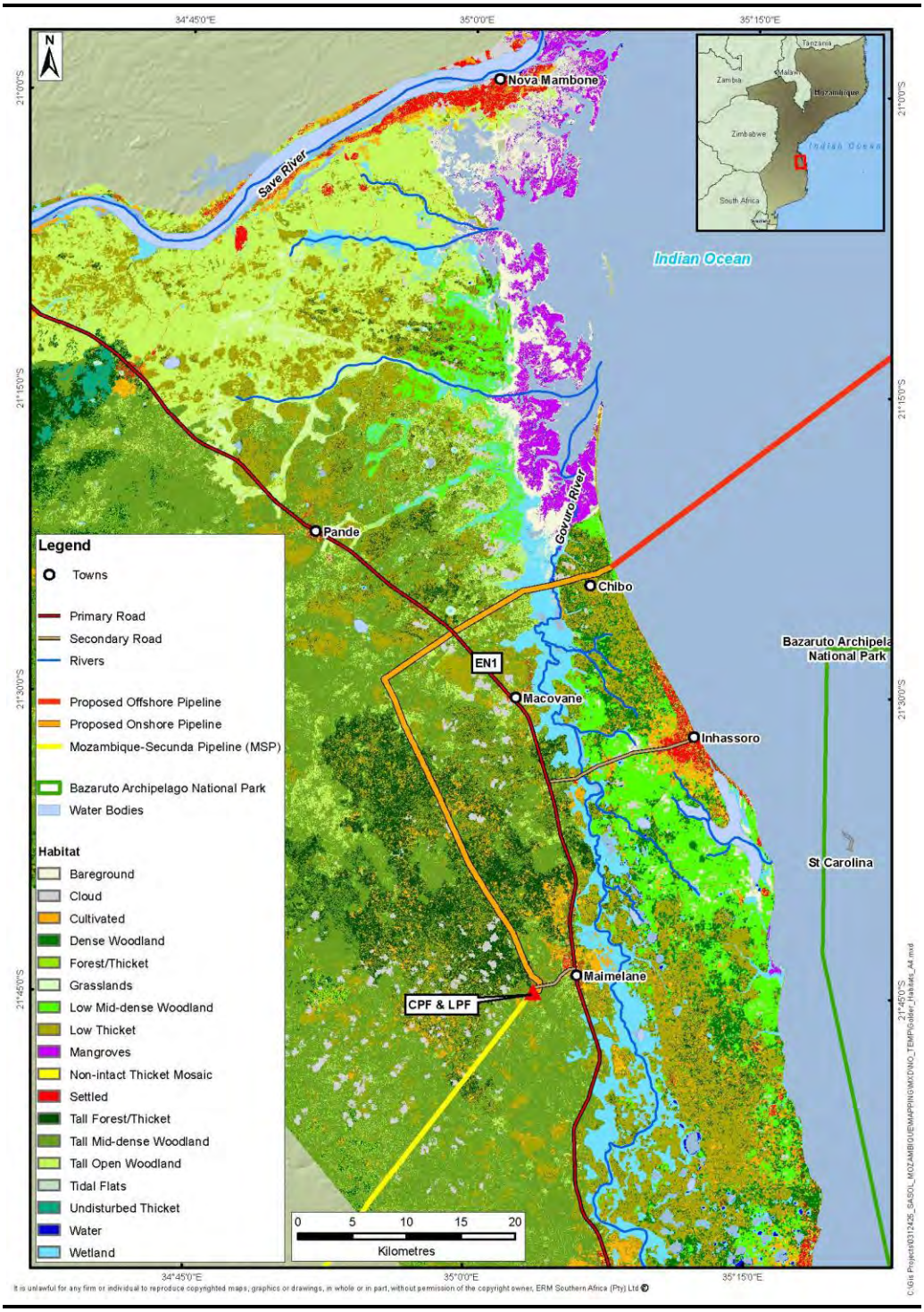
A number of surveys have been conducted recently in the broader onshore pipeline area. These include surveys in Pande Block (approximately 2 to 20 km to the north of the onshore pipeline) for the PSA Development EIA (Golder, 2015b) and for the EIA of exploration and development activities in the Pande, Temane and Inhassoro (PTI) Blocks (hereafter referred to as PTI EIA). The biodiversity data from these studies is considered broadly representative of some of the woodland and forest habitats along the FSO pipeline route. The biodiversity identified during these studies that is considered relevant to the FSO pipeline route are summarised below. Seasonal field surveys in the onshore pipeline corridor will be undertaken to confirm habitats and species that may be impacted in the area of influence of the pipeline.

6.3.2 *Vegetation and Flora*

Vegetation

Structural habitat types and land cover units in Sasol's area of operation and exploration have been mapped from 2014 satellite imagery (*Figure 6.11*) (Golder, 2015c). Habitat types traversed by the onshore pipeline are summarised in *Table 6.3*.

Figure 6.11 Habitat and Land Cover Types in the Project Area



Source: Golder 2015c

Table 6.3 Vegetation/Habitat Units Occurring in the Project Area

Vegetation/habitat type	Description
Mixed Woodland and Thicket Mosaic (Unit 1)	A mosaic of woodland and dense thicket vegetation with frequent, small patches of tall forest or thicket on termite mounds. It comprises the largest habitat unit in the Temane / Inhassoro portion of the Project Area. It occurs only west of the Govuro River between the Save River in the north and Inhambane in the south (about 300 km) and between ~20 to 60 km inland from the coast. Dense thickets contain trees up to 18 m high whereas short thickets often have 95 – 100% canopy cover and are impenetrable. Species richness and cover of woody climbers is high with many flora species largely or entirely restricted to this habitat. Ilala palms (*Uchema*), used for making palm wine, occur throughout vegetation/habitat units 1 and 2. Logging, mostly illegal, has resulted in severe over-exploitation of the Pod Mahogany tree.
Julbernardia-Brachystegia Short Woodland and Thicket (Unit 2) (includes coastal forests and dune forests)	This vegetation is dominant in the area east of the Govuro River, and comprises short thicket communities with high species diversity. Regionally, the largest and best conserved patches of coastal forest and dune forest along 90 km of coastline occur within this habitat, with trees of up to 18 m in coastal forest (although not within the FSO pipeline corridor). The trees *Julbernardia globiflora* and *Brachystegia spiciformis* were not recorded anywhere else within the Project Area. An absence of large trees is probably the result of current and historical use of fire to clear land for cultivation. *Julbernardia* and *Brachystegia* in the east of the Project Area appear to be unsustainably harvested for sale as firewood.
Govuro River Floodplain	Wetland systems occurring on the coastal plain include riverine floodplains, swamps and pans, largely situated within the Govuro River floodplain, and mangrove (tidal) forests along the coast. Marsh vegetation and hygrophilous grassland plant communities are entirely restricted to the Govuro River and its floodplain within the Project Area . A critically endangered species of cycad, *Encephalartos ferox* subsp *emersus,* has been recorded in the Govuro floodplain (Rousseau, 2015). Various plant species appear to be largely or entirely restricted to these types of coastal floodplains, including a sedge - a new record for Mozambique - and a grass likely to represent a unique 'ecotype' (both confirmed near the Nhangonzo coastal stream approximately 25 km south of the pipeline). The Govuro River plays a crucial role in maintaining the mangrove swamps at its mouth in Bartolomeu Dias Bay, regarded as some of the most species - rich mangroves on the entire East Africa seaboard (http://ramsar.wetlands.org), where it supports commercial and subsistence fisheries. The river supplies drinking water, building material (the reed *Caniço*) and termite-resistant thatching grass (*D'jeca or Musule*) to local communities, and assists with flood attenuation. The Govuro River provides important fishing resources, especially from the lower reaches and estuary.

Vegetation/habitat type	Description
Ephemeral Drainage Lines (only flow in response to heavy rainfall and can experience no flow for long intervals, years or even decades)	Various ephemeral streams and large ephemeral wetland flats occur east of and drain into the Govuro River. They have important functional value by maintaining hydrological patterns and water quality in the systems into which they discharge. Several plant species have been recorded only from Ephemeral Drainage Lines. No coastal streams traverse the coastal plain near the onshore pipeline route but several occur nearer Vilanculos, some of which are assessed as Critical Habitat mainly due to the presence of peat wetlands (Golder, 2014a). These occur approximately 25 km south of the pipeline route.
Mangrove Swamps	The mangrove forests of the Govuro and Save River estuaries comprise the largest remaining and largely intact area of estuarine mangroves along the coastline of Sofala Bay. The next nearest estuary is the Nhangonzo estuary, located to the south. These mangrove forests exhibit high species diversity relative to those in South Africa, with eight of the 11 mangrove species recorded for Mozambique confirmed here. The edge of the mangrove forest on the seaward side is surrounded by mud flats where large flocks of waders occur. Mangroves fringe the Govuro River approximately 4 km north of the proposed pipeline crossing and become more extensive in the estuary itself. None occur at the pipeline crossing.
Hummock Dune Pioneer Communities (pioneer communities of salt tolerant species (halophytes) restricted to primary dunes).	This is a unique ecosystem which occurs along an approximately 3 km length of coastline on small primary dunes on the landward side of bands of mangrove forest situated below the high water mark. The landward side of the dunes consists of freshwater wetlands formed by non-perennial tributaries of coastal streams and seepage from high frontal dunes (with dune forest communities). These vegetated dunes are likely to play a critical role in allowing freshwater seepage into the mangrove swamps, whilst preventing the influx of tidal surges into the tributaries.

Flora

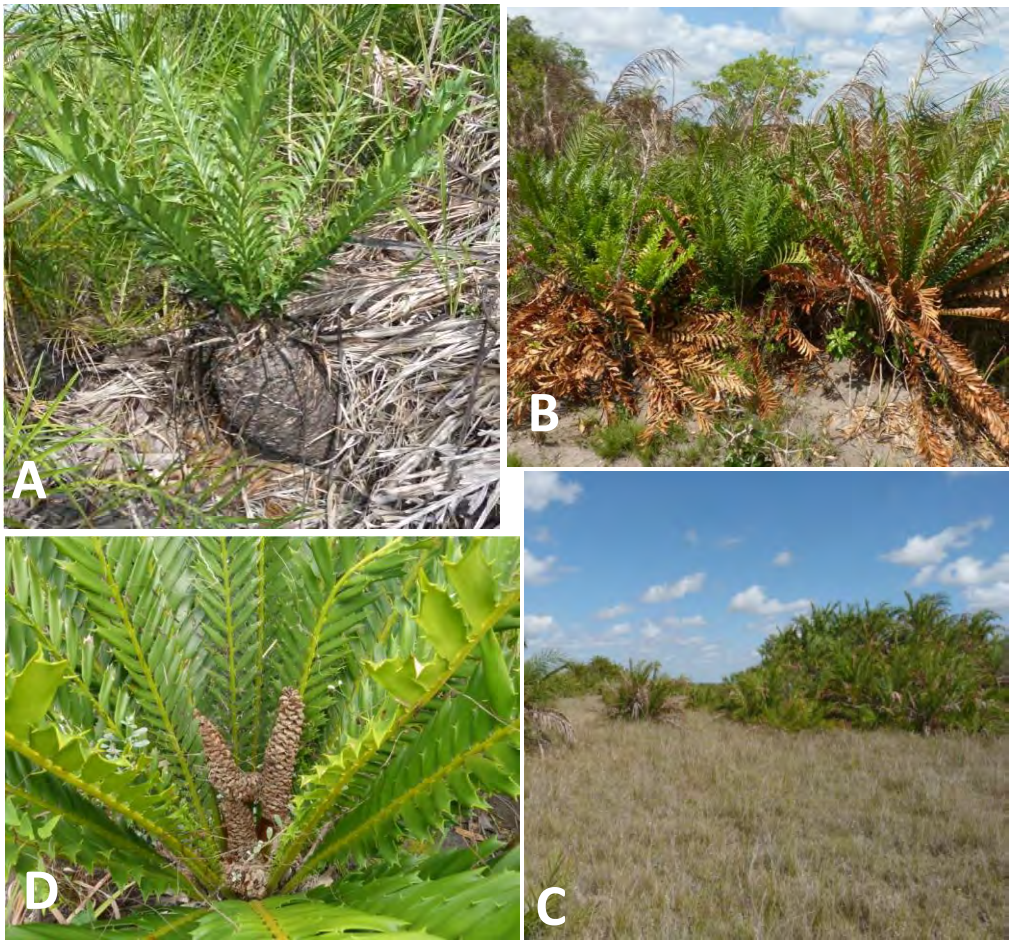
A number of plant species of conservation concern have been found in the Project Area, either because they are IUCN red-listed species, at risk of extinction, or because they are endemic species with localised distribution. These include:

- A critically endangered subspecies of cycad – *Encephalartos ferox* subsp *emersus* – recorded on the Govuro River floodplain (*Figure 6.12*).

- Three tree species of conservation concern (*Dalbergia melanoxylon*, *Pterocarpus angolensis* and *Afzelia quanzensis*) that are listed as Near Threatened on the IUCN red list (2015).

- *Xylia mendoncae* (Vulnerable species on Mozambique red list, endemic to Inhambane Province but relatively common on the coastal floodplain (listed as Data Deficient by IUCN); *Crinum stuhlmannii* (listed as declining on the South African Red Data List), and two endemic and Data Deficient species - *Carissa praetermissa* and *Ziziphus pubescens* (recorded in coastal habitats).

Figure 6.12 Cycad Encephalartos ferox subspecies emersus and its Typical Habitat



A = Adult Plant; B = Plants damaged by a recent fire; C = Typical cycad habitat; D = Male cones

Source: Rousseau 2015

6.3.3 Terrestrial Fauna

An estimated 29 frog species, 56 reptile species, 275 bird species and 94 mammal species are expected to occur in the region (Golder, 2014b). Woodland and thicket vegetation types potentially support the most diverse range of terrestrial fauna (~363 species) followed by coastal wetlands with 156 species, and the Govuro River and floodplain with 143 species. The majority of mammal and bird fauna species expected to occur are widespread habitat generalists.

Mammals

Based on anecdotal reports and field reconnaissance, most large animals (eg elephant, lion, and hippopotamus) no longer occur in the Project Area of the pipeline, although they may occur in the lower Govuro River and the Save River valley. However, a wider diversity of buck and other mammals can be expected to occur in dense woodland and thickets in the more inaccessible northern portions of the pipeline Project Area.

Few, if any, Red Data mammal species are expected to be found in the woodlands of the area and it is only the striped leaf-nosed bat and leopard that probably occur in small numbers in the denser, more isolated parts of the Project Area.

The Govuro and Save estuaries and inshore coastal habitats provide favourable habitat for the marine mammal, the dugong, listed as globally Vulnerable on the IUCN red list (refer to *Section 6.4.1* and *6.4.4*).

Birds

Bird diversity in terrestrial habitats is expected to be relatively high, especially in woodland and forest habitats. The majority of Red Data bird species confirmed or likely to occur are widely distributed and with large home ranges and include: white-headed vulture, bateleur eagle, pallid harrier, martial eagle, crowned eagle, sooty falcon, European roller, plain-backed sunbird and secretary bird. The Near-Threatened lesser flamingo may visit the barrier lake wetlands and estuarine habitats, while the Vulnerable wattled crane may be seasonal visitors to the Govuro floodplain wetlands.

Along the coast, mangroves and the extensive estuarine mud flats provide feeding grounds for freshwater and marine wading birds.

Reptiles and Amphibians

Previous surveys of reptiles and amphibians were restricted to localised areas, particularly in the southern portion of the Project Area. New distributional records of reptile species and possibly a new species of lizard (Golder, 2014b) were recorded in the coastal streams of Nhangonzo near Inhassoro, to the south of the pipeline. One Red Data reptile, the Zambezi flat-shelled terrapin, is expected to occur in the coastal estuarine area downstream of the onshore pipeline. The majority of reptiles in the Project Area are expected to be widely distributed across the woodland habitats. No amphibian species are expected to be restricted to localised areas of the pipeline corridor as few wetland types are present and the Govuro floodplain is fairly uniform along its length.

6.3.4 Aquatic Ecology

The Govuro River is the only perennial river crossed by the proposed pipeline and comprises the flowing river course (aquatic) and the associated floodplain (riparian). The aquatic habitats of the Govuro River are largely unmodified in the area of the pipeline crossing, although the riparian zones are cultivated close to settlements in upper reaches of the river.

The only noteworthy use of plant resources along the river system is the harvesting of reeds (*Phragmites australis*), saw grass (*Cladium mariscus*) and Ilala palms (*Hyphaene coriacea*), which are dominant species within the central zone of the floodplain. Riparian trees are scarce as the riverine zone rapidly merges into the terrestrial woodland system.

The in-stream habitats of the Govuro River are fairly similar for most of its length comprising an incised channel with water weeds and emergent lilies. There are no riffle rocky substrate areas although calcrete outcrops occur in the river in places. This limited habitat diversity is expected to restrict the biodiversity of aquatic biota - a total of 49 fish species are expected in the Govuro River system (Golder, 2013), of which 26 species have been collected in surveys associated with Sasol. Six fish species were reasonably common in the coastal streams to the south of the study area near Inhassoro; namely the sharptooth catfish, eastern river bream, Mozambique tilapia, black tilapia, many-spined climbing perch and mesh-scaled topminnow.

The tidal influence on water quality results in the occurrence of some species tolerant of estuarine conditions in the lower reaches of the river. Several estuarine or marine species, such as the oxeye tarpon, round moony, butterfly fish, rock flagtail, longspine glassy, river bream, flathead mullet and large-scale mullet have been recorded near the existing pipeline crossing (Golder, 2013).

Although fish surveys to date under-represent actual fish diversity due to sampling difficulty, only one threatened species has so far been recorded in the Govuro River: the orange-breasted river bream (Endangered), caught in 2004. Mozambique tilapia is regularly caught by the local fishermen and is Near-Threatened.

Twelve barrier lakes are situated between the Govuro River and the coastline to the south of the pipeline crossing. Although the terrestrial flora and fauna along the barrier lakes is diverse, the aquatic diversity in the lakes is low (Deacon, 2014). Notwithstanding the low diversity, the presence of fresh water as a source of drinking water and the presence of fish as food for humans create an ecosystem that has high conservation value. None of these barrier lakes are within the area of influence of the pipeline.

6.3.5 Protected Areas and Species

No onshore protected areas occur near the onshore pipeline. The Zinave National Park occurs to the west of Pande Block and the Coutada 4 Hunting Reserve on the north side of the Save River (*Figure 6.16*).

Certain species within the Project Area are protected, as follows:

- Forest and Wildlife Law (*Decree No 12/2002*) provides for the protection of timber trees; many medium to large mammals and birds. Protected trees species relevant to the onshore pipeline will be determined and listed in the EIR.

6.4 OFFSHORE BIOLOGICAL ENVIRONMENT

6.4.1 Marine Fauna

Phytoplankton and Zooplankton

Plankton are microscopic organisms which drift in the seawater column. There are two main categories of plankton, which are phytoplankton (microscopic plants) and zooplankton (microscopic animals). Phytoplankton are the primary producers in the food chain and form the basis of the marine trophic web and are therefore a key indicator of the productivity of a local ecosystem. Zooplankton, which includes eggs and larval forms of various marine life, play a significant role in the marine trophic web by transferring energy from phytoplankton through to higher trophic levels when they are eaten by larger marine animals.

Little information is available on phytoplankton in offshore Mozambique. Phytoplankton abundance and distribution in the region is strongly dependent on the environmental and oceanographic conditions, such as currents and upwelling, as well as river run off (Sá *et al,* 2013).

As with phytoplankton, information on zooplankton in the Mozambique Channel is scarce. A survey of the western Mozambique Channel in 1980 indicated higher levels of mesozooplankton in inshore regions compared to offshore regions (Nehring *et al,* 1987). During this survey, the inshore region of the Bazaruto Archipelago was seen to be among the most productive along the Mozambican Coast (Nehring *et al,* 1987; Ternon *et al,* 2014).

Large Invertebrates

Crustaceans are a diverse group of fauna which includes shrimp, lobsters and crabs. They are widespread and found in nearly all marine habitats in the Project Area. Rock lobsters are found in the intertidal rocky shore and in deep recesses of the rocky reefs while crabs are found in a diversity of habitats ranging from sandy flats and shores, rocky shores, mangroves as well as salt marshes, seagrass, coral reefs, and deeper water. Mangrove mud crab (*Scylla serrata*) are common in the estuaries and the mangrove creeks at Sofala Bank (from Govuro Bay and northward) while the blue crab species (*Portunus sanguinolentus*) is abundant in the turbid but saline shallow waters (depth<20 m) of the Sofala Bank.

Several species of squid, cuttlefish and octopus species may occur in the Project Area and adjacent habitats. Squid species are common in the deep open sea. In Bazaruto Bay, deep channels nearshore allows some squid species to be caught by the beach seine fishery. Most individuals caught are juvenile (immature) specimens of the diamond-back squid and Indian squid. The cuttlefish (*Sepia pharaonis*) is common in shallow waters and dominates the beach seine fishery along the coast of Vilanculos and Inhassoro Districts (ERM, 2008).

Benthic Community

There are no data available on the benthic fauna of the Bazaruto region. As in other marine environments, benthic community structure is expected to be linked to sediment properties (Newell *et al,* 1998). Benthic data will be collected along the offshore pipeline route in the marine ecology specialist study during the EIA phase.

Seabirds

Pelagic seabird species are considered to be rare around the Project Area, including the Archipelago, due to the proximity to the coast and lack of upwelling water to produce a constant supply of food. However, previous sightings of pelagic species in the BANP Area include the red-footed booby, the cape gannet, the greater frigate bird and the lesser frigate bird (ERM, 2006; ORI, 2008).

Marine Mammals (Whales, Dolphins, Dugongs and Seals)

Whales and Dolphins

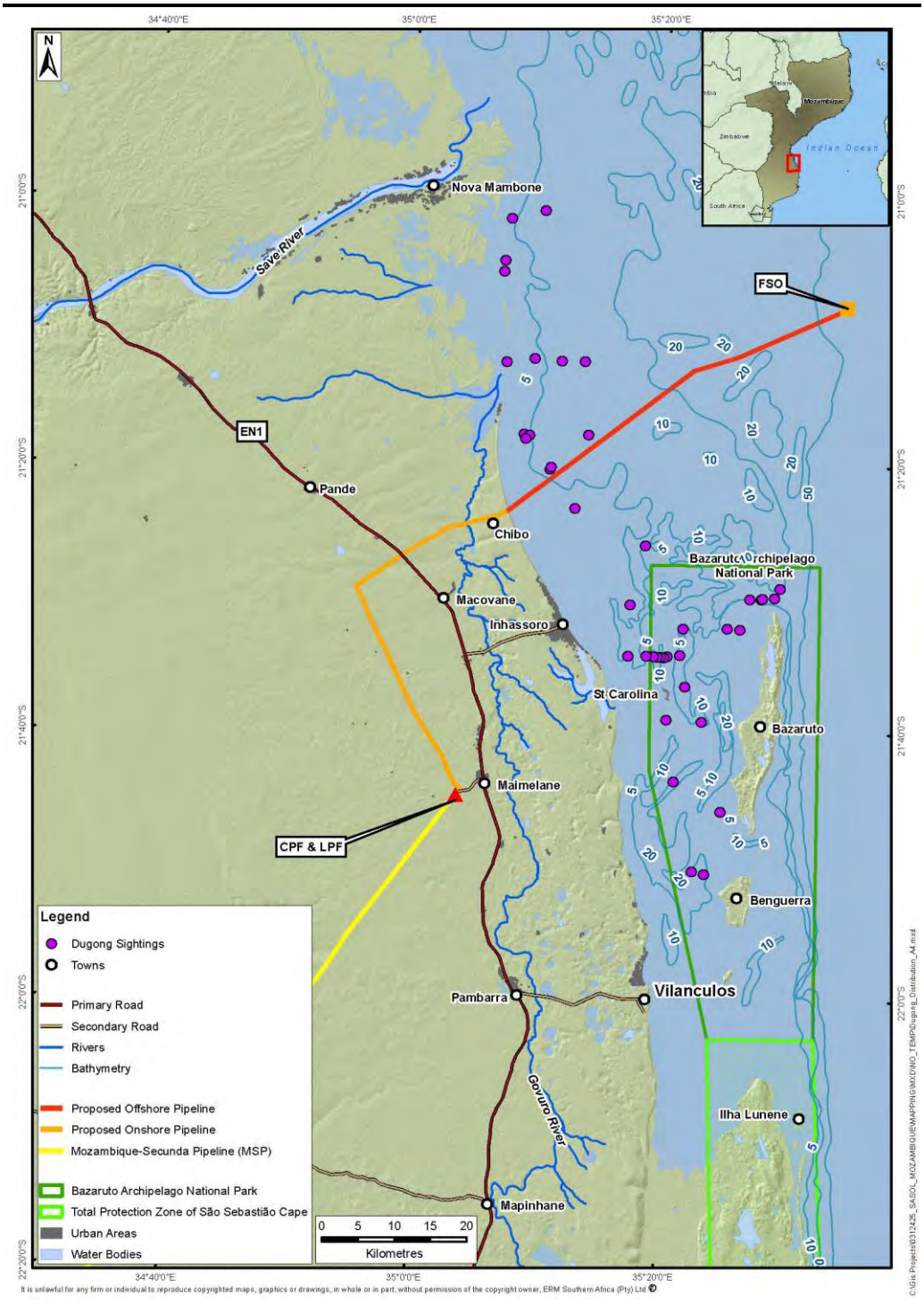
Five species of dolphins (namely the common, humpback, bottlenose, spinner and spotted dolphins), five species of toothed whales (namely the short-finned, false, beaked, sperm, and dwarf sperm) and two species of baleen whales (Minke and humpback whales) have been recorded in the Project Area (ERM and Impacto, 2011). All cetaceans are considered protected species in Mozambique (Forest and Wildlife Law *Decree No 12/2002*).

Dugongs

Dugongs occur mainly in shallow waters of the sheltered bay between the islands of the Bazaruto Archipelago region, from Cabo São Sebastião in the south to the Save River mouth in the north (Findlay et al. 2011; Allen 2013; Samoilys et al. 2015) and are often seen in the vicinity of seagrass beds where they feed (*Figure 6.13*). Small calves have been observed in the area, suggesting the dugong population is breeding. This population is considered regionally important and the last remaining viable population along the Western Indian Ocean coastline, where it is estimated to number 200 to 250 individuals (EWT, 2013). They are listed by IUCN as Vulnerable to extinction but have been assessed as regionally Endangered[3]. In Mozambique dugongs are considered a protected species under the Forest and Wildlife Law (*Decree No 12/2002)*. Anthropogenic threats to dugongs include habitat loss, hunting, incidental killing in fisheries and collision with boats.

[3] Second signatory state meeting of the Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats throughout their Range, 2013, cited in EWT 2013.

Figure 6.13: Dugong Adult Distribution in the Project Area



Sources: Cockcroft et al, 2008 and EWT, 2014

Seals

Two seal species, namely the crabeater seal and sub-antarctic fur seal are occasionally found in the area (Guissamulo & Cockroft, 1996) but these records are of vagrants considered to be outside of their normal distribution range (ERM, 2006).

Marine Turtles

Five species of sea turtles are likely to occur in the Project Area, namely the green, loggerhead, olive-ridley, leatherback and hawksbill turtles (ERM, 2006).
The species that may occur in the Project Area are classified as threatened (IUCN, 2016):

- Loggerhead turtle: Vulnerable (global population) and Near threatened (South West Indian Ocean subpopulation);
- Leatherback turtle: Vulnerable (global population) and Critically Endangered (Southwest Indian Ocean subpopulation);
- Green turtle: Endangered (global population);
- Hawksbill turtle: Critically Endangered (global population); and
- Olive-ridley turtle: Vulnerable (global population).

*T*he green turtle and the loggerhead turtle are caught in the inshore beach seine fishery which indicates the presence of these species in the inshore waters of Inhassoro and Bazaruto Bay (Chacate, 2005). Most catches of adults occur between October and December.

The sandy beaches along the coast from Inhassoro to the Govuro River mouth, especially those areas characterized by small dunes, larger beach width and weak erosion (such as on the Nhamábuè Point) are suitable nesting areas of the loggerhead turtle and possibly of the green turtle (Marshall *et al*, 2015). Green and olive ridley turtle remains were recorded in the São Sebastião area (Jacobsen *et al*, 2008) although it was not clear if they breed here. Leatherback turtles also nest in the São Sebastião area (*Figure 6.16*). The nesting season of these turtle species is between October and February and hatched turtles are found between January and April. These periods are critical for nesting, although resident turtle species, such as the green turtle, may occur year round (ERM, 2008). All sea turtles are considered protected species in Mozambique (Forest and Wildlife *Decree No 12/2002*).

Fish

The fish which occur around the Archipelago represent more than eighty percent of all marine fish families of the Indo-pacific region (CSIR, 2001). Recruitment of fish to the Archipelago will be reasonably secure in view of the large area of their distribution. Sailfish, three species of marlin, sharks and migratory tuna are common in the deeper waters off the continental shelf.

Within the floodplains of the Govuro and Save Rivers the following fresh water fish are known to occur: Red-breasted Tilapia, Mozambique Tilapia and Black Tilapia.

Mozambique Tilapia and Black Tilapia are particularly abundant in the barrier lakes and form an important part of the subsistence fisheries in the area (Mark Wood Consultants, 2002).

6.4.2 Sensitive Coastal Habitats

This section describes a number of coastal habitats that are regarded as sensitive due to their ecological importance or vulnerability to disturbance.

Sand Dunes

The dunes most sensitive to human disturbance would be those on the eastern seaboard of the islands. These are mobile and are advancing in a westerly direction. The fore-dunes on the western side are mainly bare coastal sand dunes with few pioneer plant species.

Removal of these pioneers destabilizes the dunes. Likewise, the seaboard coast of São Sebastião at the sand spit known as Ponat Minga, the coast north of Vilanculos and the coast south of the Govuro River mouth and estuary (along the Bartolomeu Dias Peninsula), have recently established dunes with white sands, showing the same features of instability as those of the islands. The older dunes along some stretches of the coast from Vilanculos and along the northern coast of Inhassoro District, have suffered severe erosion caused by wind, human settlement and rainfall.

Sandy Beaches

Sandy beaches occur along most of the coast of the mainland between Cabo São Sebastião and Bartolomeu Dias Point, where they make up most of the east and west coasts of the islands of the Archipelago. Beaches are typically relatively narrow and of shallow gradient, and in the Project Area are backed by a steep dune of ~35 m height (*Figure 6.6*).

In the area of the shoreline crossing the sand is reddish because of erosion of ancient elevated dunes. Beaches further north between the Govuro estuary and along the Bartolomeu Dias Peninsula are dominated by soft white sand. Some sandy beaches both within the Archipelago and along the adjacent coastline on the seaward facing coastlines are exposed to strong wave action, long-shore currents and cyclones. Coastal erosion of the dune system and embankments by wind and tidal action is increasingly evident in these areas, which has caused collapse of some tourism infrastructure in exposed areas such as Bartolomeu Dias Peninsula and in Inhassoro. The dunes in this area are therefore highly dynamic. North of Bartolomeu Dias Peninsula, sandy beaches are replaced by mangroves at the Save River mouth.

Two species of ghost crabs (*Ocypode ryderi* and *O. ceratophthalmus)*, typically occur on the sandy beaches exposed to the open sea. These beaches are also important shelter and feeding areas for several seabirds and waders during high tide.

Estuaries

In the southern African context the following is a generally accepted definition of an estuary: "*it is a partially enclosed, coastal body of water which is either permanently or periodically open to the sea and within which, there is a measurable variation of salinity due to the mixture of sea water with fresh water derived from land drainage*" (Day, 1980). There are two main estuaries in the Project Area, namely the Govuro and Save River estuaries. The fresh water and nutrients provided by these rivers is vitally important in maintaining the mangroves that is an integral part of these estuaries and the seagrass meadows along the coast. These estuaries are important fish nursery areas which provide sheltered fishing for local communities.

Mangroves

The mangroves in the region of the Govuro and Save River mouths are among the best developed mangrove systems occurring in Mozambique (de Freitas, 1984). Mangroves start to occur approximately 8 km downstream of the onshore pipeline crossing on the Govuro River. Bazaruto, Benguerua and Santa Carolina islands, as well as the Nhangonzo stream (90 km to the south) also have small but viable mangrove communities. Five species of mangrove are represented comprising the red mangrove (*Rhizophora mucronata*), black mangrove (*Bruguiera gymnorrhiza*), Indian mangrove (*Ceriops tagal)*, and white mangrove species (*Avicennia marina* and *Sonneratia alba*). *Sonneratia alba*, found at Inhambane within the Bazaruto Archipelago, is close to its southernmost limit of distribution on the East African coast (de Freitas, 1984). Other mangrove species occurring in the Govuro and Save River mouth areas are black mangrove (*Lumnitzera racemosa),* looking-glass mangrove *(Heriteria littoralis)* and cannon-ball mangrove (*Xylocarpus granatum*) (Mark Wood Consultants, 2002). Mangroves are under significant harvesting pressure as a timber resource in many parts of the coastline although there appears to be relatively little pressure on the mangroves in the Govuro estuary at present.

6.4.3 Sensitive Marine Habitats

This section describes marine habitats that are considered sensitive due to their ecological importance or vulnerability to disturbance.

Seagrass Meadows

Seagrass habitats are highly productive ecosystems and play an important ecological role as nursery grounds for fish and crustaceans, as a food source and shelter for many organisms, and in the recycling of nutrients (Richmond, 1997). Their importance in Bazaruto Bay, where they occur between the Save estuary in the north and São Sebastião and Pomene Points in the south, is elevated due to their importance as a food source for populations of threatened green turtle and dugong that are resident in the area (Cockroft *et al*, 2008; Findlay *et al*, 2011). Seagrass meadows are also important as fishing grounds for the artisanal beach seine fishery.

Knowledge of seagrass species composition, extent and distribution in Bazaruto Bay mainly comes from boat-based transect surveys done in 2008 between Inhassoro and the Save estuary as part of a dugong study for Sasol's Block 16/19 EIA (Cockroft *et al,* 2008). The extent and density of seagrass meadows varies in the bay (*Figure 6.14*) with greater abundance and distribution closer to Inhassoro where they may extend 10 km offshore (Guissamulo, 2006) in depths generally less than 10 m (Cockcroft *et al*, 2008). Seagrass meadows were sparser closer to the Save estuary. Seagrass species mapped in this area included *Thalassodendron ciliatum, Halophila ovalis, Halodule uninervis, H wrightii* and *Cymodocea rotundata*. These species occur in different densities and compositions in different portions of the coastline (Cockroft *et al,* 2008).

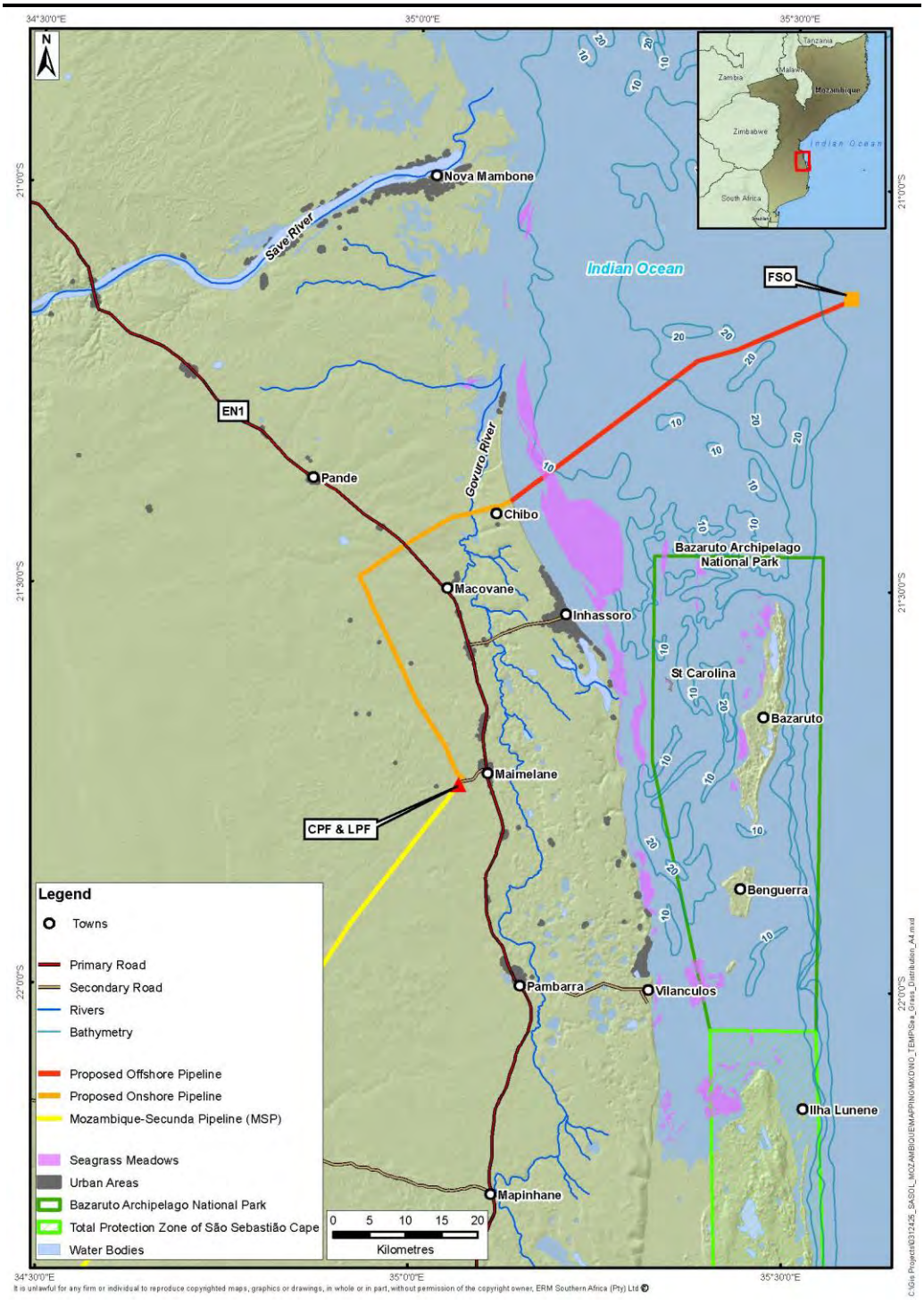
Coral Reefs and Coral

The coastline of Mozambique incorporates a full spectrum of reef types, covering an estimated area of 1 290 km^2 in total (Rodrigues *et al*, 2000). The majority of the reef formation occurs in the north, along the coral coast eco-region of Mozambique, where the reefs are found almost continuously along the coast, and the region is characterised by fringing reefs and island reefs with clear, warm water (Pereira *et al,* 2014) and dominated by hard corals (Schleyer *et al,* 1999). The reefs characterising the Archipelago are variable in nature, due to the oceanographic conditions, and range from a sparse growth or a thin veneer of corals on underlying Pleistocene sandstone substrata to true hermatypic reef formations (Pereira *et al,* 2014). The majority can be divided into three main types: patch reef, submerged sandstone reefs and submerged fringing reefs (Everett *et al,* 2008). Schleyer and Maggs (2008) further categorised the reefs as submerged offshore reefs, submerged rocky massifs, fringing reefs, barrier reefs or sedimented rocky shelves. The reefs in the Archipelago are concentrated mainly on the eastern side of Bazaruto Island, where there are large submerged offshore reefs and fringing reefs exposed to deep water, particularly on the seaward side of the island. Several of these offshore reefs are sought after recreational fishing areas such as 25-mile reef to the north of Bazaruto Island (*Figure 6.15*). Inshore of the islands, on the extensive sand flats, the area is dominated by seagrass beds, although isolated smaller reefs do occur (Schleyer and Celliers 2005).

The Archipelago has representatives of the two main orders of corals: Scleractinia (hard corals) and Alcyonacea (soft corals) with the other orders being Gorgonacea (sea fans) and Antipatharia (black corals). Hard corals dominate the coral reef fauna and include the genera: *Porites, Acropora, Pocillopora, Stylophora, Montipora, Pavona, Favia, Platygyra / Leptoria*, and *Dendrophyllia*. Soft corals are represented by the mushroom-shaped colony *Sarcophyton*.

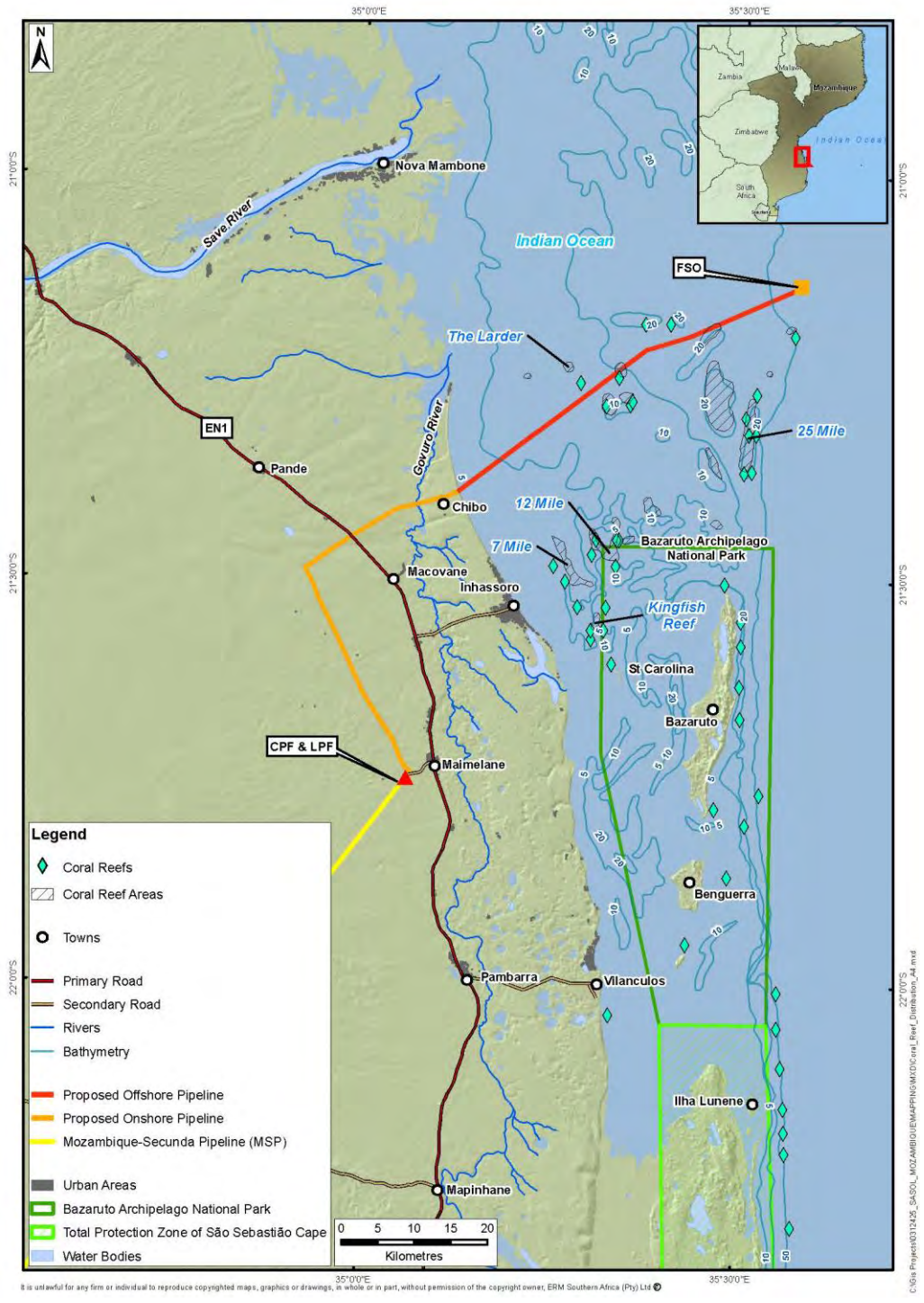
The reefs present in the Project Area are relatively unknown. Surveys of the offshore pipeline route will be conducted as part of the Marine Ecology Study to confirm the presence of coral reefs and potential risks.

Figure 6.14 Distribution of Seagrass Meadows in the Project Area



Source: Guissamulo, 2006

Figure 6.15 Coral Reefs Distribution in the Project Area



Sources: ERM 2006; Mahon (Variprint) downloaded from www.sealine.co.za

Other Marine Habitats

Hard substrate ledges: Approximately 50 m offshore of Bazaruto Island, sandstone ledges have been found on the seabed. They are generally dominated by marine algae and some have minimal coral growth. The structure varies with sloping flat ledges and drop-offs of between 0.5 to 3 m.

The ledges are also colonised by numerous benthic organisms (echinoderms, crustaceans, sponges, ascidaceans, and molluscs, including the giant clam *Tridacna*, which is common on these reefs), and provide refuge and food for a variety of fish life.

Channels - deeper coarse sandy channels occur between the islands, characterised by strong currents with depth varying from 5 to 26 m. These channels are the routes of tidal water movement between the islands and the mainland. Where there is reef in the channels it is low profile and dominated by marine algae, with little to no coral growth and low benthic fauna numbers (CSIR, 2000).

6.4.4 Protected Areas and Species

Bazaruto Archipelago National Park

The Bazaruto National Park (BNP) was created in 1971 with an aim to protect the marine fauna, specifically dugongs and sea turtles. The area covered three islands namely the Bangue, Magaruque and Benguerua Islands in the district of Vilanculos. In 2001, new boundaries of the BNP were defined through the *Decree No 39/2001*. With the implementation of the new boundaries, the Bazaruto and the Santa Carolina Islands in the Inhassoro District were incorporated within the Park, which was then designated the 'Bazaruto Archipelago National Park' (BANP). The BANP is a conservation area managed by the Park Administration, under the jurisdiction of the Tourism Ministry. The Park has a Management Plan for 2002-2006, approved by the Ministry of Tourism (*Figure 6.16*). Most of the park management's efforts are focused on regulating fishing and tourism activities, and the protection of marine resources, notably dugong, turtles and coral reefs.

The BANP Management Plan is currently being reviewed and updated by the National Administration of Conservation Areas (ANAC). ANAC have advised that once the final management plan is released to the public there will be guidance on mitigation and monitoring activities that will need to be implemented during the Project activities in order to ensure the sensitive species (eg: dugongs, dolphins and turtles) present in the Project Area are protected. These mitigation and monitoring measures will be reviewed by Sasol and, where appropriate, incorporated into the relevant EMPs for the Project.

Protected Area of São Sebastião

The Total Protection Zone of the Cabo São Sebastião, located to the south of the BANP, was created under the *Decree Nº 18/2003,* with an objective to protect the natural resources of the São Sebastião Peninsula. The "Vilanculos Coastal Wildlife Sanctuary" Project has a concession area of approximately 25 500 ha designated for the establishment of a Private Nature Reserve.

Protected Species

Certain coastal and marine species within the Project Area are protected, as follows:

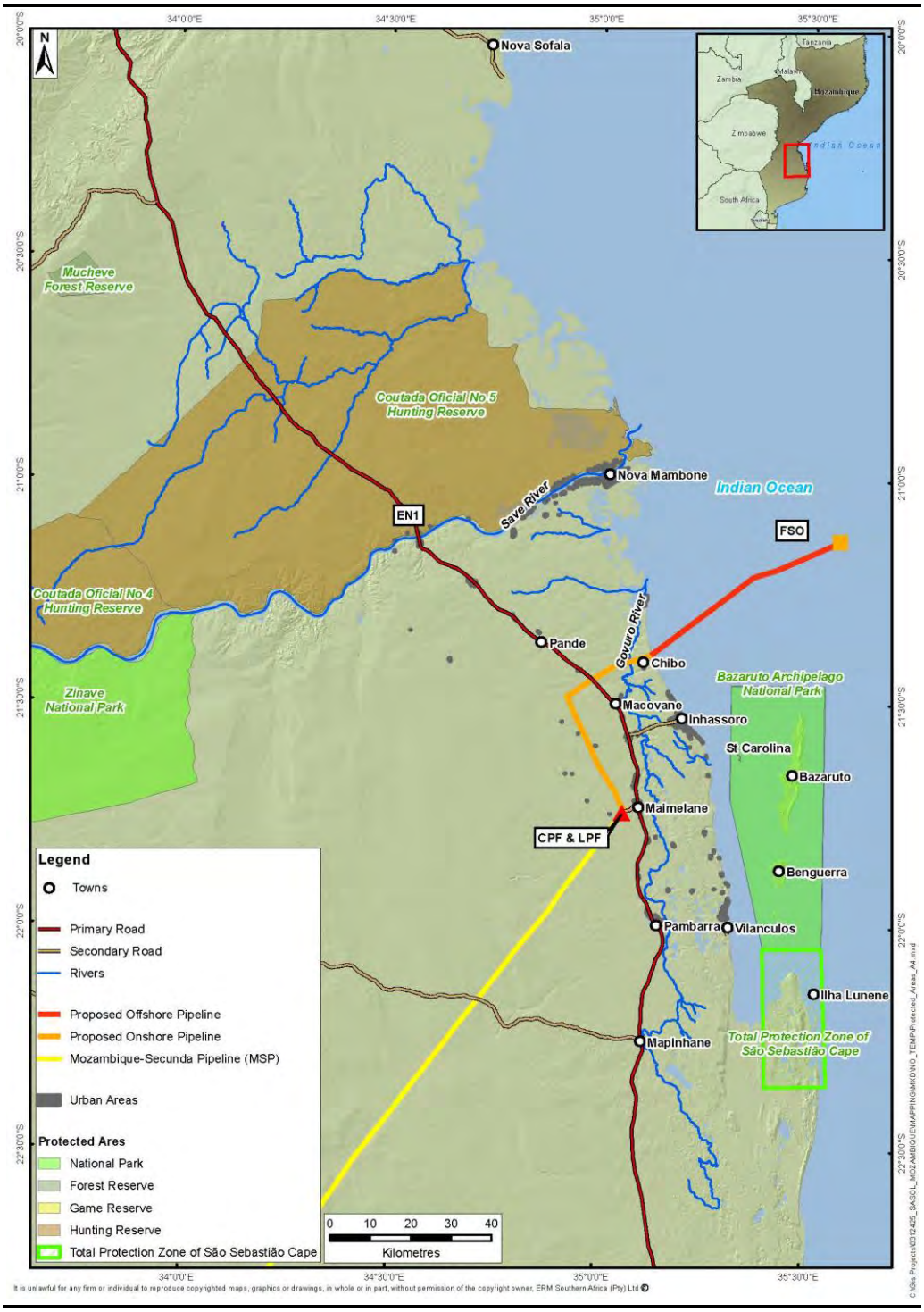
- Regulations under the Forest and Wildlife Law *Decree No 12/2002* provides for the protection of dugongs, turtles, and certain species of coastal and marine birds (eg flamingos, pelicans and storks);

- Regulations under the Sport and Recreational Fishing *Decree No 51/1999* provides for protection of dugongs, whales, dolphins, sea turtles and some species of fish, bivalves and gastropods;

- Regulations on Pollution Prevention and Protection of Coastal and Marine Environment (Decree no. 45/2006, 30th November), protects coastal and marine sensitive ecosystems such as mangroves.

Note: the new Conservation Law, *Act 16 of 2014*, includes stricter penalties for illegal activities relating to protected species in protected areas and lists prohibited activities similar to those under current legislation.

Figure 6.16 Protected Areas Present in the Project Area



6.5 SUMMARY OF THE BIOPHYSICAL ENVIRONMENT

Table 6.4 Summary of the Biophysical Environment

Climate	• The Mozambican climate can be described as highly variable and is vulnerable to climatic events such as floods, droughts and cyclones as well as climate change. • Mozambique is currently experiencing effects of climate change manifesting through coastal erosion and extended drought.
Air Quality	• Onshore industrial air quality measured at the boundary of the CPF meets requirements of the CPF Operational EMP and Mozambique and IFC air quality standards. • Onshore rural air quality is mainly impacted by the seasonal burning of woodland and grassland, as well as localised burning of waste and fuels. • Offshore air quality is generally good as the only source of air pollution is from vessels travelling along shipping lanes, including those involved in oil and gas operations in the area.
Noise	• Onshore industrial noise measured at the CPF meets IFC requirements (nighttime noise level of 45 dBA). • Onshore rural noise is largely unaffected by noisy activities except traffic noise along transport routes. • Offshore rural noise is influenced largely by ambient natural noise sources (water movement and weather events) with contributions from existing vessel traffic.
Water Quality	• The water quality of the Govuro River is generally good, with the water mainly fresh and clear (low turbidity) and having low but variable salinity levels as it exhibits tidal influence. • Groundwater quality increases in salinity towards the coast. • The physico-chemical characteristics of the water masses of Bazaruto Bay and the nearshore areas north of the Bay exhibit spatial and temporal variability.
Geology, Soils and Seabed Sediments	• In the coastal areas of Inhassoro District, the soils are variable but are generally sandy and of low arable potential. • The seabed sediment characteristics in the Project Area are currently unknown but expected to be predominantly sandy.
Topography and Seabed Bathymetry	• The terrain along the proposed pipeline route between the CPF and the shore crossing is relatively flat to slightly rolling and intersected by the south to north draining Govuro River and floodplain. • The proposed shore crossing area is characterised by a gently sloping beach leading from the sea up to 10 to 35 m high cliffs. • The offshore pipeline route shows an approximate one meter drop in sea level every kilometer from the nearshore shallow water (average water depth of 10 m) to the proposed FSO location (approximately 50 m deep).
Physical Oceanography	• The circulation of the open ocean adjacent to Bazaruto Archipelago is governed by the Mozambique Channel circulation system which comprises a series of intermittent large-scale eddies drifting southward.

Onshore Biological Environment	• Vegetation along the pipeline corridor comprises a mosaic of woodland and thicket for most of the route and the Govuro River floodplain wetland systems. Mangroves and estuarine habitats occur in the lower Govuro River system north of the pipeline route. • A number of plant species occur in the Project Area, some of which are of conservation concern, either as they are IUCN red listed species with a high risk of extinction or because they are endemic species of localised distribution. This includes a critically endangered subspecies of cycad. • The fauna found in habitats along the onshore pipeline route is expected to be more diverse in the more remote areas where human presence is lower and may include various medium to large mammals and a high diversity of birds. • Sensitive coastal habitats include vegetated sand dunes, sandy beaches, estuaries and mangroves.
Offshore Biological Environment	• Marine fauna includes phytoplankton and zooplankton, large invertebrates, seabirds, marine mammals (whales, dolphins, dugongs and seals), marine turtles and fish. • The marine mammals (dolphins, whales, dugongs and seals) present in the Project Area are considered protected species in Mozambique. • The dugong population present in the Project Area are of conservation importance as they are the last remaining viable population along the Western Indian Ocean coastline and they are on the IUCN list as Vulnerable to extinction. • All sea turtles (green, loggerhead, olive-ridley, leatherback and hawkbill turtles) present in the Project Area are considered protected species in Mozambique and are all on the IUCN list as threatened and therefore are of conservation importance. • Sensitive marine habitats comprise seagrass meadows, coral and coral reefs as well as channels that act as the routes of tidal water moving into and out of the area between the islands and the mainland. • Protected Areas present in the Project Area include Bazaruto Archipelago National Park (BANP) and the Cabo São Sebastião. These areas are important conservation areas for marine specifically dugongs and sea turtles.

7 SOCIO-ECONOMIC BASELINE

7.1 INTRODUCTION

This Chapter provides a brief overview of the socio-economic baseline in the Project Area. The information presented is from secondary data sources including EIRs undertaken for other projects in the district (refer to *Section 6.1*), and other relevant reports and studies, mostly conducted for Sasol. As such, data are only provided at the level of Inhambane Province and Inhassoro District. Several detailed studies were completed by ERM and Impacto between 2006 and 2008 as a part of an EIA and additional studies for seismic and drilling exploration in the offshore Blocks 16 and 19, including data on tourism, dugongs, sea grass, coral reefs and fishing. This will provide valuable data for comparison with new data that will be collected for this EIA on the *Sasol Pipeline and FSO Project*.

Specialist studies will be undertaken to provide a detailed socio-economic baseline of the Area of Direct Influence supported by secondary data for the Area of Indirect Influence. It should also be noted that the outcomes of the Scoping Report Disclosure Meetings will also influence the final definition of the Direct and Indirect Areas of Influence.

7.2 ADMINISTRATIVE DIVISION AND SETTLEMENTS

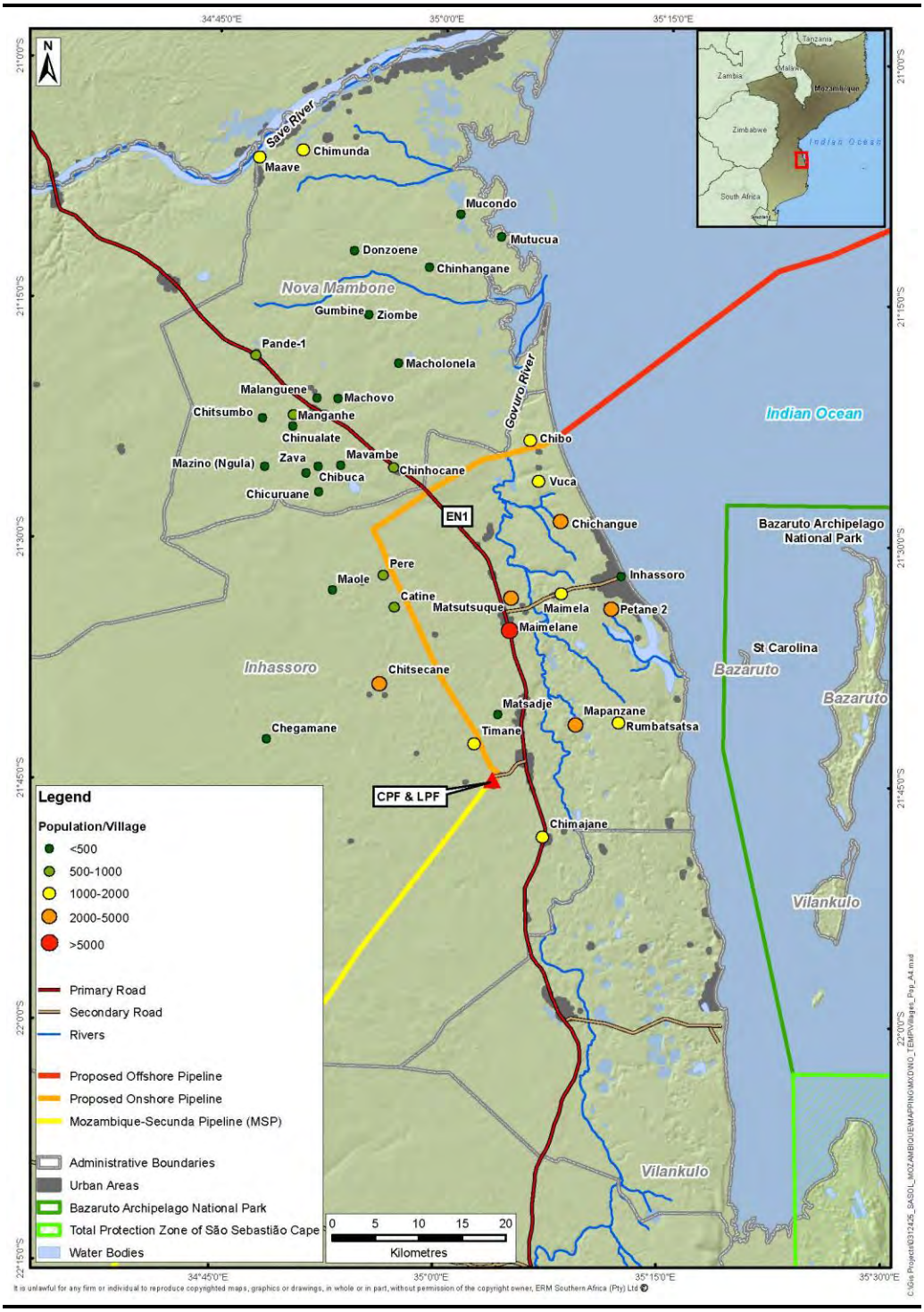
The Project is located in the southern region of Mozambique in Inhambane Province, the capital of which is the town of Inhambane. The onshore pipeline will pass though Inhassoro District and Inhassoro and Bazaruto Administrative Posts as shown in *Table 7.1*.

Table 7.1 Administrative Divisions of the Inhassoro District

Province	District	Administrative Post	Locality
Inhambane	Inhassoro	Inhassoro	Cometela Inhassoro Maimelane Nhapele
		Bazaruto	Bazaruto

The nearest settlements to the onshore pipeline are Temane, Masadge, Catine, Pere, Chinhocane and Chibo, as illustrated in *Figure 7.1* below. A detailed inventory of settlements within the Project Area will be undertaken as part of the socio-economic specialist study for the EIA Phase.

Figure 7.1 Distribution of Villages Surrounding the Onshore Pipeline



7.3 DEMOGRAPHICS – POPULATION AND POPULATION DENSITY

7.3.1 Inhambane Province

In 2011, Inhambane Province had a total estimated population of 1 402 245 inhabitants, representing approximately 6.1 percent of the total population of Mozambique. Projections developed by INE (2010) indicate that Inhambane Province will have 1 523 635 inhabitants by 2016.

The population distribution in the Inhambane Province is determined by the relatively poor agro-ecological conditions inland and the fishing and tourism opportunities along the coast. The southern districts and those in the interior of Inhambane Province have a predominantly dry climate and poor soils, which are not favourable for agriculture; as such, these districts have low population densities. There are higher population densities along the coast, especially in the southern part of the Province due to intensive coconut production. Availability of water supply and access to roads are also determinants of settlement distribution. Recent drought has also resulted in the relocation of some inland villages. Although the majority of households in the Project Area are grouped in villages, some isolated households can be found along the roads.

7.3.2 Inhassoro District

The population of Inhassoro District accounts for approximately 3.8 percent of the Province´s total population and is predominantly rural (76.6 percent). According to the national census of 2007, the District had 48 190 inhabitants, with a population density of 10.2 people/km^2 which is significantly below the population density for the Province (18.5 people/km^2) as well as other coastal districts in Inhambane Province (77.7 people/km^2). More than 90 percent of the population in Inhassoro District is concentrated in the district headquarters. Projections developed by INE (2010) indicate that by 2016 Inhassoro District will have 62 132 inhabitants, indicating a population growth of less than one percent since 2007.

Table 7.2 Population per Administrative Post for Inhassoro District

Area	Total Population	Percent	Surface Area (km^2)	Population Density (people/km^2)
Inhassoro Administrative Post	45 597	94.6	4 645.4	9.8
Bazaruto Administrative Post	2 593	5.4	100.3	25.9
Inhassoro District	48 190	100	4 746	10.2

Source: INE, results of the 2007 Census

The average household size in Inhassoro District is six people; however, some households consist of up to 10 family members. Households may comprise extended families (two to three generations) and core household members (father, mother and children) (Golder, 2014b). Many household heads work as migrant labourers outside of the Project Area.

7.4 ECONOMIC ACTIVITIES

In Inhassoro District, the majority of the population (70.2 percent) is engaged in the agriculture, forestry and fisheries sectors. Approximately 12.5 percent of the population is engaged in the trading and finance sectors, mainly related to informal trading (fish products and other essential food supplies). *Table 7.3* below shows the distribution of the population per economic sector for the District.

Table 7.3 Population per Economic Sector in Inhassoro District, 2010

Economic Sector	**Population Per Sector**	
	Number	**Percentage**
Agriculture/Fisheries/Forestry	11.234	70.2
Mining	275	1.7
Manufacturing industry	517	3.2
Energy	26	0.2
Construction	706	4.4
Transports and Communications	172	1.1
Commerce and Finance	2.007	12.5
Administrative Services	148	0.9
Other Services	889	5.6
Unknown	34	0.2
Total	**16.008**	**100**

Source: INE, 2010

7.4.1 *Fishing*

The Fisheries Law No. 3/90 of 26 September 1990, which establishes the basic Fisheries legislation to be applied in Mozambique, classifies fishing activities according to the purpose of the fishing activity. In 2009, the Ministry of Fisheries identified six subsectors with important roles in the development of fisheries in Mozambique in a 'Master Plan for the Fisheries Sector for the period 2010-2019':

1. Small-Scale Fishing (also known as artisanal fishing);
2. Semi-Industrial Fishing;
3. Industrial Fishing;
4. Industrial Aquaculture;
5. Small scale Aquaculture; and
6. Processing.

Fishing is the dominant economic activity in the coastal areas of Inhassoro District. Small-scale (artisanal) fishing is the predominant type of fishing practiced in the Govuro River estuary and near-shore area of Inhassoro District (*Figure 7.2*), while industrial and semi industrial line fishery is practised east of the Bazaruto Archipelago (*Figure 7.2*and *Figure 7.3*).

Figure 7.2 A Typical Household and Fishing Net

Source: (Impacto, 2015)

The Mozambican Fisheries Regulation ((*Decree 43/2003*) determines zones for the different fishing sectors operating in Mozambique. According to this zoning, industrial vessels may operate from 5.5 km offshore, semi-industrial vessels from 1.8 km, while artisanal fishers can operate up to 5.5 km offshore.

Furthermore, an exclusive zone for the semi-industrial shrimp trawlers was created by a ministerial dispatch in 2003. This zone is located from Savane (19°47'S in Dondo District of Sofala Province) to the Save River mouth (21°00'S) and extends offshore to a set limit which is represented by the 35°11'E line of longitude.

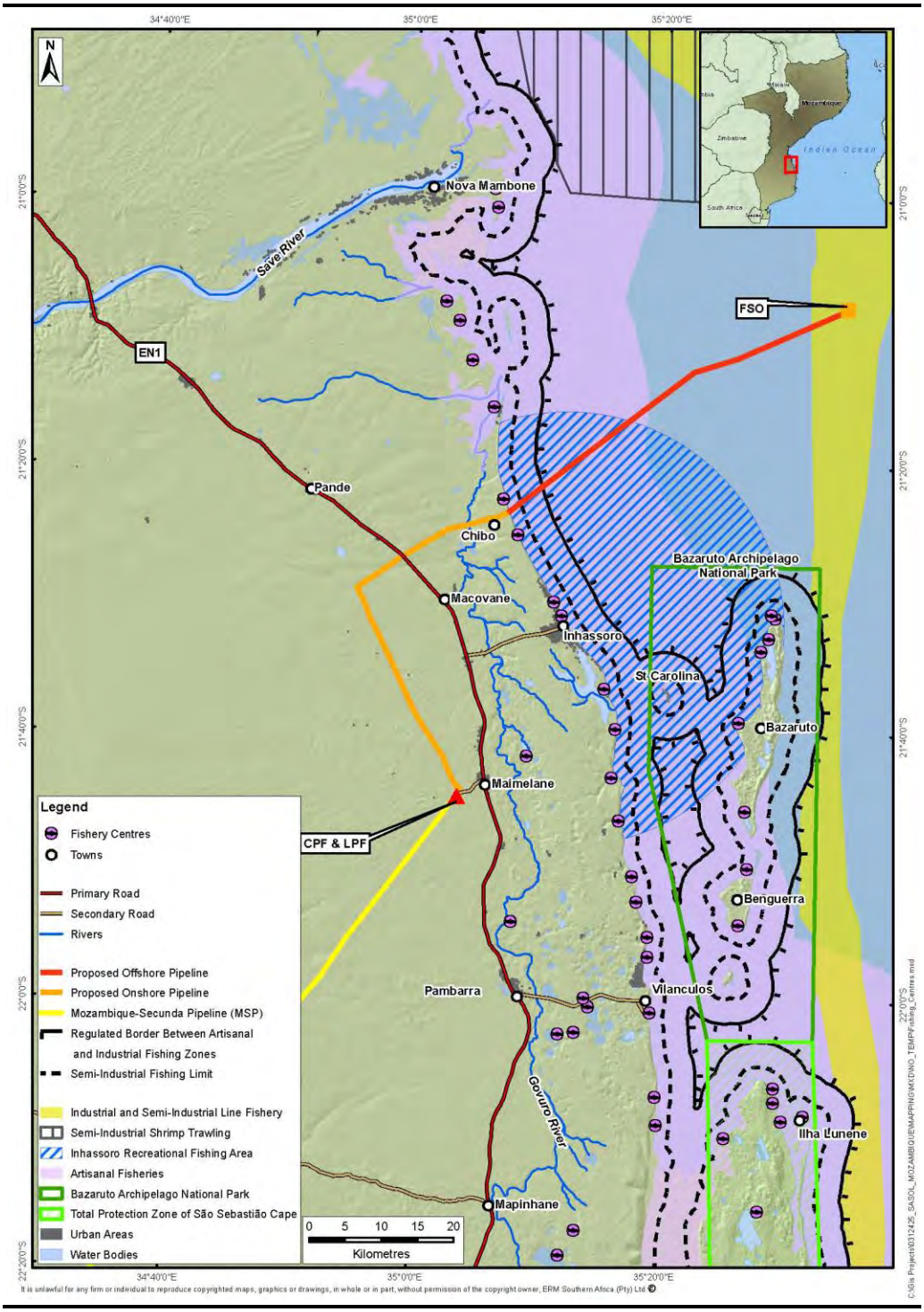
From 1987, the European Union (EU) and Mozambique have signed various Fisheries Partnership Agreements. The fisheries agreement allows EU vessels (mainly from France, Spain, Portugal, Italy and UK) to fish in Mozambican waters and is part of the tuna network fisheries agreements in the Indian Ocean. Mozambique and the European Union signed a three - year extension to the current fisheries partnership agreement, which came into force in January 2012 (and has since expired and not yet been renewed). Under that agreement 75 European boats were allowed to fish off the coast of Mozambique beyond the 12 nautical mile limit (approximately 21.6 km) in exchange for funding to support the Mozambican sectoral fisheries policy to promote sustainability in its waters [(1)] .

The Project Area falls outside of the Sofala Bank, which is considered to be the most important fishing ground in Mozambique. Sofala Bank is the shelf region that extends for over 900 km of coastline from Angoche District in Nampula Province (16° 20'S) to the Save River mouth (21°00'S).

Figure 7.3 shows the main fishing grounds of the different types of fishery activities, as well as the location of the fishing centres along the coast and Bazaruto Island, based on data sourced from the Small-Scale Fisheries Development Institute (IDPPE) (2009), IIP, and the Department of Aquatic Environment (2011). As part of this EIA, a fishery study will identify and confirm the location of sensitive receptors during baseline data collection.

(1) http://ec.europa.eu/fisheries/cfp/international/agreements/mozambique/index_en.htm

Figure 7.3 Different Types of Fishing Activities in the Project Area and Fishing Centres



Small-Scale (Artisanal) Fishing

Small-scale (artisanal) fishing in Mozambique is defined as fishing practised on small boats of no more than 10 m in size, with simple means of propulsion and with less than 24 hours at a time (per trip) spent at sea. This definition also includes fishing without the aid of boats. The artisanal fishermen in Mozambique use diverse gear including seine nets, gill nets, traps and hook and line. They are grouped in villages, called fishing centres, some of which are temporary and can only be accessed with difficulty.

Catches are used for both subsistence and for cash income. Small-scale fishing and associated processing and sales at markets contribute significantly to the food security of communities along the coast. As can be seen in *Figure 7.3* the onshore section of the offshore pipeline (including the 500 m safety zone) overlaps with the regulated artisanal fishing zone.

A fishing census undertaken by the IDPPE in 2007 provided numbers of fishermen, fish processors and vessels present in the Districts of Inhambane Province (*Table 7.4*). It indicates that Inhassoro District had fewer permanent fishers and vessels than Vilanculos District but more non-permanent fishers and twice as many fish processors (Impacto and ERM, 2010). Besides artisanal fishers, the fishing industry also supports men and women involved in fish processing and resale (*Table 7.4*). Fish processing involves drying, salt drying, smoking, freezing, and resale of fresh fish within Inhambane Province but also further afield including Maputo. The socioeconomic baseline study as part of the EIA will provide more detail on fish processing and resale.

Table 7.4 Number of Fishermen, Fish Processors and Vessels by District in the Inhambane Province in 2007

Province	District	Permanent Fishers	Non-permanent Fishers	Fish Processors	Vessels
Inhambane	Inhambane Bay	278	71	5	202
	Vilanculos	1 988	1 032	59	540
	Inhassoro	1 400	1 158	128	305
	Govuro	996	273	102	321

Source: IDPPE 2007

In Inhassoro District, the main fishing gear generally used includes line, seine net, harpoon, trap and gill nets. However, a census conducted by IDPPE in 2009 indicated that the active fishing gear used in Inhassoro District is beach seine and hand-line (*Table 7.5*). Gill nets are used in neighbouring districts of Vilanculos and Govuro (Impacto and ERM, 2010). Divers (generally for lobster) also represent a significant proportion of the people involved in small-scale fishing. The socioeconomic baseline study as part of the EIA will provide more recent data on fishing gear used in the Project Area.

Table 7.5 Active Fishing Gear Counted in Each District in the Inhambane Province in 2009

Province	District	Beach Seine	Hand-line	Otter trawl	Chicocota (Mosquito Net Traps)	Gill net	Long-line	Spear
Inhambane	Inhambane Bay	14 159	26 711	0	0	14 642	0	0
	Tofo	0	8 340	0	0	471	0	0
	Vilankulos	36 625	10 731	0	0	3,081	0	0
	Inhassoro	15 803	7 691	0	0	0	0	0
	Bazaruto	3 443	98	0	0	0	0	0
	Govuro	3 743	0	0	0	13 023	0	0

Source: IIP 2009

Hook and Line Fishing

Line fishing takes place in the open sea, estuaries and rivers using an "*almadia*(1)". The lines used are either of the monofilament type or hand-made from plant fibres, eg raffia, and are between 80 and 100 m in length. One or more variable sized hooks are attached to each line. Hook and line artisanal fishing activities are expected to occur within the overlapping section of the offshore pipeline route but there is no overlap with the FSO location (*Figure 7.3*).

Seine Nets

Nearshore beach seine nets are used at several locations along the coast, within a range of 3 km from the shore, namely:

- Along the west coast of Bazaruto Island;
- The coast of Vilanculos and Inhassoro Districts;
- On some shallow banks inside Bazaruto Bay; and
- Inside the Govuro River estuary.

Nearshore beach seine net fishing is practised at low spring tides, near the channels and usually in areas where there is extensive seagrass cover. Beach seine fishing is undertaken using small boats and nets made from conventional material such as multifilament twine and netting. The nets are relatively small, ranging from 100 m to 150 m long, with mesh size under 2.5 cm and with the rope warps up to a maximum of 150 m. These nets are set from non-motorised canoes. To pull in the nets groups of around seven to 10 people are required.

The artisanal pelagic seine fishery in the Bazaruto Bay catches schools of scad (*Decapterus russellii*) and mackerel (*Rastrelliger kanagurta*) that enter the calm neap tide waters.

(1) Type of canoe

Gill Nets and Hand Line

Gill netting usually occurs in shallow waters and estuaries. The netting is made of monofilament and has stretch mesh of 5 to 7.5 cm. In most cases, the nets are 50 and 200 m in length and are usually set from a small canoe by two fishers.

The method of gill net fishing that is practiced inshore in the Govuro estuary and along the coast of Machanga District catches small species such as glassnose (*Thryssa vitrirostris*), kelee shad (*Hilsa kelee*), flathead mullet (*Mugil cephalus*) and Indian pellona (*Pellona ditchela)*.

The artisanal hand line fishery operates within 10 km from shore, mainly in the following areas:

- The east coast of Benguerua and Magaruque Islands, which have been demarcated by the National Park as a multiple use area;
- The shallow rocky reefs in the northern area of Bazaruto Bay, east of Inhassoro and north of Santa Carolina Island; and
- The deep rocky reefs located northeast of the Inhassoro/ Govuro Coast and south of Machanga District.

Fishing mainly takes place from the early morning to lunchtime except on Sundays, public holidays, days of mourning or in bad weather. *Figure 7.4* below shows two images of artisanal fishing activities, including drying fish on the beach, while *Figure 7.5* shows a fishing market/camp and typical fisherman in the lower Govuro estuary.

Figure 7.4 Fishing Activities in the Inhassoro Coastline

Source: Impacto, 2004

Figure 7.5 ***Fish Market / Camp and Fisherman on Lower Govuro River, near Estuary***

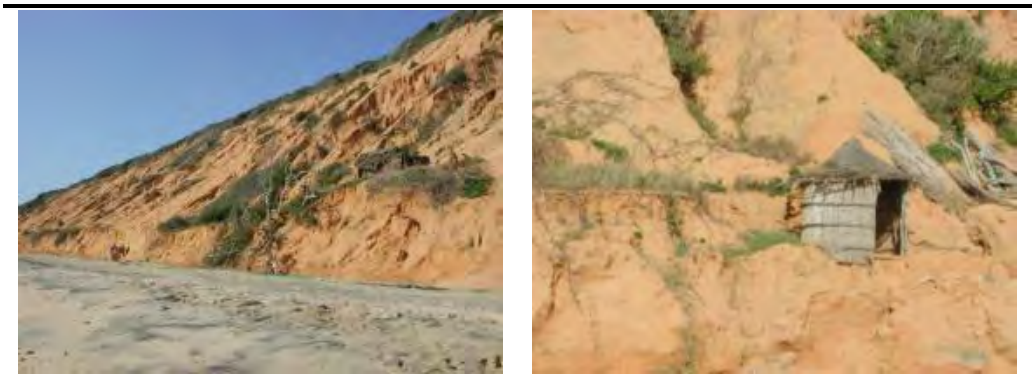
Source: J Hughes, 2015

Despite being known to occur, little is known about mangrove, estuarine and freshwater artisanal fisheries in the Project Area and this will be investigated in the EIA Phase.

Fishing Centres

A maritime fishing census done by the IDPPE in 2007 estimated that there were 79 fishing centres along the coast of Inhambane. Although artisanal fishing is a year round activity, some migration of fishermen does occur between fishing villages and from one province to another on a seasonal basis. *Figure 7.3* above show the location of the fishing centres while *Figure 7.6* below shows a typical traditional hut built on the beach dunes of Inhassoro. There is a fishing centre located about 2 km to the north of the pipeline landfall site and one about 5 km to the south of the landfall site.

Figure 7.6 ***Traditional Huts Used by Fishermen on the Inhassoro Beach Dunes***



Source: (Impacto, 2004)

Semi-Industrial and Industrial Fishing

As indicated in *Figure 7.3*, the FSO location overlaps with the industrial and semi industrial line fisheries. The semi-industrial and industrial vessels fish primarily shrimp and a variety of by-catches which supply the local, regional and international markets with seafood.

The semi-industrial fleet is characterized by locally-owned vessels and fishing is practised along the coast by vessels of up to 20 m long, powered by engines and using ice and mechanical refrigeration systems for on-board conservation of the catches. Some of these vessels use mechanical fishing methods. Equipment used includes hand lines as well as stout fishing rods with large, non-geared reels.

The industrial fleet comprises freezer vessels that can operate continuously over three weeks or more and are at least 20 m in length, consisting of two types of operators:

- The first is made up of joint venture companies between the Mozambican State and large multinationals based in Europe, with sufficient financial means to support fleet renovation and to place the produce on the international market. These companies have between eight and 30 vessels each and exploit 70 percent of the Total Allowable Catch (TAC), which contributes to foreign exchange earnings.

- The second type is that of industrial companies using local capital, with a maximum of four vessels per company and with low productivity due to the obsolescence of their fleet and equipment (Impacto and ERM, 2010).

Industrial line-fishing vessels operating in the Project Area are based in the Ports of Beira, Inhambane and Maputo. Data from 2007 indicates that approximately 10 shrimp fishing vessels were active in the Project Area at a depth of 10 to 45 m using trawl nets (Impacto 2007, cited in Impacto and ERM, 2010). According to the National Directorate for Fisheries Administration (ADNAP), 14 vessels were conducting line fishing within the Project Area in 2004. Line-fishing techniques are usually undertaken within depths varying from 30 to 250 m and operate year-round (Impacto and ERM, 2010).

Shrimp trawling occurs in sandy bottom areas between parallels 17°S and 25°40´S, which is south to southeast of the Project Area (*Figure 7.3)*. According to the National Directorate for Fisheries Administration, about 12 industrial trawling vessels operated in the country in 2004.

These fleets trawl between March and December with the closed season in the summer months of January and February. The peak catch rates are reported from March to May-June when 60 percent of the year's catch is landed (Impacto and ERM, 2010).

Fishing data for the Project Area will be updated in the EIR by the fisheries specialist study.

Recreational Fishing

Recreational fishing is also undertaken within the Project Area, usually by amateur anglers participating in recreational fishing competitions. The number of fishing vessels for this activity is dependent upon each competition. Apart from the sports fishing competitions, there are also other sports fishing activities conducted by leisure boats from the tourist resorts. During the EIA Phase, the nature and number of any sports fishing competitions and recreational fishing by tourists will be defined as anecdotal evidence suggests there has been a decline in such activities in recent years.

Recreational fishing targets billfish species and their activities take place in two main areas:

- The area offshore of Bazaruto Archipelago; and
- The Cabo São Sebastião within a range of 2 to 5 km offshore.

Recreational fishing further takes place between 15 and 30 km east of Inhassoro and the Govuro River estuary, targeting both demersal rocky dwellers and pelagic species. The most popular fish species include marlin, sailfish, wahoo, skipjack and yellowfin tuna, trevally and Spanish mackerel. The rocky bottom fish dwellers, targeted by some sport-fishing clubs are also species targeted by the semi-industrial and artisanal line fishing industry.

There is a private fishing centre located on the banks of the Govuro River mouth, approximately 12.5 km along the coast north of the pipeline beach shore crossing. This lodge operates a catch and release system and offers deep-sea fishing, shore fishing, estuary fishing and salt water fly fishing, as well as charter fishing and fly fishing trips.

As can be seen in *Figure 7.3* the recreational fishing area overlaps with a section of the offshore pipeline route (including the 500 m safety zone). There is no overlap with the FSO location.

Illegal Fishing

Any artisanal, semi-industrial or industrial fishing operations in Mozambican waters, and all other businesses connected to fishing, are required to obtain an official fishing licence from the state. Fishing for personal subsistence is excluded from this rule.

Illegal fishing is known to occur in offshore Mozambican waters. Local boat owners are aware of occurrences of night fishing, mainly by foreign vessels. These activities take place particularly in the region of Cabo Delgado, Nampula and Inhambane (in the Bazaruto area), and are presumably related to migratory species, such as tuna.

The 85 km length of coastline between Morrumbene and Pomene appears to have the most concentrated artisanal illegal shark fisheries in southern

Mozambique, although the entire area from the Bazaruto Archipelago south to around Závora is subject to relatively high fishing pressure. Bottom-set longlines may be the most commonly used gear.

Regulatory and Strategic Framework of the Fishing Sector

The regulatory framework guiding the strategy of the Mozambican fisheries sector and its subsectors comprise:

- The Fisheries Law No. 3/90, which provides the legal framework for fishing in the country;
- Fishing Policy and Implementation Strategies, Resolution No. 11/96;
- The General Regulation of Offshore Fishing, *Decree No. 43/2003*, which regulates fishing activities at sea;
- The Regulation of Fishing in Inland Waters, *Decree No. 57/2008*;
- The Regulation of Operation of the Fishing Co-Management Committees, Ministerial Diploma No. 147/2007;
- The Fisheries Master Plan 2010-2019 (PDP 2010-2019)), which defines the long-term vision and the development goals of the sector, the target groups and other indirect beneficiaries, the contribution of the six fishing subsectors to the PDDII goals and the cross-sectorial aspects which impact on the development and promotion of fishing activities.
- The Strategic Plan of the Small-Scale Fishing Subsector, prepared in 2007 (implemented by the IDPPE: Mozambican Institute for the Development of Small-Scale Fishing, defines a vision for small-scale fishing with a ten-year horizon and a 5 year implementation period (now complete). The five main pillars of the PESPA include:
    - Improved social conditions in the fishing communities;
    - Growing income for small-scale fishers;
    - Marketing of the fish catches brings more favourable results for small-scale fishers;
    - Financial services aimed at the small-scale fisheries are accessible to and easier to obtain by a larger number of fishers; and
    - Institutions that are dedicated to the development and management of small-scale fishing are strengthened and improved.

- The Strategic Development Plan for Tuna Fisheries, approved on July 2013(1), has been aligned with the 2010-2019 Fisheries Master Plan (see above), as well as other relevant policies and strategies. The Strategic Plan aims to maximise the benefits of the tuna industry to the economy of Mozambique, through better use and control of the tuna fisheries in the Exclusive Economic Zone (EEZ) and participation in the strengthening of the management of tuna stocks in the Indian Ocean. This Strategic Plan defines priority actions as well as general actions for the management of tuna fisheries, small-scale fisheries and industrial fishing activities. The Ministry of Fisheries is responsible for the implementation of this strategy at a national level.

- The Line Fishing Management Plan within Marine Waters of Mozambique for the period 2014-2018 was approved by Ministerial Decision No. 162/2014. This Plan establishes requirements to be met in order to undertake line fishing within marine waters under Mozambican jurisdiction (which extends to 12 nautical miles offshore). It focuses on the contribution of fisheries to the national economy. The main objective of the Management Plan is to contribute to a sustainable use of living marine resources while supporting economic growth and improvement of conditions of fishing communities.

7.4.2 Agricultural Activities and Food Security

Soils are generally poor and sandy in the coastal areas of Inhassoro District. The majority of the local population practices 'rain fed, slash and burn' shifting agriculture and the most common crops are sorghum, millet, peanuts, beans, cassava and maize. Agriculture is mainly practised on small plots (*machambas*) at the household level. Each household cultivates an average area of 1.8 ha, mainly for subsistence, but any surplus is sold to provide a source of income. Given the low fertility soils and long periods of drought, as is currently experienced, , the area faces cyclical food security problems. In the interior areas of the District, where the soil productivity and rainfall are adequate there is some commercial production of maize and peanuts.

Besides cropping, households carry out various activities that contribute to household income and which may play a central role in the livelihood strategies of these families during drought periods. These include:

- Creation of reed and wood products in the coastal areas and the interior of Inhassoro;
- Livestock rearing and bushmeat hunting;
- Fishing along the coast and in rivers and lakes in the interior;
- Harvesting and sale of forest products (fruit, honey, medicinal plants, timber poles, etc);
- Production of charcoal and firewood, which are mainly sold along the EN1;
- Artisanal production of stone for construction;

(1) At the 22nd Ordinary Session of the Council of Ministers.

- Thatching grass;
- Manufacture of traditional beverages (e.g. palm wine); and
- *Ganho-Ganho* (temporary labour).

Figure 7.7 below illustrates some of the above livelihood activities.

Figure 7.7 Livelihood Activities of the Families in the Project Area

Source: Impacto, 2015

7.4.3 Timber Resources

The main timber resources exploited in Inhassoro District comprise Mondzo (*Combretum imberbe*), Chanfuta (*Afzelia quanzensis*), Umbila (*Pterocarpus angolensis*), Cimbirre (*Androstachys johnsonii*), Sandalwood (*Spirostachys africana*), Chacate-preto (*Guibourtia conjugata*) and Msasa (*Brachystegia spiciformis).*

According to the Inhassoro District Profile for the Strategic Environmental Assessment (Impacto, 2011) there were 18 forestry operators[1] in 2011 within the district with annual licenses, of which four were in Cometela Locality, 12 in Maimelane and two in Nhapele. In addition there are two timber processing companies in Inhassoro Town and Maimelane.

Although the use of uncontrolled fires has reduced significantly due to awareness initiatives, Inhassoro District is still affected by erosion and deforestation as timber is used by the local communities for local construction and as firewood for fuel (MAE, 2005).

7.4.4 Tourism

Inhambane Province is one of the main tourism destinations in Mozambique. Tourism has been defined as "the greatest asset for the development of the province's economy" (GPE, 2010, cited in Golder, 2014b) and is the largest formal sector employer in the coastal region of Inhassoro District.

1 Forestry operators are awarded a forestry concession for the purpose of forest exploration, in particular, felling, transportation, extraction, drying, including the manufacture of charcoal, as well as timber processing, according to a previously approved management plan.

Inhassoro District is situated within the Vilanculos/Bazaruto/Inhassoro region and is listed as one of the Priority Areas for Tourism Investment (PATI), as shown in *Figure 7.8* below. The Vilanculos/ Bazaruto/ Inhassoro cluster is currently Mozambique's most developed leisure destination. Tourist attractions include pristine islands, the BANP, with marine-based recreational activities including high quality diving and snorkelling, extensive beaches, recreational fishing, and swimming in clear, calm waters (Golder, 2014b).

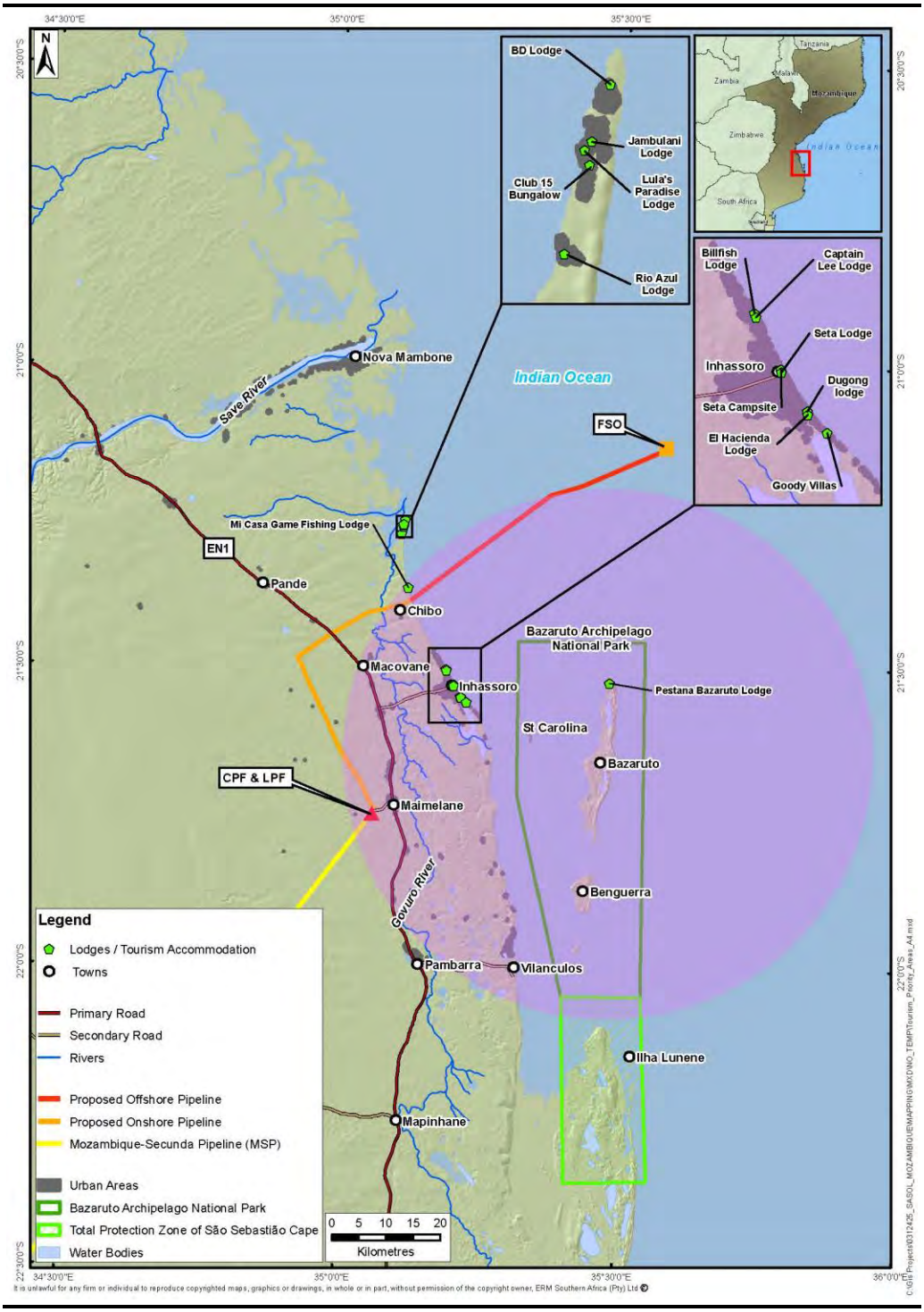
Several national and provincial strategies have recognised the tourism potential of the area (Golder, 2014b), including:

- The Strategic Plan for the Development of Tourism in Mozambique (2004-2013) which classifies the Bazaruto islands and the mainland coast (including the Project Area) as a Type A Priority Area for Tourism Investment. Available details on the impact of this Plan and any updates will be considered in the EIA;

- The inclusion of the BANP into the Greater Limpopo Transfrontier Conservation Area would add additional weight to the region's priority status; and

- The Inhambane Tourism Strategy, prepared in 2012 but not yet adopted, aims to develop world-class tourism based on the province's key, mainly coastal, attractions (Tourism Strategy Company, 2012). The status of this strategy will be verified during the development of the EIA.

Figure 7.8 ***The Vilanculos/Bazaruto Priority Area for Tourism in Relation to the Onshore and Offshore Project Components***



The most significant recent intervention in the Province has come from the Mozambique Anchor Tourism Investment Programme (MATIP). This joint initiative by the Government of Mozambique (GoM) and the International Finance Corporation (IFC) identified 2 750 ha about halfway along the coast between Inhassoro and Vilanculos as an 'anchor investment site', and developed an ambitious plan for large-scale tourism. However, this area falls outside the Project Area (to the south – south-east) (Golder, 2014b).

The District is well served by a range of tourism facilities, from affordable lodges to high-end hotels and resorts, estimated to total around 50 establishments in Inhassoro, Bartolomeu Dias Peninsula and Bazaruto Archipelago (*Figure 7.9*). Luxury establishments are concentrated on the Bazaruto Archipelago islands, Vilanculos town and the nearby São Sebastião Peninsula. These areas, especially the islands, have developed a profile as an upmarket destination for regional and international tourists.

Figure 7.9 Tourism Establishment Signboards in Inhassoro

Source: J Hughes 2015

It is important to highlight that only the Bazaruto and Santa Carolina islands are in the Inhassoro District (Bazaruto Administrative Post). The other islands are in the Vilanculos District and are outside the Project Area; hence their absence from the table below. Santa Carolina is the smallest island of the Bazaruto Archipelago and has the ruins of the old Hotel Santa Carolina. Over the years, there have been several plans by investors to build a new hotel on the island but to date none has gone ahead. Data on tourism will be updated as part of the EIA Phase.

The closest lodge to the pipeline shore crossing site is the Mi Casa Game Fishing Lodge – approximately 2 km from the shore crossing - which became operational from November/ December 2015, but which is located outside of the primary tourism areas. Offshore, the closest lodge to the pipeline and FSO is the Pestana Bazaruto Lodge, located at the northern tip of the Bazaruto Island, while further north on Bartolomeu Dias Peninsula are several other lodges accessed by a 4x4 vehicle via the coastal track or along the beach depending on tides and estuary water levels (*Figure 7.9)*.

Turnover generated by the estimated 1 798 bed nights available in tourism establishments in Inhassoro and Vilanculos Districts in 2005 was in the order of US$17.5 million. This was based on reported occupation rates and consumption of food and drink and other third party goods and services – the latter estimated at approximately 31 percent of the value of income to tourism facilities in Inhassoro, and 57 percent in Vilanculos (Impacto and ERM, 2010).

Data from the Ministry of Tourism indicate that Inhambane Province attracted 18 510 international visitors during 2010, ranking second only to Maputo City (Golder, 2014b). The average occupancy rate of tourism establishments in the Province is however decreasing with occupancy levels being around 10 percent due to the international economic crisis; high operating costs; low standards of service delivery; red tape; corruption; inadequate infrastructure; and insecurity in Mozambique. Tourism is highly seasonal with the peak periods over Christmas and Easter given its distance from the main tourist source areas in South Africa and Zimbabwe.

The main attractions are diving and snorkelling with the most popular dive sites being the north-western side of Magaruque including Two Mile Reef, Five Mile Reef, the Potholes, the Greek Temple, and reefs along the eastern side of Bazaruto Island and the Coral Gardens in the north (Impacto and ERM 2010) as shown in *Figure 7.3*. A key advantage of the area is that the reefs are easily accessible and provide for a range of diver experience levels. The Twelve Mile Reef is mainly visited by divers from the Archipelago lodges but is also a key deep sea fishing area. The best diving period is between April and December, while deep sea fishing events (involving 30 to 60 boats) usually take place in the peak holiday periods of April, December / January. Most recreational fishing for billfish takes place north of Bazaruto Island, sometimes up to 20 km from shore with the 25 Mile Reef often cited as a good fishing area (www.sealine.co.za). As noted previously, sports fishing competitions/events and recreational fishing by tourists will be confirmed and documented in the EIA, as anecdotal evidence suggests there may have been a decline in these activities in recent years mainly linked to insecurity in central Mozambique.

7.4.5 Hydrocarbon Exploration and Production

Seismic and drilling exploration activities in the region have taken place over the past 45 years. Most notably Sasol has been undertaking activities in Inhambane Province since 2000 and extracting onshore gas resources in Inhambane Province since 2004, which is processed at the Temane Central Processing Facility (CPF), in the Inhassoro District. According to INE (2010), 1.7 percent of the population in Inhassoro is engaged in the mining sector, which includes oil and gas operations.

Of direct relevance to the proposed *Sasol Pipeline and Offshore FSO* Project is the previous EIA Process and additional studies for Block 16 and 19. Issues raised during the EIA process in regulatory meetings and by the stakeholder forum that was established for the project, centred mainly on project risks to conservation, fishing and tourism. Priority concerns included risks to priority coastal features contributing to the conservation importance of the BANP, namely coral reefs and reef fish, dugongs, and turtles and the potential impact on tourism and fishing.

Due to the concerns raised over shallow water seismic surveys in particular, additional more detailed studies of dugongs and seagrass, coral reefs, fisheries and tourism were conducted to establish an improved baseline. Monitoring studies were also conducted for fisheries and marine turtles.

A compensation mechanism to compensate fishermen for temporary loss of access to fishing grounds in the safety zone around project activities was also developed and implemented.

In July 2006, Sasol compiled a Preamble for inclusion in the EIR for Sasol's Exploration Project in Blocks 16 and 19 in which it agreed with the recommendations of the EIA and committed to postponing seismic surveys and the drilling of wells in the shallow water area until the completion of further studies. In its response to Sasol's application for an Environmental License for activities in the deep water, its commitment to postpone exploration activities in the shallow water and to conduct further studies, MICOA (Ministry for the Coordination of Environmental Affairs) recommended that the 'environmental impact of hydrocarbon activities in the shallow water environment be investigated in detail'.

The subsequent additional (2007) and monitoring (2008) studies undertaken focussed on the area's dugong population and their habitat, the artisanal fishery, the tourism industry, coral reef health, noise impact modelling and marine turtle monitoring. These studies were supported by a well-documented stakeholder engagement process as well as an independent peer review by SAIEA (Southern African Institute for Environmental Assessment.

Two key aspects of this process were:

1. That the dugong study indicated that the Bazaruto area contained probably the last viable population of dugongs in the Western Indian Ocean and recommended that no exploration activities occur in the shallow water area with the retention of exploration rights and the establishment of a reserve for dugongs; and

2. That the artisanal fishery study concluded that the local fishery played a key role in the local economy, recommending that no seismic surveys take place in the shallow water near Inhassoro since the local fish resources were particularly sensitive.

In August 2008, and on the basis of the additional and monitoring studies' findings, Sasol committed not to pursue any shallow water exploration activities (seismic surveys and drilling) at that stage. It also committed to wait for the recommendations of the Strategic Environmental Assessment (SEA) which the Mozambique Government planned to undertake, before reviewing this decision and revisiting its exploration plan for the shallow water area.

The project team is aware of the issues and concerns raised and how they were addressed during the Block 16 and 19 EIA process and cognisant that the proposed pipeline and offshore FSO project will likely generate similar stakeholder concerns. This is especially likely given several recent EIA processes that have raised awareness of Sasol's expanding footprint in the region.

In October 2015, the National Petroleum Institute (INP) of Mozambique announced the results of the fifth license round for concession areas for exploration and production of oil and gas in 11 offshore areas and four onshore areas. Sasol Petroleum Mozambique Exploration Ltd, partnering with ENH, was awarded the PT5-C area, which encompasses the land between the Pande and Temane Blocks and a large portion located to the south of the CPF.

7.5 AMENITIES AND SERVICES

In general the Project Area is poorly served by social infrastructure, and where this exists it is concentrated at the District Headquarters and at some Administrative Post headquarters.

7.5.1 Schools

Inhassoro District has 40 first level primary schools (EP1), seven second level primary schools (EP2), one secondary school (ESG) and one professional school (ETP) in the Inhassoro centre, supported by the Catholic Church (Inhassoro District Profile for the Strategic Environmental Assessment, Impacto, 2011). Only one school is known to be located close to the onshore pipeline route, situated at Chibo village on the western side of the Govuro River.

In the survey undertaken by Kula, Estudos e Pesquisas Aplicadas, Lda for the PSA Development and LPG Project (Golder, 2014b), one third of the population had no formal education, and about half have finished primary school. Only 8.2 percent had completed secondary school. Adult literacy was low at 7.3 percent. Furthermore, none of the interviewees had completed university education and only 0.6 percent had completed some form of vocational education.

Figure 7.10 Example of a Typical Primary School in the Area, Located in Maperepere, in the Nhapele Locality in Inhassoro District

Source: (Impacto, 2016)

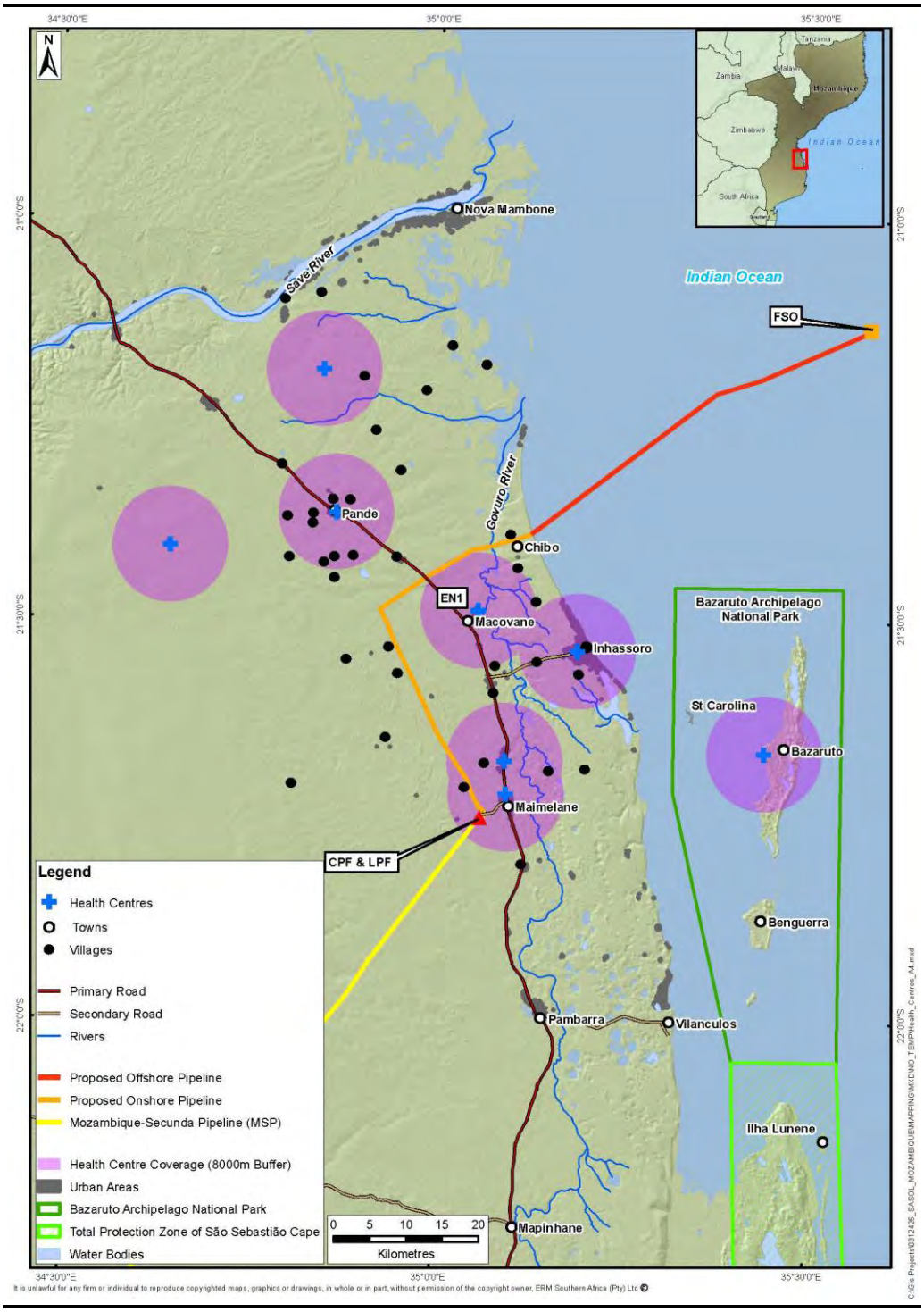
7.5.2 Health

In general Inhassoro is poorly served and there is no hospital in the District with the nearest one located in Vilanculos. Type 1 Rural Health Centres with improved resources are located in the District Headquarters and in the most populated areas located along the EN1 national road, such as the new health centre in Mangugumete (Administrative Post of Maimelane), funded by the Sasol's Corporate Social Investment programme. The district also has three type 2 Rural Health centres and Bazaruto Island has one Urban Type Health Centre (*Figure 7.11*).

The main diseases in Inhassoro District in 2011 comprised malaria, diarrhoea and dysentery, sexually transmitted diseases (including HIV/AIDS), tuberculosis and pneumonia (Impacto, 2011). Many people still rely on traditional herbal medicines and several traditional doctors operate in the area. According to the District Government (2011) the main cause of deaths amongst adults in the District was HIV/AIDS due to non-adherence to the basic principles of prevention and anti-retroviral treatment. However, in 2013 a 10 percent improvement in enrolment of people into the anti-retroviral programmes was achieved, along with a 29 percent improvement in retention of patients on the Programme. Sasol's HIV/AIDS Awareness Programme is reported to have contributed substantially to this (Golder, 2014b).

Plans, strategies and initiatives in the health sector will be reviewed and documented in the EIA, with reference to the National Strategic Framework for the Health Sector 2014 – 2019 (MISAU, 2013) and other relevant data sources.

Figure 7.11 Health Facilities in the Inhassoro District



7.5.3 *Water Supply and Sanitation*

Piped water systems exist only in the District Headquarters and communities depend on hand pumps and traditional open shallow wells and cisterns to collect rainwater for their water supply. There are insufficient hand pumps to meet the needs in the rural areas, especially in the interior areas where water supply relies on boreholes. Water from boreholes is sometimes brackish, of poor quality or saline.

These boreholes supply water to people and also to cattle. The Non-Governmental Organizations (NGOs) Kulima and German Agro Action have been supporting communities located along the coast to build protected wells. However, some people living near the pipeline route still rely on hand-dug wells to reach water 2-5 m below ground level, but many of these are drying up during the current drought period forcing people to either move or go further to find water (ERM pers. obs. 2015). *Figure 7.12* illustrates some examples of manual water pumps found in the Inhassoro District.

Figure 7.12 Examples of Manual Water Pumps in the District of Inhassoro

More than half of the households in the district (55.3 percent) do not have latrines, meaning that Inhassoro is one of the coastal districts with a high rate of defecation in the bush. Of the 44.7 percent who have access to latrines, nine percent of the total households in the District have improved latrines and 34.9 percent have traditional latrines. Only 0.8 percent of households in the district have toilets connected to septic tanks.

7.5.4 Electricity Supply

Inhassoro District has a 33kV power distribution network that covers the headquarters of the Inhassoro Administrative Post and some localities along the coast. However, only 1.5 percent of the households in the district benefit from this source of energy (Impacto, 2011). More than half of the District's population (50.8 percent) use alternative energy sources (eg paraffin and kerosene) for lighting. This is below the provincial level (76 percent) and slightly below the national level (54 percent).

Most cooking is done with locally produced charcoal or wood and approximately 28 percent of households in Inhassoro are depend on wood as fuel, which makes Inhassoro the most fuel wood dependent coastal district in the Province (Impacto, 2011). The main wood source for firewood and charcoal is a timber locally known as Chanfuta (Pod Mahogany, *Afzelia quanzensis*), listed as Near-Threatened in the IUCN Red List.

7.5.5 Road Network

The road network in Inhassoro District comprises a total of 236.7 km of roads, of which 156.8 km are classified and 79.9 km unclassified. With the exception of the EN1, and the current surfacing of the Inhassoro to EN1 road, all of the District roads are unpaved.

Roads in the Project Area are generally passable by vehicles subject to weather conditions. Communities benefit from roads established by Sasol to well sites and along pipelines. These roads provide access to natural resources (such as timber, fuelwood, non-timber forest products, and bush meat); to other communities either for social interaction or trade, or to reach health centres or schools.

7.5.6 Maritime Transport

There is a state vessel, with capacity for 32 passengers which serves the local area but which has been out of order for several years. Transport to the islands is by motorised boats from tourism establishments or other owners in Inhassoro or by means of traditional boats (*dhows*) (Impacto, 2011). Refer to *Section 6.7* below for additional details related to shipping and navigation.

7.6 SHIPPING AND NAVIGATION

The marine area between Sofala and Maputo is an important area for shipping traffic. Ships in deeper waters, to the east of the proposed FSO location, are generally routed from Beira Port to the northern ports in Mozambique such as Quelimane and Nacala Ports or to the Maputo Port in the south, or are travelling to other international ports, such as Durban. Approximate vessel transport routes are shown in *Figure 7.13* below. Durban is regarded as the "Mother-Port" for the Southern Africa region and accounts for the majority of traffic along the eastern seaboard, including traffic to and from the ports of Durban and Richards Bay.

Fishing vessels and commercial ships travel close to the coast between the Ports of Quelimane, Beira, Inhambane and Maputo. The Maritime Authority (the National Maritime Institute - INAMAR) indicated that an annual average of 1 000 cargo and fishing ships cross the Project Area at a distance of 20 to 35 miles (36 to 63 km) from the coast, mostly in transit through the Mozambique Channel (Impacto and ERM, 2010). This category of traffic includes Industrial and Semi-Industrial Fishing Vessels, which use the Port of Beira as a base. A large number of small-scale fishing vessels, numbering about 7 400, are also involved in artisanal fishing in Sofala Bay (to the north of the Project Area), generally within three nautical miles (5.5 km) of the coastline (Impacto and ERM, 2010).

The Port of Beira is the most important port near the Project Area and handles international shipping, domestic and regional cabotage (1), small-scale transport, fishing vessels and tourism vessels. The Port of Beira acts as a transit port, handling the import and export of cargo from Zimbabwe, Malawi, Zambia, South Africa and other countries in the region.

International vessel movement using the Beira Port and crossing the Project Area includes shipping traffic from Europe, Asia and the Americas, as well as some non-regular traffic from North Africa, the Horn of Africa and other parts of the world. Much of the traffic through the Mozambique Channel comprises oil tankers passing through at a great distance from shore (*Figure 7.13*) shows approximate distance from the coast).

National cabotage in Mozambique using the Beira Port and crossing the Project Area accounts for the second tier of marine traffic in the region. It involves traffic between Beira-Maputo and Beira-Quelimane, followed by traffic between Beira and other national ports of Pemba, Nacala, Angoche and Inhambane. Additional traffic in the region is accounted for by traffic from other regional ports such as Mombassa (Kenya), Dar es Salaam (Tanzania), Moroni (Comoros) and Tamatave (Madagascar).

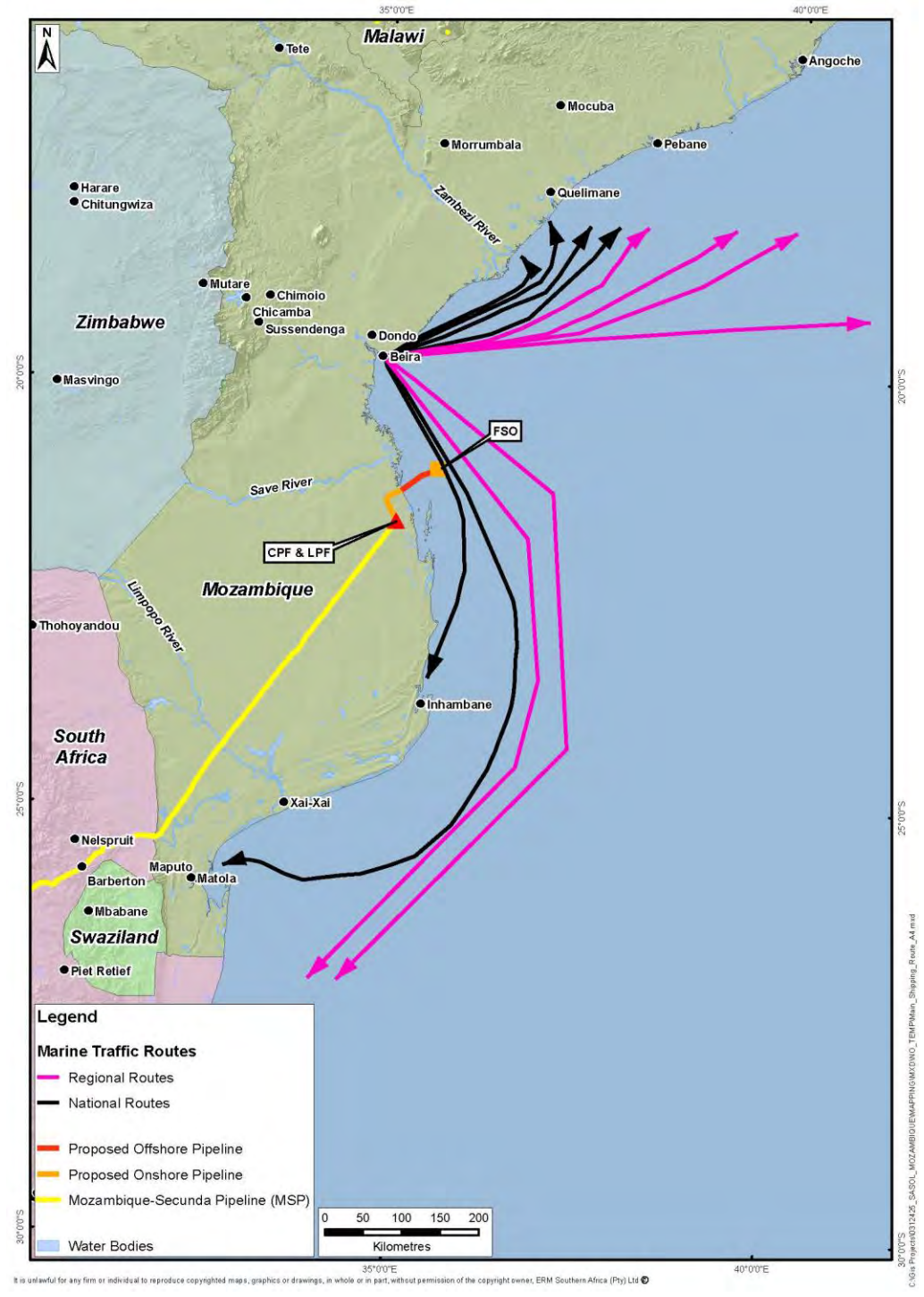
Traffic from tourism vessels includes cruise ships, yachts and small pleasure boats. Cruise ships and yachts undertake temporary visits to the Bazaruto Archipelago, while the small pleasure boats tend to remain in the area on a permanent basis. Generally, tourism vessels are mainly concentrated in the Bazaruto Area around the islands. The best diving period is April to December, while the peak times for deep sea and recreational fishing are the peak seasons of April, December and January, especially in areas to the north of Bazaruto Island, sometimes up to 20 km from shore (Impacto and ERM, 2010). Generally, over December and January an average of 17 and sometimes up to 20 - 30 boats may be found on and around the Two Mile Reef, supporting diving and snorkelling (ERM and Consultec, 2006). As noted previously, the presence of diving and sports fishing vessels in the area will be defined during the EIA Phase.

Another important category of maritime travel is small-scale transport. This category of traffic includes small passenger vessels connecting the various Islands of the Bazaruto Archipelago with the mainland (Vilanculos, Inhassoro and Nova Mambone at the Save River mouth).

Figure 7.13 below shows the national (domestic) navigation routes closer to the Project Area than the international routes.

(1) Cabotage refers to the transport of goods or passengers between two places in the same country by a transport operator from another country.

Figure 7.13 Main Shipping Navigation Routes in the Project Area



Source: Adapted from Impacto and ERM, 2010

7.7 CULTURAL ASPECTS, ARCHAEOLOGY AND CULTURAL HERITAGE

The main ethno-linguistic groups in this region comprise the Matsuda, the Ndau and Elomwe. The predominant local language in the region is Xitswa. According to SAL (2006), a native population known as "Bazarutos" or "Mahoca", descendants of Ndau origin Tsonga group, migrated from the Save River to the islands of the Bazaruto Archipelago. This group speaks "Xihoca" which is a mixture of Cindau and Xitswa.

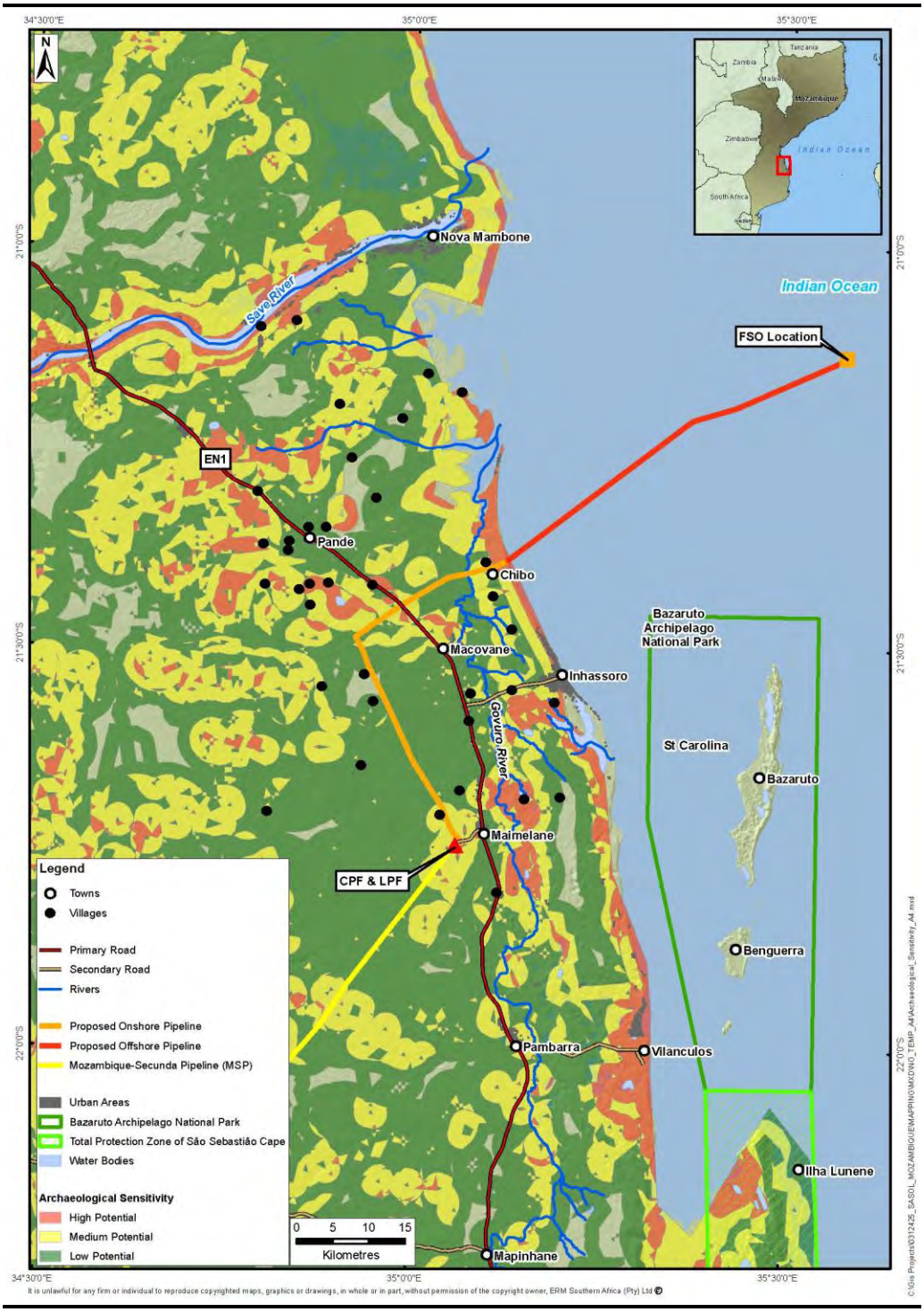
The main religions practiced are Catholicism (45.9 percent), Protestant / Evangelical (23 percent) and Zionism (5.4 percent). Family cemeteries are generally located near people's residence. In all Administrative Posts there are cemeteries for the local traditional chiefs that have access restrictions that need to be respected. Cultural sites such as sacred forests, trees and pools have also been identified in the Inhassoro District by Golder (2014b).

Inhassoro District has high archaeological potential due to its strategic setting along the coastal trade routes (both inland and along the shoreline) and the Govuro River. Five well-documented sites occur in the broader PSA Project Area (Golder, 2014b). Similar sites may also be found within the Pipeline and FSO Project Area and will be validated in the EIA.

Archaeological remains collected in neighbouring areas in the Inhambane Province include potsherds/fragments of ceramics, iron slag, beads, stone tools and lithic instruments (Impacto, 2012) as well as microlithic artefacts, pottery shards of the Matola tradition, characteristic of early farming communities (Early Iron Age), associated with shells, etc found in the PSA Project Area (Golder, 2014b). However, the majority of archaeological sites have been damaged by humans or climate - induced erosion (Golder, 2014b).

Figure 7.14 below illustrates the potential areas of archaeological interest and cultural heritage sites close to the onshore pipeline route (ERM, 2015). Areas of medium and high interest are typically associated with settlements. These will be studied in more detail during the EIA phase.

Figure 7.14 Archaeological Sensitivity Map



7.7.1 *Vulnerability to Climate Change*

The Project Area is located in areas with low soil productivity, low precipitation and in areas prone to cyclones. In the coastal areas of Inhassoro District, the soils are poor and sandy and the majority of the population practices rain-fed, slash and burn shifting agriculture. Agriculture has extremely low levels of productivity, and is highly dependent on climatic factors; as a result, the area faces cyclical food security problems, with long periods of drought.

Floods also regularly occur in the region, causing major constraints for the population living and/or practicing agriculture on the river banks. Besides agriculture and fishing, rural residents rely heavily on other natural resources to supplement food supply and income, which play a major role in livelihood strategies especially during drought periods. Due to Inhambane's high poverty levels and dependence on natural resources the population is extremely vulnerable to climate change. Coastal erosion of dunes and embankments between Inhassoro and the Bartolomeu Dias Peninsula is evident and threatens tourism and other infrastructure.

7.7.2 Social Development Plans and Strategies

The development strategy of the Government of Mozambique is summarised in two plans, the Action Plan for the Reduction of Absolute Poverty 2006-2009 (PARPA II) and the Poverty Reduction Action Plan 2011-2014 (PARP). Any available details on the impact of these plans and any updates will be considered in the EIA Phase.

Heads of state and government from across the world, including Mozambican President Filipe Nyusi, approved a new agenda for sustainable development covering the next 15 years and replacing the Millennium Development Goals (MDGs). The UN Sustainable Development Goals (SDGs) contain goals such as the eradication of poverty, combating inequalities and minimizing the impact of climate changes. Outcomes and updates of the country's commitments to the SDGs will be reviewed as part of the main EIA.

The Inhambane Province Development Plan 2011-2020 draws on national strategies and defines as the general objective the reduction of poverty from 57.9 percent (2009) to 45.0 percent in 2014 and 40.0 percent by 2020. Details of this plan will be presented in the EIA Phase.

The Inhassoro District Strategic Plan for Development 2011-2015 (PEDD) gives local effect to the national and provincial plans. Any available details on the impact of this plan and any updates for the period 2016-2020 will be considered in the EIA Phase.

Fisheries and tourism related plans are referred in the respective sections above.

7.8 SUMMARY OF THE SOCIO-ECONOMIC ENVIRONMENT

Table 7.6 Summary of the Socio-Economic Environment

Administrative Structure	• The Project is located in the southern region of Mozambique in Inhambane Province. • The onshore pipeline will pass though Inhassoro District and Inhassoro and Bazaruto Administrative Posts. • The nearest settlements to the onshore pipeline are Temane, Masadge, Catine, Pere, Chinhocane and Chibo.
Demographics	• There are 1 402 245 people in Inhambane Province (2011), approximately 6.1 percent of the population of Mozambique. • Inhassoro District comprises 3.8 percent of the Provinces population and is predominantly rural. • The main religions practiced are Catholicism (45.9 percent), Protestant / Evangelical (23 percent) and Zionism (5.4 percent). • The predominant local language is Xitswa.
Economic Activities	• The majority of the population (70.2 percent) of Inhassoro District is engaged in the agriculture, forestry and fisheries sectors. • Fishing is the predominant activity in coastal areas. • Small-scale (artisanal) fishing for subsistence and cash is the predominant type of fishing practiced in the Govuro River estuary and the near-shore. • The main fishing gear used includes line, seine net, harpoon, trap and gill nets. Diving (generally for lobster) is also undertaken. • Fish processing and resale is also an important economic activity. • Industrial and semi industrial line fishing is practised east of Bazaruto Archipelago and supplies fish to national and international markets. • Agriculture is practiced across the District and is mainly 'rain fed, slash and burn' shifting agriculture. • Common crops are sorghum, millet, peanuts, beans, cassava and maize. • Agriculture is mainly practised on small (approximately 1.8 ha) plots. • Secondary economic activities including hunting, harvest and sale of non-timber forest products and labouring also form an essential part of households livelihood strategies
Tourism	• Inhambane Province is one of the main tourism destinations in Mozambique. • The Vilanculos/Bazaruto/Inhassoro cluster is listed as one of the Priority Areas for Tourism Investment (PATI) and is Mozambique's most developed leisure destination. • Tourist attractions include pristine islands, the BANP, marine-based recreational activities including diving and snorkelling, beaches, recreational fishing, and swimming. • The District is well served by a range of tourism facilities, from affordable lodges to high-end hotels and resorts. • Tourism is the largest formal sector employer in the coastal region of Inhassoro District.
Infrastructure	• Education facilities are limited in the District with a third of the population having no formal education. • There is no hospital in Inhassoro District; Rural Health Centres are located in the District Headquarters. The main diseases in 2011 comprised malaria, diarrhoea and dysentery, sexually transmitted diseases (including HIV/AIDS), tuberculosis and pneumonia. • The main sources of energy are wood, charcoal paraffin and kerosene,. • All District roads are unpaved with the exception of the main EN1.

Cultural Heritage	• Inhassoro District has high archaeological potential due to its strategic setting along the coastal trade routes • Family cemeteries are located near people's residences and cemeteries for local chiefs with access restrictions are located in each Administrative Post. • Cultural sites such as sacred forests, trees and pools have also been identified in Inhassoro District.

8 IDENTIFICATION OF KEY ENVIRONMENTAL AND SOCIAL ISSUES

8.1 INTRODUCTION

The purpose of the Scoping Phase is primarily to identify key environmental issues and impacts that need to be assessed in more detail in the EIA process, and to enable early identification of any potential fatal flaws that may preclude environmental licensing. Understanding of these issues serves to ensure the Terms of Reference of the specialist studies covers all potentially significant Project risks. As discussed in *Chapter 1*, Sasol has been active in the Project Area since 2001 and has conducted multiple EIAs of their activities. Many of the issues associated with onshore pipeline and offshore Projects and likely stakeholder issues are therefore reasonably well understood.

As described in *Chapter 6 and 7*, this Project is located in an environmental and socially sensitive location, close to the Bazaruto Archipelago National Park (BANP) which is a Marine Protected Area. Onshore, the pipeline traverses the coastal plain which is intersected by the largely intact Govuro River and floodplain, which drains into the Govuro / Save estuary – an important area for mangroves and fishing. The scattered and largely rural communities living in the area are mainly dependent on agriculture, forestry and fisheries sectors for their livelihood. Artisanal fishing is the dominant economic activity along the coast. Natural resource-based tourism is an important form of income generation and employment in the coastal region of Inhassoro District.

The opening of new access into remote and inaccessible areas with woodland and forest habitats for pipeline construction may lead to increased human access for timber harvesting, hunting and clearance for agriculture. In the Govuro floodplain, improved access may lead to increased harvesting of threatened cycads, while potential spills during construction or from the pipeline could lead to pollution of the Govuro River and estuary. However, such improved access is likely to be welcomed by community members to facilitate access to natural resources.

Offshore, issues related to the risk and consequence of oil spills on the conservation status of the coastal and marine environment (especially coral reefs, fish, dugongs and turtles) are a key concern, since this environment underpins the BANP and the associated tourism sector. This issue dominated discussions with the stakeholders involved in the EIA for exploration activities in Block 16 and 19, and it is likely that similar concerns will be raised about the FSO Project, notwithstanding the FSO's location outside of the immediate area of use around the BANP. These concerns are valid and must be carefully considered in this EIA process.

Another key stakeholder issue that must be considered in the EIA process is the interference and exclusion from fishing areas during construction and operation of the offshore pipeline and FSO and any loss of fishermen's income, and to the wider fishing economy as a result. These issues highlight the need for a compensation mechanism and good communication with fishing associations and tourism operators on access restrictions at sea and potential loss of income.

Stakeholder issues related to the onshore pipeline will likely include interference with access and land use activities in the Right of Way and requirement for compensation; the allocation of jobs and training; and Corporate Social Investment (CSI) needs.

This Chapter outlines the anticipated impacts of the proposed Project's activities (*Chapter* 2), on the biophysical environment (described in *Chapter 6*), and the socio-economic environment (*Chapter 7*). It also considers the potential cumulative impacts of the proposed Project in the context of Sasol's previous and existing activities in the area. Furthermore, this Chapter discusses how physical, biological and social environmental attributes of the Project Area may influence and potentially impact on the Project.

The known key issues have been summarised in the introduction whilst the subsequent tables presented in *Section 8.4* define all of the significant issues to be considered in the EIA Phase of this Project.

Impacts identified in this Scoping Report will form the basis of the Environmental Impact Assessment and identification of appropriate mitigation/management measures for the Project.

8.2 THE SCOPING PROCESS

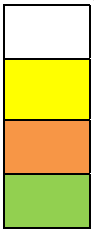
The identification of key environmental and social issues associated with the Project has been generated by:

- Inputs from the technical team leaders and their specialist team members based on previous site visits to the area and experience on similar Projects in the region;
- Review of previous and ongoing EIRs for similar Sasol Projects in the broad Project Area (Temane, Inhassoro and Pande);
- Review of stakeholder issues arising during previous Sasol EIAs in the region; and
- Discussions and findings obtained during a Scoping Workshop between members of the ERM team with the Sasol Project Management and technical design team held in January 2016 in London.

8.3 POTENTIAL PROJECT INTERACTIONS WITH ENVIRONMENTAL COMPONENTS

Potential interactions between the onshore and offshore components of the Project (both planned Project activities and unplanned events) and physical, ecological or socio-economic components of the affected environment are summarised in *Table 8.1*and *Table 8.2*. These provide a basis for more detailed description of potential Project risks in *Section 8.4*.

The key for tables *Table 8.1* and *Table 8.2* is provided below:



No interaction

Interaction with the environment or receptor which is not expected to be significant

Interaction with the environment or receptor that could be significant

Positive interaction

Table 8.1 Onshore Project Linkages

Activity	Environmental/ Social Sensitivity																																		
	Physical							Biological							Social																					
	Ambient Air Quality and Dust	Global Climate	Noise	Topography / Landform	Soils, Geology and Land Capability	Surface and ground water quality/quantity	Hydrology	Terrestrial Flora	Terrestrial fauna (animals)	Sensitive or Critical Habitats	Freshwater Aquatic ecosystems	Aquatic fauna and instream flora	Coastal / estuarine habitats	Marine / Coastal fauna and flora	Riparian vegetation	Community Health Safety and Security	Government Stakeholders	Traffic & Transportation	Cultural Heritage	Landscape &Visual	Employment & Income	Fishing	Agricultural activities and food security	Forestry concessions	Tourism & Recreation	Amenities and social services	Community Health	Local Economy	Future Activities	Public Utilities (eg landfills)
Pipeline Construction																																			
Onshore pipeline																																			
Site preparation: demining, vegetation clearance and topsoil removal and storage																																			
Pipeline installation: trenching and backfilling																																			
Water use / abstraction (source to be confirmed)																																			
Widening existing / new access track in remote areas																																			
Increased construction traffic																																			
Labour, equipment and services supply																																			
Beach Valve Station and Shore Crossing																																			
Pipeline installation and construction using Horizontal Directional Drilling (HDD)																																			
Disposal of HDD waste to nearshore																																			
Installation beach valve station																																			
Widening of existing coastal track																																			
EN1 Road Crossing																																			
Pipeline installation and construction using HDD																																			
Water use /abstraction (source to be confirmed)																																			
Govuro River Crossing																																			
Construction of pipeline river crossing using auger bore drilling																																			
Possible installation of bridge																																			
Water Use / abstraction (source to be confirmed)																																			
Disposal of waste water (to be confirmed)																																			
Oil export facility within LPF area																																			
Construction of oil export facilities in the new PSA LPF																																			
Increased traffic																																			
Lighting of site																																			
Support Activities / Labour																																			
Re-use existing camps, lay-down areas, refueling sites																																			
Enforcement of safety exclusion zones along ROW																																			
Transport and disposal of hazardous waste and non-hazardous waste																																			
Labour, equipment and services supply																																			
Pipeline Commissioning																																			
Hydro-testing of pipeline																																			
Water Use / abstraction (source to be confirmed)																																			
Disposal of waste water																																			
Pipeline Operation and Maintenance																																			
Operation of the export pumps, pig launchers and mainline valves																																			
Pigging of pipeline (every 5 years)																																			
Transport and disposal of hazardous waste and non-hazardous waste																																			
Decommissioning of Onshore Pipeline																																			
Decommissioning of pipeline, beach valve station, valves etc.																																			
Transport and disposal of hazardous waste and non-hazardous waste																																			
Rehabilitation of disturbed areas																																			
Accidental Event/ Emergency																																			
Hydrocarbon / chemical spills (minor)																																			
Hydrocarbon Spills (major)																																			
Chemical spills																																			
Vegetation fires																																			
Road Traffic Accidents																																			

Table 8.2 Offshore Project Linkages

Activity	Environmental/ Social Sensitivity																										
	Physical									Biological								Social									
	Ambient Air Quality	Global Climate	Noise Levels (Airborne and Underwater)	Light / illumination	Seabed Topography	Seabed sediments	Hydrology	Geology	Marine Water Quality	Benthic Communities	Fish & Pelagic Flora & Fauna	Marine Mammals (eg dugongs)	Marine Reptiles (turtles)	Seabirds	Coral Reefs / Outcrops	Protected Areas/ Critical/ Sensitive Habitat	Coastal habitats / estuary	Community Health Safety and Security	Government Stakeholders	Traffic & Transportation (Marine and onshore)	Cultural Heritage	Landscape/Seascape &Visual	Tourism & Recreation	Employment & Income	Local Economy	Fishing	Shipping and Navigation	Public Utilities (eg landfills)
Offshore Pipeline Construction																											
Marine supply base																											
Mobilisation of support vessels																											
Operation and presence of installation, supply and support vessels, helicopters, and crane																											
Safety exclusion zone around pipeline and support vessels																											
Power generation by vessels																											
Removal of fishing equipment/ vessels and debris																											
Installation of pipeline, including safety exclusion zone																											
Installation of FSO																											
Installation of FSO Turret Mooring including riser and umbilical																											
Fuel use for helicopter and supply and support vessels																											
Tow / sail out of FSO, hook up to the mooring																											
Presence of safety exclusion zone around FSO																											
Commissioning of Offshore Pipeline and FSO																											
FSO pre-commissioning leak and pressure test SSIV and riser																											
FSO introduction of hydrocarbon																											
Diesel storage and use for black start conditions																											
General Support Activities																											
Provision of potable water to POB																											
Disposal of hazardous & non hazardous wastes																											
Disposal of galley (food) waste, black and grey water to sea																											
Discharge of sanitary effluents (black and grey water)																											
Ballast water from support and construction vessels																											
Labour, equipment and services supply																											
Operation of Offshore Pipeline and FSO																											
Presence of FSO and safety exclusion zone																											
Power generation																											
Cooling water discharge																											
Venting operations																											
Heating, Ventilation and Air Conditioning (HVAC) systems																											
Drainage system																											
Provision of potable water to POB																											
Disposal of hazardous and non hazardous wastes																											
Disposal of galley waste																											
Discharge of sanitary effluents (black and grey water)																											
Routine maintenance (incl. cleaning tank, foul removal, painting)																											
Oil transfer to shuttle tanker																											
Ballast from FSO																											
Support and supply vessels(including temporary anchoring)																											
Presence of offshore pipeline																											
Pigging and disposal of waste																											
Pipeline , mooring and riser inspection																											
Labour, equipment and services supply																											
Operation of FSO marine supply base																											
Decommissioning of FSO																											
Removal of riser, FSO mooring system																											
Removal of FSO mooring systems																											
Tow away of FSO																											
Disposal of hazardous and non hazardous wastes																											
Operation of and presence of decommissioning support and supply vessels																											
Ballast from FSO, support and supply vessels																											
Labour, equipment and services supply																											
Decommissioning of Pipeline																											
Flushing of pipeline																											
Removal of pipeline																											
Removal of safety zone																											
Disposal of hazardous and non hazardous wastes																											
Operation of and presence of decommissioning support and supply vessels																											
Ballast from FSO, support and supply vessels																											
Labour, equipment and services supply																											
Accidental Event																											
Hydrocarbon Spills (minor)																											
Hydrocarbon Spills (major)																											
Explosion/ fire FSO																											
Cyclone																											
Bunkering -diesel spill																											

8.4 IDENTIFIED ISSUES

From the scoping assessment, the Project is likely to cause a number of impacts that are significant or which are perceived by stakeholders to be significant, and which require further assessment and the need for specialist studies in the EIA Phase.

Significant impacts that are predicted to result from the advanced works, construction, commissioning and operational activities are summarised in *Table 8.3*. Potentially significant impacts arising from unplanned events (accidents) are summarised in *Table 8.4* while those considered insignificant from planned activities are summarised in *Table 8.5*. *Table 8.6* summarises issues that will be managed under relevant management plans and operating procedures and are not a component of the proposed specialist studies.

A number of the identified issues are interlinked across components (eg increased dust on community health or reduced water quality causing degradation in aquatic ecosystems). However for the purpose of this Scoping Report impacts are categorised by their primary impact (eg air quality impacts fall under physical not social environment). These linkages will be explored and assessed more fully in the integrated EIR.

Table 8.3: Potentially Significant Issues from Planned Activities

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
1	**Onshore Physical Environment**			
1.1	**Dust**: Increased dust levels causing decreased ambient air quality (and community health risks)	Advanced works and construction phases	Vegetation clearing, demining activities and topsoil removal and storage	The advanced works and construction phase activities will result in increased dust emissions in the construction area, which may result in community nuisance or even health effects in the Project Area. Further assessment is required to determine the extent and significance of dust emissions on the community.
1.2	**Decreased Ambient Air Quality:** Decreased onshore ambient air quality in the vicinity of the CPF	Operational phase	Air emissions arising from the LPF export pumps adjacent to the CPF	The operation of export pumps located at the LPF will generate additional emission sources near the CPF facility. The contribution of the export pump emissions at the LPF will be quantified and assessed cumulatively with the CPF facility onshore.
1.3	**Climate Change:** Increased emissions contributing to Climate Change	Operational phase	Venting emissions and power generation at the FSO and other Project vessels.	In order to predict the Projects contribution to climate change an emission inventory will be prepared of all expected pollutants resulting from venting emissions and power generation at the FSO and other Project vessels..
1.4	**Onshore Noise:** Increased onshore noise in combination with noise generated by the CPF	Operational phase	Increased noise levels generated by operation of the export pumps located inside the new LPF site.	The export pumps, as an additional noise source, could result in the overall noise footprint of the CPF/LPF extending further from the CPF boundary and affect surrounding communities. The additional increase in noise will be modelled to confirm if noise levels will exceed target levels specified in the CPF oEMP..
1.5	**Altered River Hydrology:** Altered hydrology of the river channel to flooding	Construction phase	Auger boring under the Govuro River will require water for drilling and excavation of work pits adjacent to the river which will require dewatering	Auger boring beneath the Govuro River may affect river flow through possible abstraction of water for drilling, and drainage or seepage of water into adjacent excavated works areas on the river banks (that will require settlement and pumping back to the river), or through creation of mounding on the floodplain that may affect flooding. Thus, further assessment of the river hydrology and baseline aquatic ecosystem health against the Project activities and expected water needs, potential sources and its management is required to determine this risk and the significance of water-related impacts. Sasol will be responsible for obtaining permits from Ara-Sul for water abstraction from groundwater or surface water sources.
1.6	**Reduced Water Quality:** Increased turbidity / sedimentation of Govuro River causing reduced water quality (and reduced aquatic habitat status)	Construction phase	Excavation and return of water to the river	Excavation of works areas on either side of the Govuro River during auger boring is likely to result in the need for return of seepage water and drilling waste water back to the river. This is expected to cause elevated turbidity of the river water quality, with potential risks to aquatic ecology (see points 2). Further assessment of the water quality risks and significance of potential impacts on aquatic ecology is required.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
1.7	**Increased Erosion**: Increased erosion of exposed soils and embankments	Advanced works and construction phases	HDD of the pipeline and construction of the beach valve station will require excavation of unconsolidated coastal soils	Cliffs along the beach front in Inhassoro District are increasingly prone to wind and wave erosion and are exhibiting evidence of destabilisation. Clearance of coastal vegetation, excavation in sandy soils and construction of pipeline infrastructure may subject affected areas to exposure and erosion over time, further exacerbating coastal erosion. Mitigation of these risks will be addressed through design of construction methods and infrastructure. Proposed mitigation measures will be reviewed during the EIA in order to confirm that there is no further risk of erosion.
2	**Onshore Ecological Environment**			
2.1	**Terrestrial Flora and Fauna:** Disturbance and removal of terrestrial vegetation and flora, including possible threatened and protected species, and displacement of fauna. New access into remote areas will increase human influx for resource use (eg bush meat hunting, timber harvesting, and habitat clearance for agriculture and settlement).	Advanced works and construction phases	Vegetation clearing and topsoil removal along the onshore pipeline route to prepare the pipeline servitude and Right of Way	Vegetation clearing of the pipeline route, ROW and for widening existing access tracks will impact upon certain habitats likely to contain threatened flora and fauna, and will facilitate improved human access to undisturbed remote areas with higher biodiversity. Several threatened plant species have been identified in the Project Area and many mammal species are under severe hunting threat in the remaining less disturbed habitats. Therefore, advanced works and construction activities will result in both direct and indirect impacts on flora and fauna. Thus, further assessment of the ecological importance of the fauna and flora along the undisturbed area of the pipeline route and its potential to qualify as a critical or sensitive habitat will be required.
2.2	**Aquatic / estuarine ecosystems:** Disturbance of aquatic and estuarine ecosystems, including threatened and protected species.	Advanced works and construction phases	Clearing of vegetation, excavation and removal of topsoil near aquatic ecosystems along the onshore pipeline route especially at the Govuro River crossing	Habitat clearance and construction activities along the onshore pipeline route will impact the aquatic habitats of the Govuro River and possibly small seasonal pans through altering surface and subsurface run-off, increasing sedimentation and turbidity, and possible contamination by pollutants. Auger boring under the Govuro River is proposed as a method to minimise the physical impacts of the pipeline crossing on the river system. Auger boring under the Govuro River may however cause degradation of the stretch of the river at the crossing point through excavation of floodplain sediments, return of seepage water with elevated turbidity to the river, and loss or disturbance of riparian vegetation, possibly destabilising the river margins. Sedimentation effects may extend some way upstream and downstream due to the tidal influence. Further assessment of the ecological importance of the aquatic and estuarine ecology of the onshore pipeline route in order to assess the impact of the alignment and construction methods proposed for the Govuro River crossing will be required.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
2.3	**Coastal habitats** Removal of coastal vegetation and flora, and disturbance of coastal fauna.	Advanced works and construction phases	Habitat clearance and excavations on the coastal belt for pipeline construction and associated infrastructure at the beach valve station, and associated human disturbance of the coastal fauna and flora	Habitat clearance and excavation in the coastal zone may result in removal of threatened and/or protected flora, and disturbance to coastal fauna, including in the area of the proposed HDD entry point and beach valve station. These activities at the top of the cliff will likely expose sandy soils to increased wind erosion and destabilisation. Thus, further assessment of the ecological importance of the coastal ecology of the offshore pipeline route will be required.
3	**Onshore Socio-economic Environment**			
3.1	**Community Issues:** Community disruption, and altered community health, safety and security	Advanced works and construction phases	Restricted access to the onshore pipeline corridor	Advanced works and construction activities along the pipeline will lead to a number of issues that may cause community disruption, nuisance and potential safety risks. These include restricted access to the onshore pipeline route corridor along access routes, and the presence of open trenches during the advanced works phase. Thus, further assessment of the impact of the advanced works and construction activities on community health and safety in the Project Area will be required.
			Presence of the workforce in the Project Area	Construction workers will be sourced locally, regionally and internationally depending on the skills required for the work and in accordance with Mozambican requirements. The presence of workers housed in a personnel camp near local communities may create health and security concerns although the location of the camp near local communities may also provide work opportunities. The impacts of worker presence on the health of local communities may be significant if not managed correctly, and therefore will be assessed.
3.2	**Labour recruitment:** Employment, fair labour practices, use of migrant or foreign labour, training / capacity building of local people and competition and potential jealousies and conflicts as a result of recruitment practices	Advanced works, construction, operational and decommissioning phases	Employment of labour and allocation for jobs	The Project will employ workers during all the phases. These workers will be sourced both locally, regionally and internationally depending on the skills required for the work. Sasol has an approved labour agreement with the Mozambican Government, which ensures respect of national law as well as the use of local labour as far as possible, in combination with skills training. Provisions of fair recruitment and labour practices will need to be addressed in the EIR and EMP for this Project as stakeholder concerns related to Sasol's recruitment process have been raised in previous EIA studies. Unless a transparent and fair recruitment process is implemented with specific attention to local employment and procurement of services, conflict and competition for jobs within and between villages and towns and with Sasol may arise. Failure to manage these risks could lead to work stoppages or road blocks. Therefore, the potential conflict of the recruitment process and the hiring of outsiders need to be further assessed to ensure appropriate recruitment policies are implemented to address the risk and significance of this potential impact.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
3.3	**Local economy:** Pipeline and FSO construction can benefit the local economy through job creation and resultant increased local cash expenditure as well as procurement of local service providers. However, such Projects can also impact the existing local economy if there are conflicts with tourism and fishermen.	Advanced works, construction, operational and decommissioning phases	Use of local service providers to supply food, water and waste services to the Project	While the Project, once operational, can have large economic benefits at the national scale, it can have both positive and negative impacts on the local economy during and after construction. The advanced works and construction phases have the greatest potential to benefit the local economy through job creation and procurement of accommodation for contractors, and other services. However, it is also possible that the Project construction and operation could negatively affect the semi-industrial and artisanal fishing sector of access to fish catches are affected or the tourism sector if recreational fishing, diving and other ecotourism-based activities are impacted.
3.4	**Loss of fields and compensation issues:** Pipeline servitude clearance will result in loss and disturbance of agricultural land in certain stretches, particularly north of the CPF and in the eastern coastal section.	Advanced works and construction phases	Vegetation clearance and topsoil excavation, and reinstatement of topsoil post construction	Advanced works and construction activities will damage or destroy crops in places or will prevent germination of crops already planted, resulting in loss of labour. Poor reinstatement of topsoil to disturbed areas could cause reduced crop yields in places. These issues have been raised during stakeholder engagement on previous EIAs have required careful consideration of compensation measures that will also need to be applied in the implementation of this Project. The impacts on agriculture and their mitigation requirements will be addressed.
3.5	**Cultural heritage:** Pipeline construction may cause loss of cultural heritage such as spiritual sites, graves, and archaeological sites (eg stone age/iron age sites, tribal pottery remains, shell middens etc).	Advanced works and construction phases	Clearing and excavation of the pipeline route	Vegetation clearance and soil excavation along the onshore pipeline route and ROW will cause changes in land surface and may damage/ remove any cultural heritage resources that are within the construction ROW. The presence of cultural heritage resources along the pipeline route will be further assessed to determine the significance of this impact and mitigation requirements.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
3.6	**Waste management:** Generation of waste will include hazardous waste (such as hydrocarbon contaminated soil, rags and containers; drilling fluid and biocide containers; pigging waste); and non-hazardous wastes (such as plastic and polystyrene wrapping and containers; waste wood/pallets; cabling etc). Poor waste management and disposal practices can result in littering, pollution of soil, water and air.	Advanced works, construction, operational and decommissioning phases	Generation, transport and disposal of hazardous and non-hazardous waste.	The full range of wastes to be generated and managed by the different phases of the Project requires confirmation. A waste management plan will be developed during the EIA Phase of this Project to ensure waste management is done in accordance with the legal requirements for Mozambique and international good practice, and taking account of available waste management facilities.
3.7	**Fresh water availability and supply** During all the phases of the Project freshwater will be required for Project activities and drinking water for labour	Advanced works, construction, operational and decommissioning phases	Fresh water use for activities	Water is scarce in the region and therefore Sasol will need to establish the availability of water in existing boreholes and additional sources that may be required.
3.8	**Increased traffic onshore**	Advanced works, construction, operational and decommissioning phases	Transportation of manpower to/ from the site, equipment and materials to the site and waste	The Project will generate additional road traffic on existing roads for transportation of manpower to/ from the site, equipment and materials to the site; and waste during all phases of the Project. However, this will be undertaken on a larger scale during the construction phase as materials/ equipment will be transported from the Port of Beira to the Project site. The additional traffic has the potential to cause interference with existing road users including traffic congestion and delays; increased road accidents; damage to road infrastructure from heavy vehicles; and reduced safety and accessibility for other road users such as pedestrians and cyclists. Thus, impact on road traffic and transportation may be significant and will be assessed further during the EIA process.
4	**Offshore Physical and Biological Environment**			

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
4.1	**Seabed sediment disturbance**: Disturbance of seabed sediment resulting in increased turbidity, loss of benthic fauna and displacement of fish other marine fauna and change in seabed topography.	Advanced works and construction phases	Seabed disturbance will be caused by: • Anchoring of the turret mooring system during its installation, deployment of anchors and anchor chains to moor the FSO and shifting of the anchor chains for the period the FSO is on site. • Trenching and burying of part or the entire offshore pipeline. • Anchoring of the pipelay barge vessel during construction of the offshore pipeline.	Disturbance and suspension of sediments in the FSO area during mooring and anchoring of the FSO and pipelay vessels, and trenching and laying of the pipeline from the shore crossing to FSO will remove benthic habitat and fauna and disturb fish and other marine fauna. The nature of the benthic sediment and fauna will be assessed in the marine ecology study to inform determination of the significance of this impact.
4.2	**Marine water quality**: Reduction in marine water quality with potential impacts on fish, plankton, seagrass and other marine fauna dependent on these for food.	Advanced works, construction, operational and decommissioning phases	Water-related pollution impacts in the marine environment will occur from: • Waste water and sewage discharge from vessels during all phases of the Project (in accordance with MARPOL standards) • Discharge of ballast water from vessels • Discharge of hydro-test and dewatering water during the offshore pipeline commissioning phase..	Discharge of waste water and hydro-test discharge as well as increased turbidity in the marine environment north of the BANP may be an issue of concern to stakeholders given the conservation status of the area and the importance of sensitive marine species (eg seagrass, coral reefs and dugongs) that depend on high coastal water quality. Thus, the impact of wastewater discharges on offshore water quality in the Project Area will be assessed further.
4.3	**Seagrass and Dugongs** Disturbance and displacement of marine fauna (eg fish, dugongs, turtles etc) as a result of removal of seagrass along the pipeline route, sediment generation due to trenching, increased noise, vibration, light and offshore traffic	Advanced works, construction and operational phases	Increased noise, vibration and offshore traffic during construction operation, and trenching of the pipeline in near shore environment.	The BANP and the area crossed by the pipeline route is recognised as hosting one of the last remaining viable populations of dugongs along the East Coast region with an estimated 200 to 250 dugongs thought to occur between the Save estuary and the islands of the BANP. The presence of dugongs and the sensitivity of the Bazaruto coastal region was a major issue of concern during the EIA of nearshore exploration in Block 16 and 19. Therefore, it is likely to be a key issue raised by conservation stakeholders in the current study. Key real and perceived risks to dugongs will include collisions with support and pipeline laying vessels; noise and vibration impacts, and loss of seagrass through direct removal or sediment smothering. Stakeholders are likely to be concerned about the potential risk of an oil spill affecting dugong foraging habitat and general marine fauna nursery areas in the Govuro / Save estuary. In order to confirm the risks to dugongs, a dedicated aerial survey and assessment of potential impacts on dugongs in the integrated marine ecology study will be undertaken in the Project Area prior to pipeline construction.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
4.4	**Noise, vibration, light and offshore traffic on Marine ecology** Disturbance and displacement of marine fauna (eg fish, dugongs, turtles etc) and potential risks to BANP as a result of increased noise, vibration, light and offshore traffic.	Construction and operational phases	Noise, vibration and offshore traffic from pipeline laying and FSO mooring vessels, and helicopter and supply vessels during construction, and from FSO operations, lighting and tanker shuttling	The offshore pipeline and FSO construction and operational activities will result in disturbance of the marine environment including sensitive marine fauna and flora that provides the basis for the BANP. These will result from a variety of effects that require further assessment in the EIA through modelling studies of turbidity plumes; noise and vibration modelling on marine fauna, and visual illumination modelling. The results of these studies will be interpreted in the integrated EIA to confirm the extent and significance of these impacts on sensitive marine receptors and to identify appropriate mitigation measures.
5	**Offshore Socio-economic Environment**			
5.1	**Disruption and Loss of Artisanal Fishing** Reduced access to artisanal fishing areas and displacement of fish resources from construction activities causing loss of income, food security and livelihood of local fishing communities.	Advanced works, construction phases	Activities that will impact on artisanal fishing include: • Exclusion from the 500 m safety exclusion zone around the pipeline and support vessels during installation. • Retrieval of fishing gear from the pipeline corridor. • Noise, vibration and increased turbidity linked to pipeline laying and vessel activities.	Reduction in fish catch and loss of income was a significant issue raised during the EIA of exploration in the nearshore environment of Block 16 and 19 and is likely to be a key issue raised by artisanal and recreational fishing stakeholders for this Project. There may also be a perception that the fish will be attracted to the safety exclusion zone around the FSO where they cannot be caught (although this may also serve as a small protected fish nursery area which can improve fish recruitment). Fishing provides the main livelihood and protein source for the majority of the coastal residents who will likely expect compensation to be paid for reduced catch and exclusion from fishing grounds. Thus, given the socio-economic importance of fishing in the area, a fisheries study will be undertaken to confirm the trends and current status of fishing in the Project Area as the basis for assessing the significance of the Project's impacts on artisanal fishing.
5.2	**Exclusion of Semi and Industrial Fishing from FSO area** Semi and industrial fishing vessels will be excluded from the 500 m safety exclusion zone around the FSO for the lifespan of the Project.	Advanced works, construction, operational and decommissioning phases	The presence of a 500 m safety exclusion zone around the FSO (including subsea infrastructure)	Semi-industrial and industrial line fishing takes place in the FSO location. Exclusion of fishing vessels from the FSO safety exclusion zone could result in the perception of reduced fish catch and loss of revenue. The extent to which the safety exclusion zone will impact on industrial fishing will be assessed with consideration of any inputs raised during the participation process by industrial fishing stakeholders.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
5.3	**Increased offshore traffic and presence of FSO offshore**	Advanced works, construction, operational and decommissioning phases	Offshore traffic will be impacted by the following activities: • The presence of installation and support vessels during the advanced works and construction phases. • Crew changes and supplies to the FSO for the length of its operation. • The presence of the FSO. • Operation of shuttle tankers.	The Project will generate additional vessel traffic in the Project's Area during all phases of the Project. However, this will be undertaken on a larger scale during the construction phase as materials/ equipment will be transported from the Port of Beira to the Project site. The additional offshore traffic has the potential to cause interference with existing users of the sea and limit the accessibility for users such as merchant vessels and fishing vessels. Thus, impact on offshore traffic may be significant and will be further assessed.
5.4	**Tourism:** Industrial Projects, and in particular oil and gas projects, in natural resource based tourism areas, such as the Bazaruto Archipelago, could lead to reduction in tourism and altered tourism profile over time. These may result from a combination of visual impacts of infrastructure from sensitive tourism receptors (eg lodges, diving sites), perceived or real loss of 'sense of place' as a wilderness tourism destination, and noise, vibration or vessel disturbance and pollution events on the sensitive coastal and marine ecosystem that is the primary basis for the tourism industry.	Advanced works, construction, operational phases	Increased noise, vibration, illumination and offshore traffic in the coastal marine environment and the presence of oil and gas infrastructure near a sensitive conservation area (BANP)	The potential impact of offshore exploration around Bazaruto on tourism was a key issue that was raised during the EIR for Block 16 and 19 and is expected to be a significant issue raised by stakeholders for this Project. Many stakeholders are likely to be concerned about risks to the natural environment that underpins the tourism industry but some operators may also welcome the increased demand for accommodation and services that such a Project is expected to bring, especially during the construction phase. A tourism study will be undertaken to understand the tourism trends in the Project Area. The findings of stakeholder meetings will be integrated into as a record of perceptions of tourist operators. Assessment of impacts on tourism will include integration of findings from the visual modelling study and the noise and vibration modelling study to address possible perceptions of visual and noise impacts on tourism.

	Issues of Concern	Project Phase	Planned Activities	Reason for Further Assessment Required in the EIA Phase of the Project
5.5	Social disruption, increased health risks and community grievances due to presence of foreign workers	Advanced works, construction, operational phases	Employment and presence of foreign staff for offshore pipeline construction and FSO installation in Project Area	The Project will require the presence of staff of contractors and vessel crew to be present in the Project Area in Beira at the marine base and in Inhassoro/Vilanculos to construct the offshore pipeline and to install and operate the FSO. This may result in foreign nationals being present in the community when they are on shore leave or in transit. Presence of foreign staff may lead to increased social pathologies related to presence of a dominant male workforce with cash supply, and elevated risk of seeking sexual favours from local women, over-consumption of alcohol and related social ills. The social disruption and links to health risks (eg HIV/AIDS, STDs etc) that may arise from interaction of these contractor crew members in the local community will be assessed and mitigation measures developed in the EMPs.

Table 8.4: Significant Issues from Unplanned (Accidental) Events

	Issues of Concern	Project Phase	Unplanned/ Accidental Events	Reason for Further Assessment Required
1	**Onshore Physical, Biological and Social Environment**			
1.1	**Traffic Accidents**: Increased construction traffic involving both sedan vehicles and abnormal trucks will increase the risks of traffic accidents with local communities, especially residents along access roads used during onshore pipeline construction.	Construction Phase	Road traffic accidents by construction vehicles involving local pedestrians or drivers	Increased risk of traffic accidents involving construction vehicles could cause loss of life or disability of local residents and will require assessment and the development of appropriate mitigation measures in the EMPs .
1.2	**Oil spill risks onshore:** Contamination of surface and groundwater with potential risks to sensitive aquatic systems such as the Govuro River and estuary, with potential consequences for fishing and tourism (depending on the size of the spill)	Operational Phase	Pipeline break or leak resulting in major hydrocarbon spill	A major oil spill in the Govuro River in particular could have significant consequences on the lower Govuro River and estuary. Assessment of this risk in the EIA will involve hydrological modelling of spill scenarios against an understanding of the tidal flow variations of the river and the sensitivity of the aquatic ecosystem assessed in an aquatic ecology study.
2	**Offshore Physical, Biological and Social Environment**			
2.1	**Marine pollution from drilling mud** Contamination of seabed sediment and decreased marine water quality from release of drilling mud with potential consequences for seagrass habitats, benthic fauna, fish and fishing.	Construction Phase	Accidental release of drilling mud from the HDD at the point of emergence of the drilling head from the seabed.	Drilling muds used in HDD when laying the pipeline across the beach and nearshore zone will be water-based and are of low toxicity, and largely comprising a mixture of water and bentonite (clay). Accidental release of drilling muds could nevertheless cause some degree of marine water pollution and elevated turbidity which until dispersed by wave action could result in displacement of fish and fishing activities.

	Issues of Concern	Project Phase	Unplanned/ Accidental Events	Reason for Further Assessment Required
2.2	**Marine pollution and degradation of marine and coastal ecosystem from major oil spill:** Contamination of the water quality column and seafloor sediments and the impacts on sensitive receptors	Operational Phase	A major hydrocarbon spill resulting from: • A leak or damage to the pipeline, onshore valves or subsea infrastructure. • Accidental vessel collisions. • Loss of oil from the FSO / Shuttletanker.	In order to assess the implications on sensitive receptors (dugongs, turtles, dolphins, the conservation status of the BANP, tourism and fishing sectors) major oil spill scenarios will be modelled and the significance of impacts on coastal and marine habitats, species, fishing, tourism and other users will be assessed.
2.3	**Risk to human health and safety at sea**: An accident at sea from a collision with a fishing vessel and the FSO could pose a health and safety risk to fishermen or recreational vessels in the area.	Operational Phase	A risk assessment will be conducted in order to establish the likelihood and possible outcomes an • Accidental vessel collisions in the sea. • The potential impact on trawled fishing activities and the need for burial of the offshore pipeline.	Risks associated with accidents posing a risk to human safety at sea will be identified in the socio-economic specialist study, and mitigation measures will be identified and incorporated into the EMPs, where appropriate.

Table 8.5: Issues Considered Not-Significant from Planned Activities

	Issues of Concern	Project Phase	Planned Activities	Reason for No Further Assessment Required
1	**Onshore Physical, Biological and Social Environment**			
1.1	Impact on tourism from onshore pipeline	Operational Phase	Visual changes to the landscape due to the installation of the pipeline and supporting infrastructure	The visual impact of the onshore pipeline is considered insignificant as it will be buried and the footprint of the beach valve station is small and located above and behind the cliffs leading to the beach.
1.2	Reduced ground and onshore surface water quality from waste water discharge from construction camps	Construction and Operational Phase	Onshore waste water discharges	Portable toilets and ablution facilities in existing camps will be used by the workers during all phases of the Project and therefore the impact will not be significant and no further assessment is required.

Table 8.6: Issues from Unplanned Activities that will be Managed under Relevant Management and Operational Plans

	Issues of Concern	Project Phase	Unplanned/ Accidental Events	Reason for No Further Assessment Required
1	**Onshore and Offshore Physical, Biological and Social Environment**			
1.1	Loss of terrestrial fauna and flora and threats to agricultural lands	Advanced works, construction, operational and decommissioning phases	Vegetation fires	This risk of a vegetation fire is low with the implementation of fire prevention measures during welding activities and at the camp sites. If a vegetation fire breaks out Sasol will respond immediately and therefore the footprint will be small and the impact is unlikely to be significant.
1.2	Contamination of groundwater , surface water, geology and soils by chemicals	Advanced works, construction, operational and decommissioning phases	Onshore chemical spills	Sasol has a chemical spill management plan to immediately clean up and address chemical spills onshore and therefore the impact of a spill is unlikely to be significant.
1.3	Decreased marine water quality due to offshore chemical spills	Operational Phase	Offshore chemical spills	Sasol will immediately clean up chemical spills onboard the Project vessels and the FSO. These chemicals are very unlikely to enter the marine environment due to the closed drainage systems onboard.
1.4	Pollution of the marine/ coastal or onshore environment	Operational Phase	Minor hydrocarbon spill	Sasol will manage small oil spills onboard the Project vessels and the FSO by cleaning up the spill immediately. These spills are very unlikely to enter the marine environment due to the closed drainage systems onboard.
1.5	Loss of FSO mooring	Operational Phase	Cyclones	The FSO mooring system (turret mooring) will be designed to withstand 100 year cyclone events. Offloading will not be permitted during unsuitable weather conditions and sea states. The limits for offloading will be established in the Sasol Marine Assurance Plan. The risk is very low and therefore no further assessment is required.

Note: Unplanned events will be managed by either existing plans or new plans developed in the EIA Phase.

8.5 *SUMMARY OF KEY ISSUES*

Based on a review of previous EIAs and an understanding of the Project and the affected environment a number of significant Project risks to the environment have been identified. Onshore and offshore impacts and include:

Onshore

- Removal of habitats and loss of threatened flora during advanced works and construction activities arising from routing of the onshore pipeline including potential loss of critically endangered cycads on the Govuro floodplain;
- Increased human access to remote areas during advanced works, construction and throughout operation activities for harvesting of timber and cycads; bush meat hunting; and possibly habitat clearance for new settlement and agriculture.
- Degradation of Govuro River during construction of the river crossing through increased sedimentation, pollution risks, altered flow and consequent potential loss of aquatic fauna (invertebrates and fish);
- Interrupted access, and increased noise and dust affecting nearby residents during advanced works and construction activities;
- Loss of cultural heritage resources during advanced works and construction activities;
- Social disruption and health risks caused by presence of construction workers during advanced works and construction activities;
- Increased risks of traffic accidents (both offshore and onshore) during advanced works and construction activities.
- Job creation (positive) during advanced works and construction activities; and
- Risks of an unplanned event during operation (eg pipeline break / oil spill) on soil, water, Govuro estuary, and fish resources; and
- Loss of land and the implementation of safety exclusion zones on agriculture and human settlement during construction and operational activities;

Offshore

- Exclusion of fishing activities during advanced works, construction and operational activities;
- Increased noise, vibration and offshore traffic impacts on dugongs and other marine fauna, and tourism activities (eg fishing, diving) during advanced works and construction activities;
- Visual impacts during construction and operational activities of infrastructure and support activities on tourism and residents; and
- Increased risks of pollution during construction and operational activities on marine and coastal environment with impacts on Bazaruto archipelago (eg coral reefs, sea grass) and natural resource-based tourism.

It is emphasised that some of these potential risks generate significant stakeholder concern – notably impacts on the marine and coastal environment of the Bazaruto archipelago, tourism and fishing. Such stakeholder perceptions of Project risks will be carefully and objectively evaluated to ensure that a balanced analysis of impacts is presented in the EIR.

8.6 FATAL FLAWS

A number of significant risks to the environment have been identified that require further investigation in the EIA (as summarised in *Section 8.5)*. A population of critically endangered cycads, *Encephalartos ferox* subsp. *emersus* on the Govuro floodplain may result in a section of the proposed pipeline route being fatally flawed. In this event, an analysis of alternative routes and other possible mitigation measures will be conducted by Sasol and ERM during the EIA Phase to minimise the risks to this species.

The ToRs for the specialist studies, presented in *Chapter 9*, takes account of these identified risks with significant attention on specialist baseline and modelling studies to ensure integrated assessment and evaluation of the potential impacts.

8.7 PROJECT AREA

The Project Area comprises the area that may be affected by the Project from direct impacts (Area of Direct Influence) and indirect impacts (Area of Indirect Influence) on the various environmental and socio-economic receptors.

Direct and indirect impacts of the Project affect the various environmental and social receptors (eg air, noise, water, biodiversity, socio-economic aspects etc) differently. Except for the unplanned direct impacts of the Project (eg oil spills), which may affect a large area, the Area of Direct Influence (ADI) tends to occur across a more narrowly defined area while the Area of Indirect Influence (AII) can influence a much broader area.

8.7.1 Defining the Area of Influence for this Project

Table 8.7 below defines the Area of Influence (ADI and AII) for both planned and unplanned events based on issues identified above. Unplanned events are all considered direct impacts of the Project.

Note: the defined Area of Influence refers to the spatial or physical scale at which the impact may occur – it does not relate to the potential consequence of the impact. For example, loss of a globally threatened species is assigned a Site or Local scale and not Global/International. The importance of a receptor will be evaluated and assigned a sensitivity or vulnerability rating in the EIR when assessing impact significance (refer to IA methodology in *Section 4.6*).

In summary, the majority of direct and indirect impacts would occur at a Site to Local scale. Indirect impacts – which are most often related to impacts associated with induced human access and related settlement and other land and coastal use activities – tend to occur at a Local to Regional scale.

Table 8.7: The Definitions for the Project Areas of Influence

Spatial Extent	Definition
Insignificant	No significant spatial Area of Influence (AoI)
Uncertain	Uncertain AoI requiring investigation
Site	Immediate footprint of the Project development (including physical area of pipeline route and FSO, access roads, construction camps, lay down areas) and proximal areas within the servitude of the Project infrastructure (ie 50 m servitude either side of onshore pipeline; 500 m safety exclusion zone around the offshore pipeline (during construction) and 500 m around the FSO (throughout operations).
Local	Area in close proximity to the Site (generally within 2 to 5 km) that may be directly or indirectly affected by advanced works, construction and operation activities.
Regional	Broad area around the Project infrastructure extending beyond 5 km radius, and including the coastal plateau and coastline within the Districts of Inhassoro and Govuro between Vilanculos and Beira.
National	The Republic of Mozambique
Transboundary / Global	Areas extending beyond border of Mozambique which can include impacts of Global significance (eg loss of globally threatened EN or CR species, or climate change) or transboundary importance such as oil spill..

Table 8.8 Area of Influence of the Project for Each Environmental Component

Type of Project Receptor	Advanced works and construction		Operation		Comment
	ADI	AII	ADI	AII	
Air Quality	Local	Insignificant	Insignificant	Insignificant	Air quality impacts mainly relate to increased dust associated with advanced works and construction activities and may extend 2 to 5 km from construction areas, especially for fine dust on the Govuro Floodplain.
Noise	Local	Insignificant	Insignificant	Insignificant	Noise impacts will primarily occur during advanced works and construction phases and will be restricted to a Local scale, within a 1 to 2 km radius of the pipeline and access routes.
Surface Water	Site	Local	Insignificant	Insignificant	Direct advanced works and construction impacts on surface water would occur mostly at Site scale (150 m wide corridor of pipeline or transport routes) although increased human influx to the area by the Project could impact on water resources at a Local scale.
Geohydrology	Local	Local	Site	Local	Direct and indirect advanced works and construction impacts could impact on groundwater resources at a local scale through altered groundwater flows or quality. Indirect impacts on groundwater during operation that may arise from induced human influx and settlement may occur at a Local scale through increased groundwater withdrawal or contamination.
Soils / Geology	Site	Local	Insignificant	Local	Direct advanced works and construction impacts on soils would occur at Site scale along the pipeline and road access routes. Induced impacts on soils associated with population influx and agriculture/settlement attracted by the Project activities during operation could occur at a Local scale.
Terrestrial / coastal vegetation habitats	Site	Local	Insignificant	Local	Advanced works and construction impacts on vegetation would occur at Site scale along the pipeline and access routes. Induced impacts associated with population influx or new development attracted by the Project activities could impact vegetation at Local scale during advanced works, construction and operation activities depending on extent of new habitat clearance for settlement along new access routes.
Terrestrial flora (plants)	Site	Local	Insignificant	Local	Direct impacts on flora species of conservation concern (eg cycads) would occur at the Site scale during advanced works and construction activities. Indirect impacts from increased human access for harvesting could extend to a Local scale.
Terrestrial fauna (mammals, birds, herpetofauna)	Site	Regional	Insignificant	Regional	Direct advanced works and construction impacts on fauna is limited to the Site scale but induced access to remote areas for hunting may have Regional scale impacts on mammal populations, in particular, extending into the operational phase.

Type of Project Receptor	Advanced works and construction		Operation		Comment
	ADI	AII	ADI	AII	
Aquatic Habitats and fauna (snails, fish & macroinvertebrates	Local	Local	Insignificant	Regional	Direct and indirect impacts on aquatic habitats – mainly on the Govuro River - are expected to occur at a Local scale but will depend on the extent of sedimentation and pollution impacts and how these risks are managed. Direct operational phase impacts are expected to be insignificant but induced human settlement along new access routes could have Regional scale impacts on the Govuro River through human use, pollution, abstraction etc. Apart from the Govuro River, no significant wetlands occur along the pipeline (only a few small seasonal pans).
Coastal habitats and Protected Areas	Local	Local	Insignificant	Regional	Direct impacts of pipeline advanced works and construction activities in the coastal / marine environment are predicted to be of Local scale. Induced impacts during advanced works and construction activities may have Local scale impacts on coastal habitats if coastal settlements expand or increase. Human influx and settlement throughout operation could have Regional scale impacts on coastal habitats and protected areas.
Marine habitats, coral reefs, sea grass	Local	Insignificant	Insignificant	Insignificant	Construction of the offshore pipeline and installation of the FSO and mooring is expected to have Local scale impacts on marine habitats (ie within 5 km of pipeline). Operation impacts are expected to be insignificant..
Marine fish	Local	Insignificant	Local	Insignificant	Construction of the offshore pipeline and installation of the FSO and mooring is expected to have Local scale impacts on marine fish (ie within 5 km of pipeline). Operation impacts are expected to be insignificant.
Marine fauna (eg dugongs, turtles, whales, dolphins)	Local	Local	Uncertain	Uncertain	Impacts caused by noise and vibration when trenching and laying the offshore pipeline is uncertain but expected to have Local scale impacts on marine fauna mainly through displacement from foraging habitats and movement routes. Operational impacts of FSO activities on marine fauna eg dugongs is uncertain and requires evaluation through noise and vibration modelling in the EIA.
Socio-economic profile/status	Local	Local	Local	Local	Advanced works and construction activities may have Local scale impacts on the socio-economic profile and status of communities along the pipeline through disruption of livelihood activities in the pipeline ROW, compensation for loss of fields or other structures, etc. Operational phase impacts are expected to be of Local scale through ongoing exclusion of access to the ROW for cropping and settlement.
Community health	Local	Local	Insignificant	Local	Impacts on community health associated with presence of construction staff or altered access to water supplies (direct) and from influx of work-seekers (indirect) are expected to be of Local scale, mainly affecting villages within 2 to 5 km of the pipeline. Direct impacts during the operational phase on community health are expected to be insignificant while increased influx of people due to improved access during operation could result in Local scale impacts on community health and health services.

Type of Project Receptor	Advanced works and construction		Operation		Comment
	ADI	AII	ADI	AII	
Fisheries	Local	Local	Local	Local	Advanced works and construction and operation phase impacts on fisheries – both freshwater, estuary and marine – are expected to occur at Local scale through disturbance and exclusion from fishing areas. Impacts on fishing in the marine environment will be mitigated by trenching of the offshore pipeline allowing for ongoing artisanal fishing across the pipeline route and compensation for loss of access, if appropriate. The FSO location is outside the artisanal or semi- or industrial fishing zones.
Agricultural production	Site	Local	Local	Local	Impacts on agricultural production will occur at Site scale (direct loss of fields) or Local scale from indirect impacts associated with increased population influx pressure on agricultural land. A major spill onshore, although unlikely, could have Regional scale impacts on agricultural production or arable land.
Cultural heritage	Site	Local	Insignificant	Local	Advanced works and construction impacts on cultural heritage, particularly in situ archaeological remains if present will occur at the Site-scale. Induced impacts related to human influx and clearance of areas for new settlement/agriculture could have Local-scale impacts on cultural heritage from the advanced works through to operation. Direct operational impacts on cultural heritage are expected to be insignificant.
Onshore traffic nuisance	Local	Local	Insignificant	Insignificant	Traffic impacts during advanced works and construction activities will be at Local scale and are considered Insignificant during operation. Communities may have difficulty using usual access routes during advanced works and construction phases although expected to be mitigated using detours.
Onshore traffic nuisance	Local	Local	Insignificant	Insignificant	Traffic impacts during advanced works and construction phases will be at Local scale and are considered Insignificant during operation. Communities may have difficulty using usual access routes during advanced works and construction activities although expected to be mitigated using detours.
Offshore traffic hazards	Regional	Regional	Regional	Regional	Offshore traffic between Beira and the offshore pipeline and FSO location will increase and occur at the Regional scale during advanced works, construction and throughout operation (although standard marine navigation regulations will apply). This may result in increased navigational requirements of fishing vessels or pressure on port services.

Note: The AOI is based on the spatial extent from planned Project activities

9 TERMS OF REFERENCE FOR THE EIA STUDIES

9.1 INTRODUCTION

In this Chapter, the Terms of Reference are set out for each of the specialist studies recommended as a basis for the EIA process for this Project. The following specialist studies are proposed to be undertaken:

- Air Quality;
- Onshore and Offshore Noise;
- Hydrology, Surface and Groundwater Quality;
- Soils and Geology;
- Terrestrial, Aquatic and Nearshore Ecology;
- Marine and Coastal Ecology (including dugongs, turtles and marine mammals);
- Ecosystem Services;
- Community Health;
- Social and Socio-Economic;
- Archaeology and Cultural Heritage;
- Tourism;
- Fisheries;
- Visual Illumination;
- Onshore and Offshore Traffic; and
- Qualitative Risk Assessment.

The subsections below describe the methodology for each specialist study and the assessment of impacts for each study. The specialist study reports, which will be appended to the EIR, will only include a description of the baseline environment for the Project Area. After the completion of the baseline reports, the specialists will attend a specialist workshop and conduct an assessment of the impacts based on the impact assessment methodology presented in Chapter 4. The results of this specialist workshop will be included in the Impact Assessment Section of the EIR.

The initial assessment of impacts will be undertaken by the specialist task team leaders on the EIA team (representing social, biodiversity, soils and water and marine components) using the methodology presented in *Chapter 4*. This will be done in collaboration with the relevant specialists who undertook the fieldwork and compiled the baseline reports. An integrated team workshop will be held to present and discuss the draft impacts and mitigation requirements to ensure all relevant impacts are identified and assessed using a standardised approach. The workshop will also facilitate coordinated sharing of information and alignment of the specialist team on overlapping issues. After the workshop, the impact assessment will be finalised and the assessed impacts will be integrated into the EIR. Note: by following this collaborative approach, impacts will be described and assessed only in the EIR and will not be provided within the separate specialist reports.

A brief description of the objectives, methods and outputs of each study is provided. Most of the specialist studies involve baseline field research, which is described in the text. In some instances, such as the water studies, there is seasonal baseline work required, and the methodology includes for repeated surveys.

9.2 AIR QUALITY

Table 9.1 Air Quality Baseline and Impact Assessment

Aspect	Methodology
Dust Emissions	**Baseline** • Describe existing sources of dust emissions in the Project Area; and • Describe the sources of dust emissions from the proposed advanced works and construction activities associated with the Project. • Prepare baseline report. **Impact Assessment** • Assess impacts by comparing predicted ambient concentrations resulting from emissions from the FSO, with Mozambique standards and other relevant guidelines, including the cEMP for the PSA Development and the IFC/WHO guidelines. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend any mitigation measures.
Atmospheric emissions	**Baseline** • Review available desktop data for air quality and meteorological data for the Project Area based on secondary data. • Quantify of the contribution of the export pump emissions at the LPF. • Prepare an emission inventory of all expected pollutants and Green House Gases (GHG) resulting from venting emissions and power generation at the FSO and other Project vessels. • Prepare of baseline report. **Impact Assessment** • Model dispersion of pollutants from the FSO using the US EPA, using the recommended SCREEN-3 dispersion model. Undertake the modelling using the emission inventory and built-in default meteorological data in order to estimate likely ambient concentrations of pollutants resulting from emissions from the FSO. • Assess impacts by comparing with Mozambique standards, the IFC/WHO guidelines and other relevant air quality guidelines. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Qualitatively assess the resultant ambient concentrations of air pollutants from the emissions at the FSO using the Standard US-EPA emission inventory methodologies. • Assess the contribution of the Project to Sasol existing emissions in the area and Mozambique GHG emission by comparing the Project GHG emissions with Sasol's current emissions inventory and the country GHG emissions reported to the United Nations Framework Convention on Climate Change. • Recommend any mitigation measures.

9.3 ONSHORE AND OFFSHORE NOISE

Table 9.2 Noise Baseline and Impact Assessment

Aspect	Methodology
Onshore	**Baseline** Review available data from the PSA Development and LPG Project EIR on the noise environment in rural areas similar to those along the pipeline ROW. **Impact Assessment** • Assess the impacts on surrounding communities of the predicted increase noise footprint of the CPF/LPF extending further from the CPF boundary by comparing the noise footprint with the existing guidelines in the oEMP. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend mitigation and monitoring measures.
Offshore	**Baseline** • Review available desktop data for offshore noise for the Project Area • Prepare the baseline and modelling reports. **Impact Assessment** • Model underwater acoustic dispersion including noise generated during construction of the offshore export pipeline and the installation of the subsea infrastructure and operation of the FSO, including shuttle tankers. • Assess the impacts of noise and vibration on local fish catches and on sensitive receptors such as marine mammals and turtles, as well as on coral reef species and recreational divers in and around the Bazaruto Archipelago. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend mitigation and monitoring measures.

9.4 HYDROLOGY, SURFACE AND GROUNDWATER QUALITY

Table 9.3 Hydrology and Surface Water Quality Baseline and Impact Assessment

Aspect	Methodology

Hydrology and surface and groundwater quality	**Baseline**
	• Conduct fieldwork, collect and analyse samples.
	• Collect available information on surface water, groundwater quality, aquifer properties and hydrological information.
	• Gather primary information on water features, water supply sources and sources of potential water pollution in the Project Area.
	• Gather primary information on groundwater features, groundwater supply sources (eg: boreholes and hand-dug wells) and existing sources of potential groundwater pollution in the Project Area
	• Prepare a watershed model for the Govuro River to predict the transport of contaminants in the river and floodplain resulting from a possible spill from the pipeline.
	• Prepare baseline and modelling reports.
	Impact Assessment
	• Numerically model surface water in the Project Area in order to assess the impacts of the Project activities, using:
	  • A Govuro River watershed model to estimate river flow rates;
	  • A hydraulic model of Govuro River from the River Crossing to the estuary to predict transport of contaminants to the river and floodplain; and
	  • A hydrocarbon spill fate and transport model for groundwater spill (e.g. Bioscreen).
	• Consider waste generation and water use and sediment impacts on the Govuro River during construction in assessment of impacts;

Aspect	Methodology
	• Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend any mitigation and monitoring measures.

9.5 SOILS AND GEOLOGY

Table 9.4 Soils and Geology Baseline and Impact Assessment

Aspect	Methodology
Soils and geology	**Baseline** • Review available desktop data on soils in existing reports for the Project Area. • Survey the onshore export pipeline route corridor to understand broad soil zones and identify potential sample locations based on the Project infrastructure, identified land uses and potential impacts of the Project. • Collect soil samples (shallow and deep samples) along the footprint of the proposed infrastructure. • Log (according to an acceptable soil profiling methodology) any observations of layer depth, grain size, texture, colour, structure. • Analyse samples for pH, organic matter, total nitrogen, phosphorus, metals (Ca, Mg, Na, As, Cu, Zn, Ni, Cd, Fe, Mn, extractable Hg and Pb), aliphatic hydrocarbons, aromatics (BTEX), poly aromatic hydrocarbons, chlorinated hydrocarbons, sulphides and total sulphur. • Comment on the potential suitability of the land for crop farming. • Prepare baseline report. **Impact Assessment** • Assess the potential for erosion of the soils resulting from the Project activities. • Assess the land capability for crop sustainability. • Assess the erosion risks to the dunes from HDD. • Assess the potential impact of chemical pollution of the soils. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend any mitigation measures.

9.6 TERRESTRIAL ECOLOGY

Table 9.5 Terrestrial Ecology Baseline and Impact Assessment

Aspect	Methodology
Terrestrial ecology	**Baseline** **Habitat Mapping:** • Review available desktop data and conduct field-based ground-truthing of existing maps of vegetation and land use classifications for the onshore export pipeline route corridor to the beach, including coastal habitats (eg estuary and mangroves). Use maps and field surveys to determine the presence of high conservation value habitats which will also be categorised into modified, natural and potential critical habitats following IFC categorisation. • Conduct field surveys to record vegetation types and collect information on flora and habitats along the onshore export pipeline corridor and surrounding accessible areas at defined GPS locations. . **Terrestrial Flora:** • Review available previous flora survey data in order to confirm priority species and habitats that may be present in the Project Area.

Aspect	Methodology
	• Survey flora along pre-identified survey points and walked transects located in representative habitats along the pipeline route to confirm representative flora composition of habitats and identify species of conservation concern. Flora data will be correlated with relevant landscape attributes. **Terrestrial Mammals:** • Record mammals present in habitats along the pipeline route along walked transects in all representative habitats along the pipeline route. • Record all mammal signs, including footprints, scats, den sites, burrows, hairs, scrapings and diggings use to identify mammal species present. **Birds (Avifauna):** • Review previous survey data in order to confirm key priority species and habitats that are expected to be present in the Project Area. • Survey a dry and wet season field for birds and record all observed or birds calls in representative habitats along the pipeline route. • Survey coastal wetlands present in the Project Area will be undertaken to confirm if these habitats are suitable to host threatened migratory birds. **Reptiles and Amphibians (Herpetofauna)** • Review previous survey data and herpetofauna records for the Project Area to confirm priority species and habitats that may be present in the Project Area. • Record sightings of reptiles and amphibians to support the findings of the desktop review. **Terrestrial Invertebrates:** • Review previous survey data on terrestrial invertebrates in the broader Project Area. The small direct footprint of the linear pipeline is not expected to have a significant impact on insects that warrants an insect field survey. **Specialist Baseline Reporting:** • Compile a single integrated baseline report covering vegetation, flora, birds, mammals, herpetofauna and insects. **Impact Assessment** • Assess the impacts of the Project with particular reference to impacts on areas of high biodiversity or threatened plant species, and habitats with known or expected breeding sites of threatened faunal species. • Assess the risk of habitat destruction and increased hunting of fauna and removal of vegetation as a result of changes in human access and settlement that may result from the Project. Indirect impacts will be contextualised against field evidence of habitat impacts from previous exploration and development projects in the area. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Mitigation measures to minimise and monitor impacts on biodiversity features will be described. • Recommend mitigation and monitoring strategies.

9.7 AQUATIC ECOLOGY

Table 9.6 Aquatic Ecology Baseline and Impact Assessment

Aspects	Methodology
Aquatic ecology	**Baseline** **Habitat Mapping:** • Obtain available land use and aquatic habitat mapping, review and conduct ground-truthed during field surveys. • Use field surveys and imagery analysis to delineate wetlands and other aquatic features in and near the pipeline corridor. • Collect information on habitat types along the onshore export pipeline corridor and surrounding accessible areas at defined GPS and update the available aquatic habitat mapping.

Aspects	Methodology
	• Use maps and field surveys to determine the presence of high conservation value habitats which will also be categorised into modified, natural and potential critical habitats following IFC categorisation. **Aquatic Ecology:** • Review previous aquatic survey data in order to confirm key priority aquatic species and habitats likely to be present in the Project Area. • Sample aquatic habitats for fish, aquatic invertebrates, molluscs and amphibians (where caught) using fishing nets, direct observation, and interviews with local fishers to look at fish catch etc. Collect and identify macro-invertebrates using hand nets. • Measure water parameters (eg, pH, electrical conductivity) using a portable multi-meter. • Document the diversity and status of different aquatic habitats and their component fauna and flora in the pipeline corridor in a baseline report. **Specialist Baseline reporting:** • Prepare a single integrated baseline report covering type, distribution and status of aquatic habitats, fish, macroinvertebrates and other fauna collected during field surveys. **Impact Assessment** • Identify and describe direct and indirect impacts on aquatic habitats and specific aquatic fauna, including potential impacts of an unplanned event in the Govuro floodplain. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend mitigation measures to avoid, minimise and monitor impacts on aquatic biodiversity will be described.

9.8 MARINE AND COASTAL ECOLOGY

Table 9.7 Marine and Coastal Ecology Baseline and Impact Assessment

Aspect	Methodology

Marine baseline, including fauna, flora, seabed sediment and marine water quality	**Baseline**
	• Conduct primary data collection (marine baseline survey).
	• Review secondary data sourced from existing studies in the Project Area.
	• Collect primary and secondary data on the following receptors present in the Project Area:
	  • Intertidal, rock shores and beach ecology and beach sediment types;
	  • Coral reefs and reef fish;
	  • Fish;
	  • Seagrass;
	  • Marine mammals (including separate study on Dugongs);
	  • Marine turtles;
	  • Marine water quality;
	  • Seabed sediments;
	  • Macrobenthos community; and
	  • Metocean (wind, wave and climate) data.
	• Review available desktop data of distribution and status of coastal habitats such as shoreline habitats, sea grass, and coral reefs.
	• Review available desktop data of distribution and status of coastal habitats such as shoreline habitats, sea grass, and coral reefs
	• Prepare an integrated baseline report.
	Impact Assessment
	• Assess the predicted increase of marine activities and shore crossing during the advanced works and construction phases on sensitive marine fauna.

	• Assess historical and forecasted trends of the dugong and turtle population, size and viability in the Project Area in order to place potential Project impacts into context. • Assess the potential impact of the Project on coastal and marine habitats, in the context of the local and regional conservation importance of the affected habitats and species • Model the generation and fate of the sediment plumes, including settling, deposition, resuspension, transport and dispersion and assess the impact seabed sediment disturbance on marine fauna. • Model the worst-case scenario for an oil spill using the MIKE 3 Oil Spill Model and assess the impact on marine fauna including the sensitive species. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Identify specific mitigation and monitoring measures.

9.9 ECOSYSTEM SERVICES

Table 9.8 Ecosystem Services Baseline and Impact Assessment

Aspects	Methodology
Ecosystem services	**Baseline** • Review desktop information to identify the full range of ecosystem services to be considered. • Obtain relevant information on use of natural resources; fisheries, tourism, socioeconomics, health and cultural heritage from relevant specialist reports • Document and assess the dependence of local stakeholders and the Project on ecosystem services in the Project Area. • Compile an ecosystem services report using IPIECA guidance documents. **Impact Assessment** • Assess Project impacts on ecosystem services. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Identify specific mitigation and monitoring measures.

9.10 COMMUNITY HEALTH

Table 9.9 Community Health Baseline and Impact Assessment

Aspect	Methodology
Community health	**Baseline** • Review available data on health and health facilities from existing EIA reports and other health research/reports in the Project Area. • Review secondary statistics from the national, provincial and district health reports; health statistics, including (but not limited to) the Annual Performance Reports (Balanço do Plano Económico e Social Provincial), the District Health Catchment´s Area Profiles (Reconhecimento da Área de Saúde) developed by each district; the National Health Policy Declaration (MISAU, 2007) and the National Strategic Framework for the Health Sector 2004 – 2019 (MISAU, 2014). • Conduct Fieldwork: Incorporate health questions into the Focus Group Discussions, Key Informant Interviews and Household Surveys. **Impact Assessment** • Critically assess the potential impacts of the construction and operation of the Project on the health of communities in the Project Area drawing on the findings of previous assessments. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend measures to minimise negative and enhance positive impacts.

Aspect	Methodology
	• Recommend monitoring requirements for the construction and operational phases of the Project.

9.11 SOCIAL AND SOCIO-ECONOMIC

Table 9.10 Social and Socio-Economic Baseline and Impact Assessment

Aspect	Methodology

Socio-economic	**Baseline**
	Desktop Studies:
	• Review available data from existing EIA reports and other socio-economic research/ reports for the Project Area.
	• Prepare study protocols:
	  • Household Questionnaires;
	  • Scripts for Focus Groups Discussion with Local Leaders;
	  • Scripts for Focus Groups Discussion with Men;
	  • Scripts for Focus Groups Discussion with Women; and
	  • Checklists for interviews with local government officials and NGOs.
	  • Preparations for the primary logistical aspects of the study, including selection of enumerators and enumerators training day in Vilanculos.
	Fieldwork:
	Collect both primary and secondary data with local government, local communities, private sector and NGOs, making use of participatory and qualitative data collection methods (focus group discussions, key informant interviews and participatory rural assessments) as well as quantitative methods (household survey questionnaire).
	Interviews:
	• Conduct interviews with government institutions and NGOs at Provincial and District levels. The baseline investigations will aim at the identification and analysis of the socio-economic trends in the Project Area, as a basis for impact assessment and long term monitoring.
	• Conduct semi-structured and key informant interviews with members of the local government such as the Administrator, Permanent Secretary, Heads of District Services, Head of Localities and Administrative Posts, Local Village Leaders and Fishermen in the Bazaruto Archipelago, Inhassoro, Nova Mambone and Machanga communities which were not assessed previously.
	Household Survey:
	• Administer the Household (HH) Survey Questionnaire to a number of households within the Project Area, in order to collect information regarding the composition of the households; their social and demographic characterization, the main infrastructure they own and the use of natural resources such as land, water, forests, the sea, primary strategies for maintenance and development of the households, perceptions and expectations about the Project.
	Focus Groups:
	• Conduct focus groups with men, women and local leaders in the Project Area in order to obtain a more detailed qualitative understanding of issues such as access to land, use of natural resources, household livelihood strategies, vulnerable groups, local cultural practices and traditions, local and area history, as well as expectations related to the Project.
	Impact Assessment
	• Critically assess the potential impacts of the construction and operation of the Project on the socio-economic status (including noise, traffic, fisheries, tourism, health, visual, cultural heritage and loss of crops) of communities in the Project Area.
	• Recommend measures to minimise negative and enhance positive impacts.

Aspect	Methodology
	• Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend monitoring requirements for the construction and operational phases of the Project.

9.12 ARCHAEOLOGY AND CULTURAL HERITAGE

Table 9.11 Archaeology and Cultural Heritage Baseline and Impact Assessment

Aspect	Methodology
Archaeology and Cultural Heritage	**Baseline** • Identify, map, classify and assess of the significance of archaeological and historical heritage in the Project Area. • Review available information on cultural heritage, historical and cultural value attributes, shipwrecks and other marine archaeology in the Project Area. • Examine by observation on foot the onshore section of the pipeline corridor and immediately surrounding area in order to identify structures and artefacts of archaeological and historical value and to collect lithic raw materials, with georeferenced locations to create a reference collection. Excavate test pits will be excavated, if necessary. • Collect and record the material on data sheets. The archaeological remains from each collection unit will be separated and packed according to the type of raw material (stone, bone, ceramic, metal). **Impact Assessment** • Critically assess the potential impacts of the construction and operation of the Project on cultural heritage in the Project Area. • Recommend measures to minimise impacts to cultural heritage. In cases where sites could be damaged or destroyed during the advanced works and construction phases assess the impact on the site and recommend preferred management options, including: • Record of site (no excavation/ artefact removal required) • Surface scatterings to be remove prior to construction • Site to be fenced to prevent construction damage (if off the construction alignment) • Site of high conservation significance and alignment of infrastructure to be relocated • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend monitoring requirements for the construction and operational phases of the Project. • Recommend a 'Chance Find Procedure' protocol in accordance with the IFC guidelines in this regard.

9.13 TOURISM

Table 9.12 Tourism Baseline and Impact Assessment

Aspect	Methodology
Tourism	**Baseline** • Collate available baseline tourism data for Inhassoro relating to tourist operators (ie accommodation, diving and recreational fishing operators, restaurants, and other service providers); occupancy and revenues generated.

Aspect	Methodology
	• Conduct a questionnaire survey of tourism operators (lodges and other service providers) in Inhassoro to determine activities offered, occupancy, revenues, seasonality; trends in, and perceived threats to, tourism, and perceptions of tourism' • Analyse tourism data and preparation of baseline tourism report incorporating an analysis of future trends in Mozambique. **Impact Assessment** • Assess potential impacts of the Project on tourism (lodge occupancy; tourism services, and recreational fishing and diving; and altered 'sense of place'. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Identify appropriate mitigation and monitoring strategies including the potential requirement for compensation to operators.

9.14 FISHERIES

Table 9.13 Fisheries Baseline and Impact Assessment

Aspect	Methodology
Fisheries	**Baseline** • Review available information in existing reports for the Project Area and local statistical data and information pertaining to the Project Area, relevant policies and legislation, etc. • Conduct key informant interviews and focus group discussions with key stakeholders (eg local fishermen, tourism operators and fisheries institutions). • Map the main artisanal fishing zones and routes used by fisherman between the fishing centres and the fishing zones using participatory techniques with local fishermen. • Obtain additional data on primary fishing areas from observations by the marine survey team to illustrate the intensity of use of the area for fishing. • Review the value chain associated with fishing activities, including those involved in processing and trading fish across the Project Area. • Obtain data on livelihoods obtained from fishing for different types of fishermen. • Conduct a trend analysis related to catch rates, fishing effort and revenues by comparing data collected during this study with data from previous studies. **Impact Assessment** • Critically assess the potential impacts (disruption and loss of artisanal fishing, exclusion of semi and industrial fishing from FSO area) of the construction and operation of the Project on fishing communities in the Project Area with a particular focus on impacts to livelihoods. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend measures to minimise negative and enhance positive impacts. • Recommend monitoring requirements for the construction and operational phases of the Project. • Identify appropriate mitigation and monitoring strategies including the potential requirement for compensation to operators.

9.15 VISUAL ILLUMINATION

Table 9.14 Visual Illumination Baseline and Impact Assessment

Aspect	Methodology
Visual illumination	**Baseline** • Identify landscape resources within the Project Area and determine the relative importance of these landscapes. • Identify the Zone of Visual Influence and Key Observation Points within the Project Area. • Understand the FSO components, activities and embedded controls relevant to illumination which may affect important or sensitive receptors. **Impact Assessment** • Assess the impacts of illumination and the Project's appearance on important or sensitive receptors and their significance relying on desktop research and modelling through computer visualisations. • Develop visibility/ viewshed analysis mapping of the FSO and other key infrastructure; lighting footprint map for the FSO indicating the extent of the impact. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Visual Assessment report • Recommend mitigation and monitoring strategies.

9.16 ONSHORE AND OFFSHORE TRAFFIC

Table 9.15 Traffic and Impact Assessment

Aspect	Methodology
Onshore Road Traffic	**Baseline** • Desktop review of the available information of onshore traffic for the Project Area based on secondary data. • Observe traffic movements during field work. **Impact Assessment** • Assess the predicted increase of traffic generated on existing transport infrastructure and existing transport infrastructure and other road users and surrounding communities. • Recommend measures to minimise negative and enhance positive impacts. • Recommend monitoring requirements for the construction and operational phases of the Project.

Aspect	Methodology
Offshore Vessel Traffic	**Baseline** • Review the statutory requirements for vessel operations in the Project Area. • Describe shipping activities in and around the Project Area, including the number and type of vessels, type of cargo transported and analysis of the vessel traffic flow in the Project Area including the forecast vessel traffic required for the proposed vessel operations. • Conduct a navigation assessment to determine the likely vessel trajectories for the proposed vessel operations and the typical trajectories for the transiting vessel traffic within the Project Area. • Identify the marine risk on the basis of general shipping risks and on the risks associated specifically with the proposed vessel operations. **Impact Assessment** • Assess the predicted increase of traffic generated on existing marine traffic and other users of the sea. • Assess any cumulative impacts of this Project in relation to planned activities in the Project Area. • Recommend measures to minimise negative and enhance positive impacts. • Recommend monitoring requirements for the construction and operational phases of the Project.

9.17 QUANTITATIVE RISK ASSESSMENT

Table 9.16 Quantitative Risk Assessment and Impact Assessment

Aspect	Methodology
Quantitative Risk Assessment	**Baseline** • Review available risk information in the Project Area based on secondary data. • Conduct a Risk Assessment of Pipeline involving: • Hazard Identification; • Evaluation of consequences of potential incidents involving major hazards. • Calculation of frequencies associated with potential major hazard events. **Impact Assessment** • Conduct a major accident Quantitative Risk Assessment (QRA) of the onshore portion of the pipeline route. This assessment focuses on incidents that could result in fatalities or serious injury to the population rather than environmental impact. • This assessment will be based on International best practices using the UK's HSE Land Use Planning (LUP) methodology. • The gas plant, subsea pipeline and FSO are excluded from this assessment. • Generate risk isopleths and risk transects for the pipeline servitude.

9.18 PROPOSED SPECIALIST TEAM

Table 9.17 Proposed Specialist Team for the EIR

Activity	Name	Company and Location
Terrestrial and estuarine habitats, Flora & Mammals	Warren McCleland	EcoRex- South Africa
Avifauna & Mammals (terrestrial/ coastal)	Duncan McKenzie	EcoRex- South Africa
Herpetofauna	Luke Verburgt	Enviro-Insight - South Africa
Aquatic ecosystems	Rob Palmer	Nepid, South Africa
Mangroves & estuarine flora	Warren McCleland	Ecorex, South Africa
Marine turtles & Conservation Initiatives	Eduardo Videira	Impacto - Mozambique
Marine Ecology and Water Quality: Marine Scientist	Laura Weston	Lwandle
Coral Reefs, Sea Grass, Beach Ecology	Nina Steffani	Lwandle
Coral Reefs, Sea Grass, Beach Ecology	Andrea Pulfrich	Lwandle
Marine mammals (dugongs, whales and dolphins)	Almeida Guissamulo	Impacto - Mozambique
Socio-economic Studies	Paula Santos	Impacto – Mozambique
Socioeconomic Studies Assistant	Joyce Maguivanhane	Impacto – Mozambique
Marine Traffic	Eugenio Muianga	Impacto - Mozambique
Fisheries Study	Atanásio Brito	Impacto – Mozambique
Tourism and Resource Economist (Sea Fisheries and Tourism)	Jane Turpie	Anchor – South Africa
Resettlement/ Compensation	Victor Hugo Nicolau	Impacto - Mozambique
Archaeology and Cultural Heritage	Marta Langa	Impacto – Mozambique
Visual Impacts Specialist	Peter Austin	ERM, South Africa
Stakeholder Engagement Specialist	Mia Couto	Impacto - Mozambique
Stakeholder Engagement	Felicidade Munguambe	Impacto, Mozambique
Public Consultation Assistant	Sandra Fernandes	Impacto - Mozambique
Soils & Geology & Surface and Ground Water Quality Support	Justin Kmelisch	ERM, South Africa
Hydrology (Model)	George Krallis	ERM USA
Hydrogeology	Andreas Stoll	ERM South Africa
Sediment Dispersion & Oil Spill Modelling	Stephen Luger	PRDW, South Africa
Air Quality Modelling	Mark Zunckel	uMoya-NILU (Pty) Ltd, South Africa
Noise Modelling (Marine)	Michael Fraser	ERM, UK
Maritime Traffic	Eugénio Muianga	Impacto – Mozambique
Quantitative Risk Assessment Study	Gary McFadden	ERM South Africa
GIS Specialist	Andrew Thurlow	ERM South Africa
GIS Specialist	Doug Park	ERM SA

Airshed Planning Professionals Pty Ltd.(2015) Environmental Impact Assessment for Sasol PSA and LPG Project. **Air Quality Impact Assessment Specialist Report 1**.

Allen K (2013) **Dugong distribution and Fishing Pressure in the Bazaruto Archipelago.** Rapid Assessment Report. Endangered Wildlife Trust.

Chacate O E (2005) **Avaliação das capturas acidentais de tartarugas marinhas pela pesca de arrasto de praia na costa de Vilanculos e Inhassoro.** Trabalho de Licenciatura. Universidade Eduardo Mondlane.

Cockcroft V C, Guissamulo A T and Findlay K (2008) **Dugongs (Dugong Dugon) of the Bazaruto Archipelago, Mozambique.** Unpublished data. Report compiled for Sasol Environmental Impact Assessment.

Council for Scientific & Industrial Research (2000) **Final Environmental Impact Assessment Report: Environmental Impact Assessment for a natural gas pipeline to the Bazaruto Archipelago, Mozambique.**

Council for Scientific & Industrial Research (2001) **Impacts of an offshore buoy for transport of condensate.** Sasol Natural Gas project Mozambique to South Africa: Environmental Impact Study**.** Day J H (1980) **What is an estuary?** South African Journal of Science.

Deacon A (2014) Aquatic Fauna Impact Assessment. **Specialist Report No 11. Environmental Impact Assessment for Sasol PSA and LPG Project.** Report for Sasol Petroleum Mozambique Limitada & Sasol Petroleum Temane Limitada. Golder Report Number: 1302793 - 10712 – 1212.

De Freitas A_J (1984) **The Penaeidea of South-East Africa. I. The study area and key to South-East African species**. Inv. Rep. Durban.

Dutton T P and Zolho R (1990) **Conservation Master Plan for sustainable development of the Bazaruto Archipelago, Republic of Mozambique**. WWF/SANF Report.

ERM & Consultec (2006) **EIA for Sasol´s Offshore Exploration Project in Concessions 16 & 19.** Final Environmental Impact Report, prepared for Sasol.

ERM & Consultec (2008) **Environmental Impact Assessment for Sasol's Offshore Exploration Project in Blocks 16 and 19 – Inhambane and Sofala Provinces**. Report on behalf of Hidrocarbenetos de Mozambique and Sasol Petroleum Sofala Limitada.

Everett B I, van der Elst R P and Schleyer M H (eds) (2008) **A natural history of Bazaruto Archipelago, Mozambique.** Oceanographic Research Institute, Durban. (Special Publication No 8/118).

Endangered Wildlife Trust (2013) EWT: Rapid Assessment Report. **Dugong distribution and Fishing pressure in the Bazaruto Archipelago June-July 2013**.

Findlay K P, Cockcroft V G and Guissamulo A T (2011) **Dugong abundance and distribution in the Bazaruto Archipelago, Mozambique**. In: Kirkman S P, Elwen S H, Pistorius P A, Thornton M, Weir C R (eds), Conservation biology of marine mammals in the southern African subregion. African Journal of Marine Science 33 (3): 441–452.

Jacobsen N H G, Pietersen E W and Pietersen W (2008) **A preliminary herpetological survey of the Vilanculos Coastal Wildlife Sanctuary on the San Sebastian Peninsula, Vilankulo, Mozambique**. Herpetology Notes, Volume 3: 181-193 (2010).

Mark Wood Consultants (July 2003) **National Gas Project. Regional Environmental and Social Assessment.** Report on behalf of Sasol Technology.

Genesis (2014) **PSA Field Development Liquids Export Feasibility Study.** Mozambique PSA Surface Facilities FEED.

Golder Associates (2013) **EIA for Sasol PSA and LPG Project. Terrestial Fauna Impact Assessment** (Specialist Report 10)

Golder Associates (2014a) **EIA for the Petroleum Sharing Agreement (PSA) Development and Liquefied Petroleum Gas (LPG) Project**.

Golder Associates (2014b) **Final Environmental Impact Assessment Report.** ***PSA Development and LPG Project*** **(including a number of specialist studies)**: Air Quality Impact Assesment prepared by Airshed Planning Professionals (Pty) Ltd.

Golder Associates (2015a) **Sasol PSA and LPG Project: Final EIA Addendum** (including specialist studies).

Golder Associates (2015b) **Baseline Biodiversity Studies for the proposed Pande Wells Expansion Project and associated Seismic Exploration activities (Pande and Temane Blocks).**

Golder Associates (2015c) **Biodiversity Sensitivity Map for the proposed seismic exploration within the Pande and Temane areas, Mozambique Draft Report**.

Golder Associates (2015d) **Ecological studies for the Nhangonzo Coastal Stream Critical Habitat Biodiversity Assessment (for Sasol PSA Development and LPG Project Inhambane Province (EIA Addendum)**, including studies on vegetation and flora, terrestrial fauna, wetlands, fish and aquatic habitats, surface water quality, mangroves and estuaries.

Guissamulo A T and Cockroft V G (1996) **Estado Actual da Investigação de Mamíferos Marinhos em Moçambique. Proceedings do Workshop: O Papel da Investigação Na Gestão da Zona Costeira, Maputo**. 24 e 25 de Abril de 1996. pp. 61-65.

IDPPE (2009) **Atlas of artisanal fishery in Mozambique, Maputo.**

Department of the Aquatic Environment (2011) IIP- **Mapping of the main fishing grounds of the commercial fisheries resources.** Maputo, Draft Version.

Impacto (2004) **Environmental and Social Diagnostic of the Inhambane Province.** Inhassoro District**.**

Impacto & ERM (2010) **EIA for the Offshore Exploration Drilling Activities in the M-10 Concession Area.** Inhambane and Sofala Provinces, Mozambique.

Impacto (2012) **EIA for Hydrocarbon Exploration in the Onshore Area A Concession Block**. Inhambane Province.

INE (2010) **Projecções Anuais da População Total, Urbana e Rural, dos Distritos da Província de Inhambane 2007 – 2040**. Instituto Nacional de Estatística, Moçambique.

INGC (2009) Main report: INGC Climate Change Report: **Study on the impact of climate change on disaster risk in Mozambique**. [Asante K, Brito R, Brundrit G, Epstein P, Fernandes A, Marques M R, Mavume A, Metzger M, Patt A, Queface A, Sanchez del Valle R, Tadross M, Brito R (eds.)] Maputo: INGC.

Leal M C, Sá C, Nordez S, Brotas V, Paula J (2009) **Distribution and vertical dynamics of planktonic communities at Sofala Bank, Mozambique**. Estaurine, Coastal and Shelf Science 84 (2009) 605-616.

LMC (2016) PSA Liquids Export Pipeline and FSO. **Marine Design Consultant Scope of Services: Emissions, Waste and Discharges Report**.

MAE - Ministério da Administração Estatal (2005) **Perfil do Distrito de Inhassoro, Província de Inhambane.**

Mark Wood Consultants (2002) EIA 2002 - **Seismic Exploration, Exploratory and Development drilling Temane and Pande**.

Mark Wood Consultants and Impacto (2002) **Environmental Impact Study: Temane and Pande gas fields.** Ministry of Planning and Development/National Directorate of Studies and Political Analysis (2010) **Poverty and Well-being in Mozambique: Third National Assessment.** Maputo

Marshall A D, Conradie J, Duinkerken D V, Pierce S, Rohner C and Watts A (2015) **Key aggregation areas and recommendations for marine megafauna in the greater vilanculos area.** Marine Megafauna Foundation/ Marine Megafauna Association. 18pp.

MISAU (2007) **The National Health Policy Declaration.** Ministry of Health, Mozambique.

MISAU (2013) **The National Strategic Framework for the Health Sector 2014-2019.** Ministry of Health, Mozambique.

Nehring D, Hagen E, Jorge da Silva A, Schemainda R, Wolf G, Michelchen N, Kaiser W, Postel L, Gosselck F, Brenning U, Kühner E, Arlt G, Siegel H, Gohs L, Bublitz G (1987) **Results of oceanological studies in the Mozambique Channel in February-March 1980**. Beiträge zur Meereskunde, Berlin (56/51-63).

Newell R C, Seiderer L J and Hitchcock D R (1998) **The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed**. Oceanogr. Mar. Biol. Annu. Rev., 36, 127– 178.

OCHA (2015) **Southern Africa Regional Climate Outlook Summary**. Accessed: 11/02/2016. http://reliefweb.int/sites/reliefweb.int/files/resources/southern_africa_sarcof_and_el_nino_2015_ocha.pdf

ORI (2008) **A Natural History of the Bazaruto Archipelago, Mozambique.** Everett B I, van der Elst R P and Schleyer M H (eds). Published by : South African Association for Marine Biological Research. ISBN 0-86989-082-4.

Pereira M A M, Litulo C, Santos R, Leal M, Fernandes R S, Tibiriçá Y, Williams J, Atanassov B, Carreira F, Massingue A and Marques da Silva I (2014) **Mozambique marine ecosystems review**. Final report submitted to Fondation Ensemble.

Pierce S J, Trerup M, Williams C, Tilley A, Marshall A D, Raba N (2008) **Shark fishing in Mozambique: A preliminary assessment of artisanal fisheries**. Eyes on the Horizon, Maputo.

Richmond M D (1997) **A Field Guide to the Shores of Eastern Africa and the Western Indian Ocean Islands 2nd ed**. Published by Sida/ Department for Research Cooperation, SAREC and University of Dar es Salaam.

Rodrigues M J, Motta H, Whittington M W and Schleyer M H (2000a) **Coral reefs of Mozambique**. In: Mcclanahan T, Sheppard C and Obura D (eds) Coral reefs of the Indian Ocean: Their ecology and conservation. Oxford Universty Press, New York: 107-129.

Rousseau P, Vorster P J, Afonso A V and Van Wyk A E (2015) **Taxonomic notes on *Encephalartos ferox* (Cycadales: Zamiaceae), with the description of a new subspecies from Mozambique.** *Phytotaxa* 204(2): 99-115.

Samoilys M, Pabari M, Andrew T, Maina G W, Church J, Momanyi A, Mibei B, Monjane M, Shah A, Menomussanga M and Mutta D (2015) **Resilience of coastal systems and their human partners in the western Indian Ocean.** IUCN ESARO, WIOMSA, CORDIO and UNEP Nairobi Convention. Nairobi, Kenya. 88 pp.

Sá C, Leal M C, Silva A, Nordez S, André E, Paula J, Brotas V (2013) **Variation of phytoplankton assemblages along the Mozambique coast as revealed by HPLC and microscopy.** Journal of Sea Research (79/1-11).

Schleyer M H, Obura D, Motta H and Rodrigues M J (1999) **A preliminary assessment of Coral Bleaching in Mozambique**. South African Association for Marine Biological Research Unpublished Report (168/ 1-12).

Schleyer M H and Celliers L (2005) **The Coral Reefs of Bazaruto Island, Mozambique, with recommendations for their management**. Western Indian Ocean Journal of Marine Science 4 (2): 227-236.

Schleyer M H and Maggs J Q (2008) **Surveys of Reef Benthos Conducted in the Bazaruto Archipelago on Behalf of Sasol in 2007**. Oceanographic Research Institute, Durban. Unpublished Report (257/ 9)

Tadross M (2009) **Climate change modelling and analyses for Mozambique, March**. Unpublished Report.

Tadross M and Johnston P (2012) **Climate Systems Regional Report: Southern Africa**. ISBN: 978-0-9921794-6-5.

Ternon J F, Roberts M J, Morris T, Hancke L, Backeberg B (2014) **In situ measured current structures of the eddy field in the Mozambique Channel**. Deep-Sea Research II (100/10–26).

Tenreiro de Almeida J (no date) **Brief description of the main fisheries in Mozambique**.

Ternon J F, Roberts M J, Morris T, Hancke L, Backeberg B (2014) **In situ measured current structures of the eddy field in the Mozambique Channel**. Deep-Sea Research II. 2014;100:10–26.

Tourism Strategy Company & Spark 'n Sprite (2012) **Tourism Development Strategy for Inhambane Province, Mozambique.**

WWF & UNEP (2004) **Towards a Western Indian Ocean Dugong Conservation Strategy: The Status of Dugongs in the Western Indian Ocean Region and Priority Conservation Actions**. WWF, Dar es Salaam, Tanzania.

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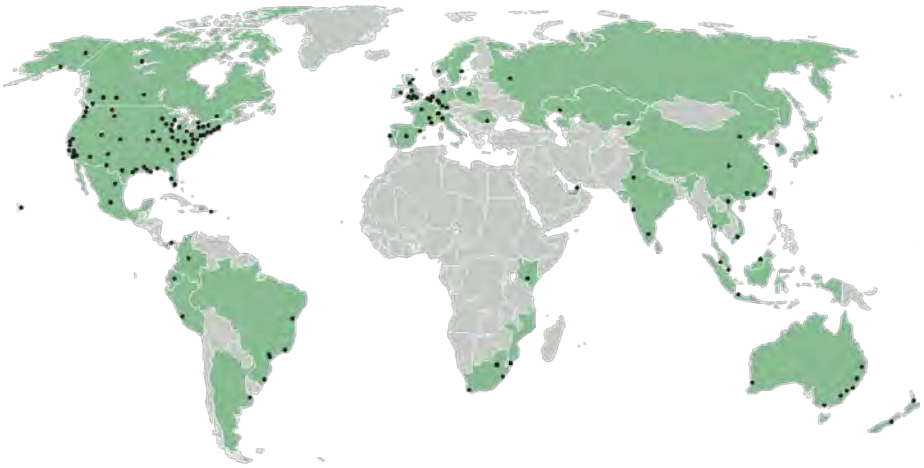

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