REPORT

Central Térmica de Temane Project - Health Impact Assessment

Moz Power Invest, S.A. and Sasol New Energy Holdings (Pty) Ltd

Submitted to:

Ministry of Land, Environment and Rural Development (MITADER)

Submitted by:

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18103533-321020-14

November 2018

Distribution List

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Executive Summary

Introduction

SHAPE has been contracted by Golder Associados Moçambique Limitada (GAML) to conduct a Health Impact Assessment (HIA) for the Central Térmica De Temane project (CTT, or the Project) in Inhassoro District, Inhambane Province, Mozambique. The Project is being developed under a joint development agreement between Moz Power Invest, S.A. (MPI), a company to be incorporated under the laws of Mozambique and Sasol New Energy Holdings (Pty) Ltd (SNE). MPI's shareholding will be comprised of Electricidade de Moçambique, E.P (EDM) and Temane Energy Consortium (Pty) Ltd (TEC). The joint venture partners are collectively referred to as the proponents.

The HIA seeks to anticipate the potential direct, indirect and where relevant, cumulative impacts on community health by the proposed Project, prior to implementation, such that:

- Potentially significant adverse effects can be avoided or reasonably mitigated;
- Potentially beneficial impacts can be enhanced; and
- The probability for sustainable development is increased.

The HIA considers all the on-shore and near-shore elements of the Project and while presented as a prospective standalone assessment under this cover, it has considered information from specialist biophysical and social studies, and forms part of the broader Environmental and Social Impact Assessment (ESIA) assessment.

Project Description

The Project involves developing and operating a 450MW natural gas fired power plant, with gas fed from the existing Sasol Central Processing Facility (CPF) near Temane (via a 2 km long pipeline) and the generated power distributed via a transmission line (400 kV) to the proposed Vilanculos substation over a total length of 25 km. The Project will consist of a construction phase including beach landing of heavy equipment and materials near Inhassoro that will then be transported to site by large trucks.

A number of alternatives have been considered for the location of the CTT plant, with the preferred site approximately 500 m to the South of the Sasol Central Processing Facility (CPF), near Temane. The estimated footprint of the CTT power plant is approximately 20 ha.

Legal Framework and Health Impact Assessment Methodology

While there is no specific national legislation that requires a standalone HIA, the assessment substantially complies with specific Mozambican regulations (including those under MITADER) as well as proponents internal policies (where available) and good international industry practice as per the 2016 International Petroleum Industry Environmental Conservation Association (IPIECA) Good Practice Note on HIA and International Financial Institution requirements (and specifically International Finance Corporation [IFC] Performance Standard 4 that deals with community health, safety and security.

The methodology used in the HIA follows the reductionist approach based on the IPIECA Good Practice Note on HIA (2016) and the IFC Introduction to HIA (2009) utilising 12 Environmental Health Areas (EHAs) to ensure the process is systematic, as described in more detail in section 4.

Health Impact Assessment Activities

The activities performed as part of the HIA include a desk and field component:

- Desktop:
  - A review of the Project description and related Project documentation. This includes the terms of reference for the current ESIA
  - A review of baseline health information collected from the study area as part of the update of community health studies (June 2018)
  - A review of reports from other bio-physical and socio-economic studies.
  - Impact assessment and design of recommended mitigation measures.
- Fieldwork:
  - The field work performed as part of the updated community health baseline (June 2018).

Key Health Determinants, Impacts and Recommended Management Measures

Table A and **Table B** presents a dashboard summary (presented in the EHA framework) of the inherent and residual risks in construction and operations, respectively.

In construction the most significant inherent risks are related to the potential increase in the transmission of sexually transmitted infections (STIs) and the potential for accidents leading to injuries. A number of other moderate potential inherent impacts are noted, with the potential environmental health determinants that may have a cross cutting influence to human health ranked in separate specialist studies.

In operations, the potential impacts associated with the increased transmission of STIs and the potential for accidents and injuries remains the most significant risk. The operation of the power plant may bring about environmental health risks and the indirect influence of Project induced in-migration and changing economic factors lead to social challenges that may impact on human health.

While the EHA framework provides for an approach to systematically assess potential health impacts, the most important direct and indirect impacts are summarised in **Table C**, together with key management/ mitigation recommendations. The presence and operation of the CPF Project has a meaningful impact on potential community health impacts and these associated cumulative impacts are highlighted in below so that the importance of aligning/ integrating management measures between Projects is emphasised.

While no HIA or formal community health management and monitoring plan was developed for the CPF project (to the knowledge of the author), a number of construction and operational Environmental Management Plans (c-EMP and o-EMP) were developed to guide project activities. While these plans have not been reviewed they can serve as tools to guide mitigation measures based on successes and lessons learned. The inclusion of Contractor Management Requirements (CMRs) will be essential as there is the potential for many impacts to be caused from this sector of the workforce.

Following the impact assessment presented in this study, it is recommended to develop a community health information system to support monitoring of health impacts for the current Project, looking at process, structural and outcome indicators (this also forms part of the community health, safety and security plan).

Table A: Dashboard summary of inherent and residual health impacts in construction

Environmental Health Area		Before Management		After Management/Enhancement	
		Significance	***Direction***	***Significance***	***Direction***
EHA #1	Communicable diseases linked to the living environment	***Moderate***	**Negative**	***Low***	**Negative**
EHA #2	Vector related diseases	***Moderate***	**Negative**	***Low***	**Negative**
EHA #3	Soil, water and waste related diseases	***Moderate***	**Negative**	***Low***	**Negative**
EHA #4	Sexually transmitted infections including HIV/AIDS	***High***	**Negative**	***Low***	**Negative**
EHA #5	Food and nutrition	***Moderate***	**Negative**	***Low***	**Negative**
EHA #6	Non-communicable diseases	***Low***	**Negative**	***Low***	**Negative**
EHA #7	Accidents and Injuries	***High***	**Negative**	***Low***	**Negative**
EHA #8	Veterinary medicine and zoonotic diseases	***Low***	**Negative**	***Negligible***	**Negative**
EHA #9.1	Environmental health determinants: Air quality	**Not ranked in HIA**			
EHA #9.2	Environmental health determinants: Water quality and quantity	**Not ranked in HIA**			
EHA #9.3	Environmental health determinants: Noise and vibration	**Not ranked in HIA**			
EHA #9.4	Environmental health determinants: Hazardous chemical substances.	***Moderate***	**Negative**	***Low***	**Negative**
EHA #10.1	Social determinants of health: Local economic development and, employment	***Benefit***		***Benefit***	
EHA #10.2	Social determinants of health: Social harmony, inequalities and Project expectations	***Moderate***	**Negative**	***Benefit***	
EHA #11	Cultural health practices and health seeking behaviors	***Low***	**Negative**	***Low***	**Negative**
EHA #12	Health services and infrastructure	***Moderate***	**Negative**	***Low***	**Negative**

Table B: Dashboard summary of inherent and residual health impacts in operations

Environmental Health Area		Before Management		After Management/Enhancement	
		Significance	***Direction***	***Significance***	***Direction***
EHA #1	Communicable diseases linked to the living environment	***Low***	**Negative**	***Negligible***	**Negative**
EHA #2	Vector related diseases	***Low***	**Negative**	***Low***	**Negative**
EHA #3	Soil, water and waste related diseases	***Low***	**Negative**	***Low***	**Negative**
EHA #4	Sexually transmitted infections including HIV/AIDS	***Moderate***	**Negative**	***Low***	**Negative**
EHA #5	Food and nutrition	***Low***	**Negative**	***Low***	**Negative**
EHA #6	Non-communicable diseases	***Moderate***	**Negative**	***Low***	**Negative**
EHA #7	Accidents and Injuries	***Moderate***	**Negative**	***Low***	**Negative**
EHA #8	Veterinary medicine and zoonotic diseases	***Low***	**Negative**	***Low***	**Negative**
EHA #9.1	Environmental health determinants: Air quality	**Not ranked in HIA**			
EHA #9.2	Environmental health determinants: Water quality and quantity	**Not ranked in HIA**			
EHA #9.3	Environmental health determinants: Noise and vibration	**Not ranked in HIA**			
EHA #9.4	Environmental health determinants: Hazardous chemical substances.	***Moderate***	**Negative**	***Low***	**Negative**
EHA #10.1	Social determinants of health: Local economic development and, employment	***Benefit***		***Benefit***	
EHA #10.2	Social determinants of health: Social harmony, inequalities and Project expectations	***Moderate***	**Negative**	***Benefit***	
EHA #11	Cultural health practices and health seeking behaviors	***Low***	**Negative**	***Low***	**Negative**
EHA #12	Health services and infrastructure	***Low***	**Negative**	***Low***	**Negative**

Table C: Summary of key potential direct and indirect health impacts and proposed management measures

Potential direct impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures
Communicable disease transmission from incoming construction workforce	Incoming construction workforce has the potential to increase the risk for the transmission of communicable diseases, especially those associated with close contact via the respiratory route. This workplace risk has the potential to spread to the local community, with the weak health system increasing the public health risk for increased burdens of disease. Diseases may include tuberculosis, viral infections (such as seasonal influenza), as well as novel infections that may be circulating in other regions/parts of the world.	Limited cumulative risk as the focus is on in-coming construction workforce.	• Develop a communicable disease strategy and programme that includes employees, contractors and visitors to prevent local introduction and spread of disease. This is a primary workplace health intervention but extends to reduce risks of disease transmission in the community. This should include vaccine preventable and outbreak preparedness and response elements. • Fitness for work programmes to screen employees/contractors for communicable diseases. • Ensure adequate accommodation space is available in the construction camp to reduce the need for contractors to rent space in the local communities.
Increased risk of sexually transmitted diseases due to high risk sexual practices and behaviour of the workforce	This in-coming semi-skilled and skilled workforce has the potential to significantly impact on the increased local transmission of sexually transmitted infections (STI). The risks will be highest during the construction phase when the temporary construction workforce dominates. This male dominated mobile workforce are prone to develop casual sex relations with the local community and as they often have high rates of STIs there is an increased risk for transmission. Sexual encounters are often transactional in nature (male workforce has disposable income), targeting local girls and women who have limited ability to negotiate safe sex practices. Transport workers are a well-described high-risk group and are known to have multi sexual partners and to develop sexual networks along transport corridors. This may lead to localised increases of STIs along the EN1 transport corridor but also from the temporary beach offload area to the site. Both heavy vehicle and light duty drivers are a risk group.	Cumulative risk is high. Due to behaviours of the CPF workforce with similar challenges associated with single men who have disposable income and transport workers	• Extend the communicable disease strategy to include management of STIs and HIV. • Develop strict camp access controls and consider a total closed camp option. • Develop a code of conduct that restricts fraternization of the workforce with the community and internally amongst the workforce (especially towards local female employees). • Develop procedures to limit the development of a commercial sex trade, including at the lodge where an element of the workforce will stay in Inhassoro. • Develop a specific HIV and STI prevention programme for long distance truck drivers and other transport workers. • Support health systems strengthening activities of the public health sector including awareness and behaviour chance communication and care/treatment programmes. • Support social development initiatives for the empowerment of women and girls in the area to support livelihoods and reduce vulnerability of transactional sexual relationships. • Implement the GBV/SAE Action plan described in the CHSS Plan
Camp facilities management	A number of health risks can originate from the construction accommodation facility and spread to the community if certain safeguards are not anticipated and developed, including: • Overcrowding in accommodation areas may increase risks for transmission of communicable diseases (such as TB) - as per above. • Pollution of surface and ground water sources through ineffective management of waste-water and solid waste. • Creation of vector breeding sites through inadequate environmental controls with increased risk of malaria and arbo-viral disease. • Lack of entertainment facilities, codes of conduct and controlled access in camp leading to the development of casual or transactional sexual relations in camps or communities- as per above. • Potential to attract rodents and snakes to camps through poor waste management, with a potential risk for bites or zoonotic diseaseso.	Limited direct cumulative risk as restricted to Project camp facilities but workplace behaviours do overlap	• Effective camp facilities management at accommodation camps to prevent overcrowding etc. • Effective management of waste-water and solid waste from camps, offices and work areas to prevent pollution of soil and surface/groundwater. • As part of communicable diseases strategy develop a malaria and vector control programme. This should include source reduction through environmental controls, chemical vector controls, bite prevention and effective medical services. • Develop entertainment facilities and a small supply store onsite that limits the need for the community to enter the local communities. • Effective camp/site management and solid waste management, especially of food products to prevent attraction of rodents. Rodent controls in camps and workplace. • Snake handling (catch and release) capability • Limit domestic pets on site (dogs and cats) and as required support vaccination and sterilisation of animals.

Environmental manipulation and potential for pollution from Project activities	These are discussed in more detail in the respective biophysical specialist studies but can include potential impacts from:
	• Reduced air quality:
	  ○ Dust from constructions and from passing vehicles.
	  ○ Vehicle emissions.
	  ○ Plant activities.
	• Water quality and quantity:
	  ○ Draw down effects from boreholes used on the construction camp and for the plant potentially reducing the water table, and as result the quantity of water available for communities who mainly rely on ground-water sources.
	  ○ Potential pollution of surface and ground water sources due to spills or other Project activities.
	• Noise and vibration from construction activities, passing mobile equipment and on-going plant operations.
	• Numerous hazardous chemical substances.
		Potential for cumulative risk, depending on activities and location of sensitive receptors	• Recommended management and monitoring measures as proposed by relevant specialist studies.
			• Evaluate potential human health impacts from various determinants once specialist studies baseline and impact assessments are completed
			• Develop effective occupational hygiene programmes to manage workplace exposures, as these by extension will limit public exposure risks.
			• Hazardous chemical substance management programmes in alignment with local legislation and good international industry practice. This should include procedures to prevent the re-use of containers that may have contained hazardous substances in the community.
			• Develop effective source reduction and environmental controls to reduce vector breeding sites.

Potential direct impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures
	In addition to these alteration of the physical environment has the potential to increase the risks for vector related diseases, including: • Malaria risks due to the creation of potential breeding site where mosquitos can proliferate. • Arbo-viral conditions (such as dengue fever) due to the import of goods through the temporary beach landing site and areas (such as lay-down yards) where water can collect in man-made containers and provide a suitable habitat for these specific mosquitoes to breed and proliferate.		
Economic displacement	While this is still subject to an updated study, the potential loss of land or access to arable land and fishing grounds (for coastal communities) need to be considered as this is central in local livelihoods, food security and traditional values/sense of place.	Potential as CPF project also historically displaced people.	• Depending on the outcome of the resettlement and displacement studies that are on-going consider potential health impacts especially food security.
Community safety risks due to accidents with Project equipment	There is an increased potential for accidents impacting on community safety due to: • Accidents with Project mobile equipment including long distance trucks, light duty vehicles and earthmoving equipment etc. • Accidents with ships and barges used to off load goods	Cumulative due to road traffic risks.	• Develop community security and safety management plans, including emergency preparedness and response plans for both road traffic and maritime risks. • Develop and implement road safety campaigns. • Develop specific workplace health and safety standards and procedures for the management of Project mobile equipment and machinery, including specific requirements for driver training, fatigue management, vehicle roadworthiness, over-speeding, substance abuse etc.
Health system and services	The Project workforce will require medical services to support their general, occupational and emergency care requirements. As the public health system is weak and overstretched in the study area any increased demand will place pressure on the ability to deliver an acceptable quality service to the community.	Limited as CPF has its own medical service and a medical service in the Nhamacunda housing estate in Vilankulo.	• Develop an effective site based medical service to cater for the primary care, occupational health and emergency care needs of the workforce to limit the need to refer into the local public health system. This will need to include effective referral systems for routine and emergency cases. Evaluate opportunities to integrate with current CPF facilities to maximise use of resources (this may require some expansions or enhancements). • Evaluate opportunities for health systems strengthening in the public health sector.

Potential indirect impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures
Project induced in-migration	While cumulative in nature due to the existing activities, it is likely that the development of the Project will be an additional attractor due to its potential additional economic benefit and ability to provide potential jobs. This may lead to the introduction of communicable disease, deterioration in environmental health conditions increasing the potential for disease transmission, place pressure on limited available infrastructure and services (e.g. waste, housing and healthcare), and influence the emergence of social pathologies that can give rise to substance abuse and interpersonal violence.	Cumulative risk is high. While more likely to peak in construction impacts may persist into operations in a cumulative manner	• Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline to develop Project specific plans, or extend these plans to address potential cumulative impacts. • Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project to limit the attraction of job seeking migrants.
Local economic development and lifestyle related changes	Local economic development and change of lifestyles and eating habits may increase the potential for non- communicable diseases	Cumulative risk with other local economic developments	• Develop workplace wellness programmes and extend these to the family units. • Support specific health systems strengthening in association with the district health authorities (aligned with community health, safety and security plan).

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APPENDICES

Health Facility Assessment Service (Availability and Readiness Assessment (SARA) Tool)

ACRONYMS / ABBREVIATIONS

Acronym or Abbreviation	Full Term
ADI	Area Direct Influence
AII	Area Indirect Influence
APE (CHA)	Agent Polyvalent Communitaire (Community Health Agent)
AQIA	Air Quality Impact Assessment
CCGT	Combined Cycle Gas Turbine
c-EMP	Construction Environmental Management Plans
CHIS	Community Health Information System
CHMMP	Community Health Management and Monitoring Plan
CPF	Central Processing Facility
CMR	Contractor Management Requirement
CTT	Central Termica de Temane
CTRG	Central Térmica de Ressano Garcia
DHIS2	District Health Information System 2
EDM	Electricidade de Mozambique
EHA	Environmental Health Areas
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGD	Focus Group Discussion
HIA	Health Impact Assessment
HRA	Health Risk Assessment
HSS	Health Systems Strengthening
IFC	International Finance Corporation
IPIECA	International Petroleum Industry Environmental Conservation Association
KII	Key Informant Interviews
KPI	Key Performance Indicators
MDHS	Mozambique Demographic and Health Survey

Acronym or Abbreviation	Full Term
MITADER	Ministério da Terra, Ambiente e Desenvolvimento Rura (Ministry of Land, Environment and Rural Development)
NCDs	Non-Communicable Diseases
OCGE	Open Cycle Gas Engines
o-EMP	Operational Environmental Management Plans
OHSMP	Occupational Health and Safety Management Plan
PACs	Potentially Affected Communities
PIIM	Project Induced In-Migration
PPZ	Partial Protection Zone
STI	Sexually Transmitted Infection
WHO	World Health Organization

1.0 INTRODUCTION

The Mozambican economy is one of the fastest growing economies on the African continent with electricity demand increasing by approximately 6-8% annually. In order to address the growing electricity demand faced by Mozambique and to improve power quality, grid stability and flexibility in the system, Moz Power Invest, S.A. (MPI), a company to be incorporated under the laws of Mozambique and Sasol New Energy Holdings (Pty) Ltd (SNE) in a joint development agreement is proposing the construction and operation of a gas to power facility, known as the Central Térmica de Temane (CTT) project. MPI's shareholding will be comprised of EDM and Temane Energy Consortium (Pty) Ltd (TEC). The joint development partners of MPI and SNE will hereafter be referred to as the Proponent. The Proponent propose to develop the CTT, a 450 MW natural gas fired power plant.

The proposed CTT project will draw gas from the Sasol Exploration and Production International (SEPI) gas well field via the phase 1 development of the PSA License area, covering gas deposits in the Temane and Pande well fields in the Inhassoro District and the existing Central Processing Facility (CPF). Consequently, the CTT site is in close proximity to the CPF. The preferred location for the CTT is approximately 500 m south of the CPF. The CPF, and the proposed site of the CTT project, is located in the Temane/Mangugumete area, Inhassoro District, Inhambane Province, Mozambique; and approximately 40 km northwest of the town of Vilanculos. The Govuro River lies 8 km east of the proposed CTT site. The estimated footprint of the CTT power plant is approximately 20 ha (see Figure 1).

Associated infrastructure and facilities for the CTT project will include:

1) Electricity transmission line (400 kV) and servitude; from the proposed power plant to the proposed Vilanculos substation over a total length of 25 km running generally south to a future Vilanculos substation. [Note: the development of the substation falls outside the battery limits of the project scope as it is part of independent infrastructure authorised separately (although separately authorised, the transmission line will be covered by the Project ESMP, and the Vilanculos substation is covered under the Temane Transmission Project (TTP) Environmental and Social Management Plans. Environmental authorisation for this substation was obtained under the STE/CESUL project. (MICOA Ref: 75/MICOA/12 of 22nd May)];

2) Piped water from one or more borehole(s) located either on site at the power plant or from a borehole located on the eastern bank of the Govuro River (this option will require a water pipeline approximately 11km in length);

3) Access road; over a total length of 3 km, which will follow the proposed water pipeline to the northeast of the CTT to connect to the existing Temane CPF access road;

4) Gas pipeline and servitude; over a total length of 2 km, which will start from the CPF high pressure compressor and run south on the western side of the CPF to connect to the power plant;

5) Additional nominal widening of the servitude for vehicle turning points at points to be identified along these linear servitudes;

6) A construction camp and contractor laydown areas will be established adjacent to the CTT power plant footprint; and

7) Transhipment and barging of equipment to a temporary beach landing site and associated logistics camp and laydown area for the purposes of safe handling and delivery of large oversized and heavy equipment and infrastructure to build the CTT. The transhipment consists of a vessel anchoring for only approximately 1-2 weeks with periods of up to 3-4 months between shipments over a maximum 15-month period early in the construction phase, in order to offload heavy materials to a barge for beach landing. There are 3 beach landing site options, namely SETA, Maritima and Briza Mar (Figure 7). The SETA site is considered to be

the preferred beach landing site for environmental and other reasons; it therefore shall be selected unless it is found to be not feasible for any reason;

8) Temporary bridges and access roads or upgrading and reinforcement of existing bridges and roads across sections of the Govuro River where existing bridges are not able to bear the weight of the equipment loads that need to be transported from the beach landing site to the CTT site. Some new sections of road may need to be developed where existing roads are inaccessible or inadequate to allow for the safe transport of equipment to the CTT site. The northern transport route via R241 and EN1 is considered as the preferred transport route (Figure 8) on terrestrial impacts; however, until the final anchor point is selected, and the barge route confirmed, the marine factors may still have an impact on which is deemed the overall preferable route.

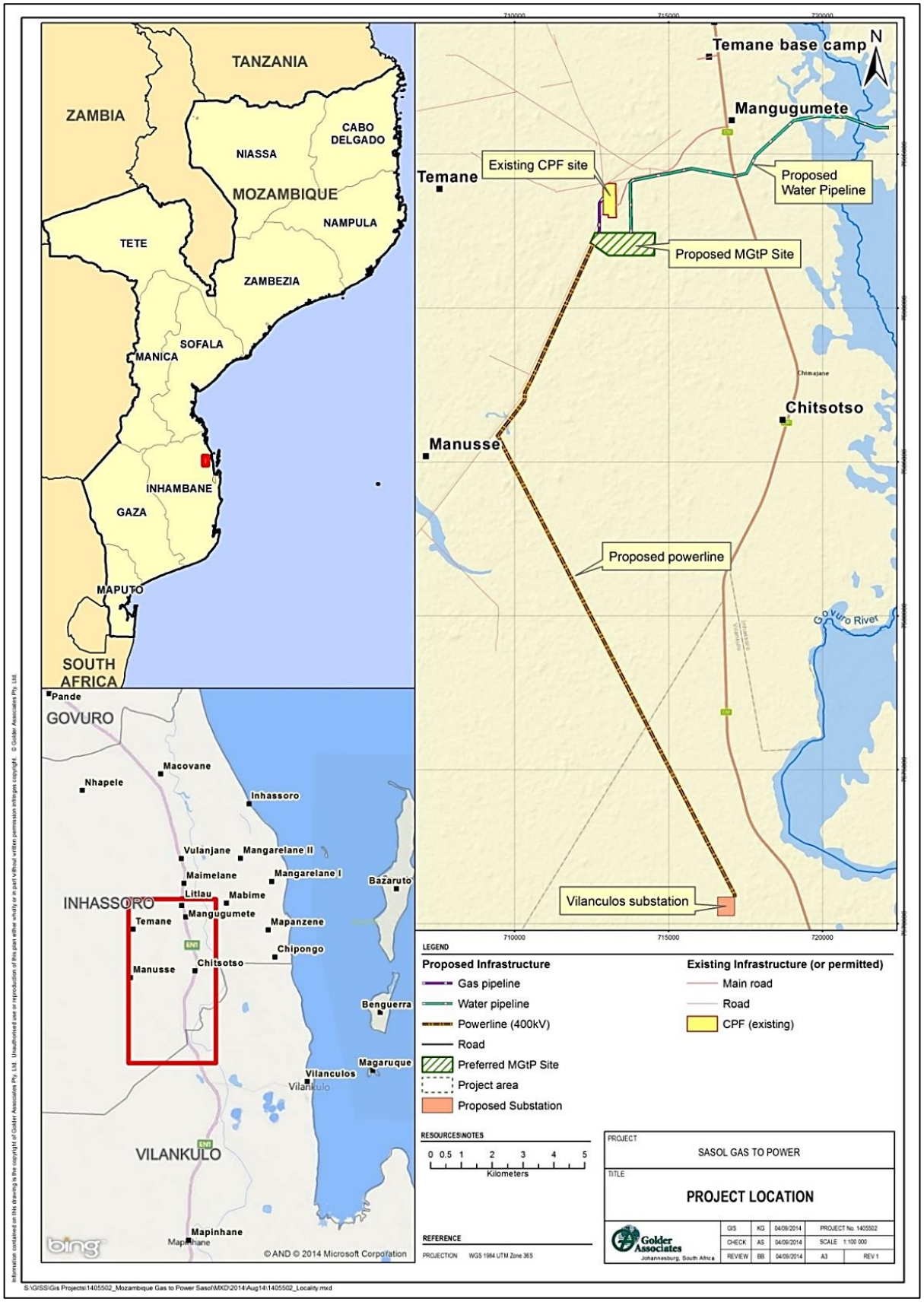

Figure 1: Project location

2.0 DESCRIPTION OF THE KEY PROJECT COMPONENTS

The CTT project will produce electricity from natural gas in a power plant located 500 m south of the CPF. The project will consist of the construction and operation of the following main components:

- Gas to Power Plant with generation capacity of 450MW;
- Gas pipeline (±1.2 km) that will feed the Power Plant with natural gas from the CPF or from an alternative gas source;
- 400kV Electrical transmission line (± 25 km) with a servitude that will include a fire break (vegetation control) and a maintenance road to the Vilanculos sub-station. The transmission line will have a partial protection zone (PPZ) of 100 m width. The transmission line servitude will fall inside the PPZ;
- Water supply pipeline to a borehole located either on site or at borehole located east of the Govuro River;
- Surfaced access road to the CTT site and gravel maintenance roads within the transmission line and pipeline servitudes;
- Temporary beach landing structures at Inhassoro for the purposes of delivery of equipment and infrastructure to build the power plant. This will include transhipment and barging activities to bring equipment to the beach landing site for approximately 1-2 weeks with up to 3-4 months between shipments over a period of approximately 8-15 months;
- Construction camp and contractor laydown areas adjacent to the CTT power plant site; and
- Temporary bridge structures across Govuro River and tributaries, as well possible new roads and/or road upgrades to allow equipment to be safely transported to site during construction.

Figure 2: Examples of gas to power plant sites (source: www.industcards.com and www.wartsila.com)

The final selection of technology that will form part of the power generation component of the CTT project has not been determined at this stage. The two power generation technology options that are currently being evaluated are:

- Combined Cycle Gas Turbine (CCGT); and
- Open Cycle Gas Engines (OCGE).

Please refer to Chapter 5 of the main ESIA document for further details on the technology option.

At this early stage in the project a provisional layout of infrastructure footprints, including the proposed linear alignments is indicated in Figure 1. A conceptual layout of the CTT plant site is shown below in Figure 3.

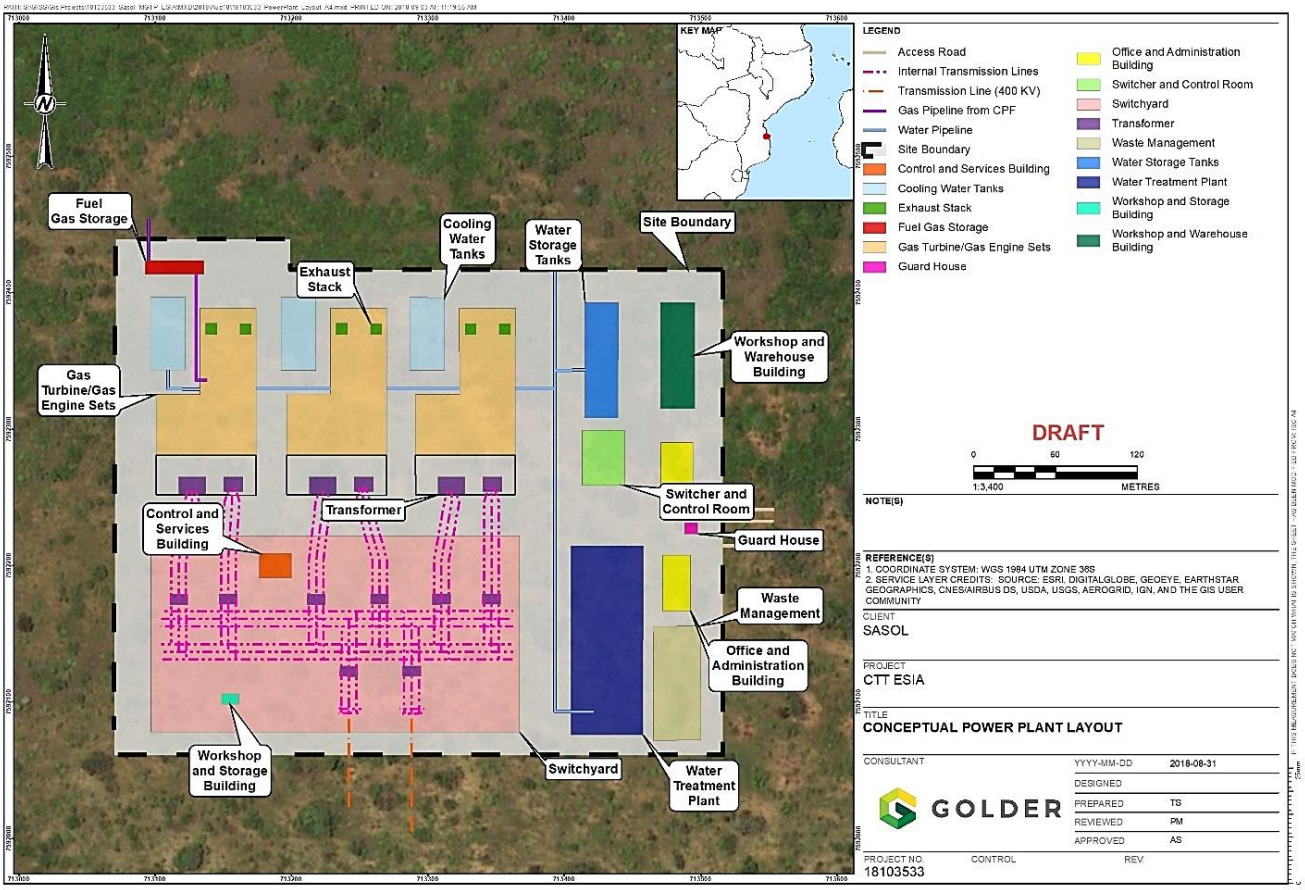

Figure 3: Conceptual layout of CTT plant site

2.1 Ancillary Infrastructure

The CTT project will also include the following infrastructure:

- Maintenance facilities, admin building and other buildings;
- Telecommunications and security;
- Waste (solid and effluent) treatment and/or handling and disposal by third party;
- Site preparation, civil works and infrastructure development for the complete plant;
- Construction camp (including housing/accommodation for construction workers); and
- Beach landing laydown area and logistics camp.

The heavy equipment and pre-fabricated components of the power plant will be brought in by ship and transferred by barge and landed on the beach near Inhassoro. The equipment and components will be brought to site by special heavy vehicles capable of handling abnormally heavy and large dimension loads. Figure 4, Figure 5 and Figure 6 show examples of the activities involved with a temporary beach landing site, offloading and transporting of large heavy equipment by road to site.

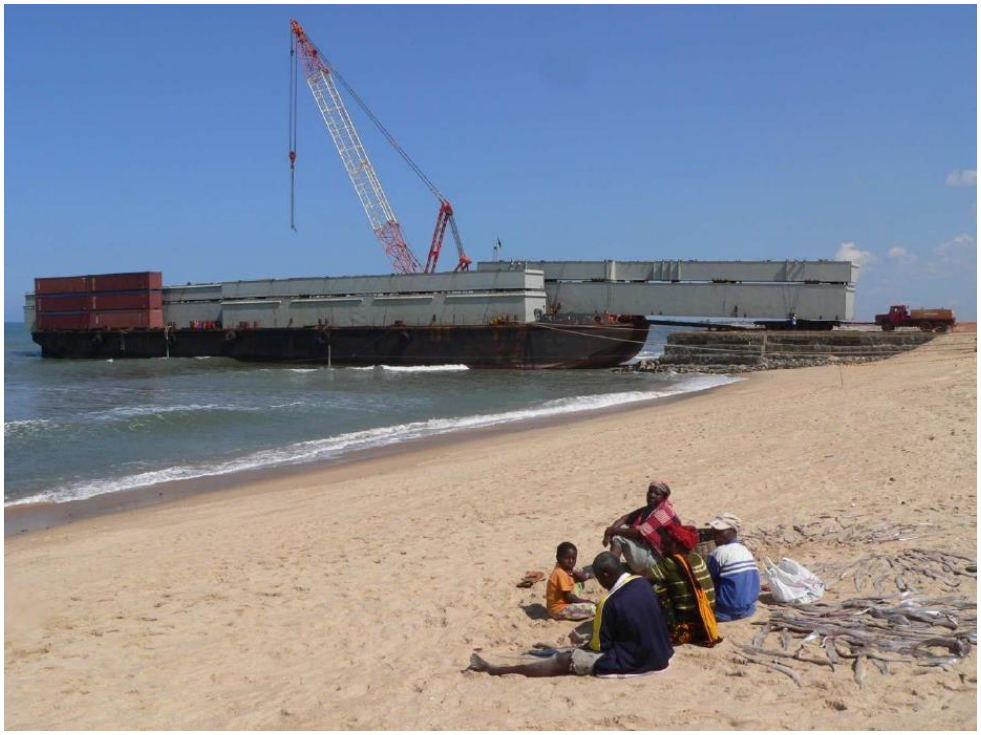

Figure 4: Typical beach landing site with barge offloading heavy equipment (source: Comarco)

Figure 5: Example of large equipment being offloaded from a barge. Note the levels of the ramp, the barge and the jetty (source: SUBTECH)

Figure 6: Heavy haulage truck with 16-axle hydraulic trailer transporting a 360 ton generator (source: ALE)

2.2 Water and electricity consumption

The type, origin and quantity of water and energy consumption are still to be determined based on the selected technology to construct and operate the CTT plant. At this stage it is known that water will be sourced from existing boreholes located on site or east of the Govuro River for either of the technology options below:

- Gas Engine: ± 12 m^3/day; or
- Gas Turbine (Dry-Cooling): ± 120 – 240 m^3/day.

2.3 Temporary Beach Landing Site and Transportation Route Alternative

As part of the CTT construction phase, it was considered that large heavy equipment and materials would need to be brought in by a ship which would remain anchored at sea off the coast of Inhassoro. Equipment and materials would be transferred to a barge capable of moving on the high tide into very shallow water adjacent to the beach to discharge its cargo onto a temporary off-loading jetty (typically containers filled with sand) near the town of Inhassoro. As the tide changes, the barge rests on the beach and off-loading of the equipment commences.

Currently, the SETA beach landing site is the preferred beach landing site together with the road route option to be used in transporting equipment and materials along the R241 then the EN1 then via the existing CPF access road to the CTT site near the CPF. Figure 7 and Figure 8 indicate the beach landing site and route transportation option. The alternative beach landing sites of Maritima and Briza Mar are still being evaluated as potential options, as well as the southern transport route, which would also require road upgrades and a temporary bridge construction across the Govuro at the position of the existing pipe bridge. As part of the transportation route, the Grovuro River bridge may need to be upgraded / strengthened to accommodate the abnormal vehicle loads. Alternatively, a temporary bypass bridge will be constructed adjacent to the existing bridge.

Figure 7: The three beach landing site options and route options at Inhassoro

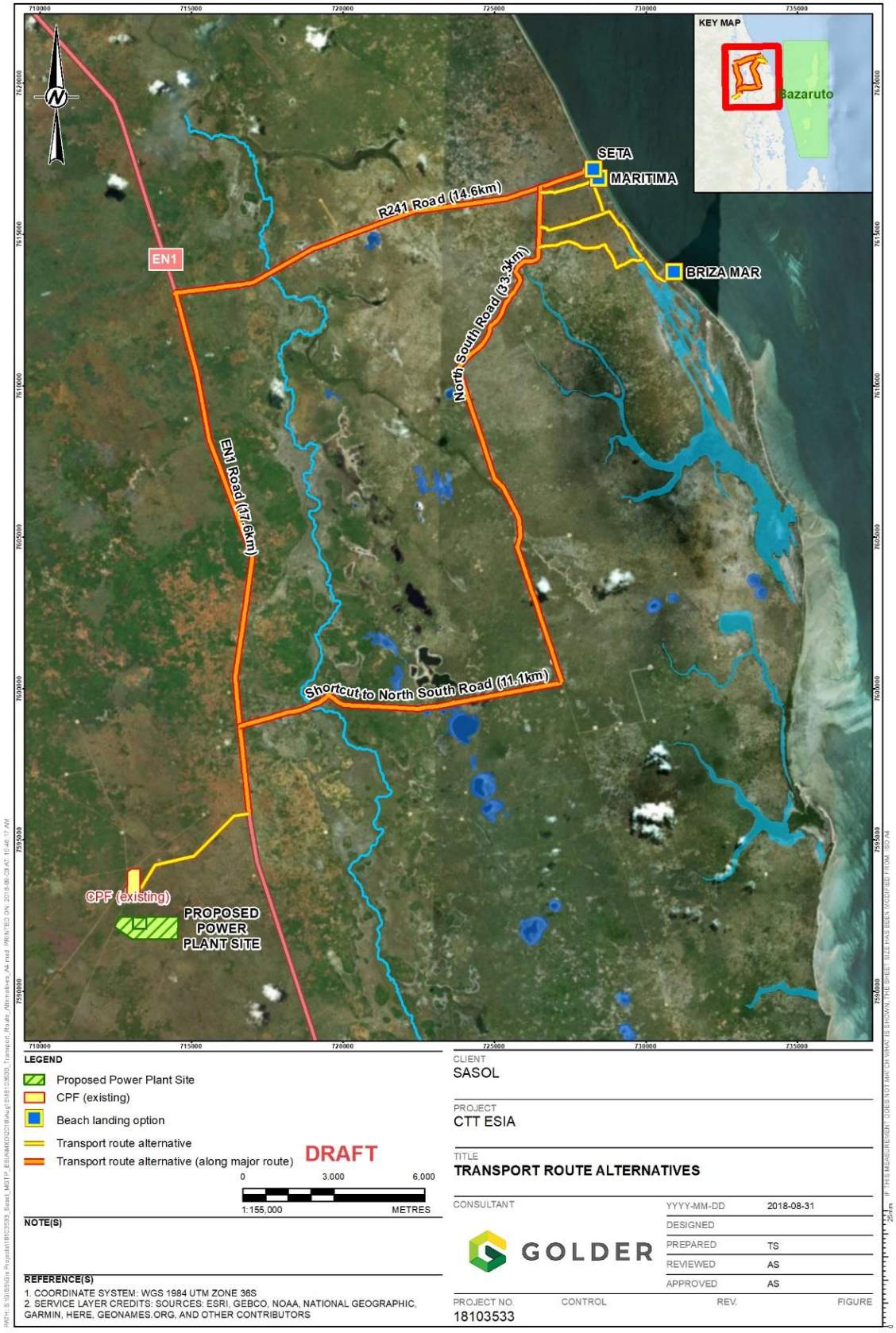

Figure 8: The two main transportation route alternatives from the beach landing sites to the CTT site

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The proposed project has been determined as 'Category A' in terms of Mozambique's environmental law (Decree No. 54/2015 of 31 December, which has been in force since April 2016). For 'Category A' projects, an Environmental and Social Impact Assessment (ESIA) must be prepared by independent consultants as a basis for whether or not environmental authorisation of the project is to be granted, and if so, under what conditions. The final decision maker is the Ministry of Land, Environment and Rural Development (Ministério da Terra, Ambiente e Desenvolvimento Rural (MITADER) through the National Directorate of Environmental Impact Assessment (DNAIA). MITADER consults with other relevant government departments prior to making a decision.

This document represents the Health Impact Assessment (HIA) undertaken to support the ESIA, with a detailed outline of the applicable Mozambican legislation and regulations, international financing institution best practice guidelines, industry guidelines as well as the Proponent corporate standards outlined in the main ESIA report. Elements relevant to community health are highlighted briefly in the following section.

3.1 National Legislation and Regulations

There is no specific reference in Mozambique legislation that requires a HIA to be performed as part of project permitting. There are some references to the safe-guarding and protection of public/human health, but these are not supported by specific references to the required approach or methods. The following laws, regulations and strategies have reference to community and public health:

- General laws:
  - Mozambique's 2004 Constitution;
  - The Labour Law (Law 23/07 of 1 August 2007), with articles 216 through 236 outlining occupational health and safety requirements;
  - Law on Local State Administration no 8/2003 and Decree no 15/2000 on Local Authorities, which both expand on the level of control and responsibility to local authorities for development and decentralization; and
  - Guidelines on Safety and Health in the Workplace. Ministry of Health (December 2008).
- Environmental and mineral resources laws:
  - The Environmental Law n.º 20/97, of 1 of October 1997;
  - The Environmental Impact Assessment Regulation, approved by Decree n.º 54/2015, that updates the decree n.º 45/2004. This updated decree was enacted on the 1st of April 2016;
  - The Environmental Regulations for Petroleum Operations is set out in Decree n.º 56/2010, of 22 November;
  - Regulation to Prevent Pollution and Protect Marine and Coastal Environment, approved by Decree n.º 45/2006, of 30 of November;
  - The Land Law (Law n.º 19/97, of 1 of October);
  - The Land Planning Law (Law n.º 19/2007 of 18 of July) and its regulations;
  - Mine (14/2002) and Oil (3/2001) Laws;
  - The National Water Law (1991); and

- Pesticides Regulation (n.º 153/2002, of 11 of September).

- Specific Health and Community Related Policies and Legislation:
  - Regulation on Environmental Quality and Waste Emission (Decree n.º 18/2004 of 2 of June);
  - Pesticides Regulation (Ministerial Diploma n.º 153/2002, of 11 of September);
  - Regulation on Medical Waste Management (Decree 8/2003, of 18 of February);
  - Housing Policy;
  - Occupational health and safety management;
  - National Water Law in 1991 and the National Water Policy from 1995 (plus updates from 2007); and
  - Law on HIV/AIDS (SIDA). Law 5 of 2002.

- General strategies:
  - The 2014 Corporate Social Responsibility Policy for the Mineral Resources Extractive Industry (which includes the oil and gas sector). This focusses on poverty reduction and the framework aims to support the development of realistic and practical programmes that align to government and corporate development plans- based on good international industry practice.
  - Poverty Reduction Action Plan 2011-2014. This strategy places emphasis on the need for economic growth as a means to reducing poverty.
  - The Mozambique Health Sector Strategic Plan (PESS) 2014-2019 (1).

3.2 International Management Standards and Regulations

3.2.1 Conventions and Regulations

Mozambique is a signatory to various international conventions that can provide direction in the absence or limitation of local legislation or policy, with those relevant to health including:

- The International Labour Organization Conventions of which Mozambique is a member and a signatory to the following conventions:
  - Hours of Work (Industry) Convention, 1919
  - Right of Association (Agriculture) Convention, 1921
  - Weekly Rest (Industry) Convention, 1921
  - Workmen's Compensation (Accidents) Convention, 1925
  - Workmen's Compensation (Occupational Diseases) Convention, 1925
  - Forced Labour Convention, 1930
  - Hours of Work (Commerce and Offices) Convention, 1930
  - Labour Inspection Convention, 1947
  - Freedom of Association and Protection of the Right to Organize Convention, 1948
  - Employment Service Convention, 1948

  - Right to Organize and Collective Bargaining Convention, 1949
  - Equal Remuneration Convention, 1951
  - Abolition of Forced Labour Convention, 1957
  - Discrimination (Employment and Occupation) Convention, 1958
  - Employment Policy Convention, 1964
  - Minimum Age Convention, 1973
  - Tripartite Consultation (International Labour Standards) Convention, 1976
  - Worst Forms of Child Labour Convention, 1999
- International Health Regulations as promulgated by the World Health Organization.
- United Nations partner programs such as the Sustainable Development Goals.
- The United Nations Declaration on Rights of the Indigenous Peoples.
- Stockholm Convention on Persistent Organic Pollutants (Resolution No. 19/96 of November 26, 1996).
- United Nations Framework Convention on Climate Change (Resolution No. 1/94 of August 24, 1994).
- Kyoto Protocol (Resolution No. 10/2004 of 28 July).
- Cartagena Protocol on Biosafety (Resolution No. 11/2001 of 20 December).
- Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and Their Disposal (Resolution 18/96 to November 26, 1996);
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Resolution 10/2009 of 29 September.

3.2.2 Development Financing Institution Guidelines

There are a number of international guidelines or good international industry practice guidelines that support an approach to evaluating community health impacts linked to industrial development projects. The 2012 version of the International Finance Corporation (IFC) Performance Standard on Environmental and Social Sustainability and specifically Performance Standard 4 (four) is followed in this assessment[1] (2, 3). This well-established methodology forms the default guidance for a number of multilateral financial institutions and industry trade associations, and generally represents the default standard used to support the Equator Principles for Financing Institutions.

In 2009, the IFC developed an “Introduction to Health Impact Assessments” Good Practice Note and toolkit on HIA to support Performance Standard 4. The guidance follows a reductionist approach to HIA and has been used as the preferred approach for this assessment (4). This methodology is referenced on the World Health Organization (WHO) site as a valid approach. In addition, industry guidelines have been used to guide the assessment with the 2016 International Petroleum Industry Environmental Conservation Association (IPIECA) Good Practice Note on Health Impact Assessment used as the benchmark standard for oil and gas projects (5).

[1] The client will evaluate the risks and impacts to the health and safety of the affected communities during the project life-cycle and will establish preventive and control measures consistent with good international industry practice as in the World Bank Group Environmental, Health and Safety Guidelines or other internationally recognized sources. The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. These measures will favor the avoidance of risks and impacts over minimization.

This approach is substantially similar to the IFC guideline following a reductionist method that considers a number of Environmental Health Areas (EHAs) based on past World Bank approaches.

The IFC and World Bank Group have developed guidelines with respect to environment, occupational/ community health and safety, as well as industry sector guidelines including infrastructure with specific guidance on gas distribution systems and electrical power transmission and distribution and onshore oil and gas developments. These guidelines include a range of factors, some of which overlap to human health (6).

A detailed methodology and approach of the HIA is described in Section 4.

3.2.3 Company Management Standards

The CTT Project company has not yet been formed and therefore does not yet have Project specific guidelines or company management standards to support the assessment of community health risks or impacts. While Globeleq, EleQtra and Sasol (Joint Development partners) have relevant company standards, the IPIECA and IFC standards have been used as good international industry practice.

4.0 HEALTH IMPACT ASSESSMENT FRAMEWORK AND METHODOLOGY

4.1 Introduction and Definitions

A HIA seeks to identify and estimate the lasting or significant changes of different actions on the health status of a defined population. HIA may be defined as “a combination of procedures, methods and tools by which a project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population”. The HIA identifies appropriate actions to manage those (8, 9). Thus, HIA has an important role as a key decision-making tool in development planning at the project level.

The WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. This is influenced by a complex interaction of social, economic, genetic, and environmental factors (10) and follows a social model of health. A reductionist approach is used to consider all these factors as described in Section 4.2 (7, 9).

HIA assists extractive industry projects by understanding the existing health needs of the community and considering the consequences of different project processes and activities, and how these may influence community health as a decision-making tool. These consequences will be formulated into a Community Health Management and Monitoring Plan (CHMMP) so that the negative health effects are avoided or mitigated, and potential positive effects are enhanced.

HIA is generally a participative process and inputs of various stakeholders are sought throughout. The process allows the views of different groups, including vulnerable ones, to be considered and to ensure that the proposed CHMMP is respectful of local cultures, perceptions and requirements.

4.2 Health Impact Assessment Methodology

4.2.1 Workplace and Community Health

At the outset, it is important that a distinction is made between HIA and Health Risk Assessment (HRA). An HRA is concerned with the identification of hazards and exposure risks to the workforce which relate to occupational health and safety/ engineering design. Generally, HRA is “within the fence” while HIA is “outside the fence”, but there are distinct overlaps with HIA often taking a central position as workplace activities can affect community health and existing community health needs or disease burdens can affect workplace health.

So, while workplace (occupational) health is specifically out of scope for this assessment, the HIA will evaluate commonalities where workplace activities may impact on community health, and where management measures within the workplace can mitigate or enhance community health.

4.2.2 Form and Nature of Health Impact Assessment

Figure 9 outlines the six-phase framework in the HIA process, with the final output a 'fit for purpose' and evidence based CHMMP that can be integrated into the Project's Environmental and Social Management Plan (ESMP). Monitoring and evaluation of project impact management/mitigation plans allow for a continuous risk assessment and re-evaluation of health impacts and the success of management measures.

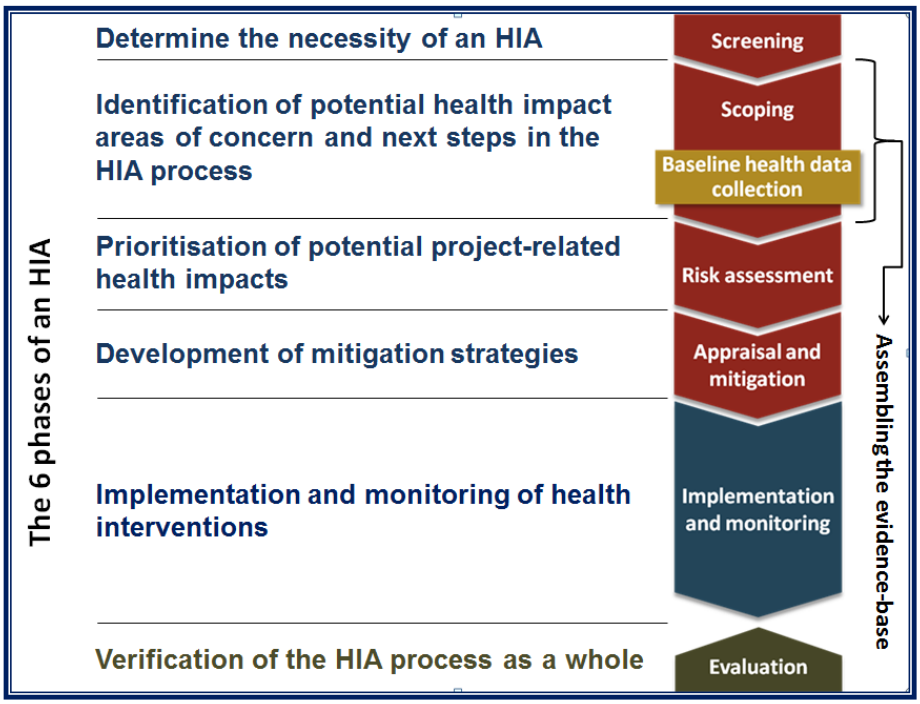

Figure 9: HIA flow chart

HIAs are generally divided into three main levels as described in Table 1. These levels are generally determined at scoping by considering the phase of the project and following three variables (11), viz. (i) the range and magnitude of potential health impacts; (ii) the social sensitivity of the Potentially Affected Communities (PACs); and (iii) the definition of the project and its areas of influence (project footprint), which can include direct actions and activities as well indirect actions that may follow irrespective if they are the direct consequence or responsibility of the project.

The form of the current HIA follows a hybrid approach, with the 2013 assessment adopting a comprehensive level, and the updated regional HIA a rapid appraisal approach.

Table 1: Levels of HIA

Level of HIA	Characteristics
Desktop/Scoping HIA	• Provides a broad overview of possible health impacts. • Analysis of existing and accessible data. • No new Project specific survey data collection.
Rapid Appraisal HIA	• Provides more detailed information of possible health impacts. • Analysis of existing data. • Stakeholder and key informant analysis. • No new Project specific quantitative data collection at household or community level.

Level of HIA	Characteristics
Comprehensive HIA	• Provides a comprehensive assessment of potential health impacts. • Robust definition of impacts. • New Project specific survey data collection including specific quantitative data collection at household or community level (generally requires bioethical clearance). • Participatory approaches involving key stakeholders.

4.2.3 Environmental Health Areas

The IFC methodology uses 12 EHAs as summarized in Figure 10 to support the systematic analysis of health considerations based on the reductionist approach described earlier (10).

	Environmental Health Areas (EHAs)
1.	**Communicable diseases linked to the Living Environment**– Transmission of communicable diseases (e.g. acute respiratory infections, pneumonia, tuberculosis (TB), meningitis, plague, leprosy, etc.) that can be linked to inadequate housing design, overcrowding and housing inflation. It also considers indoor air pollution related to use of biomass fuels.
2.	**Vector-related diseases** – Mosquito, fly, tick and lice-related diseases (e.g. malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, human African trypanosomiasis, onchocerciasis, etc.)
3.	**Soil-, water- and waste-related diseases** – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases, etc.)
4.	**Sexually-transmitted infections, including HIV/AIDS –** Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and, most importantly, HIV/AIDS. Linkages of TB will be discussed where relevant under HIV, but often linked to EHA1.
5.	**Food- and nutrition-related issues** – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g. changes in agricultural and subsistence practices, or food inflation; gastroenteritis, food-borne trematodiases, etc. This will also consider feeding behaviours and practices. Access to land plays a major role in developing subsistence farming contexts
6.	**Non-communicable diseases** – Cardiovascular diseases, cancer, diabetes, obesity, etc.
7.	**Accidents/injuries** – Road traffic or work-related accidents and injuries (home and project related); drowning
8.	**Veterinary medicine and zoonotic diseases** – Diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.)
9.	**Exposure to potentially hazardous materials, noise and malodours** – This considers the environmental health determinants linked to the project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impacts will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvents or spills and releases from road traffic and exposure to mal-odours. There is a significant overlap in the environmental impact assessment in this section. Ionizing radiation also falls into this category.
10.	**Social determinants of health** – Including psychosocial stress (due to e.g. resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, gender based domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning,. There is a significant overlap in the social impact assessment in this section.
11.	**Health seeking behaviours and cultural health practices** – Role of traditional medical providers, indigenous medicines, and unique cultural health practices
12.	**Health systems issues** – Physical health infrastructure (e.g. capacity, equipment, staffing levels and competencies, future development plans); program management delivery systems (e.g., malaria-, TB-, HIV/AIDS-initiatives, maternal and child health, etc.)

Figure 10: IFC methodology uses 12 EHAs

The set of EHAs provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporate a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of an HIA focusing primarily on disease-specific considerations. While every EHA may not be relevant to a given project, it is still important to systematically analyse the potential for project-related impacts (positive, negative or neutral) across the various EHAs.

4.2.4 Community Profiling

To identify and quantify potential health impacts an accurate population profile is required and it is important to distinguish between differences in exposure and susceptibility (the presence of a hazard and potential for exposure). Thus, besides a demographic profile of the at-risk population and the identification of the most vulnerable groups, it is crucial to understand how project activities are likely to impact at an individual, household and community level.

As part of the analysis, the relevant overall population is stratified into PACs. Findings of social and economic assessments, resettlement plan and influx management plan need to be considered as this allows linkage between the PACs and key demographic determinants such as age structure and population numbers.

Mitigation strategies also require specific considerations for the different PACs so that these effectively target susceptible or vulnerable communities and allow for the development of mitigation measures specific to anticipated health impacts.

4.2.5 Risk Assessment and Impact Categorization

This process analyses, models and ranks the potential impacts associated with the Project and their potential influence on PACs through the different life cycle stages of the Project. It includes the analysis of potential negative impacts and their management measures, but also the discussion of potential positive impacts and measures to enhance these. This is based on the evidence presented in the baseline health description, the project activities and information obtained from the ESIA process and other specialist reports/studies which are available.

A standardized risk assessment model was followed for the modelling of impacts and includes:

- Identification of health-related issues where project activities may impact on a variety of receptors. This generally includes a description of prevailing community health vulnerabilities based on baseline data or evidence.
- A prediction of what may happen to the PACs and environment as a result of the direct and indirect activities of a project- the impact definition/assessment. The precautionary principle (Principle 15 from the Rio Declaration on Environment and Development in 1992) was adopted in analysing and modelling the impact definition[2] (14, 15).
- The impact evaluation which considers the significance of the health impacts based on a consequence and likelihood modelling. This initial inherent ranking considers the risks at baseline (no-go situation/ present health status of communities, or the existing health needs) and the project related impacts without mitigation; and the residual risks consider the significance of risks after the successful implementation of mitigation measures.

Potential impacts are assessed according to the direction, intensity (or severity), duration, extent and probability of occurrence of the impact. These criteria are discussed in more detail below:

Direction of an impact may be positive, neutral or negative with respect to the particular impact. A positive impact is one which is considered to represent an improvement on the baseline or introduces a positive change.

[2] If an action or policy has a suspected risk of causing harm to the public or to the environment, and in the absence of reliable evidence that the action or policy is harmful, then the burden of proof that it is *not* harmful falls on those taking the action. In addition, when an activity raises threats of harm to human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

A negative impact is an impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.

Intensity / Severity is a measure of the degree of change in a measurement or analysis (e.g. the concentration of a metal in water compared to the water quality guideline value for the metal), and is classified as none, negligible, low, moderate or high. The categorisation of the impact intensity may be based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment). The specialist study must attempt to quantify the intensity and outline the rationale used. Appropriate, widely-recognised standards are used as a measure of the level of impact.

Duration refers to the length of time over which an environmental impact may occur: i.e. transient (less than 1 year), short-term (1 to 5 years), medium term (6 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the project) or permanent.

Scale/Geographic extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international. The reference is not only to physical extent but may include extent in a more abstract sense, such as an impact with regional policy implications which occurs at local level.

Probability of occurrence is a description of the probability of the impact actually occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40 % to 60 % chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

Impact significance will be rated using the scoring system shown in Table 2 below. The significance of impacts is assessed for the two main phases of the project: i) construction ii) operations. While a somewhat subjective term, it is generally accepted that significance is a function of the magnitude of the impact and the likelihood (probability) of the impact occurring. Impact magnitude is a function of the extent, duration and severity of the impact, as shown in Table 2.

Table 2: Scoring system

Severity	Duration	Extent	Probability
10 (Very high/don't know)	5 (Permanent)	5 (International)	5 (Definite/don't know)
8 (High)	4 (Long-term – longer than 15 years and impact ceases after closure of activity)	4 (National)	4 (Highly probable)
6 (Moderate)	3 (Medium-term- 6 to 15 years)	3 (Regional)	3 (Medium probability)
4 (Low)	2 (Short-term - 1 to 5 years)	2 (Local)	2 (Low probability)
2 (Minor)	1 (Transient – less than 1 year)	1 (Site)	1 (Improbable)
1 (None)			0 (None)

After ranking these criteria for each impact, a significance rating was calculated using the following formula:

- **SP (significance points) = (severity + duration + extent) x probability.**

The maximum value is 100 significance points (SP). The potential environmental impacts were then rated as of High (SP >75), Moderate (SP 46 – 75), Low (SP ≤15 - 45) or Negligible (SP < 15) significance, both with and without mitigation measures in accordance with Table 3.

Table 3: Impact significance rating

Value	Significance	Comment
SP >75	Indicates **high** environmental significance	Where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts of high significance would typically influence the decision to proceed with the project.
SP 46 - 75	Indicates **moderate** environmental significance	Where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. Such an impact is unlikely to have an influence on the decision. Impacts may justify significant modification of the project design or alternative mitigation.
SP 15 - 45	Indicates **low** environmental significance	Where an effect will be experienced, but the impact magnitude is small and is within accepted standards, and/or the receptor is of low sensitivity/value or the probability of impact is extremely low. Such an impact is unlikely to have an influence on the decision although impact should still be reduced as low as possible, particularly when approaching moderate significance.
SP < 15	Indicates **negligible** environmental significance	Where a resource or receptor will not be affected in any material way by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels. No mitigation is required.
+	**Positive impact**	Where positive consequences / effects are likely.

In addition to the above rating criteria, the terminology used in this assessment to describe impacts arising from the current project are outlined in Table 4 below. In order to fully examine the potential changes that the project might produce, the study area can be divided into Areas of Direct Influence (ADI) and Areas of Indirect Influence (AII).

- Direct impacts are defined as changes that are caused by activities related to the project and they occur at the same time and place where the activities are carried out i.e. within the ADI.
- Indirect impacts are those changes that are caused by project-related activities but are felt later in time and outside the ADI. The secondary indirect impacts are those which are as a result of activities outside of the ADI.

Table 4: Types of impact

Term for Impact Nature	Definition
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors or a specific cause-and-effect relationship (i.e. between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (i.e., pollution of water placing a demand on additional water resources). It may also be described as a secondary by-product of an interaction among multiple variables and may be a consequence of a direct effect.
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned activities) to affect the same resources and/or receptors as the Project. For the purpose of this HIA, cumulative impacts are considered to be generated by multiple causes and pathways and may arise on a human receptor at any scale (13).

4.2.6 Management and Mitigation

4.2.6.1 Impact Evaluation and Mitigation

Mitigation refers to measures that avoid, minimize, eliminate an adverse effect, or maximize a potential benefit. Mitigation should be reviewed and adjusted on an on-going basis as per the *plan, do, check, act* (or similar) management cycle.

Recommendations for mitigation/management will focus on identification of measures that can be taken to reduce potential impacts to as low as reasonably practicable (ALARP) both from a technical and financial perspective. These are generally presented based on a hierarchy of controls with avoidance as the priority where possible, as presented in the following (in order of importance) list:

- Avoid at source – remove the source of the impact;
- Abate at source – reduce the source of the impact;
- Attenuate – reduce the impact between the source and the receptor;
- Abate at the receptor – reduce the impact at the receptor;
- Remedy – repair the damage after it has occurred; and
- Compensate – replace a lost or damaged resource with a similar or a different resource of equal value.

For the purposes of the Project, mitigation measures have been divided into three categories based on the focus of the intervention, namely:

- **Project impact mitigation:** Interventions required in order to mitigate the future health impacts of the Project on PACs. Due to their influence, these mitigation measures are deemed as required (may be regulatory requirements) and not merely voluntary contributions, and thus the precautionary principle will apply where relevant.
- **Occupational health, safety and environmental management:** Interventions aimed at ensuring a healthy, safe and productive workforce. In addition, it considers aspects that can be controlled in the workforce to prevent community health impacts occurring from a health, safety and environmental perspective.
- **Social development mitigation and management:** Interventions suggested that will improve the existing health status of the communities. These can be in the form of negotiated commitments made by the project proponents as well as extended benefits, which should bring about health benefits and improve social license to operate in the receptive communities.

The current HIA will have limited focus on these strategic community investments as it is anticipated that these will be developed as part of the social investment strategy, which sits out of the scope of the current HIA. It is however noted that there is often an overlap between required mitigation measures and extended benefits which are generally based on negotiated commitments to maximize potential health benefits in the affected communities.

The management and mitigation measures proposed in the impact assessment will form part of the framework CHMMP which will form the final commitments to be included in the ESMP.

4.2.7 Community Health Management Plan

The impact evaluation will determine priorities for health impact management based on the significance of the ranking and the residual impacts. Thus, impacts with higher significance can be prioritized for intervention ahead of the less significant impacts.

This will allow the development of short and medium term CHMMP which can be presented to stakeholders and developed for planned implementation of health programs; with assigned accountabilities.

The CHMMP will have a monitoring element to ensure that the associated mitigation measures and interventions are meeting the desired objectives. This surveillance should consider monitoring of impacts as well as any health management interventions. Any monitoring system should have sufficiently sensitive and specific Key Performance Indicators (KPIs) for each intervention so that changes in key objective endpoints can be documented in an appropriate and timely manner.

4.2.8 Stakeholder Consultation

Stakeholder engagement and consultation is a crucial element of the HIA process. Project stakeholders are defined by the IFC as 'those individuals and groups that are affected by, or express an interest, in the project'. Stakeholder consultation in an impact assessment improves the quality and relevance of the findings by providing insights into the likely positive and negative health impacts both from stakeholder experience of the locality, as well as their experiences of other projects (14).

5.0 ACTIVITIES CONDUCTED IN HEALTH IMPACT ASSESSMENT

5.1 Form and Level of Health Impact Assessment

The HIA is a prospective assessment following a rapid appraisal approach as described in 4.2.2.

5.2 Completed Health Impact Assessment Activities

5.2.1 Desktop Activities

The following desk-based activities were performed to support the HIA:

- Review of the Social and Health Baseline Study conducted in March 2015 (15).
- Update of the Social and Health Baseline Study in July 2018 that included:
  - A literature review of national, provincial and where available district data, where information from standard source health data was available in the public domain. This was conducted following the EHA framework and included the following core documents:
    - Preliminary results of the 2017 census (16).
    - 2017 World Bank overview of Mozambique (17).
    - Mozambique 2012 Demographic and Health Survey (MDHS) (18).
    - 2016 burden of disease estimates for Mozambique (19).
    - Mozambique 2011-2014 poverty reduction strategy paper (20).
- Health systems data and reports from the Inhassoro District that were collected (as available) during the field work.
- Review of Project documents including:
  - 2017 EIA for the Future expansion, appraisal and development in Sasol licence areas (23).
  - The environmental scope definition and terms of reference for the Project completed and approved by MITADER in 2015 (24).
  - Various biophysical and socio-economic specialist studies including baseline descriptions and impact assessments (2017-2018).

5.2.2 Field Work and Stakeholder Engagement

The field work to support the updated health baseline was conducted from the 18th June to 22nd June 2018 and included:

- Stakeholder engagement and collection of data through participatory methods; including:
  - Key Informant Interviews (KIIs) with stakeholders who could provide insights into the current health challenges in the community, their determinants, specific vulnerabilities, trends in burden of disease and social challenges. The following were interviewed using a semi-structured tool.
    - Inhassoro District Health Administrator.
    - Inhassoro District Chief Medical Officer.
    - Clinical personnel in charge of Inhassoro, Mangugumete and Pambara health centres
  - Focus group discussions (FGDs) in five villages that were considered as potentially impacted (Mabime, Mangarelane, Vulanjane, Chitsotso and Pambara). These villages were selected based on their proximity to the various project elements and to get a broader perspective of the study area.
- Direct observation of the study area to observing the general environmental health and hygiene conditions such as waste (garbage) management, housing, water supply, availability of sanitation services, markets, street pharmacies etc.
- Health facility assessment:
  - Three health facilities in the study area were visited (Inhassoro (Sede), Mangugumete and Pambara) and evaluated using an assessment tool adapted from the WHO Service Availability and Readiness Assessment index, including an evaluation of the following variables:
    - Quantity and skills of healthcare personnel;
    - Availability and range of general health services;
    - Availability of services;
    - Referral networks and the quality and cost of access to the health system, and
    - The most common diseases or burden of disease at the facility.
    - An understanding of the main health challenges in their target population, why this is the case, who is vulnerable and the structural and operational challenges they face at facility level.
- Data and reports were also requested from the key informants and health facility managers, so these could be analysed after the field trip and form part of the baseline

6.0 COMMUNITY PROFILE

6.1 Project Location and Demographics in Study Area

The Project is situated in the district of Inhassoro in the northern part of the Inhambane Province in southern Mozambique. The district is bordered to the north by Govuro district, to the south by the districts of Vilanculos and Funhalouro, to the East by the Indian Ocean and to the West by the Districts of Massinga and Mabote. The district is crossed by the Govuro River. The district has two administrative divisions, Inhassoro Sede (more populated) and Bazaruto (on the island) (21).

The social baseline has listed 12 villages and communities and Inhassoro Sede (due to the beach landing) as PACs; namely; Temane, Mangugumete, Manusse, Chitsotso, Mabime, Mapanzene, Chipongo, Maimelane, Mangarelane, Litlau, Munavalate and Pambara (21).

The population in the study area (11 villages) is estimated at 15 318 inhabitants in 3 991 households, with an additional estimated 7000 people in the three groupings in Pambara (21). No accurate population statistics were available for Inhassoro Sede.

6.2 Potential for Project Inducted In-Migration

The social baseline outlines that in-migration has occurred in the study area and specifically to the larger towns of Mangugumete and Maimelane, with further influx anticipated to these areas as a result of this Project. In a previous study, villages mentioned the main reason for influx due to the arrival of people from outside the area in search of work and opportunities.

6.3 Potential for Physical Resettlement and Economic Displacement

As part of the 2014 pre-feasibility phase for the Project a resettlement action plan was developed. As part of this communities who may be economic displaced due to the development of the plant and along the transmission, gas pipeline and water pipeline route were compensated.

The potential for additional economic displacement and physical relocation is subject to an on-going study. Based on current designs there will be no need for the physical relocation of households to accommodate Project infrastructure. If any economic displacement is required then this will be managed in alignment with national policies and IFC Performance Standard 5, with compensation as required.

6.4 Ecosystems Services

Access to land plays an important role in supporting local livelihoods with subsistence agriculture and rearing of poultry and cattle (goats), reported as the main activities. Maize and groundnuts were the main crops.

Use of natural resources from the ecosystem was also important. Wild fruit and berries are collected by some villages and small-scale fishing played an important role in supplementing local livelihoods. Fishing was however restricted to the communities closer to the coast (Mangarelane, Chipongo and Mapanzene) but some do fish in the inland streams and wetlands. Palm tree were used to make and sell palm wine.

Wood is used for construction of houses and enclosures for livestock as well as the main fuel source for cooking/ heating. Reeds from the Govuro River are also used for construction purposes. Charcoal production was also an importance source of livelihood, but more in the communities of Munuvalate and Pambara where the product was sold commercially. Pressure was noted on the local woodlands, but surveys have determined that the harvesting and selling of firewood was the most important income for some low income households. The demand for wood and charcoal was generally from the larger towns and cities.

6.5 Project Potentially Affected Communities

For the purposes of the HIA, the population who may be affected by the Project are stratified into PACs[3]. These communities, which range from larger towns to smaller villages, have been divided into similar exposure groups based on:

- Their relative proximity to Project activities;
- Similar potential direct and indirect health risks from the Project, and

[3] A PAC is a defined community within a clear geographical boundary where project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and simply represent best professional judgments

- Similar demographic or community profiles.

These PACs are recognized as a “working model” that may evolve and change as the demographic structure in the communities change due to Project, and non-Project related influences, and thus need regular review and as required, adaptation.

The PACs considered for the Project are divided between construction and operations, as follows:

- Construction (Figure 11):
  - PAC1: Communities of Vulanjane, Mangungumete, Maimelane and Litlau given their proximity to the current CPF and proposed Project. These communities are likely to experience cumulative impacts due to Project including project induced in-migration and increased traffic along the EN1.
  - PAC2: Inhassoro Sede due to the temporary beach activities and transport of goods and indirect effects from the Project workforce.
  - PAC3: The communities in the broader study area along the EN1 access route to Vilankulo. These include Chitsotso and Pambara 1
  - PAC4: The communities in the broader study area including Pambara 2 and 3, Munavalate, Temane, Mangarelane, Chipongo, Mapanzene, Mabime and Manusse.
  - PAC5: Communities in the regional study area including those along the transport access road (EN1) and Vilankulo.
- Operations (Figure 12):
  - PAC1: Communities of Mangungumete, Maimelane and Litlau given their proximity to the current CPF and proposed Project and continued potential for cumulative impacts.
  - PAC2: Inhassoro due to indirect and cumulative impacts from the presence of the Project and it activities.
  - PAC3: The communities in the broader study area along the EN1 access route to Vilankulo.
  - PAC 4: The communities in the broader study area but not on the EN1 road.
  - PAC5: Communities in the regional study area including those along the transport access road (EN1) and Vilankulo.

The demographics of the different PACs are outlined in detail in the social impact assessment.

6.6 Vulnerable or Indigenous Groups

Based on data from different ESIA studies, and when including groups from a health perspective, the following groups are vulnerable:

- Women and young girls;
- The elderly;
- Disabled people;
- Children who may be more vulnerable to certain health effects such as infectious diseases and acute/ chronic respiratory tract infections from exposure to dust and other airborne pollutants;
- Poor households; and

- Those without access to or ability to own land. Poverty was likened to the amount of surplus that a family can, or cannot, produce and access to land and ecosystems is essential as the community is dependent on fishing and agriculture to provide for their family units. Thus, reduced access can have an impact on food security and nutrition, and the ability to afford services such as health care. It may also influence general perceptions of well-being as ownership of land has important traditional value.

There are no self-identifying marginalized ethnic or religious groups in the study area.

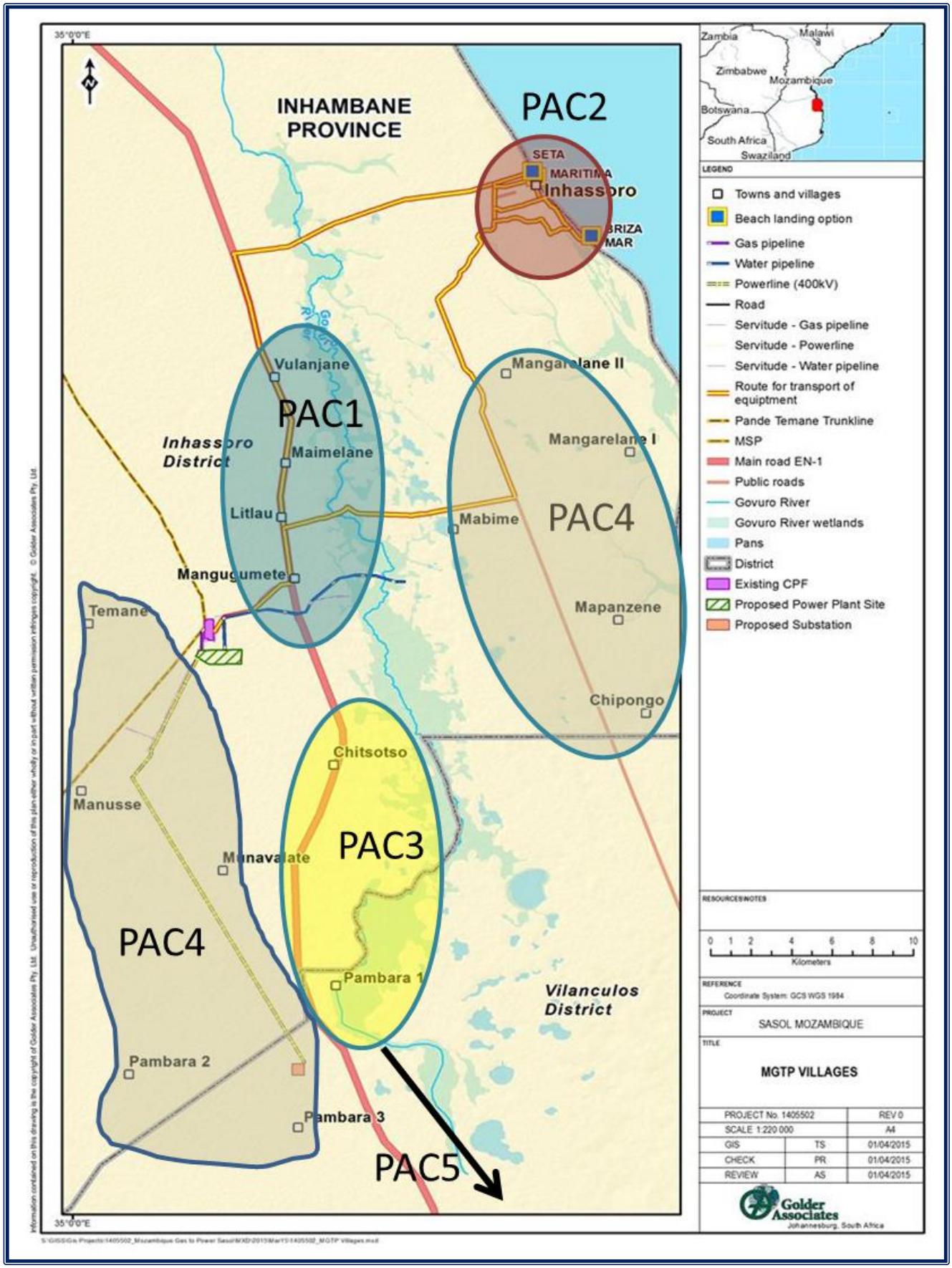

Figure 11: Potentially affected communities: construction

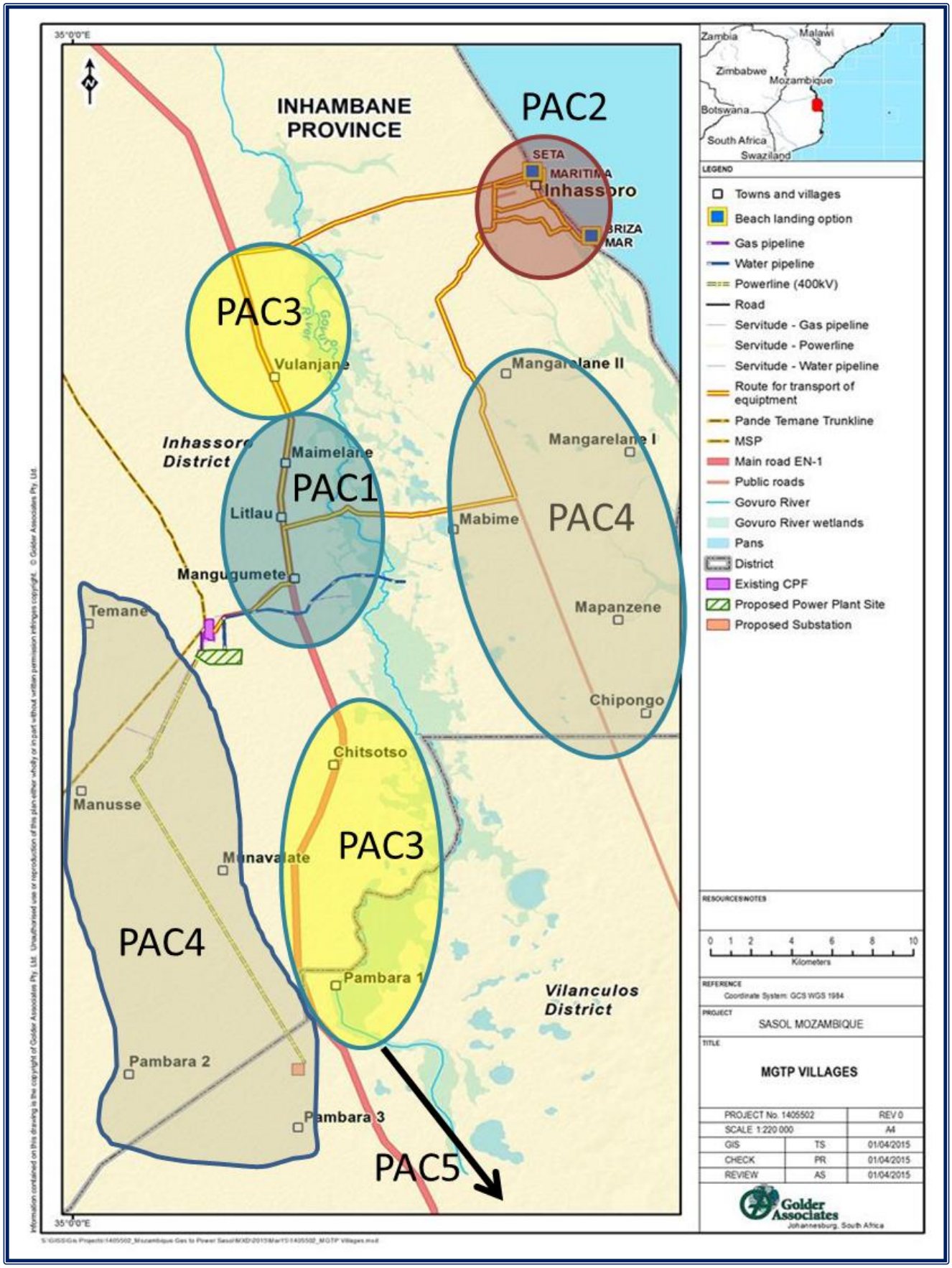

Figure 12: Potentially affected communities: operations

7.0 BASELINE CONDITIONS

7.1 National Health Profile

Mozambique has a population of 28.6 million inhabitants, according to preliminary results of the 2017 national population census [1]. As of 2016, the annual population growth rate stood at 2.9% [2]. Similar to other countries in sub-Saharan Africa (SSA), the fertility rate is high (5.9 children per woman) with a significant disparity between urban (4.5) and rural (6.6) settings [3]. About 70% of its population live and work in rural areas [2]. Life expectancy at birth is short (56 years in 2016) but has nevertheless shown some increase over the past decades [4]. The health indicators for Mozambique describe a challenging situation with some health data worse than the average for SSA (Table 5). In 2011, the national infant and under-five mortality rates were reported at 64 and 97 per 1,000 live births, a significant decline from the 1990 figures of 155 and 233, respectively [5, 6]. However, maternal mortality, a useful indicator for health sector performance, remains high, recorded at 408 per 100,000 live births in 2011 [3].

Table 5: Key health and demographic indicators for Mozambique

Indicator	Year	Mozambique	Sub-Saharan Africa
Life expectancy at birth (years)	2016	56	60
Urban population (%)	2015	30	-
Total fertility rate (child per woman)	2015	5.3	4.7
Contraceptive prevalence rate, any methods (% of women ages 15-49)	2015	27	26
Population with access to safe drinking water (%)	2015	63	58
Population with access to improved sanitation (%)	2015	32	28
Infant mortality rate (per 1000 live births)	2011	64	53
Under-5 mortality rate (per 1000 live births)	2011	97	95
Maternal mortality ratio (per 100,000 live births)	2011	408	500
Children stunted (% under-5 years)	2011	42.6	-
Children wasted (% under-5 years)	2011	5.9	-
Children underweight (% under-5 years)	2011	14.9	-
Full immunisation coverage	2015	65.8	70
Proportion of institutional deliveries (%)	2015	54.8	-
Prevalence of malaria in children under-5	2015	40	-
HIV prevalence (% adults 15-49 years)	2015	13.2	-
TB incidence (per 100,000 population)	2015	551	-

Note: Table compiled from various sources including World Bank, World Health Organisation (WHO), and national health and demographic surveys for Mozambique.

7.1.1 Mortality and Burden of Disease

The distribution of disease burden in Mozambique reflects a predominance of communicable diseases, maternal, neonatal and nutritional diseases. The 2015 WHO Burden of Disease (BOD) estimates put the disease burden in Mozambique at 19.6 million Disability Adjusted Life Year (DALY)[4] [7]. Communicable diseases account for 64% of the BOD while the remainder is shared between non-communicable diseases (27%) and injuries (9%). HIV/AIDS (13%), neonatal conditions (12%), acute respiratory infections (8%), malaria (8%) and diarrhoeal diseases (6%) are the leading causes [7]. HIV/AIDS has recorded a decrease in burden from 22.4% in 2012 [8]. Among non-communicable diseases, malignant neoplasm and cardiovascular disease were the leading causes, both accounting for 5% of overall disease burden in 2015. Road traffic injuries contribute substantially to the total BOD from injuries [7]. In terms of deaths, the leading causes in 2016 were HIV/AIDS, malaria, lower respiratory infection (pneumonia), tuberculosis and cerebrovascular disease (Figure 13) [9].

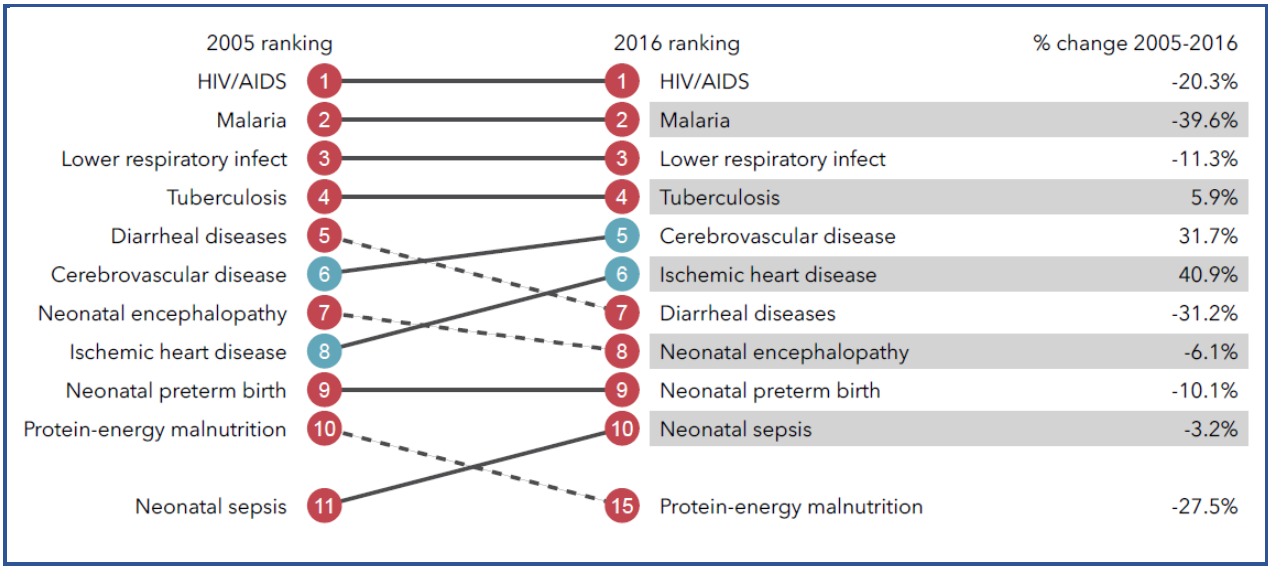

Figure 13: Ranking of leading causes of deaths in Mozambique, 2016 versus 2005

The figure shows the top 10 causes of deaths in 2016 and percentage change, 2005-2016. Solid lines indicate a cause has moved up in rank or stayed unchanged. Broken lines indicate a cause that has moved down in rank.

Source: Institute for Health Metrics and Evaluation, 2016

7.1.2 Health Policy and Plans

The Mozambique Health Sector Strategic Plan 2014 - 2019 (PESS[5]) is the guiding policy document for the Ministry of Health (MoH). It adopts primary health care (PHC) in its guiding principles for equitable health service delivery, with a focus on the most vulnerable populations.

The MoH is responsible for health sector policy and strategic direction as well as supervision of national referral hospitals. There are National programmes for HIV, Tuberculosis and Malaria Control.

[4] The DALY is a measure of overall disease burden. It is designed to quantify the impact of premature death and disability on a population by combining them into a single, comparable measure. It extends the concept of potential years of life lost due to premature death to include equivalent years of 'healthy' life lost by virtue of being in state of poor health or disability, quantified as years lived with disability.

[5] Plano Estratégico do Sector da Saúde

Provincial Health Directorates (DPS[6]) are responsible for providing technical and policy oversight to districts and supervision of provincial hospitals, and district health directorates oversee the health facilities in their decentralised catchment.

7.1.3 Health System Context

The public health sector is by far the largest provider of health services in Mozambique, and there is limited availability of private health care services (especially outside of the larger cities). It is estimated that only about 65% of the population can access a health facility in less than 45 minutes on foot [10].

The Mozambique National Health Service (NHS) has four levels of health care:

- **Health centres and health posts** offering PHC, including outpatient, and maternal-child health services;
- The first referral level, comprising **rural**, **general and district hospitals**;
- The second referral level, comprising **provincial hospitals**; and
- Third referral level comprising three **central hospitals** (north, central and south) and two specialist hospitals.

Although the number of secondary health facilities is steadily increasing, there are only 66 secondary level health facilities across all 156 districts; consequently, some districts rely on a health facility in a neighbouring district [11].

Despite a commitment to increasing access to and coverage of health services, as well as their efficiency and quality nationwide, the provision of adequate services is a major obstacle. There is insufficient healthcare infrastructure (23,000 inhabitants per health centre in 2007), and a shortage of healthcare workers (5.6 clinicians, 26.3 nurses and 68.6 midwives per 100,000 population- compared to WHO recommended minimum standards of 20 clinicians and 100 nurses/100,000 population) [12, 13]. The majority of clinic-based services are provided by non-physician staff, in particular by clinical officers (*técnicos*) and nurses. To address human resource shortages, funds have been allocated to increase recruitment for more remote areas, but doctors remain unevenly distributed across the country; incentives and facilities seemingly insufficient to encourage many health workers to spend substantial periods in remote areas [12].

As rural areas have not benefited significantly from an increase in the number of doctors, the MoH is training mid-level, non-physician health staff i.e. medical technicians and surgery technicians (*técnicos*) and strengthening integrated community case management through the *Agente Polivalente Elementar* (APE)[7] Programme, reviewed and launched in 2010. APEs are an official health cadre and serve as an extension of the PHC facility to the community. APEs provide much of the preventive care in rural communities including community talks on key diseases and health conditions such as malaria, pneumonia and diarrhoea, counselling on family-planning methods, promoting deliveries within health facilities, linking to nutrition programmes, malaria prevention and improved health-seeking behaviours. APEs link the community to the NHS as the first step in the referral system. Preventive care comprises 80% of the APE's duties. The remaining 20% of the APE's duties consists of curative care for illnesses such as upper respiratory tract infections, diarrhoeal diseases and uncomplicated malaria.

[6] Direcção Provincial de Saúde

[7] Community health worker

As part of strengthening the collaboration between health facilities and community, the Community Involvement Strategy (MISAU[8], 2004) has been reinforcing linkages between community and health facility, by promoting the establishment and reinforcement of community structures such as the health community council, and co-management councils to facilitate linkages and interface.

7.2 Inhassoro District Health Profile

The annual health report (2017) shows that Inhassoro District has only 1 physician for every 31,980 inhabitants and 1 nurse for every 3,366 inhabitants (compared to the WHO recommended ratio of 1 per 10,000 and 1 per 1000 respectively). The district has a total of 72 beds including 20 for maternity and 8 for paediatrics. Service delivery at community level is supported by 21 APEs serving 16 villages [14]. The main reasons for health consultations are malaria, diarrhoea, HIV/AIDS, anaemia, tuberculosis and acute respiratory tract infection including pneumonia (Figure 14) [15].

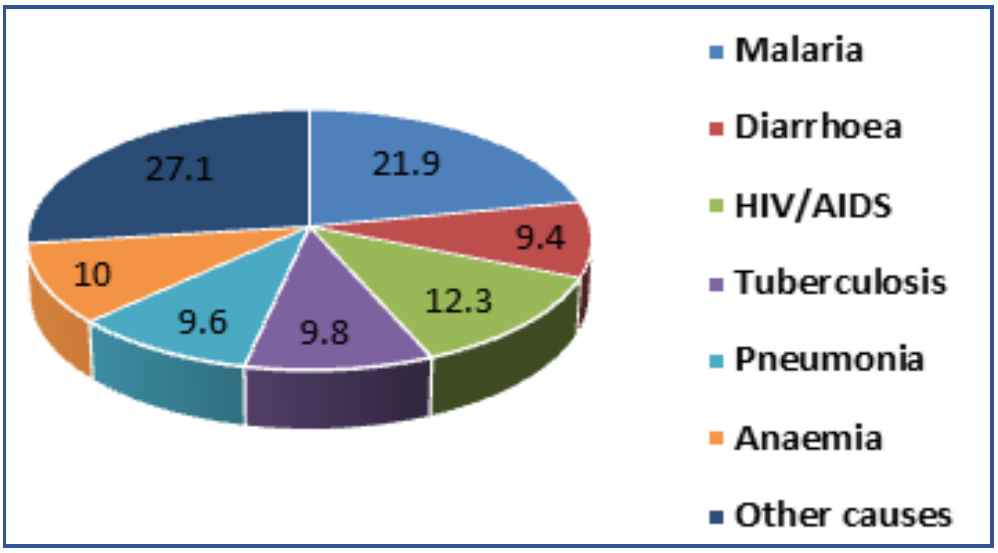

Figure 14: Main reasons for visiting health facilities (morbidities only)

Source: Inhassoro District Annual Health Report 2013

7.2.1 District Health Infrastructure

Inhassoro is generally poorly served with no district hospital (as at 2018) and relies on the District hospital located in Vilanculos [14]. The district has 9 operational health units. These include two Type I Rural Health Centres; i) Inhassoro Sede located at the district headquarters, which acts as the main unit of reference in the district; and ii) the facility located in Mangugumete along the EN1 national road. These facilities provide maternity and in-patient services in addition to PHC outpatient services, basic paediatric services, anti-retroviral treatment, blood transfusions, pharmacy and basic laboratory services. Both refer directly to Vilanculos Rural Hospital. The district also has five Type II Rural Health Centres and a Type II Urban Health Centre on Bazaruto Island. The Inhassoro Sede facility also provides basic dentistry services and serves as the district depot for medicines and vaccines. The district health facilities are summarised in Table 6. The Sasol Corporate Social Investment programme funded the construction of Mangugumete Health Centre as well as the recently completed health centres in Temane and Pambara (Vilanculos District) to serve surrounding communities.

[8] Ministério de Saúde (Ministry of Health)

Table 6: Health facilities in Inhassoro District, 2017

Health facility	Locality	Reference zone[1]	Level of attendance (capacity)[2]	Maternity ward and hospitalisation	HIV treatment	Notes
Inhassoro Health Centre (Sede)	Inhassoro	Vilanculos Rural Hospital	I	Yes	Yes	
Mangugumete Health Centre	Maimelane	Vilanculos Rural Hospital or Inhassoro	I	Yes	Yes	Constructed by Sasol
Macovane Health Centre	Maimelane	Inhassoro	II	No	No	---
Cometela Health Centre	Cometela	Inhassoro	II	No	No	---
Nhampele Health Centre	Nhampele	Inhassoro	II	No	No	---
Bazaruto Health Post	Bazaruto	Inhassoro and Vilanculos Rural Hospital	II	No	Yes	Urban type health centre
Chitsecane Health Centre	Maimelane	Inhassoro	II	No	No	---
Temane Health Centre	Maimelane	Inhassoro	II	No	No	Constructed by Sasol
Machulane Health Centre	Bazaruto	Inhassoro	II	No	No	New facility, commissioned 2017

Source: Inhassoro District Annual Health Report, 2017

[1] Reference Zone: Health facility with higher capacity to where the most severe cases are transferred, in order to obtain a more comprehensive service.
[2] Level of attendance (capacity): Classification of the health centres according to their capacity of assistance, level and quality of health professionals and the target population. A type I health centre in Mozambique targets 5,000 to 15,000 inhabitants; should have higher education professionals (bachelor degree) and has better diagnostic and treatment capabilities, as well as maternity and hospitalization services. A type II health centre serves a population of 2,000 to 5,000 inhabitants; provides an interdisciplinary care with basic medical consultations and laboratory examination.

7.2.2 Accessibility of Health Facilities

About half of the population of the district is within favourable (0 - 5 km) distance from a health facility, 35% travel more than 10 km to the nearest health facility and the rest travels 15 km or more (see Table 7) [15].

Table 7: Accessibility of health facilities for the 10 communities in the study area

Community/ village	Nearest health facility	Approximate distance (km)	Condition of road to health facility	Public transport available to health facility?	Notes
Chipongo	Health centre of Inhassoro	20 km	Reasonable	No	Population also seeks care at the health facility of Macunhe (District of Vilanculos). There is a community health worker.
Maimelane	Health centre of Macovane and health centre of Mangugumete	Less than 5 km	Reasonable	Yes	---
Mangugumete	Health centre of Mangugumete	0 km	Good	Yes	---
Litlau	Health centre of Mangugumete	Less than 5 km	Good	No	---
Mabime	Health centre of Mangugumete	6 km	Bad	No	There is a community health worker
Mangarelane	Health centre of Inhassoro	15 to 20 Km	Reasonable	No	There is a community health worker
Mapanzene	Health centre of Mangugumete	20 km	Reasonable	No	---
Manusse	Health centre of Mangugumete	15 to 20 km	Bad	No	---
Temane	Health centre of Mangugumete	Less than 10 km	Reasonable	No	---
Chitsotso	Health centre of Mangugumete	Less than 10 m	Bad	Yes	---

Figure 15 shows some of the health facilities in the Project study area. A detailed SARA assessment report of the facilities is presented in the baseline health description that is presented in Appendix A.

Health post in Mabime

Health centre in Mangugumete

Figure 15: Health facilities in the villages of the Project study area

7.3 Baseline Health Status According to Environmental Health Areas

The information used to analyse the baseline health status is based on data obtained from secondary sources such as the household survey conducted in 2014, national surveys and health systems data for Inhassoro District, as well as the primary participatory data obtained during the field work conducted in June 2018.

7.3.1 Communicable Diseases Linked to the Living Environment

7.3.1.1 Housing

Communicable diseases (e.g. acute respiratory infections, pneumonia, tuberculosis, meningitis, plague, leprosy, etc.) rely on fluid exchange, contaminated substances, or close contact to travel from an infected carrier to a healthy individual. Therefore, they are directly linked to housing design, overcrowding and housing inflation.

The average household size in Mozambique is 4.4 persons (4.6 in urban and 4.3 in rural areas) [3]. Households in Inhassoro District are generally larger at an average of 6 persons [15]. The great majority of households (97% nationally) use biomass fuels (wood, charcoal, animal or plant residues) for cooking and heating [3]. Findings from FGDs show that majority of households in the Project study area cook outside their main dwelling, primarily using wood. Poor housing emerged as a major theme and this was directly linked to poverty. Improvement in housing structures was reported in some communities especially those along the main EN1 road (Pambara, Mangugumete, Chitsotso and Vulanjane) as well as Mangarelane, while Mabime reported no change at all. Overt overcrowding was not evident in any of the local communities.

Housing structures in the study area are predominantly traditional (described in detail in the socio-economic report). Figure 16 shows some of the housing structures in the local communities.

Traditional housing structures in Mabime

Solid housing structure in Mangarelane

Figure 16: Housing structures in the local communities

7.3.1.2 Acute Respiratory Infection

Acute respiratory infection (ARI) is responsible for 8% of disease burden in Mozambique [7]. The disease is only second to malaria as the leading cause of morbidity among young children, nationally. Findings from KIIs with Inhassoro District health officials indicate that ARI is among the top-five causes of overall morbidity in the district. It also emerged from the FGDs in the study area that cough-related illnesses were among the commonest ailments, especially affecting young children. Data from the 2017 district health report show that pneumonia (a severe form of ARI) was the second leading cause of hospitalisation in the district with 31 cases and 3 deaths in 2017, this increasing four-fold from 7 cases and 1 death in 2016 [14].

7.3.1.3 Tuberculosis (TB)

Mozambique is ranked among the world's 22 high TB burden countries; the disease particularly affecting young adults and people living with HIV/AIDS. Around 12% of the TB cases in the country are children [16].

While some progress has been made, the country continues to register high rates of transmission with around 154,000 new infections per year [16]. Estimates indicate an incidence rate of around 551 cases per 100,000 population [17]. Nearly half (44%) of the TB cases are co-infected with HIV. Multi-drug resistant TB is an emerging threat, with 911 cases recorded in 2016, a prevalence of 3.7%, nationally [16]. TB is a common cause of morbidity in Inhassoro, with the district registered 248 cases of TB, including 56 that were laboratory confirmed in 2017 [14]. The number of TB cases has increased from 170 in 2014, 192 in 2015 to 203 in 2016. Treatment success rate is generally high and has increased from 78% in 2014, to 95% in 2016. The district also recorded a significant decrease in TB deaths from a high of 22 in 2015, to 6 in 2016 and 2 in 2017 [14, 18]. Table 8 gives a summary of the districts' TB statistics.

Table 8: Tuberculosis morbidity and mortality in Inhassoro District, 2014-2017

Year	Total cases of TB (including suspected cases)	New laboratory confirmed cases of TB	Multi- drug resistant TB cases	TB deaths	TB-HIV+ (%)	Treatment success rate (%)
2017	248	56	3	2	35.8	Not reported
2016	203	49	2	6	46.7	95
2015	192	67	1	22	55.4	89
2014	170	55	0	-	50.2	78

Source: Inhassoro District Annual Report 2016 and 2017

7.3.1.4 Measles, Meningitis and Leprosy

Measles remains a challenge in the country despite the availability of a safe and effective vaccine. In 2015, measles vaccine coverage was recorded at 83% nationally, thus below the 90% minimum threshold required for herd immunity [19]. Inhassoro District reported 32 suspected cases of measles in 2017 (an increase from 16 in 2016) but no cases were confirmed or deaths reported. The district records generally high coverage of measles vaccine, 94% in 2016 and 98% in 2017[14].

No case of meningococcal meningitis has been reported in the district over the past five years (2013-2017). The district recorded 1 confirmed case of leprosy in 2017 but no cases during 2014-2016.

7.3.2 Vector-related Disease

7.3.2.1 Malaria

Malaria continues to be the principal public health challenge facing Mozambique, contributing 8% of the overall disease burden [7]. The whole country is considered a high transmission area and entire population is at risk of infection. Transmission shows a seasonal pattern, with peak season between July and November, which coincides with the warm and wet summer season. *Plasmodium falciparum* accounts for nearly 100% of the malaria infections. The major malaria vectors in the country are *Anopheles (An.) gambiae, An. arabiensis and An. funestus* [20].

Latest statistics (2015 IMASIDA9) indicate a malaria prevalence of 40% among children under-5 years, increasing from 38% in 2011 [19]. The prevalence varies by regions as shown in Figure 17 [19]. The prevalence among pregnant women has increased at national level from 9% in 2011 to 22% in 2015 [3, 19].

[9] Inquérito de Indicadores de Imunização, Malária e HIV/SIDA em Moçambique

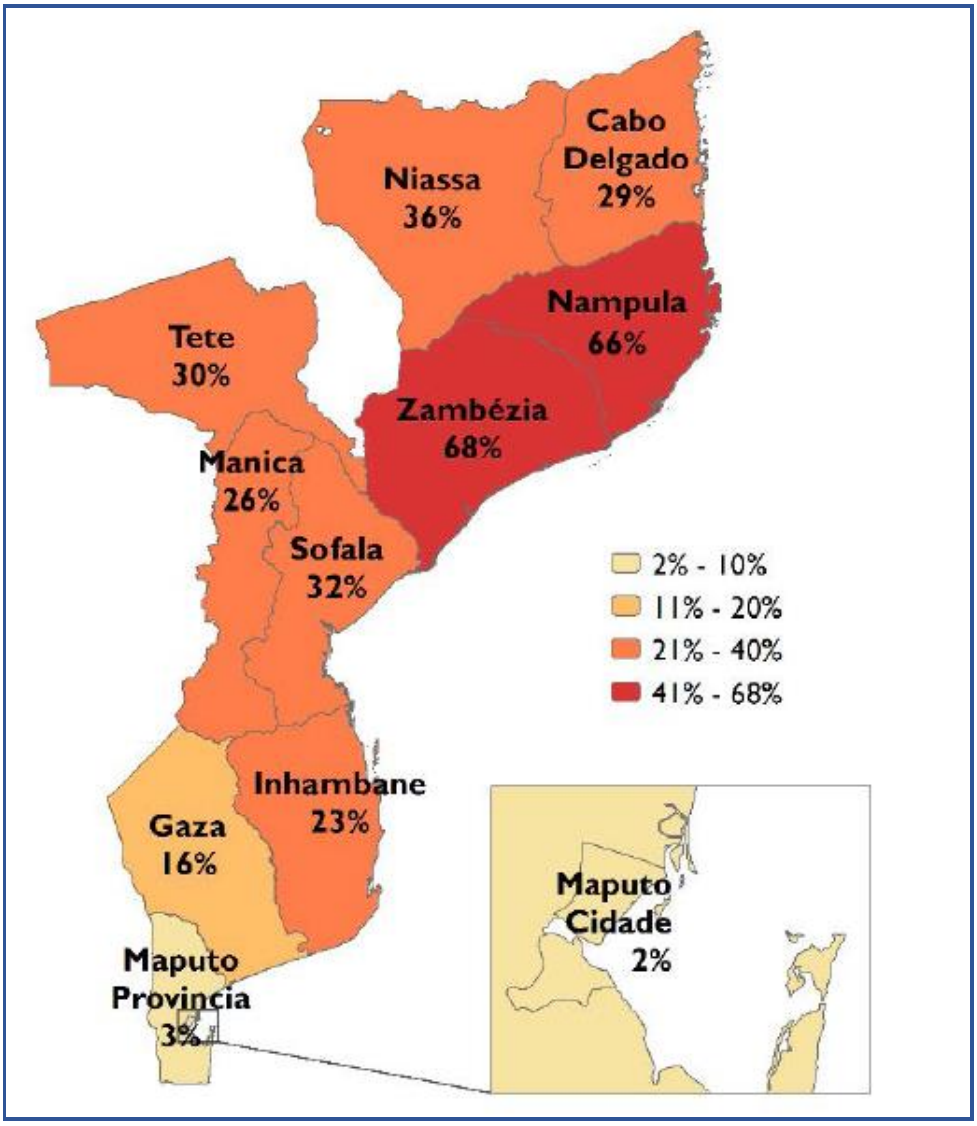

Figure 17: Prevalence of malaria in children under-five years by region, 2015

Source: 2015 IMASIDA

Baseline data shows that malaria is the number one cause of morbidity in Inhassoro District. In 2017, the district recorded 27,094 cases of malaria, a four-fold increase from the number of cases recorded in 2016 (Figure 18) [14]. The number of malaria deaths however, remained very low, with just 4 deaths recorded over the period 2014-2017.

According to key informants, the contributing factors to the high burden of malaria were environmental exposures, poor housing (that allows entry and breeding of mosquitoes), limited use of personal protective measures such as mosquito nets and limited awareness about the disease. Findings from FGDs also showed that malaria was the biggest health challenge for the communities. While majority of FGD participants recognised that malaria is transmitted by mosquito bites, some had misconceptions that malaria could be transmitted from “drinking dirty water”. It also emerged that bed nets were sometimes used for other purposes such as fishing or covering seedlings in home gardens. A mass net distribution campaign was conducted in the district in November 2017, but majority of FGD participants reported receiving just one or two nets, and these were inadequate for most households. Indoor residual spraying is not implemented in the district and there were no other vector control measures in place.

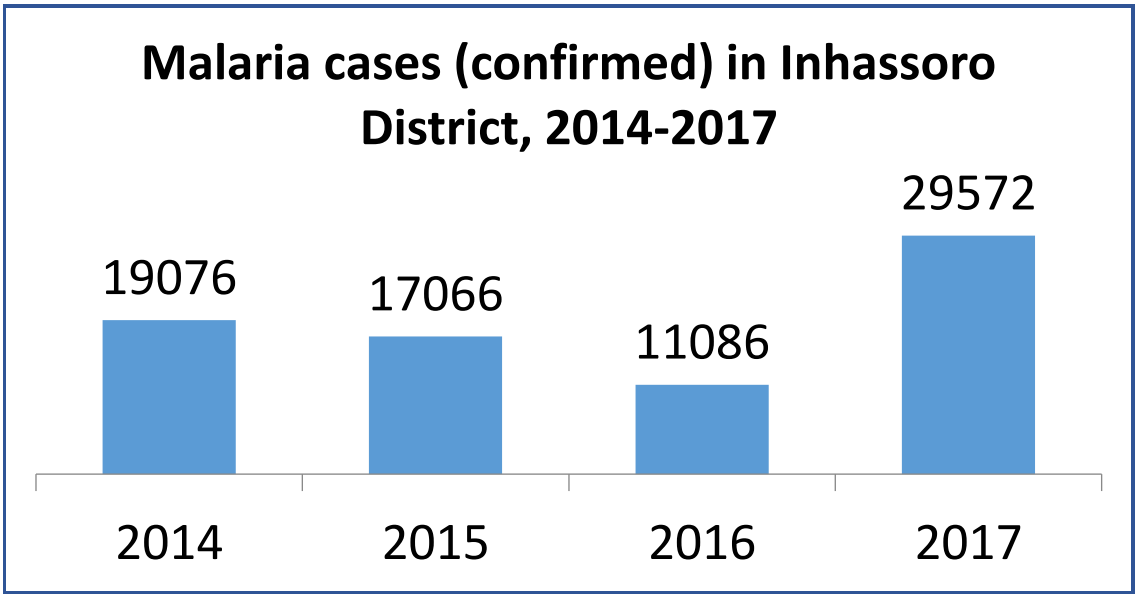

Figure 18: Trend in malaria cases in Inhassoro District, 2014-2017

Source: Inhassoro District Annual Report, 2016 and 2017

7.3.2.2 Arboviruses

The most important arboviral (arthropod borne viral) diseases that may occur in the Project study area are dengue and chikungunya fever. Rift valley fever is also a potential risk. These diseases are transmitted by several species of day-biting mosquitoes from the genus Aedes and Culex that are generally domestic and breed in dirty/polluted water or in human-made containers. Often these diseases are un-reported due to similarity in clinical presentation with other febrile illnesses (such as malaria) and diagnostic challenges.

Available evidence shows that dengue is prevalent in Mozambique but remains poorly documented. In 2007, flooding caused by the Zambezi river increased the prevalence of dengue with 1600 cases reported in January of that year [21]. Chikungunya fever is poorly described in Mozambique, but infection is known to occur. There were no data on arboviral diseases at the district or local level and key informants were not aware of the existence of such diseases in the study area.

7.3.3 Soil, Water and Waste-related Diseases

7.3.3.1 Access to Safe Drinking Water and Adequate Sanitation

The prevalence of soil, water and waste-related diseases depend highly on sanitation coverage and access to safe drinking water, factors which often show high variations at national and regional levels. Sustainable Development Goal (SDG) 6 calls on the global community to “ensure availability and sustainable management of water and sanitation for all”. Access in this regard is considered as a multi-dimensional indicator including other aspects of service, such as quality, availability (including quantity and continuity), and affordability [22].

While Mozambique has expanded its water and sanitation coverage over the last two decades, large disparities remain in terms of the availability and quality of services across provinces [22]. Latest statistics from the 2015 IMASIDA show that nearly two-thirds (63%) of the country’s households have access to safe drinking water, with just a third (32%) having access to an improved sanitation facility Access is significantly higher in urban compared to rural areas. Over a quarter (28%) of households have no sanitation facility at all and therefore rely on, or practice, open defecation [19].

Access to safe drinking water and sanitation remains a huge challenge in Inhassoro District. In 2015, the district had 212 boreholes equipped with hand-pumps, of which 31 (15%) were faulty; as well as 17 small piped water systems, of which only 12 were operational (with 1786 connections) [14].

The local communities largely relied on groundwater sources, mainly boreholes fitted with hand pumps as well as shallow hand-dug wells. In most cases, there was only one functional hand-pump for the entire village. Mabime village entirely relied on shallow well and surface water for their drinking and domestic needs.

Findings from KIIs show that less than a third of households have sanitation facilities, the commonest type being ordinary pit latrine. FGD participants reported that most of their households lacked toilet facilities and this was partly linked to poverty and the “culture” of indiscriminate disposal of human waste (in the bush or open field). Waste disposal remained a challenge with no organised waste collections system. Domestic waste was generally buried in pits or disposed of in open fields. None of the district’s health facilities had an incinerator for medical waste and therefore relied on open pit disposal. Figure 19 shows the sources of drinking water and waste disposal practices in the study area.

Open well drinking water source in Mabime village

Functional hand-pump borehole in Chitsotso village

Ordinary pit latrine in Chitsotso village

Medical waste pit in Mangugumete health centre

Figure 19: Sources of drinking water and sanitation conditions in the study area

7.3.3.2 Diarrhoeal Diseases, Cholera and Typhoid Fever

Diarrhoeal diseases account for 6% of the disease burden in Mozambique [7]. It is also a leading cause of morbidity in Inhassoro District owing to the underlying challenges of poor access to safe drinking water and sanitation. In 2017, the district recoded 2,644 cases of simple diarrhoea, increasing by 9% from 2,418 cases in 2016 [14].

Cases of dysentery also occur but the number has remarkably declined from 376 in 2014, to 18 in 2017 (Figure 20). Typhoid fever is endemic in the entire country but due to diagnostic challenges, the disease is not well documented in the district. No case of cholera has been reported in the district in the past 5 years.

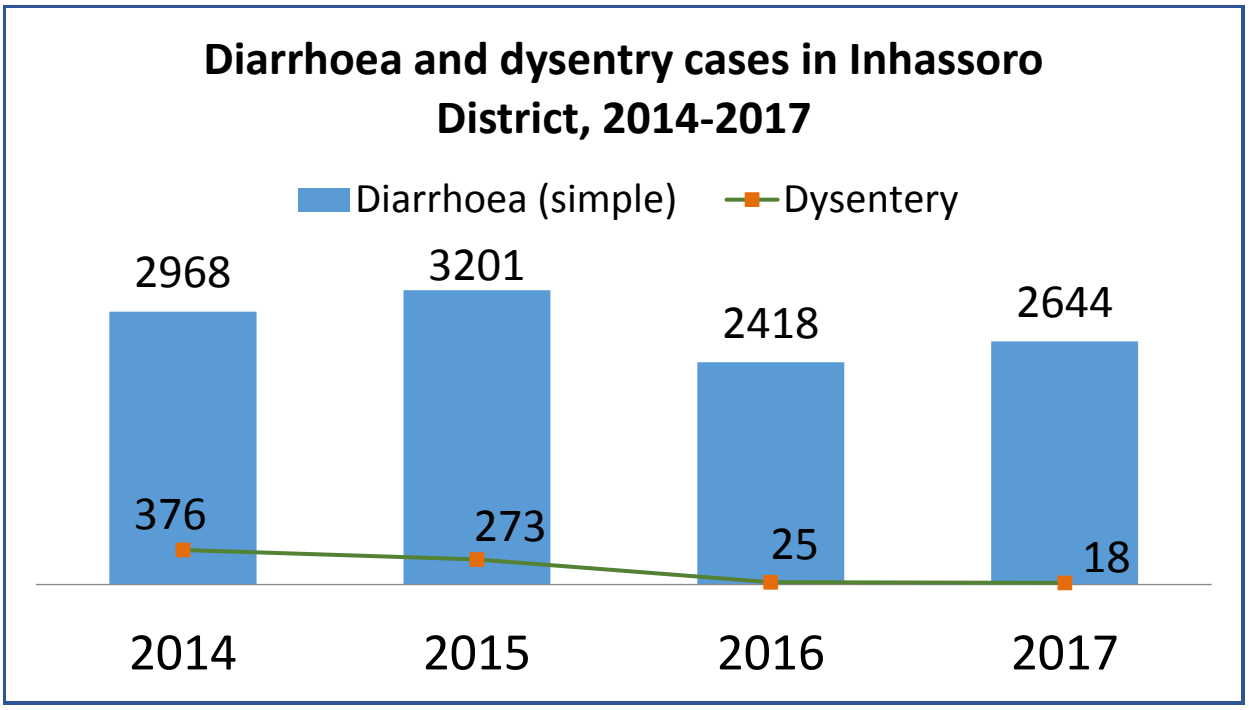

Figure 20: Trend in diarrhoea and dysentery cases in Inhassoro District, 2014-2017

Source: Inhassoro District Annual Report, 2016 and 2017

7.3.3.3 Soil-Transmitted Helminthiasis and Schistosomiasis

Soil-transmitted helminthiasis (STH) commonly referred to as intestinal worms, are endemic in Mozambique. A national epidemiological survey conducted in the period from 2005 – 2007 (in schoolchildren aged 9 - 14 years) found that the most common species were roundworms (*Ascaris lumbricoides)* at 66%, whipworms (*Trichuris trichiura*) at 54%, and hookworms at 39%. Among protozoa species, the most prevalent were *Entamoeba coli* (47.7%), followed by *Entamoeba histol*ytica (31.2%) and *Giardia lamblia* (19.0%) [23]. It is estimated that ~12 million children in the country require preventive chemotherapy against soil transmitted helminths annually, with a high coverage of 91% in 2016 [24]. Data for Inhassoro District shows a high coverage for preventive chemotherapy against soil transmitted helminths among children (100% in 2016 and 2017) and pregnant women.

Schistosomiasis, also known as bilharzia, is a disease caused by a parasitic trematode. Fresh water snails are the intermediate hosts and they become infected with schistosome eggs when the water is contaminated with infected urine or faeces. The two major schistosomiasis species are *Schistosoma (S) haematobium* (which mainly infects the bladder) and *S. mansoni* (which infects the intestine). Most parts of Mozambique are at moderate to high risk for *S. haematobium*, but the risk for *S. mansoni* is relatively low [25]. The overall prevalence is reported around 47% for *S. haematobium infection*, and is highest in the northern parts of the country [23]. It is estimated that ~14 million individuals in the country require preventive chemotherapy against schistosomiasis every year, but the coverage remains low (43% in 2016). Baseline data on the occurrence of schistosomiasis in the local communities was not conclusive, with no documentation of the disease in the district annual reports and lack of awareness of the disease by key informants.

7.3.4 Sexually-transmitted Infections, including HIV/AIDS

7.3.4.1 HIV/AIDS

The HIV epidemic in Mozambique is generalized, but with a higher burden of disease in the southern region, which has links to the higher prevalence rates in South Africa and the migrant labour system. Figure 21 gives a summary of the HIV/AIDS statistics for the country. The national HIV prevalence (adults 15 - 49 years) was recorded at 13.2% in 2016, increasing from 11.5% in 2009. Women are disproportionately affected, recording a prevalence of 15.4% compared to men (10.1%) [19].

Key and vulnerable populations for HIV transmission in Mozambique are sex workers and their clients, gay men (together contributing 28.7% of new HIV infections), prisoners, and mobile and migrant workers (e.g., miners, agricultural workers and truck drivers). Adolescent girls and young women are also considered vulnerable to HIV infection due to transactional or intergenerational sex.

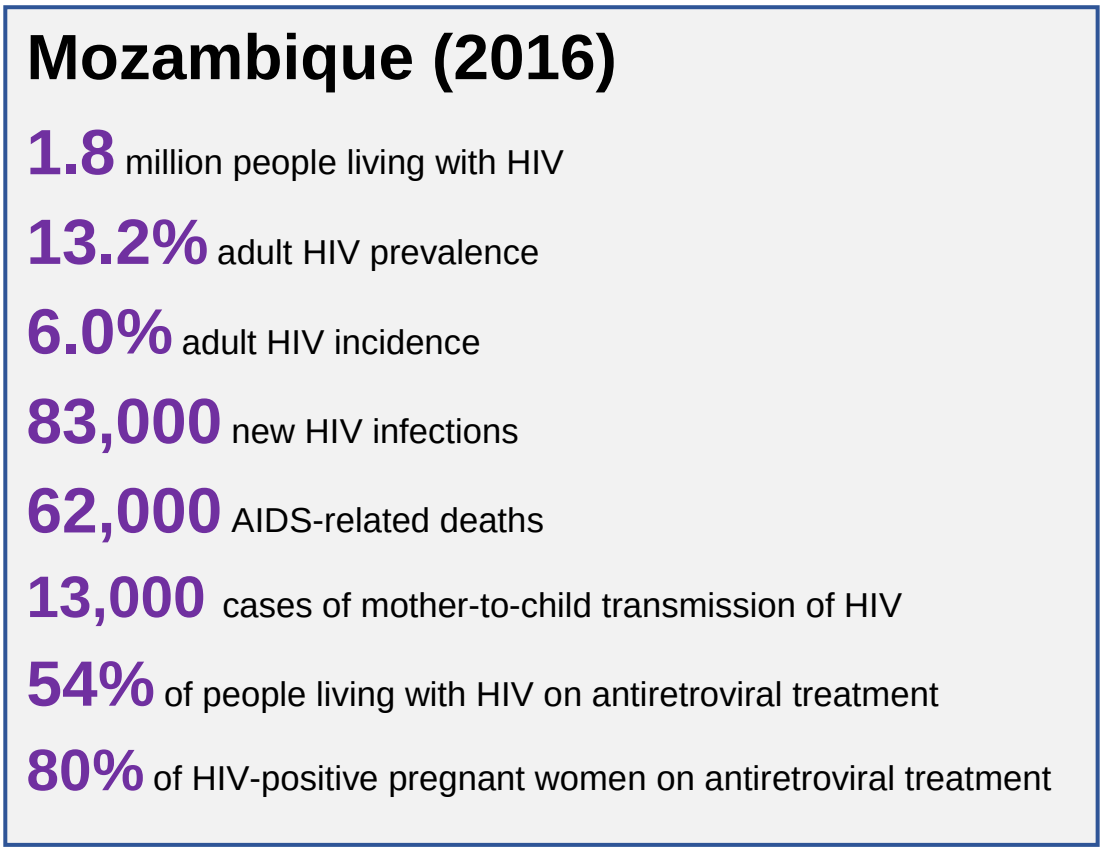

Figure 21: HIV/AID in Mozambique, at a glance

HIV/AIDS is the leading cause of adult morbidity in Inhassoro District. Around 30% of hospitalisations in the district in 2016 were due to HIV, but this fell to 11% in 2017 [14]. It is also the single leading cause of deaths, claiming 8 lives in 2017, and 32 in 2016. The number of patients on antiretroviral treatment (ART) has marginally increased from 947 in 2014, to 1,089 in 2017. HIV testing services were available in all the district facilities, including health posts. HIV treatment and care services were available in four health facilities, including the two Type 1 Health Centres (Inhassoro and Mangugumete).

Findings from FGDs show that HIV is one of the biggest challenges for the local communities. Participants were generally aware of the transmission and prevention methods, but there appeared to be high levels of stigma. Uptake of HIV testing remained poor even though the tests were freely available in the local health facilities.

Multiple sexual partnerships and exposure to unprotected heterosexual sex were seen as the key contributing factors.

Condoms were very much available at the local health facilities, but the distribution channels appeared inadequate and failed to reach certain communities (e.g., Mangarelane and Mabime). Table 9 gives a summary of the HIV indicators for the district.

Table 9: HIV morbidity and mortality in Inhassoro District, 2014-2017

Year	Total HIV tests	HIV positive tests	HIV positivity rate (%)	HIV deaths	TB+HIV (%)	Number of patients on ARVs
2017	20326	1137	46.8	32	35.8	1089
2016	14831	1245	47.9	8	46.7	908
2015	2007	961	8.4	7	55.4	961
2014	2023	947	5.6	37	50.2	947

Source: Inhassoro District Annual Report, 2016 and 2017

7.3.4.2 Sexually Transmitted Infections

Sexually transmitted infections (STIs) such as gonorrhoea, syphilis and chlamydia all cause significant morbidity but are an important consideration as certain STIs can increase the risk of acquiring and transmitting HIV and they can alter the course of HIV disease progression. This also includes hepatitis B virus which is predominantly transmitted through sexual contact, contaminated blood products, or trans-placentally from mother to child; in a similar fashion to HIV. The prevalence of STIs in Mozambique has been reported around 6% among adults and generally similar between men and women [26]. Findings from KIIs showed the STIs are relatively common in the local communities, but this was not documented in the district's annual reports.

7.3.5 Food- and Nutrition-related Issues

7.3.5.1 Food Security

Mozambique achieved some hunger targets under Millennium Development Goal 1, but challenges remain in terms of SDG 2, particularly with regard to chronic malnutrition rates and vulnerability to natural disasters, which are among the highest worldwide. Chronic food insecurity now sits at 24% (down from 61% in 1990s) but 80% of the population cannot afford the minimum requirements to meet the needs of an adequate diet [27].

Findings from FGDs show that majority of the local communities do not have adequate food. Most households eat only one or two meals a day. The diet largely consists of carbohydrates (cassava, maize meal, or rice) and beans or local vegetables. Fish is available at times, while other animal proteins (chicken, meat, or milk) are a rarity. The majority of respondents reported that they buy food from the local market because they do not grow enough to feed their families. Food prices were reported to be increasing especially rice, maize flour, sugar, and cooking oil.

7.3.5.2 Malnutrition and Anaemia

Malnutrition is considered the underlying cause of death in an estimated 30% of children under-five years in Mozambique [28]. It develops from a combination of factors including poor intake of nutrients, mal-absorption and increased requirements. It is currently a priority area for the government. National statistics from the 2011 Demographic and Health Survey (DHS) showed that 43% of children had stunted growth (an indicator of chronic malnutrition), 15% were underweight and 6% were wasted (an indicator of acute malnutrition and food insecurity) [3]. Stunting has remained high for decades (47% in 2003 and 42% in 1997) [29].

Child malnutrition is greater in the north of the country and in rural areas. Data from Inhassoro District shows only a few cases of malnutrition recorded in the health units. In 2017, the district recorded 9 cases of severe malnutrition, decreasing from 20 cases in 2016. The number of cases of mild and moderate malnutrition was not properly documented. Despite the reported challenges of access to food, FGD participants did not mention malnutrition among their health concerns.

Anaemia is an important health consideration as it can retard mental and physical development in children. It can also lead to poor outcome of pregnancies including neonatal deaths.

Iron deficiency, parasitic infections such as malaria and hookworm, and hereditary conditions such as sickle cell disease are important contributors. Data shows that two-thirds (69%) of children and half (54%) of women in Mozambique suffer from some level of anaemia [3]. In 2017, Inhassoro District hospitalised 26 patients with anaemia compared to 6 in 2016 [14]. Several other cases were treated as outpatients.

7.3.6 Non-communicable Diseases

The burden of Non-Communicable Diseases (NCDs) is increasing worldwide. In SSA, it is predicted that NCDs and injuries may cause up to 60% of morbidity, and 65% of mortality by 2020; and that this increasing burden may overwhelm already over-stretched health services [30]. The four major NCDs are cardiovascular disease, diabetes mellitus, cancers and chronic respiratory diseases. The risk factors underlying these NCDs are well documented to include unhealthy diet, physical inactivity, alcohol consumption and smoking [31]. In 2015, NCDs were responsible for an estimated 27% of disease burden in Mozambique (increasing from 21% in 2012) and caused 23% of deaths [7, 32]. Baseline findings from KIIs show that NCDs are an emerging challenge in Inhassoro District, particularly increasing cases of hypertension.

7.3.6.1 Cardiovascular disease, hypertension and diabetes

Ischaemic heart disease and cerebrovacular disease now rank among the top-ten causes of overall mortality, with hypertension as the key predisposing factor. A national survey conducted in 2009 found that 33% of Mozambicans were hypertensive [33], with a higher prevalence in urban (40.6%), compared to rural areas (29.8%) [28]. The survey also found that majority (85%) of those with hypertension were not aware of their condition, and that 60% had uncontrolled hypertension. The national prevalence of obesity has been reported at 5%, with diabetes at 4.6% [32]. Data on the burden of these diseases at district or community level were not available. Assessment of health facilities revealed that treatment and care for hypertension was available but was limited by lack of specialised care and poor awareness by patients.

7.3.6.2 Chronic respiratory disease

The most common non-infectious chronic respiratory diseases are asthma and chronic obstructive pulmonary disease which includes emphysema, chronic bronchitis, asbestosis, silicosis etc. Risk factors for these diseases include tobacco smoking, indoor air pollution, outdoor pollution, allergens and occupational exposure (asbestos, silica, certain gasses). According to PESS 2014-2019 nearly one-quarter of Mozambican men (15 - 64 years) use tobacco compared to only 3% of women [28]. The predominant use of biomass fuels by households is an important risk factor consideration for chronic respiratory disease in this setting. Key informants reported the occurrence of asthma in the local communities but cases were not well documented. There was no data or information on these conditions at the district or local level.

7.3.6.3 Cancer

Cancers represents 5% of the disease burden in Mozambique. The most common cancers are Kaposi sarcoma, oesophageal, liver and prostate cancer among men; and cervical cancer, breast cancer and Kaposi sarcoma among women [34]. In 2009, the MoH began a cervical and breast cancer prevention programme with basic screening established in at least 75 health facilities.

According to the chief medical doctor for Inhassoro, only few cases of cancers are seen in the local facilities, with these generally always referred to higher level facilities. Statistics on cancers remain limited owing to the lack of a national cancer registry.

7.3.7 Accidents and Injuries

Road traffic accidents are a leading cause of injuries in Mozambique, accounting for 5% of DALYs [7]. The main causes are careless driving, drunk driving, fatigue, speeding, poor condition of roads and jaywalking [35]. The country registers over 5,000 road crashes annually, with about 34% directly fatal [36]. Pedestrians are the most vulnerable road users, accounting for more than half (55%) of road traffic deaths. The annual economic cost of road traffic accidents in Mozambique is estimated to be around 90 to 100 million US dollars. In 2011, the government launched the Decade of Action for Road Safety with commitment to reduce the number of injuries and deaths on the country's roads [36].

Findings from KIIs indicate that road traffic accidents are relatively common in the study area especially along the main EN1 road. The EN1 road is in generally poor condition, narrow in most parts and relatively busy with heavy commercial vehicles making it quite dangerous. Road signs were only evident in some parts. FGDs in Vulanjane, Chitsotso and Pambara revealed that accidents occur on the EN1 road (but not often) and some have been fatal. The district annual reports did not indicate the number of road casualties or deaths.

7.3.8 Veterinary Medicine and Zoonotic Diseases

Zoonotic diseases are caused by infectious agents that can be transmitted between animals and humans. Environmental changes, human and animal demography, pathogen changes and changes in farming practices as well as social and cultural factors such as food habits and religious beliefs all play an important role in emergence of zoonotic diseases. In recent times, there has been a concern related to spread of highly pathogenic influenza viruses that have mutated to pose transmission risk to humans, from animal hosts, with the potential to cause pandemics. These include SARS, H5N1 and H1N1 viruses.

No cases of pandemic influenza (either H5N1 or H1N1) have been reported in Mozambique over the recent years. Viral haemorrhagic fevers remain a remote but possible threat owing to increasing global population mobility and mixing. Surveillance for these conditions remains in place especially in the wake of a recent (2014 - 2016) large outbreak of Ebola in West Africa, but no cases have been registered in Mozambique to date.

Mozambique remains a high-risk country for rabies [37]. Transmission predominantly occurs from infected dog bites. Once symptoms of the disease develop, rabies is entirely fatal. The most cost-effective mode of prevention is vaccination of domestic dogs. Timely post exposure vaccination in humans is often effective. Findings from KIIs show that animal bites (especially dogs and snakes) were common in the Project study area.

7.3.9 Potentially Hazardous Materials, Noise and Malodours

These may also be listed as environmental health determinants and include pollution of air, soil and water, as well as possible exposure to pesticides or other organic or inorganic pollutants, noise and malodours. The pathway of human exposure to pollutants can be complex and may be the result of a variety of sources including air, soil, water, plants and animals. Baseline data on this section will rely on findings from the environmental/biophysical specialist studies.

It is important to mention that none of the communities visited during the baseline reported any concern of air, soil or water pollution. The communities along the EN1 road (Mangugumete, Chitsotso, and Vulanjane) reported some noise disturbance from the road.

7.3.10 Social Determinants of Health

The health status of a population is affected by factors known as health determinants.

These are varied and include natural and biological factors (age, gender and ethnicity); behaviour and lifestyles, such as smoking, alcohol consumption, diet and physical exercise; the physical and social environment, including housing quality, the workplace and the wider urban and rural environment; and institutional factors such as access to medical care.

7.3.10.1 Mental Health

Mental and behavioural disorders account for an estimated 2% of disease burden, nationally [7]. In 2016, 4,240 cases of mental disorders were treated in the country's public health facilities [38]. Inadequate mental health facilities and personnel remain a challenge. In 2008, the country had only 2.3 psychiatric beds per 100,000 population, 6 psychiatrists, 36 psychologists, 56 psychiatric technicians, and 2 therapists serving the entire country [39]. The majority of mental health care services are centred in Maputo, and based on provincial mental health care reports, only 0.29% of the population is being reached [40]. Major depressive disorder is the commonest mental illness followed by anxiety disorders and substance abuse disorders [8]. Neuropsychiatric disorders, particularly epilepsy, also contribute significantly to the BOD from these conditions [41].

A mental health programme is in place in Inhassoro District, and in 2015 the district recorded 855 consultations due to mental and behavioural illness of which 232 (27%) were new cases, increasing from 704 cases in 2014. In the same year, 1 case of attempted suicide was recorded. Only the two Type 1 Health Centres (Inhassoro and Mangugumete) offered mental health services but there are currently no designated facilities or beds available for psychiatric patients in the district.

7.3.10.2 Substance Abuse

Abuse of substances such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health [42]. It is further associated with crime, violence, prostitution and domestic violence. Reports indicate that 29% of women, and 58% of men, in Mozambique consume alcohol on a regular basis. The prevalence of alcohol abuse increases with age and education in women, and with income in men [43]. More than half of mental disorders treated in the country's public health facilities in 2016 were related to alcohol and drugs [38]. Reports also point to Mozambique as an important drug transit point for South Africa and Europe [38].

Findings from KIIs and FGDs show that alcohol abuse is very common in the study area. Consumption ranges from traditional brews (e.g., "nipa" and "sabanga") to conventional beers and spirits. Tobacco smoking was reported especially among men. Abuse of hard drugs (e.g., cannabis, heroin, cocaine, etc) was not explicitly reported in the local communities. FGD participants indicated that they were not aware if such drugs were available or being consumed locally.

7.3.10.3 Gender-based Violence

There are high levels of violence against women in Mozambique, and its acceptance as a socio-cultural and traditional norm by many remain a major constraint to the implementation of gender equality commitments. Having emerged from a long civil war, the effects of violence are still evident and women and young girls remain vulnerable [44]. A 2011 survey conducted by the country's interior ministry revealed that >50% of women have suffered some form of physical, sexual or psychological violence at some stage [44].

Available data (Figure 22) shows that gender-based violence is common in Inhassoro District. In 2017, the district recorded 146 cases of physical violence against women, increasing from 95 in 2016. Cases of sexual violence decreased from 25 in 2016, to 10 in 2017 [14]. Services for victims of violence were available in both Inhassoro Sede and Mangugumete health centres with a dedicated private room to handle such cases. FGDs revealed that domestic violence is common in the communities but most victims suffer in silence and cases are not reported (therefore data is likely to be skewed due to under reporting). Alcohol abuse, economic frustrations and mistrust between partners were seen as contributing factors.

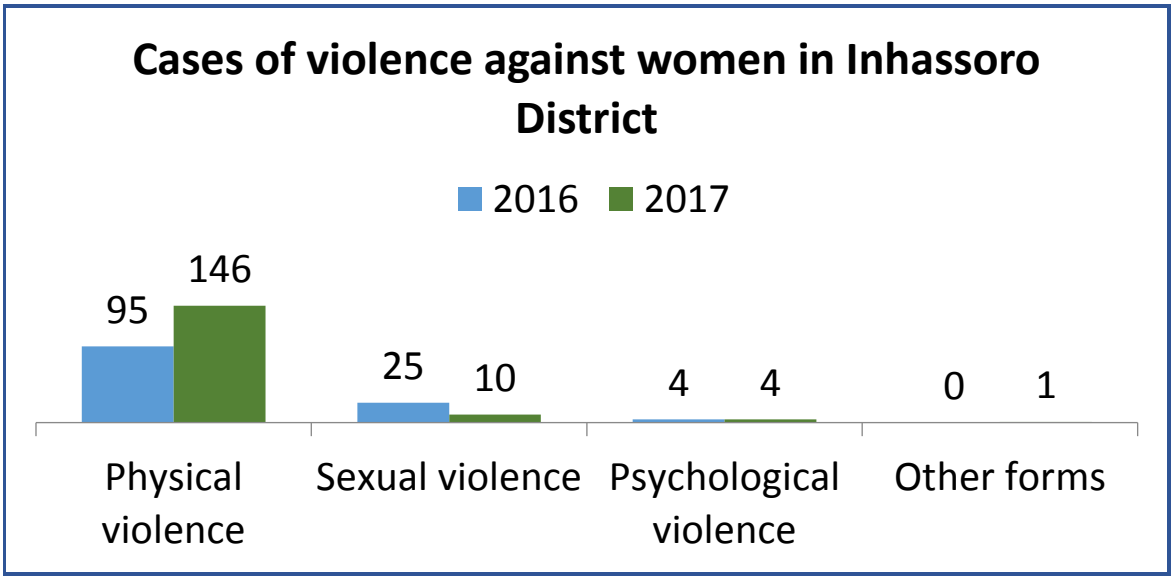

Figure 22: Cases of violence against women in Inhassoro District, 2016-2017

Source: Inhassoro District Annual Report, 2016 and 2017

7.3.11 Health Seeking Behaviour and Use of Traditional Medicine

Health seeking behaviour, the manner in which people choose which health provider to consult, and when to consult them, depends on a variety of factors. It is essential to understand these factors and identify the community practices to support an understanding of entry into a health care system. In circumstances where accessibility and cost is a limitation in accessing modern healthcare, the use and access to traditional medicine (TM) and the informal health sector may be promoted. In addition to the NHS outreach services and health campaigns, a number of basic services are provided by APEs, traditional midwives and other community health actors e.g., home based care providers.

Mozambique has more than 70,000 traditional healers, significantly outnumbering the registered medical practitioners in the country. According to the PESS 2014-2019 report [28], TM practitioners are known to meet 70% of PHC needs at community level and it is estimated that there is one TM practitioner for every 200 inhabitants. Given its coverage limitations, the MoH has recognized the need to integrate TM practitioners into health service delivery and created an institute to promote knowledge and use of traditional and alternative medicine. Baseline findings show that majority of the local communities prefer modern health care and utilisation has increased over time. However, TM use remains popular and this has contributed to delays in seeking proper care. FGD participants indicated that there were some conditions that could not be treated with conventional medicine, citing epilepsy and mental illnesses for which people often prefer TM.

7.3.12 Health Services and Systems Infrastructure and Capacity

Owing to the large size of the country and the remoteness and inaccessibility of many areas, the health system in Mozambique faces numerous challenges. This is further complicated by other factors such as lack of infrastructure and skilled personnel. The health system was discussed in more detail in section 0.

According to the 2014 household survey, more than a third of all respondents (Figure 23) considered themselves having a good health status (38.2%), especially those from Mangarelane (55.3%), Chipongo (52.9%) and Maimelane (47.1%) [15]. Another third (34.4%) rated themselves as having a reasonable health status, especially Chitsotso (46.9%), Mabime (44.4%) and Temane (42.4%). Those that reported very bad health status (1.5%) were mainly from Manusse (6.1%) and Litlau (3.1%) [15].

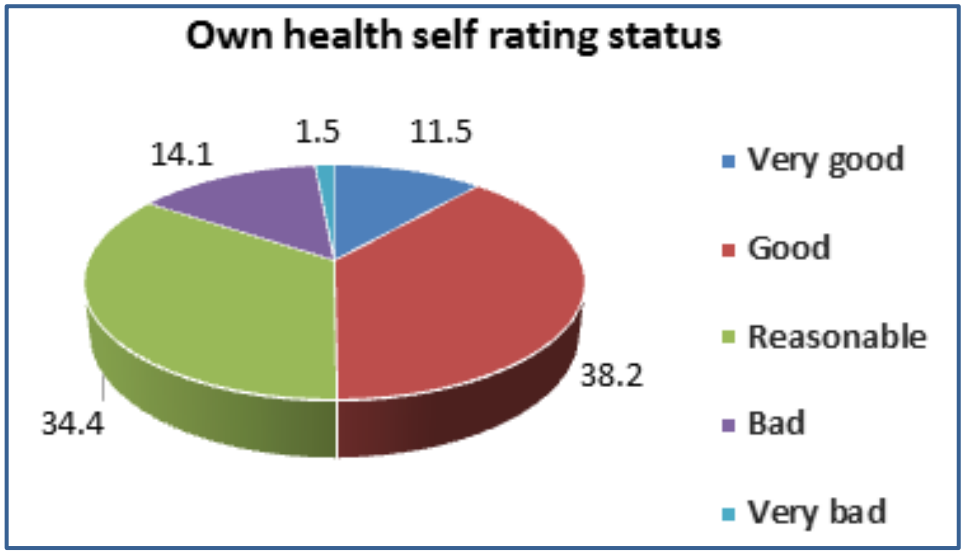

Figure 23: Rating by respondents of their own health status, average for the 10 communities surveyed
Source: KULA Social and Health Impact Assessment, 2014

7.3.12.1 Reproductive Health

Family planning is an essential component of reproductive health. According to the 2015 IMASIDA, unmet need for contraceptives in Mozambique stood at 23%. Overall fertility rate has declined from 5.9 in 2011 to 5.3 in 2015. Baseline findings show that majority of the population does not practice family planning.

According to the 2014 household survey in the Project study area, less than half (44%) of respondents reported use or knowledge of someone in their household who was using any family planning method [15]. Manusse, Litlau and Mangugumete were the communities with the lowest use of family planning, where the higher usage rates were seen in Mapanzene, Chipongo and Maimelane. The majority of female respondents (40%) indicated hormonal injections as the method of choice, followed by oral contraceptives (21.3%). Condom use as a contraceptive method was very low at 4.7% [15].

FGD participants reported that access and uptake of family planning has increased and that the services were available for free at the local health facilities. However, there were still challenges in assessing these services as they are not always supported by men, some of whom still prefer to have many children.

7.3.12.2 Maternal Health

Key indicators for maternal health include maternal mortality, access and quality of antenatal care, delivery care and postnatal care. Access to maternal health services in Mozambique has improved significantly over the past 15 years. The rate of institutional deliveries has risen from 44% in 1997, to 55% in 2011. Delivery assistance by a skilled birth attendant has reached 80.6% in urban areas, though progress is still lagging in rural areas at 46.8% [12]. The national maternal mortality ratio per 100,000 live births remains high, but has shown a decline from 1,000 deaths in 1990, 692 deaths in 1997, 780 deaths in 2000 to 408 deaths in 2011 [3, 6].

Data for Inhassoro District show that the number of institutional deliveries increased by 40% between 2014 and 2017 (Figure 24) [14, 18]. The leading causes of maternal morbidity were pre-eclampsia/eclampsia, obstructed labour and haemorrhage. No cases of maternal deaths was recorded in the district between 2014 and 2017 [14, 18]. Access to antenatal services in the district is nearly universal, with 96% of pregnant women in 2017 receiving the full component of skilled antenatal care.

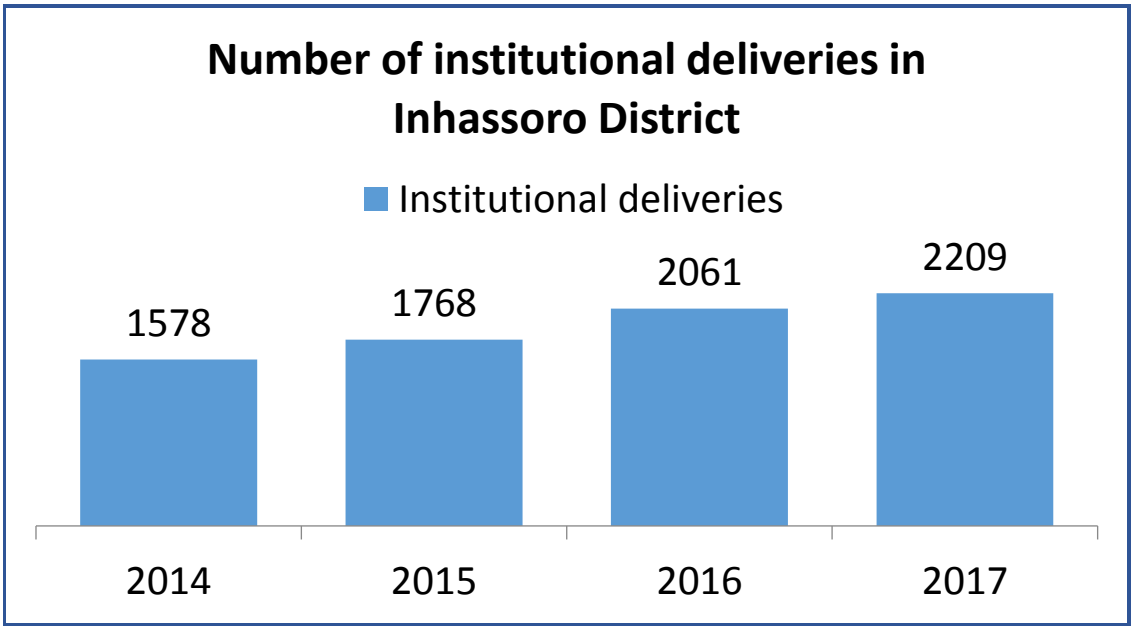

Figure 24: Institutional deliveries in Inhassoro District, 2014-2017

Source: Inhassoro District Annual Report, 2016 and 2017

Findings from the 2014 household survey showed that majority (92.3%) preferred to deliver their babies at the local health centres (Mangugumete and Inhassoro). A few respondents from Chitsotso and Temane considered the use of a traditional birth attendant (1.8%) while few others from Mabime and Mangarelane regarded family members (0.6%) preferred using family members for delivery assistance [15]. A summary of the findings is presented in Table 10. The main reasons for respondent's preference for institutional deliveries were related to availability of skilled personnel and prompt treatment, comfort and hygiene [15].

Table 10: Delivery preferences by women in the local communities

Community	Health facility (%)	Traditional birth attendant (%)	Family members (%)	More than one option (%)	Others (%)	Not sure (%)
Chipongo	91.2	2.9	0.0	0.0	0.0	5.9
Maimelane	100.0	0.0	0.0	0.0	0.0	0.0
Mangugumete	100.0	0.0	0.0	0.0	0.0	0.0
Litlau	96.7	0.0	0.0	0.0	0.0	3.3
Mabime	85.7	2.9	2.9	0.0	0.0	8.6
Mangarelane	94.4	2.8	2.8	0.0	0.0	0.0
Mapanzene	88.2	2.9	0.0	5.9	2.9	0.0
Manusse	96.2	0.0	0.0	0.0	0.0	3.8
Temane	84.8	3.0	0.0	0.0	6.1	6.1
Chitsotso	87.1	3.2	0.0	0.0	0.0	9.7

Community	Health facility (%)	Traditional birth attendant (%)	Family members (%)	More than one option (%)	Others (%)	Not sure (%)
Total	**92.3**	**1.8**	**0.6**	**0.6**	**0.9**	**3.7**

Source: KULA Social and Health Impact Assessment, 2014

7.3.12.3 Child Health and Immunisation

Mozambique has made significant gains in child survival despite the increasing threat of AIDS and diseases such as malaria, ARI, diarrhoea and malnutrition. Neonatal conditions such as prematurity, birth asphyxia and low birth weight also claim many children. Under-5 mortality rate (per 1,000 live births) stood at 97 in 2011, decreasing from 152 in 2003, and 201 in 1997 (Figure 25) [3, 26]. Infant mortality rate (per 1,000 live births) has also decreased from 135 in 1997, and 101 in 2003, to 64 in 2011 [3, 29]. Data from the annual reports for Inhassoro District show that two-thirds (65%) of hospitalisations and one-fifth (21%) of deaths were children [14, 18]. Despite this, the district has only 8 paediatric beds (4 each in Mangugumete and Inhassoro).

The commonest ailments affecting young children in the local communities were identified as malaria, upper respiratory infections, pneumonia, diarrhoeal diseases and anaemia.

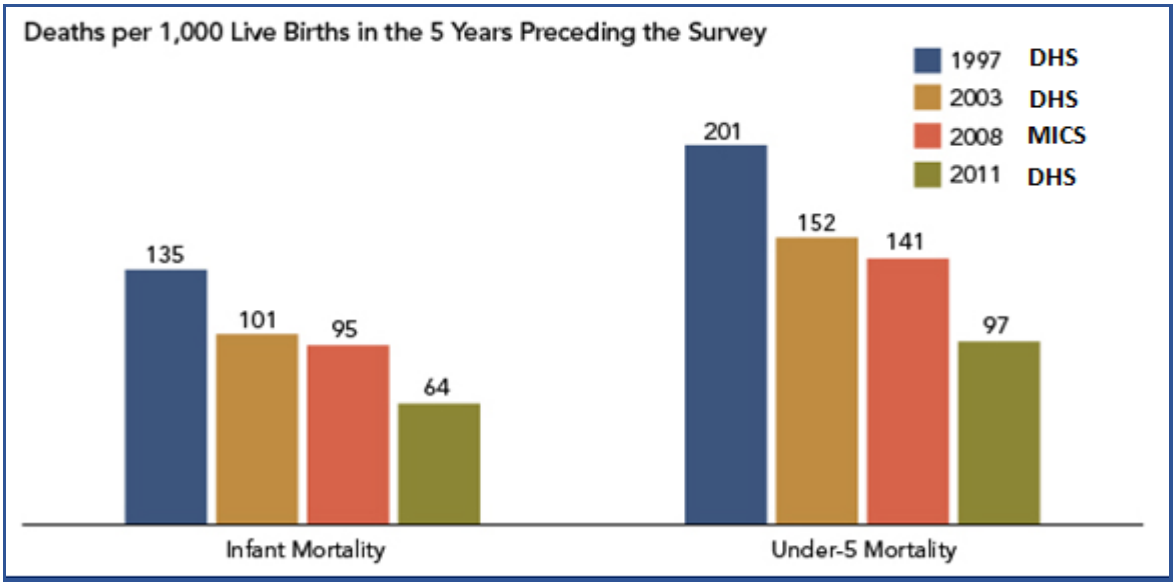

Figure 25: Child mortality trends in Mozambique, 1997-2011

Source: Mozambique DHS 2011

Childhood immunisation against common ailments is an important factor that ensures proper child growth and development; with implications into adulthood. Mozambique childhood immunisation schedule is well aligned to the WHO recommendations [45]. Immunisation services are offered in >90% of the country's public health network. Despite the progress made in recent years, the overall vaccination coverage is still low and there are inequalities throughout the country, with a considerably lower coverage in the north and rural areas. In 2015, full immunisation coverage stood at 66% at national level, an increase from 64% in 2011, 63% in 2003 and 47% in 1997 [3, 19]. Full immunisation coverage in Inhambane province is among the highest in the country, recorded at 81% in 2015.

Inhassoro District (Table 11) has an adequate immunisation programme, with full immunisation coverage increasing from 84.5% in 2014 to 98.8% in 2017 [14, 18]. Each of the individual vaccines (in 2017) reached the minimum 80% threshold required for herd immunity indicating that the local communities are generally well protected against outbreaks from the vaccine preventable diseases. This does however depend on the accuracy of the population to be vaccinated, because if the number of children to be vaccinated is under-estimated then the coverage may be lower than reported, with public health implications.

Table 11: Immunisation coverage in Inhassoro compared to national and provincial coverage

	Inhassoro District				National (2015)	Inhambane (2015)
Vaccine	**2014**	**2015**	**2016**	**2017**		
BCG	75.3	83.0	95.1	99.9	93.0	97.4
Polio3	84.5	89.0	93.6	97.8	73.0	84.9
DPTHIB3[10]	84.5	89.0	93.6	97.8	82.0	90.2
PCV3	84.5	89.0	93.6	97.8	76.0	89.0
Rotavirus (RV2)	-	80.1	95.0	99.4	-	-
Measles	85.3	91.8	94.2	98.9	83.0	96.1
Fully immunised	**84.5**	**91.8**	**93.7**	**98.8**	**66.0**	**81.**

Source: Inhassoro District Annual Report, 2016 and 2017 and 2015 IMASIDA

8.0 IMPACT ASSESSMENT

This section details the analysis, modelling and ranking of the potential health impacts associated with the Project and considers the analysis of potential negative impacts and their mitigation measures, but also potential positive impacts and measures to enhance these.

As health impacts may vary significantly in the different Project phases, these have been separated, as relevant into construction and operations, using the EHA framework approach. As potential impacts are not likely to affect all PACs equally, a short discussion on the spatial distribution of impacts is presented at the end of each impact evaluation section to support focused implementation of mitigation measures.

8.1 Summary of Health Impacts per Project Life-cycle

Table 12 and Table 13 summarizes the major health impacts for both the construction and operations phase in a dashboard matrix so it is possible to quickly identify the significance of both inherent health impacts, and how effective the proposed management measures are with an outline of residual risks.

The most significant inherent risks are related to the potential increased transmission of sexually transmitted infections and accidental and non-accidental injuries. The potential for Project induced in-migration, presence of a temporary construction workforce are major factors that can influence social determinants in the area. It is noted that most of the potential impacts are cumulative in nature, with an influence from the Sasol operations at the CPF.

[10] Diphtheria, Pertussis, Tetanus, and Haemophilus influenza type b

While the CPF project is supporting some mitigation measures under their o-EMPs, these may not be adequate to effectively support the mitigation measures required for the Project. In addition, the monitoring of impacts related to management measures for specific community health impacts for the operational phase of the CPF is limited, which limits the ability to understand and adjust the effectiveness of interventions.

If the proposed management measures are implemented effectively and in a sustained manner the significance of the residual risks is low. However, it will be important to monitor both interventions and impacts in a longitudinal fashion to ensure that the proposed interventions are indeed effective. It is also noted that many of the suggested management measures recommended a combined approach of the Project with the CPF.

Table 12: Summary of inherent and residual health impacts in construction

Environmental Health Area		Before Management				After Management/Enhancement			
		Magnitude	***Probability***	***Significance***	***Direction***	***Magnitude***	***Probability***	***Significance***	***Direction***
EHA #1	Communicable diseases linked to the living environment	High	Highly probable	**Moderate**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #2	Vector related diseases	Moderate	Highly probable	**Moderate**	**Negative**	Moderate	Low probability	**Low**	**Negative**
EHA #3	Soil, water and waste related diseases	Moderate	Highly probable	**Moderate**	**Negative**	Moderate	Low probability	**Low**	**Negative**
EHA #4	Sexually transmitted infections including HIV/AIDS	Very high	Definite	**High**	**Negative**	High	Medium probability	**Low**	**Negative**
EHA #5	Food and nutrition	High	Highly probable	**Moderate**	**Negative**	Moderate	Medium probability	**Low**	**Negative**
EHA #6	Non-communicable diseases	High	Medium probability	**Low**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #7	Accidents and Injuries	High	Definite	**High**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #8	Veterinary medicine and zoonotic diseases	Very high/don't know	Low probability	**Low**	**Negative**	High	Improbable	**Negligible**	**Negative**
EHA #9.1	Environmental health determinants: Air quality	**Not ranked in HIA**							
EHA #9.2	Environmental health determinants: Water quality and quantity	**Not ranked in HIA**							
EHA #9.3	Environmental health determinants: Noise and vibration	**Not ranked in HIA**							
EHA #9.4	Environmental health determinants: Hazardous chemical substances.	High	Highly probable	**Moderate**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #10.1	Social determinants of health: Local economic development and, employment	**Benefit**							
EHA #10.2	Social determinants of health: Social harmony, inequalities and Project expectations	High	Highly probable	**Moderate**	**Negative**	**Benefit**			
EHA #11	Cultural health practices and health seeking behaviours	Moderate	Medium probability	**Low**	**Negative**	Low	Low probability	**Low**	**Negative**
EHA #12	Health services and infrastructure	High	Highly probable	**Moderate**	**Negative**	Moderate	Low probability	**Low**	**Negative**

Table 13: Summary of inherent and residual health impacts in operations

Environmental Health Area		Before Management				After Management/Enhancement			
		Magnitude	***Probability***	***Significance***	***Direction***	***Magnitude***	***Probability***	***Significance***	***Direction***
EHA #1	Communicable diseases linked to the living environment	High	Low probability	**Low**	**Negative**	High	Improbable	**Negligible**	**Negative**
EHA #2	Vector related diseases	Moderate	Medium probability	**Low**	**Negative**	Moderate	Low probability	**Low**	**Negative**
EHA #3	Soil, water and waste related diseases	Moderate	Medium probability	**Low**	**Negative**	Moderate	Low probability	**Low**	**Negative**
EHA #4	Sexually transmitted infections including HIV/AIDS	Very high	Highly probable	**Moderate**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #5	Food and nutrition	High	Medium probability	**Low**	**Negative**	Moderate	Low probability	**Low**	**Negative**
EHA #6	Non-communicable diseases	High	Highly probable	**Moderate**	**Negative**	High	Medium probability	**Low**	**Negative**
EHA #7	Accidents and Injuries	High	Highly probable	**Moderate**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #8	Veterinary medicine and zoonotic diseases	Very high/don't know	Low probability	**Low**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #9.1	Environmental health determinants: Air quality	**Not ranked in HIA**							
EHA #9.2	Environmental health determinants: Water quality and quantity	**Not ranked in HIA**							
EHA #9.3	Environmental health determinants: Noise and vibration	**Not ranked in HIA**							
EHA #9.4	Environmental health determinants: Hazardous chemical substances.	High	Highly probable	**Moderate**	**Negative**	High	Low probability	**Low**	**Negative**
EHA #10.1	Social determinants of health: Local economic development and, employment	**Benefit**							
EHA #10.2	Social determinants of health: Social harmony, inequalities and Project expectations	High	Highly probable	**Moderate**	**Negative**	**Benefit**			
EHA #11	Cultural health practices and health seeking behaviours	Moderate	Medium probability	**Low**	**Negative**	Low	Low probability	**Low**	**Negative**
EHA #12	Health services and infrastructure	Moderate	Highly probable	**Low**	**Negative**	Moderate	Low probability	**Low**	**Negative**

8.2 Impact Definition/Evaluation and Associated Mitigation Measures

8.2.1 EHA #1 – Communicable Diseases Linked to the Living Environment

8.2.1.1 Baseline Description

The baseline related to this EHA includes burden of disease and socio-economic factors:

- Challenges with housing presented as a major theme in the FGD that were conducted as part of the updated health baseline. This was directly linked to poverty with the poorer households living in houses made of traditional material (mud and wood walls and grass roofing) with wealthier families living in structures made with brick and plaster walls and metal sheet roofing. Better housing was especially noted in communities living along the EN1 road (e.g. Pambara, Mangugumete, Chitsotso and Vulanjane) compared to more rural settings (e.g. Mabime).
- The social baseline describes the housing characteristics with the type of floor used as an indicator of socio-economic status. Clay (unimproved) floors were the most common, followed by cement, with the communities along the EN1 having the highest coverage of these improved floors (59% in Mangugumete and 50% in Maimelane) (21).
- Sections of Pambara village mainly consist of reeds and thatch sourced from the banks of the Govuro River (21).
- Overt overcrowding was not reported to occur and no informal/ make-shift developments were noted in any of the towns or villages.
- In terms of burden of disease:
  - Acute respiratory infections (including pneumonia) are only second to malaria as the leading cause of morbidity among young children nationally and among the comment's ailments locally.
  - There is a high burden of TB nationally and a common cause of morbidity in Inhassoro, with an increasing trend. Treatment success rates are generally above the WHO threshold of 85%, but case detection may not be adequate due to the weak health system.
  - There is a high co-morbidity with TB and HIV infection, with rates ranging from 36-55%.
  - Suspected measles outbreaks have occurred in the district, despite reports of good vaccine coverage. This may relate to less people targeted for vaccination than those who need to receive, thereby limiting the herd immunity- possibly as a result of influx.
- In terms of infrastructure in villages and towns (21):
  - Most roads in the area are dirt that contributes to the localised production of dust.
  - Temane, Mangugumete and Maimelane have electricity, none of the other villages do. Most cooking is done with local charcoal or wood.
  - In some villages, solar panels are being used by some inhabitants to provide power for their households. A solar panel is one of the main status defining factors for families in the area and one of the main imports from migrant workers in South Africa

8.2.1.2 Potential Direct Impacts

- **Impacts on communicable disease transmission from incoming construction workforce:**

There is the potential for an increased risk for the transmission of communicable diseases from the incoming workforce to the community in the study area.

This will be more marked in construction, with limited impacts persisting into operations.

Communicable diseases are generally spread by close contact via the respiratory route and are often associated with poor socio-economic conditions, or where people work or live in close quarters to one other. During especially construction the workforce will reside in an accommodation camp in close quarters to one another, and also work in relative proximity. This may increase the risk for spread in the workforce and ultimately in the community. The risk may extend into operations but as it is relatively small workforce, the potential is much lower. In addition, the migrant workforce that supports the CPF and other Sasol activities may present a potential cumulative risk.

The incoming construction workforce is a risk as they may be sourced from countries/areas where the burden of communicable diseases is higher than in the host community, or from areas where diseases novel to the local area may occur. The relatively weak local public health system is poorly capacitated to detect and manage these conditions effectively and coupled with poor health seeking behaviours in the community may lead to delayed diagnosis and potentially further transmission of the disease.

Communicable disease risks can include; i) viral infections, with seasonal influenza a major risk to vulnerable communities, especially with travellers from other hemispheres where a different seasonal virus strain may circulate; ii) other novel virus infections such as pandemic influenza; and iii) other transmissible conditions such as TB and multi-drug resistant TB which has significant public health implications. The co-morbid relationship of HIV and TB is important to consider locally.

The local community will be sensitive to any increase in these conditions, with vulnerable sectors including young children, the elderly and those with a weak immune system. The geographical distribution of this impact are summarised in the table below.

EHA 1 – Incoming migrant workforce					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		
Operations	YES				

- **Impacts on communicable disease due to reduced air quality:**

Reduced air quality because of direct Project activities (dust, oxides of nitrogen and sulphur) and indirect influences (focal in-migration and increased use of biomass fuels) has the potential to increase the risks for acute and chronic respiratory conditions. This may pre-dispose the community to a higher risk for acquiring communicable diseases from bacterial and viral origin. This has overlaps with section 8.2.9.1 with children and those with pre-existing respiratory disease more vulnerable, and the spatial impacts in the immediate local study area and along transport corridors. The risk will be higher in construction.

EHA 1 – Reduced air quality					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

8.2.1.3 Potential Indirect Impacts

- **Project Induced In-Migration (PIIM)**

While cumulative in nature due to the existing activities, it is likely that the development of the Project will be an additional attractor due to its potential additional economic benefit. This is additionally discussed in the social impact assessment with health impacts related to population movement, unplanned development and an expanding population potentially including:

- Movement of people has the potential to introduce disease that local communities may be naïve to, especially if the people originate from areas that have higher rates of disease, or the introduction of novel or resistant strains of disease.
- Deterioration in environmental health conditions increasing the potential for disease transmission due to overcrowding, poor hygiene etc.
- Potential for increased pressure on available housing. This may lead to the development of more makes-shift housing, increased overcrowding due to limited available land and a worsening of environmental hygiene conditions. Localised inflation due to supply and demand may increase the cost of housing and rentals, which may promote overcrowding and development of make-shift housing structures. As there will be a demand to settle where the bulk of economic activity may occur there is the potential for housing to develop in close quarters to each other.
- Pressure on already limited healthcare services to support the increased potential burden of disease.
- Limiting the reach of health prevention activities, such as vaccination campaigns, due a higher population than planned for coverage. The weak health system, and especially outreach services limits the ability to rapidly respond to these changing demands, and with the potential that there is inadequate coverage for vaccine preventable diseases and a risk for disease outbreaks.
- An increased use of biomass fuel may lead to a deterioration of both indoor and outdoor air quality, potentially leading to increased risks for acute and chronic respiratory conditions.

While PIIM is likely to be most marked in construction it is likely to persist into operations, likely in a cumulative manner with other gas related activities. It is noted that any effects of PIIM will be additional to that already experienced in the local study area, but with a potential for localised influx into Inhassoro during the temporary beach activities.

EHA 1 – PIIM					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

- **Increased traffic loads:**

This is also cumulative in nature, but local economic development may lead to an increased ability to afford motorised forms of transport. Increased traffic loads (on access roads and in communities) may lead to increased dust and vehicle emissions. This may potentially increase the risk acute and chronic respiratory conditions, making the community more susceptible to communicable disease. The spatial impacts are similar to PIIM but can include the transport corridors. It is noted that these will decrease in operations but the cumulative impacts will persist to some degree.

EHA 1 – Increased traffic loads					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

Table 14: Impact evaluation: EHA#1- Communicable disease linked to the living environment

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Communicable disease linked to the living environment in construction	8	4	2	4	**Moderate 56**	8	4	2	2	**Low 28**
Communicable disease linked to the living environment in operations	8	4	2	2	**Low 28**	8	4	2	1	**Negligible 14**
Communicable disease linked to the living environment in decommissioning	8	4	2	2	**Low 28**	8	4	2	1	**Negligible 14**

8.2.1.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - As part of the Management of Population Influx Plan develop and implement initiatives to monitor the state of general environmental health conditions in the PACs, and support the local authorities and communities in addressing noted challenges.
  - Support dust suppression activities on unsealed access roads through communities, especially where Project transport passes. This may include speeding regulations, wetting of roads and other methods.
  - Develop a Community Health Information System (CHIS) to collect and monitor key community health indicators in a longitudinal fashion. This may require specific Health Systems Strengthening (HSS) in the local health facilities so that they can be used as a reliable source of information, and potentially support of Community Health Agent/ Agent Polyvalent Communitaire (CHA/APE) in the respective communities.

There may be a need to support better diagnostics for TB in the study area and reporting on the District Health Information System (DHIS2).

- Occupational health, safety and environmental management:
  - Develop workplace health strategies as part of the occupational health plan or organisational health plan, to include:
    - A communicable disease strategy or c-EMP that has an initial workplace (including contractors and short-term labourers) focus, with the view to extend to manage potential community health impacts. It is important that core interventions are implemented at an early stage so that these are in place prior to the start of construction. The focus of the programmes should include malaria control, HIV/AIDS, TB and STI control and general and personal hygiene. This plan can potentially be expanded on the c-EMP developed for the CPF to include elements such as HIV, but also TB and other communicable disease risks that may originate from the workforce. This plan will need to have specific CMR provisions.
    - Plan and manage construction accommodation camps so that overcrowding does not occur during development of the Project. Develop a Camp Facilities Management c-EMP based on the IFC workers accommodation and camp facilities standards where applicable (25).
    - Ensure adequate space is available to reduce the need for any externally contracted workforce to stay in the surrounding community as this will place pressure on available housing and potentially increases rentals.
    - Develop a vaccine preventable disease programme for all employees, contractors and visitors based on risk for travellers and at risk occupations.
    - Develop effective fitness to work procedures and programmes (especially in-coming contracted workforce) to reduce communicable disease transmission by implementing an effective pre-deployment screening process for TB and other communicable conditions. Specific CMR provisions should be part of the procedure.
    - Develop and/or extend outbreak preparedness policies and programmes to reduce the impact of any suspected or confirmed outbreak at the local level
- Social development mitigation and management:
  - Support HSS with improved case detection and case management of TB especially from the three health centres and with support of APE programmes.
  - Support with development and extension of community based integrated management of childhood illness programmes in APEs.

8.2.2 EHA #2 – Vector related Diseases

8.2.2.1 Baseline Description

Malaria is the main public health infectious disease challenge in Mozambique, and indeed Inhassoro district where it is the number one cause of morbidity. In 2015, the prevalence rates in Inhambane province were 23%, still relatively high, bit lower than the rates in the more northern coastal provinces. Key elements include:

- Malaria is well described to limit economic growth and stifle development in communities that have a high burden of disease, with malaria almost certainly contributing to the poverty in the study area.

- The study area is situated within an area classified as highly endemic for *P. falciparum* with transmission throughout the year. The environment in the study area is conducive for the breeding of Anopheles mosquitoes. This includes the natural habitat and environmental conditions in and around villages. Transmission occurs throughout the year with peaks in the hot and wet summer months (November to April (22).
- Key informants considered poor housing and a suitable environment for the breeding of mosquitoes as important factors in the high burden of disease. This was coupled with poor awareness and prevention practices.
- The clinical managers interviewed all considered the burden of disease due to malaria as one of the main health challenges.
- In the FGD, malaria was highlighted as the biggest health challenge and that prevention practices were not always adequate.
- A mass bednet distribution campaign was conducted in 2017, but most respondents in the FGDs reported that not enough nets were distributed per household and not all of the family residents can sleep under one.
- No active vector control programmes (indoor residual spraying) are on-going in the district

Arbo-viral infections that are transmitted through the bite of a day-time biting mosquito from the *Aedes* group are poorly documented in Mozambique. This is generally due to limited recognition and diagnostic challenges but it is likely that both dengue and chikungunya fever either occur, or have a risk of occurring, in the study area, particularly along the coast. These mosquitoes have the preference to breed in man-made containers such as drums or tyres.

8.2.2.2 Potential Direct Impacts

- **Alteration of the physical environment:**

Localised areas where the physical environment is altered or manipulated to support construction or operational activities may increase the available breeding habitats for mosquitoes and other vectors to breed in. This may potentially increase the number of suitable vector breeding sites leading to increased mosquito densities with an increased biting rate potential.

This is most relevant in construction but may extend into operations. The following are noted risk areas:

- Increased potential for malaria (generally localised to where activities are occurring), including:
  - General clearing of ground;
  - Development of borrow pits;
  - Development of roads with drainage furrows;
  - Rutting on access roads; and
  - Construction yards etc.
- Increase potential for arbo-viral conditions:
  - Shipping of products and equipment from international destinations where arbo-viruses such as dengue and chikungunya are common- for example Asia, may lead to localised introduction of these conditions (or an increase rate of disease transmission) into the study area.

The temporary beach landing area and associated lay-down yards are especially high risk areas as infected larva and eggs may be transferred from the point of origin in goods or packaging that can collect water; especially man-made containers such as tyres, drums or other receptacles. Importantly, mosquitoes that transmit dengue and chikungunya fever do not have to acquire it from a human host before they can transmit it to other humans, as eggs or larva can emerge already infected with the virus with resultant local transmission.

- **Workforce implications:**

Malaria is a direct risk to the health of the workforce and workplace productivity, in both those living in site provided accommodation and the local community. The disease can have significant workplace impacts including:

- Absenteeism through repeated infections will have a significant impact on productivity and increased costs. It is estimated that an expatriate non-immune employee will take at least 5-7 days to reach optimal productivity after an uncomplicated case of malaria and a semi-immune local employee 2-3 days.
- Health and safety risks: Patients with malaria who still work may pose a risk to fellow employees and themselves. The effects of the disease and the treatment drugs may reduce alertness and some medications may reduce hearing sensitivity.
- Increased cost of overall health care: The cost of malaria management through large caseloads can become significant. An uncomplicated case of malaria may cost about US$20-$25 to manage, without considering human resource and initial capital expenses. The impact of a complicated case of malaria, that may require medical evacuation and extended hospitalization in an ICU setting, can be very costly, and may run into tens of thousands of dollars.
- Increased burden on the medical service: High caseloads of malaria will take a significant amount of time in the medical service and limit the effectiveness of other health programs, such as occupational health programs, health promotion and prevention activities.
- Employee turnover and attractiveness: Exposure to risk may decrease the ability to attract skilled staff to work in the area. Repeat infections and decreased morale from the risks related to the disease may also increase employee turnover.
- Employer liability: The risk exists for an employer to be held liable for complications that may arise from an infection, especially if mitigation measures have not been put in place

These potential risks are more likely in construction when there is more alteration of the environment and shipping of goods. They will however extend into operations due to the permanently altered environment, but to a lesser extent. The impacts will be localised to where Project activities are likely to occur.

EHA 1 – Vector related conditions- due to direct impacts					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		
Operations	YES				

8.2.2.3 Potential Indirect Impacts

- **Project induced in-migration:**

PIIM and movement of people in and out of the area, as well as the development of makeshift settlements, or the unplanned expansion of existing settlements with poor environmental health conditions may affect local vector related disease transmission patterns, in the following ways:

- Increasing the burden on limited basic services including adequate housing, waste management and health services (including care and effects of programs such as bednet distribution).
- Make-shift settlements with associated poor housing (if it occurs) will reduce natural protection against mosquitoes entering houses.
- Unchecked development with no planning for drainage or general domestic garbage/waste management may also alter the physical environment and create improved vector breeding sites, which may increase vector densities and risk for disease transmission.
- Continuous movement and an increased concentration of people from outside the area may increase the circulating reservoir of the malaria parasite and increase the risk for disease transmission as the parasite may be continually introduced from other areas. This may undermine any control programmes.

This potential indirect impact is cumulative in nature to the existing Sasol activities. The potential impacts are likely to be localised to areas where PIIM is likely to occur and as with other EHAs will be more marked in construction but may extend into operations

EHA 2 – PIIM					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

Table 15: Impact evaluation: EHA#2- Vector related diseases

Indicator of potential impact	**Pre-mitigation**					**Post-mitigation**				
	Magnitude	**Duration**	**Geographic Extent**	**Probability**	**Significance**	**Magnitude**	**Duration**	**Geographic Extent**	**Probability**	**Significance**
Vector related diseases in construction	6	4	2	4	**Moderate 48**	6	4	1	2	**Low 22**
Vector related diseases in operations	6	4	2	3	**Low 36**	6	4	1	2	**Low 22**
Vector related diseases in decommissioning	6	2	1	3	**Low 27**	6	2	1	2	**Low 18**

8.2.2.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline.

These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.

- Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
- Extend specific community based malaria and vector controls as part of the recommended communicable diseases strategy. Ideally this should be performed in partnership with the CPF and consider:
  - Support maintaining effective environmental health controls in the communities in close proximity to the Project and where influx has occurred and likely to occur in the future. The aim will be to address source reduction and vector densities through environmental control mechanisms by developing “Clean Community Campaigns”. These can be managed by local community based organisations in partnership with the communities with potential incentives to communities based on performance. These initiatives can possibly present additional value as a number of cross-cutting environmental health issues can be addressed in this way (for example hygiene and sanitation).
  - Evaluate opportunities to work with the district health authorities and national malaria control programme in extending support to deliver elements of the national programme in the local and broader study area. This will need to be investigated with these bodies but can include:
    - ✓ Logistics support of the supply chain of diagnostic kits and medications to the health centres,
    - ✓ Logistics support of the supply chain of insecticide treated bednets to the community;
    - ✓ Support with training and provision of diagnostic test kits to recognise potential cases of arbo-viral disease (especially dengue);
    - ✓ HSS of the APEs to support community based integrated management of childhood illness and advocacy on malaria prevention activities; and
    - ✓ Improved collection of data on the burden of disease from malaria and arbo-viral diseases. This information should be collated for use in the proposed CHIS as part of key indicator monitoring.

- Occupational health, safety and environmental management:
  - Use as a guideline (with review and as applicable revision) the malaria and vector control c-EMP developed for the CPF phase and adapt to the needs of the Project (including CMR). This should be included as part of the overall integrated communicable disease strategy, managed by a specialised team (or team that is trained) to consider the following workplace elements:
    - Develop and maintain strict environmental controls around earth works and related construction activities, so as to avoid the development of suitable vector breeding sites. Where environmental controls are not possible consider other options for source reduction including:
      - ✓ Covering of areas where water may collect as soon as possible.
      - ✓ Limit rutting on Project roads or water collection on road verges.
      - ✓ Limit earth-moving activities (such as borrow pits) to areas away from human settlements if this is possible.

- ✓ Consider larval source management with biological or chemical agents- with this managed by the vector control team. This should include considerations for mosquitoes that transmit arbo-viruses and include avoidance of collection of water in man-made containers (such as tyres) with the temporary beach storage area and construction lay-down yard especially important areas to manage these potential sources.

- Awareness and education programmes in the workforce on how to prevent and effectively treat malaria.
- Bite prevention activities including effective physical barriers to prevent mosquito entry into accommodation units (screens), use of insecticide treated bednets and insect repellents.
- Develop a policy on the use of and compliance to malaria chemoprophylaxis in the non-immune workforce.
- Chemical vector control programmes
- Effective case management in the early detection and effective treatment of malaria and arboviral conditions.

- Malaria control activities should extend into operations with a slightly different focus. The o-EMP developed and currently on-going at the CPF can be reviewed and revised as applicable.

- Social development mitigation and management:
  - Extend support of the national malaria control programme into the local communities but in a longer term more strategic focus including elements such as indoor residual spray.

8.2.3 EHA #3 – Soil-, Water- and Waste-related Diseases

8.2.3.1 Baseline Description

Water, sanitation and hygiene related determinants and conditions are a significant challenge nationally and in Inhassoro district, with key findings including:

- The communities in the study area generally relied on groundwater sources, mainly from improved standpipes for their water supply. However, in many instances there was only one functional hand-pump for the entire village and therefore shallow hand dug wells (unimproved sources) were also used to supplement demand. The social baseline reported that 47% of respondents had their main source of water from a protected standpipe, with 30% obtaining their water from an unprotected well (21).
- Key informants reported that less than a third of residents in the district had formal toilet facilities. This was validated in the FGD were respondents reported that the majority of households lacked toilet facilities with this related to poverty (unable to afford a construction of a pit latrine) as well as a culture of indiscriminate disposal of waste. In the social baseline 58.4% of respondents reported that they use an unimproved (traditional) pit latrine as the main source, with this highest in the communities of Mangugumete (97.1%), Litlau (84.4%) and Maimelane (82.4%). Access to an improved latrine (with a slab) was only reported in 3.2% of the cases and 40% reported that they buried waste in the bush (indiscriminate defaecation).
- The clinical managers interviewed all considered the burden of disease due to inadequate access to water and reliable sanitation as one of the main health challenges.
- Disposal of household waste (garbage) was a challenge with no organised waste collection system. Waste was moved to the edge of yards and burned or disposed of in open fields or pits.

- Diarrhoeal diseases contribute to about 6% of the overall burden of disease in Mozambique and are in the top five most important communicable disease risks. These conditions are also a leading cause of morbidity in Inhassoro due to the challenges related to clean drinking water and sanitation. Cases of dysentery and typhoid occur and while the district is at risk for cholera outbreaks so cases have been reported in the last 5 years.
- Soil transmitted helminths (intestinal and skin parasites) are common in Inhassoro but there is good preventive chemotherapy coverage in school children and pregnant women.
- Urogenital schistosomiasis (bilharzia) is likely to occur but there is no data on the occurrence and preventive chemotherapy is low. The wetlands and Govuro River that occur in the study area are likely to represent a high risk location where the disease can be transmitted.

8.2.3.2 Potential Direct Impacts

- **Water quality and quantity:**

Water will be required to support the construction and operations of the Project, as well the domestic needs of the accommodation camps and offices. Based on current plans this water will be sourced from groundwater sources on the proposed plant site with the potential to impact on water quality and quantity discussed in section 8.2.9.2 and the respective specialist bio-physical studies on water quality.

- **Pollution of surface and groundwater sources:**

The potential for pollution of surface and superficial groundwater sources will also be described in section 8.2.9.2 and the relevant biophysical study. However, the most significant community health risks related to direct Project activities include:

- Discharge of inadequately treated water from the waste-water and sewerage treatment plants.
- Contamination of water from domestic waste from accommodation camps
- Spills of hydrocarbons or hazardous chemical substances on-site (in workshops etc.) or along transport corridors due to accidents or inappropriate handling.

The potential for these risks will be more marked in construction with the movement of products, but the draw down potential of water from ground water sources and potential for pollution of water bodies from domestic or camp activities will extend from construction for the duration of operations. The potential spatial impacts are considered below.

EHA 3 – Direct impacts on water quality and quantity					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

8.2.3.3 Potential Indirect Impacts

- **Project induced in-migration:**

As mentioned in other sections the potential impacts associated with PIIM will be cumulative in nature.

While access to water was generally from an improved source in communities that have experienced influx, there are not enough sources to meet the current demand, and an increased number of people will add to this constraint. Importantly, quality of water is not the only determinant in access to a safe water supply with time to collect, and water quantity playing an important role as summarised in Table 16. Therefore, reduced quantities may reduce access to a quality water supply in the PACs.

Access to sanitation services was limited and any increase in demand will potentially lead to a worsening of the already poor environmental hygiene conditions in the PACs and a potential risk in contaminating surface and superficial ground water bodies with human, animal and domestic waste.

There is limited capacity in the district authorities to plan for, or to develop the infrastructure required to support these potential increased needs.

Due to this there is an increased risk for an increased burden of disease from diarrhoeal diseases, including the potential for outbreaks.

This indirect impact is likely to be localized to areas where PIIM is likely to occur and as with other EHAs will be more marked in construction but may extend into operations.

EHA 3 – PIIM					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

Table 16: Water and levels of service

Service level	Distance/time measure	Likely quantities collected	Level of health concern
No access	More than 1000m or 30 minutes total collection time.	Very low (often less than 5 litres per consumer per day (l/c/d)).	Very high as hygiene not assured and consumption needs may be at risk. Quality difficult to assure; emphasis on effective use and water handling hygiene.
Basic access	Between 100 and 1000 m (5 to 30 minutes total collection time).	Low. Average is unlikely to exceed 20 l/c/d; laundry and/or bathing may occur at water source with additional volumes of water.	Medium. Not all requirements may be met. Quality difficult to assure.
Intermediate access	On-plot, (e.g. single tap in house or yard).	Medium, likely to be around 50 l/c/d, higher volumes unlikely as energy/time requirements still significant.	Low. Most basic hygiene and consumption needs met. Bathing and laundry possible on-site, which may increase frequency of laundering. Issues of effective use still important. Quality more readily assured.
Optimal access	Water is piped into the home through multiple taps.	Varies significantly but likely above 100 l/c/d and may be up to 300 l/c/d.	Very low. All uses can be met, quality readily assured.

Table 17: Impact evaluation: EHA#3- Soil, water and waste related diseases

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Soil, water and waste related diseases in construction	6	4	2	4	**Moderate 48**	6	4	2	2	**Low 24**
Soil, water and waste related diseases in operations	6	4	2	3	**Low 36**	6	4	1	2	**Low 22**
Soil, water and waste related diseases in decommissioning	6	2	2	2	**Low 20**	6	2	2	1	**Negligible 10**

8.2.3.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - Develop and implement environmental control measures for surface and ground water as part of c-EMP and o-EMP. This should include a review and application of the Water and Effluent Management as well as c-EMP and o-EMP.
  - Ensure open and transparent communication with potentially affected communities on water quality and water availability as per the Project specific Grievance Procedure and Compliments and Complaints Register c-EMP and o-EMP.
  - HSS to improve reporting of key water and sanitation related indicators for recording in the proposed CHIS.
  - HSS to support an improved outbreak response capability in the district to enable an effective response to a suspected diarrhoeal disease outbreak (e.g. cholera) as these can have potential business resilience and continuity risks.
- Occupational health, safety and environmental management:
  - Effective management of waste-water from the Project construction camp and related facilities, including sewerage treatment plants and discharge of waste water.
  - Conduct awareness and campaigns in the workforce (include contractors) on hygiene and sanitation to prevent pollution of community water sources.

    It is especially important to include field work crews that may work in proximity to communities.

- Provision of chemical (or portable toilets) in remote work areas away from formal toilet infrastructure to prevent the need for the workforce to use the bush. Develop codes of practice that encourage the use of these facilities.
- As some workers will reside in the hotel or lodge in Inhassoro to support the temporary beach landing activities it is important that the waste management practices from these institutions is acceptable so as not to cause an indirect association impact. Therefore, these should be subject to review to ensure they are of the correct standard in selecting the facility.

- Social development mitigation and management:
  - Consider supporting specific water, sanitation and hygiene programmes in the wider community, especially increasing the number of improved community water points, development of latrines and waste management. These can be managed as per the 'Clean Community Campaigns' mentioned earlier as part of a broader environmental health management initiative.

8.2.4 EHA #4 – Sexually-transmitted Infections and High Risk Sexual Practices, including HIV/AIDS

8.2.4.1 Baseline Description

In 2016, an estimated 1.8 million Mozambicans were living with HIV and there were 83,000 (73,000-96,000) new HIV infections and 62,000 (50,000-73,000) AIDS-related deaths. Other relevant data includes:

- The national HIV prevalence (adults 15-49 years) was recorded at 13.2% in 2016, increasing from 11.5% in 2009. Women are disproportionately affected, recording a prevalence of 15.4% compared to men at 10.1% (22). The prevalence in Inhambane was similar to national rates, with no local data available.
- High risk populations in Mozambique include sex workers and their clients, gay men (together contributing 28.7% of new HIV infections), prisoners, and mobile and migrant workers (e.g., miners, agricultural workers and truck drivers). Adolescent girls and young women are also considered vulnerable to HIV infection due to transactional or intergenerational sex.
- HIV/AIDS is the leading cause of adult morbidity in Inhassoro District. Around 30% of hospitalisations in the district in 2016 were due to HIV, but this fell to 11% in 2017 (22).
- All three clinic managers from the various health facilities visited in the baseline reported that HIV and sexually transmitted infections (STIs) were in the top three causes of morbidity in their clinics. In addition, all three respondents reported that there was need to improve health promotion and education programmes to support behaviour change.
- In terms of HIV services in the district (22):
  - HIV testing services were available in all the district health facilities, including the health posts.
  - HIV treatment and care services (including access to anti-retroviral therapy) were available in four health facilities, including the two Type 1 Health Centres (Inhassoro and Mangugumete).
- Findings from FGDs show that HIV is one of the biggest challenges for the local communities, with the following observations:
  - While there was good knowledge on how HIV was transmitted and could be prevented, there were misconceptions and high levels of stigma were noted.
  - The stigma and concern related to the disease reflects in the relatively low uptake of testing for HIV.

- Condoms were available from the health centres but there were inadequate distribution channels so use remained low.
- Multiple sexual partnerships were noted to occur.

- While not documented in the district health reports, it was reported from the key informants that STIs were relatively common in the study area, with an increasing trend:
  - The social baseline evaluated sexual exploitation and determined that there was a sexual network in the study area, especially at the end of the week ('salary Friday') when local male youth contact the local women to see who would be interested in engaging in transactional sex from workers from the CPF (mainly expatriates). In the evening workers would enter the taverns in the central area of Mangugumete village and make contact with the 'pimps' to see what has been arranged. They would then make contact with a girl and overnight in a local hut and return to the plant in the morning.
- The 2017 EIA for the future exploration, appraisal and development activities in Sasol licence areas noted:
  - Inhassoro district was noted as an area with the potential for high population growth rates, with the potential that rates of STIs and HIV may increase in association with the population movement and weak health system.
  - Sasol has run information and awareness campaigns on HIV/AIDS in previous years- linked to the CPF development.

8.2.4.2 Potential Direct Impacts

The potential for exposure to gender-based violence and sexual exploitation and abuse is discussed in the social impact assessment.

- **Reputational risk:**

Although not an impact as such, there is a significant reputational risk for the Project as similar projects have had an unfortunate legacy of increasing rates of STIs and HIV as an indirect result of their activities. In addition to the health impacts, there is the potential that the Project can be accused of human rights abuses to vulnerable groups in the study area, either directly or as a result of corporate inaction. These reputational risks extend to criticisms from shareholders, local communities, government and general civil society.

- **Workplace risk:**

The workplace health risk related to HIV/AIDS and the impact on business have been well described in literature and will require planning and mitigation both from the community health perspective as described above, but also for workplace health, productivity and business resilience

- **Project workforce and associated behaviours:**

The development of the Project has the potential to increase STIs and HIV transmission in the study area, which includes the PACs in proximity to the proposed construction site, the temporary beach landing and offload area, as well as along local and regional transport corridors.

The incoming semi-skilled and skilled workforce may originate from areas where the HIV prevalence rates may be significantly higher and also carry different viral strains than what occur locally (for example other areas of Mozambique or the sub-region). The risk will be highest during the construction period due to the casual mobile temporary construction workforce who move from project to project, away from their family units, often in different regions in remote settings.

Due to potential high-risk practices linked to casual sexual relations, these male dominated groups often have higher rates of STIs and HIV and are a recognized high-risk group that can cause increased transmission of STIs in the local community.

In addition, this group often has higher levels of disposable income and thus may engage in transactional sexual relationships with the community and even local employees. This can extend to attract formal commercial sex workers to the area (not difference between casual transactional sex and formal commercial sex) who are more likely to have higher rates of STIs and HIV and coupled with additional social ills may give rise to STI transmission risk.

The workforce is likely to be predominately male and based on literature and from precedence in similar Projects, is more likely to engage in high-risk sexual encounters, especially in a society where women are vulnerable to sexual advances (especially transactional given the high levels of poverty in the area) and have a limited ability to negotiate safe sex practices.

Plans are such that the accommodation construction camp will have restricted access to the community and to the workforce during work hours. However, the workforce will not be restricted to camp outside of work hours and on off periods on weekends (especially Sundays). In addition, a portion of the workforce will reside in a lodge in Inhassoro and this will provide the opportunity for the workforce to engage and mix with the local community.

The potential impact will persist into operations as has been noted with the CPF activities, in a cumulative manner. However, the potential inherent risk will be markedly lower as the size and type of workforce will be reduced.

EHA 4– Project workforce and associated behaviours					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES	YES	YES
Operations	YES		YES		YES

- **Transport corridors:**

There is the potential for increased high-risk sexual encounters along the transport corridors to and from the study area, especially along the EN1 but also along the R241 and around Inhassoro. Transport workers are a well-described high-risk group and are known to have multi sexual partners and to develop sexual networks along transport corridors - so called “core-spreaders”. It is noted that this impact will be cumulative in nature and also be associated with logistics to the CPF and other non-Project related activities. The 2017 EIA that outlines the future expansion and appraisal of Sasol activities in the wider area highlights that there are known HIV/AIDS hotspots along the EN1 due to the presence and behaviour of long distance truck drivers (23). Therefore, this potential cumulative impact needs to consider the increased practice of high risk sexual activity along the whole transport route but also in the local study area as an end destination.

The transport corridors and public roads in the local study area are also important to consider as the limited local public transport system will promote the potential to offer lifts in exchange for sexual favours from drivers (of light duty vehicles).

EHA 4– Transport corridors					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES	YES	YES
Operations	YES		YES		YES

- **Altered economics and transactional sex:**

While the area has experienced local economic development there are still high levels of poverty in the area, with women and young girls especially vulnerable as they may have limited participation in the local cash economy. Increased levels of disposable income may give rise to forms of transactional sex, where women may be enticed into sexual encounters to supplement their household income, especially vulnerable from advances of men with money. Cultural norms may also make it difficult for a young woman to refuse sexual advances and this vulnerability will make it challenging to negotiate safe sex practices, such as the use of condoms. Young girls may also be vulnerable to trans-generation sex ('sugar-daddy' or 'blesser' phenomenon) where they are given payment, or payment in kind in the form of material goods, for sexual favours and companionship (food, clothes, airtime and other gifts). This is a real risk given the present high rates of teenage pregnancy and transactional sex in areas.

Men who benefit directly and indirectly from the Project in monetary terms also need to be considered in the altered economics, as weak financial management may mean that money meant for the family unit is spent on personal effects or entertainment to the detriment of the household. As women need to provide for the needs of the household they may be forced, or more readily enticed into forms of transactional sex to support the needs of the household.

These potential impacts are again cumulative in nature as they can be influenced by activities of the CPF. The spatial impact will be especially felt in PAC1 in construction and operations, near Inhassoro in construction and along the transport corridors.

EHA 4– Altered economics					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

8.2.4.3 Potential Indirect Impacts

- **Project Induced In-migration:**

PIIM is also an important factor related to mobility and the introduction of new strains of the HI virus and other STIs. Mixing of people with higher STI prevalence rates may promote the increased transmission of disease.

This potential impact is again cumulative in nature with the CPF and previous Sasol activities leading to localised in-migration. However, if this is significant it may lead to the development of make-shift settlements or localised overcrowding, with a limited capacity of the local authorities to anticipate or manage this effectively. The relative weak health system may also be unable to cope with an increase in disease burden.

As with other sections this is likely to be experienced in a localised area.

EHA 4 – PIIM					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

Table 18: Impact evaluation: Construction: EHA#4- Sexually-transmitted infections and high risk sexual practices, including HIV/AIDS

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Sexually-transmitted infections and high risk sexual practices in construction	10	4	3	5	**High 85**	8	4	3	3	**Low 45**
Sexually-transmitted infections and high risk sexual practices in operations	10	4	3	4	**Moderate 68**	8	4	3	2	**Low 30**
Sexually-transmitted infections and high risk sexual practices in decommissioning	10	4	2	3	**Moderate 48**	8	4	2	2	**Low 28**

8.2.4.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - As part of the proposed communicable diseases strategy develop and implement a clear management of the spread of HIV/AIDS and STIs policy and plan. This should align with the c-EMP previously developed for the CPF project with relevant revisions/ adjustments. This should include specific CMR provisions. Activities of the plan should be reported on. Workplace activities are described below with interventions in both the workforce and community including:
    - Information and awareness campaigns on HIV/AIDS and STIs in both the community and the workplace

- Support for widespread availability and social marketing of condoms in the workplace, hot spots in the community (bars and taverns) and at the lodge/hotel in Inhassoro.

- Align with the current HIV/AIDS and sex worker management o-EMP that is on-going for the CPF with relevant adjustments for the Project.
- Evaluate the status of the camp and consider developing procedures to maintain a closed camp status to reduce opportunities of transactional sexual activity between the employees/contractors and vulnerable local communities. Ideally, this should be in place and strictly enforced in all contractors.
- Develop a plan with lodge/hotel management in Inhassoro to limit the entry of commercial sex workers onto the hotel property and for Project related residents to invite women (or men) into their accommodation.
- Develop a code of conduct that restricts fraternization:
  - From the workforce with the local communities with a CMR developed that includes severe sanctions for non-compliance.
  - Within the workforce and especially towards female employees that originate from the local community, as this group (especially cleaners and catering staff) may be vulnerable to advances from the male dominated workforce. This should specifically include a CMR and sanctions for non-compliance.
- As part of the Traffic Access and Safety Management Plan c-EMP and o-EMP consider developing the following:
  - A specific HIV and STI prevention programme for long distance truck drivers. Awareness and education programmes and promotion of condom use will be important interventions. This will require contractor support and management and should include the road transport corridor. Consider NGO implementing partners that can support IEC programs along the transport corridors (for example Pathfinder). These should ideally be performed in association with the CPF.
  - Restrictions for Project associated vehicles (including contractors and service providers) from providing lifts to the local community.
  - Consider the placement of Project specific truck stops within the Project fence line to prevent trucks stopping or overnighting in the local community. This should include the lay-down yard in Inhassoro as well as at the proposed plant site, and drivers should be provided accommodation and meals within these areas (or in the camps). Develop CMRs to enforce and monitor this.
- Support HSS activities in the local health centres and with the APEs on the management of HIV, TB and STIs. Support improvements in the local ability to collect and report on data that feeds into the DHIS to support longitudinal data collection and analysis from this source. This information should in turn be fed into the CHIS as part of key disease indicator surveillance.

- Occupational health, safety and environmental management:
  - In addition to the elements above, the following should be considered as part of the communicable disease strategy on the management of the spread of HIV/AIDS and STIs policy and plan in the workplace:
    - Screen for STIs & hepatitis B/C virus as part of pre-employment fitness to work process. This should not restrict the final offer of employment, but all identifies cases that should be treated.

Individuals who test positive should be referred for counselling to consider undergoing an HIV test.

- Develop a HIV testing and care/treatment programme based on the 90:90:90 principle[11] that includes the workforce and contractors. Treatment should be done in conjunction with the individual's private insurer, company or the public sector so that at the end of the construction or when the person leaves the Project they are maintained on treatment.

- As part of the Camp Management Standards, ensure adequate entertainment and recreational facilities in camps to prevent the need for the workforce to seek entertainment opportunities in the community.

- Social development mitigation and management:
  - Support HSS activities that may include:
    - Support awareness and behaviour change communication activities in the communities. The APEs will be a valuable intervention advocates but should also consider large scale community interventions using a variety of media (e.g. edutainment, sports events etc.)
    - Improving the ability to diagnose and treat HIV and STIs, including effective adherence programmes.
    - Strengthen prevention of mother to child transmission programmes and data management of pregnant mothers as an indicator of HIV in the surrounding communities.
  - Evaluate opportunities for the empowerment of women and girls in the area to support livelihoods and reduce vulnerability of transactional sexual relationships.

8.2.5 EHA #5 – Food- and Nutrition-related Issues

8.2.5.1 Baseline Description

Malnutrition is a significant challenge nationally due to chronic food insecurity, lack of a diversified diet, high levels of infectious disease and vulnerability to natural disasters. Key baseline findings include:

- The majority of respondents in the FGD reported that there is a chronic insufficiency of food, with many households only eating one to two meals per day. There was a lack of a diversified diet with carbohydrates dominating meals (cassava, rice and maize) with beans and available vegetables used to supplement the dish. Fish is available at times, while other animal proteins (chicken, meat, or milk) are a rarity. Consumption of dairy products was rare. However, even with these challenges the respondents did not mention malnutrition as a major perceived health concern.

- Food inflation was important locally as many of the respondents reporting that they needed to buy food to supplement what they grow. Prices were reported to be increasing making it challenging to buy essentials such as maize flour, rice, oil and sugar.

- Fishing played an important role in the local economy and the area supports artisanal (at subsistence level), commercial and sports fishing. Inhassoro was well recognised for its excellent fishing. Fisherman were interviewed near the three beach landing areas with the following key findings (21):
  - Many have been fishing for most of their lives.
  - They use small boats (sail or motorised).

[11] The 90:90:90 principle has the target that 90% of a population is aware of their HIV status; 90% are on ART; and 90% having a reduction in viral load

- Catches are sold on the beach at an informal fishing market.

- Malnutrition was important nationally with it contributing significant to deaths in children under 5 years of age. Based on national surveys, stunting (an indicator of chronic malnutrition) and wasting (an indicator of acute malnutrition and food insecurity) rates were high, with similar statistics were not available in the district.
- It is likely that cases of mild and moderate malnutrition were not adequately recognised in the district as there are no specific screening programmes for children after the initial routine vaccinations are completed at one year of age. However, there are not many cases of severe acute malnutrition reported from the local health facilities.
- Anaemia was a local challenge, especially in children and pregnant women but accurate statistics were not available.

8.2.5.2 Potential Direct Impacts

- **Positive due to economic benefits:**

While this will be cumulative in nature with the CPF and other developments, the development of the Project should have a positive impact on the local economy. This is discussed in more detail in the socio-economic assessments, but as a general principle if sectors of the community benefit from the Project (directly or indirectly) it can stimulate the local economy and deliver benefits in reducing poverty and enabling the community to support their nutritional requirements, afford better healthcare services, improved education etc.

This potential benefit will be most marked at the local level but should extend into the broader study area, especially if effectively supported.

EHA 5 – Local economic benefits on nutrition					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		
Operations	YES	YES	YES	YES	

- **Physical resettlement and economic displacement:**

While impacted households were compensated in 2014 the potential for physical relocation or economic displacement due to the Project activities is subject to on-going studies. This is important as reduced access to land for farming or other related subsistence activities may affect local livelihoods and potentially food security.

Based on current assessments the temporary beach landing should not impact on local fishing activities, but this is subject to an on-going study. Fish and products from the sea are an important local source of protein and impacts on access to fishing grounds has the potential to impact on food security and dietary diversification.

This potential impact is likely to be experience in a localised area and should be addressed as part of any resettlement activities. Potential impacts at the temporary beach landing site will be experience for the duration of these activities.

This is further discussed in the social impact assessment.

EHA 5 – Physical resettlement and economic displacement					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

8.2.5.3 Potential Indirect Impacts

- **Project Induced In-migration:**

PIIM may potentially affect nutrition in the following ways (noting this as a cumulative potential impact):

- Increased demand for food products may create food inflation and make vulnerable groups more susceptible to escalating food prices that were already described as expensive. Certain vulnerable groups may have limited access to the cash economy, which may limit their procure food products especially if they increase in price.
- Uptake of arable land for housing and other unplanned developments may limit the available land to cultivate food crops. Subsistence farming plays an important role in local food security and loss of land can impact on this. New arrivals may also not have access to suitable arable land, potentially leaving them as a vulnerable group.
- Increase demand on food products and especially fish may lead to an over-exploitation of the resource with limited catches. This will reduce available fish to buy or increase prices.
- Theft of crops may become an issue in the area if there is competing interests for land and availability of food. Other than the social challenges this may lead to early harvesting of crops to avoid theft with associated impacts on food security and nutrition.

As with other sections this potential impact is likely to be experienced in a localised area.

EHA 5 – PIIM					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

- **Infectious diseases:**

Malaria and intestinal parasites are major contributory factors towards malnutrition and sustainable improvements in nutritional indicators will not be realized without supplementary programs in these areas.

The comorbid role that infectious diseases play in malnutrition is also extremely important as sustainable improvements in nutritional indicators will be not be realized without supplementary programs in these areas. For example, malaria and intestinal parasites can cause or contribute toward micronutrient deficiencies such as anaemia and this is an extremely powerful indicator to monitor as it may be influenced by a number of factors and can thus provide an overall indication of well-being.

Table 19: Impact evaluation: Construction: EHA#5- Food and nutrition related issues

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Food and nutrition related issue in construction	8	3	2	4	**Moderate 52**	6	3	2	3	**Low 33**
Food and nutrition related issue in operations	8	3	2	3	**Low 39**	6	3	2	2	**Low 22**
Food and nutrition related issue in decommissioning	8	2	2	2	**Low 24**	6	2	2	2	**Low 20**

8.2.5.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - Depending on the outcome of the resettlement and displacement studies that are on-going ensure that food security risks are considered as part of the Onshore Compensation & Resettlement Plan c-EMP.
  - Develop and implement the CHIS to longitudinally monitor the nutritional status in the PACs and broader study area. This may require specific HSS and use of APEs. A baseline may need to be established as part of this, which may entail conducting a nutrition and micronutrient deficiency (anaemia) survey.
- Occupational health, safety and environmental management:
  - Support workplace communicable disease strategies as discussed in other sections.
- Social development mitigation and management:
  - Evaluate opportunities to create local economic development initiatives associated with agriculture, farming and getting goods to market as well as other entrepreneurial activity. This should have the objective of supporting local food security and generating sustainable improvements in livelihoods.
  - HSS including community based integrated management of childhood illness and nutritional surveillance (middle upper arm circumference, wasting and stunting) through APEs.

8.2.6 EHA #6 – Non-communicable Diseases

8.2.6.1 Baseline Description

Non-Communicable Diseases (NCDs) are poorly described both nationally and locally due the weak health system that is prioritized on maternal and child health and the high burden of communicable diseases. In addition, there is relatively low awareness of these conditions in the community with limited health seeking behaviour for screening or effective management of the conditions.

Key findings related to NCDs include:

- These conditions are an emerging challenge in the district with especially hypertension reported to occur commonly and with increasing frequency. While hypertension was reported in the top 4 conditions from Mangugumete clinic the actual incidence was not clear (nor in the other facilities) due to poor health seeking behaviour, limited access to health care services and lack of recording of this type of data. A national survey (in 2009) reported that as many as 33% of Mozambicans suffer from hypertension, with this figure now likely to be significantly higher. Of these 85% were not aware of their condition with the impacts of the disease usually manifesting when complications emerge.
- Data on the burden of diseases from other NCDs (e.g. diabetes, chronic lung disease, cancer) at district or community level were not available.
- It was reported to be challenging to manage NCDs as the community struggle to adhere to the follow up medical requirements or the need to take medication on a chronic basis. The health services are also weak with limited experience in dealing with these conditions, lack of specialised care and a lack of suitable (and affordable) medication to manage conditions.
- Cancers were rare and usually detected at a late stage and depending on the means of the individual referred to the hospital in Vilankulo or Inhambane.
- Risk factors for these diseases include tobacco smoking, indoor air pollution, outdoor pollution, allergens and occupational exposure (asbestos, silica, certain gasses). According to 2014-2019 national strategic health plan nearly one-quarter of Mozambican men (15-64 years) use tobacco compared to only 3% of women (1). The use of biomass fuel (wood and charcoal) is also an important risk factor for the development of chronic respiratory disease.

8.2.6.2 Potential Direct Impacts

Other than chronic airways disease from reduced air quality (discussed in section 8.2.9), there should be no other direct community health impacts from NCDs, but the local population who are employed by the Project (and their families) will likely have an improved economic status and the potential ‘well- worker” benefits may lead to lifestyle related risks that can lead to the development of NCDs. This poses a significant business risk (due to absenteeism and loss of trained skilled people) in a similar manner to HIV, but long-term complications may be more challenging to manage.

8.2.6.3 Potential Indirect Impacts

- **Local economic development and lifestyle related changes:**

Indirect impacts attributable to Project influences are likely to be of low significance and related to local economic development. These are likely to be localised with changes in life-style and eating habits potentially pre-disposing the community to conditions including obesity, hypertension, diabetes, dental caries and some forms of cancer. Further, a shift in the burden of disease to these chronic conditions has the potential to place pressure on the already weak local health care system that has a limited current ability to effectively manage these types of conditions.

The emergence of these types of conditions is difficult to predict at the local level and any impacts will at best be cumulative in nature. Mitigation and management at the local level is however important to consider in the short term due to the insidious nature of these diseases and associated long term consequences, especially in the workforce and their extended families. Due to their chronic nature they are more likely to become apparent in operations and be more relevant in this period.

EHA 6 – Non- communicable diseases					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES				
Operations	YES	YES	YES	YES	

Table 20: Impact evaluation: Construction: EHA#6- Non-communicable disease

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Non-communicable diseases in construction	8	2	2	3	**Low 36**	8	2	2	2	**Low 24**
Non-communicable diseases in operations	8	4	2	4	**Moderate 56**	8	4	2	3	**Low 42**
Non-communicable diseases in decommissioning	8	4	2	1	**Negligible 14**	8	4	2	1	**Negligible 14**

8.2.6.4 Proposed Management Measures

- Occupational health, safety and environmental management:
  - Develop wellness programmes in the workforce that include:
    - Awareness and education programs on nutrition and dietary practices, exercise and management of modifiable risk factors (smoking, salt and sugar intake etc.).
    - Manage the onsite catering facilities in the type of food and the size of portions that are provided. Seek guidance form dieticians to support the design of menus in the canteens.
    - Screen for NCDs as part of fitness for duty medical surveillance requirements. Use these opportunities to support health promotion activities. Surveillance of weight or body mass index as a predictor for NCDs can be used and supported by aggressive routine screening for hypertension, cholesterol and diabetes in higher risk groups, especially those working in safety sensitive roles.
    - Ensure the on-site medical service is able to recognize, manage and effectively follow up chronic diseases. This will require specialized diagnostics including the use of Hb1Ac surveillance in diabetics and screening for early kidney, eye and heart disease.
- Social development mitigation and management:

- Support HSS to support the surveillance of key NCDs in the proposed CHIS in collaboration with the district health authorities. These should include hypertension, diabetes, non-infectious chronic lung disease and cancers.
- Support school-based awareness and education programmes as they are the generation who are most likely to be affected by these diseases in the medium to long term. Work with the local educational authorities to incorporate these programs into the local curriculum and support sporting and other interventions that encourages exercise and a healthy lifestyle. These sporting activities are ideal opportunities to support awareness and education activities, but should equitably focus on activities for boys and girls and focus on an extension into adult life

8.2.7 EHA #7 – Accidents and Injuries

8.2.7.1 Baseline Description

Key baseline findings include:

- Reports from key informants are that road traffic accidents are relatively common, especially along the main EN1 road that is in generally poor condition, narrow in most parts and relatively busy with heavy commercial vehicles.
- The FGD in communities along the EN1 reported that road traffic accidents did occur but could not say on the incidence. They did report that many of the accidents had fatalities.
- There is no pre-hospital ambulance or fire/ rescue service in the district that will respond to road traffic accidents.
- The health services in the district have limited capacity to manage trauma cases as they are only at the level of a health centre and have doctors or operating theatre facilities.
- The social baseline evaluated gender based violence and received anecdotal and other evidence that indicated the presence of this. A policeman of a local police post reported that 15 cases of gender based domestic violence had occurred in the past three months.
- There was limited data on other non- accidental injuries such as water or sea related accidents.

8.2.7.2 Potential Direct Impacts

- **Road traffic accidents from Project related vehicles:**

The movement of vehicles for the transportation of equipment, goods and personnel has the potential to increase motor vehicle and pedestrian vehicle accidents. Children are especially at risk for pedestrian vehicle accidents and a noted vulnerable group.

Due to the movement of heavy equipment from the temporary beach landing site and lay-down yard the most significant risk will be in Inhassoro and along the transport corridor on the R241 and the EN1 towards the plant site. In addition, light duty vehicles and conveyance of people of busses and good (such as supplies from Vilankulo or further afield) are additional risks.

Other than the transport of goods to support construction activities from the temporary beach landing site and lay-down yard, the other potential impacts are considered cumulative in nature due to the on-going activities at the CPF.

EHA 7 – Road traffic accidents from Project related vehicles					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

- **Maritime accidents:**

There is a risk for maritime accidents with community boats and barges (and ships) that will offload goods at the temporary beach landing site in Inhassoro. There are plans to mitigate these risks with a pilot boat to warn other seas users to steer clear of the barges, but there is a potential risks for offshore and nearshore accidents with these activities.

EHA 7 – Maritime accidents					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction		YES			
Operations					

- **Workplace accidents:**

While workplace occupational health and safety is out of scope for the HIA, the fact that a significant component of the workforce will be sourced from the local communities is important as activities in the workplace at the individual level can impact on community health. In the construction phase a significant portion of the labour force may be employed from the local community who may not be aware of modern health and safety requirements and may thus be more prone to high risk behaviours that could potentially lead to accidents.

In addition, the Project will have a range of occupational health and safety hazards, including physical (injuries, UV radiation, heat, noise and vibration), chemical, biological and psychosocial factors. Occupational injuries or diseases from these risks may be permanent or chronic in nature, with the potential for incapacity if conditions were serious. There is limited capacity for these individuals to be supported by the family unit if this was to occur, especially if they were the initial bread-winner. The labour and compensation laws in Mozambique are not well advanced and disability management and appropriate compensation standards and regulations may limit the ability to support the on-going livelihood of an ill or injured person.

The impact is limited to those who are employed to work on the Project, either as contractors or employees, with a broader spatial impact.

- **Security and community safety:**

The manner in which the Project manages its security will need to be considered to avoid any potential impacts related to community injuries associated with their activities. The Voluntary Principles of Security and Human Rights will be important to consider in managing these potential risks, but it is anticipated that this will be addressed in a separate study. It is noted that this will be a cumulative risk related to the CPF activities, noting that the different project may have different security management systems and procedures.

8.2.7.3 Potential Indirect Impacts

- **Increased ownership of motorized transport:**

Improved socio-economic conditions in the area may increase traffic loads as well as ownership of motorized forms of transport, including motorcycles and cars.

An increased number of vehicles on the road may increase the potential for accidents especially if road surfaces deteriorate due to excessive use and poor maintenance, high levels of dust that reduces visibility in unsealed roads and through poor adherence to road rules.

This impact will be cumulative in nature as associated with broader influences on local economic development. Impacts are more likely in the local study area and along transport corridors.

EHA 7 – Increased ownership of motorized transport					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

- **Non-accidental injuries due to social pathologies:**

PIIM, stress on already limited resources and development of a local currency has the potential to impact on traditional values and social harmony in the study area. This may alter cultural practices, erode the traditional authority and alter lifestyle practices with the potential development of increased levels of social ills such as alcoholism and substance abuse as well as crime that may be associated with violence and injuries. This can include gender based violence.

EHA 7 – Non-accidental injuries due to social pathologies					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES	YES		
Operations	YES		YES		

Table 21: Impact evaluation: Construction: EHA#7- Accidents and injuries

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Accidents and injuries in construction	10	2	3	5	High 75	10	2	3	3	Low 45
Accidents and injuries in operations	10	4	3	4	Moderate 68	10	4	3	2	Low 34
Accidents and injuries in decommissioning	10	2	3	4	Moderate 60	10	2	3	2	Low 30

8.2.7.4 Proposed Management Measures

- Project impact mitigation:
  - As per the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.

- Revise and adjust the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
- Develop a community security and safety management plan for the Project related to different activities. This should include emergency response plans for both community related accidents and also for the workplace, and should capacity and capability to deal with fire, rescue and chemical spill response, as well as medical emergency response. This plan will need to cater for both maritime and road traffic accidents. This should integrate or add to the Traffic Access and Safety Management Plan c-EMP developed for the CPF.
- Develop an effective communication strategy with the local community on this plan so that there is an awareness of what the Project will be responsible for in term of accidents and injuries and where its responsibility ends. This is particularly important given the high rate of road traffic accidents on the EN1 that may not be associated with the Project. This strategy should be aligned with the Grievance Procedure and Compliments and Complaints Register c-EMP.
- As per the Traffic Access and Safety Management Plan c-EMP developed for the Project that may include traffic calming measures, reduction of dust etc.
- Develop and implement road safety campaigns in the local study area and along access roads that targets roads users/ pedestrians. A specific focus should include school children as a vulnerable group.
- As part of the proposed CHIS collect data and monitor trends of road traffic accidents and non-accidental injuries (assault etc.) in the study area. Policy records, medical records and records from APEs may be useful sources of longitudinal data.

- Occupational health, safety and environmental management:
  - As part of the Projects Occupational Health and Safety Management Plan (OHSMP) develop (to include CMRs):
    - Ensure all aspects of occupational health and safety are addressed, including training, PPE use, compliance verification, risk assessment principles, etc.
    - Ensure that the plan considers community exposure due to workplace hazards and appropriate controls; e.g. workers returning home with soiled work clothes and exposing their family to potential hazards (e.g. handling chemicals).
    - As part of the fitness for duty program, develop appropriate medical surveillance for drivers and shipping personnel that includes screening for chronic diseases (hypertension and diabetes), substance abuse and compliance with specific physical standards.
    - Develop specific workplace health and safety standards and procedures for the management of Project mobile equipment and machinery, including specific requirements for driver training, fatigue management, vehicle roadworthiness, over-speeding etc.
    - Consider equipping all light duty and long-distance trucks with on-board electronic speed governors and fleet monitoring systems. Each contractor company should be mandated to send reports from vehicles that deliver goods to site as part of shipment acceptance.

  - Develop and strictly enforce a drug and alcohol policy for all work-related vehicles and barges- including contractor transport vehicles that operate in the study area and along the road transport corridor.
- Implement a social code of conduct policy for all employees to ensure that violence and other threatening behaviour is not tolerated on the site or within the broader community.
- Consider adopting the Voluntary Principles of Security and Human Rights in the security department, and if this is in place for the CPF adopt a similar process.

- Social development mitigation and management:
  - In partnership with the local authorities and other potential implementing partner/s and police, coordinate awareness and education campaigns about responsible driving including speed management, vehicle safety and pedestrian safety etc.

8.2.8 EHA #8 – Veterinary Medicine and Zoonotic Diseases

8.2.8.1 Baseline Description

Key baseline findings include:

- Zoonotic diseases are poorly recognized and described in the study area as there are limited local veterinary public health services and the local health services have limited capacity to recognize or manage zoonotic diseases.
- Snake bites probably present the biggest zoonotic hazard and have been reported to occur occasionally. The local health services have limited capacity to manage severe snake bites.
- Mozambique is a recognized high-risk area for rabies but there is limited reporting and recognition of cases. Media reports of rabies within Mozambique were last noted in 2012 (22). Key informants reported that dog bites were relatively common.
- There was no data on influenza type virus disease or cases of novel influenza type outbreaks (H1N1) locally.
- Viral haemorrhagic fevers have not been described in Mozambique, but the study area may be at risk for rift valley fever or Crimean Congo fever cases

Zoonotic conditions have a significant outbreak potential, which can be unpredictable, with the development of the Project potentially creating direct and indirect health impacts in the following manners.

8.2.8.2 Potential Direct Impacts

- **Garbage and camp facilities management from the Project site:**

Poor hygienic conditions and ineffective management of especially food waste from the construction camp and other areas, and any waste management facility that handles food or organic products (e.g. landfill) may attract rodents and other wild animals to these areas. This attraction may increase the number of rodents in the study area with the potential to transmit disease associated with poor sanitation. The increased number of rodents may also attract snakes into the area with the increased potential for snake bite in both the workforce and community. The spatial impact will be localised to where these practices may occur.

EHA 8 – Camp facilities management					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

- **Snake and animal bite:**

Clearing of bush and movement of earth in construction activities may increase contact with different species of snakes and other wild animals in both the workforce and to the community in proximity to these activities. This may increase the risk for bites or injury. The risks will be highest in construction and be localised to where these activities occur

EHA 8 – Snake and animal bite					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations					

8.2.8.3 Potential Indirect Impacts

- **Project-induced in-migration:**

In-migration and movement of animals with incoming migrants may pose a risk for the introduction of zoonotic diseases locally. Make-shift settlements with poor sanitation and domestic waste management also have the potential to attract wild animals and rodents into these areas, with similar impacts as discussed above. Movement of people in and out of (or through) the study area has the potential to spread an infectious disease that may have a zoonotic origin into the local community. Disease spread by close contact or droplet spread as the biggest risks.

These potential impacts will cumulative in nature with a similar spatial distribution to other potential impact associated with PIIM.

EHA 8 – PIIM					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

- **Local economic development and increased animal husbandry:**

Improved socio-economic circumstances in the study area may increase the ownership and handling of domestic animals as well as dogs. Due to limited public veterinary health programs there is the potential for the dog population to increase as no reproductive management measures are available (such as sterilizing female dogs), and vaccines to prevent diseases are similarly lacking. This may pose a risk for the transmission of rabies and zoonotic diseases in cattle/chickens to increase (e.g. brucellosis).

This is also a cumulative impact and more likely to be experienced in PAC1 in the local study area.

EHA 8 – Local economic development					
	PAC1	PAC2	PAC3	PAC4	PAC5
Construction	YES	YES			
Operations	YES				

Table 22: Impact evaluation: Construction: EHA#8- Veterinary medicine and zoonotic diseases

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Veterinary medicine and zoonotic diseases in construction	10	2	2	2	**Low 28**	8	2	2	1	**Negligible 12**
Veterinary medicine and zoonotic diseases in operations	10	4	2	2	**Low 32**	8	4	2	2	**Low 28**
Veterinary medicine and zoonotic diseases in decommissioning	10	2	2	2	**Low 28**	8	2	2	1	**Negligible 12**

8.2.8.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Restrict access of the community into any of the Project waste areas, including any landfills if they are developed. Waste pickers should not be allowed entry to these areas under any circumstances.
  - Develop the capacity from the workforce where skilled (trained) personnel from the Project can respond to and remove a snake from workplace areas and the community and safely relocate it.
- Occupational health, safety and environmental management:
  - As party of general outbreak risk management, develop and implement a disease outbreak preparedness and response procedures (that include potential zoonotic diseases) that include business resilience and recovery elements. These will need to consider interaction with a broad range of stakeholders including the local community, district as well as national health authorities.
  - Consider hazards related to the potential for increased encounters with snakes as part of bush clearing activities in the early works and construction phase. Management measures should be implemented to reduce the risk of encounters with snakes, relocation of snakes, as well as the possibility of being bitten and immediate first aid management.

- Review and revise the waste management c-EMP used for the CPF and make relevant for the current Project, and develop a Camp Facilities Management c-EMP that consider:
  - Effective waste management practices in all accommodation and work areas to reduce the risk for pests being attracted or proliferating in these areas. This will need to include controls on food waste and disposal, general camp cleanliness and hygiene and rodent control activities. If possible it would be ideal to incinerate all waste (where this is possible/ permissible).
  - Design, build and manage accommodation and camp facilities to prevent rodents from gaining access to accommodation, kitchens and food/water storage areas.
  - Prohibit employees from keeping pets on the Project site and accommodation area and manage the control of stray pets that find their way onto the site.
- Develop effective protocols and procedures for managing dog and snake bites from the Project's workplace medical service.
- If dogs are required for security purposes, ensure that they are appropriately vaccinated.

- Social development mitigation and management:
  - Support the improvement of veterinary public health services in study area. This can include awareness and education programmes in the community on animal husbandry and support to the local authorities in providing animal health services, especially preventive programs such as vaccinating and sterilizing dogs/cats.

8.2.9 EHA #9 – Environmental Health Determinants

Potential environment health determinants and exposure to hazardous chemical substances will be addressed as part of specific sections in the biophysical specialist studies in the EIA. These include noise and vibration, water and air quality, visual intrusion and waste management and include evaluation of the potential human health aspects. Therefore, these will not be addressed in detail in the HIA or ranked based on potential impact. However, a summary of considerations is presented below for completeness, noting that this information is obtained from the respective specialist studies.

8.2.9.1 Air Quality

8.2.9.1.1 Baseline Description

As air quality has potential human health impacts a standalone baseline air quality assessment was completed in March 2015 as part of the EIA studies for the Project. Key findings include:

- Wind direction is dominated by southerly and easterly winds, with some north easterly winds especially in summer.
- Rainfall shows a summer pattern with peaks between December and April, and limited rain in the winter months.
- Important sources that may contribute to reduced air quality include:
  - Agricultural activities are limited and dust may contribute to particulate emissions in dry periods from fallow fields.
  - Unpaved roads and vehicle entrained dust contributing to particulate emissions.
  - Domestic fuel (biomass) burning from burning of wood and charcoal for cooking and heating.

- Vehicle emissions including potential primary pollutants such as carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (including polycyclic aromatic hydrocarbons), sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and particulates.
- Oil and gas activities with potential criteria air pollutants (SO_2, CO, NO_x and particulate matter) and toxic air contaminants (hydrogen sulphide and volatile organic compounds (benzene, toluene, ethyl benzene and xylene)).

- Findings from the baseline included:
  - Dust fallout did not exceed South African residential guidelines.
  - Particulate matter did not exceed IFC guidelines.
  - NO_2 and SO_2 did not exceed the IFC guidelines.
  - Hydrogen sulphide and volatile organic compounds were below detection limits and EU guideline values, respectively.
  - The conclusion was that air quality in the study area was not degraded in any way.

8.2.9.1.2 Potential Direct Impacts

The air quality impact assessment (AQIA) summarises the following potential direct air quality impacts:

- Construction and decommissioning phase:
  - The potential impacts for both the OCGE and CCGT technology options were similar and anticipated to be of low significance for nitrous dioxide (NO_2), particulate matter (PM_{10}) and sulphur dioxide (SO_2). Therefor
  - A range of mitigation measures have been recommended to reduce these low significance impacts further including:
    - PM_{10}: wet suppression of roads and work areas, inspection and maintenance of unpaved roads, progressive rehabilitation, managing unnecessary traffic, speed control of vehicles, limiting burning of waste on-site and other dust suppression activities.
    - NO_2/SO_2: vehicle maintenance to reduce emissions, use of low sulphur fuels and limiting burning of waste etc.
  - Based on these models, significant human health impacts are not anticipated in the construction and decommissioning phase. However, it is important to implement the recommended controls to reduce potential impacts to as low as reasonably possible.
- Operations phase:
  - The potential air quality impacts from the CCGT were anticipated to be low for all of NO_2, SO_2 and PM_{10}.
  - The potential air quality impacts from the OCGE are anticipated to cause a moderate inherent impact from NO_2 and a low potential impact from both NO_2 and PM_{10}.
  - Therefore, CCGT is the preferred technology option from a pure air quality perspective, but the residual impact from NO_2 can be reduced to low with a number of management measures, including increasing the current stack height.

- The potential for human health impacts associated with reduced air quality may be associated with emissions of NO_2, but with effective management and monitoring these potential risks should be low.

Table 23: Impact evaluation: Construction: EHA#9 Air quality

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Environmental health determinant: air quality	Not ranked as part of the HIA									

8.2.9.1.3 Proposed Management Measures

- Project impact mitigation:
  - As per findings and recommendations of the specialist AQIA report.
  - Consider specific actions including:
    - Dust suppression activities in and around communities where Project equipment or vehicles pass on unsealed roads.
    - Effective vehicle maintenance to reduce vehicle emissions to as low as reasonably practical.
  - Ensure open and transparent communication with potentially affected communities on air quality as per the Project specific Grievance Procedure and Compliments and Complaints Register c-EMP and o-EMP.
  - CMRs should be part of any management plans.
- Occupational health, safety and environmental management:
  - As part of the OHSMP develop effective occupational hygiene programs to assess and monitor potential air pollutants in the workforce and develop appropriate controls.

8.2.9.2 Water Quality and Quantity

8.2.9.2.1 Baseline Description

As surface and ground water quality and availability have the potential to cause human health impacts these have been studied as part of the EIA. Key findings include:

- Hydro-geology study (July 2018):
  - Groundwater quality in the study area is virtually unaffected by human activity.
  - While groundwater quality in inland areas is saline (due to limestone), it remains potable.
  - Groundwater levels have generally decreased since Sasol started monitoring in 2003.
  - The main source of water for the communities in the Temane area is from a single aquifer, with the system prone to high salinity but with areas of fresher water in areas likely to higher recharge zones. This system was considered to be vulnerable to potential pollution, with consequences for environmental health impacts.

- Surface water study (July 2018):
  - The Govuro River (the only major surface water resource in the area) does not appear to be impacted by any of Sasol's activities.
  - The floodlines of the Govuro River will not impact on the CTT Project infrastructure.
  - Water quality:
    - Water quality is generally good, with exceedances for WHO drinking water standards for total dissolved solids due to sea water intrusion in areas.
    - Most inorganic parameters are within guideline limits, with slight exceedances of zinc and lead compared with South African water quality standards, but this has more relevance to the aquatic ecosystem than human users. These and other trace metals were compliant with Mozambican effluent/discharge standards.
    - The pH of surface water was within acceptable guidelines and described as slightly basic.

8.2.9.2.2 Potential Direct Impacts

The potential surface water impacts are outlined in detail in the specialist surface water and groundwater studies.

- Surface water:

The most significant potential impacts from a direct human health perspective in construction is related to; i) the spillage of hydrocarbons and chemical substances; ii) increased sedimentation in the Govuro River; and iii) waste water from sewerage treatment plants and camp activities as discussed in section 8.2.3. The residual risk of these potential impacts was considered to be low.

In operations, spills from the evaporation ponds and from the first flush pond were considered as the most significant with a moderate residual risk. In decommissioning, the residual risks were all ranked as low.

- Groundwater:

The most significant potential impact on the groundwater system is related to the potential water level decline caused by the abstraction of water from the local boreholes. This was especially a risk in operations with the CCGT option requiring more water than the OCGE option. The aquifer system is high yielding and likely to be able to supply the water requirements for the Project requirements, but additional abstraction boreholes may be required. The potential for reduction on groundwater to local communities is reported to be low/ negligible if the recommended water management and monitoring plan is followed. This will be important to manage as reduced water quantity may be related to water quality and cause significant human health impacts (see Table 16).

Other impacts may be associated with potential pollution from chemicals, hydrocarbons and sewerage water from the receiving surface water environment. This is a risk in construction will be most low and higher in operations with potential spills from the evaporation ponds and first flush pond as mentioned above. As with surface water management, this residual risk is reduced to a low significance.

Table 24: Impact evaluation: Construction: EHA#9- Water quality and quantity

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Environmental health determinant: water quality and quantity	Not ranked as part of the HIA									

8.2.9.2.3 Proposed Management Measures

- Project impact mitigation:
  - As per findings and recommendations of the specialist surface and ground water reports. No additional specific actions related to human health are recommended.
  - Develop and implement environmental control measures for surface and ground water as part of c-EMP and o-EMP. This should include a review and application of the Water and Effluent Management as well as and hazardous materials/ spills management c-EMP and o-EMP for the CPF and adapt for current use.
  - Ensure open and transparent communication with potentially affected communities on water quality and water availability as per the Project specific Grievance Procedure and Compliments and Complaints Register c-EMP and o-EMP.
  - CMRs should be part of any management plans.
- Occupational health, safety and environmental management:
  - As per section 8.2.3.4.

8.2.9.3 Noise and Vibration

8.2.9.3.1 Baseline Description

A noise baseline study was conducted as part of the EIA (July 2018) with key findings including:

- Detailed studies have been conducted on the pre-development ambient noise levels in the study area.
- There are no topographical features that can provide acoustical shielding, but the vegetation cover is dense that will aid in the attenuation of noise over longer distances.
- The potentially sensitive receptors that may be affected by noise are sparse with the exception of to the West in the direction of Mangugumete.

8.2.9.3.2 Potential Direct Impacts

The IFC and WHO international standards for noise management for residential, institutional and educational receptors are used as the reference point for the community health impacts from noise exposure. Noise annoyance can lead to stress related impacts on health and general well-being and may have an influence on mood, performance, fatigue and cognition. Sleep can be disturbed by as little as 35dB of noise (26).

The noise impact specialist study modelled and reported on potential noise exposures to sensitive receptors for both technologies with the following findings:

- The OCGE technology produces the largest noise impact footprint.
- The significance of noise impacts for both technologies during construction and decommissioning is negligible but is modelled as low in the operations phase.
- Sleep disturbance was noted as negligible in both technologies across all Project phases.
- Transport noise events were considered to be low due to the limited frequency of vehicles passing, short event duration and limited number of households affected.
- In the operations phase for OCGE, the criteria set by WHO and the IFC are met with values below thresholds in the day and night. There may be some sporadic complaints related to noise in a small number of households, with the source likely to be from the cooling fans.

Table 25: Impact evaluation: Construction: EHA#9- Noise and vibration

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Environmental health determinant: noise and vibration	Not ranked as part of the HIA.									

8.2.9.3.3 Proposed Management Measures

- Project impact mitigation:
  - As per findings and recommendations of the specialist noise impact assessment report with controls to consider:
    - Engineering designs of the plant and other equipment to reduce potential impacts on noise sensitive receptors. This specifically includes the minimisation of noise from cooling fans through alternative placement or design changes.
    - Use of mobile equipment such as generators should include decisions on where to place them and potentially enclose to avoid or minimize impacts on noise sensitive receptors.
    - Effective maintenance of vehicles to minimise noise, especially exhaust silencers.
    - Administrative controls such as avoiding night-time activities especially through or in proximity to communities. The planned movement schedule of extra heavy transport vehicles from the beach landing to the plant site will need to be published and adhered to.
    - CMRs should be part of any management plans.
  - Ensure open and transparent communication with potentially affected communities on noise as per the Project specific Grievance Procedure and Compliments and Complaints Register c-EMP and o-EMP.
- Occupational health, safety and environmental management:
  - As part of the OHSMP develop effective occupational hygiene programs to assess and monitor noise exposures in the workforce and develop appropriate controls.

8.2.9.4 Hazardous Chemical Substances

8.2.9.4.1 Baseline Description

The Project will utilize different types of hazardous chemical substances in the construction and operations phases, with potential sources including:

- Pest control: insecticides, pesticides and rodenticides to control insect and other vermin such as rats.
- Water treatment: chlorine and associated water treatment chemicals used in the treatment of potable water as well as waste water.
- Concrete batch plant effluent.
- Material for construction and maintenance including paints and solvents as well as flux and welding rods.
- Domestic cleaning agents.
- Petroleum products to support heavy vehicles and light duty vehicles on site, including diesel fuel, mineral oils, grease, degreasers, etc.
- Laboratory.
- The site based medical services including cleaning agents, laboratory equipment as well as medications (especially expired ones requiring disposal).
- Potentially contaminated surface water including storm water, fire water and wash-down water originating from dirty areas.
- Other solid waste including contaminated rags, florescent light tubes, batteries etc.

In addition, some chemicals by-products may be produced in the power production process, depending on the technology chosen, with these required to be handled appropriately.

8.2.9.4.2 Potential Direct Impacts

As the procurement, storage and use of hazardous chemical substances is a dynamic process, it was not the intent of the HIA to evaluate each product individually but rather highlight the need for proper hazardous chemical substance management to avoid any direct impacts. Thus management of hazardous chemical substances needs to occur within the framework of best practice as defined by local Mozambican legislation and other industry guidelines.

Any potential impacts are likely to be localised with a small likelihood of long-term effects, but this is dependent on the type of chemical and exposure. Potential impacts may occur from spills, leaks and inappropriate disposal of products (for example florescent light tubes due to mercury content). They may also occur from the re-use of discarded containers that have stored hazardous chemical substances by the community for storing water or other domestic product. This is more likely in the construction period as there is a higher potential that more agents will be in use.

EHA 9 – Hazardous chemical substances					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		YES
Operations	YES		YES		YES

Table 26: Impact evaluation: Construction: EHA#9- Hazardous chemical substances

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Environmental health determinant: hazardous chemical substances in construction, operations and decommissioning	8	3	2	4	**Moderate 52**	8	3	2	2	**Low 26**

8.2.9.4.3 Proposed Management Measures

- Project impact mitigation:
  - Develop and implement recommendations from the EIA and general and hazardous waste management plan in alignment with the current c-EMP and o-EMPs in place at the CPF and determine if these are still fit for purpose.
  - Perform effective monitoring of emissions, water quality etc. and transparent reporting to stakeholders, including communities.
  - Develop appropriate hazardous chemical substances management programs in alignment with IFC PS3 guidance as well as the International Code of Conduct on the Distribution and Use of Pesticides.
  - Effective waste management so the communities do not use Project-related discarded containers that may have contained hazardous materials for collecting of water or storage of water or related domestic products.
  - Pest control activities and associated selection of insecticides for malaria control and other pest control activities will need to be performed in alignment with national programs and policies. If products are used injudiciously, there is the potential to create a public health impact if insecticide resistance is introduced locally.
- Occupational health, safety and environmental management:
  - Develop a system that requires both environmental and health/safety approvals to request new hazardous chemical substances for procurement. The procurements department needs to be the gatekeeper and systems should be developed that prohibit any new substance coming onto site without approval. If the environmental and health/safety review raises a concern then the requesting user may need to suggest a safer alternative, and if this is not possible prepare a justification why the product is required and what measures will be put in place to manage any potential risks.
  - Undertake a risk assessment on all hazardous chemical substances on site and determine the specific human health risks that may potentially result from exposure to a product or by product of a process or emission. Develop specific workplace health, safety and environmental plans based on the risk assessments, with clear emergency preparedness and response capability (equipment and trained personnel) for hazardous materials management.

- Ensure adequate personal protective, hygiene and washing facilities for employees that handle any form of pesticide. This should include dedicated personal protective clothing as well as showering and changing room facilities so that personnel are required to change potentially contaminated clothing before they go home, thus preventing exposures to their family unit or other workers.
- Medical surveillance (including biological monitoring) of employees handling hazardous chemical substances should be incorporated into the Projects OHSMP.
- Ensure effective and on-going contractor management with all occupational health, safety and environmental programs.

8.2.10 EHA #10 – Social Determinants of Health

Social determinants that may influence health and well-being at the local level will be described in more detail in the specialist social and economic studies, but elements relevant to health and well-being will be discussed in this section.

The holistic model of health and well-being acknowledges that the health status of a population is affected by factors known as health determinants. They are many and varied and include, for example; natural and biological factors, such as age, gender and ethnicity; behaviour and lifestyles, such as smoking, alcohol consumption, diet and physical exercise; the physical and social environment, including housing quality, the workplace and the wider urban and rural environment; and institutional factors such as the access to medical care. All of these are closely interlinked and differentials in their distribution lead to health inequalities. The model for the determinants of health is depicted in Figure 26.

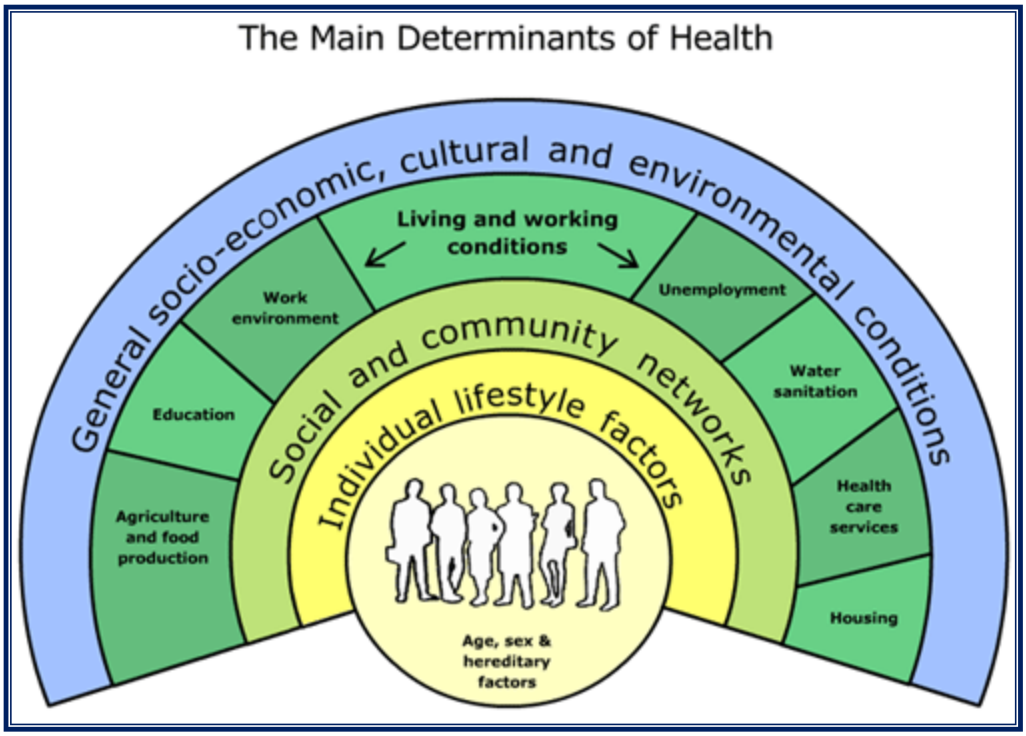

Figure 26: Determinants of health

8.2.10.1 Local Economic Development and Employment

8.2.10.1.1 Baseline Description

As shown in Figure 26, education and employment opportunities play an important role in the living and working conditions that contribute to quality of life and well-being.

While education is described in more detail in the social baseline it is a major challenge in the study area with geographical and gender inequalities. Sasol has supported a number of schools in the broader area including the secondary school in Inhassoro (21).

The poor educational attainment and indeed quality of education is a major challenge to breaking the cycle of poverty, ability to be formally employed or to develop a local business through entrepreneurship.

Employment is a major factor in the area as local opportunities are limited. The social baseline presents the various sources of employment that are limited to a few school teachers, healthcare workers and government officials in the public sector, and employment with Sasol or associated service companies and a few jobs associated with tourism in the private sector.

It was noted that the local communities consider that there was in general no long term benefit in the ad-hoc opportunities that were provided by Sasol. In addition, it was noted that employment patterns with Sasol favoured people living closer to the EN1 highway.

Political instability has affected the tourism industry that has significantly affected income and employment opportunities in this sector.

8.2.10.1.2 Potential Direct Impacts

The potential impacts related to employment and increased economic revenue are also discussed in the social impact assessment.

- **Direct employment at the Project:**

The Project is relatively technical with a high level of skill required to construct and operate the power plant and associated infrastructure. As a result, there will only be a limited number of job opportunities available to the portion of the local population who are relatively unskilled (about 120 for the CCGT and 100 for the OCGE in construction, and only 40-50 in operations).

Although limited, these employment opportunities will have a positive effect on the local economy as individuals and their families may benefit directly and more money will circulate in the local communities with a potential increased uptake of services and purchase of goods (multiplier benefits as discussed below).

However, the employment opportunities may bring about some negative consequences (or perceived consequences):

- Unfulfilled expectations that the Project will employ vast numbers of people and reduce poverty in the area, especially in the light of limited other opportunities.
- Employment for a short period of time may change local practices from subsistence farming/fishing to earning a paid wage. While positive in this period, it may be challenging for the individual (especially men) to revert back to fishing and farming once the employment opportunities cease.

These impacts are more likely to be experienced in the broader area where the community may have an expectation for additional jobs. It is also likely to be a cumulative impact with the effects of the CPF and related activities in the area.

EHA 10 – Direct Project employment					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES	YES	
Operations	YES	YES	YES	YES	

8.2.10.1.3 Potential Indirect Impacts

The following indirect impacts may influence health and well-being associated with local economic development:

- **Multiplier effects:**

The development of the Project may result in the additional development of facilities or services in the local communities to take advantage of the improved local economic conditions; including hotels, restaurants, services etc. These associated facilities could employ additional people from the community or distribute wealth and create multiplier effects in stimulating local economic growth.

- **Local investment and development:**

This relates to the point above where the development of the Project may increase local investment and development opportunities; especially if the businesses are created that support the needs and requirements of the Project and the community. If these entrepreneurs are correctly identified and supported it may improve their sustainability in the longer term.

Both these potential impacts can also be related to the existing Sasol operations and thus cumulative impacts are possible.

EHA 10 – Local investment opportunities					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES	YES	
Operations	YES	YES	YES	YES	

Table 27: Impact evaluation: Construction: EHA#10- Local economic development and employment

Indicator of potential impact	**Pre-mitigation**					**Post-mitigation**				
	Magnitude	**Duration**	**Geographic Extent**	**Probability**	**Significance**	**Magnitude**	**Duration**	**Geographic Extent**	**Probability**	**Significance**
Local economic development and employment in construction and operations	Benefit									

8.2.10.1.4 Proposed Management Measures

- Project impact mitigation:
  - As per recommendations related to local economic development as discussed in the social impact assessment and related management measures.
  - Develop and implement procedures for communication and management of expectations related to the realistic benefits of the Project in terms of employment and local economic development.
  - Develop an effective stakeholder engagement strategy with authorities, communities and other parties so that there is a mutual ownership of any intervention in the community (whether impact mitigation or social development), with the intent to support the ultimate sustainability of activities.

- Social development mitigation and management:
  - Evaluate opportunities to create an effective linkage programme where local businesses are used in support of the Project and opportunities are leveraged where small enterprises are created to support these businesses. Any of these interventions should be conducted in alliance or partnership with the CPF project and for this reason it would be important to understand what activities the CPF were supporting to determine if the Project could support or enhance these.
  - Evaluate opportunities for the empowerment of women and girls in the area, as a specific vulnerable group. Microfinance and self-reliance/co-operative schemes may be such an option to stimulate entry into the cash economy and become financially independent.

8.2.10.2 Social Harmony, Social Ills, Inequalities and Project Expectations

8.2.10.2.1 Baseline Description

The updated social baseline has described some social harmony challenges related to population influx and effects on social dynamics related to gender based violence and sexual exploitation (21). The June 2017 EIA report for future Sasol exploration and development activities describes a number of potential impacts related to the future development and how social harmony may be influenced by influx and high expectations of the local authorities and the community. Unmet expectations could give rise to community discontent towards the Project, especially related to job and local economic development.

Key findings from the health baseline include (22):

- Substance abuse is an important health determinant as it has links to mental health, but can be further associated with crime, violence, gender based domestic violence and prostitution:
  - More than half of mental disorders treated in the country's public health facilities in 2016 were related to alcohol and drugs.
  - Reports from key informants and FGDs indicate that substance abuse is very common in the study area and a key contributor to social ills. Use of illicit drugs was not noted to be a major challenge, with FGDs not aware if such drugs were available or being consumed locally.
  - Tobacco smoking was reported to be common, especially in men.
- Gender based violence was discussed in section 8.2.7 but it was noted that there are high levels of violence against women in Mozambique, with its practice tolerated and even accepted as a socio-cultural and traditional norm. Based on available data cases of physical and sexual violence was noted to occur commonly in Inhassoro district, with a dedicated private room in both the Inhassoro Sede and Mangugumete health centres to handle such cases. Women respondents in the FGDs reported that domestic violence was common and in most cases victims suffer in silence with cases not reported. Substance abuse and economic pressures were the most common contributing factors.

8.2.10.2.2 Potential Indirect Impacts

The potential for exposure to gender based violence and sexual exploitation and abuse as well as Project related expectations that have the potential to influence social harmony in the study area are discussed in more detail in the social impact assessment. Potential indirect impacts that have an overlap to community health include:

- **Altered traditional values, social ills and gender inequality:**

PIIM, stress on or competition for limited resources, altered lifestyle practices and possible development of increased levels of social ills such as sex work and substance abuse are some of the factors that may impact on the traditional values and social harmony in the study area as a result of the Project development.

These have been discussed in previous sections and have the potential to increase levels of criminality and crime that may be associated with violence and injuries. This can include gender based domestic violence as women are a vulnerable sector in the community and at risk to forms of transactional sex and other forms of marginalization.

- **Inequalities:**

The Project has the potential to create inequalities or perceptions of inequalities through direct and indirect factors:

- Those who may have been displaced from land or may be displaced in the future. This may cause a loss of sense of place, especially with potential comparisons to those how have not been impacted through loss of access to land.
- Those who benefit from direct Project employment (as workers or contractors) compared to those who don't.
- Gender inequalities as the Project is more likely to employ men than women, especially in the construction phase and linked to unskilled manual labour.

- **Project induced in-migration:**

This may induce impacts on well-being and lifestyle and erode quality of life through:

- Eroded cultural and traditional values with a mix of different cultures and ethnic background;
- Increase in crime;
- Increase in alcoholism and potentially drug abuse;
- Increase in gender based domestic violence;
- Increase in commercial sex work; and
- Various psychosocial effects related to lifestyle change and perceptions of well-being.

- **Migrant workforce:**

A significant portion of the workforce will originate from outside of the study area, and even the country. This group may have a different cultural and value system and be wealthier than the local community, which may have the potential to create frustrations in the study area due to the limited alternative employment opportunities in the local communities with the perception that these outsiders are taking jobs that could be provided to local inhabitants. There is also the potential for this incoming workforce to be disrespectful of the local cultures and norms and flaunt wealth. As described earlier there is also the potential that outsiders may use wealth (disposable income) to entice local women into transactional sexual relationships, and as local men have limited ability to compete with this it may be a source of potential conflict.

As with other impacts these are likely to be cumulative in nature and be more likely to occur in close proximity to the Project activities and less marked in the broader area.

EHA 10 – Social harmony, inequalities and Project expectations					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES	YES		
Operations	YES		YES		

Table 28: Impact evaluation: Construction: EHA#10- Social harmony, inequalities and Project expectations

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Social harmony, inequalities and Project expectations in construction and operations	8	3	2	4	**Moderate 52**	Benefit				

8.2.10.2.3 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - Attempt a gender balance in the workforce noting the limitations in number of employees and ability to employ females in some forms of manual labour. Where possible non manual tasks should be reserved for women, and support CMRs as part of this.
  - Where these are effective support the roles of traditional authorities in the study area in the proactive management of social ills and social discord. This may require support with community cohesion activities and be considered as part of the Population Influx Plan.
  - Support the district and traditional authorities with local policing initiatives and an effective justice system so that crimes are rapidly dealt with, respecting human rights and based on Mozambican regulations.
  - Restrict mixing of the contracted migrant workforce and the local community by managing effective accommodation camps, ideally with a closed camp status.
- Social development mitigation and management:
  - Promotion of gender-based programs as mentioned above under local economic development.
  - Training and skills development in local communities- especially in youth. This should have a focus to support local entrepreneurs and local business development.

8.2.11 EHA #11 – Cultural Health Issues and Health Seeking Behaviour

8.2.11.1 Baseline Description

Traditional medicine plays an important role in local health seeking behaviour as traditional healers often play a significant role in supporting healthcare requirements, especially when access to formal health services is limited. Cultural and spiritual factors also play a role in health seeking behaviour.

Findings from the health baseline showed that the majority of the local communities prefer to utilise the formal healthcare sector in the first instance, with utilisation to this sector increasing over time. However, traditional medicine still plays a major role, as FGDs respondents reported that certain conditions could not be treated with conventional medicine, citing epilepsy and mental illnesses as examples. However, access to, acceptability and affordability (including transports costs) was a major determinant in health seeking behaviour and preference or not of traditional medicine. Mozambique has a system of CHAs/APEs that play a vital interface in health seeking behaviour with the strength of these programmes playing an important role in primary health care and entry into the formal health sector. It was acknowledged that use of traditional healers can delay in seeking proper care. All three clinical managers of the health facilities interviewed as part of the health baseline considered that the use of traditional medicine to be a health challenge in the study area due to delay in seeking care.

8.2.11.2 Potential Indirect Impacts

There are no obvious direct Project impacts, with potential indirect impacts including:

- **Project Induced In-Migration:**

PIIM may mean that the capacity of the available formal public health services will not be able to meet the demands of the community. There is a general inability of the formal sector to meet any increased requirements. This may generate an increased demand for informal health services including use of traditional medicine and purchase of medications from clandestine street pharmacies. These are likely to provide a lower standard of care, lead to delayed diagnosis and not allow for the accurate reporting of the burden of disease as these cases are not recorded anywhere.

In addition, local economic development may lead to the influx of people touting their services as traditional healers, or the development of clandestine street pharmacies. An increased demand may increase this type of service offering.

As with other areas, the effects of PIIM will be cumulative and experience in the immediate study area (PAC1 and PAC2).

EHA 11 – PIIM					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

Table 29: Impact evaluation: Construction: EHA#11- Cultural health issues and health seeking behaviour

Indicator of potential impact	**Pre-mitigation**					**Post-mitigation**				
	Magnitude	**Duration**	**Geographic Extent**	**Probability**	**Significance**	**Magnitude**	**Duration**	**Geographic Extent**	**Probability**	**Significance**
Cultural health issues and health seeking behaviour in construction and operations	6	3	2	3	**Low 33**	4	3	2	2	**Low 18**

8.2.11.3 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.
  - This element will need to specifically focus on impacts on increased demand in available health services as discussed in section 8.2.12 and their ability to effectively serve the needs of the PACs. While Mangugumete health centre was developed by the CPF project it faces numerous operational challenges that may require HSS so that the additional potential PIIM due to the Project does not create an impact. Any intervention should be performed in association/partnership with the CPF as part of a broader strategy.
- Occupational health, safety and environmental management:
  - As described in section 8.2.12 develop effective Project medical services so that any increased demand for healthcare does not originate from the Project. The medical services and facilities c-EMP and o-EMP used for the CPF should be reviewed and revised as required for the current Project.
- Social development mitigation and management:
  - Evaluate HSS activities to support improved health seeking behaviours, with the proposed support of the APEs and related awareness and education and community based care a potential option.
  - Support the local authorities in the regulation of clandestine pharmacies and traditional healers, including supporting collaboration between the health centres/APEs and recognised/respected traditional healers.

8.2.12 EHA #12 – Health Services, Infrastructure and Programmes

8.2.12.1 Baseline Description

The capacity and quality of health care services is generally limited in the district. The health baseline describes the current health infrastructure in detail with the following key findings:

- Despite having 65% of all hospitalisations and recording 21% of all deaths, there are only 8 dedicated paediatric beds in the district (4 each in Mangugumete and Inhassoro health centres).
- Access to and use of antenatal services has improved and is more or less universal. Delivery of babies in medical facilities has increased in the district, with no maternal deaths have been reported since 2014.
- In terms of family planning, respondents from FGD reported that uptake had increased due to better access to and availability of health services.
- Childhood immunisation rates in the district were acceptable.
- A Service Availability and Readiness Assessment was completed on three health facilities (Pambara, Mangugumete and Inhassoro health centres) with the following key findings:
  - Sasol have supported Pambara and Mangugumete health centres.

However, challenges were noted in both:

- Pambara: newly commissioned and busy but it is poorly staffed with only 7 workers compared to the 34 and 44 at Mangugumete and Inhassoro respectively).
- Mangugumete: While the building is good certain aspects of the facility are poorly maintained and lack basic services (with no running water, leaking roof and generator non-functional (so unreliable power). The vaccine fridge runs off solar power.

- Services are generally limited to a primary health level with referral to Vilankulo rural hospital for secondary care (including all surgery).
- There is no ambulance in the district and therefore rely on the ambulance from Vilanculos (when it is available). This is a free service but if not available then patients rely on private transport.
- With the exception of Pambara, there is a good range of primary healthcare medications with adequate supply chain support.
- Only Inhassoro has a functional mortuary (with freezers).
- All three clinic managers felt that improving service delivery in clinic and supporting effective health awareness and health education were important to improving healthcare in their communities.
- There was good community cohesion towards health outreach initiatives with all facilities supported by APEs at the community level. Support with outreach was a noted constraint.

The 2015 social baseline reported that while the number and type of health care facilities in the Inhassoro District have increased due the corporate social investment support of Sasol, many communities still have limited access to adequate public health services. Some communities reported that the lack of good roads in areas restricted their ability to access health facilities.

8.2.12.2 Potential Direct Impacts

- **Workplace health services:**

In the construction phase the relatively large construction workforce will require an effective medical service to manage worker emergency care, primary healthcare and occupational health needs. The available public health service has limited capacity to manage this increased demand, especially during the construction phase. There is the risk that it will be overburdened if the workforce needs to utilise these services to the potential detriment to the local community. In addition, the workforce may not accept the standard of care provided at these facilities.

This potential impact is likely to be most marked in construction but can extend into operations. Spatially it will be experienced in PAC1 and PAC2.

EHA 12 – Workplace health services					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

8.2.12.3 Potential Indirect Impacts

- **Project induced in-migration:**

PIIM into the area has the potential to significantly exceed the capacity of what are already limited health care facilities. There is minimal institutional capacity to support this potential increased demand either from a planning, budget or a delivery perspective with a potential for a negative impact on service delivery due to the poor infrastructure, weak supply chain, lack of staff and equipment.

Health programmes such as vaccination provision or distribution of bednets may be impacted by a sudden increase in demand. Planning for these services would have been done on a defined population and a sudden increase in population my mean that there is an inadequate supply in commodities, leading to lower than required vaccination.

As with other areas, the effects of PIIM will be cumulative and experience in the immediate study area (PAC1 and PAC2).

EHA 12 – PIIM					
	PAC1	**PAC2**	**PAC3**	**PAC4**	**PAC5**
Construction	YES	YES			
Operations	YES				

Table 30: Impact evaluation: Construction: EHA#12- Health services, infrastructure and programmes

Indicator of potential impact	**Pre-mitigation**					**Post-mitigation**				
	Magnitude	**Duration**	**Geographic Extent**	**Probability**	**Significance**	**Magnitude**	**Duration**	**Geographic Extent**	**Probability**	**Significance**
Health services, infrastructure and programmes in construction	8	3	2	4	**Moderate 52**	6	3	2	2	**Low 22**
Health services, infrastructure and programmes in operations	6	3	2	4	**Low 44**	6	3	2	2	**Low 22**

8.2.12.4 Proposed Management Measures

- Project impact mitigation:
  - Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline. These may need to be reviewed and revised as required to ensure effectiveness and to cater for the potential cumulative effect of the Project.
  - Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project. This will be an important element of the Management of Population Influx Plans as it will be designed to limit the attraction of job seeking migrants.

    This element will need to specifically focus on impacts on increased demand in available health services and their ability to effectively serve the needs of the PACs. While Mangugumete health centre

was developed by the CPF project it faces numerous operational challenges that may require HSS so that the additional potential PIIM due to the Project does not create an impact. Any intervention should be performed in association/partnership with the CPF as part of a broader strategy.

- Consider supporting health programme initiatives in the study area that may be impacted by the increasing demand related to PIIM (these can overlap into social development management). If the CPF has a current strategy the Project should align or seek to expand this, and if not it would be beneficial for the two Projects to work in a coordinated fashion. These will be considered as specific HSS activities and should be supported in partnership with the provincial and district health authorities. A formal gap analysis with the local authorities will need to be conducted to understand health programmes that have been affected by influx of people and support provided on that basis. These may include:
  - Outreach and facility based child health and vaccination programmes.
  - School health programmes such as deworming activities.
  - Supply chain of medication and consumables (adequacy of stock and range of stock).
  - Malaria programmes including availability of bednets, rapid diagnostic test kits and treatment.
  - HIV programmes including availability of medication for anti-retroviral and prevention of mother to child transmission programmes.
  - As with other sections support of the APE activities.
- A specific HSS activity should be to consider the support of the DHIS2 system in the recording and reporting of data. This should in turn support the objective of monitoring key selected indicators as part of the proposed CHIS.

- Occupational health, safety and environmental management:
  - Use as a guideline the medical services and facilities c-EMP and o-EMP used for the CPF (with review and revision) for the current Project to support the development of an appropriate site based medical service. As part of this plan review opportunities to integrate the planned services (either fully or partially) for the Project, with those currently available on the CPF. This may limit duplications and waste of resources, although enhancement or expansion of services may be required in the construction phase. However, it is important that the medical service for the Project cater for effective primary care, occupational health and emergency care. Systems to refer more complex cases either on an elective or emergency basis will need to be developed. The objective behind this scope is to limit the need for the workforce to utilise the local and district public health services so as not to overburden them. Access to workplace medical services will need to include contractors and visitors so they also don't need to use the available public health services.
  - The team working in Inhassoro will also need to access the medical services in the plant construction site.
  - Use as a guideline (with review and revision) the CPF medical waste c-EMP and o-EMP to support Project requirements.
- Social development mitigation and management:
  - HSS as per other sections. This may need to include specific support of the Mangugumete health centre.

9.0 CONCLUSIONS AND RECOMMENDATIONS

In concluding, the potential direct and indirect impacts and their associated determinants as well as key management/ mitigation recommendations are summarised in Table 31. As the presence and operation of the CPF Project is likely to have an important cumulative influence, these potential factors are highlighted to emphasise the importance of aligning/ integrating management measures between different projects and operations.

Table 31: Summary of key potential direct and indirect health impacts and proposed management measures

Potential direct impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures
Communicable disease transmission from incoming construction workforce	Incoming construction workforce has the potential to increase the risk for the transmission of communicable diseases, especially those associated with close contact via the respiratory route. This workplace risk has the potential to spread to the local community, with the weak health system increasing the public health risk for increased burdens of disease. Diseases may include tuberculosis, viral infections (such as seasonal influenza), as well as novel infections that may be circulating in other regions/parts of the world.	Limited cumulative risk as the focus is on in-coming construction workforce.	• Develop a communicable disease strategy and programme that includes employees, contractors and visitors to prevent local introduction and spread of disease. This is a primary workplace health intervention but extends to reduce risks of disease transmission in the community. This should include vaccine preventable and outbreak preparedness and response elements. • Fitness for work programmes to screen employees/contractors for communicable diseases. • Ensure adequate accommodation space is available in the construction camp to reduce the need for contractors to rent space in the local communities.
Increased risk of sexually transmitted diseases due to high risk sexual practices and behaviour of the workforce	This in-coming semi-skilled and skilled workforce has the potential to significantly impact on the increased local transmission of sexually transmitted infections (STI). The risks will be highest during the construction phase when the temporary construction workforce dominates. This male dominated mobile workforce are prone to develop casual sex relations with the local community and as they often have high rates of STIs there is an increased risk for transmission. Sexual encounters are often transactional in nature (male workforce has disposable income), targeting local girls and women who have limited ability to negotiate safe sex practices. Transport workers are a well-described high-risk group and are known to have multi sexual partners and to develop sexual networks along transport corridors. This may lead to localised increases of STIs along the EN1 transport corridor but also from the temporary beach offload area to the site. Both heavy vehicle and light duty drivers are a risk group.	Cumulative risk is high. Due to behaviours of the CPF workforce with similar challenges associated with single men who have disposable income and transport workers	• Extend the communicable disease strategy to include management of STIs and HIV. • Develop strict camp access controls and consider a total closed camp option. • Develop a code of conduct that restricts fraternization of the workforce with the community and internally amongst the workforce (especially towards local female employees). • Develop procedures to limit the development of a commercial sex trade, including at the lodge where an element of the workforce will stay in Inhassoro. • Develop a specific HIV and STI prevention programme for long distance truck drivers and other transport workers. • Support health systems strengthening activities of the public health sector including awareness and behaviour chance communication and care/treatment programmes. • Support social development initiatives for the empowerment of women and girls in the area to support livelihoods and reduce vulnerability of transactional sexual relationships.
Camp facilities management	A number of health risks can originate from the construction accommodation facility and spread to the community if certain safeguards are not anticipated and developed, including: • Overcrowding in accommodation areas may increase risks for transmission of communicable diseases (such as TB) - as per above. • Pollution of surface and ground water sources through ineffective management of waste-water and solid waste. • Creation of vector breeding sites through inadequate environmental controls with increased risk of malaria and arbo-viral disease. • Lack of entertainment facilities, codes of conduct and controlled access in camp leading to the development of casual or transactional sexual relations in camps or communities- as per above. • Potential to attract rodents and snakes to camps through poor waste management, with a potential risk for bites or zoonotic diseases	Limited direct cumulative risk as restricted to Project camp facilities but workplace behaviours do overlap	• Effective camp facilities management at accommodation camps to prevent overcrowding etc. • Effective management of waste-water and solid waste from camps, offices and work areas to prevent pollution of soil and surface/groundwater. • As part of communicable diseases strategy develop a malaria and vector control programme. This should include source reduction through environmental controls, chemical vector controls, bite prevention and effective medical services. • Develop entertainment facilities and a small supply store onsite that limits the need for the community to enter the local communities. • Effective camp/site management and solid waste management, especially of food products to prevent attraction of rodents. Rodent controls in camps and workplace. • Snake handling (catch and release) capability • Limit domestic pets on site (dogs and cats) and as required support vaccination and sterilisation of animals.

Potential direct impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures

Environmental manipulation and potential for pollution from Project activities	These are discussed in more detail in the respective biophysical specialist studies but can include potential impacts from:
	• Reduced air quality:
	  ○ Dust from constructions and from passing vehicles.
	  ○ Vehicle emissions.
	  ○ Plant activities.
	• Water quality and quantity:
	  ○ Draw down effects from boreholes used on the construction camp and for the plant potentially reducing the water table, and as result the quantity of water available for communities who mainly rely on ground-water sources.
	  ○ Potential pollution of surface and ground water sources due to spills or other Project activities.
	• Noise and vibration from construction activities, passing mobile equipment and on-going plant operations.
	• Numerous hazardous chemical substances.
	In addition to these alteration of the physical environment has the potential to increase the risks for vector related diseases, including:
	• Malaria risks due to the creation of potential breeding site where mosquitos can proliferate.
	• Arbo-viral conditions (such as dengue fever) due to the import of goods through the temporary beach landing site and areas (such as lay-down yards) where water can collect in man-made containers and provide a suitable habitat for these specific mosquitoes to breed and proliferate.
		Potential for cumulative risk, depending on activities and location of sensitive receptors	• Recommended management and monitoring measures as proposed by relevant specialist studies.
			• Evaluate potential human health impacts from various determinants once specialist studies baseline and impact assessments are completed
			• Develop effective occupational hygiene programmes to manage workplace exposures, as these by extension will limit public exposure risks.
			• Hazardous chemical substance management programmes in alignment with local legislation and good international industry practice. This should include procedures to prevent the re-use of containers that may have contained hazardous substances in the community.
			• Develop effective source reduction and environmental controls to reduce vector breeding sites.

Economic displacement	While this is still subject to an updated study, the potential loss of land or access to arable land needs to be considered as this is central in local livelihoods, food security and traditional values/sense of place.	Potential as CPF project also historically displaced people.	• Depending on the outcome of the resettlement and displacement studies that are on-going consider potential health impacts especially food security.
Community safety risks due to accidents with Project equipment	There is an increased potential for accidents impacting on community safety due to: • Accidents with Project mobile equipment including long distance trucks, light duty vehicles and earthmoving equipment etc. • Accidents with ships and barges used to off load goods	Cumulative due to road traffic risks.	• Develop community security and safety management plans, including emergency preparedness and response plans for both road traffic and maritime risks. • Develop and implement road safety campaigns. • Develop specific workplace health and safety standards and procedures for the management of Project mobile equipment and machinery, including specific requirements for driver training, fatigue management, vehicle roadworthiness, over-speeding, substance abuse etc.
Health system and services	The Project workforce will require medical services to support their general, occupational and emergency care requirements. As the public health system is weak and overstretched in the study area any increased demand will place pressure on the ability to deliver an acceptable quality service to the community.	Limited as CPF has its own medical service and a medical service in the Nhamacunda housing estate in Vilankulo.	• Develop an effective site based medical service to cater for the primary care, occupational health and emergency care needs of the workforce to limit the need to refer into the local public health system. This will need to include effective referral systems for routine and emergency cases. Evaluate opportunities to integrate with current CPF facilities to maximise use of resources. • Evaluate opportunities for health systems strengthening in the public health sector.

Potential indirect impacts			
Potential impact	Determinants	Cumulative CPF	Recommended management measures
Project induced in-migration	While cumulative in nature due to the existing activities, it is likely that the development of the Project will be an additional attractor due to its potential additional economic benefit and ability to provide potential jobs. This may lead to the introduction of communicable disease, deterioration in environmental health conditions increasing the potential for disease transmission, place pressure on limited available infrastructure and services (e.g. waste, housing and healthcare), and influence the emergence of social pathologies that can give rise to substance abuse and interpersonal violence.	Cumulative risk is high. While more likely to peak in construction impacts may persist into operations in a cumulative manner	• Use the c-EMP and o-EMP Management of Population Influx Plans used for the CPF development or other Sasol related developments as a guideline to develop Project specific plans, or extend these plans to address potential cumulative impacts. • Use as a guideline the c-EMP and CMR elements of the Employment and Labour Management plan developed for the CPF to support the requirements and local applicability of the Project to limit the attraction of job seeking migrants.
Local economic development and lifestyle related changes	Local economic development and change of lifestyles and eating habits may increase the potential for non- communicable diseases	Cumulative risk with other local economic developments	• Develop workplace wellness programmes and extend these to the family units. • Support specific health systems strengthening in association with the district health authorities.

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APPENDIX A

Health Facility Assessment Service (Availability and Readiness Assessment (SARA) Tool)

HEALTH FACILITY ASSESSMENTS

Assessment of the quality of health care in the local communities was carried out in three health facilities serving the project area namely the health centres of Inhassoro (Sede), Mangugumete and Pambara. The assessment was conducted using a modified Service Availability and Readiness Assessment (SARA) tool, a conceptual framework of measuring quality in health care developed by the WHO [25]. Using this standard tool, the indicators assessed can be monitored over time as required. Key informants at the respective health facilities, generally the person in charge, were interviewed to gain an understanding of the main health challenges in their target population as well as potential structural and operational challenges at facility level. The key parameters for the assessment included the following:

- Human resource capacity;
- Quality and continuity of services;
- Availability of essential medical equipment, diagnostic equipment, drugs and supplies;
- General infrastructure;
- Emergency care;
- Referral services;
- Common diseases and
- Challenges/opportunities.

The findings are presented in the Table that follows, with main challenges including:

- Poor access to health care (only half of the population have access to a facility within a radius of 5 km). Access is hampered by poorly maintained roads and limited public transport;
- Inadequate range of services with complete lack of specialist and surgical services. Limited availability of emergency services;
- Challenges of infrastructure especially lack of a functional power backup system (except for solar powered vaccine fridges). Most of the facilities lack running water;
- Inadequate waste disposal facilities. None of the district's health facilities had an incinerator for management of hazardous medical waste;
- Inadequate bed spaces often resulting in mixing of patients in the wards increasing the risk of exposure to communicable diseases. Only Inhassoro Sede and Mangugumete health centres offered inpatient services; and
- Inadequate availability of skilled staff. Most health professionals have mid-level training and almost 50% are general nurses and maternal-child health nurses. Only 5% of the staff had superior (university) qualification.

Health facility assessment

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
Date of Interview	19.06.2018	20.06.2018	22.06.2018
Full Name of Informant (s)	Alberto Nhabau	Farai Kassitomo	Sergio Manrique
Position/Function	Clinical Technician	Clinical Officer In Charge	Clinical Technician
Health Care Provider availability			
Specialists (medical/surgical)	0	0	0
General doctor / GP	2	1	0
Medical technician	4	3	1
Nursing Officer	12	7	2
Nurse Midwife	7	6	0
Anaesthetist officer/nurse	0	0	0
Public Health Officer	1	0	0
Environmental Health Officer	0	0	0
Laboratory technician	3	2	0
Laboratory assistant	1	0	0
Radiographer	0	0	0
Dentist	1	0	0
Dental technician	0	0	1
Dental assistant	0	0	0
Pharmacist	1	0	0
Pharmacy technician	2	2	1
Pharmacy assistant	2	0	0
Nutrition technician/officer	1	1	0
Support staff	7	5	2
Total	**44**	**34**	**7**
Service availability			
Out-patient services	√	√	√
In-patient services	√	√	√
24 hour emergency	√	√	Limited to basic assessment and referral
Emergency surgery	Basic	Nil	Nil
Caesarean section	Nil	Nil	Nil
Assisted vaginal delivery	√	√	√

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
Blood transfusion	√	√	Nil
Neonatal resuscitation with bag and mask	√	√	√
Pharmacy	√	√	√
Immunization	√	√	√
Growth monitoring	√	√	√
IMCI (Integrated Management of Childhood Illnesses)	√	√	√
VCT for HIV/AIDS	√	√	√
PMTCT of HIV/AIDS	√	√	√
Primary health care	√	√	√
Maternal health care	√	√	√
Ambulance service (functioning)	√	√	Nil (relies on ambulance from Vilanculos Hospital
Intensive care	Nil	Nil	Nil
Laboratory services	√	Basic	Limited to a few rapid diagnostic tests
General Surgery	Nil	Nil	Nil
Orthopaedic surgery	Nil	Nil	Nil
Specialist services	Nil	Nil	Nil
Radiology	Nil	Nil	Nil
Number of in-patient beds	20	13	0
Total beds	**20**	**13**	**1 (observation bed)**
Diagnostic ability			
Malaria RDT	√	√	√
Malaria Microscopy	√	√	Nil
HIV RDT	√	√	√
HIV ELISA	Nil	Nil	Nil
HIV CD4 count	√	√	Nil
Syphilis test	√	√	√
TB diagnostic	√ (limited to sputum analysis)	√ (limited to sputum analysis)	Nil
Haematology	√	Only check haemoglobin	Nil
Biochemistry	√	Nil	Nil
Parasitology	√	√	Nil

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
Urinalysis	√	√	Nil
Availability of drugs (always in stock)			
Antimalarials (ACTs)	√	√	√
Parenteral Quinine/Artesunate	√	√	√
Fansidar/SP	√	√	√
ART (Zidovudine, Nevirapine, Efavirenz)	√	√	√
TB drugs	√	√	√
Routine child vaccines (EPI)	√	√	√
Antihelmintic drugs	√	√	√
Oral rehydration solution	√	√	√
Oxytocin/Misoprostol	√	√	√
Penicillin (Any)	√	√	√
Erythromycin	√	√	Nil
Doxycycline	√	√	√
Vitamin A	√	√	√
Vitamin K	√	√	√
Iron supplements	√	√	√
Folic acid	√	√	√
Insecticide treated bednets	√	√	√
Hypertension drugs	√	√	√
Antipyretics	√	√	√
Injectable diazepam / valium	√	√	√
Injectable magnesium sulphate or other anticonvulsant	√	√	√
Injectable ergometrine	√	√	√
Tetanus anti-toxin injection	√	√	√
Adrenaline injection	√	√	√
Anti-protozoa drugs	√	√	√
Anti-histamines	√	√	√
Dermatological preparations (anti-fungal, anti-allergic or anti-inflammatory)	√	√	√

Health Facility	Inhassoro Health Centre (Sede)		Mangugumete Health Centre		Pambara Health Centre	
Availability and functionality of medical equipment						
A=Available; F=Functional	A	F	A	F	A	F
Table for gynaecological examination	Nil		√	√	√	√
Fetoscope	√	√	√	√	√	√
Autoclave	√	√	√	Not functional	√	Not functional
Pressure cooker for sterilization	Nil	Uses autoclave	Nil		Nil	
Speculum	√	√	√	√	√	√
Blood giving set	√	√	√	√	Nil	
Delivery Forceps	√	√	√	√	√	√
Intravenous sets	√	√	√	√	√	√
Vacuum extractor	Nil	Use discouraged	√	√	√	√
Manual vacuum aspirator	√	√	√	√	√	√
Dilatation and curettage kit	Nil		Nil		Nil	
Operating table	Nil		Nil		Nil	
Operating light	Nil		Nil		Nil	
Anaesthesia equipment	Nil	Local anaesthesia	Nil		Nil	
Oxygen equipment	Nil		Nil		Nil	
Bag valve mask and resuscitator	√	√	√	√	√	√
Blood pressure apparatus	√	√	√	√	√	√
Stethoscope	√	√	√	√	√	√
Thermometer	√	√	√	√	√	√
Weighing scale	√	√	√	√	√	√
Glucometer	√	√	√	√	Nil	
Infrastructure						
Regular/reliable running water	√ (supplied from private company)		Not reliable		√	
Regular/reliable electricity	√ (national grid, 99% reliable)		Not reliable		√	
Solar power	Nil		√ (only for vaccine fridge)		Nil	
Generator	Nil		√ (not functional)		Nil	
Any type of electricity	√		√		√	
Functioning refrigerator	√		√		√	

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
Functioning landline	Nil	Nil	Nil
Functioning mobile	√	√	√
Functioning 2-way radio communication	Nil	Nil	Nil
Refrigerated mortuary	√ (capacity for 6)	Mortuary has no freezer	Nil
Continuity of services			
In-patient services 24/7	√	√	Nil
Emergency services 24/7	√	Basic	Basic
Official opening hours per day (in hours)	24 hrs	24 hrs	0730-1530 hrs
Staff lives in proximity to HF	Yes, has staff quarters	Yes, has staff quarters	Yes
Access to a referral hospital			
Proximity of referral hospital (in hours)	40 km to Vilanculos Rural Hospital (1 hr by ambulance)	Vilanculos Rural Hospital (50 min by ambulance)	Vilanculos Rural Hospital (30 min by ambulance)
Transportation possibility to referral hospital	Ambulance	Ambulance	Ambulance or public transport
Cost of referral (both ways)	Free	Free	Free for ambulance
Staff in-service training			
Staff trained in life saving skills (number)	Yes (5 in number)	Yes (3 in number)	Yes
Staff trained in IMCI (number)	√	√	√
Process of health care			
Use of disposable gloves	√	√	√
Use of protective eye wear	√	√	√
Evidence of use of cleaning disinfectant in wards and casualty	√	√	√
Evidence of soap in wash basins, or hand sanitizer in wards	√	√	√
Hand washing	√	√	√
Use of autoclave	√	√	√
General state of building and state of cleanliness	Old infrastructure, needs repairs in certain areas	Good and generally clean, reported leaking roof	New building, generally clean. Reported leaking roof
Cost of health care			
How much does a basic	1 met (free for chronic	1 met (free for chronic	1 met (free for chronic

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
outpatient consultation cost	diseases)	diseases)	diseases)
How much does diagnosis and treatment for malaria cost (with RDT use)	Free	Free	Free
How much does an admission for a child cost?	Free	Free	Free
General Questions			
How many people have access to this health care facility- the target population?	Whole district, acts as official centre of reference	At least 8 neighbouring villages	Pambara village and neighbouring villages
What are the 3-5 main health challenges facing the community	1. Malaria 2. Poor access to safe drinking water and sanitation 3. Use of traditional medicine 4. Poor health seeking behaviour 5. Poverty	1. Poor access to safe drinking water and sanitation 2. Malaria 3. Use of traditional medicine 4. Limited awareness	1. Poor sanitation and hygiene 2. High burden of malaria 3. Use of traditional medicine 4. Inadequate health services, shortage of medicines, etc
If you had 3-5 wishes to improve health care in the communities that you serve in, what would they be?	1. Control malaria 2. Improve access to safe drinking water and sanitation 3. Health promotion and education 4. Poverty alleviation	1. Health promotion to improve awareness 2. Improve access to safe drinking water 3. Promote good sanitation practices 4. Improve service delivery	1. Control malaria 2. Health promotion and education 3. Improve service delivery
What are the 5 most common diseases in children under 5 years?	1. Malaria 2. Acute respiratory infections 3. Diarrhoea 4. Conjunctivitis	1. Malaria 2. Diarrhoea 3. Acute respiratory infections 4. Generalised fevers	1. Malaria 2. Diarrhoea 3. Cough and cold 4. Skin infections 5. Febrile illness (not specified) N/B: Only few cases of malnutrition
What are the 5 most common diseases for adults?	1. Malaria 2. Sexually transmitted infections 3. Acute respiratory infections 4. Diarrhoea 5. HIV	1. Malaria 2. HIV 3. Sexually transmitted infections 4. Tuberculosis 5. Hypertension	1. Malaria 2. Diarrhoea 3. Sexually transmitted infections 4. HIV 5. Cough and cold N/B: TB features in

Health Facility	Inhassoro Health Centre (Sede)	Mangugumete Health Centre	Pambara Health Centre
	N/B: TB features in the top-ten		the top-ten
Is there good community cohesion to supporting health initiatives?	Yes, generally good. Has linkages through APEs that support basic health care delivery at community level	Yes, generally good. Health delivery supported by APEs at community level	Yes, generally good. Health delivery supported by APEs at community level
Are there measures in place at facility level to deal with disease outbreaks? If yes, specify	Yes, there are measures in place including surveillance of notifiable diseases and response guidelines	Yes, coordinated at the district headquarters	Yes, coordinated at the district headquarters
Notes	Relies on water pumped to the facility from a private payable source. Old infrastructure requires rehabilitation	Facility was built by SASOL. No running water in taps because of faulty pump system. Gas generator not functional. Leaking roof in some sections.	New facility, commissioned in 2016. Busy but poorly staffed.

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