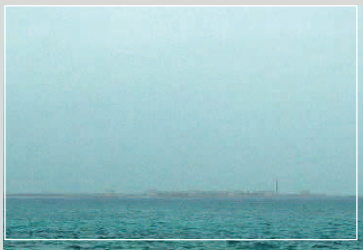
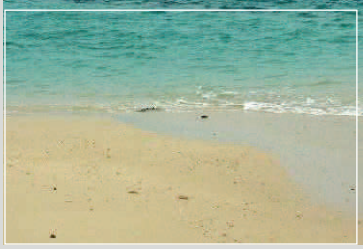
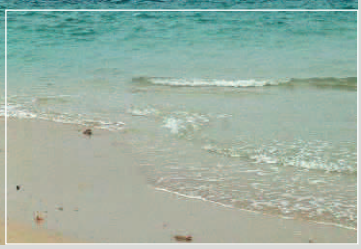
Mozambique Gas Development Project

Non-Technical Summary (NTS)








Project Ref: 0133576

February 2014

Anadarko Moçambique Área 1, Lda

eni

IMPACTO PROJECTOS E ESTUDOS AMBIENTAIS

ERM

Mozambique Gas Development Project

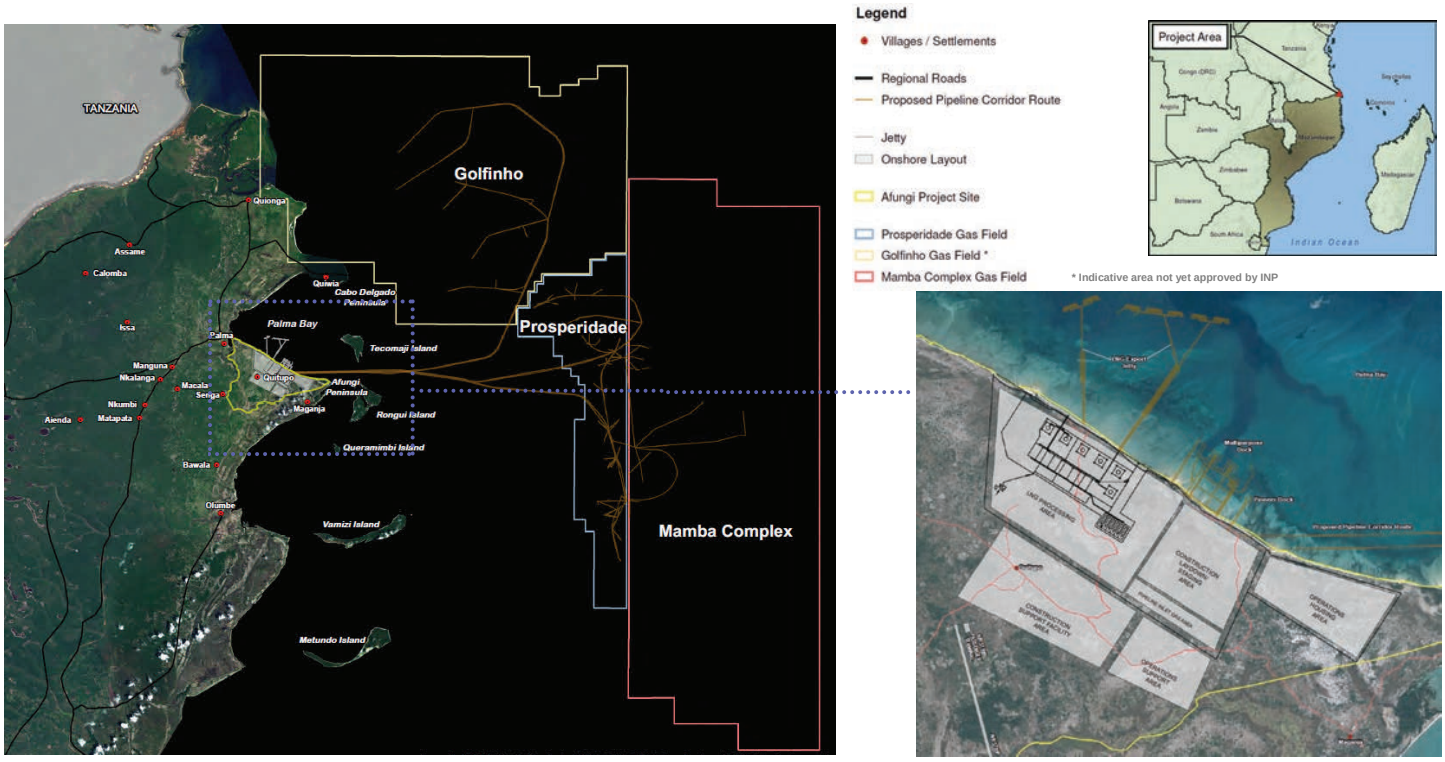
Introduction and Background

Natural gas discoveries made in the Rovuma Basin off the coast of northern Mozambique are among the world's most significant discoveries in the last 20 years. Anadarko Moçambique Área 1, Lda (AMA1) holds rights to explore, develop and produce natural gas reserves in Area 1 in the Rovuma Basin and Eni East Africa S.p.A (eni) holds similar rights to explore, develop and produce in Area 4. These areas are adjacent to one another and a number of gas reservoirs or gas fields have been discovered within each area. AMA1 and eni are joint proponents for the Project, working to develop a Liquefied Natural Gas (LNG) Facility and associated infrastructure to convert the natural gas to a liquid state and export it to international markets.

The proposed LNG Project (hereinafter "the Project") would see Mozambique become one of the world's leading natural gas exporting countries. Figure 1 below illustrates the location of the Project.

The Project is required to obtain permission (in the form of an environmental licence(s) from the Government of Mozambique) before AMA1 and eni can construct and operate the facilities. An Environmental Impact Assessment (EIA) Report has therefore been developed to inform the Government's decision making process. The EIA Report documents the process undertaken for identifying, assessing, mitigating and managing the biological, physical and socio -economic impacts of the Project.

Figure 1: Location Area



The Project Developers

AMA1

AMA1 is a wholly-owned subsidiary of Anadarko Petroleum Corporation (APC) and is a commercial entity duly registered under the Republic of Mozambique Laws. AMA1 has offices in Maputo and Pemba. APC is headquartered in The Woodlands, Texas, United States of America and is among the largest independent oil and natural gas exploration and production companies in the world. Information on AMA1 can be accessed on the internet at:

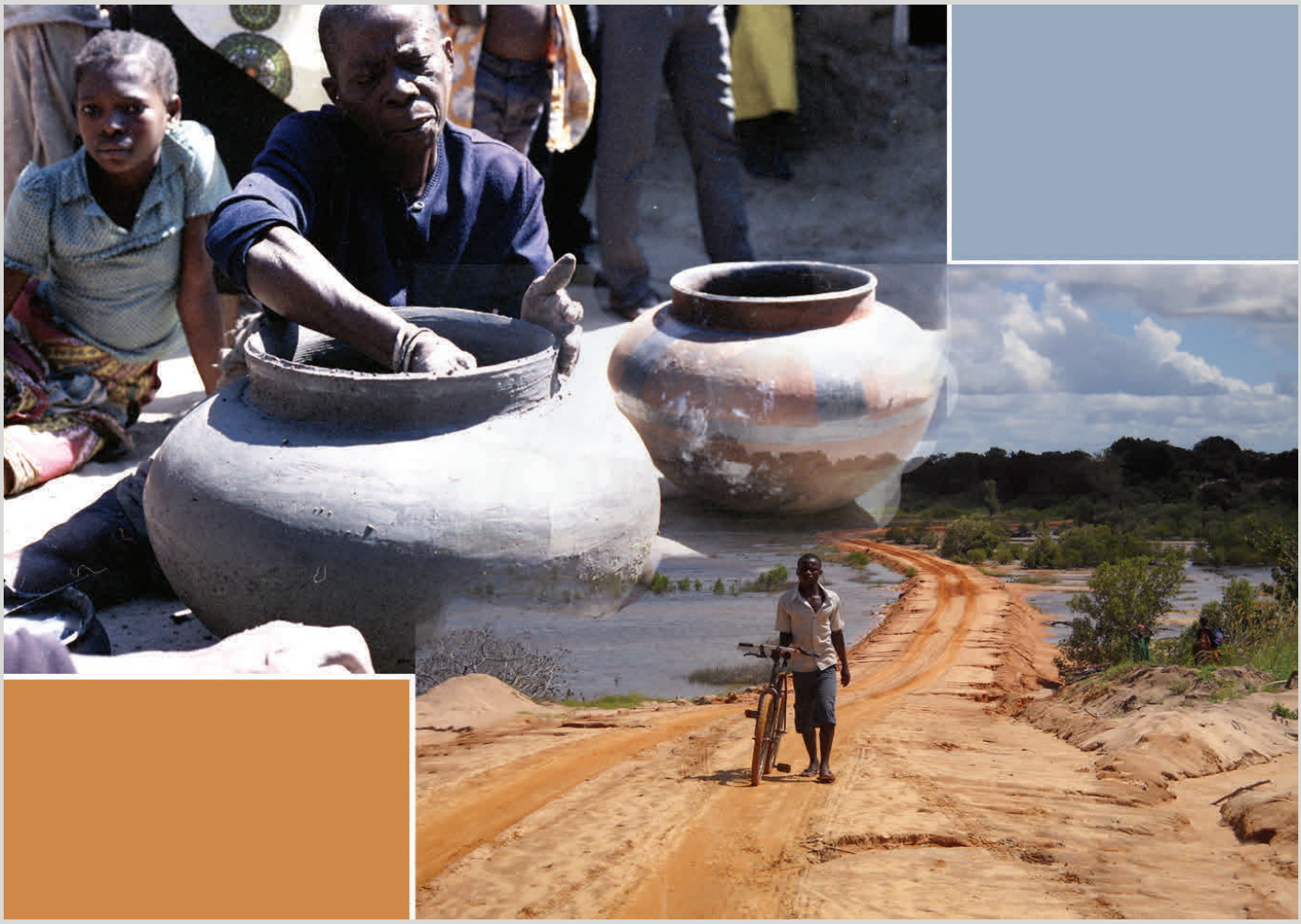
http://www.anadarko.com/Operations/Pages/LNGmozambique.aspx

ENI

eni S.p.A is an Italian company with activities in close to 85 countries. Eni East Africa S.pA (eni) is an affiliate of eni S.p.A. and has a branch in Mozambique with offices in Maputo and Pemba. eni S.p.A. is one of the leading global operators in the deep-water sector worldwide and is currently involved, as operator or partner, in exploration activities in deep water in the Gulf of Mexico and along the coast of Brazil. More information on eni can be accessed on the internet at:

http://www.eni.com/en_IT/media/casebook/casebook-mozambique.html

Economic Benefits of the Project



The initial LNG development (two LNG trains estimated 10mtpa) represents an overall investment of up to US$25—30 billion, making the project the largest single investment project in Mozambique to date. Assuming export of the LNG to premium markets, such as Japan and the Far East, the Government of Mozambique should see a significant increase in Gross Domestic Product (GDP) and increased revenue through its royalty, tax and equity gas rights.

Mozambique will benefit from a substantial increase in Government revenue for several decades. This economic benefit could be used to improve the health, education and quality of life of the people of Mozambique.

As the number of trains and volume of LNG export, increases, the economic benefits could be compounded several times. The Government of Mozambique has stated it wishes to encourage industrial development using natural gas in the area of the Project. This could further increase the social and economic benefits derived from the Project.

The purpose of the Project is to gather, process, and export natural gas in liquid form known as LNG. This LNG will be used as a fuel source in other countries.

The process begins offshore in Area 1 and Area 4 of the Rovuma Basin, where natural gas will be extracted via subsea wells from gas reservoirs (storage areas) up to 1,500m below the seafloor. The collected gas will be transported to the onshore LNG facility by pipelines on the seafloor. Once onshore, the gas will be processed in the LNG facility to remove impurities, converted to liquid (by cooling the gas) and stored in specially designed storage tanks.

The LNG will then be transported through pipelines to an export jetty where it will be loaded into specialized LNG carriers to be transported to international markets. These specially designed ships maintain the LNG in a refrigerated liquid state for sea voyages of several thousand kilometres. The Project has an initial 30 year lifespan but this may be extended depending on future gas reserve development.

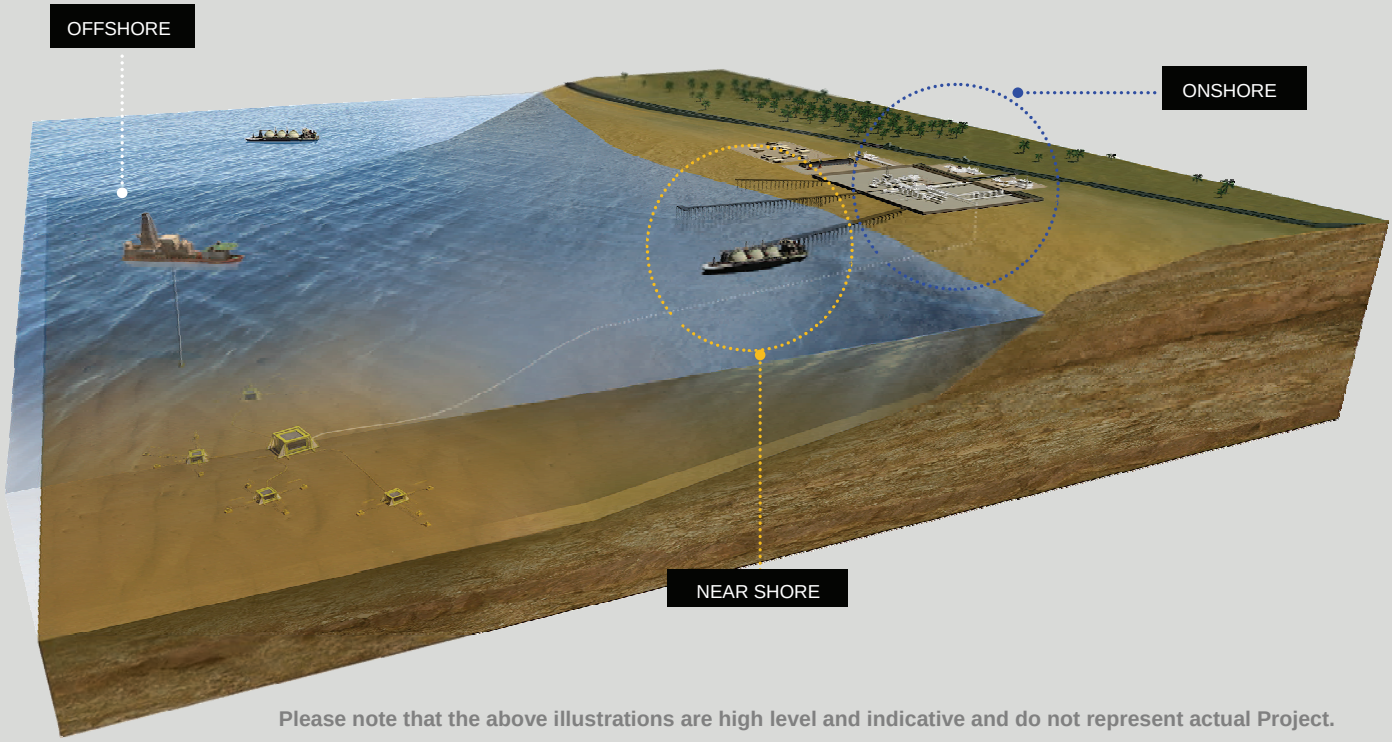
The three main elements of the Project are as follows and illustrated in Figure 2:

- **Offshore** - drilling of wells and installation of pipelines on the seafloor to connect the wells and then bring the natural gas to the shore.
- **Near Shore** - construction of a Multi-Purpose Dock and jetties. The dock will house support vessels and allow for equipment and material (for onshore construction) to be brought ashore. LNG carriers will berth at the jetties while they are filled with the LNG.
- **Onshore** - construction and operation of the LNG Facility and all associated infrastructure eg housing, construction camp, airport etc.

The above three main elements are described in detail overleaf.

The project description will be refined through the Front End Engineering and Design (FEED) process currently being undertaken). Should there be any significant departure from the project description in the EIA, such that impacts are different or there needs to be new mitigation measures, the Project will undertake the necessary environmental processes (eg addendum to the EIA).

Figure 2: Illustrative Scheme of Project



Please note that the above illustrations are high level and indicative and do not represent actual Project.

The term 'Offshore' refers to the deep water environment. Offshore Project components comprise the wells, infrastructure connecting the wells with systems known as manifolds, to the gas pipelines leading up to Palma Bay (areas within Palma Bay are referred to as the Near Shore). The process begins in Area 1 and Area 4, where natural gas will be extracted via subsea wells from gas reservoirs below the seafloor. The Offshore Project components will consist of production wells and the pipeline system. Production wells are planned for AMA1's Golfinho and Prosperidade gas fields and for eni's Mamba gas field. Up to 60 production wells are planned for the Prosperidade and Mamba gas field and a further 60 production wells are planned for the Golfinho gas field.

The wells in each field will be connected to central collection systems on the sea bed so gas from multiple wells can be collected together. The collected gas will be transported by pipelines (running in a single corridor as they approach the near shore) from the offshore facility to the onshore facility. The offshore system is anticipated to produce up to 4 billion cubic feet of gas a day.

The offshore facility will be constructed by the drilling and installation of wells using dynamically positioned drill ships. Multi-purpose vessels will also be used to install the offshore central collection systems on the seafloor. Once operating, gas will be collected and transported to the onshore facility.

Figure 3 : Example of a Drill Ships and Construction Vessels

Example of a Dynamically Positioned Drill Ship

Example of a Light Construction Vessel

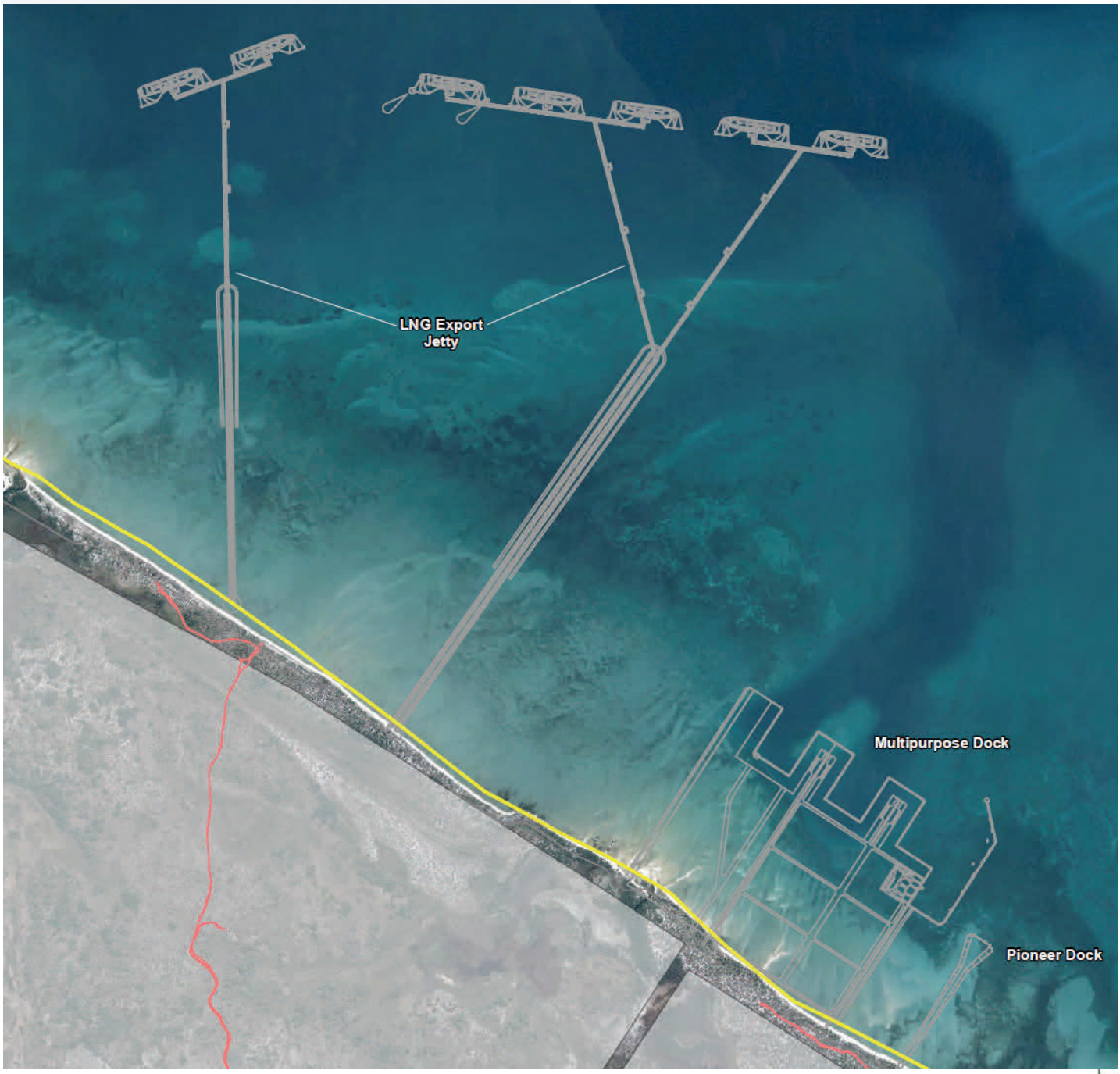
Example of a Deepwater Pipelay Vessel

Example of a Flexible Pipe and Umbilical Lay Vessel

The Near Shore refers to the shallow water within Palma Bay; from the islands of Tecomaji and Rongui to the shoreline. The Near Shore Project components will consist of port facilities (jetties and berths), a Multi-Purpose Dock to support construction activities (eg bringing in heavy equipment and materials), a shipping lane and the pipeline corridor within Palma Bay. Figure 4 below provides an indicative illustration of the near shore infrastructure.

Access channels to the port facilities will be widened and deepened by dredging the seabed in Palma Bay to allow large ships to reach the jetty and berths. Dredging will also be required in the Near Shore to enable pipe-laying. Some dredged material will be used for infill in the near shore while the rest will be disposed of at designated areas offshore.

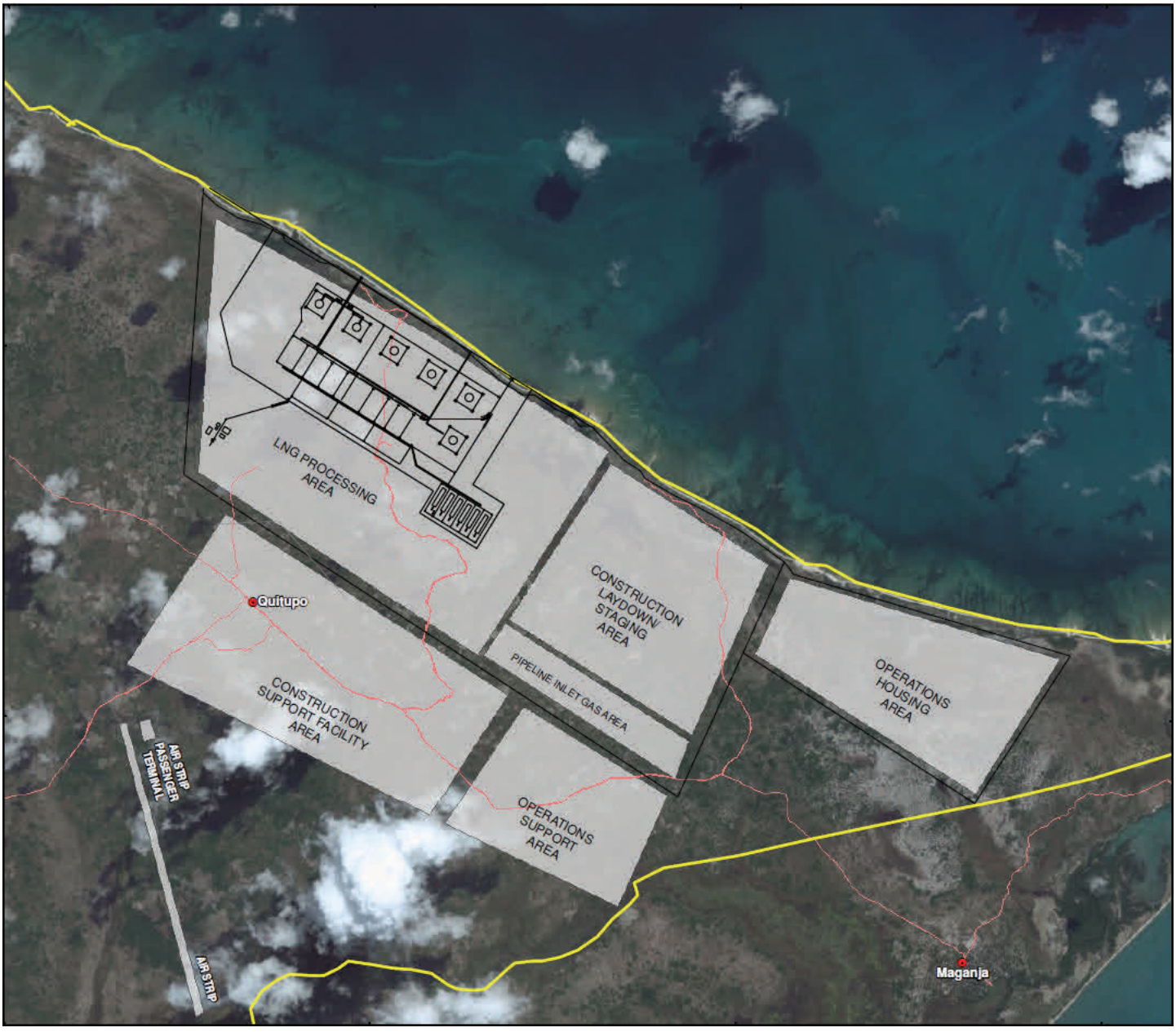
Figure 4 : Illustration of Near shore Infrastructure



The precise layout of the various Onshore components will be defined during the current Front End Engineering and Design (FEED) process. Thus indicative layouts have been used as the base case of the impact assessment. Figure 5 provides an indicative illustration of the Onshore Project components. Vegetation will need to be cleared and the land leveled prior to construction of the Onshore Project footprint. The Project footprint area is currently approximately 3,600 ha, within the allocated approximately 7,000 ha DUAT area.

The Onshore Project components comprises facilities necessary to treat and process natural gas and supporting infrastructure such as worker accommodation facilities, construction areas, access roads and an airport. The LNG processing plant will receive gas from the offshore facilities, remove impurities in the gas and produce LNG by progressively cooling the gas to a temperature of -163^{o}C. The LNG will be stored in cooled storage tanks on site and transferred by pipeline to the jetties for loading onto ships. The processing plant will produce between 3,000 and 5,000 barrels of LNG a day. The process will also generate water that will be recycled into the process and natural gas condensate, a byproduct that will be sold.

Figure 5: Illustration of Onshore Infrastructure



The EIA process

The purpose of the EIA is to predict the significance of the Project's impacts on the existing (baseline) physical, biological and socio-economic environment; and to identify measures to minimise negative impacts and maximise positive ones. This information will be used to inform decision-making by the Government of Mozambique.

The EIA study comprised the following steps:

- An integrated environmental, socioeconomic and engineering Site Selection study was undertaken to determine the most appropriate site for the construction and operation of the LNG Facility;
- The potential impacts of the Project were initially identified during the 'Estudo de Pré-Viabilidade Ambiental e Definição de Âmbito' (EPDA) or Scoping Phase;
- The existing baseline conditions and any environmental or socio-economic sensitivities were determined through fieldwork and review of existing information;
- Stakeholder concerns raised during the EPDA Phase and Impact Assessment Phase were considered;
- The significance of impacts prior to mitigation measures being applied was assessed;

Figure 6: EIA Process Overview

- Specialist experience and knowledge coupled with modelling in some cases (eg noise, drilled cuttings dispersion) was used to inform the impact assessments;
- Mitigation measures were developed and refined during workshops and meetings with the Project engineers and contractors;
- Workshops and meetings were convened to ensure that the proposed mitigation measures were practical and implementable;
- The Onshore Project layout was revised and reduced based on identified baseline sensitivities, outcomes of the impact assessment and following inputs from environmental and social specialists;
- The significance of residual impacts, prior to mitigation measures being applied was assessed; and
- An Environmental and Social Management Plan (ESMP), Waste Management Plan and Decommissioning and Rehabilitation Plan were developed and a process for training and educating staff about these plans was prepared.

Stakeholder Engagement

Stakeholder engagement (including communication with local communities) is a critical part of the EIA process and activities were carried out at key stages of the EIA process to ensure that stakeholder concerns and comments are addressed in the EIA. Meetings were held with stakeholders during the EPDA and Impact Assessment Phases. In addition, focus group meetings were held during the Impact Assessment Phase with key stakeholders. The Draft EIA Report was made available for public comment between 27 August and 31 October 2013.

All comments received throughout the engagement process and commenting period were recorded, and responses are provided in a Public Participation Report (*Annex A* of EIA Report).

The Draft EIA Report was updated based on comments received prior to submission to MICOA in February 2014.

Prediction, Evaluation and Mitigating Impacts

Impacts were identified by the EIA team with inputs by stakeholders (eg local communities, government departments and local communities). An impact is any change to a resource or receptor brought about by the presence of the Project component or by the execution of a Project-related activity. The impacts assessed fall into two main categories; environmental and socio-economic. Environmental impacts include both physical impacts of the Project such as changes in air quality and biological impacts such as changes to marine and land based habitats.

The socio-economic impacts are effects of the Project on people and their livelihoods. This includes positive impacts such as employment or increased demand for local goods and services as well as negative impacts such as loss of access to farm land or access to parts of Palma Bay for engaging in subsistence livelihoods activities. The following aspects were considered when determining the significance of identified impacts:

- **nature of impact:** positive or negative;
- **duration of impact:** temporary, short term, medium term, long term or permanent;
- **scale of impact:** onsite, local, regional, national or international/ transboundary; and
- **intensity of the impact:** negligible, low, medium, high.

Table 1 shows the definitions for the categories of significance used in this EIA.

Table 1 : Definition of Significance Levels

NEGLIGIBLE	The existing environmental and social conditions will not be affected or the affect is not detectable. A negligible impact is likely to be of no concern to the government, communities and organisations.
MINOR	The environmental and/or social conditions will be affected, but the impact small enough that it is unlikely to be of concern to the government, communities and organisations.
MODERATE	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP).
MAJOR	A major impact is one where there will be a large change to communities or the natural environment. The aim of the EIA is to provide ways to stop these large impacts from occurring. At times this is not possible and it is up to the government to decide if this is acceptable when considering the benefits of the Project.

Mitigating Impacts:

The Project philosophy regarding mitigation is outlined in Table 2. The Project first sought to avoid impacts to the extent practical. If impacts could not be avoided they were mitigated through modifying the design or implementing mitigation at the impact site. In cases where these first two mitigation strategies were not possible, the Project would aim to remediate impacts wherever possible and finally investigate options for compensation or offsets where necessary or required.

Table 2 : The Mitigation Hierarchy for Planned Project Activities

AVOID AT SOURCE; REDUCE AT SOURCE Avoiding or reducing at source is 'designing' the project (embedded controls) so that a feature causing an impact is designed out (eg a waste stream is eliminated) or altered (eg reduced waste volume). Often called minimization.
ABATE ON SITE This involves adding something to the basic design to abate the impact - pollution controls fall within this category. Often called 'end-of-pipe'.
ABATE AT RECEPTOR If an impact cannot be abated on-site then measures can be implemented off site. An example of this would be to use a silt trap to capture any sediment that may flow into streams.
REPAIR OR REMEDY Some impacts involve unavoidable damage to a resource, eg land disturbance. Repair involves restoration and reinstatement measures, such as re-vegetation
COMPENSATE IN KIND Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage, and general intrusion might be appropriate.

The EIA has assessed the potential impacts of the proposed Project on the biophysical and socio-economic environment. Throughout the EIA process evolving project information has been fed into the assessment process, allowing for the EIA to be updated as the Project concept was developed. Thus, impacts have been assessed taking into account the mitigation measures that were built into project design. Potential 'cumulative' impacts (ie impacts acting in conjunction with each other on a common resource or receptor) and the risk of accidents (eg gas pipeline rupture) have also been assessed as an integral part of the assessment exercise.

The findings of the EIA process are presented in this section. A large number of potential impacts were assessed in the EIA process and the detailed findings are presented in the EIA Report.

BASELINE

The offshore project area is located in deep waters, in depths of around 1,000m to 2,300m. The offshore marine environment supports a wide range of larger animals such as whales and dolphins as well as many species of fish, turtles and sea birds. Deep water reef structures (mainly hard substrate structures) have been observed on the seabed.

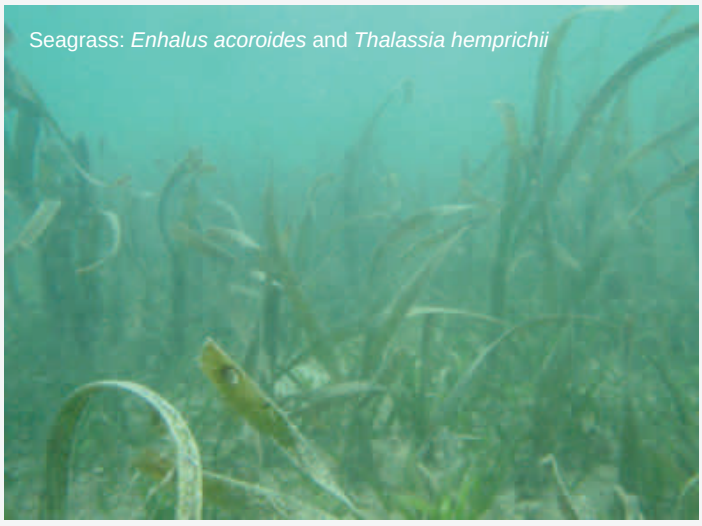
The near shore environment, in and around Palma Bay, has clear water (low levels of suspended sediment), temperatures in the range of 30 to 35^{o}C and a number of different habitats; rocky bottom, sand beaches, mangroves and mudflats. Figure 7 shows a range of the typical habitat types. Palma Bay supports sea grass beds close to the shore with coral reefs scattered within the bay and around the islands of Tecomaji and Rongui.

PROJECT ACTIVITIES

Project activities that could affect this baseline include dredging, disposal of dredge material, installation of subsea infrastructure, and the construction of the jetties and Multi-Purpose Dock.

Figure 7 Habitats in the Offshore and Near Shore Environment


Coral Habitat and Fish


Seagrass: *Enhalus acoroides* and *Thalassia hemprichii*


Intertidal Zone


Mangrove species: *R. mucronata* and *Avicennia marina*

Impacts due to discharge of drill cuttings:

Dispersion modelling of drill cuttings and the sensitivity of offshore benthic fauna and flora indicates that impacts from physical inundation (burial and change in sediment grain size) will be of MINOR significance before and after mitigation. The drilling of the offshore production wells will be the primary activity likely to result in potential impacts to water quality and marine ecology (such as whales, dolphins and benthos) in the offshore area. With the implementation of mitigation measures, all residual impacts are predicted to be of NEGLIGIBLE and MINOR significance in the offshore marine environment.

Deepwater reef structures and associated organisms, however, may be at risk of enduring more severe effects. This is because the recovery of reef structures is expected to take an appreciable amount of time due to generally slow growth rates of these organisms. Therefore the predicted impact to offshore reef communities may potentially be of MODERATE significance prior to mitigation. It should be noted that both the high and low-relief structures observed in the deep waters offshore largely comprise scattered rock and sediment, and do not apparently support high densities of fauna. With the implementation of mitigation, this impact will be reduced to MINOR.

Impacts due to discharge of residual muds:

Impacts on benthic marine organisms or those in the water column (ie plankton) from discharges of residual muds (small amounts of muds that remain on the drill cuttings after treatment) are predicted to be of MINOR significance because of low toxicities of the quantities and types of muds used/or discharged to the offshore environment. Impacts will be reduced to NEGLIGIBLE with the implementation of mitigation.

Impacts due to discharge of hydrotest water:

The impacts on marine ecology and/or marine ecological processes associated with the discharge of hydrotest water at depths of approximately 1,500m in the offshore gas fields during commissioning (ie the construction phase) will be NEGLIGIBLE, as the hydrotest water will be discharged in a phased approach, at pressures that will ensure that the water quality effects of the discharges are restricted to close proximity of the release points.

Impacts due to increased traffic:

Potential impacts from vessel and helicopter noise, lighting and movements on offshore marine ecology (birds, fish, benthic fauna etc) with the exception of marine mammals will be NEGLIGIBLE. Effects of vessel collisions or disturbance on whales may be more severe due to their conservational value or importance and the associated impact is predicted to be of MODERATE significance. However, mitigation measures specific to whales will ensure that vessel collisions with whales are avoided and thus impact significance is reduced to NEGLIGIBLE.

Impacts due to habitat modification:

The introduction of the subsea infrastructure, a hard structure, on to the seabed in the Offshore Project Area will result in changes to the character of the sea bed and consequently the diversity and structure of the benthic community. Such an impact will be of MODERATE significance, particularly at deep water reef structures, where benthic organisms including deepwater reef structures, may be affected. Mitigation measures will ensure that the subsea infrastructure is located to avoid areas of sensitive benthic communities to the extent practical. Thus reducing the impact significance to NEGLIGIBLE.

Summary of Key Near Shore Environmental Impacts

Construction activities in the Near Shore are likely to result in disruptions to seagrass, coral reefs and some loss of mangrove and estuary areas. These features play critical roles in ecological interrelationships and directly and indirectly support productivity and biodiversity in the Palma Bay area. The implementation of mitigation has helped to reduce the significance of such impacts but the potential remains for bay-scale productivity to be affected.

Impacts due to dredging: Pre-mitigation impacts to marine ecology from dredging activities in the Near Shore Project Area have been assessed as severe, with a number of MAJOR significant impacts being identified. Examples of such impacts include; the effects on seagrass, coral and associated biological communities from increased turbidity in the water column, cutting a trench through coral reef and rock, depositing fine sediment on benthos and modifications to the seabed. The significance of these MAJOR impacts is largely reduced through mitigation. Key mitigation measures include changing the proposed dredging/cutting techniques and avoidance of areas considered particularly sensitive (ie corals along the pipeline route) and measures to reduce turbidity.

The deposition of fine sediments from dredging activities can inundate seagrass beds and also cover corals with a veneer of sediment that may take considerable time to recover. The re-suspension of sediment and subsequent deposition is unavoidable and subsequent effects to benthos and coral are likely to remain as MAJOR significance post-mitigation.

Dredge material discharged in a dredge placement area at the head of the Afungi Canyon in Palma Bay will smother and possibly result in negative impacts to benthos within the designated 1km^2 placement area. The impact will be of MODERATE significance within dredge placement area itself pre-mitigation, and MINOR post-mitigation. Benthos will likely recover within 1 to 3 years after the cessation of dredging.

Impacts due to modification of the beach: The installation of Near Shore infrastructure across the intertidal beaches and extending into the shallow subtidal zone will modify beach structure and dependant ecological processes. This is likely to result in a loss of parts of the productive sand beach and subtidal zones and areas of seagrass meadow. It will allow the establishment of hard substrate communities in the lower intertidal and corals, sponges and associated organisms in the subtidal and may also facilitate colonisation by alien and potentially invasive species. The impacts to the marine biotopes and associated communities within the bay will be MODERATE for the construction and operational phases. With mitigation, including design mitigation, these impacts will be reduced to MINOR significance.

Impacts due to increased noise: Impacts to fish, whales, dolphins and turtles from noise associated with pile driving in Palma Bay are predicted to be of MODERATE significance although the extent of the effects differs among groups. Should a 'soft start' procedure be implemented prior to construction activities when megafauna are present in the bay, the impact will be reduced to MINOR.

Impacts due to alien invasive species: If invasive alien species are transferred into Palma Bay via ballast water, effects on biodiversity and marine ecology, including seagrass and corals may be of MODERATE significance. The progressive adoption of ballast water control measures and processing techniques as sanctioned by International Maritime Organisation (IMO) will further reduce the likelihood of releasing of non-indigenous organisms. However, due to the high magnitude of the effects that may arise should invasive species become established in northern Mozambique, the significance rating would remain as MODERATE.

Impacts due to discharges into the bay: Discharges from the proposed desalination and sewage treatment plants as well as from treated produced water and stormwater from the LNG Facility is are likely to have NEGLIGIBLE to MINOR significant impacts on near shore water quality and marine flora and fauna in Palma Bay prior to mitigation. All impacts from sources of discharge post-mitigation will be NEGLIGIBLE.

Impacts due to waste discharges: Discharged solid and liquid wastes from marine vessels during any phase of the Project could potentially result in impacts of MODERATE significance through the proliferation of litter and compromised water quality harming marine organisms, seabirds and biodiversity in Palma Bay. With effective mitigation of waste with appropriate facilities impacts will be reduced to NEGLIGIBLE.

Impacts due to loss of an estuary and its mangroves: The impacts on marine ecology resulting from the loss of the estuary and associated mangrove stand to the east of Afungi Project Site during the construction phase will be of MODERATE significance. The impact will remain as MODERATE significance post-mitigation given the loss of the multi -species mangrove stand.

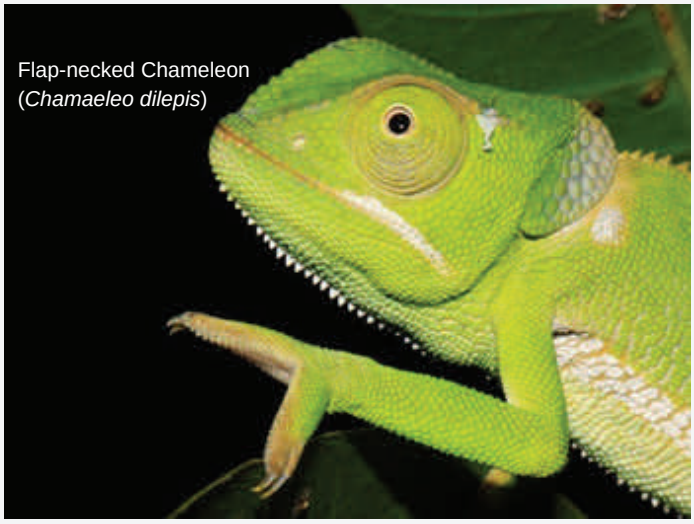
Impacts due to the security exclusion zones: The establishment of security (exclusion) zones around the LNG Facility and the Near Shore Project infrastructure during construction and operations will displace artisanal fishing effort and locally increase exploitation pressure on the fish community outside of the zones resulting in impacts of MINOR significance. Mitigation measures to help reduce such impacts have yet to be identified.

Summary of Key Onshore Environmental Impacts

BASELINE

The onshore project area is located in an area that has three main habitat types, marshlands, wetlands and woodlands. All of these habitats are considered important due to the animal and plant life they support. Figure 9 shows some of the plants and animals in the Afungi Project Site. The wetlands are fed by drainage channels upstream of the site; the flows in these channels are highly variable with very high flow in the wet season and very low flow in the dry season. The wetlands are of particular importance as they provide habitat for frogs and lizards (amphibians). These amphibians are eaten by other animals and largely support the food chain in the area.

Figure 8 Examples of plants and animals in the Afungi Project Site



PROJECT ACTIVITIES

During the construction phase, the activities that will impact on the baseline are the clearance of vegetation, infilling of an estuary, and other general site preparation activities (eg levelling of land). During the operation phase, activities that could affect the baseline are associated with accidental spills, runoff and sedimentation.

REVISION TO ONSHORE PROJECT LAYOUT

Field studies conducted during the Baseline Phase of the EIA identified and mapped sensitive habitats for a variety of vegetation, terrestrial fauna and avian species. Once these species-specific sensitive habitat maps were overlaid (see Figure 9), it became apparent that certain areas within the Afungi Project Site were more sensitive than others. Most of the species relied heavily on the wetlands within the Onshore Project Footprint Area for the ecological functions they provide (food, water, breeding habitat, etc).

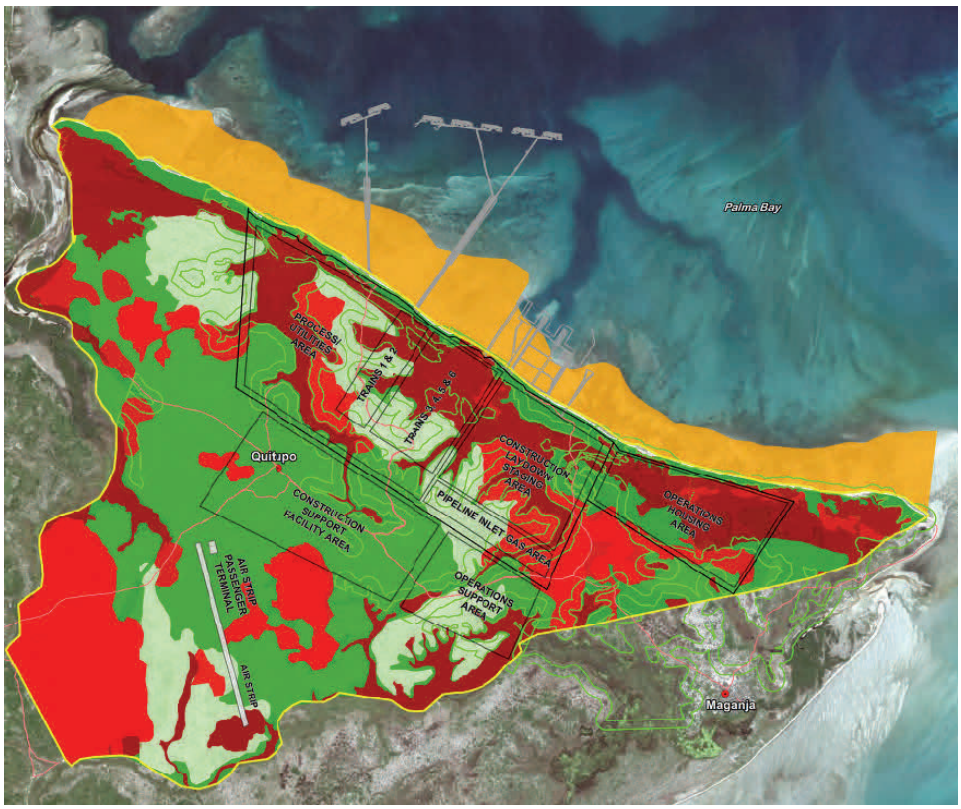
Through baseline studies and sensitivity mapping, it became obvious the Project could reduce adverse environmental impacts by revising the Onshore Project Footprint Area. With the sensitivity map in mind, the Project began to investigate methods to avoid or minimise potential footprint impacts. This was facilitated by a series of interactions held between the EIA and Project Engineering Teams. The EIA Team, in conjunction with AMA1, revised the base case Project layout (Figure 9) to avoid or minimise impacts on the identified high-sensitivity areas. Figure 10 shows the Revised Project Footprint Area. The potential FEED Contractors were then tasked with determining whether they could design the Project to work within the revised areas. Each of the potential FEED Contractors confirmed that they were able to work within the revised layout.

This mitigation exercise enabled the avoidance of some impacts and the minimisation of others to as low as reasonably practicable (ALARP). The Revised Project Footprint Area effectively reduces the disturbance of areas classified as High to Very High terrestrial ecological sensitivity from approximately 2,340ha to 1,695ha, thereby avoiding the disturbance of approximately 645ha of High to Very High sensitivity.

Revised Footprint Area

The Onshore Project Footprint (see Figure 9) was revised to minimise impacts to area considered to be of high sensitivity to habitats and various animals such as birds, mammals and frogs. This was a key mitigation measure developed and the revised Project footprint is shown below in Figure 10.

Figure 9 Base Case



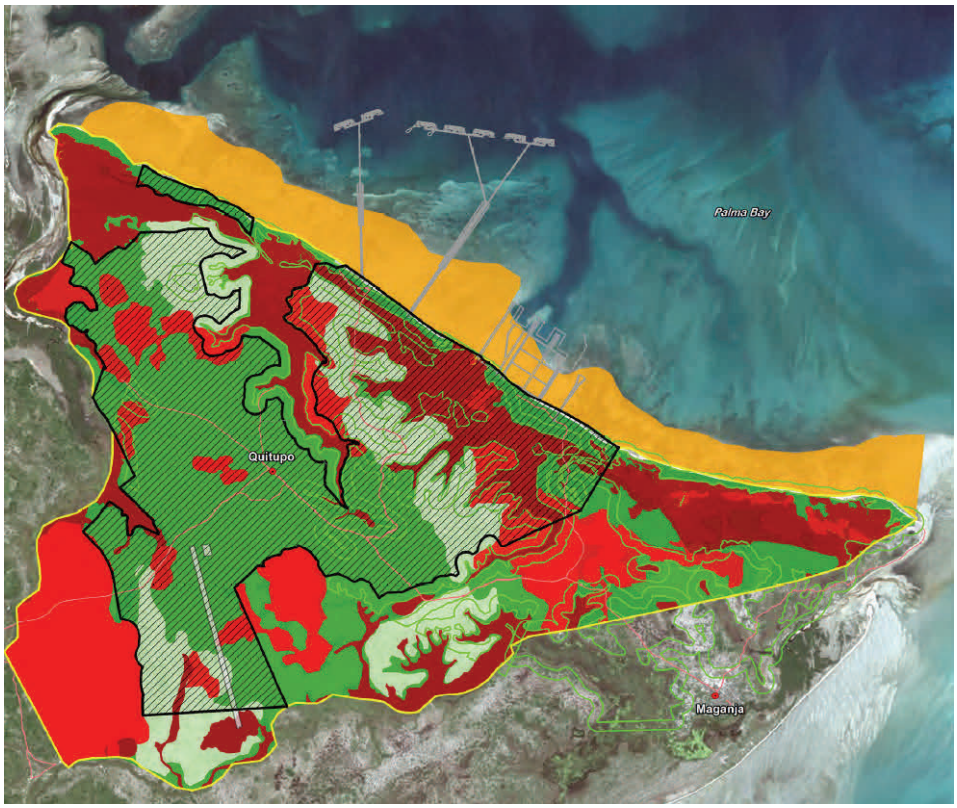
Legend

- Villages / Settlements
- Regional Roads
- Existing Roads
- Nearshore Components
- Airstrip
- Afungi Project Site
- Revised Project Footprint

Sensitivity Rating

- Very High
- High
- Medium-High
- Med
- Low
- 150m Buffer

Figure 10 Revised Footprint



Impacts due to air emissions: Air dispersion modelling undertaken indicates that during the operational phase of the Two-Train LNG Facility, there will be minimal impacts to human and ecological receptors outside the Afungi Project Site from changes to air quality. Impacts to receptors outside of the Afungi Project Site will be of NEGLIGIBLE significance for all pollutants modelled pre- and post- mitigation with the exception of SO_2 which will be of MINOR significance prior to mitigation and NEGIGIBLE post-mitigation.

However, with the expansion of the LNG Facility to six trains, a potential impact of MODERATE significance may occur from increased levels of SO_2 pre-mitigation. Further consideration of the design of the LNG Facility (in terms of both stack height and turbine technology adopted) is recommended to avoid the potential of exceeding air quality standards during operations of an expanded six train facility.

Impacts due to emissions of greenhouse gasses: Assuming Mozambique's Greenhouse Gas (GHG) emissions will increase by 8 percent per year (based on World Bank GDP predicted growth figures), emissions from the Project will increase the country's global contribution of GHG emissions from between 0.4 percent per year up to 10 percent per year, depending on the year and period of development (ie construction or operation). The pre-mitigation impact of the Project on Mozambique's national GHG emissions is likely be of MAJOR significance both during the construction and operational phases of the Project. Given the scale and nature of the Project, while good practice can be employed to reduce the GHG emissions, the overall significance of the impact is not expected to significantly change post-mitigation.

Impacts due to noise generation: Noise modelling has shown that during normal construction and operational activities noise levels will remain in compliance with Mozambican and IFC noise limits/standards at Noise Sensitive Receptors at night and during the day. Impacts are therefore predicted to be of NEGLIGIBLE to MINOR significance pre-mitigation and similar post mitigation.

Impacts to the visual landscape: Project activities during the construction phase, including the movement of vessels in and out of Palma Bay and the presence of highly visible equipment and machinery onshore, are likely to have a visual impact of MODERATE to MAJOR significance on Palma Bay Seascape Unit (ie in the coastal area of Palma Bay). During the operational phase this impact will increase to MAJOR significance, with the introduction and long term presence of the LNG Facility and associated infrastructure on Afungi Peninsula and within Palma Bay. Further south in the Afungi Peninsula to Cabo Nondo Seascape Unit, visual impacts experienced as a result of the Project will be of MINOR significance during construction and MODERATE during operations.

Visual impacts at a number of viewpoint locations in the wider area which are considered to be particularly sensitive to change are mainly expected to be of MINOR to MODERATE significance during construction. During operations when Project infrastructure is more visible, significance of visual impacts is likely increase to MODERATE to MAJOR, especially in nearby areas such as Palma town, Maganja and within Palma Bay. However, areas further removed from the Afungi Peninsula (Quiwia and the islands of Tecomaji and Rongui) visual impacts are expected to be of MINOR to MODERATE significance during operations. Vamizi Island and Olumbe are expected to have MINOR to NEGLIGIBLE visual impact during operation due to their distance from the Project.

Impacts on soil: Impacts on soil and land capability will predominantly be felt during the construction phase during site clearance activities, and will include soil compaction and topsoil loss, water and wind soil erosion and alteration of natural drainage. Impacts of MODERATE significance will be reduced to MINOR with the implementation of appropriate mitigation measures. Spills or leaks of fuel are likely to have NEGLIGIBLE impacts on soil resources as procedures will be put in place to prevent, contain, clean-up and dispose of any spillage.

Impacts due to groundwater use: Potential impacts to groundwater will be predominantly be felt during the early stage of the construction phase when groundwater will be the only source of fresh water. Groundwater abstraction from the production water supply wells may result in the lowering of groundwater levels (drawdown) in and around abstraction boreholes; however this is deemed to be of low magnitude potentially having a NEGLIGIBLE impact to community wells in the area adjacent to the production water supply wells. Additionally, water abstraction for Project use may have a NEGLIGIBLE impact on environmental receptors reliant on surface water.

Impacts on surface water ecology: The loss of wetland and estuarine habitat during the construction phase has been assessed as being of MAJOR significance. This significance rating is due to the loss of the ecological functions provided by the wetlands and of important habitat for species of conservational value or importance. The reconfiguration of the Project layout will result in a much reduced area of wetland and estuarine habitat being lost and this coupled with the additional mitigation measures proposed will reduce impact significance to MODERATE.

With the implementation of mitigation, all other impacts to wetland and estuarine flora and fauna are predicted to be MINOR, reduced from MODERATE in most instances, with the exception of impacts associated with increased turbidity and changes to sediment patterns. Increased turbidity in the wetland and estuaries is mainly likely to occur during the construction phase from onshore activities (eg removal of vegetation, site levelling, infilling of wetlands) and activities in the Near Shore (eg dredging). A change in sedimentation patterns may affect connectivity of the wetlands, primary production, benthic invertebrates, fish species etc. Impact significance could potentially be MAJOR during this phase of the Project but reduced to MINOR to MODERATE with mitigation.

Impacts on vegetation: Much of the existing vegetation within the Afungi Project Site has been altered from its natural state (eg for subsistence agriculture) and fragmented. Site clearance activities during the construction phase are expected to result in further fragmentation and the removal or disturbance of some sensitive vegetation units. Site clearance is expected to result in an impact of MODERATE significance. Given the mitigated Revised Project Footprint layout, the areas of sensitive vegetation units to be lost will be reduced and impact significance is thus reduced to MINOR.

Impacts of MODERATE significance to ecological system functioning may occur due to the introduction of undesirable plant species during the construction phase, although with appropriate mitigation such impact will be reduced to NEGLIGIBLE.

Impacts on reptiles and amphibians: The impact of site clearance activities during the construction phase, in particular the infilling of wetland areas within the Afungi Project Site will be of MODERATE to MAJOR significance to reptiles and amphibians given the importance of freshwater wetlands in the functionality of their communities. However, the Revised Project Footprint Area reduces the amount of wetland disturbance and reduces this impact to MINOR significance.

Other impacts to reptiles and amphibians likely to arise during the construction and operational phases of the Project include mortality, disturbance and displacement due to the development of access roads and similar linear structures. Changes in water quality of the wetlands within the Afungi Project Site and adjacent areas also present potential impacts of MINOR to MODERATE significance to reptiles and amphibians. These impacts are reduced to NEGLIGIBLE to MINOR post-mitigation.

The influx of people into the wider area as a result of the Project is expected to put pressure on reptiles and amphibians population density through increased bush fires, reduced water quality from poor sanitation, subsistence poaching and hunting. Such activities could potentially result in reduced breeding success and depleted local populations of reptiles and amphibians and equating to impacts of MAJOR and MODERATE significance during the construction and operational phases respectively. Impacts to areas outside the Project's control are difficult to manage. However with the implementation of proper mitigation, the impact significance will be reduced to MODERATE and MINOR to MODERATE significance respectively.

Impacts on birds: Areas of important avian sensitivity are largely associated with estuarine salt marshes, freshwater wetlands, large intact forests and the inter-tidal zone and mangrove forests. Five International Union for Conservation of Nature (IUCN) listed bird species are known to occur within the Afungi Project Site and the loss of such bird habitat is considered MODERATE to MAJOR in significance. However the revision of the Project layout avoids or minimises impact to these sensitive areas. This in conjunction with additional mitigation measures serves to reduce the significance of the impact to MINOR to MODERATE.

Population influx may include the introduction of domestic animals (livestock and pets) into the area and the introduction of feral animals (dogs and cats). Feral animals are likely to prey on birds and livestock is likely to reduce habitat quality. As a consequence, avian impacts of MODERATE to MAJOR significance are possible during construction (when workforce is greatest); the impact significance is anticipated to be reducing to MODERATE during operations. With the introduction of mitigation measures, the impact will be reduced to MODERATE and MINOR to MODERATE during the construction and operational phases respectively. Other impacts to birds are reduced to NEGLIGIBLE to MINOR post-mitigation.

Impacts on mammals: Project activities likely to result in impacts of MAJOR significant to mammals are largely associated with site clearance activities. Burrowing mammals, tree dwelling species and smaller mammals are likely to be most affected as they are less able to escape construction equipment or vehicles than larger species. Impacts during the operational phase are likely to be MINOR to MODERATE. However with management through mitigation, impacts are reduced to MINOR significance during both development phases.

The presence of infrastructure including roads, fencing, trenches and pipelines will cause loss or fragmentation of mammalian habitat. These may act as deterrents to mammals and have the potential to affect mammalian movements and cause disruption of mammalian migration. Impacts are assessed to be of MODERATE significance during both the construction phase and operational phase of the Project but reduce to MINOR with mitigation.

The most significant potential impacts to mammals remaining following mitigation are the indirect impacts associated with the influx of people into the area. These impacts are likely to be similar to those described for other species above. The various mitigation measures to be implemented by the Project are likely to reduce mammalian impacts to MODERATE during construction and MINOR to MODERATE during operations. All other impacts to mammals will be reduced to MINOR post-mitigation.

BASELINE

The Afungi Project Site is located within Palma District. Most people over the age of 15 in the district have received no formal education and illiteracy is high in the area. Formal employment is scarce and almost non-existent within the private sector. The majority of the population in the Afungi Project Site are therefore highly dependent on natural resources such as fishing and small scale agricultural activities. Figure 11 shows a local community's dependence on natural resources.

There are very few health care facilities in Palma District yet communities are regularly at risk of health problems arising from water and sanitation. The communities largely use natural water sources such as open wells and streams. The sanitation in the area is poor with few formal toilets, this puts the water sources at risk with potential for out breaks of diarrhoea and cholera.

PROJECT ACTIVITIES

The main Project activities that could change socio-economic conditions include the removal of access to land on the Afungi Peninsula, removal of access to parts of Palma Bay, an increasing in-migrant population within the Project area, training and employment of local people and use of local goods and services.

Figure 11 Dependence on Natural Resource


Community using borehole


Fishing village in Afungi

Fish drying


Cassava crops

Impacts due to physical and economic displacement:

The Project expects that everyone residing within the Afungi Project Site will be permanently displaced resulting in loss of dwellings and infrastructure associated with the household, livelihood activities and community assets within the Afungi Project Site. Access to areas of collective natural resource value (eg forests, wooded grassland, flood plains/ lowlands, dune shrub vegetation, fruit trees, and coconut plantations) will be permanently lost due to the acquisition of land required for the Project. In addition, fishing and sea-based transportation will be affected by Project activities in Palma Bay during the construction and operational phases of the Project due to increased vessel traffic and safety exclusion zones around Project infrastructure. The impacts associated with physical and economic displacement are expected to be of MAJOR significance both during the construction and operational phases. Following the implementation of the Resettlement Action Plan (RAP), the significance will be reduced to MODERATE .

Impacts on tourism: The tourism establishments situated on the islands of Tecomaji, Rongui and Queramimbi will be affected by visual and noise impacts resulting from Project construction activities as well as the presence of the Project and vessel traffic during the operational phase. The disruption and loss of attraction to tourism destinations is expected to be an impact of MAJOR significance. This will be reduced to MODERATE with the implementation of mitigation measures including the design of facilities to minimise visual intrusion on tourism receptors and through appropriate ongoing engagement with tourism operators. While the Project activities are anticipated to negatively influence tourism, there will be a positive impact associated with potential increase in use of tourist facilities by the Project. A MODERATE positive impact is expected as a result of increasing demand for accommodation and use of resorts for leisure purposes during both the construction and operational phases.

Impacts due to in-migration: A wide range of direct and indirect negative environmental, social, and economic impacts on local receptors in Project's host communities such as social services, infrastructure and utilities, social dynamics and cultural life, economy and livelihoods and community health are associated with Project related in-migration, leading to a potential deterioration in the socio-economic environment of the Project's host communities. These impacts are likely to be MAJOR. With appropriate mitigation, including engagement and coordination with relevant authorities impact significance will be reduced to MODERATE.

Impacts on community health: Community health is likely to experience MAJOR significant impacts from the presence of the Project workforce, and due to Project related in-migration into the wider area as well such as an increase in communicable diseases (eg respiratory disease and sexually-transmitted infections and vector borne diseases such as malaria). Similarly, MAJOR significant impacts to community health may arise indirectly from Project activities or associated with Project related in-migration (such as increased pressure through demand on health infrastructure, food and nutrition related issues, community accidents and injuries and soil, water and waste borne diseases). With the implementation of mitigation measures, most impacts are reduced to MODERATE significance, and some MINOR. During the construction and operational phase, the potential for increased sexually-transmitted infections and high risk sexual practices may remain as MODERATE to MAJOR significance post-mitigation.

Enhancement measures to be implemented will promote community health benefits from the presence of the Project. MODERATE to MAJOR positive impacts on community health are anticipated particularly during the operational phase of the Project.

Impacts on local, regional and national economy: The Project will have a range of positive economic impacts at the local, regional, and national levels, including income growth (linked to employment and procurement opportunities), capacity development and increased government revenue. These will range from MINOR positive to MAJOR positive in significance and occur during both the construction and operational phases of the Project. The Project will implement measures to enhance these economic benefits.

There are high expectations associated with the Project to provide opportunities for employment and procurement of goods and services locally and regionally and general economic development. A potential negative impact is associated with unmet community expectations in relation to these opportunities and impact significance is expected to be MODERATE during all Project phases, even with the implementation of mitigation measures.

Impacts due to increase in marine vessel movement: Impacts to international maritime traffic and national and regional cabotage will range from NEGLIGIBLE to MODERATE significance due to the presence of Project vessels and the designation of exclusions zones around Project infrastructure, construction areas and vessels. All impacts will be reduced to NEGLIGIBLE to MINOR once mitigation measures are implemented.

Commercial fishing activities are expected to experience impacts of MINOR to NEGLIGIBLE significance. These potential impacts will be confined to the construction phase of the Project and are most likely to occur in the deep water offshore. Temporary exclusions zones in the offshore gas field and pipeline corridor may impede access to commercial fishing grounds. Impacts are expected to be NEGIGIBLE post-mitigation.

Impacts on archaeology: Impacts to onshore archaeology and cultural heritage are expected to be of MODERATE significance during site clearance and construction activities. However impacts will be reduced to MINOR significance with the implementation of the proposed mitigation. During the operational phase impacts will be NEGLIGIBLE.

Impacts to offshore archaeology and cultural heritage are expected to be MINOR during the construction and operational phases prior to mitigation and NEGLIGIBLE following the implementation of the mitigation measures.
All other impacts to mammals will be reduced to MINOR post-mitigation.

Summary of Unplanned Events

An unplanned event is defined as 'a reasonably foreseeable event' that is not planned to occur as part of the Project, but which may conceivably occur as a result of Project activities (eg accidents), even with a low probability. Unplanned events can occur at any phase of the Project onshore and offshore.

The consideration of unplanned events in the EIA has focused primarily on the risks of:

- large volume spills of chemicals or hydrocarbons; and
- failure of subsea infrastructure (such as well blowout or pipeline failure).

Although unlikely to occur should large volumes of hydrocarbon spill in the marine environment the potential consequence to biophysical and socioeconomic receptors could be MAJOR. Sensitive habitats (such as corals and mangroves), local communities dependent on fisheries, as well as tourism operators or aquaculture farms in the vicinity would likely be adversely impacted by such an unplanned event.

Impacts associated with the release of large volumes of natural gas in the marine environment (from failure to or damage of subsea infrastructure) will be less significant.

During the FEED process the Project will identify, assess, mitigate and manage health and safety hazards and risks associated with the Project through a Safety Case. The findings of which will inform decisions related to the design and layout of the Project to reduce the likelihood of unplanned events occurring.

The Emergency Response Plan for the Project sets out response and preparedness measures and incorporates an Oil Spill Contingency Plan. These measures serve to reduce the likelihood, extent and duration of adverse impacts if an unplanned event occurs and establish effective response mechanisms to minimize impacts should such an unlikely event occur.

Cumulative Impacts

It is likely that a number of Mozambique's offshore natural gas resources will be exploited for gas in the coming years resulting in rapid growth in Cabo Delgado Province as a result of the hydrocarbon industry. The cumulative impacts in the region, both positive and negative, as a result are likely to be significant over the life of the Project and beyond. The following have been considered as 'reasonably defined' future developments that could act together with the Project to cumulatively affect the environment:

- establishment of an Industrial Zone (IDZ) by the Government of Mozambique in the vicinity of, or incorporating, the Afungi Project Site.
- future phases of exploration and development of hydrocarbon resources by AMA1, eni and others.

Each of these developments alone has the potential to cause positive and negative biophysical and socio-economic impacts. Cumulatively, the developments will result in significant economic development of the Cabo Delgado Province and the country. The overarching negative cumulative impact of the industrialisation of this area will be the loss of some natural resources as the underdeveloped areas are transformed.

The establishment of the IDZ may result in direct and indirect environmental and social impacts at the local level, but in the long term, consolidating the Project and other operators within the IDZ will serve to confine impacts to one area and ideally allow for easier management of such impacts. Therefore, if managed properly, the IDZ could have an overall positive impact on both biophysical resources and on socio-economic receptors at the regional level given that the Mozambican hydrocarbon resources in this region will undoubtedly be developed. Strategic spatial planning by the Government of Mozambique and its agencies at this early stage is important to promote sustainable development in the region.

Environmental and Social Management Plan (ESMP)

A number of measures to manage residual impacts are captured in the Project Environmental and Social Management Plan (ESMP) and other specific management plans have been developed according to the requirements of Mozambican law and good international industry practice. The ESMP and other plans (listed below) will be implemented during construction and operation of the project.

Environmental Education and Training: This is included in Chapter 17 of the EIA Report and describes how Project staff will be made aware of the environmental and social management measures and controls that they will be required to implement.

Project ESMP: This is a tabulated list of environmental and social management measures and is included in Annex D of the EIA Report. The ESMP references the impacts identified in the impact assessment chapters and categorises the management measures according to phase in which they will be implemented and by responsibility for implementation. Specific monitoring requirements have been identified where required.

Waste Management Plan: The Waste Management Plan is included in Annex E of the EIA Report. It defines waste streams, estimates volumes, categorises wastes streams and describes the means by which the Project will manage waste. The Project has committed to following the waste hierarchy:

Reduce the amount of waste generated;

Re-use materials, where appropriate;

Recycle wastes, where appropriate;

Recover as many materials as practical from the remaining waste;

Treat wastes as necessary to render them less hazardous and/or to enable them to be reused or recycled; and

Dispose of residual wastes responsibly at authorised facilities

Decommissioning and Rehabilitation Plan: This plan outlines the Project's commitments to progressively rehabilitate and re-vegetate disturbed areas wherever possible. In line with good international industry practice and the requirements of Mozambican law, this plan provides the principles that will be followed for decommissioning and rehabilitation and commits the Project to reviewing and updating it at least two years before closure. The plan is included in Annex F of the EIA Report.

Emergency Response Plan: This plan is included in Annex H of the EIA Report. It details the emergency organisational structure and protocols that will be implemented to respond to any major incident in a safe, rapid, effective, and efficient manner within the region. Incidents are defined as an event or hazardous circumstance that poses a significant impact to people, the environment, or property.

Initial Resettlement Plan: The Project's Initial Resettlement Plan (IRP) is included in Annex I of the EIA Report. It describes the approach, principles and procedures that will be followed to manage all unavoidable displacement. The IRP provides the framework for the future development of a full Resettlement Action Plan (RAP). The RAP will be prepared in accordance with Mozambican legislation and the International Finance Corporation's Performance Standard 5: Land Acquisition and Involuntary Resettlement (IFC PS 5) in close consultation with the affected communities.

WHAT IS THE NEXT STEP IN THE PROCESS?

The Draft EIA Report has been finalised in light of all comments received during the public commenting period (27 August to 31 October 2013).

The Final EIA Report has been made submitted to MICOA for decision making (February 2014). If any person or organisation that is interested in or affected by the Project (Interested and Affected Parties (I&APs) has further comments on the Final EIA Report, they are requested to submit these directly to MICOA.