REPORT

Central Térmica de Temane Project - Terrestrial Ecology 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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Executive Summary

Introduction

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 fired power plant, known as the Central Térmica de Temane (CTT) project (formerly referred to as the Mozambique Gas to Power Project, MGtP). The proposed project will draw gas from either the Sasol Petroleum International (SPI) Temane gas well field via the existing Central Processing Facility (CPF) or from an alternative gas source.

The proposed Power Plant site is thus located in close proximity to the existing CPF, in the Temane/Mangugumete area, Inhassoro District, Inhambane Province of Mozambique. Proposed project components that are likely to impact terrestrial ecology includes, *inter alia*; the development of the Power Plant site (20 ha) and a 25 km transmission line; the establishment of a beach landing site; and, the upgrade of road access route. This document presents a terrestrial ecology impact assessment for these proposed project components.

Study Methods

The impact assessment was informed by a baseline ecological characterisation that was developed by consolidating several existing biodiversity datasets, with observations made during two targeted field inspections of proposed infrastructure footprints (conduced in 2015 and 2018).

Main Findings of Impact Assessment

The region is defined by a prominent human-ecological system coupling. Areas in close proximity to towns and villages and along the major access roads are either completely transformed or highly disturbed. Further afield however, disturbance levels generally decrease, and indigenous habitats become more prevalent. The study area is dominated by Open and Closed Woodland habitats, with localised areas comprising and Low Thickets, Tall Forest/Tall Thicket, and Permanent and Seasonal Wetlands (associated with the Govuro River and inland depressions/pans).

During the critical habitat screening conducted for the regional biodiversity studies (Golder, 2017), two areas were identified as potential critical habitat in the broader region, namely the Govuro River Floodplain Critical Habitat and the Nhangonzo Critical Habitat. A subsequent Area Categorisation study determined that most (over 85%) of the Nhangonzo area does not in fact qualify as critical habitat, in terms of IFC PS6 (2012) (Impacto, unpublished). Only 64 ha of Coastal Dune Thicket/Forest occurring in a narrow strip along the coastal foredunes and secondary dunes could be designated as critical habitat (Impacto, unpublished). Both the Govuro River Floodplain Critical Habitat and 64 ha of Coastal Dune Thicket/Forest in the Nhangonzo area are located outside of project infrastructure footprints, and therefore will be not be impacted by the proposed project activities.

Proposed new infrastructure footprints (i.e. Power Plant site and powerline) were cleared of vegetation in 2015 as part of demining activities. It was evident during the 2018 field inspection that vegetation has recovered well following the original clearing, with significant regeneration of the herbaceous component in all areas, and woody vegetation in certain areas. It was also apparent that sites associated with the proposed upgrade components of the project (i.e. road access routes and beach landing sites) remain largely unchanged from the condition documented in 2015.

Local people, particularly those living in more remote rural locations are rely heavily on natural resources to meet their daily livelihood requirements. Several ecosystems services were noted during the field inspection including *inter alia*; the harvesting of plant biomass for fuel and building material, grazing of livestock, commercial and subsistence farming, growing and collecting of fruits and vegetables, hunting and fishing and the use of fresh water.

Several negative impacts on terrestrial ecology were identified and assessed for significance. These included:

- Vegetation clearing and earth works causing a loss or disturbance of natural habitat;
- Establishment and spread of alien invasive plant species;
- Loss of flora species of conservation concern;
- Death or injury of fauna;
- Sensory disturbances to fauna (artificial lighting and noise); and
- Secondary habitat loss/modification due to resource exploitation.

The rating of these impacts during the construction, operational and closure phases indicates that before mitigation, they have either a high or moderate significance. With the implementation of appropriate mitigation measures however, their significance can be reduced to moderate or low. It is therefore important that the mitigation measures outlined in this report are incorporated into the CTT project's overall environmental management programme.

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ACRONYMS/ABBREVIATIONS

Acronym or Abbreviation	Full Term
ESIA	Environmental and Social Impact Assessment
CTRG	*Central Térmica de Ressano Garcia*
EDM	*Electricidade de Mozambique*
MGtP	Mozambique Gas to Power
SNE	Sasol New Energy Holdings (Pty) Ltd
SPI	Sasol Petroleum International
CPF	Central Processing Facility
MITADER	Ministério da Terra, Ambiente e Desenvolvimento Rural
CCGT	Steam turbines for Combined Cycle Gas Turbine
OCGE	Open Cycle Gas Engines
ADI	Areas of Direct Influence
AII	Areas of Indirect Influence

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 either 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) or from an alternative gas source. 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. 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 11 km 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 or from an alternative gas source;

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;

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 days 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; and

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.

1.1 Study Background and Objectives

The ecological study for the proposed CTT project was originally conducted in 2015 (ref. Golder, 2015b). It focused on describing the baseline terrestrial ecology of potentially affected areas, with a view of identifying important or sensitive species and sites/habitats, and how these may be impacted by proposed project activities. The 2015 study was informed by comprehensive biodiversity assessments of the broader Temane Exploration Block, coupled with a targeted field inspection of the proposed project footprints.

After completion of the 2015 terrestrial ecology study, the proposed CTT project was placed on hold. In 2018, Sasol communicated their intention to re-initiate the project, and requested that Golder conduct a follow-up field inspection of the proposed project footprints to assess whether there have been any significant changes to terrestrial ecology.

This report thus presents a summary of the regional terrestrial baseline ecology, based on several previous biodiversity studies, as well as an updated characterisation of proposed project infrastructure sites. These data were then used to inform a terrestrial ecology impact assessment.

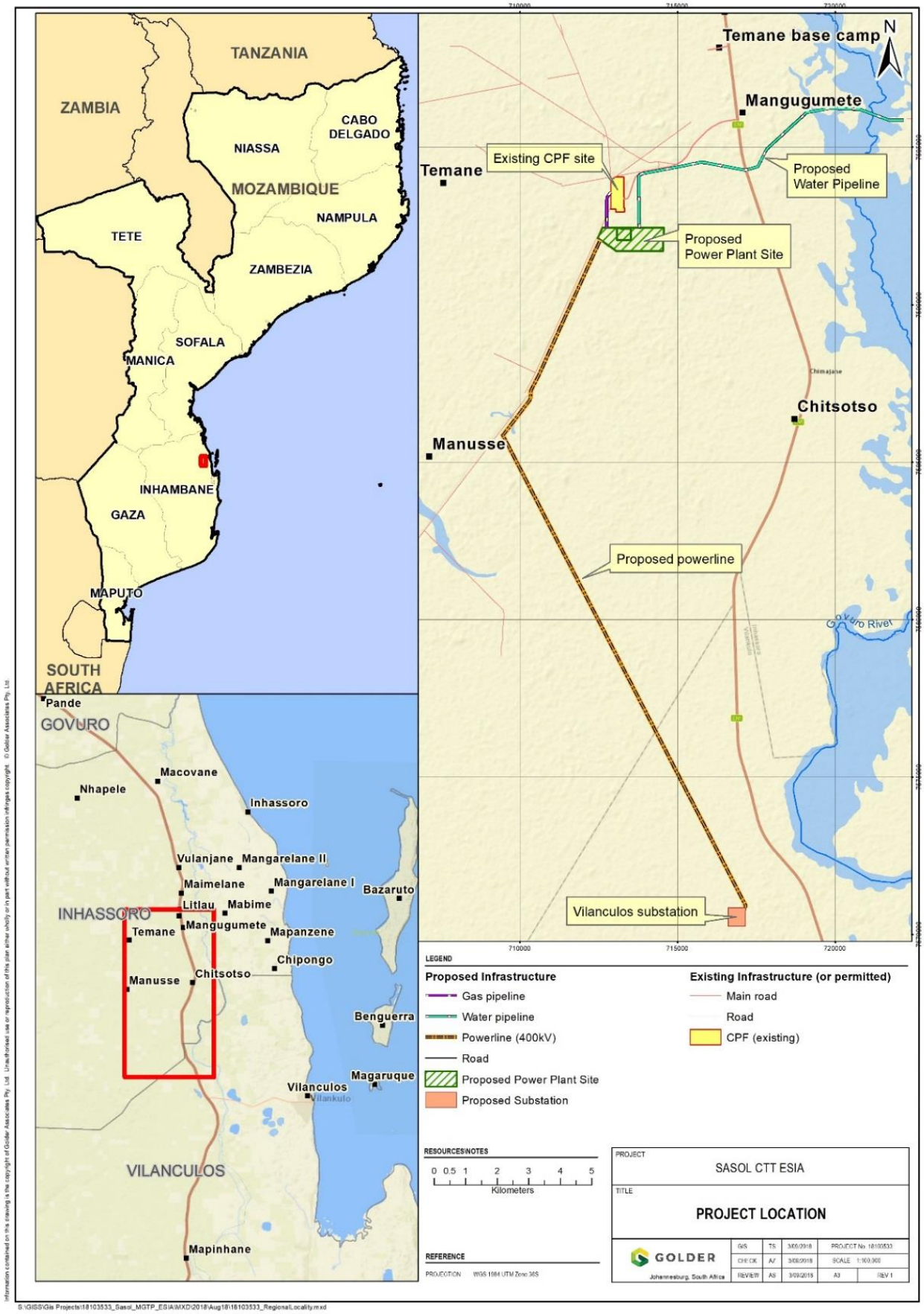

Figure 1: Project Location

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 450 MW (examples are shown in Figure 2);
- Gas pipeline (±2 km) that will feed the Power Plant with natural gas from the CPF;
- 400 kV Electrical transmission line (± 25 km) with a servitude that will include a fire break (vegetation control) and a maintenance road to the Vilanculos substation. The transmission line will have a partial protection zone (PPZ) of 100m width. The transmission line servitude will fall inside the PPZ;
- Water supply pipeline to one or more borehole(s) 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 days 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 4 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.

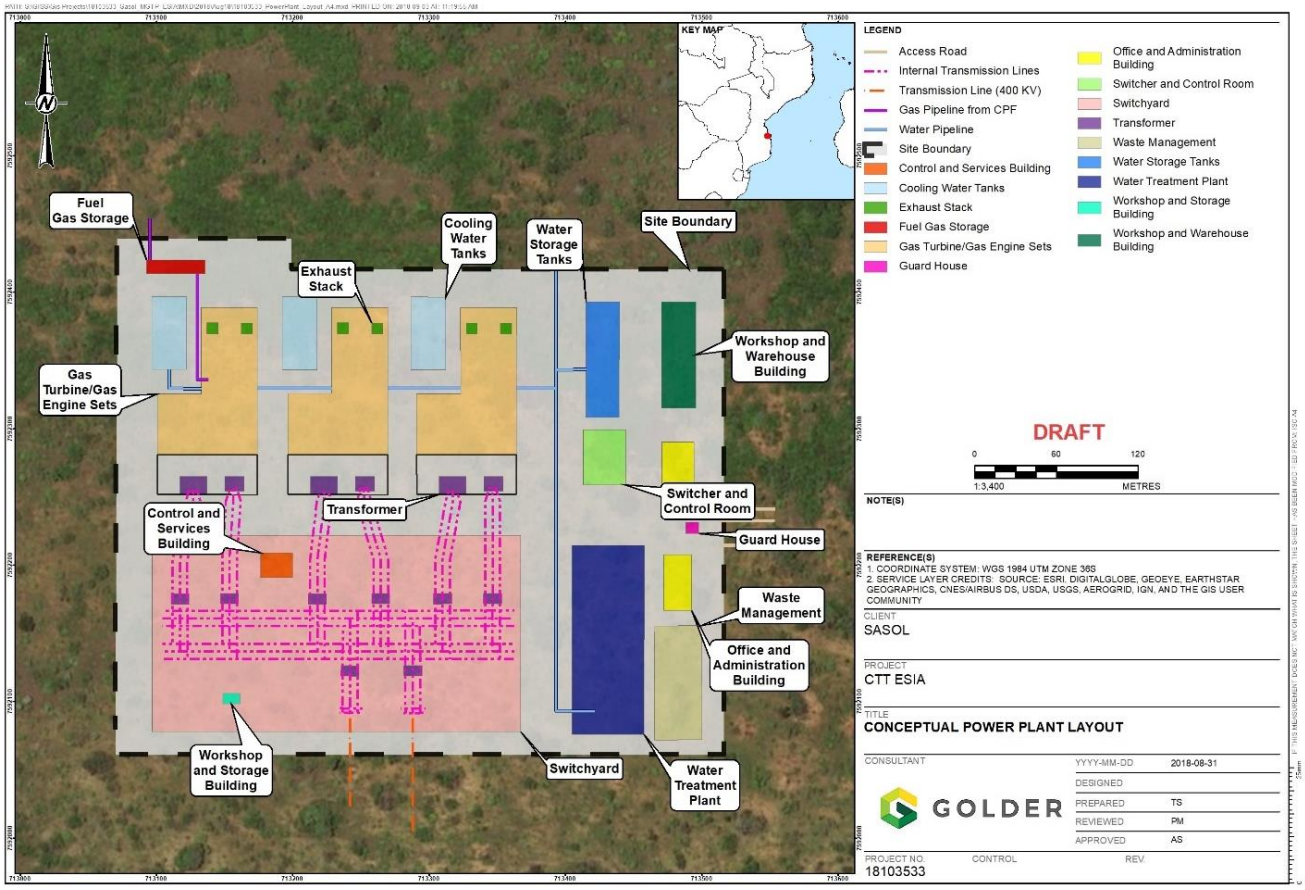

Figure 3: Conceptual layout of CTT plant site

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.

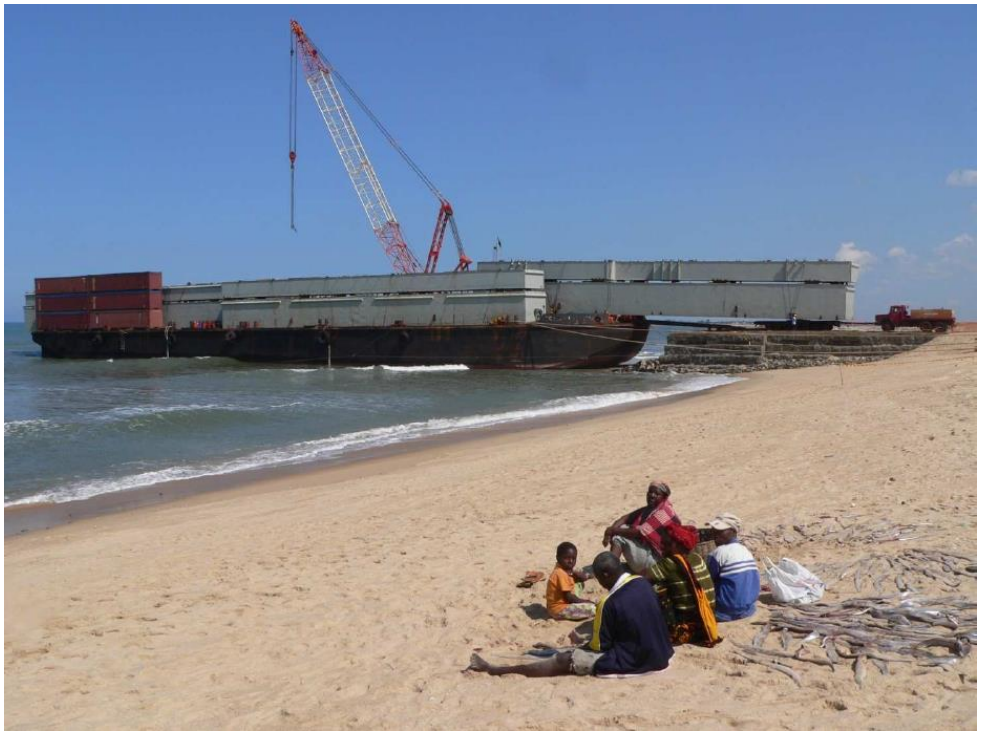

Figure 4: Typical beach landing site with barge offloading heavy equipment (source: Comarco)

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 Govuro 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.

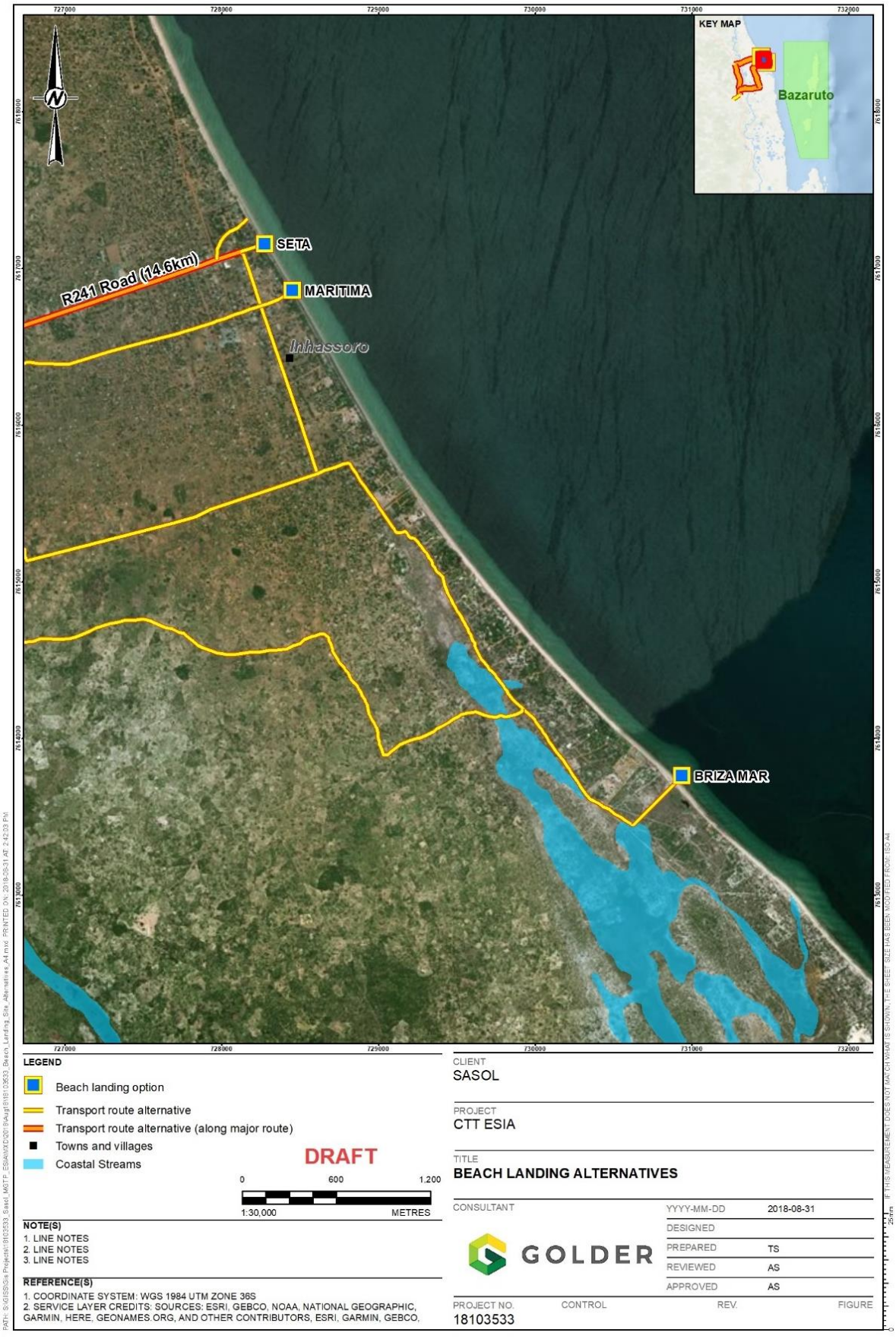

Figure 7: The three beach landing site options and route options at Inhassoro

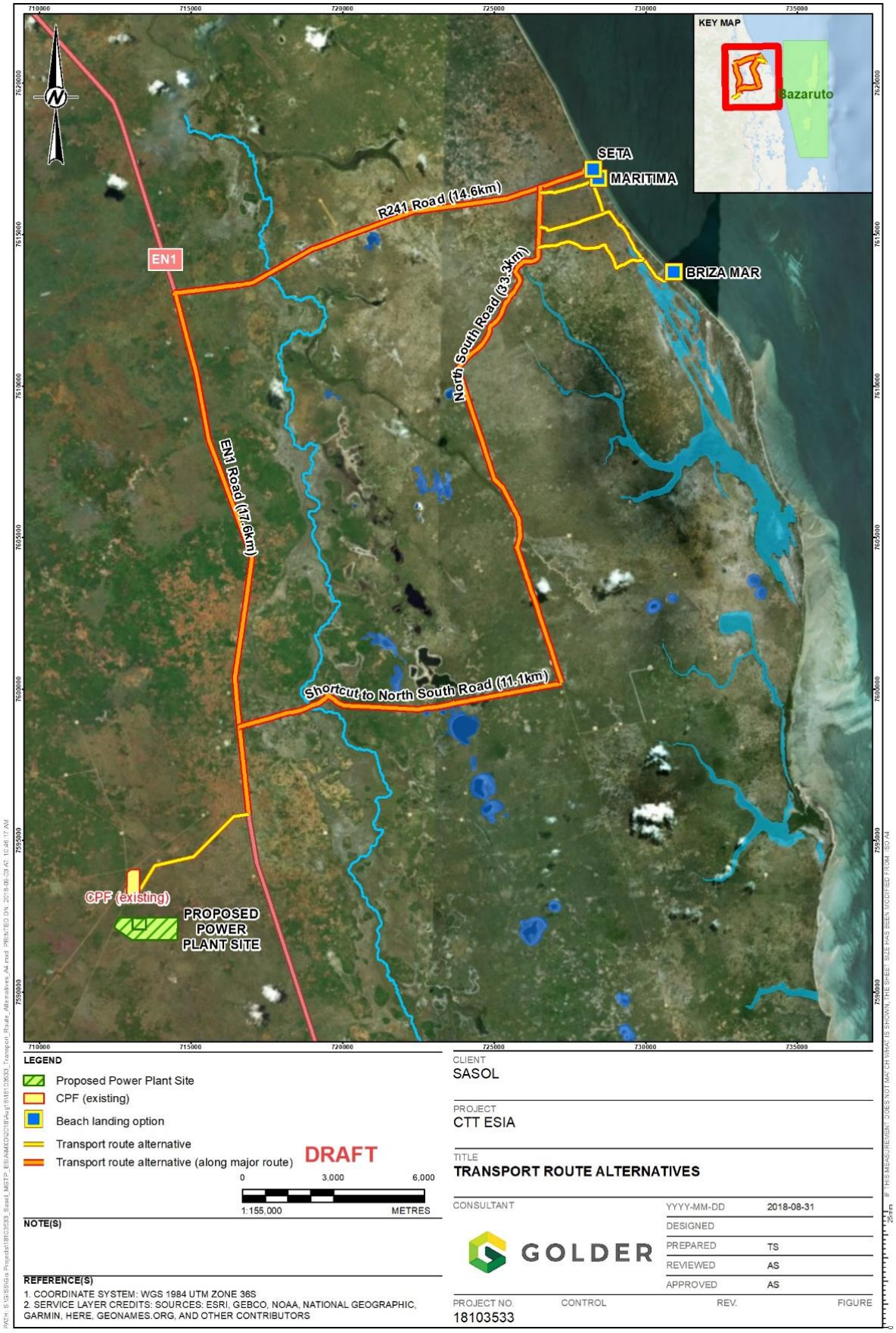

Figure 8: The two main transportation route alternatives from the beach landing sites to the CTT site

3.0 LEGISLATION

3.1 Applicable Mozambique Legislation

The proposed project has been determined as 'Category A' in terms of Mozambique's environmental law (Decree 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 presents the Terrestrial Ecology Impact Assessment undertaken to support the ESIA. This study was undertaken in line with Mozambique environmental legislation, specifically:

- The Environment Law (Law 20/97 of 1 October) - Articles 12 and 13;
- The Land Law (Law 19/97 of 1 October) and Land Law Regulations (Decree 66/1998 of 8 December); and
- The Law on Forest and Wildlife (Law 10/99 of 7 July) - Articles 11 and 13.

3.2 Conventions and International Agreements

Mozambique is a signatory to the following applicable international conventions and agreements relating to biodiversity:

- Convention on Biological Diversity (CBD): Under the convention, each contracting party is expected to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity;
- Convention on International Trade in Endangered Species (CITES): The aim of CITES is to control the trade and exploitation of endangered species;
- Convention on Wetlands of International Importance (the Ramsar Convention): This convention aims to provide the mechanism form identifying and formally designating wetlands that are of significant international importance owing to various criteria; and
- United Nations Convention to Combat Desertification: The objective of this convention is to combat desertification and mitigate the effects of drought through national action plans.

3.3 International Guidance

3.3.1 International Finance Corporation's Performance Standards

At the project financing level, the management of biodiversity is addressed by IFC Performance Standard 6 (PS6), and the supplementary Guidance Notice 6 (GN6). Specifically, these relate to:

- The protection and conservation of biodiversity;
- Maintenance of ecosystem services; and
- Sustainable management of living natural resources.

The requirements set out in PS6 have been guided by the Convention on Biological Diversity. PS6's main priority is that the proposed project related activities should seek to avoid impacts on biodiversity and ecosystem

services. When avoidance of impacts is not possible, measures to minimise impacts and restore biodiversity and ecosystem services should be implemented.

4.0 STUDY METHODOLOGY

4.1 Approach

The ecological attributes of the region surrounding Inhassoro have been comprehensively studied as part of Sasol's gas exploration and gas to power generation programme. Data from these studies were augmented with the findings of two targeted field inspections of proposed infrastructure footprints (conducted in 2015 and 2018) and used to develop the baseline ecological characterisation for this impact assessment. A brief summary of study methods is presented below.

4.2 Consolidation of Existing Ecological Baseline

The Golder, (2015b) report presented a regional characterisation of the terrestrial ecosystems (both flora and fauna communities) of the Temane Block, based on specialist studies, which included both wet- and dry season field programmes, conducted earlier that year, specifically:

- De Castro & Brits (2014). Botanical Biodiversity & Habitat - Specialist Report 9. EIA for Sasol PSA and LPG Project: Golder Associates Africa - Report No. 1302793-10712-21 (ref. De Castro and Brits, 2014); and
- Deacon, A. (2014). Terrestrial Fauna Impact Assessment - Specialist Report 10. EIA for Sasol PSA and LPG project: Golder Associates Africa - Report No. 1302793-10712-20.

The report also included habitat characterisations of the proposed project sites, which were based on observations made during a field visit conducted in February 2015. Presented data included *inter alia*:

- Broad habitat descriptions, including general flora characteristics;
- Type and intensity of incidences of disturbance/degradation;
- Evidence of natural resource use (e.g. wood collecting, grass harvesting, hunting etc.); and
- Representative photographs.

In this report, we present a broader synopsis of the regional ecological characterisation from Golder (2015b), with additional information from subsequent studies including:

- A regional[1] biodiversity study undertaken by Golder in 2015 (ref. Golder, 2015a), which included a terrestrial ecology field programme, comprising one dry-season survey; and
- A more recent (2017) regional EIA of Sasol's License Areas, which was also conducted by also Golder (ref. Golder, 2017):
  - The biological component of the (Golder, 2017) study extended the existing dataset, and used remote sensing data, supported by field work, to determine land cover, habitats and vegetation types and their associated biodiversity sensitivity across an extensive range encompassing Sasol's license areas. The field programme for this study comprised additional dry- and wet-season field surveys (Golder, 2017); and
  - Biodiversity conservation value was determined from the land cover classification and was based on the conservation status and functional importance of land cover/habitat types. Habitat sensitivity was

[1] Sasol's Temane and Pande Exploration Blocks

based on the relationship between biodiversity conservation value and transformation level (Golder, 2017). These data were also used to identify potential critical habitat, as per IFC PS6 (2012).

We also present the habitat characterisations of the actual proposed project infrastructure sites (footprints), that were described in Golder (2015b). These were used to identify potential changes in ecological character that have occurred between 2015 and the findings of the 2018 targeted field inspection (discussed in section 4.3).

4.3 Targeted Field Inspection

The field inspection consisted of one field visit, conducted from the 18th to 21st of June 2018 (dry season). The primary aim of the field inspection was to visit sites of proposed infrastructure and document current on-site habitats characteristics, specifically related to:

- General vegetation condition;
- Evidence of woodland regeneration;
- Alien invasive species establishment; and
- Evidence and potential changes to the nature and degree of natural resource use (e.g. woodland clearing, agriculture, etc.).

These data were then compared to the 2015 dataset and used to inform an updated ecological baseline for the CTT project and guide the ecological impact assessment process.

4.4 Identification of Natural, Modified Habitats and Potentially Critical Habitats

Based on the ecological characterisation, and in line with IFC PS6 (2012), areas potentially affected by the proposed project were classified as either ‘natural’ or ‘modified’ habitat in order to determine the significance of potential impacts.

The presence of critical habitat was informed by the findings of the regional biodiversity studies (detailed above) that were commissioned by Sasol with the intent of identifying ecologically sensitive areas, including areas of critical habitat as per IFC PS6 (2012), in their license areas.

The identification of modified and natural habitats was based on the detailed vegetation community map that was developed by Golder (2015a) for Sasol, coupled with the finding of the field inspection discussed above.

5.0 SUMMARY OF THE REGIONAL BASELINE CONDITIONS

This section presents a high-level overview of the regional ecological characteristics based on the findings of the previous biodiversity studies.

5.1 Climate

The climate of the region is tropical humid and defined by rainy, hot summer periods (December to March) and fresh winter periods (June to August). Mean annual rainfall is between 800 to 1 000 mm, with February generally experiencing the most rain (164 mm), and July the lowest (18.8 mm). Mean annual temperature is 24°C (De Castro and Brits, 2014).

5.2 Soils

Soils to the east of the Govuro River are of marine origin and are characteristically deep aeolian sands, and range in colour from white to brown (De Castro and Brits, 2014).

The clay content of soils to the west of the river is appreciably higher than those to the east. These soils are generally brown to red-brown sandy loams (De Castro and Brits, 2014).

5.3 Topography

The topography of the study area ranges from flat to undulating (De Castro and Brits, 2014). A low, north-south trending dune ridge runs between the coast and the Govuro River, and acts as a natural watershed. The Govuro River lies at 13 m above sea level (m.a.s.l). Land to the west of the river rises to 58 m.a.s.l, while that to the south rises to 68 m.a.s.l (De Castro and Brits, 2014).

5.4 Regional Landscape Context

The study area falls within Swahilian/Maputaland Regional Transitional Zone (De Castro and Brits, 2014). As the name suggests, this area is defined by a botanical transition, containing elements of both the Swahilian Regional Centre of Endemism, which extends from the north, and the Maputaland-Pondoland Regional Mosaic which extends from the south (De Castro and Brits, 2014). The study area is dominated by three main landscape units, namely Southern Coastal Plains, Govuro Floodplain and Western Plains (Golder, 2017).

5.5 Vegetation/Habitat Units

In their study of the Temane Block, De Castro & Brits (2014) recognised eight broad-scale vegetation/habitat units, consisting of three terrestrial units and five wetland units. Of these, five are particularly relevant to the proposed CTT project, namely:

- Mixed Woodland and Thicket Mosaic;
- *Julbernardia – Brachystegia* Short Woodland and Thicket;
- Govuro River Floodplain;
- Ephemeral Drainage Lines; and
- Barrier Lakes.

A finer-scale mapping exercise conducted in 2015 parsed the De Castro & Brits (2014) habitat units into six primary classes or vegetation formations, consisting of 33 vegetation communities (habitats) (Golder, 2015a, 2017). Of the primary vegetation formations, the following are relevant to this study:

- Open and Closed Woodland (incl. dense woodland, low mid-dense woodland and tall mid-dense woodland mapping habitats);
- Low Thicket (incl. non-intact thicket mosaic mapping habitat);
- Tall Forest/Tall Thicket, and
- Wetlands (Permanent and Seasonal).

Descriptions of vegetation communities that may be affected by the proposed project are presented in APPENDIX A. Other potentially affected land types include Urban (i.e. Inhassoro) and Cultivation (e.g. maize fields). Vegetation maps of the CTT project area are presented in Figure 9 and Figure 10.

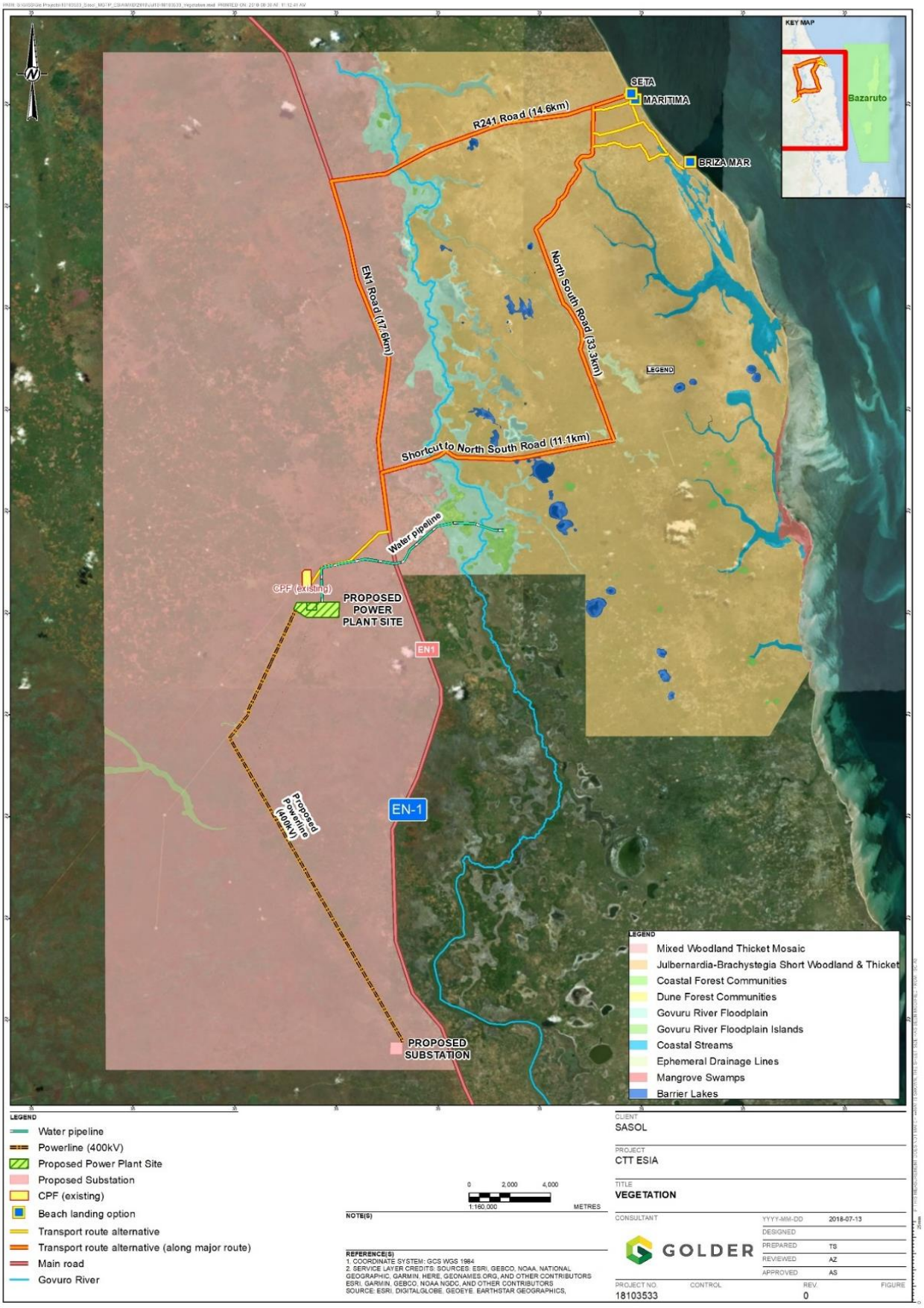

Figure 9: Broad-scale habitat units associated with the study area (from De Castro and Brits, 2014)

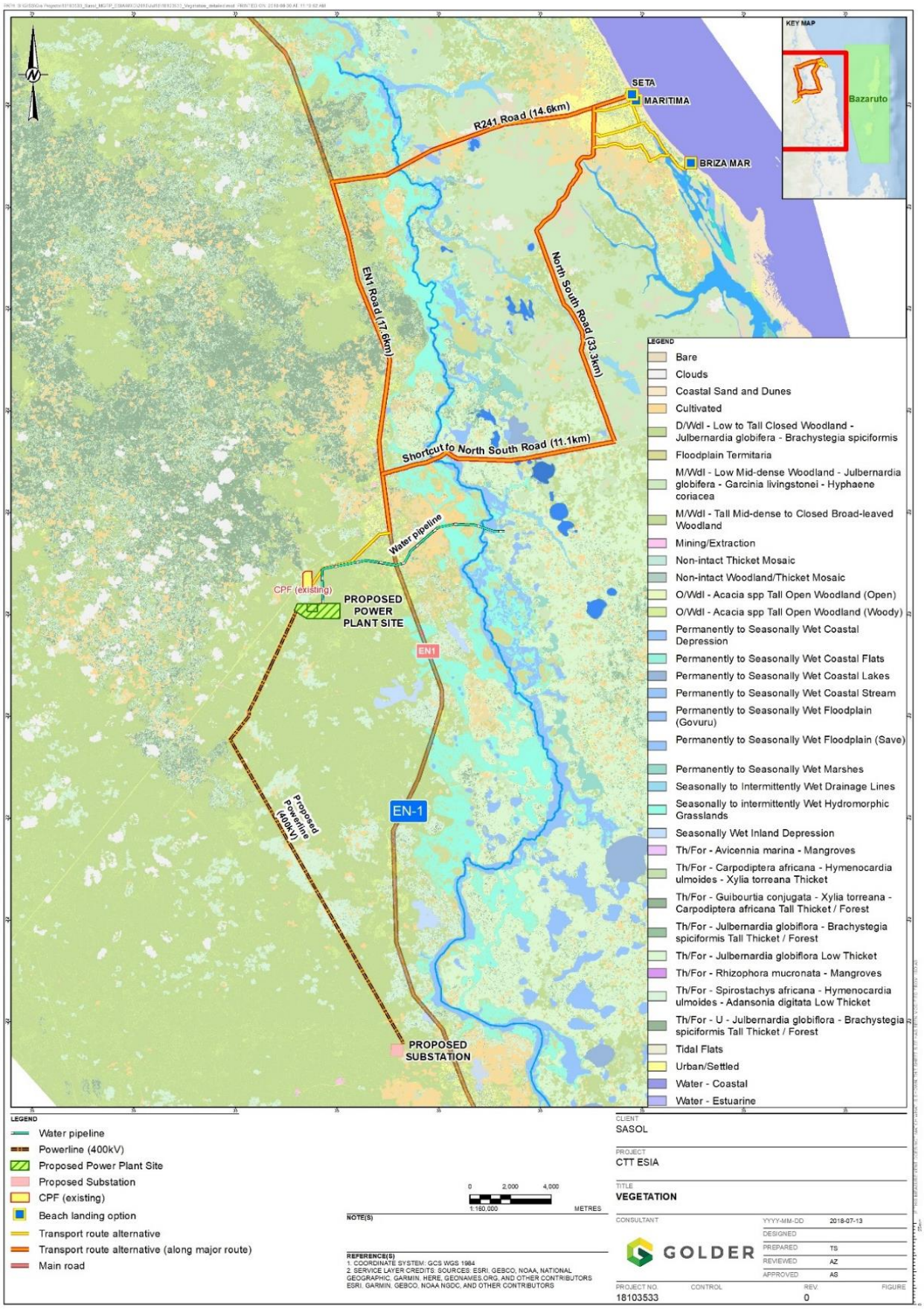

Figure 10: Finer-scale vegetation communities associated with the study area (from Golder, 2015a)

5.6 Classification of Modified and Natural Habitat

IFC GN6 (2012) recognises that natural and modified habitats exist on a continuum that ranges from largely untouched, pristine, natural habitat to intensively-managed transformed habitats.

For this study, natural habitats were defined as those habitats where key processes, composition, and structure were largely intact. Areas displaying moderate degrees of disturbance, yet that are likely to return to, or at least approximate, reference conditions in the short- to medium term, were also delineated as natural.

Modified habitats were defined as areas that have been altered by human activity and may contain large portions of non-native plants and animals (e.g. agricultural landscapes). These areas were deemed unlikely to return to their 'natural' state due persistent and long-term anthropogenic pressure.

Based on the detailed vegetation map developed by Golder (2015a) the cultivated, mining/extraction and settled/urban mapping units were classified as 'modified' habitat in terms of (IFC PS6, 2012). All other vegetation communities were classified as 'natural' habitat – refer to Figure 11. Modified habitat associated with urban areas is strongly linked to the main transport routes, while cultivated fields are located throughout the area.

5.7 Biodiversity Value of Vegetation Communities

The biodiversity value of vegetation communities that are likely to be affected by the proposed CTT project, as per Golder (2017), are listed in Table 1.

Table 1: Biodiversity value of vegetation communities affected by the proposed CTT project

Vegetation Formations (Primary Class)	Modified / Natural Habitat	Biodiversity Value
Open and Closed Woodland	Natural	Medium
Low Thicket	Natural	Medium-high
Tall Forest/Tall Thicket	Natural	High
Wetlands (Permanent and Seasonal, incl. rivers and pans)	Natural	High
Urban	Modified	Low
Cultivation	Modified	Low
Source: Golder (2017)		

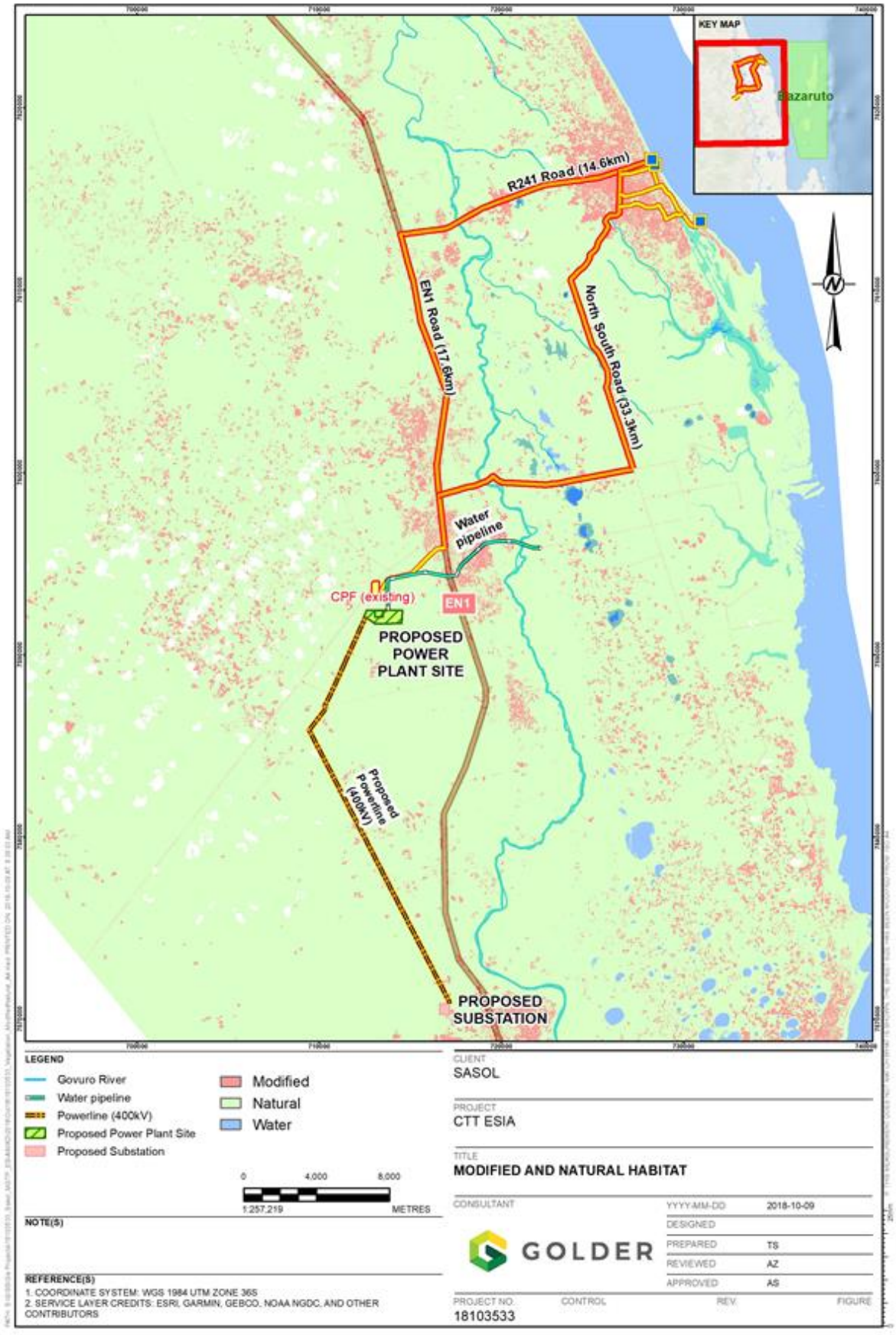

Figure 11: Delineation of natural and modified habitat

5.8 Flora Species

De Castro & Brits (2014) indicate that the region is highly species rich, with 389 indigenous plant species recorded during their study of the Temane Block. Subsequent botanical work over the larger Sasol license area recorded numerous other taxa, bringing the total flora species count to 796 (Golder, 2017).

5.8.1 Flora Species of Conservation Importance

Fifty flora species of conservation importance are known to occur in Inhambane Province (Golder, 2015a). These comprise 21 threatened species, 10 Near Threatened species and 19 Data Deficient taxa. Threatened species are those that meet the IUCN criteria for Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) status in descending order of importance. Ten species considered local endemics have also been confirmed in the area (Golder, 2017). In addition, the Forest and Wildlife Act No. 10 of 1999 lists a number of protected tree species, of which 63 occur in the area (Golder, 2017).

Fourteen plant species of conservation concern are known to occur in the broader region, as per (Golder, 2015b, 2015a, 2017) . These are listed in Table 2.

Table 2: Red List flora species

Scientific Name	Red List Status
Afzelia quanzensis	Lower Risk – Near Threatened
Brachylaena huilensis	Near Threatened
Bivinia jalbertii	Near Threatened
Croton inhambanensis	Vulnerable
Dalbergia melanoxylon	Lower Risk – Near Threatened
Dolichandrone alba	Vulnerable
Encephalartos ferox subsp. *emersus*	Critically Endangered
Encephalartos ferox subsp. *ferox*	Near Threatened
Euphorbia lividiflora	Vulnerable
Milicia excelsa	Lower Risk – Near Threatened
Paropsia braunii	Near Threatened
Pavetta gracillima	Data Deficient
Pterocarpus angolensis	Near Threatened
Xylia mendoncae	Vulnerable DD
Status as per IUCN (2018-1) or Izidine and Bandeira (2002)	

5.8.2 Flora Species of Human Utility

Several plant species recorded in the area contribute significantly to the livelihoods of local households (De Castro and Brits, 2014). These are listed in Table 3.

Table 3: Common indigenous plant species of human utility

Commercial Value	Species
Precious timbers	*Spirostachys africana*
	Dalbergia melanoxylon
First class timbers	*Afzelia quanzensis*
	Albizia versicolor
	Combretum imberbe
	Cordyla africana
	Millettia stuhlmannii
Second class timbers	*Sclerocarya birrea*
	Julbernardia globiflora
	Pteleopsis myrtifolia
	Trichilia emetica
Firewood and charcoal production	*Julbernardia globiflora*
	Brachystegia spiciformis
Thatching material	*Cladium mariscus*
Building construction	*Phragmites australis*
Palm wine	*Hyphaene coriacea*
Source: Castro & Brits (2014)	

5.9 Identification of Critical Habitat

According to the IFC guidelines for 'Biodiversity Conservation and Sustainable Management of Living Natural Resources (IUCN Performance Standard 6), Critical Habitats are areas with high biodiversity value (IFC PS6, 2012), including:

- Habitat or significant importance to Critically Endangered and/or Endangered species;
- Habitat of significant importance to endemic and/or restricted-range species;
- Habitat supporting globally significant concentrations or migratory species and/or congregatory species;
- Highly threatened and/or unique ecosystems; and/or
- Areas associated with key evolutionary processes.

During the critical habitat screening conducted for the regional biodiversity studies, two areas were identified as potential critical habitat in the broader region (Golder, 2017). These are discussed in more detail below, with Figure 12 showing their location in relation to proposed project infrastructure:

- The **Govuro River Floodplain Critical Habitat** was identified in the study area in 2015 by ERM and confirmed by further field assessment in 2016 (Golder, 2017). This area of 71 ha consists of about 47 colonies of approximately 550 critically endangered cycads -*Encephalartos ferox* subsp. *emersus* (Golder, 2017). The Govuro River Floodplain Critical Habitat is located close to the mouth of the Govuro River well to the north of proposed project infrastructure (also shown in Figure 12), and therefore will also not be impacted by the proposed project; and
- The second area that was initially proposed as potential critical habitat by De Castro and Brits (2014) is referred to as the **Nhangonzo Critical Habitat.** It is located to the east of the intersection of the proposed route of the North-South Road and Shortcut Road (shown in Figure 12). It was first identified in 2014 during the field work for the PSA Development and LPG Project EIA based on a number of key characteristics on which the assessment of critical habitat is based (Golder, 2017). Additional field work was conducted by EOH for the PSA and LPG Project EIA in 2015, which focused on the Nhangonzo area and confirmed its critical habitat status as 'provisional'. However, a reassessment of all data was conducted for an Area Categorisation study by Impacto in 2018. This study has determined that most (over 85%) of the Nhangonzo area that was provisionally described as critical habitat does not qualify as critical habitat, in terms of IFC PS6 (2012) (Impacto, unpublished). Rather, the Area Categorisation study indicated that only 64 ha of Coastal Dune Thicket/Forest occurring in a narrow strip along the coastal foredunes and secondary dunes within the Nhangonzo area could be designated as critical habitat (Impacto, unpublished) (also shown in Figure 12).

Both the Govuro River Floodplain Critical Habitat and 64 ha of Coastal Dune Thicket/Forest in the Nhangonzo area are located outside of project infrastructure footprints, and therefore will be not be impacted by the proposed project activities.

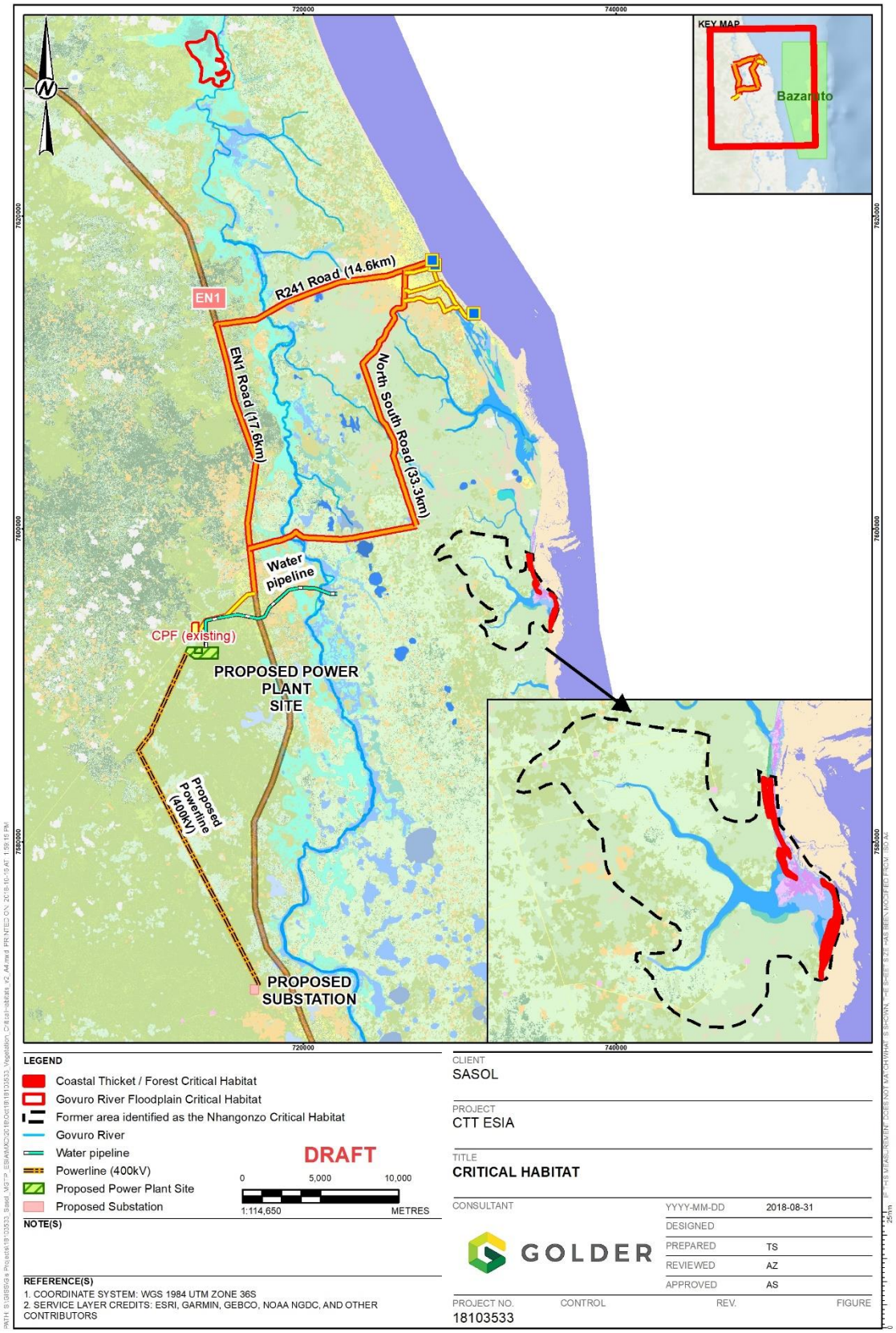

Figure 12: The Govuro River Floodplain Critical Habitat (cycads) (north) in relation to proposed project infrastructure and the potential Nhangonzo Critical Habitat

5.10 Fauna Assemblages – A Synopsis

There are a wide diversity of terrestrial and aquatic habitats in the study area, resulting in a similar diversity in fauna. Habitats that are important for fauna include:

- Forests/thickets,
- Woodlands and grasslands (including floodplain wetlands), and
- Open water (lakes, pans, rivers).

This section provides a brief overview of the main findings of the faunal surveys that have been conducted in the region. Specifically highlighted are the presence/potential presence of species of conservation concern.

5.10.1 Mammals

Literature indicates that up to 109 terrestrial mammal species potentially occur in the region (Golder, 2015a). Of these, 39 species were documented for the study area (Golder, 2015a) (see Table 4).

We note that as a consequence of long-term and widespread hunting, several species that are listed in Table 4 are probably localy extirpated or confined to very remote well-wooded areas. These are likely to include large ungulates such as the Kudu (*Tragelaphus strepsiceros*) and Impala (*Aepyceros melampus*), as well as other species that are either favoured as bush meat (e.g. Aardvark - *Orycteropus afer*) or are larger predators (e.g. Leopard - *Panthera pardus*) that depend on a reliable prey base and are often persecuted.

Of terrestrial mammals potentially occurring in the study area based on historic distributions, several are of conservation concern. These are listed in Table 5.

Table 4: Mammals recorded in the study area

Family	Species Name	Common Name	Preferred Habitats				
			Forest/ Thicket	Woodland	Grassland	Freshwater Wetlands	Estuarine/ Coastal
Chrysochloridae	*Calcochloris obtusirostris*	Yellow Golden Mole		X	X		
Galagidae	*Otolemur crassicaudatus*	Thick-tailed Bushbaby	x	X			
	Galagoides granti	Grant's Galago[#]	X				
Cercopithecidae	*Papio ursinus*	Chacma Baboon	X	X	X	X	X
	Cercopithecus pygerythrus	Vervet Monkey	X	X			
	Ceropithecus mitis	Samango monkey	X				
Leporidae	*Lepus saxatilis*	Scrub Hare		X	X		
Hystricidae	*Hystrix africaeaustralis*	Porcupine	X	X			

Family	Species Name	Common Name	Preferred Habitats				
			Forest/ Thicket	Woodland	Grassland	Freshwater Wetlands	Estuarine/ Coastal
Pedetidae	*Pedetes capensis*	Springhare		X	X		
Thryonomyidae	*Thryonomys swinderianus*	Greater Cane Rat			X	X	
Bathyergidae	*Cryptomys hottentotus*	Common Molerat		X	X		
Sciuridae	*Paraxerus palliatus*	Red Squirrel	X				
Crocidura	*Crocidura hirta*	Lesser Red Musk Shrew				X	
Muridae	*Gerbilliscus leucogaster*	Bushveld Gerbil		X			
	Acomys spinosissimus	Spiny Mouse	X	X			
	Saccostomus campestris	Pouched Mouse		X	X		
	Aethomys sp.	Veld Rat Species		X	X		
	Grammomys dolichurus	Woodland Mouse	X	X			
Mantidae	*Manis temminckii*	Pangolin	X	X			
Mustelidae	*Ictonyx striatus*	Striped Polecat	X				
Herpestidae	*Herpestes sanguinea*	Slender Mongoose	X	X	X		
	Atilax paludinosus	Water Mongoose				X	X
	Mungos mungo	Banded Mongoose		X			
Viverridae	*Genetta maculata*	Large-spotted Genet	X	X			
	Civettictis civetta	African Civet	X	X			
Canidae	*Canis adustus*	Side-striped Jackal		X			
Felidae	*Caracal*	Caracal		X	X		
	Panther pardus	Leopard	X	X			
Orycteropodidae	*Orycteropus afer*	Aardvark		X	X		
Hippopotamidae	*Hippopotamus amphibius*	Hippopotamus				X	

Family	Species Name	Common Name	Preferred Habitats				
			Forest/ Thicket	Woodland	Grassland	Freshwater Wetlands	Estuarine/ Coastal
Suidae	*Potamochoerus larvatus*	Bushpig	X	X			
Bovidae	*Tragelaphus angasii*	Nyala	X	X			
	Neotragus moschatus	Suni	X				
	Tragelaphus scriptus	Bushbuck	X	X			
	Cephalophus natalensis	Red Duiker	X				
	Aepyceros melampus	Impala		X			
	Sylvicapra grimmia	Common Duiker		X	X		
	Raphicerus campestris	Steenbok		X	X		
	Tragelaphus strepsiceros	Kudu	X	X			

Table 5: Terrestrial mammal species of conservation concern recorded and potentially occurring in the study area

	Species Name	IUCN (2018-1)	Probability of Occurence
Hippopotamidae	Hippopotamus (*Hippopotamus amphibius*)	Vulnerable	Possible
Hipposideridae	Striped Leaf-nosed Bat (*Hipposideros vittatus*)	Near Threatened	Recorded
Felidae	Leopard (*Panthera pardus*)	Vulnerable	Unlikely
Pteropdidae	African Straw-coloured Fruit Bat (*Eidolon helvum*)	Near Threatened	Recorded
Mustelidae	Cape Clawless Otter (*Aonyx capensis*)	Near Threatened	Probable
Mantidae	Ground Pangolin (*Manis temminckii*)	Vulnerable	Unlikely
Source: Golder (2015a) and Golder (2017)			

5.10.2 Birds

Three hundred and fifty six bird species have been recorded in the Sasol License Area (Golder, 2017). Of these, eight are considered threatened and near threatened by the (IUCN, 2018) and are therefore of conservation concern. These, along with other birds of conservation that potentially occur in the study area, are listed in Table 6.

Table 6: Birds of conservation concern recorded or potentially occurring in the study area

Family	Species Name	IUCN (2018-1)	Probability Of Occurence
Accipitridae	White-backed Vulture (*Gyps africanus*)	Critically Endangered	Probable
	Hooded Vulture (*Necrosyrtes monachus*)	Critically Endangered	Recorded
	Martial Eagle (*Polemaetus bellicosus*)	Vulnerable	Recorded
	White-headed Vulture (*Trigonoceps occipitalis*)	Critically Endangered	Possible
	Crowned Eagle (*Stephanoaetus coronatus*)	Near Threatened	Recorded
	Bateleur (*Terathopius ecaudatus*)	Near Threatened	Recorded
Falconidae	Sooty Falcon (*Falco concolor*)	Vulnerable	Recorded
Phoenicopteridae	Lesser Flamingo (*Phoeniconaisas minor*)	Near Threatened	Recorded
Nectariniidae	Neergaard's Sunbird (*Cinnyris neergaardi*)	Near Threatened	Possible
	Plain-backed Sunbird (*Anthreptes reichenowi*)	Near Threatened	Recorded
Gruidae	Wattled Crane (*Bugeranus carunculatus*)	Vulnerable	Recorded
Source: Golder (2015a) and Golder (2017)			

5.10.3 Herpetofauna (Reptiles and Amphibians)

Literature indicates that up to 89 reptile species and 40 amphibian species potentially occur in the study area (Golder, 2017). Of these, field surveys over the last five years documented 49 species of reptile and 27 species of amphibian (Golder, 2017) (Table 7).

No terrestrial reptiles recorded or potentially occurring in the study area are of conservation concern. However, five marine turtles that are of conservation concern are known to occur off-shore. These are listed in Table 8. Of amphibians documented for the study area by Golder (2015a), none are of conservation importance. We note however, that the Giant Leaf-folding Frog (*Afrixalus fornasinii*) is a range restricted species.

Table 7: Herpetofauna documented for the study area

Family	Species Name	Common Name
Reptiles		
Agamidae	*Agama armata*	Peter's Ground Agama
	Agama mossambica	Mozambique Agama

Family	Species Name	Common Name
Boidae	*Python natalensis*	Southern African Python
Chamaeleonidae	*Chamaeleo dilepis*	Flap-necked Chameleon
Colubridae	*Dasypeltis scabra*	Common/Rhombic Egg Eater
	Mehelya capensis	Cape File Snake
	Philothamnus semivariegatus	Spotted Bush Snake
	Telescopus semiannulatus	Eastern Tiger Snake
	Thelotornis capensis mossambicanus	Vine Snake
Lamprophiidae	*Psammophis mossambicus*	Olive Grass Snake
	Psammophis orientalis	Eastern Striped-bellied Snake
	Psammophis subtaeniatus	Stripe-bellied Sand Snake
Elapidae	*Dendroaspis polylepis*	Black Mamba
	Naja annulifera	Snouted Cobra
	Naja mossambica	Mozambique Spitting Cobra
Gekkonidae	*Hemidactylus mabouia*	Moreau's Tropical house Gecko
	Hemidactylus platycephalus	Flat-headed Gecko
	Homopholis arnoldi	Arnold's Velevt Gecko
	Lygodactylus capensis	Cape Dwarf Gecko
Lacertidae	*Ichnotropis capensis*	Cape Rough-scaled Lizard
	Meroles squamulosa	Common Rough-scaled Lizard
Leptotyphlopidae	*Leptotyphlops scutifrons*	Peters Thread Snake
Scincidae	*Acontias aurantiacus baarutoensis*	Bazaruto Golden Legless Skink
	Lygosoma afrum	Mozambique Writhing Skink
	Mochlus sundevallii	Sundavall's Writhing Skink
	Panaspis wahlbergii	Snake-eyed Skink
	Trachylepis boulengeri	Boulenger's Skink
	Trachylepis depressa	Eastern Coastal Skink
	Trachylepis striata subsp. striata	Striped Skink

Family	Species Name	Common Name
	Trachylepis varia	Variable Skink
Typhlopidae	*Afrotyphlops fornasinii*	Fornasini's Blind Snake
Varanidae	*Varanus niloticus*	Water Monitor
Viperidae	*Bitis arientans*	Puff Adder
Amphibians		
Arthroleptidae	*Arthroleptis stenodactylus*	Shovel-footed Squeaker
Breviceptidae	*Breviceps adspersus adspersus*	Bushveld Rain Frog
Bufonidae	*Amietophrynus gutturalis*	Guttural Toad
Hyperoliidae	*Afrixalus fornasinii*	Giant Leaf-folding Frog
	Hyperolius marmoratus	Painted Reed Frog
	Kassina maculata	Red-legged Kassina
	Hyperolius argus	Argus Reed Frog
	Hyperolius tuberlingius	Tinker Reed Frog
	Kassina senegalensis	Bubbling Kassina
Microhylidae	*Phrynomantis bifasciatus*	Banded Rubber Frog
Phrynobatrachidae	*Phrynobatrachus mababiensis*	Dwarf Puddle Frog
	Phrynobatrachus natalensis	Snoring Puddle Frog
Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog
	Ptychadena mascareniensis	Mascarene Ridged Frog
	Ptychadena mossambica	Mozambique Ridged Frog
	Ptychadena oxyrhynchus	Sharp-nosed Ridged Frog
Pyxicephalidae	*Pyxicephalus adulis*	African Bullfrog
	Tomopterna cryptotis	Tremolo Sand Frog
Rhacophoridae	*Chiromantis xerampelina*	Southern Foam Nest Frog
Xenopodinae	*Xenopus muelleri*	Tropical Platanna
Source: Golder (2015a).		

Table 8: Marine reptiles of conservation concern potentially occurring off-shore

Family	Species Name	IUCN (2018-1)
Cheloniidae	Green turtle (*Chelonia mydas*)	Endangered
	Hawksbill Sea Turtle (*Eretmochelys imbricata*)	Critically Endangered
	Olive Ridley Turtle (*Lepidochelys olivacea*)	Vulnerable
	Loggerhead Turtle (*Caretta caretta*)	Vulnerable
Dermochelyidae	Leatherback Turtle (*Dermochelys coriacea*)	Vulnerable

6.0 ECOLOGICAL CHARACTERISTICS OF SITES ASSOCIATED WITH PROPOSED PROJECT INFRASTRUCTURE

6.1 Proposed Power Plant Site, Powerline Corridor and Substation Site

These infrastructure sites are located to the west of the Govuro River and fall within the Open and Closed Woodland, with scattered patches of Low Thicket and Tall Forest/Thicket. These habitats are considered to have medium-, medium-high and high biodiversity value respectively (Golder, 2017).

The proposed Power Plant site is approximately 40 ha in extent and located 500 m south of the existing CPF. As part of demining activities, the site was largely cleared of vegetation prior to the February 2015 field visit. At the time, vegetation thus comprised only scattered large trees, isolated thickets associated with termitaria, as well as pioneer herbaceous regrowth throughout (see Figure 13 and Figure 14). Recorded large trees included *inter alia; Senegalia burkei, Vacheliia nilotica, Bolasanthus specious, Combretum imberbe, Diospyros mesepiliformis, Sclerocarya birrea, Spirostachys africana,* with *Dichrostachys cinerea, Flueggia virosa* and *Ziziphus mucronata* common as smaller shrubby plants (Golder, 2015b).

During the 2018 field survey it was evident that vegetation at the site is recovering, with significant regeneration of the herbaceous component. As expected, ruderal species were dominant, with the pioneer grass *Heteropogon contortus* and various *Hyparrhenia* species particularly abundant and often forming dense swards (Figure 15). Other common pioneer species in the herbaceous layer herbs included *Waltheria indica* and *Lippia javanica*. The emergence of woody shrubs amongst the grass was also noted, with several species present including *inter alia*; *Dichrostachys cinerea*, *Flueggia virosa, Grewia micrantha, Hyphaene coriaceae, Phyllanthus reticulatus*, *Sclerocarya birrea* subsp. *caffra* and *Strychnos madagascariensis* (Figure 16).

Despite the disturbance caused by the 2015 vegetation clearing, there was no evidence of large scale colonisation of taxa such *D. cinerea*, which is a recognised encroaching species. Moreover, although the alien invasive *Ricinus communis* var. *communis* was recorded in a small disturbed patch immediately adjacent to the Power Plant site, this species has not established on the site itself.

February 2015

Figure 13: Interior of the Power Plant Site

Figure 14: Access track adjacent to the Power Plant Site

June 2018

Figure 15: Interior of the Power Plant Site

Figure 16: Power Plant Site, note emergence of scattered woody plants

The proposed powerline route is 25 km long and traverses on a north-south orientation from the proposed Vilanculos substation site to the Power Plant site, through areas also comprising Open and Closed Woodland and patches of Low Thicket and Tall Forest/Thicket.

Like the proposed Power Plant site, vegetation in the powerline corridor had been cleared during 2015, and as a result at the time of the 2015 field visit it was characterised by only emergent grasses and herbs, and a few woody plants - see Figure 17 and Figure 18 (Golder, 2015b).

During the 2018 field survey, it was noted that vegetation had re-established substantially, and unlike in the 2015, it was not possible to drive along on the old vehicle track the runs the length of the corridor. Along most portions of the corridor, grasses are the most abundant re-coloniser - *Heteropogon contortus* and tall *Hyparrhenia* species are typically dominant, while other taxa such as *Digitaria eriantha*, *Melinis repens, Panicum maximum* and *Urochloa mossambicensis* were also noted. Along grass-dominated portions, the corridor is readily distinguished from adjacent vegetation, as shown in Figure 19. Along other portions however, woody vegetation has established well and colonised the cleared footprint.

In these areas, it was often difficult to even discern where the corridor bisected the various gravel roads that are used to gain access to it (Figure 20). Common woody colonisers include species such as *inter alia*; *Dichrostachys cinerea, Piliostigma thonningii, Phoenix reclinata*, *Ormocarpum trichocarpum* and *Terminalia sericea.*

No alien invasive plant species were recorded along the powerline corridor during the 2018 field visit. We further note that various forms of natural resource utilisation were present in the general vicinity of the proposed Power Plant site and powerline corridor.

February 2015

Figure 17: Cleared powerline corridor through woodland

Figure 18: Cleared powerline corridor through area thicket

June 2018

Figure 19: Relatively open powerline corridor, dominated by grasses

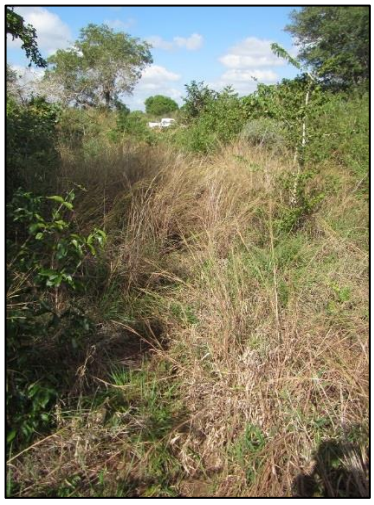

Figure 20: Densely re-vegetated portion of the powerline corridor. Note establishment of woody taxa

6.2 Proposed Road Access Route Alternatives from Inhassoro to Power Plant Site

The proposed vehicle access routes from the coast and Inhassoro inland to the Power Plant are all existing roads that are used extensively by people living in the region and travelling through it.

The proposed access roads were driven during the 2015 field visit, and then again during the 2018 field visit. It was evident during the latter programme that vegetation surrounding each proposed route remains largely unaltered from the 2015 condition. We have thus included, and where necessary updated, the text from the Golder (2015) report below, and representative photographs taken during the 2018 field visit.

EN1 and R241 Access Roads

The EN1 is currently the major vehicle transport route in the region, linking northern and southern Mozambique. The EN1 road servitude is about 20 m wide. A double lane section in the middle of the servitude is tarred, and there is a relatively wide gravel shoulder on both sides of the road (Figure 21).

Across the study area the EN1 traverses mostly through the Open and Closed Woodland and patches of Low Thicket vegetation communities. The density of human habitation along the road is high, particularly in the vicinity of Maimelane and Jofane villages.

Land adjacent to the southern portion of the road (i.e. immediately north of the CPF entrance road) is heavily disturbed, with large areas transformed for farming and classified as cultivated. Non-transformed land along the road is mostly classified as Tall Mid-Dense to Closed Broad-leaved Woodland (Golder, 2015a).

The R241 road servitude from Inhassoro is about 10 m wide (Figure 22). The tarred portion of the road has been widened since the 2015 and it is now a full two-lane road. In terms of floristic composition and species dominance, the terrestrial vegetation adjacent to the road differs markedly on either side of the Govuro River. The dominant vegetation community along the R241 is Open and Closed Woodland. To the east, woodland trees comprises mostly J*ulbernardia* and *Brachystegia* species (De Castro and Brits, 2014). The land adjacent to the road along its entire length is heavily disturbed by current or historic cultivation, with only small patches of natural vegetation remaining. In the vicinity of Inhassoro, human habitation increases and the adjacent land is completely transformed.

The R241 road crosses the Govuro River approximately 10 km west of from Inhassoro. Although at the bridge crossing, the river channel is relatively narrow, both immediately up and down stream of the bridge, the river is characterised by a broad, open floodplain comprising hydrophytic grasses, sedges and rushes. The Govuro River Floodplain is considered to have high biodiversity value (Golder, 2017), and is therefore an important and sensitive habitat.

Figure 21: The EN1 in 2018

Figure 22: The double lane R241 Inhassoro road as it crosses the Govuro River in 2018

Alternative Route

The alternative transport route from Inhassoro to the proposed Power Plant site (termed the North South Road) initially follows a well-developed gravel road running southward to the east of the Govuro River, before heading west along a smaller vehicle track (termed the Shortcut Road).

Both the North South Road and the Shortcut Road traverse through areas of Open and Closed Woodland, with scattered patches of Low Thicket and Tall Forest/Thicket. Archetypal miombo species *Julbernardia globifera* and *Brachystegia spiciformis* are co-dominant in these areas (Figure 23). Close to Inhassoro, the vegetation adjacent to the road is mostly transformed. Beyond the limits of the town, vegetation is less disturbed, although small scattered patches of cultivation were noted.

The vehicle track crosses a dry ephemeral drainage line, which drains into an adjacent inland depression/pan. The drainage line is grass dominated and fringed by *Julbernardia* and *Brachystegia* trees. The track also bypasses an inland depression/pan. Like the Govuro River, these wetland features are considered high biodiversity value, and are therefore both important and sensitive (Golder, 2017).

The vehicle track also crosses the Govuro River at a point where the river is characterised by a broad floodplain, with a reed-dominated channel (see Figure 24).

Figure 23: Vehicle track running through *Julbernardia-Brachystegia* Short Woodland (2018)

Figure 24: Vehicle track as it crosses the Govuro River (2018)

6.3 Proposed Beach Landing Sites

The three proposed beach landing sites are all located in the town of Inhassoro. The town is a small coastal settlement characterised by various commercial and administrative operations and residential houses. The land surrounding the road access routes varies from being typical urban in the town itself, to more peri-urban and agricultural landscapes beyond the town confines. Similarly, the approaches to all three beach landings sites are transformed.

Like the road access routes discussed in section 6.2, there has been little to no significant changes to the terrestrial ecology character of the beach landing sites since the 2015 field visit. Table 9 presents a brief description of each site, with accompanying photographs.

Table 9: Descriptions of the proposed beach landings sites

February 2015	June 2018	Notes
 **Figure 25: Approach to the Seta beach landing site - 2015**	 **Figure 26: Approach to the Seta beach landing site - 2018**	A large concrete strip dominates the approach to this landing site. Grasses such as *Cynodon dactylon*, *Aristida congesta* subsp. congesta, *Heteropogon contortus, Urochlora mossambicensis, Panicum maximum* and *Dactylotenium* sp. are common along the approach. Alien invasive species recorded at this side include *Casuarina* cf *equisetifolia, Calotropsis procera, Leucaena leocucephala, Opuntia* sp. and *Senna occidentalis*. There is no evidence of significant change in the ecological character of this site.
 **Figure 27: Approach to the Maritima beach landing site - 2015**	 **Figure 28: Approach to the Maritima beach landing site - 2018**	The approach to the Maritima beach landing site is also grass dominated, with woody vegetation confined to the adjacent embankments. Species recorded along the approach include *Cynodon dactylon*, which dominates the field layer along the approach, as well as *Panicum maximum* and the tall reeds *Phragmtes australis* and *P. mauritnus.* Taller woody vegetation such as *Hyphaene coriacea* is confined to the adjacent embankments. There is no evidence of significant change in the ecological character of this site.

February 2015	June 2018	Notes
 **Figure 29: View from the beach toward the Briza Mar access point**	 **Figure 30: View from the beach toward the Briza Mar access point -2018**	The approach to this beach landing is narrow and bordered on either side by tourist lodges. Flora species recorded include the grass *Cyndoon dactylon* and *Panicum maximum*, and at the entrance onto the beach the woody *Hyphaene coriacea*. Several alien invasive species were noted including *Casuarina equisetifolia, Leucaena leocucephala, Senna* sp. and *Ziziphus mauritiana.* Vehicle tracks suggest that this approach is frequently used, probably by adjacent tourist lodges, to lauch boats or gain access to the beach. There is no evidence of significant change in the ecological character of this site.

7.0 ECOSYSTEM SERVICES

Ecosystem services are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. The term encompasses all the natural products and processes that contribute directly and indirectly to human well-being, as well as the personal and social enjoyment derived from nature (IFC PS6, 2012; Landsberg *et al.*, 2013). The benefits gained can either be physical or psychological, and can be obtained actively or passively, directly or indirectly.

Ecosystem services include goods or products obtained from ecosystems (provisioning services) such as fresh water, wild foods and timber; control of natural processes (regulating services), such as flood control, erosion protection and climate regulation; and social, non-material benefits (cultural services) such as spiritual values, and recreational and aesthetic enjoyment. These services are underpinned by natural processes (supporting services), such as nutrient cycling, habitat provision and primary production (IPIECA, 2011; Landsberg *et al.*, 2013). The IFC define two types of priority ecosystem services:

- **Type I Ecosystem Services**: Ecosystem Services on which the Project operations are most likely to have an impact and, therefore, which result in adverse impacts to affected communities (beneficiaries); and
- **Type II Ecosystem Services**: Ecosystem Services on which the Project is directly dependent for its operations, for example, water.

Although ecosystem services are largely addressed by IFC PS 6, the assessment of ecosystem services is spread throughout the environmental and social Performance Standards (PS) because the potential effects of a project on ecosystem services relates to all aspects of peoples' relationship with the environment, including health and safety risks, land ownership or usage, and cultural heritage.

The Inhassoro region has a relatively large human population. Several established urban centres are present, including the town of Inhassoro and various large villages (e.g. Jofane, Maimelane) that straddle the main EN1 arterial road. There are also numerous other smaller villages and homesteads scattered throughout the region.

Local people, particularly those living in more remote rural locations are expected to rely heavily on natural resources to meet their daily livelihood requirements. Indeed, we expect that the livelihood strategies of residents of even the more populous urban centres are likely to feature a reliance on, at least in part, locally sourced ecosystem services.

During the 2018 field inspection, various ecosystem services were observed. These observations were augmented with informal interviews with local people and used to develop a broader understanding of important ecosystems services in the region. This section provides a synthesis of the major findings (accompanying photographs were all taken in the project area in July 2018) and informed, in part, the ecosystem services impact assessment – refer to separate report.

7.1 Provisioning Services

7.1.1 Biomass Fuel - Fire Wood and Charcoal Production

The region has a limited electricity distribution network, and as a result woody biomass is used as a common form of energy. Numerous tree species are felled by locals and used as firewood or to produce charcoal (Figure 31 and Figure 32). Tree felling for biomass fuel occurs in all woodland habitat units in the region.

Both firewood and charcoal are used by the producers themselves and/or packaged and sold commercially. Wood bundles and large charcoal bags were for sale at numerous points along the EN1 arterial road (Figure 33 and Figure 34).

Charcoal in particular, has great commercial potential - at one site, we noted a large collection of charcoal bags being loaded onto a flat-bed truck for transportation to a Vilanculos or Maputo (Figure 35).

Subsistence firewood collecting does not necessarily have a negative impact on vegetation, as dead wood is often gathered. However, the commercial sale charcoal and firewood relies on the harvesting of live trees, and this will lead to significant woodland habitat loss.

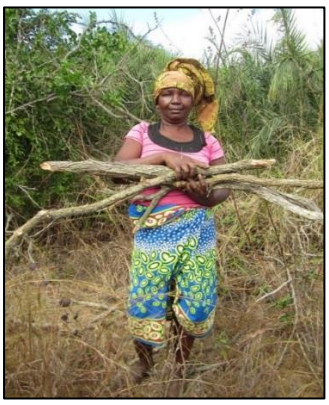

Figure 31: Local woman collecting wood to use as fuel for cooking

Figure 32: Tracts of woodland are cleared by local people to provide wood biomass for charcoal production

Figure 33: Wood bundles are stacked at the side of the road and sold to passing motorists

Figure 34: Charcoal is bagged and sold at the side of major roads - in this instance the Main EN1 arterial road

Figure 35: Charcoal bags being loaded onto flat-bed trucks for transportation to larger cities and towns, such as Vilanculos or Maputo

7.1.2 Raw Material

Biological Materials

The use of various plant materials for building huts, granaries, livestock pens and various other rural infrastructure is common throughout the region, and one of the main forms of ecosystem goods. Common uses of plant material observed during the field inspection are discussed below:

- Tall woody grasses from the genera *Hyparrhenia* and *Hyperthelia*, as well as reeds and sedges are cut at the end of the growing season, dried, and used for thatching roofs and as walling material for huts and granaries (Figure 36). It was also noted that grass bundles are stacked at the side of major roads and sold commercially (Figure 37);
- Wood from local trees of varying sizes is harvested and used as props and supports in huts and other village infrastructure (Figure 38); and
- A number of tree species in the region, such as *inter alia*; *Pterocarpus angolensis* and *Afzelia quanzensis*, are highly sought after for their timber. Although no actually timber felling was observed during the field inspection, numerous trucks transporting felled trees were observed driving south along the EN1. It is believed that these were harvested further in the interior (west and north of the project area) and are being transported to Maputo for export.

Non-Biological Raw Materials

The use of non-biological material was also noted during the field inspection. Common materials included rocks and sand that are sold for use as building material (Figure 39 and Figure 40).

Rocks are quarried and then transported to road-side chipping yards where they are broken in smaller, and differently sized rocks and pebbles using hammers and picks. These are then sold as a building aggregate. Sand for building is also quarried at local sites. Sand is loaded directly onto waiting vehicles and transported to nearby towns.

Figure 36: Local women cutting thatching grass

Figure 37: Piled thatching grass bundles, ready for sale

Figure 38: Hut built out of local sourced natural material including, thatching grass, wood and reeds

Figure 39: Rocks quarried locally are sold for the building industry

Figure 40: Sand quarry, photographed during the field visit

7.1.3 Livestock Husbandry

The keeping of livestock for domestic or commercial consumption or use is recognised a provisioning ecosystem service (Landsberg *et al.*, 2013). Despite the abundance of available rangeland for grazing, domestic livestock numbers in the study area do not appear to be large. Only occasional animals were observed during the field inspection, including cattle and goats (Figure 41 and Figure 42). Livestock herds that are present depend on being able to access a variety of grazing resources during the different seasons to meet their nutritional requirements. They will also need ready access to reliable water sources. The keeping of poultry seems to be more common in the study area, with numerous chickens observed.

Figure 41: Grazing cattle, photographed to the west of the Govuro River

Figure 42: Goats, photographed to the east of the Govuro River

7.1.4 Food

Subsistence & Commercial Agriculture

Cultivated plants (incl. grains) or agricultural products harvested for human or animal consumption are recognised as an important ecosystem service (IFC GN6, 2012; Landsberg *et al.*, 2013). Various crops are grown on both a subsistence and commercial basis. Subsistence farming is by far the most common form of agriculture and features prominently throughout the area. A shifting/semi-permanent farming method is practiced, with patches of woodland cleared and typically burnt to create an ash garden. The resulting ash is incorporated into soil at the onset of the rainy season and provides additional nutrients for crop growth. Maize and cassava are common crop plants and are sometime grown together. Depending on productivity, each plot is cultivated for a couple of years (sometimes up to four) before being abandoned in favour of a new plot - Figure 43 to Figure 45.

Larger commercial farming operations appear to be uncommon in the region (Figure 46). One large operation was observed close the proposed site for the Vilanculos substation. It comprises several hectares of cleared fields, under pivot irrigation. At the time of the field visit, a degree of dereliction made it unclear as to whether this farm was still operational.

Figure 43: Small-scale subsistence crop fields are common throughout the region (This one included a combination of maize and cassava)

Figure 44: Maize is a common crop (These cobs have been harvested and left to dry. They will later be ground to make porridge)

Figure 45: Cassava is another commonly grown crop

Figure 46: Commercial farming operation, with pivot irrigation

Fruits, Vegetables and Other Produce

Several forms of fresh produce were observed for sale at a road side stall including mangos, Marula[2] fruits, pumpkins, paw paws, chilli peppers and nuts (Figure 47 and Figure 48). These will be grown in homestead gardens and adjacent farming plots or harvested locally. Evidence of palm oil collecting, from *Hyphaene coriacea* plants, for the making of palm wine was also observed close to the Govuro River (Figure 49).

[2] *Sclerocarya birrea* subsp. *caffra*

Figure 47: An assortment of fruits and vegetables for sale at a road side vendor

Figure 48: Harvested nuts

Figure 49: Evidence of palm oil harvesting for making palm wine

Hunting and Fishing

Capture fisheries (i.e. captured wild fish) and the hunting of wild animals are important provisioning ecosystem services (IFC GN6, 2012; Landsberg *et al.*, 2013). Fishing in the Govuro River and the inland pans is common in the study area and an important means of obtaining protein (Figure 50).

No evidence of hunting was observed in the study area during the field inspection, however the practice is known to be widespread in the region. During an informal interview with a local villager, she indicated that hunting is not permitted in the area by local authorities. We expect that despite this prohibition, a dearth of game is probably the main reason why hunting is no longer a common activity.

Figure 50: Local fishermen with fish (*Claris* sp.) caught in the Govuro River

7.1.5 Fresh Water

The Govuro River is the major drainage feature in the region, and as such, it is of considerable importance as a source of water (Figure 51). The lower reaches of the river are significantly influenced by tidal fluctuations and are probably too saline for use as drinking water. It is anticipated that water further upstream is probably far less saline and can be used by local people for fresh drinking water. This notwithstanding, along much of its reach, the river is used for other purposes, such as bathing and clothes washing. The numerous barrier lakes in the study area are also frequently used for such purposes.

Water hand pumps have been installed at strategic points throughout the study area (Figure 52). Many villages and local people use these as the primary source of fresh water. They are thus critically important to the livelihoods of local people.

Figure 51: The Govuro River is a much used source of water for drinking, cooking, clothes washing and bathing

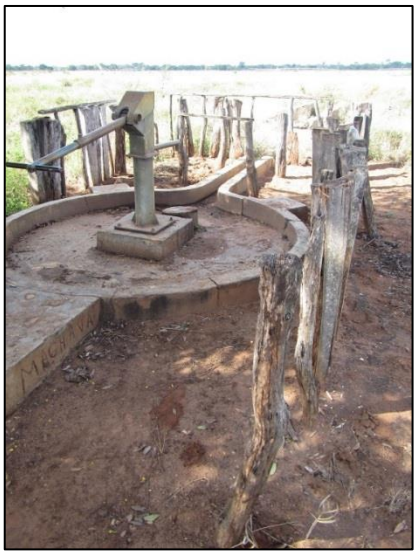

Figure 52: Hand pumps have been installed close to some villages to provide drinking water tom local people

7.1.6 Medicinal Plants

No evidence of medical plant usage was observed during the 2018 field inspection. However, this practice is expected to be commonplace in the region.

7.2 Regulating Services

Regulating water flow patterns

The sandy soils of woodland areas are permeable and so facilitate aquifer recharge, while vegetated riparian areas, such as the extensive reed and sedge beds along the Govuro River contribute to reduced flooding frequency. In this sense both woodland and grassland habitats play an important and complimentary role regulating water flow patterns.

Control of Erosion

All vegetation acts to bind soils and reduce water flow velocities. Vegetation thus reduces potential soil loss caused by storm water runoff.

Water Purification

The Govuro River is characterised by extensive grass, sedge and reed dominated beds. Riparian vegetation thus plays an important role in partial water purification.

Pollination

Bees are critically important pollination agents in natural ecosystems, as well as agricultural landscapes, with many crop-types dependant on pollination. Subsistence agriculture is therefore strongly reliant on local bee populations.

8.0 IMPACT ASSESSMENT

8.1 Assessment methodology and rating criteria

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. 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, especially as it concerns the sensitivity of the receive environment/habitat. 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); and
- **Impact significance** will be rated using the scoring system shown in Table 10 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 10.

Table 10: Scoring system for evaluating impacts

Impact Magnitude			Impact Probability
Severity	**Duration**	**Extent**	
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 11.

Table 11: 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.

Value	Significance	Comment
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 12 below. In order to fully examine the potential changes that the project might produce, the project 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; and
- 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 12: 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 (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).
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.

8.2 Identified Impacts

The assessment of identified impacts for each Project phase is described below, with the rating calculations shown in the accompanying tables. Impacts related to spills/leaks of contaminants are addressed in the Aquatic Biodiversity and the Surface Water Studies.

8.2.1 Construction Phase Impacts

8.2.1.1 Vegetation clearing and earth works causing a loss or disturbance of natural habitat

General Impact Character

Habitat loss refers to the direct removal of natural habitat. In terrestrial ecosystems, this occurs primarily through the clearing of indigenous vegetation and earth works. The immediate impact is the destruction of individual plants and some faunal species within development footprints. If remaining habitat is insufficient in size and heterogeneity to sustain ecological processes, a breakdown or impairment of ecosystem integrity and functioning at broader ecological scales can occur.

Habitat loss can also refer to habitat degradation. In this instance, although habitat is present, it has been disturbed to the extent that compositionally and structurally it is dissimilar to reference habitat conditions. In extreme cases of habitat degradation, the mix of functional species-types is altered and ecosystem functioning is impaired as a result, leading to further losses of biodiversity (*sensu* Scholes, 2009).

This is the principal negative impact on terrestrial ecology associated with the proposed project, and is likely to cause, or at least be attended by, various secondary impacts (such as alien invasive species establishment).

1) Proposed project infrastructure for which significant vegetation clearing will be required include:

- The Power Plant Study Area (incorporating the Power Plant Site and construction camp - approx. 20 ha footprint;
- Powerline corridor (incl. adjacent maintenance track) - 25 km long, with a servitude width of approx. 200 m;
- Access road from the main CPF to the Power Plant Site - approx. 2 km, with a corridor width of approx. 10 m; and
- Upgrade of Shortcut Road linking EN1 to the North – South Road – approx. 11 km, with a corridor width of approx. 10 m.

2) Other proposed infrastructure which will require minimal vegetation clearing include:

- Upgrade of the EN1 and R241 or North-South Road; and
- Establishment of beach landing site.

The significance of habitat loss and disturbance resulting from proposed project infrastructure is dependent on the type and condition of affected habitat. The proposed infrastructure sites are located in habitat characterised by the Open and Closed Woodland and patches of Low Thicket and Tall Forest vegetation communities (Golder, 2018). These are typical and widespread savanna habitat formations in the region, and are rated as having medium- and medium-high, high biodiversity value (Golder, 2018). We highlight the ecological sensitivity and importance of Govuro River Floodplain and pans located to the east of the river. These are rated as having high sensitivity value (Golder, 2018).

Table 13 provides the extent of potential habitat loss associated with each project component / alternative. A discussion of the impacts is presented in Table 14.

Table 13: Approximate extent of habitat loss

Infrastructure	Ha of Veg community lost	Approx. Habitat Loss (ha)
Power Plant Study Area	Open and Closed Woodland	137
	Low Thicket	0.1
	Transformed (Urban and Cultivation)	1.8
Powerline corridor	Open and Closed Woodland	391
	Low Thicket	77
	Tall Forest/Thicket	1.7
	Transformed (Urban and Cultivation)	6.6
Access road CPF to the Power Plant Site -	Open and Closed Woodland	1.8
	Transformed (Urban and Cultivation)	0.4
Upgrade of Shortcut Road linking EN1 to the North – South Road	Open and Closed Woodland	3.4
	Low Thicket	2.1
	Tall Forest/Thicket	0.05
	Permanent and Seasonal Wetlands (incl. river)	0.8
	Transformed (Urban and Cultivation)	5

Table 14: Habitat loss/disturbance associated with proposed infrastructure

Proposed Project Infrastructure	Potential Impacts
Power Plant study area (140 ha) and proposed powerline corridor	De-mining activities in 2015 resulted in the clearing of vegetation in the proposed Power Plant footprint (20 ha), and along the entire length of proposed powerline corridor. Vegetation in these footprint areas is thus disturbed and currently regenerating naturally. During the 2018 field visit it was observed that vegetation had recovered substantially following the original clearing – the herbaceous layer had regenerated significantly in all areas, while woody vegetation had established well in certain areas (Golder, 2018). IFC PS6 (2012) defines natural habitat as areas composed of viable assemblages of plant and/or animal species of a largely native origin,

Proposed Project Infrastructure	Potential Impacts
	and/or where human activity has not essentially modified an area's primary ecological functions and species composition. Demining activities included the stripping of herbaceous and small woody vegetation. No earth works was conducted. As a result, the soil profile was not disturbed and indigenous vegetation is returning. These areas thus retain their primary ecological function and their species composition comprises indigenous (native) plant species. Hence, these areas are classified as 'natural habitat', in line with IFC PS6 (2012). In light of this, vegetation clearing in these areas during construction will result in both the loss of natural habitat, albeit of a disturbed/recovering nature. This impact is rated of moderate significance before but can be reduced to **low** significance after mitigation.
Access road from the CPF to the Power Plant Study Area	The proposed access road will traverse across natural habitat comprising Open and Closed Woodland (1.8 ha) Table 13. Vegetation clearing for the road will thus also cause both habitat loss and disturbance, and is rated an impact of **moderate** significance, both before and after mitigation.
Shortcut Road linking EN1 to the North – South Road	The Shortcut Road is currently a narrow, single vehicle track. Upgrading it will thus require widening and construction. Habitat along the track is mostly characterised by Open and Closed Woodland (3.4 ha that is mostly dominated by *Julbernardia – Brachystegia*) and very small pockets of thicket and forest (see Table 13). The track lies adjacent to a number of pans and crosses the Govuro River Floodplain – these habitats are natural, in line with IFC PS6 (2012) and have medium-high and high biodiversity value, and are therefore ecologically sensitive and important (read Golder, 2018). Approximately 0.8 ha of wetland habitat will be lost if this route is chosen as the preferred option. This impact is rated of *high* significance before mitigation but can be reduced to **moderate** significance with successful mitigation.
Upgrade of the EN1 and R241 or North-South Road	These are both existing and well-used roads. The EN1 and R241 are major tar roads, with existing road verges, while the North-South Road is a broad gravel road. Minimal vegetation clearing is likely to be required to upgrade either route. Habitat loss and disturbance aligned to these project components is rated of **low** significance after mitigation.
Establishment of beach landing site	The three proposed beach landing options are located within (Seta and Maritima) and at the periphery (Briza Mar) of the town of Inhassoro. All three are existing beach access points, that are in current usage and consequently are disturbed sites (Golder, 2018), which will require minimal clearing of terrestrial vegetation during construction. Considering

Proposed Project Infrastructure	Potential Impacts
	the existing levels of disturbance, this is rated a **low** impact after mitigation.

Proposed Mitigation Measures

The final layout of the CTT Plant and the exact position of the powerline has yet to be confirmed. At this stage, only a conceptual layout is available. Proposed mitigation measures for this facility are thus focused on avoiding clearing important ecological features as far as possible, and limiting the extent of clearing to the absolute necessary for project activities:

- A targeted survey should be undertaken during the wet/growing season of the CTT footprint to locate, record and mark important ecological features, such as large trees (DBH >20 cm), geophytic plants and termite hills that should be avoided during construction activities. Based on collected data:
  - As far as possible, proposed infrastructure should be positioned to avoid clearing large trees (DBH >20 cm) and termite hills. Particular tree species that should be avoided during vegetation clearing are *Afzelia quanzensis* and *Dalbergia melanoxylon* – see Section 8.2.1.3;
  - Geophytes growing within development footprints should be rescued and relocated to adjacent areas of undisturbed natural habitat;
- Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas;
- Areas to be cleared should be clearly demarcated to prevent unnecessary clearing outside of these sites;
- If selected as the preferred road option, the alignment of the upgraded Shortcut Road should be re-routed to avoid impacting the adjacent inland pan/depression habitats;
- Topsoil stripped during construction should be stockpiled and used to rehabilitate disturbed areas; and
- A suitable rehabilitation programme should be developed and implemented in all disturbed areas. The programme should include active re-vegetation, using locally occurring indigenous grass and tree species:
  - Areas that should be considered priority sites for stabilisation and rehabilitation post-construction should they be negatively impacted include: a) coastal dunes at the selected beach landing site; b) Govuro River crossing point, and c) inland pan/depression habitats adjacent to the proposed Shortcut Road.

8.2.1.2 Establishment and spread of alien invasive plant species

General Impact Character

Disturbances caused by vegetation clearing and earth works can create conditions conducive to the establishment and rapid spread of alien invasive vegetation. If left uncontrolled, alien species can spread exponentially, suppressing or replacing indigenous vegetation. This may lead to a breakdown in ecosystem functioning and a loss of biodiversity.

Alien invasive plants could potentially establish in all areas where construction activities will disturb existing vegetation. Recognised alien invasive plant species that were commonly recorded in the study area and may become problematic include *inter alia*; *Calotropis procera*, *Lantana camara* and *Ricinus communis*.

This impact is rated of moderate significance before mitigation. With proactive management, specifically the implementation of a targeted alien invasive species control programme, this impact can be reduced to one of **low** significance after mitigation.

Proposed Mitigation Measures

- An alien invasive species control programme must be developed and implemented at both temporary construction sites and permanent operational sites;
- The programme must include:
  - The use of both mechanical and chemical control treatments, as required;
  - Provision for periodic follow-up treatments; and
  - Regular monitoring.
- The implementation of the programme should be overseen by an ECO officer during construction, and the environmental manager during the operational phase.

8.2.1.3 Loss of flora species of conservation concern

General Impact Character

Vegetation clearing during the construction phase may result in the destruction of floral species of conservation concern.

Two tree species of conservation concern have been recorded in the Power Plant footprint, namely *Afzelia quanzensis* and *Dalbergia melanoxylon* (Lower Risk - Near Threatened).

The loss of flora species of conservation concern is rated a moderate impact before mitigation, but this can be reduced to a **low** significance with the effective implementation of the required mitigation measures (i.e. after mitigation).

Proposed Mitigation Measures

- Wherever practical, trees of conservation concern should be avoided during construction activities; and
- If avoidance is not possible, replacement trees should be planted during rehabilitation at a ratio of 3:1, (i.e. three replacement trees of the same species, for every one tree lost).

Death or injury of fauna

General Impact Character

Small and less mobile species may be trapped, injured and killed during vegetation clearing and earth works. Fauna that are of particular concern in this regard include:

- Fossorial[3] mammals (e.g. moles, rodents);
- Nesting birds (ground and tree nesting); and
- Reptiles and amphibians.

Other common causes of fauna injury, death or disturbance during the construction phase include:

- Vehicle-wildlife collisions access roads;
- Hunting, snaring and poisoning of larger fauna by construction workers and contractors; and
- Fauna becoming trapped/caught in infrastructure, such as fences and excavations.

It is anticipated that vegetation clearing and earth works during construction may cause injury or death to several less mobile taxa (e.g. tortoises, nesting birds). This impact is rated moderate prior to mitigation but can be reduced to a residual impact of **low** significance with careful and proactive management.

Proposed Mitigation Measures

- An Environmental Control Officer (ECO) should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in *inter alia*, snake handling;
- Fences (or other suitable obstacle/deterrent) should be erected to prevent fauna gaining access to construction areas, such as open trenches and voids;
- A low speed limit (recommended 20 - 40 km/h) should be enforced on site to reduce wildlife-collisions;
- The handling, poisoning and/or killing of on-site fauna by construction workers and contractors must be strictly prohibited; and
- This prohibition needs to be clearly stated in project management policies and communicated to all employees and contractors through suitable induction training and on-site signage.

8.2.1.4 Sensory disturbances to fauna (artificial lighting and noise)

General Impact Character

Sensory disturbances caused by artificial lighting and noise can affect certain fauna taxa, such as nesting birds and bats.

Construction activities will cause disturbances to fauna in areas where there was previously little anthropogenic disturbance. This impact is rated moderate before mitigation and **low** after mitigation.

[3] Organism adapted to digging and life underground.

Proposed Mitigation Measures

- General noise abatement equipment should be fitted to machinery and vehicles;
- Noise shields, including earthen berms, should be constructed around sites of noise origin;
- Plan the lighting requirements of facilities to ensure that lighting meets the need to keep the site secure and safe, without resulting in excessive illumination. Possible options include:
  - Zoning of areas of high and low lighting requirements;
  - Movement-activated lights as opposed to permanent lights; and
  - Reducing height and angle of lights.

8.2.1.5 Contamination/pollution of soil and water resources

Impact Character

During the construction phase, soil and water resources may be contaminated by leaks and spills of fuel (e.g. petrol, diesel) and lubricants from construction vehicles and other machinery and equipment, and from the spillage of chemicals from poorly sealed containers.

This impact is rated moderate before mitigation. However, with the implementation of mitigation measures concerning the maintenance of construction vehicles and machinery, and the handling and storage of construction fuels/chemicals, this impact can be maintained at a **low** significance after mitigation.

Proposed Mitigation Measures

- Develop protocols to manage the storage, handling and disposal of all chemicals and other hazardous substances used on-site during all phases of the proposed project. Protocols should also include provision for the correct clean-up of potential spills and leaks;
- Regularly maintain and service all vehicles and machinery to minimise the potential for leaks and spills of fuels.

8.2.1.6 Secondary habitat loss/modification due to resource exploitation

General Impact Character

This is both an indirect and potentially cumulative impact. It essentially concerns the facilitation of natural resource exploitation by local communities that may result from the proposed project. Mechanisms generally include a combination of improved access to remote or previously inaccessible sites, and human population influx.

Ecosystem services feature strongly in the livelihood strategies of local people, with activities such as slash and burn agriculture, wood harvesting (for charcoal/fuel and building material) wild fruit collecting and livestock grazing all common. Natural habitat in the area, particularly in close proximity to the EN1 and R241 roads, has already been modified – mostly for subsistence agriculture, and as a result of tree harvesting for fire wood and charcoal production.

It is anticipated that the proposed project may promote an influx of people into the area, and a concomitant increase in natural resource use across the landscape. This may lead to accelerated habitat loss and disturbance.

This impact is difficult to alleviate however it can be reduced to one of **low** significance with successful mitigation.

Proposed Mitigation Measures

- Implement the recommendations of the social impact assessment, specifically concerning the development/updating of an Influx Management Plan; and
- Monitor the progression of secondary habitat transformation using aerial/satellite imagery to identify any problem areas and target for further management actions.

Table 15: Impact assessment table – Construction Phase

Indicator of potential impact		Pre-mitigation					Post-mitigation				
		Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Vegetation clearing and earth works causing a loss or disturbance of natural habitat	Power Plant study area & powerline corridor	8	4	2	5	70	4	4	1	5	45
	Access road to the Power Plant	8	4	2	5	70	6	4	1	5	55
	Shortcut Road	10	4	2	5	80	8	4	2	5	70
	EN1 and R241 or North-South Road	4	4	2	5	50	2	4	1	5	35
	Beach landing site	4	4	2	5	50	2	4	1	5	35
Establishment and spread of alien invasive plant species		8	4	1	4	52	6	4	1	2	22
Loss of flora species of conservation concern		8	1	1	5	50	6	1	1	3	24
Death or injury of fauna		8	4	2	4	56	6	4	2	2	24
Sensory disturbances to fauna		6	4	2	4	48	4	4	2	2	20
Contamination of soil and water resources		8	2	3	4	52	6	2	2	2	20
Secondary habitat loss/modification due to resource exploitation		8	5	2	4	60	6	5	2	3	39

8.2.2 Operational Phase Impacts

8.2.2.1 Establishment and spread of alien invasive plant species

Alien invasive plants will continue to be problematic in all areas disturbed during the construction phase. With correct management during the operational phase, this impact can be reduced to one of **low** significance.

Proposed Mitigation Measures

- Continue to implement the alien invasive plant species control programme, with regular monitoring informing any revisions to overall strategy, priority sites, control methods and follow-up treatments.

8.2.2.2 Death or injury of fauna

Post construction, the main causes of death / injury to fauna during the operational phase are likely to be related to:

- Vehicle collisions and fauna entering operational sites (plants, offices, camps) accidentally or for food where they may be exposed to death/injury. Particularly susceptible taxa include *inter alia*; tortoises, snakes, chameleons, frogs Vervet Monkey; and
- Potential powerline collisions / electrocution by large bird species. Several birds of conservation concern, including *inter alia*; vultures, various other raptors, cranes and flamingo have been recorded in the area and are known to be susceptible to collisions/electrocutions linked with powerlines.

Death or injury of fauna resulting from vehicle collisions and their entering of operational sites is rated an impact of **low** significance both before and after mitigation. It is best practise however, to ensure that mitigation measures are in place to reduce potential incidents and manage them correctly when they do occur.

Before mitigation powerline collisions/electrocutions by large bird species is rated an impact of moderate significance. This impact can be reduced to a **low** significance with the correct implementation of mitigation measures.

Proposed Mitigation Measures

- Selected on-site environmental staff should be trained in snake handling and be familiar with capturing and removing other faunal taxa;
- A low speed limit (recommended 20 - 40 km/h) should be enforced on site to reduce wildlife collisions;
- Powerlines should be designed to be 'raptor friendly'. Devices/designs that should be considered include staggered insulators, raptor-protectors and/or perch deterrents; and
- Periodic monitoring along the power lines should be undertaken by an ornithologist to ensure that raptor friendly devices installed on power lines are effective.

8.2.2.3 Sensory disturbances to fauna (artificial lighting and noise)

General operational activities may cause disturbances to fauna. The significance of this impact is rated moderate before mitigation but can be reduced to **low** significance with effective management.

Proposed Mitigation Measures

- Ensure that all noise abatement equipment fitted to machinery and vehicles is in working order.

8.2.2.4 Contamination/pollution of soil and water resources

During the operational phase, several potential sources of contamination/pollutants associated with operations may impact local water resources in the event of spills, leaks or incorrect management. These include spills

from the evaporation pond and the improper management of discarded sludge from the pond; spills from the first flush pump; discharge from the clean stormwater sump; and the irrigation of effluents into the surrounds.

The overall significance of this impact prior to mitigation is moderate. With correct mitigation, as per the recommended measures outlined in the surface water impacts assessment and geohydrology report, this impact can however, be reduced and maintained at a **low** significance.

Proposed Mitigation Measures

- Develop a well-designed storm water management plan for the Plant, ensuring the separation of clean and dirty water, and the containment and correct disposal of potentially contaminated water. All wastewater discharged from the site must comply with the appropriate Mozambican and IFC standards;
- Follow protocols to manage the storage, handling and disposal of all chemicals and other hazardous substances used on-site during all phases of the proposed project. Protocols should also include provision for the correct clean-up of potential spills and leaks; and
- Regularly maintain and service all vehicles and machinery to minimise the potential for leaks and spills of fuels.

8.2.2.5 Secondary habitat loss/modification due to resource exploitation

An influx of people into the area may lead to an increase in natural resource use, and accelerated habitat loss and disturbance. This impact is can be reduced to **low** significance with effective management.

Proposed Mitigation Measures

- Implement the recommendations of the social impact assessment, specifically concerning the development/updating of an Influx Management Plan; and
- Monitor the progression of secondary habitat transformation using aerial/satellite imagery to identify any problem areas and target for further management actions.

Table 16: Impact assessment table - Operational Phase

Indicator of potential impact		Pre-mitigation					Post-mitigation				
		Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Establishment and spread of alien invasive plant species		8	4	1	4	52	6	4	1	2	22
Death or injury of fauna	Vehicle collisions & disturbance and injury around operational sites (e.g. snakes, tortoises, chameleons)	8	4	2	2	28	6	4	2	2	24
	Powerline collisions/electrocutions (e.g. vultures, raptors, cranes)	10	4	2	4	64	6	4	2	3	36
Sensory disturbances to fauna		6	4	2	4	48	4	4	2	2	20
Contamination of soil and water resources		10	4	2	4	64	6	4	2	2	24
Secondary habitat loss/modification due to resource exploitation		8	5	2	4	60	6	5	2	3	39

8.2.3 Decommissioning Phase Impacts

8.2.3.1 Establishment and spread of alien invasive plant species.

Decommissioning activities (e.g. dismantling infrastructure) are likely to cause additional disturbances, which may promote alien invasive plant colonisation. With effective management during the closure phase, the residual impact is rated as one of **low** significance.

Proposed Mitigation Measures

- Continue to implement the alien invasive plant species control programme, with regular monitoring informing any revisions to overall strategy, priority sites, control methods and follow-up treatments; and
- Rehabilitate all disturbed areas, ensuring the establishment of viable coverage of indigenous vegetation; and
  - Areas that should be considered priority sites for stabilisation and rehabilitation post-construction include: a) coastal dunes at the selected beach landing site; and b) Govuro River crossing point and river approaches.

8.2.3.2 Contamination of soil and water resources

During the dismantling of project infrastructure there is potential for contaminants that have been stored and used on site during operation, such as sludge, fuels, chemicals effluent to be spilled or leaked into the environment. There is also potential for leaks and spills of hazardous substances from vehicles and machinery used for decommissioning activities.

The significance of this impact prior to mitigation during the decommissioning and closure phase is moderate. With correct mitigation, it can however be reduced to a **low** significance.

Proposed Mitigation Measures

- Follow protocols to manage the storage, handling and disposal of all chemicals and other hazardous substances used on-site during all phases of the proposed project. Protocols should also include provision for the correct clean-up of potential spills and leaks; and
- Regularly maintain and service all vehicles and machinery to minimise the potential for leaks and spills of fuels.

Table 17: Impact assessment table - Decommissioning Phase

Indicator of potential impact	Pre-mitigation					Post-mitigation				
	Magnitude	Duration	Geographic Extent	Probability	Significance	Magnitude	Duration	Geographic Extent	Probability	Significance
Establishment and spread of alien invasive plant species	8	4	1	4	52	6	4	1	2	22
Contamination of soil and water resources	10	4	2	4	64	6	4	2	2	24

9.0 ENVIRONMENTAL MANAGEMENT PLAN

The proposed environmental management plan to address identified impacts on terrestrial ecology is presented in Table 18.

Table 18: Environmental Management Plan – Terrestrial Habitat

Aspect	Potential Impact	Impact Source	Detailed Actions	Responsibility
Construction Phase				

Terrestrial Habitat	Vegetation clearing and earth works causing a loss or disturbance of natural habitat	▪ Vegetation clearing and earth works.	▪ A targeted survey should be undertaken during the wet/growing season of the CTT footprint to locate, record and mark important ecological features, such as large trees (diameter >30m), geophytic plants and termite hills that should be avoided during construction activities. Based on collected data:
			  ▪ Proposed infrastructure should be positioned to avoid clearing large trees and termite hills as far as possible. Particular tree species that should be avoided during vegetation clearing are *Afzelia quanzensis* and *Dalbergia melanoxylon* – see Section 8.2.1.3;
			  ▪ Geophytes growing within development footprints should be rescued and relocated to adjacent areas of undisturbed natural habitat;
			▪ Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas;
			▪ Areas to be cleared should be clearly demarcated to prevent unnecessary clearing outside of these sites;
			▪ Topsoil stripped during construction should be stockpiled and used to rehabilitate disturbed areas; and
			▪ A suitable rehabilitation programme should be developed and implemented in all disturbed areas. The programme should include active revegetation, using locally occurring indigenous grass and tree species; and
			  ▪ Areas that should be considered priority sites for stabilisation and rehabilitation post-construction include: a) coastal dunes at the
				Environmental Manager

Aspect	Potential Impact	Impact Source	Detailed Actions	Responsibility
			selected beach landing site; and b) Govuro River crossing point, and inland pan/depression habitats adjacent to the proposed Shortcut Road.	

Terrestrial Habitat	Establishment and spread of alien invasive plant species	■ Vegetation clearing and earth works.	■ An alien invasive species control programme must be developed and implemented at both temporary construction sites and permanent operational sites;
			■ The programme must include, as appropriate:
			  ■ The use of both mechanical and chemical control treatments, as required;
			  ■ Provision for periodic follow-up treatments; and
			  ■ Regular monitoring.
			■ The programme should be overseen by an ECO officer during construction, and the environmental manager during the operational phase.
				Environmental Manager

Individual trees	Loss of flora species of conservation concern	■ Vegetation clearing and earth works.	■ Wherever practical, trees of conservation concern should be avoided during construction activities; and ■ If avoidance is not possible, replacement trees should be planted during rehabilitation at a ratio of 3:1, (i.e. 3 replacement trees of the same species, for every one tree lost).	Environmental Manager
Fauna	Death or injury of fauna	■ Vegetation clearing and earth works; and ■ Excavations, snaring, Vehicle collisions.	■ An ECO should be on-site during vegetation clearing to monitor and manage any wildlife-human interactions. The ECO should be trained in *inter alia*, snake handling; ■ As appropriate, fences should be erected to prevent fauna gaining access to construction areas, such as open trenches and voids; ■ A low speed limit (recommended 20 - 40 km/h) must be enforced on site to reduce wildlife-collisions;	Environmental Manager

Aspect	Potential Impact	Impact Source	Detailed Actions	Responsibility
			■ The handling, poisoning and killing of on-site fauna by construction workers and contractors must be strictly prohibited; and ■ Employees and contractors should be made aware of the presence of, and rules regarding fauna through suitable induction training and on-site signage.	
Fauna	Sensory disturbances to fauna	■ Artificial lights and noise.	■ General noise abatement equipment should be fitted to machinery and vehicles; ■ Noise shields, including earth berms, should be constructed around sites of noise origin; and ■ Plan the lighting requirements of facilities to ensure that lighting meets the need to keep the site secure and safe, without resulting in excessive illumination. Possible options include: ▪ Zoning of areas of high and low lighting requirements; ▪ Movement activated lights as opposed to permanent lights; and ▪ Reducing height and angle of lights.	Environmental Manager
Terrestrial Habitat and Water Resources	Contamination of soil and water resources	■ Vehicles and machinery ■ Fuels, chemicals and other hazardous substances stored/used on-site.	■ Develop protocols to manage the storage, handling and disposal of all chemicals and other hazardous substances used on-site during all phases of the proposed project. Protocols should also include provision for the correct clean-up of potential spills and leaks; ■ Regularly maintain and service all vehicles and machinery to minimise the potential for leaks and spills of fuels; and ■ Develop a well-designed storm water management plan for the Plant, ensuring the separation of clean and dirty water, and the containment and correct disposal of potentially contaminated water. All wastewater	Environmental Manager

Aspect	Potential Impact	Impact Source	Detailed Actions	Responsibility
			discharged from the site must comply with the appropriate Mozambican and IFC standards.	
Terrestrial Habitat	Secondary habitat loss/modification due to resource exploitation	■ Community natural resource exploitation.	■ Implement the recommendations of the social and labour plan; and ■ Monitor secondary habitat transformation using aerial/satellite.	Environmental Manager
Operational Phase				
Terrestrial Habitat	Establishment and spread of alien invasive plant species	■ Vegetation clearing and earth works during construction phase.	■ Continue to implement the alien invasive plant species control programme, with regular monitoring informing any revisions to overall strategy, priority sites, control methods and follow-up treatments.	Environmental Manager
Fauna	Death or injury of fauna	■ Human conflict and vehicle collisions.	■ On-site environmental staff should be trained in snake handling and be familiar with capturing and removing other fauna taxa; and ■ A low speed limit (recommended 20 - 40 km/h) must be enforced on site to reduce wildlife-collisions.	Environmental Manager
Fauna	Sensory disturbances to fauna	■ Artificial lights and noise.	■ Ensure that all noise abatement equipment fitted to machinery and vehicles is in working order.	Environmental Manager
Terrestrial Habitat	Secondary habitat loss/modification due to resource exploitation	■ Community natural resource exploitation.	■ Implement the recommendations of the social and labour plan; and ■ Monitor secondary habitat transformation using aerial/satellite.	Environmental Manager
Decommissioning Phase				

Aspect	Potential Impact	Impact Source	Detailed Actions	Responsibility
Terrestrial Habitat	Establishment and spread of alien invasive plant species	▪ Vegetation clearing and earth works during construction phase.	▪ Continue to implement the alien invasive plant species control programme, with regular monitoring informing any revisions to overall strategy, priority sites, control methods and follow-up treatments; and ▪ Rehabilitate all disturbed areas, and ensure the establishment of viable coverage of indigenous vegetation; and ▪ Areas that should be considered priority sites for stabilisation and rehabilitation post-construction include: a) coastal dunes at the selected beach landing site; and b) Govuro River crossing point and river approaches.	Environmental Manager

10.0 MONITORING PROGRAMME

A proposed monitoring programme to gauge the effectiveness of recommended interventions and potential new impacts or impact sites is presented in Table 19.

Table 19: Monitoring programme

Objective	Detailed Actions	Monitoring Location	Frequency	Responsibility
Construction Phase				
Monitor compliance with required mitigation measures during vegetation clearance	▪ Monitor vegetation clearing activities and compliance with boundaries; ▪ Monitor implementation of rehabilitation programme; and ▪ Monitor the type of alien species, extent and density of infestations.	All areas where vegetation clearing and earth works has occurred	Daily verification during construction, with reporting on a quarterly basis	Environmental Manager
Monitor fauna deaths and injuries related to construction activities	▪ Develop and maintain a fauna incident report, detailing any occurrences of fauna death/injury linked to construction activities.	All construction areas	Ongoing from commencement of construction phase	Environmental Manager

Objective	Detailed Actions	Monitoring Location	Frequency	Responsibility
Operational Phase				
Monitor fauna deaths and injuries related to operational activities	■ Maintain the fauna incident report, to monitor any occurrences of fauna death/injury linked to Plant operation, including powerlines.	All operational areas	Ongoing	Environmental Manager
Assess the extent of alien species establishment and effectiveness of control treatments	■ Monitor the type of alien species, extent and density of infestations; and ■ The effectiveness of control and mechanical control treatments.	All areas where vegetation clearing and earth works has occurred	Annually (wet season)	Environmental Manager
Assess success of rehabilitation	■ Monitor vegetation basal cover and species composition, and take corrective measures as required.	All areas where rehabilitation has occurred. Priority sites include: coastal dunes at the selected beach landing site; and b) Govuro River crossing point	Annually (wet season)	Environmental Manager
Decommissioning Phase				
Assess success of rehabilitation	■ Monitor vegetation basal cover and species composition, and take corrective measures as required; and ■ Monitor alien invasive vegetation establishment, and take corrective measures as required.	All rehabilitated areas	Annually (wet season)	Environmental Manager

11.0 CONCLUSIONS

This impact assessment report has been informed by the findings of several biodiversity studies that have been conducted for Sasol in the region, as well as targeted field inspections of proposed infrastructure sites. We note that the study area is defined by a prominent human-ecological system coupling. Areas in close proximity to towns and villages and along the major access roads are either completely transformed or highly disturbed. Further afield however, disturbance levels generally decrease and indigenous habitats become more prevalent.

Areas of natural undisturbed vegetation do provide habitat for fauna, and although hunting has severely reduced the abundance of larger mammals, smaller mammals and numerous species of reptile, amphibian and birds have been recorded in the region.

We note that vegetation in the proposed Power Plant site and along the proposed powerline has regenerated well following the initial vgetation clearing which was conducted in 2015 for demining purposes. These areas are generally grass-dominated, although woody vegetation has established well in some areas. The findings of the field visit also indicate that there have been no significant changes in habitat characteristics or condition along the other infrastructure components of the proposed project since 2015. We further note that ecosystem goods and services are particularly important in the livlihood strategies of local communities.

Despite the high level of anthropogenic activity and associated habitat disturbances across the broader study area, the proposed project is likely to have negative impacts on terrestrial ecology. Principal among these is habitat loss and disturbance caused by vegetation clearing and earth works. This direct impact will mostly occur during the construction phase, and is likely to be attended by other impacts, such the killing / injury / disturbance of fauna and the establishment and spread of alien invasive flora, which may persist throughout all phases of the project.

It is important that all identified impacts are carefully managed to limit their significance and any further reduction in ecosystem integrity and functioning. In line with this, it is recommended that the mitigation measures outlined in this report be incorporated into the project environmental management programme (EMP).

12.0 REFERENCES

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Signature Page

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APPENDIX A

Description of Vegetation Communities and Vegetation Types

Description of Vegetation Communities and Vegetation Types, as per Golder (2017)

Vegetation Communities	Key Characteristics	Dominant Species and Species of Conservation Concern	Photographs	Biodiversity Value
1. Tall Forest/Tall Thicket Formations				
Forest is here defined as vegetation dominated by trees and shrubs, with a closed canopy, usually with interlocking crowns, and with clearly definable strata below the canopy and an herbaceous layer. Thicket is also a vegetation formation dominated by trees and shrubs, but with no definable sub-canopy strata and usually a poorly defined herbaceous layer.				
Julbernardia globiflora - *Brachystegia spiciformis* Tall Thicket / Forest	■ **Landscape Unit**: Western Plains, Southern Coastal Plain; ■ **Terrain Features**: Level to undulating plains; ■ **Soil Types***:* Deep, white Aeolian sands; and ■ **Vegetation Structure***:* Tall thicket, sometimes tall forest. Canopy cover 100%. Canopy height 4 - 8 m.	■ **Dominant Species**: *Julbernardia globiflora* and *Brachystegia spiciformis*; and ■ **Species of conservation concern**: *Afzelia quanzensis (NT*). Numerous protected species.		High
2. Low Thicket Formations				
Low thicket is here defined as vegetation dominated by trees and shrubs, generally between 2 - 8 m high, but with no definable sub-canopy strata and usually a poorly defined herbaceous layer.				

Vegetation Communities	Key Characteristics	Dominant Species and Species of Conservation Concern	Photographs	Biodiversity Value
Spirostachys africana - Hymenocardia ulmoides - Adansonia digitata Low Thicket	■ **Landscape Unit**: Western Plains; ■ **Terrain Features**: Level terrain with few termitaria; ■ **Soil Types***:* Fairly deep, reddish brown sands; and ■ **Vegetation Structure***:* Low thicket, with scattered tall emergents. Canopy cover 100%. Canopy height 3 - 7 m.	■ **Dominant Species**: *Spirostachys africana* and *Hymenocardia ulmoides*; and ■ **Species of conservation concern**: *Dolichandrone alba* (VU), *Croton inhambanensis* (VU), *Pavetta gracillima* (DD). Numerous protected species, including *Spirostachys africana, Balanites maughamii* and *Xylia torreana*.		Medium - High
Julbernardia globiflora Low Thicket	■ **Landscape Unit**: Western Plains, Southern Coastal Plain; ■ **Terrain Features**: Level to undulating plains; ■ **Soil Types***:* Deep, white Aeolian sands; and ■ **Vegetation Structure***:* Low thicket, sometimes merging with Low closed woodland. Canopy cover 80 - 100%. Canopy height 2 - 5 m.	■ **Dominant Species**: *Julbernardia globiflora*; and ■ **Species of conservation concern**: *Xylia mendoncae* (VU). Numerous protected species.		Medium - High
3. Open and Closed Woodland Formations				
Woodland is loosely defined here as vegetation dominated by trees and woody shrubs with an open to closed canopy, but not with interlocking crowns, and a well-developed grassy understory.				

Vegetation Communities	Key Characteristics	Dominant Species and Species of Conservation Concern	Photographs	Biodiversity Value
Acacia nigrescens - Acacia robusta Tall Open Woodland	■ **Landscape Unit**: Save River Valley, Low Plateau, Western Plains; ■ **Terrain Features**: Level terrain with scattered termitaria; ■ **Soil Types***:* Dark to light grey-brown clay loam or loamy sand with clay patches; and ■ **Vegetation Structure***:* Tall open woodland. Canopy cover 20 - 40%. Canopy height 5 – 8 m.	■ **Dominant Species**: Acacia *nigrescens*, Acacia *robusta subsp. usambarensis*, and *Combretum imberbe*'; and ■ **Species of conservation concern**: *Dalbergia melanoxylon* (NT). Numerous protected species.		Medium
Tall Mixed Broad-leaved Woodland	■ **Landscape Unit**: Save River Valley, Low Plateau, Western Plains; ■ **Terrain Features**: Level terrain with numerous large termitaria; ■ **Soil Types***:* Light grey-brown to reddish brown sandy loam to moderately deep reddish brown sand; and ■ **Vegetation Structure***:* Tall mid-dense to closed woodland. Canopy cover 40 - 80%. Canopy height 5 - 8 m.	■ **Dominant Species**: *Sclerocarya birrea, Xeroderris stuhlmanni, Pseudolachnostylis maprouneifolia, Terminalia sericea*, Acacia *nigrescens*, Acacia *robusta subsp*. *Usambarensis*; and ■ **Species of conservation concern**: *Dalbergia melanoxylon* (NT), *Pterocarpus angolensis* (NT). Numerous protected species.		Medium

Vegetation Communities	Key Characteristics	Dominant Species and Species of Conservation Concern	Photographs	Biodiversity Value
Julbernardia globifera - Brachystegia spiciformis Low to Tall Closed Woodland	■ **Landscape Unit**: Western Plains. Southern Coastal Plain; ■ **Terrain Features**: Undulating to level plains with scattered, large *termitaria*; ■ **Soil Types***:* Deep white to light brown sands; and ■ **Vegetation Structure***:* Low to tall closed woodland. Canopy cover 60 -80%. Canopy height 4 - 7m.	■ **Dominant Species:** *Julbernardia globifera*, *Brachystegia spiciformis*; and ■ **Species of conservation concern**: A number of protected species.		Medium
Julbernardia globifera - Garcinia livingstonei - Hyphaene coriacea Low Mid-dense Woodland	■ **Landscape Unit**: Western Plains. Southern Coastal Plain; ■ **Terrain Features**: Undulating to level plains with scattered, large *termitaria* and moist depressions; ■ **Soil Types***:* Deep white to light brown sands; and ■ **Vegetation Structure***:* Low open to mid-dense woodland. Canopy cover 40 - 60%. Canopy height 3 – 7 m.	■ **Dominant Species:** *Julbernardia globifera, Garcinia livingstonei, Hyphaene coriacea*; and ■ **Species of conservation concern**: *Pterocarpus angolensis* (NT). Numerous protected species.		Medium
4. Wetlands				
These comprise permanently or seasonally wet vegetation communities that are usually dominated by grass and/or sedge species, with trees and shrubs being absent or sparsely scattered.				

Vegetation Communities	Key Characteristics	Dominant Species and Species of Conservation Concern	Photographs	Biodiversity Value
Permanently to Seasonally Wet Coastal Depressions	■ **Landscape Unit:** Southern Coastal Plain; ■ **Terrain Features:** Relatively shallow basins on level plains; groundwater-fed systems; ■ **Soil Types:** Coarse white sands; and ■ **Vegetation Structure:** Sparse cover of emergent hydrophytes in permanently inundated zone; low density grass/sedge cover in seasonally inundated zone.	■ **Dominant Species:** *Eleocharis spp*., *Schoenoplectus spp., Cyperus spp*.; and ■ **Species of Conservation Concern**: None recorded.		High
Permanently to Seasonally Wet Floodplains (Govuro River)	■ **Landscape Unit:** Govuro Floodplain; ■ **Terrain Features:** Level floodplain on either side of river; ■ **Soil Types:** Sandy soils with leached E-horizons; and ■ **Vegetation Structure:** Various vegetation zones depending on frequency and duration of inundation.	■ **Dominant Species:** *Cladium mariscus, Phragmites australis, Cyperus spp*.; and ■ **Species of Conservation Concern**: Unique ecotype of *Chrysopogon serrulatus*.		High
Seasonally to Intermittently Wet Drainage Lines	■ **Landscape Unit:** Southern and Northern Coastal Plain; ■ **Terrain Features:** Moderately broad to narrow drainage lines on plains; ■ **Soil Types:** Sandy soils; and ■ **Vegetation Structure:** Grass meadows with limited sedges.	■ **Dominant Species:** *Imperata cylindrica, Andropogon eucomus, Phragmites australis*; and ■ **Species of Conservation Concern**: None recorded.		High
Source: Golder (2017)				

APPENDIX B

Document Limitations

Document Limitations

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iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that Golder may have retained sub-consultants affiliated with Golder to provide Services for the benefit of Golder. Golder will be fully responsible to the Client for the Services and work done by all its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, officers and directors.

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