Environmental Impact Assessment of the Namaacha Power Plant

Technical Report

Central Eléctrica da Namaacha, S.A.

November 2020 (modified in January 2022)

CONTENTS

1 INTRODUCTION

This document is the Technical Report of the Environmental Impact Assessment (EIA) of Central Eléctrica da Namaacha, SA with a total installed capacity of 63 MW to be located in Montes Libombos, in the district of Namaacha, Maputo province, as shown in Figure 1.1.

The proposed Project consists of the installation of 15 wind turbines to harness wind energy, which will be distributed over an area of approximately 855.12 ha (see Figure 1.2). This area (environmental study area) is much larger than the area planned to be used, which allows for the consideration of different alternatives for the location of the various infrastructures that make up the Project, in order to minimise the expected impacts.

The power plant's grid connection site is the Boane substation (66 kV).

The Namaacha Power Plant Project was born with the intention of taking advantage of the wind resource, which can at the present time and with the correct dimensioning, be competitive in terms of the market, also contributing to the country's goals for the integration of renewables in energy production and decarbonisation of the economy.

Central Eléctrica da Namaacha, SA. as the proponent, will have to environmentally licence the project under the terms of Decree 54/2015, submitting the Project (activity) to an Environmental Impact Assessment (EIA) process.

To this end, Central Eléctrica da Namaacha, SA, has contracted Matos, Fonseca & Associados, Moçambique, Lda., which will be responsible for developing the environmental studies for the EIA process.

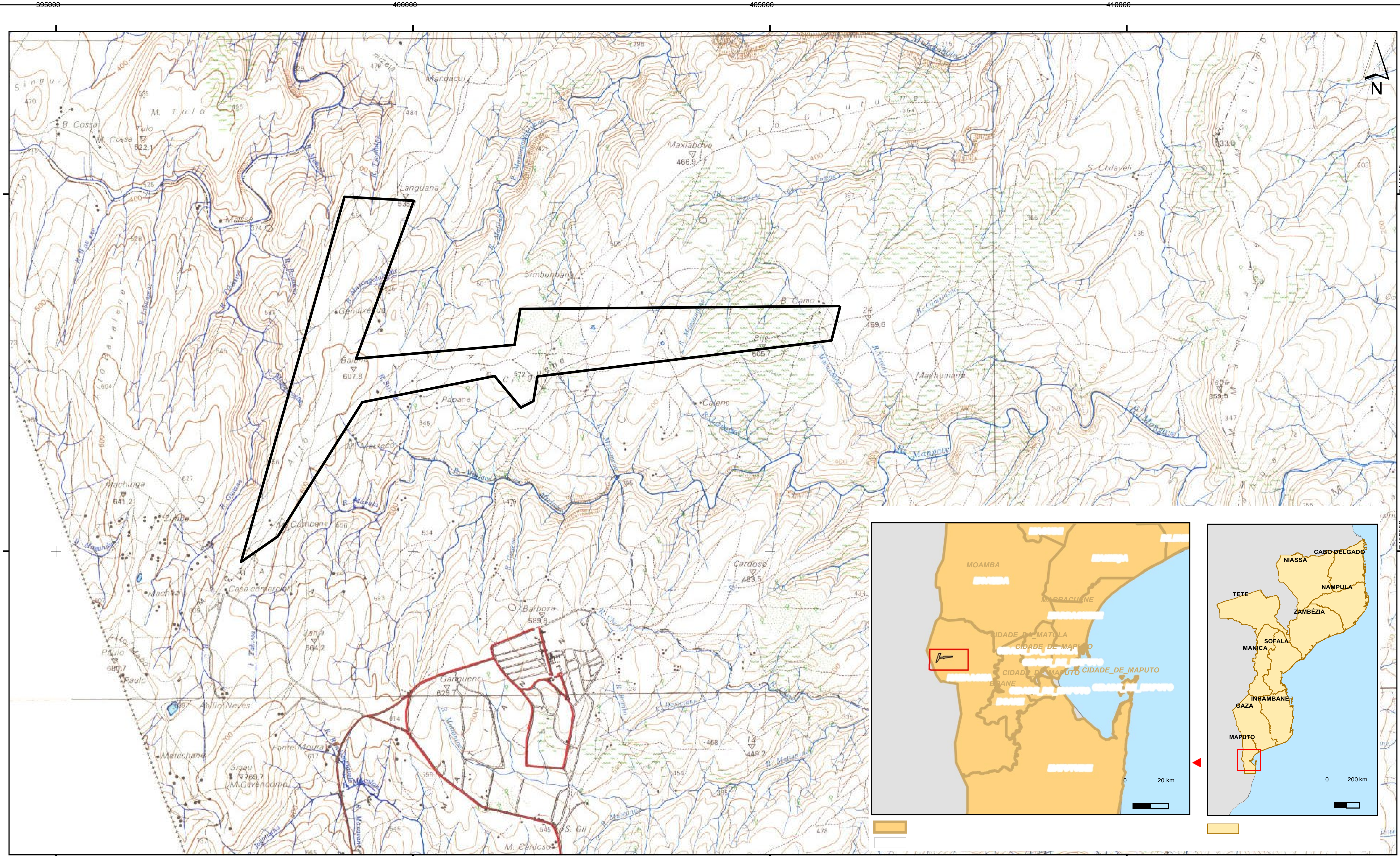
Under the aforementioned EIA Regulations, the first step in the EIA process of any project is the Process Instruction Phase. At this stage the Namaacha Power Plant, SA. submitted a Process Instruction Report to the Maputo Provincial Directorate of Land Environment and Rural Development (DPTADR-M) for a Pre-Assessment. The Project was classified as Category A, thus requiring a full EIA process to be carried out.

The project falls under point 2.6(a) of Annex II to Decree 54/2015 - hydroelectric, thermal, geothermal, photovoltaic, wind and wave energy plants.

Therefore, the steps to be completed in the EIA process are the Pre-feasibility and Scoping Study (EPDA) and Terms of Reference and the Environmental Impact Assessment, based on the Terms of Reference defined in the EPDA step.

The EPDA phase was finalised with the approval of the same by the Ministry of Land, Environment and Regional Development (MITADER). The Draft EIA Report, in accordance with the approved ToR and the general and specific guidelines for its preparation, was disclosed to the public in general, and to the Stakeholders (PI&A) in particular, in order to provide the necessary information about the Project and the EIA process, thus enabling effective public participation. As mentioned above, the Draft EIA Report was subject to the 2nd Public Consultation in December 2020, carried out within the EIA process, and was then readjusted according to the results of this consultation, resulting in the current EIA Technical Report.

This EIA was subject to evaluation in November 2020, and some questions were raised by MITADER, which need clarification, so these have been included in this review of the Environmental Impact Assessment. In addition, a response document to these questions was prepared and is presented in Annex 7 of this Report.



Source: Extract from the Military Map of Mozambique, scale 1/50,000, sheets no. A1187, A1188 and A1189, National Directorate of Geography and Cadastre

Scale 1:50 000

0 1 2 km

LEGEND

Study Area - Area of Direct Influence (AID)

Projection System: WGS84/ UTM36S Units: metres
EPSG: 32736

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Environmental Impact Assessment of the Namaacha Power Plant

Figure 1.1 - Project Framework and Location

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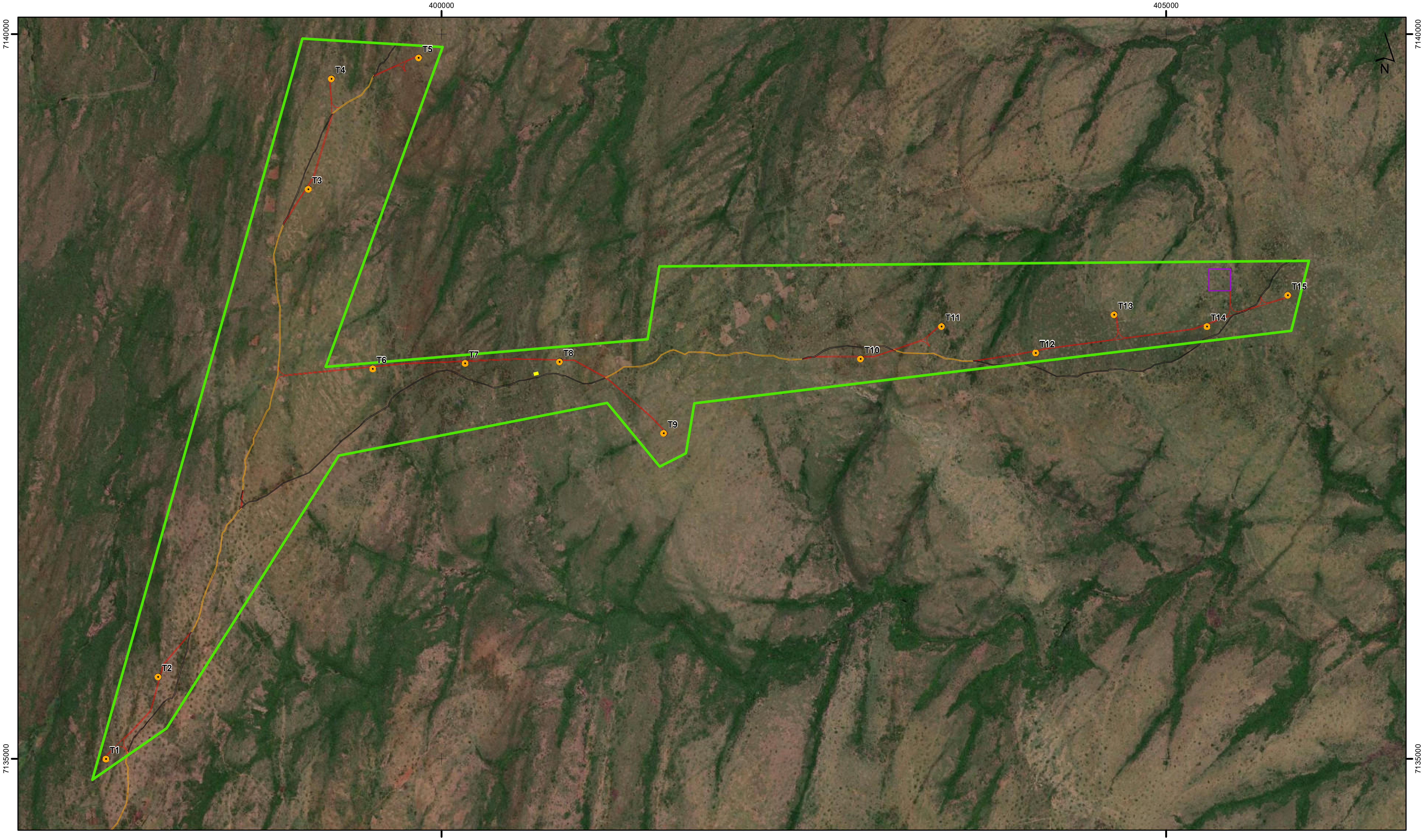
ESTUDOS E PROJECTOS LDA



Fonte: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Escala 1:25 000

0 500 1 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

LEGENDA

- Área de Influência Directa (AID)
- Aerogerador
- Estaleiro
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)

T01717_14_V0_Fig1_2.mxd(A3)

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 1.2 - Implantação do Projecto sobre Ortofotomapa

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA

2 IDENTIFICATION OF THE PROPONENT AND THE TEAM RESPONSIBLE FOR PREPARING THE EIA

2.1 ACTIVITY DEVELOPER

The activity developer is Central Eléctrica da Namaacha (CEN), SA.

The contact details are as follows:

Address: Millennium Park Building | Vladimir Lenine Av., 174, 13th | Maputo | Mozambique

Contact number: +258 (21) 321806

Contact Person: Pedro Coutinho (email: ppcoutinho@source.capital)

CEN's shareholder base is Globeleq Africa Ltd (Globeleq) (formerly Globeleq Advisors Limited) in partnership with SOURCE ENERGIA, (Source Energia).

SOURCE ENERGIA, founded in 2018, is a diversified renewable energy platform focused on the development, management, operation and maintenance of large and small scale on and off-grid projects in Lusophone Africa.

Globeleq, founded in 2002, is a company with extensive experience in the development and implementation of power projects in Africa. It currently has operational assets in Tanzania, Ivory Coast, South Africa, Cameroon and Kenya. Jointly owned by CDC Group plc (70%) and Norfund (30%) (UK and Norwegian development finance institutions), Globeleq is focused exclusively on Africa and has expertise in the development and operation of wind, solar, oil and natural gas power generation, continuing to develop renewable and conventional projects across the continent. As a responsible company, Globeleq develops projects in accordance with the International Finance Corporation (IFC) Performance Standards and the World Bank's Environment, Health and Safety (EHS) Guidelines.

The Project will be established on a Power Purchase Agreement basis with Electricidade de Moçambique (EDM) for the purchase of power generated during the exploration phase. This agreement is under negotiation and is estimated to be signed in the fourth quarter of 2021.

2.2 IDENTIFICATION OF THE TEAM RESPONSIBLE FOR PREPARING THE EIA

In order to prepare all the necessary documentation for the EIA process, Central Eléctrica da Namaacha, SA contracted Matos, Fonseca & Associados, Moçambique, Estudos e Projectos, Lda., a private limited liability company, based in Maputo, Mozambique, founded in 2012, registered with the Ministry of Land, Environment and Rural Development (MITADER) under no. 05/2019.

Matos, Fonseca & Associados, Moçambique, Estudos e Projectos, Lda., has decided to reinforce its technical team through a partnership with its "parent company" - Matos, Fonseca & Associados, Lda., which has a highly experienced team, both as consultants in the environmental area, in its different aspects, and in the provision of consultancy services in the preparation of environmental studies and projects, namely associated with the use of solar, hydro and wind energy, and energy transport. It is a company under Portuguese law, founded at the end of 2006, having started its activity in January 2007.

It is important to emphasise the experience that these companies already have in Mozambique, where they have been working for more than six years. The team was also reinforced with specialists with experience and knowledge acquired in the development of work of a similar nature, and in similar situations, some of which in Mozambique.

The contact details of the Environmental Consultant are provided below:

REDACTED

The overall work involves the technical experts listed in Table 2.1. This table shows the composition of the team assigned to the work and their role in the development of the studies.

Table 2.1

EIA Team

Name	Qualifications	Role
REDACTED	Degree in Environmental Engineering - Faculty of Science and Technology, New University of Lisbon Postgraduate Programme in Integrated Management Systems - Quality, Environment and Safety at NASQ – ISCS do Sul – Egas Moniz Master in Environmental Engineering - Profile Environmental Management and Systems - Faculty of Sciences and Technology of the New University of Lisbon	General Management and Co-ordination Waste and Effluent Management Environmental Management Air Quality Public Participation Process
	Degree in Biology, Faculty of Sciences, University of Lisbon Master's Degree in Natural Resources Management from the Instituto Superior de Agronomia of the Technical University of Lisbon	General Management and Co-ordination Ecology - Fauna Land and Resource Use Public Participation Process
	Degree in Environmental Sciences, Faculty of Sciences and Technology of New University of Lisbon Integrated Master's Degree in Environmental Engineering - Environmental Management and Systems Profile, Faculty of Science and Technology of New University of Lisbon	Project Management Support Socio-Economy Waste Management
	Degree in Environmental Engineering - Faculty of Science and Technology, New University of Lisbon	Cultural Heritage
	Degree in Environmental Engineering from the University of the Azores Post-graduation in Geographical Engineering and Geo-Informatics at the Faculty of Sciences of the University of Lisbon.	Sound Environment Air Quality
	Degree in harbour administration	Communication with the Population Participation Process
	Degree in Geography	Fieldwork Communication with the Population Participation Process
	Degree in Water Resources Engineering - University of Évora	Surface and Groundwater Resources and Geology

Table 2.1 (Continued)

EIA Team

Name	Qualifications	Role
	Degree in Environmental Sciences, Faculty of Science and Technology, New University of Lisbon	Climate Surface Water Resources
	Degree in Environmental Engineering, Higher Institute of Agronomy. Integrated Master in Environmental Engineering, New University of Lisbon - Faculty of Science and Technology.	Socio-Economy Air Quality
	Degree in Biophysical Engineering, University of Évora Post-Graduation in Municipal Risk Assessment and Mapping - Centre for Geographical Studies, University of Lisbon	Geographic Information Systems. Soils Land and Resource Use Landscape
	GIS Technician	Geographic Information Systems Modelling
	Degree in Geography	Geology and Groundwater Soils Socio-Economy
	Degree in Biology, University of Aveiro Master in Ecology, Biodiversity and Ecosystem Management, University of Aveiro	Ecology - Mammal fauna
	Degree in Biology, Eduardo Mondlane University Master in Management of Floristic and Faunistic Resources, Eduardo Mondlane University	Ecology - Flora and vegetation
	Degree in Nature Conservation, University of Pretoria	Ecology - Avifauna
	Degree in Biology, Faculty of Sciences, University of Lisbon MSc in Conservation Biology, Faculty of Sciences of the University of Lisbon	Ecology - Avifauna
	Degree in Biology, Eduardo Mondlane University	Ecology - Fieldwork support
	Degree in Biophysical Engineering, University of Évora	Ecology - Chiroptera
	Degree in Biology, University of Porto PhD in Biology, University of Porto	Ecology - Herpetofauna
	Geographic Information Systems Technician, Professional School of Geographical Sciences of the Portuguese Geographic Institute.	Ecology - Thematic cartography

All members of the Technical Team received specific and detailed Terms of Reference for the tasks to be carried out from the Study Coordinators.

2.3 INDICATION OF THE EIA AND PROJECT PREPARATION PERIOD

The EIA started in May 2017 and was finalised in November 2020. The project was developed between April 2017 and October 2019.

3 LEGAL FRAMEWORK

3.1 PROJECT LICENSING

The licensing of the proposed activity is the responsibility of the following ministries:

- Ministry of Land, Environment and Rural Development (MITADER), through the National Directorate of Environment (DINAB) - responsible for environmental licensing and environmental audits of the activity; and
- Ministry of Mineral Resources and Energy (MIREME) - Responsible for licensing for the operation, inspection and survey of the activity.

3.2 DIAGRAM OF THE EIA PROCESS - LEGAL FRAMEWORK FOR THE ACTIVITY

According to the environmental legislation in force (Decree No. 54/2015, of 31 December, which approves the Regulation on the Environmental Impact Assessment Process and repeals Decrees No. 45/2004, of 29 September and Decree No. 42/2008 of 4 November), the Environmental Impact Assessment process includes three main stages (see Figure 3.1), namely:

- Process Preparation, which will consist of the presentation of the Project to the Provincial Directorate of Land, Environment and Rural Development of Maputo (DPTADR-M) for classification in Category A+, A, B or C, being expected by the characteristics of the Project that it will be classified as Category A;

- Environmental Pre-feasibility and Scoping Study (EPDA), which sets out the main issues to be studied in the next phase and defines Terms of Reference for the Environmental Impact Assessment (EIA);

- The Environmental Impact Assessment (EIA), consisting of specialised studies in which the environmental impacts of the proposed Project are assessed in detail; the approval of the EIA results in the granting of an Environmental Licence by MITADER.

As mentioned above, Central Eléctrica da Namaacha, SA has been classified by MITADER as Category A (project typology indicated in Annex II, point 2.6-Energy, paragraph a)) and is therefore subject to an Environmental Impact Assessment (EIA).

The EPDA and ToR were subject to PUBLIC consultation and subsequently approved by MITADER.

The EIA Draft Report was carried out after the 1st Public Consultation of the Project and was carried out as of February 2019.

This Report, which corresponds to the Technical Report of the EIA, was carried out after the 2nd PUBLIC consultation of the Project and was carried out as of December 2019.

In addition to the aforementioned Decree-Law, given the nature of the Project, the following legislation will also be taken into account, which for a better understanding, is arranged in four major groups, namely:

- Groups 1, 2 and 3 - Includes the legislation in force in the territory of Mozambique, both directly linked to the Environmental Impact Assessment process and the way in which this process is regulated (Group 1) and in other matters related to the nature of the Project (Groups 2 and 3);

- Group 4 - Includes International Environmental Conventions to which Mozambique is a signatory; and relevant international guiding principles.

It should also be noted that the developer has a Land Use Right (DUAT) (Annex 2).

The legislation presented is comprehensive, relating to different Ministries depending on the aspects involved, these are: the Ministry of Land, Environment and Rural Development, the Ministry of the Sea, Inland Waters and Fisheries and the Ministry of Mineral Resources and Energy.

3.3 NATIONAL DEVELOPMENT FRAMEWORK

3.3.1 National Development Strategy

Approved in July 2014 and projected to 2035 by the Government of Mozambique (GoM, 2014), the National Development Strategy defines the Government's main strategies to "*increase people's quality of life through the structural transformation of the economy and the expansion and diversification of the production base*".

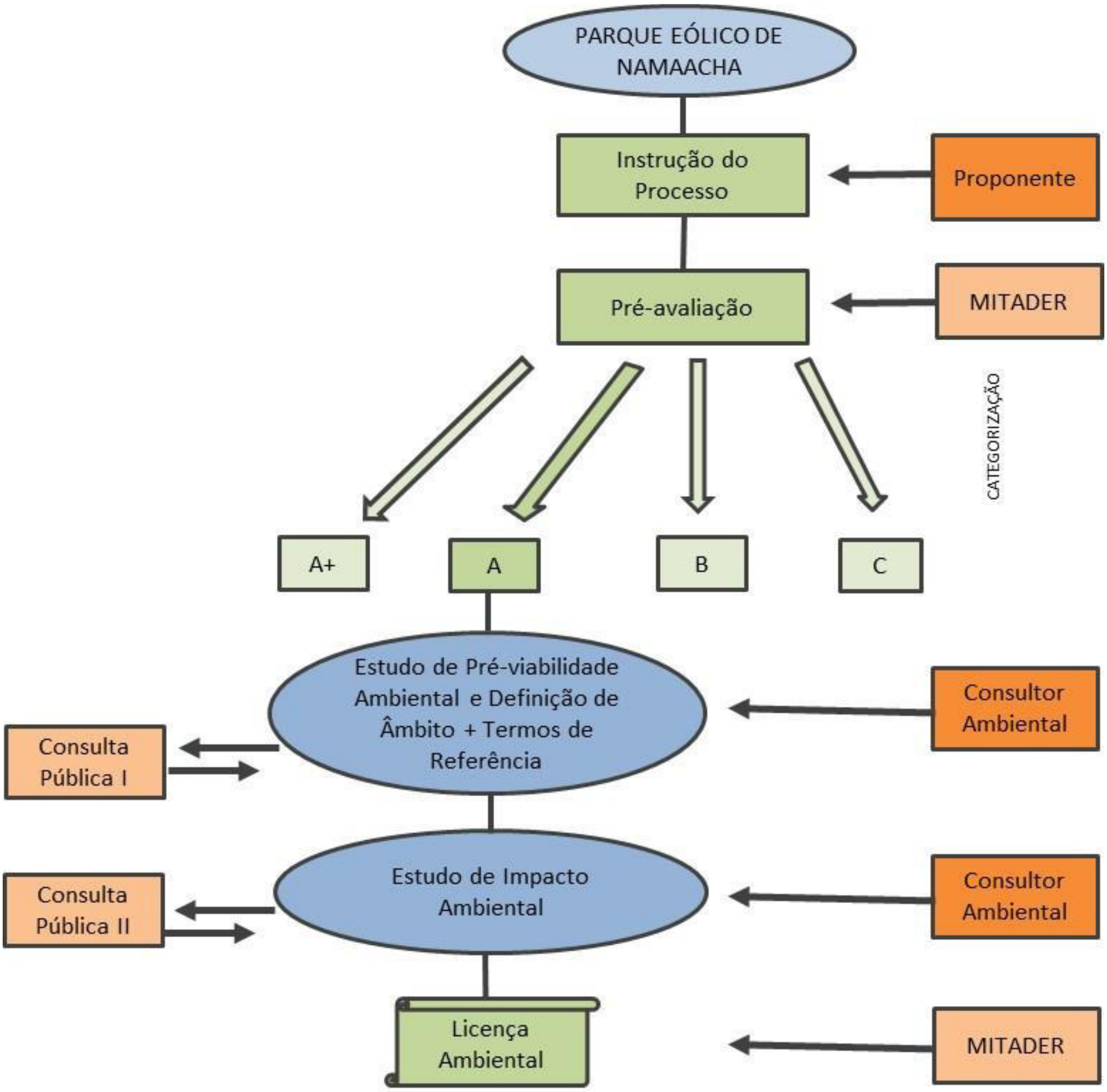


Figura 3.1 – Esquema das principais etapas do processo de AIA relativo à Central Eléctrica da Namaacha

A Estratégia Nacional de Desenvolvimento promove a industrialização como a principal forma para alcançar a prosperidade e competitividade para Moçambique. Desta forma, são definidos quatro principais pilares de desenvolvimento:

- Desenvolvimento de capital humano;
- Desenvolvimento de infra-estruturas;
- Investigação, inovação e desenvolvimento tecnológico;

- Coordination and institutional liaison.

In relation to infrastructure development, the Strategy sets out the main investment focus, namely:

- Logistics (transport and storage, with a focus on agricultural, fisheries, mineral and hydrocarbon products);
- Maritime cabotage for long-distance cargo transport;
- Energy generation, including alternative energy sources;
- Natural gas supply systems;
- Sustainable management of water resources;
- Social Infrastructure;
- Tourist infrastructure.

The Central Eléctrica da Namaacha, SA Project promotes the development of alternative energy generation projects, and is framed with the strategic objectives of infrastructure development, as defined by the National Development Strategy (2015-2035).

3.3.2 Five-Year Government Plan (2015-2019)

The Government's Five-Year Plan for the period 2015-2019, approved in February 2015 (GoM, 2015), refers as its main objective the improvement of the quality of life of the Mozambican people, by increasing job creation, productivity and competitiveness.

One of the strategic areas, where PUBLIC and private investment should be encouraged, is infrastructure development. The five-year plan has defined a NUMBER of strategic objectives, which include increasing the "*quality of access to, and availability of, electricity, liquid fuels and natural gas, to enable the development of activities, domestic consumption and exports*".

The Central Eléctrica da Namaacha, SA Project aims to improve power generation and subsequent increases in availability and quality of access to electricity for consumers, both domestic and industrial. As such, the objectives of the proposed Project are in line with the strategic objectives of the GoM Five Year Plan 2015-2019.

3.3.3 Economic and Social Plan for 2019

It constitutes the LAST instrument for the operationalisation of the Government's Five-Year Programme 2015-2019. This plan was prepared according to the forecasts presented in its First Half Balance Sheet, prioritising the central objective of the 2015-2019 PQG, which is to "improve the living conditions of the Mozambican people, increasing employment, productivity and competitiveness, creating wealth and generating balanced and inclusive development, in an environment of peace, security, harmony, solidarity, justice and cohesion among Mozambicans"

The macroeconomic objectives of the PES 2019 are:

- Achieve economic growth of 4.7 per cent as measured by Gross Domestic Product, to be influenced by the expected positive performance in the Mining, Agriculture, Fisheries, Health and Social Welfare, Education and Public Administration sectors;
- Maintain the average annual inflation rate at around 6.5 %;
- Reach the value of 5 160 million US dollars in exports of goods;
- Ensure Net International Reserves of around USD 3100 million, sufficient to cover 6 months of imports of non-factor goods.

The Mozambican economy foresees for the 2019 economic year the maintenance of macroeconomic stability through the correction of fiscal imbalances through the diversification of sources of revenue collection and intensification of audit and inspection actions on companies, accompanied by the improvement of standards of equity and tax justice.

The Central Eléctrica da Namaacha, SA Project is fully aligned with the objectives of the Economic and Social Plan, as it will contribute to the economic growth of the region through the generation of energy, its use in the various economic sectors, the improvement of the quality of life, the increase in the economy, both directly and indirectly and the creation of employment.

3.3.4 Energy Sector Strategy

Approved by Resolution 10/2009 of 4 June, the Energy Sector Strategy sets out guidelines for the implementation of the Energy Policy (approved by Resolution 5/98 of 3 March).

The Strategy recognises the importance of energy for national economic growth and poverty reduction, and refers to Mozambique's significant energy resource potential, sufficient to meet national and regional demand, in the context of Southern Africa.

Some of the principles established by the Energy Sector Strategy are:

- Sustainable increase in access to electricity;
- Sustainable development and preservation of the environment;
- Institutional coordination and consultation with all stakeholders;
- Exploitation of the regional market, enabling large energy projects;
- Efficient use of energy.

The Central Eléctrica da Namaacha, SA project is fully aligned with the objectives of the Energy Sector Strategy, as it will allow the generation of energy through alternative and renewable sources.

3.3.5 National Land Development Plan (PNDT)

According to the Regulation of the Land Use Planning Law approved by Decree No. 23/2008 of 1 July, the National Land Development Plan is one of the two land use planning instruments at the national level in Mozambique, together with the Special Land Use Planning (PEOT), and is an instrument that defines and establishes the general perspectives and guidelines that should guide the use of the entire national territory and the priorities of interventions at the national scale.

The objectives of the PNDT are to define the vocation of the major natural systems for their potential use as beneficial resources for the population, to guarantee the integrated and integral development of the country, to establish orders of priorities for the planning and materialisation of the main infrastructure networks, and also to define the set of principles that should guide the elaboration of territorial planning instruments.

The technical proposal of the PNDT was initiated at the end of January 2018 under the mandate of the Resolution of the Council of Ministers, to be approved by the Law of the Assembly of the Republic, with the Technical Meeting chaired by the National Director of Land Use Planning taking place on 15 March.

This plan is a CUPULA instrument of the territorial planning system of Mozambique that fulfils the following primary functions:

- Explains the strategy and model for the organisation of the national territory;
- It provides the basis for the spatial coordination of sectoral policies and the programming of major public investments with a territorial impact; and
- Establishes guidelines and orientations for the definition of spatial planning policy and for the preparation of other territorial plans.

In March 2019, the report of the technical proposal of the National Territorial Development Plan was presented, containing the results of Phase II of the Work Plan (territorial development strategy and territorial model). This report contains the fundamental elements that will structure the final technical proposal of the PNDT:

- The explanation of the territorial development strategy for the period 2020-2040;
- The description of the territorial organisation model to be achieved in 2040; and
- The presentation of the key features of the Action Plan.

3.4 INSTITUTIONAL FRAMEWORK

3.4.1 Energy Sector

- The Ministry of Mineral Resources and Energy (MIREME) was created by Presidential Decree No. 1/2015 of 16 January 2015, and its competences are defined in Resolution No. 14/2015. Some of these competences are the promotion of knowledge of national energy resources, the development and utilisation of these resources and the development of energy production, in order to meet national needs and take advantage of opportunities at regional level;
- The Energy Regulatory Authority (ARENE), established by Law No. 11/2017, of 8 September (Replaces the National Electricity Board), with responsibility for the supervision, regulation, inspection and sanctioning of the energy sector;
- The National Directorate of Electricity (DNE), created by Ministerial Diploma no. 195/2005, of 14 September, is the MIREME entity with competences in the design, promotion, evaluation, execution and monitoring of electricity sector policies, as well as licensing of new energy installations (defined by Ministerial Diploma No. 24/2010, of 29 January);

- Electricidade de Moçambique, E.P. (EDM) was established by Decree-Law 38/77 of 27 August as the state entity responsible for the electricity service, and transformed into a public company by Decree 27/95 of 17 July. EDM, under the tutelage of MIREME, is responsible for the establishment and operation of the Public service of generation, transmission, distribution and commercialisation of electricity in Mozambique (thus, it is the managing entity of the national electricity grid, according to Decree No. 43/2005, of 29 November).

3.4.2 Environmental Authorities

- The Ministry of Land, Environment and Rural Development (MITADER), established by Presidential Decree No. 1/2015 of 16 January 2015, is a central authority with powers to plan, coordinate, control and ensure the implementation of policies related to land management, forestry, environment, conservation areas and wildlife management, and rural development. MITANDER's role and scope of intervention are defined by Presidential Decree No. 13/2015, and its statutes are approved by Resolution No. 6/2015.

  MITADER's areas of activity relevant to the Project include:

  - National Environmental Directorate (DINAB) - whose functions include proposing environmental policies and regulations, promoting sustainable development, controlling and protecting environmental quality and monitoring ESIA processes;
  - National Directorate for Territorial Planning and Resettlement (DINOTER) - in charge of establishing rules, regulations and guidelines for territorial planning and resettlement, and promoting and monitoring the implementation of territorial planning instruments and resettlement processes;
  - General Inspectorate of Land, Environment and Rural Development - inspecting compliance with laws, rules and regulations associated with land, environment, conservation areas and forests, and wildlife.

- In addition, MITADER:
    - Includes the National Directorates for Rural Development, Forestry and Lands;
    - Oversees the National Administration of Conservation Areas (ANAC), the National Agency for Environmental Quality Control (AQUA) and the National Fund for Sustainable Development. ANAC carries out the management of conservation areas. AQUA manages and monitors environmental quality;
    - It is represented at provincial level by the Provincial Directorates of Land, Environment and Rural Development (DPTADERs). At district level, it is represented by the District Planning and Infrastructure Services;
    - Monitors ESIA processes through DINAB at national level, and through DPTADERs at provincial level.

3.5 ENVIRONMENTAL IMPACT ASSESSMENT AND RELATED

The proposed Project must fulfil the legal requirements for environmental licensing. To this end, consideration should be given to regulations specific to the ESIA and all applicable environmental regulations that may be relevant to the Project throughout its life cycle (construction, operation and decommissioning).

The main environmental impact legislation is set out in the table below.

Table 3.1

Legislation on Environmental Impact

Legislation	Description	Relevance to the Project
National Environmental Policy, Resolution No. 5/95 of 6 December 1995	It lays the foundation for all environmental legislation. According to Article 2.1 The main objective is to ensure sustainable development	The Project should aim to achieve the objectives of the policy by integrating environmental considerations into socio-economic planning, the management of the country's natural resources and the protection of key ecosystems and ecological processes.
Environment Law, Law no. 20/97, of 1 October	It sets out the legal basis for the proper utilisation and management of the environment for the sustainable development of the country. The Environment Act applies to all public and private activities that directly or indirectly affect the environment	The Project shall consider the principle of sustainable development, as defined by the Environmental Law, throughout its life cycle

Table 3.1 (Continued)

Legislation on Environmental Impact

Legislation	Description	Relevance to teh Project
Regulation on the Environmental Impact Assessment Process, Decree No. 54/2015, of 31 December	Establishes the ESIA process as one of the key instruments for environmental management. It defines the ESIA process, the necessary environmental studies, the PPP, the process of reviewing the studies, the process of deciding on environmental feasibility and the issuing of an environmental licence. It applies to all public or private activities with a direct or indirect influence on the environment.	The Project must undergo a formal ESIA process in accordance with these regulations. An environmental permit must be obtained from MITADER, and the issuance of this permit precedes any other permit or authorisation required for the Project.
Regulation of the Environmental Audit Process, Decree no. 25/2011, of 15 June	It defines environmental auditing as an objective and documented tool for the systematic management and evaluation of the management system and documentation implemented to ensure environmental protection. Its objective is to assess the compliance of operational and work processes with the environmental management plan	During the lifetime of the Project, the Proponent shall conduct annual independent environmental audits, without prejudice to any PUBLIC environmental audits that may be requested under this Decree
Regulation of the Environmental Inspection Process, Decree no. 11/2006, of 15 June	Regulates the supervision, control and verification of project compliance with national environmental protection standards	During the construction and operation phases of the Project, MITADER may carry out inspections in order to verify compliance with environmental legislation and the ESMP. The Proponent shall co-operate and facilitate these inspections.
General Guidelines for the preparation of Environmental Impact Assessments, Ministerial Diploma No. 129/2006, of 19 July 2006	It provides details on the procedures for obtaining an environmental licence, as well as the format, general structure and content of the EIA report. It aims to standardise the procedures followed by various key stakeholders in the EIA process.	The EIA report must be prepared in accordance with the specifications described in this Ministerial Diploma.

Table 3.1 (Continued)

Legislation on Environmental Impact

Legislation	Description	Relevance to the Project
General Guidelines for the Public Participation Process (PPP) of the ESIA Process, Ministerial Diploma No. 130/2006, of 19 July	Defines the basic principles, methodologies and procedures for the ESIA PPP.	The PPP of the ESIA process shall be developed according to the specifications described in this Ministerial Diploma.
Ministerial Diploma No 182/2010 of 3 November 2010	Regulates the organisation and functioning of the Technical Evaluation Commissions.	The Technical Assessment Commission, established under the terms of the Regulation on the Environmental Impact Assessment Process approved by Decree No 45/2004 of 29 September 2004, is the intersectoral committee for analysing the technical documents prepared within the framework of the Environmental Impact Assessment.

3.6 GENERAL LEGISLATION

The Constitution of the Republic of Mozambique defines, according to Article 90, the right of all citizens to a balanced environment and the duty to protect it. Already according to Article 117, the State needs to: (*i*) promote initiatives that ensure ecological balance and preserve the environment, and (*ii*) implement policies to prevent and control pollution and integrate environmental concerns into all sectoral policies to guarantee the citizen the right to live in a balanced environment supported by sustainable development

The main general legislation that may be of interest is set out in the table below.

Table 3.2

General Legislation

Legislation	Description	Relevance to the Project
Water Law (Law no. 16/91 of 3 August)	This law is based on the principle of PUBLIC water use, river basin based water management and the user pays and polluter pays principle.	If the Project needs to abstract water from natural water bodies (e.g. for concrete production), a licence from the competent authority (Regional Water Administration) will be required. If the Project needs to release effluent into water bodies (e.g. from construction sites), a licence must be obtained for this purpose.

Table 3.2 (Continued)

General Legislation

Legislation	Description	Relevance to the Project
Law on Forests and Wildlife (Law No 10 of 1999 of 07 July)	Establishes the basic rules and principles for the protection, conservation and sustainable use of forest resources and wildlife	No protection area, as defined by this Law, is interfered with by the Project.
Regulation of the Forestry and Wildlife Act (Decree No 12/2002)	Applies to the protection, conservation, use, exploitation and production activities of flora and fauna resources.	The Proponent shall notify MITADER if a species listed in this regulation.
Regulation on Environmental Quality and Effluent Emission Standards (Decree No. 18/2004)	Determines that when industrial effluents are discharged into the environment, the final effluent discharged must comply with the emission limits set out in Annex III.	The Project shall comply with the effluent emission limits set out in this Regulation so as not to harm the environment.
Lei de Electricidade (Lei n.º 21/97)	Article 9 states that the transmission of electricity requires the issue of a concession for this purpose. Article 14 states that the management of the national power transmission grid is assigned to a public entity and that private capital may participate in the development of the national power transmission grid.	EDM was designated as the managing entity of the national energy transmission grid in accordance with Decree 42/2005.
Decree No 42/2005 of 29 November 2005	Regulation establishing the rules relating to the planning, financing, construction, ownership, maintenance and operation of facilities for the production, transmission, distribution and commercialisation of national electricity. Article 3 emphasises that the construction and operation of energy transmission infrastructure requires the issuance of a concession, as required by Law No. 21/97.	
Regulation on Urban Solid Waste Management (Decree No. 94/2014 of 31 December)	It establishes the legal framework for urban solid waste management. Waste management is the responsibility of Municipal Councils and District Governments in their respective jurisdictions.	Any project should implement appropriate waste management practices during its life cycle.
Regulation for the Management of Hazardous Waste (Decree no. 83/2014, of 31 December)	It establishes the legal framework for the management of hazardous waste. MITADER is the competent authority for managing hazardous waste.	Any project must implement appropriate waste management practices during its life cycle. The Project must fulfil the requirements outlined in this regulation.

Table 3.2 (Continued)

General Legislation

Legislation	Description	Relevance to the Project
Land Use Planning Regulation (Decree 23/2008)	Defines the general bases for the planning of the national territory, to ensure the rational and sustainable use of natural resources, regional potential, urban centres and infrastructures and to promote national cohesion and the security of the population.	If the implementation of the Project requires the expropriation of land use rights, the requirements of this Regulation shall be met.
Directive on the Expropriation Process for Land-use Planning Purposes (Ministerial Diploma No 181/2010)	Establishes procedures for expropriation proceedings for land-use planning purposes, including procedures for issuing the declaration of public interest, for compensation for expropriation (including calculation methods) and for the expropriation process itself.	If expropriation of land or land use rights from the Project area is required, the procedures for this shall comply with the requirements set out in this Directive.
Law for the Protection of Cultural Heritage (Law 10/88) and Enabling Regulation for the Protection of Archaeological Heritage (Decree 27/94);	It aims to protect the material and non-material cultural heritage. Cultural heritage is defined in this law as the "set of tangible and intangible assets created or integrated by the Mozambican people throughout history, with relevance to the definition of Mozambican cultural identity”	The potential presence of cultural heritage in the Project area has been assessed in the EIA.
Labour Law (Law No. 23/2007	This law applies to legal relationships of subordinate labour established between employers and national and foreign workers, of all industries, working in the country.	The Proponent shall provide its workers with good physical, environmental and moral working conditions, inform them about the risks of their work and instruct them on proper compliance with the standards.
Law on the Protection of Persons, Workers and Jobseekers Living with HIV and AIDS (Law no. 19/2014, of 27 August)	This Law establishes the rights and duties of the person living with HIV and AIDS, and guarantees the promotion of measures necessary for its prevention, protection and treatment.	HIV/AIDS testing of workers, job applicants, candidates for training assessment or candidates for promotion at the request of employers without the consent of the worker or job applicant is prohibited. The proposer shall train and retrain all HIV/AIDS-infected workers who are capable of fulfilling their duties at work, leading them to a job compatible with their residual capacities.

Table 3.2 (Continued)

General Legislation

Legislation	Description	Relevance to the Project
Regulation on General Labour Inspectorate (Decree 45/2009)	This Regulation lays down the rules on inspection activities as part of the control of the legality of work.	The Proponent must comply with the requirements. In the case of an inspection, the tenderer must help provide all necessary information to the inspectors.
Land Use Planning Law (Law no. 19/2007, of 18 July)	It is the law that provided the legal framework for the Land Planning Policy of the Republic of Mozambique and established the legal bases for the regime of national land planning instruments. The Council of Ministers decrees, by this law, the Regulation of the Land Use Planning Law approved.	If the implementation of the Project requires the expropriation of land use rights, the requirements of this regulation shall be met. land use rights, the requirements of this regulation must be met.
Decree no. 31/2012, of 8 August 2012	Approves the Regulation on the Resettlement Process Resulting from Economic Activities. The growing demand for the country's natural resources has made it necessary to standardise the resettlement process under Law No. 19/2007. The purpose of this Regulation is to establish basic rules and principles on the resettlement process, resulting from economic activities of public or private initiative, in order to promote the quality of life of citizens and the protection of the environment.	If environmental components are used or exploited for the implementation of the Project, or if technologies or production processes are applied that may affect the territory, the requirements of these Regulations must be complied with.
Decree No 67/2010 of 31 December 2010	Amends the Regulation on Environmental Quality Standards and Effluent Emission approved by Decree No. 18/2004, of 2 June 2004. This Regulation defines the air and sea/ocean quality standards, with the limits of polluting and potentially harmful substances in the respective media under analysis.	If during the construction and operation phases substances with odorous properties are released into the atmosphere or pollutants potentially harmful to the water environment, the requirements of this Regulation shall be complied with and appropriate minimisation measures taken.
Decree No 30/2003 of 1 July 2003	Approves the Regulation of Public Water Distribution and Wastewater Drainage Systems and revokes Ordinances No. 10367 of 14 April 1943 and No. 11338 of 8 May 1946. The purpose of the Regulation is to define the technical conditions to be met by public water distribution systems in Mozambique in order to ensure their overall proper functioning. This Regulation applies to public drinking water distribution systems that have, at least, a collection, storage and distribution network, covering domestic, commercial, industrial, public, firefighting and other consumptions.	If drinking water distribution systems with a catchment, storage or distribution network are used for the implementation of the Project, the requirements of these Regulations shall be complied with.

Other general laws that may be relevant to the EIA process are:

- Fisheries Law (Law No 03/90 of 26 September);
- Local Authorities Law (Law no. 2/97 of 18 February). Approves the Legal Framework for the Implementation of Local Authorities;
- Resolution 5/98 of 3 March. Approves the energy policy;
- Decree No 11/2003 of 25 March 2003. Amends Article 20(5), Article 21(1)(g) and Article 29(e) of the Forestry and Wildlife Law Regulation;
- Regulation on the quality of water for human consumption (Ministerial Diploma no. 180/2004 of 15 September);
- Water Policy Resolution (46/2007 of 30 October);
- Ministerial Diploma No 129/2006, of 19 July 2006 and Ministerial Diploma No 130/2006, of 19 July 2006. Establish the principles for the preparation of the EIA and the Public Participation Process (PPP) during the ESIA process;
- Water Licences and Concessions Regulation (43/2007 October). Regulates the management of water resources, namely the licensing or concession of the right to use or privately exploit water;
- Decree No 11/2003 of 25 March 2003. Amends Article 20(5), Article 21(1)(g) and Article 29(e) of the Forestry and Wildlife Law Regulation;
- Regulation on Environmental Quality and Effluent Emission Standards (Decree No 18/2004 of 2 June 2004 and Decree No 67/2010 of 21 December 2010). Amends Articles 23 and 24 and Annexes I and V, referring to Article 7 and Article 16(3) of Decree 18/2004, and approves Annexes IA and IB. Defines that it is MICOA (now MITADER) to approve the noise standards;
- Decree 23/2008 of 1 July. Approves the Regulation of the Land Use Planning Law;
- Decree 24/2008 of 1 July. Approves the Regulation on the Management of Substances that Deplete the Ozone Layer;
- Energy Strategy (Resolution 10/2009 of 4 June);

- National Strategy for Adaptation and Mitigation of Climate Change (ENAMMC).

3.7 LEGISLATION THAT IS RELEVANT TO THE NATURE OF THE PROJECT IN QUESTION, BUT WHICH, DUE TO ITS SIZE AND LOCATION, WILL NOT BE APPLICABLE FROM THE OUTSET

The following table represents some legislation that may be relevant to the nature of the project in question, but which due to its size and location may not be applicable:

Table 3.3

Relevan Legislation

Legislation	Description	Relevance to the Project
National Land Policy	It establishes that the state must provide land for each household to build or own its dwelling and is responsible for planning the physical use and occupation of land, although the private sector can participate in drawing up plans.	The Project must be in accordance with the principles of the policy, as defined in the implementing laws.
Land Law (n° 19/97 of 01 October and Decree n° 66/98- regulation of the Land Law)	It establishes the legal framework for land ownership, as well as the control of land and natural resources in Mozambique.	The Land Law and its regulations define full and partial protection zones, where land use is restricted.
Land Regulation (Decree No 66/98)	Defines full protection zones, set apart for nature conservation and state protection, as well as partial protection zones, where DUATs cannot be issued and activities cannot be implemented without a licence.	-
Regulation on the Settlement Process resulting from economic activities (31/2012).	Defines the reference rules and principles to be followed in resettlement processes resulting from the implementation of public and private economic activities.	If the Project results in physical or economic resettlement this regulation applies and a Resettlement Plan will need to be developed.

3.8 INTERNATIONAL ENVIRONMENTAL CONVENTIONS TO WHICH MOZAMBIQUE IS A SIGNATORY

Mozambique is a signatory to several international environmental conventions, which are applicable to this type of project.

When countries become signatories to Conventions, Protocols, Treaties and Agreements, they agree to incorporate the principles and standards of the conventions into their legislation. From the outset, compliance with the legislation of Mozambique's legislation will ensure compliance with the provisions of the conventions because when a state commits itself, either new laws and regulations are created, or an amendment is made to the existing framework in order to incorporate all aspects arising from the commitments made.

The following is a list of the International Environmental Conventions to which Mozambique is a signatory, divided by areas of intervention.

In relation to Biodiversity:

- African Convention on the Conservation of Nature and Natural Resources (1968): Commitment by the states concerned to adopt measures to ensure the preservation, utilisation and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of individuals. Mozambique acceded to the Convention in accordance with Resolution No 18/81 of 30 December 1981;

- African Convention on the Conservation of Nature and Natural Resources (Amended version) Mozambique is a contracting party and will be subject to the commitments as soon as it enters into force in 2003;

- Convention on Wetlands of International Importance especially as Waterfowl Habitat - Ramsar (1971): Sustainable conservation and utilisation of wetlands. Ratified by Mozambique in 2003;

- Convention on International Trade in Endangered Species of Wild Fauna and Flora -Cites (1973);

- Convention on the Conservation of Migratory Species of Wild Animals - Bonn, CMS (1979): Encouraging measures to protect migratory species of wild fauna throughout their natural range. Ratified by Mozambique in 2008;

- United Nations Convention on Biological Diversity (1993): International legally binding treaty with three main objectives (the conservation of biodiversity, the sustainable use of biodiversity and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources) and aims to encourage actions that promote a sustainable future. The Convention was ratified by Mozambique in 1994, through Resolution No. 2/94;

- SADC Protocol on Wildlife Conservation and Law Enforcement (1999): Ensuring the conservation and sustainable use of wildlife resources. Ratified by Mozambique in 2002;

For waste/hazardous waste:

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Removal (1989): Regulations on the import, export and transboundary movement of hazardous wastes (replaced by the Bamako Convention - 1991). The Republic of Mozambique ratified the Basel Convention through Resolution No. 18/96 of 26 November 1996;

- Bamako Convention on the Prohibition of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa - Bamako (1991): total ban on the import of hazardous wastes into Africa. The Republic of Mozambique ratified this Convention by Resolution No. 19/96 of 26 November 1996;

Regarding Air Quality/Climate Change:

- Vienna Convention for the Protection of the Ozone Layer (1985), London (1990), Copenhagen (1992): The states concerned assumed the obligation to take appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which alter or are likely to alter the ozone layer. In accordance with Resolution No. 8/93 of 8 December, the Republic of Mozambique acceded to the Vienna Convention for the Protection of the Ozone Layer as well as to the 1990 and 1992 Amendments

- United Nations Framework Convention on Climate Change (UNFCCC) - read in conjunction with the Kyoto Protocol (1992): international environmental treaty, produced with the aim of achieving stabilisation of greenhouse gas concentrations in the atmosphere at levels low enough to prevent dangerous anthropogenic interference with the climate system. Ratified by Resolution 2/94 of 24 August;

- Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997): Establishes a legal agreement regarding the reduction of greenhouse gas emissions, between 6% and 8% on average below 1990 levels, to be implemented between the years 2008 to 2012, defined as the first budgeted deadline for emissions. The Republic of Mozambique acceded to the Kyoto Protocol through Resolution no. 10/2004, of 28 July;

- International Convention to Combat Desertification in Countries Affected by Severe Drought and/or Desertification, particularly in Africa (1994);

Concerning the area of pollution prevention:

- Stockholm Convention on Persistent Organic Pollutants (POPs) (2001): Worldwide action and control of chemicals that persist in the environment, bioaccumulate in the food chain and pose a risk to human health and the environment. Mozambique ratified this convention in 2005;

With regard to cultural heritage:

- UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972): To assist in the identification and protection of cultural and natural heritage. Mozambique ratified this convention in 1982;

- Convention for the Safeguarding of the Intangible Cultural Heritage - UNESCO (2003): Safeguarding intangible cultural heritage and ensuring respect for the intangible cultural heritage of communities, groups and individuals. Ratified by Mozambique in 2007;

- Convention on the Protection and Promotion of the Diversity of Cultural Expressions - UNESCO (2005): To protect and promote the diversity of cultural expressions, to encourage dialogue among cultures and to promote respect for cultural diversity. Ratified by Mozambique in 2007;

On the subject of human rights:

- International Labour Organization Conventions and national labour-related legislation:
    - Forced Labour Convention, ratified in June 2003: Forced or Compulsory Labour Convention;
    - Freedom of Association and Protection of the Right to Organise, Dec 1996: Convention on Freedom of Association and Protection of the Right to Organise;
    - Right to Organise and Collective Bargaining, Dec 1996: Convention on the Application of the Principles of the Right to Organise and Collective Bargaining;

  - Equal Remuneration Convention, June 1977: Convention on equal remuneration for men and women workers for work of equal value refers to rates of pay established without discrimination based on gender;
  - Convention concerning the Abolition of Forced Labour, June 1977;
  - Discrimination (Employment and Occupation) Convention, June 1977: Discrimination in Respect of Employment and Occupation Convention;
  - Minimum age specified: 15 years, June 2003: Convention on Minimum Age for Admission to Employment;
  - Worst Forms of Child Labour Convention, June 2003: Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour;

- African Charter on Human and Peoples' Rights (1981);
- International Covenant on the Elimination of Racial Discrimination: States "undertake to pursue, by all appropriate means and without delay, a policy of eliminating racial discrimination in all its forms and of promoting understanding among all races". Ratified in 1983;
- International Covenant on Civil and Political Rights: Recognises equal and inalienable rights to all human beings in terms of civil and political liberty. Ratified in 1993;
- Convention on the Elimination of Discrimination against Women: States have an obligation to ensure equal rights for men and women to enjoy all economic, social, cultural, civil and political rights. Ratified in 1997;
- Convention on the Rights of the Child: Guarantees the protection of children's rights. Signed in 1990 and ratified in 1999;
- Convention against Torture: States undertake to prohibit, under all circumstances, the commission of acts of torture and other cruel, inhuman or degrading treatment or punishment. Ratified in 1999;
- International Convention on the Rights of Migrant Workers: Its main objective is to protect migrant workers and their families, a particularly vulnerable population, from exploitation and human rights violations. Signed in 2012; ratified in 2013;
- International Convention on the Rights of Persons with Disabilities: States have an obligation to

protect the rights and dignity of persons with disabilities; signed in 2007;

- Protocols related to the African Union: Various protocols and charters promoting and protecting human rights and fundamental freedoms, the rights of children and other persons on the African continent.

Other conventions attended by Mozambique were:

- Constitutive Act of the African Union (2000);
- Agenda 21(1997);
- UNESCO (1972).

Mozambique is also part of the Southern African Power Pool (SAPP), a co-operation of national power companies in Southern Africa, founded in 1995 under the auspices of the Southern African Development Community (SADC). There are 12 SADC member countries that make up the SAPP, represented by their respective power companies, including Mozambique, represented by EDM. The SAPP aims to meet the electricity needs of its member countries, making sure that production is sustained on renewable natural resources without unsustainable effects on the environment.

3.9 INTERNATIONAL GUIDELINES AND POLICIES

The EIA process is being developed in accordance not only with national rules and regulations, but also in line with international best practice, namely the environmental and social policy and performance requirements set by the World Bank (WB)/International Finance Corporation (IFC). The following subchapter describes the main international standards and guidelines applicable to the Project.

3.9.1 World Bank Operational Safeguard Policies

Development promoters seeking financing from the WB must comply with the applicable WB operational environmental and social safeguard policies. The main objectives and description of the applicable WB environmental and social safeguard policies are presented in the table below:

Table 3.4
WB Policies

Operational Policy	Objective	Description
Operational Policy 4.01 - Environmental Assessment	Identify, avoid and mitigate potential negative environmental impacts associated with WB lending operations	It provides a framework for the WB's environmental safeguard policies and describes the process instruction and project categorisation to determine the level of environmental assessment required. For Category A projects, the ESIA process must include public consultation and information disclosure. It requires the implementation of environmental and social management plans.
Operational Policy 4.04 - Natural Habitats	Ensure that infrastructure and other development projects supported by the WB take into account biodiversity conservation as well as the environmental services and products that natural habitats provide to human society	Describes the WB policy on biodiversity conservation, taking into account ecosystem services and the management and utilisation of natural resources by project-affected people. Projects must assess potential impacts on biodiversity. The policy strictly restricts the circumstances in which conversion or degradation of natural habitats may occur.
Operational Policy 4.11 - Physical Cultural Resources	Establishes requirements to avoid or mitigate adverse impacts to cultural resources	-
Operational Policy 4.12 - Involuntary Resettlemen	Avoid involuntary resettlement to the extent possible or minimise and mitigate its adverse social and economic impacts	Where land or other assets are to be acquired, this policy requires participation in resettlement planning, compensation for assets at replacement cost, and improvement of the incomes and living standards of those affected, or at least their restoration to pre-project levels.

Table 3.4 (Continued)

WB Policies

Operational Policy	Objective	Description
Operational Policy 4.20 - Gender and Development	Reduce poverty and foster economic growth, human well-being, and development effectiveness	Address gender disparities and inequalities that are barriers to development, and formulate and implement gender and development goals
Operational Policy 4.36 - Forestry	Reduce deforestation, increase the environmental contribution of forested areas, promote reforestation, reduce poverty and stimulate economic development	-
Access to Information Policy	Support the decision-making process of the Bank and the borrower	Public dissemination of information on environmental and social aspects of projects

3.9.2 IFC Performance Standards (PS)

Table 3.5

IFC Performance Standards

Performance Standards	Objectives	Description
PS 1: Assessment and Management of Social and Environmental Risks and Impacts	Establishes the importance of (i) an integrated assessment to identify the environmental and social impacts, risks and opportunities of projects; (ii) effective community participation through information disclosure and consultation with local communities on issues that directly affect them; and (iii) the management of the client's environmental and social performance throughout the project life cycle	It emphasises the importance of managing the environmental and social performance of a project throughout its life cycle. PS 1 requires the client to undertake an environmental and social assessment process and to establish and maintain an Environmental and Social Management System (ESMS), appropriate to the nature and scale of the project and commensurate with the level of environmental and social risks and impacts

Table 3.5 (Continued)

IFC Performance Standards

Performance Standards	Objectives	Description
PS 2: Labour and Working Conditions	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises that the pursuit of economic growth through job creation and revenue generation must be accompanied by the protection of workers' fundamental rights
PS 3: Resource Efficiency and Pollution Prevention	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises that increased economic activity and urbanisation often produce increasing levels of pollution to air, water and land and consume finite resources in a way that can threaten people and the environment at local, regional and global levels
PS 4: Health, Community Safety and Security	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises that project activities, equipment and infrastructure may increase community exposure to risks and impacts
PS 5: Land Acquisition and Involuntary Resettlement	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises that project-related land acquisition and restrictions on land use may have adverse impacts on the communities and people who use that land
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises that the protection and conservation of biodiversity, the maintenance of ecosystem services and the sustainable management of living natural resources are fundamental to sustainable development

Table 3.5 (Continued)

IFC Performance Standards

Performance Standars	Objectives	Description
PS 7: Indigenous Peoples	Presents requirements for avoidance of adverse impacts, participation and consent, impacts on lands and natural resources subject to traditional ownership or customary use, relocation of indigenous peoples from lands and natural resources subject to traditional ownership or customary use, and critical cultural heritage.	Recognises that Indigenous Peoples, as social groups with identities distinct from those of conventional groups in national societies, are generally among the most marginalised and vulnerable segments of the population.
PS 8: The Cultural Heritage	It presents requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment and to improve conditions where applicable. Where social or environmental impacts are expected, the client is required to manage them through its ESMS.	Recognises the importance of cultural heritage for current and future generations

IFC's PSs are complemented by the respective Guidance Notes, which provide guidance on the requirements of the standards and on good sustainability practices to help promoters improve project performance.

3.9.3 World Bank/IFC Environment, Health and Safety Guidelines

The WB Environmental, Health and Safety (EHS) Guidelines are technical reference documents that provide examples of International Good Industry Practice for each sector of activity (as defined in IFC PS 3 in the previous subchapter). The EHS Guidelines include the various levels of performance and measures that are acceptable to the IFC and are considered feasible in new facilities, using existing technologies and at reasonable cost.

IFC-funded projects may be required to establish site-specific targets, with an appropriate timeline for their realisation, as part of the application of the EHS guidelines. The environmental assessment process may indicate alternative levels or measures that become project- or facility-specific requirements, provided they are acceptable to IFC.

The relevant IFC EHS Guidelines applicable to the Project are (i) the General EHS Guidelines (April 2007) and (ii) the EHS Guidelines for Wind Energy (August 2015).

3.9.4 Equator Principles

These Principles are developed by reputable financial institutions, and are a set of voluntary guidelines for managing environmental and social issues in the allocation of project finance credits. The Principles require that project development in countries that are not members of the Organisation for Economic Co-operation and Development (OECD) comply with the IFC's PSs and EHS Guidelines. The Equator Principles include:

- Principle 1: Analysis and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Contractual Obligations;
- Principle 9: Independent Monitoring and Information Disclosure;
- Principle 10: Information Disclosure and Transparency.

3.10 INCLUSION IN LAND-USE PLANS

The main objective of land use planning is to manage the interaction between human activities and the natural environment. In this context, there is a set of tools that aim to provide the competent authorities with guiding documents, both at the planning and management levels, always associated with a philosophy of environmentally sustainable development, thus determining which are the preferential sectors to be developed, which are the uses and constraints of the soil and which are the priorities for intervention.

Law No. 19/2007 of 18 July 2007 established the legal framework for the Land Planning Policy of the Republic of Mozambique and laid down the legal bases for the regime of national land planning instruments. planning instruments. Decree No. 23/2008, 1 July, of the Council of Ministers approves the Regulation of the Land Use Planning Law, which aims to establish the legal regime of land use planning instruments and regulate relations between the various levels of the Public Administration, and the latter with other PUBLIC and private subjects, representing the different economic, social and cultural interests, including local communities.

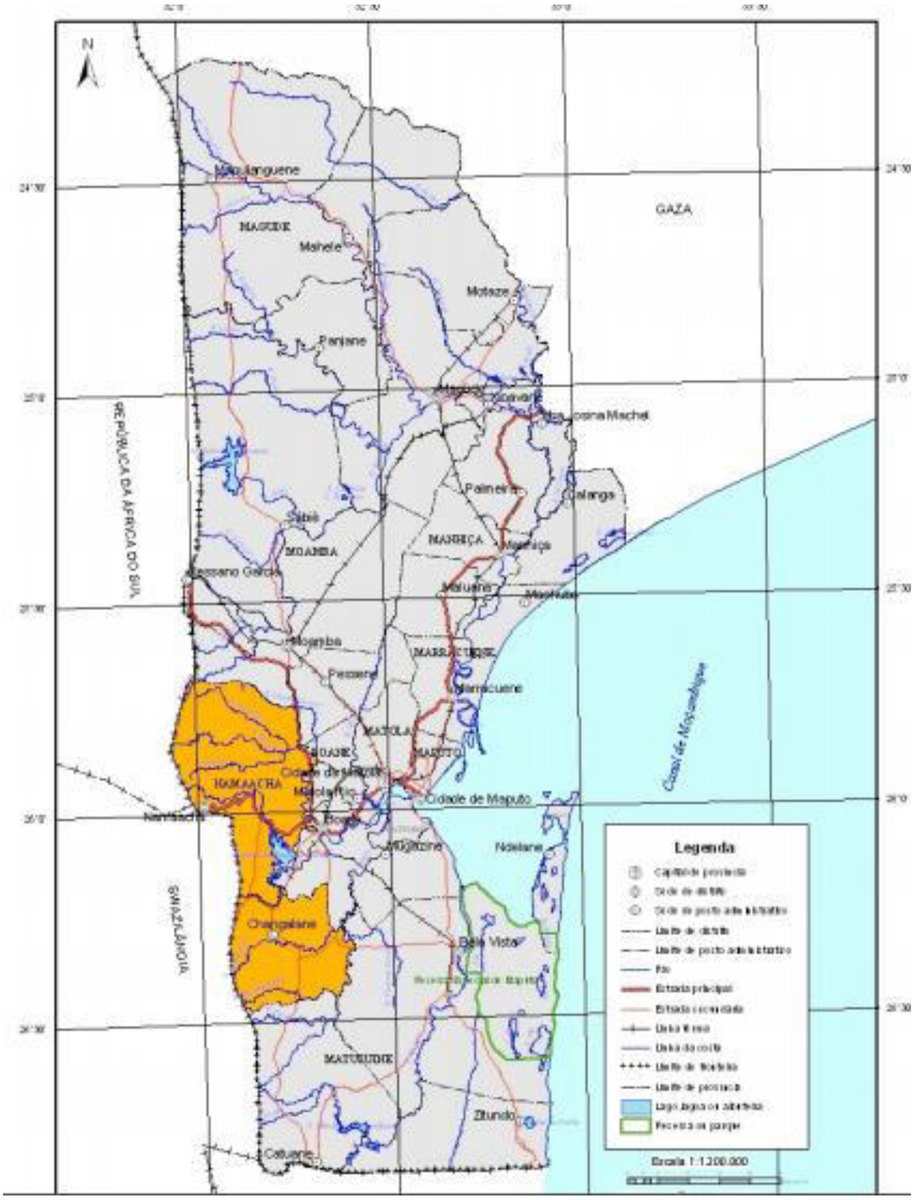
In administrative terms, the district of Namaacha is divided into two Administrative Posts and 8 Localities distributed as follows (see Figures 1.1 and 3.2):

- A.P. of Namaacha (village of Namaacha and Localities of Kala-Kala, Chimachuanine, Impaputo, Mafuiane and Matsequenha); and

- A.P. of Changalane (Localities of Changalane, Goba Station, Mahelane and Michangulene).

The Namaacha Power Plant is located at the Namaacha Administrative Post.

The district seat is in the village of Namaacha. The village was elevated to the category of town on 20 April 1964. On 2 April 2008, the Mozambican government announced the creation of the municipality of Namaacha, as part of the expansion of the country's autarchisation process to 10 new towns, one in each province.



Fonte: Perfil do Distrito de Namaacha Província de Maputo – Edição 2014

Figura 3.2- Mapa do distrito de Namaacha

A administração distrital, tal como o município, tem as suas sedes na capital do distrito, Namaacha. Embora a jurisdição da administração distrital esteja restrita aos postos administrativos e localidades fora do município, a maioria das direcções distritais tem jurisdição sobre os serviços prestados dentro dos limites do município. Também o reconhecimento oficial dos líderes tradicionais, incluindo daqueles dentro das fronteiras municipais, é da responsabilidade da administração distrital.

A área de implantação da Central Eléctrica da Namaacha (Projecto em análise) encontra-se fora da área do município da Namaacha.

The boundaries of the municipal administrative division do not coincide with those of traditional leaders, which occasionally creates situations of overlapping authority and power rivalries. The greatest rivalries result from different understandings of what can be considered legitimate authority: that installed by traditional inheritance or that resulting from popular vote or nomination.

In Maputo Province there is an area with protected status, namely the Maputo Special Reserve, but its boundaries are very far from the area where the Namaacha Power Plant is planned to be located, i.e. the Project is not located in any protected area or environmental reserve.

4 GENERAL ASPECTS OF THE EIA METHODOLOGY

4.1 FRAMEWORK

The methodology adopted for the completion of the EIA, in addressing each of the environmental aspects under analysis, was based on the following aspects:

- Obtaining the information on the current state of environmental quality in the study area necessary to define the current situation (baseline situation):
    - Analysis of the available thematic bibliography and synthesis of the most relevant aspects of interest for the assessment of impacts on the biophysical and socio-economic environment;
    - Field visits and reconnaissance carried out in the intervention area by the specialists involved in the EIA, with more significant expression for the fields of ecology, landscape, economic and social issues and land use;
- Working meetings with the different members of the technical team;
- Identification of the actions associated with the Project that are likely to cause impacts and identification of their potential environmental impacts, determined by the construction, operation and decommissioning of the Project;
- Assessment of the impacts resulting from the implementation of the Project, using a methodology based on specific criteria;
- Proposal, for the expected impacts, whenever possible, of measures to minimise the negative impacts determined by the Project, and this information was complemented with an Environmental Monitoring Plan for the Works, a Waste Management Plan and a Recovery Plan for the Intervened Areas, which are part of the Environmental Management Plan (EMP). These elements were prepared on the basis of the experience acquired with similar projects.

4.2 DEFINITION OF THE STUDY AREA AND WORKING SCALES

The Area of Influence (AoI) is defined as the geographical space directly (area of direct influence) or indirectly (area of indirect influence) affected by the environmental impacts of an activity.

The **Area of Direct Influence (AID)** (see Figure 1.2) of the activity was defined as the entire area that will be subject to the interventions of the construction and operation phases of the Project, that is, the area that will be subject to the direct impacts of the construction of the Wind Power Plant.

Although it is estimated that a very restricted area (wind turbine site, roads (new and to be rehabilitated/extended), and the site of the command building/substation) will be occupied by the Project, a comprehensive area of 855.12 ha has been defined and will be subject to a detailed assessment, with a view to the possibility of studying different alternatives within this area. In other words, it is assumed that the AID is within this wider area.

Therefore, the following areas are included as study areas, which encompass, with a margin of safety, the following areas:

- The areas that will be intervened for the execution of the various infrastructures that integrate the Project;
- The locations where supporting infrastructure will be built, such as construction sites and accommodation for workers (if applicable), parking and manoeuvring area for vehicles and machinery to be used during the construction phase, storage areas for materials (warehouse or open-air).

In addition:

- Lanes along which the definitive accesses will be opened, to be built or along the accesses to be rehabilitated / extended;
- Areas subject to traffic that will increase during the construction phase (accesses); and
- Areas where local populations may be more or less affected during the execution of the works or, subsequently, during the operation of the Project.

In turn, the **Area of Indirect Influence (AII) of the Project** is considered to be the entire region beyond the limits of the areas under direct effects of the Project, but within which its indirect impacts may be felt.

Thus, it was considered that, from a socio-economic perspective, the area that will benefit from the supply of energy produced by the wind farm is defined as an AII. It is also considered as an AII the area that will benefit from the need and presence of human and material resources allocated to the enterprise, and it is expected that this effect, which will be felt at the level of Maputo Province, but with greater intensity at the level of Namaacha District, may manifest itself in various ways (e.g. development of small and medium-sized enterprises to support the Project; migration in search of employment opportunities, trade in food products). Landscape impacts will also be felt in the surrounding region due to the presence of the wind turbines.

There is also, in an even broader perspective, the contribution of the Project to the fight against climate change, which will be felt on a global scale.

The characterisation of the study area was based on the analysis of cartography and aerial photography, bibliographic research and analysis; information provided by entities, and field reconnaissance work aimed at confirming certain factors or areas of particular importance.

The notion of time, which is more difficult to manage in a discretised and defined way, was dealt with on the basis of time horizons marked by concrete events that individualise periods with specific functional characteristics - construction and operation phase - and which coincide with short and medium/long term horizons.

4.3 EIA STRUCTURE

The EIA consists of two volumes, namely the Technical Report presented in this volume and a volume with the Non-Technical Summary. The Environmental Management Plan (EMP) is also attached to this report. This Report consists of 16 chapters, the generic contents of which are described below.

CHAPTER 1 - INTRODUCTION, which introduces the study, identifies the project and the stage it is at, identifies the licensing authority or the competent authority for authorisation.

CHAPTER 2 - IDENTIFICATION OF THE PROPONENT AND THE TEAM RESPONSIBLE FOR THE ELABORATION OF THE EIA, which presents the proponent of the Project as well as the environmental consultant and the respective team responsible for the Environmental Impact Study and the period of preparation thereof.

CHAPTER 3 - LEGAL FRAMEWORK, which presents the legislation that directly and indirectly may influence the development of the EIA, as well as the framework process of the EIA process, referring that in case of omission of Mozambican legislation, or whenever more restrictive, the rules of the IFC / World Bank are considered.

CHAPTER 4 - GENERAL ASPECTS OF THE EIA METHODOLOGY, which corresponds to this Chapter, includes the definition of the study area (area of direct influence (AID) and area of indirect influence (AII) where the location and general design of the Project are described, highlighting the main aspects related to potential environmental interactions. related to potential interactions in the environment. It presents the general aspects of the EIA methodology and its structure.

CHAPTER 5 - RATIONALE AND OBJECTIVES OF THE ACTIVITY, which presents the justification for the need for the project, the objectives of the project and its main components, the rationale for the size, technology and characteristics adopted, the framework of the project in relation to the territorial management instruments, the identification of sensitive areas and the justification for the absence of project alternatives.

CHAPTER 6 - DESCRIPTION OF THE PROJECT describes the location and general design of the Project, highlighting the main aspects related to potential interactions with the environment at the various stages of its development and throughout its lifetime, namely, construction, operation/functioning and decommissioning/conversion.

CHAPTER 7 - DESCRIPTION OF THE CURRENT STATE OF THE ENVIRONMENT, characterises the current state of the environment by considering the environmental factors likely to be affected and the interrelationship between them.

CHAPTER 8 - EVOLUTION OF THE STATE OF THE ENVIRONMENT WITHOUT THE PROJECT, which assesses what the prospects are for the Project site if the Project is not realised.

CHAPTER 9 - IDENTIFICATION AND EVALUATION OF ENVIRONMENTAL IMPACTS, which identifies the impacts of the project, analyses the potential cumulative impacts, prioritises the impacts identified, describes the measures and techniques planned to avoid, reduce or compensate for negative impacts and to enhance any positive impacts, the environmental factors to be monitored are identified, as well as potential studies to be carried out at later stages and the constraints on the development of the project

CHAPTER 10 - RISK ANALYSIS identifies the main environmental risks associated with the Project.

CHAPTER 11 - MINIMISING MEASURES describes the measures and techniques envisaged to avoid, reduce or compensate for negative impacts and to enhance any positive impacts, identifies the environmental factors to be monitored and also identifies potential studies to be carried out at later stages and the constraints on the development of the Project.

CHAPTER 12 - ENVIRONMENTAL MANAGEMENT PLAN, which sets out the monitoring programmes to be carried out and the guidelines for the environmental management plan which is also presented in this EIA.

CHAPTER 13 - PUBLIC PARTICIPATION, which presents the results of the public consultations carried out as part of the EIA process.

CHAPTER 14 - INFORMATION GAPS presents the gaps identified and their influence on the assessment carried out.

CHAPTER 15 - CONCLUSIONS, summarises the main findings of the Study carried out.

16 – BIBLIOGRAPHY.

These Chapters ensure a complete analysis of all relevant descriptors, and the further analysis of these descriptors is based on the discussion of the scope, which is presented in Chapter 4.4. It should be noted that some of the technical evidence supporting the analysis of the various environmental factors is documented in the Annexes.

The **Environmental Management Plan (EMP)**, attached (Annex 5) to this Report, will include all minimisation measures, the different impact monitoring programmes, environmental education, communication, contingency and risk management.

4.4 SCOPE DEFINITION

An important requirement for the correct development of the analysis to be carried out in an EIA is the definition of its scope, i.e. the areas of analysis to be covered and, above all, its degree of depth, depending on the type of impacts induced by the Project, the specificity and sensitivity of the environment that will host it.

Although the fields of study, as well as the aspects to be included in the analysis, are identified and also contemplated in the applicable legislation, it is important to recognise, in defining the scope of this work, which environmental descriptors deserved particular care and, consequently, greater depth.

The objective of the EIA is to identify, characterise and assess the environmental impacts resulting from the Central Eléctrica da Namaacha, SA in order to implement minimising/compensatory measures of the significant negative impacts detected, so as to obtain the good environmental framework of the Project being analysed.

4.4.1 Project Actions

The main actions potentially generating environmental impact will be grouped into the following phases:

- Project Construction;
- Project Operation and Maintenance;
- Project decommissioning/reconversion.

The actions/interventions identified in each of the phases are as follows:

- Project Construction (Photos 4.1 to 4.4 represent the construction aspects of a wind turbine):
  - Movement of persons, machines and vehicles assigned to the works;
  - Transport of various construction materials (concrete, gravel, tout-venant, among others);
  - Site installation and utilisation;
  - Construction of the Control/Substation Building;
  - Rehabilitation of existing paths and opening of new paths to access the wind turbine site from Namaacha (deforestation/stripping, removal and storage of topsoil, excavation/earth moving/compaction), execution of drainage system (construction of drainage ditches and hydraulic crossings), and paving (gravel and tout-venant);
  - Temporary storage of earth and materials resulting from excavations (gravel, rock, vegetable soil, among others);
  - Opening of the trenches for the installation of the electrical and communications cables for the interconnection of the wind turbines to the Power Plant Substation, installation of the cables, and closing of the trenches;
  - Opening the trenches for the foundations of the wind turbine towers;
  - Concreting the foundation masses of the wind turbine towers;




Fotografias 4.1 a 4.4 – Aspectos da construção de uma Central Eléctrica Eólica

- Execução das plataformas para montagem dos aerogeradores;
- Transporte e montagem dos aerogeradores (torre, cabine e pás); e
- Requalificação ambiental das zonas intervencionadas.

- Exploração e Manutenção do Projecto:
  - Presença dos aerogeradores;
  - Presença do Edifício de comando/subestação;
  - Presença dos caminhos;
  - Funcionamento dos aerogeradores;
  - Manutenção e reparação de equipamentos, dos caminhos e do sistema de drenagem; e
  - Produção de energia eléctrica.

- Project Decommissioning:
    - Dismantling of wind turbines;
    - Demolition or conversion of the Control/Substation Building;
    - Removal and transport of materials and equipment; and
    - Landscape restoration.

4.4.2 Areas and depth of analysis

The main objective of the EIA of the Namaacha Power Plant (63 MW) is to assess, characterise and evaluate the environmental impacts resulting from the implementation of the Project, in order to implement measures to minimise/compensate for the significant negative impacts detected, so as to obtain its appropriate environmental and social framework. The definition of the depth of the analysis of the different descriptors depends, as previously mentioned, on the general characteristics of the Project, the sensitivity of the area where it will be located and its area of influence. Thus, and taking into account the characteristics of both the Project and the area of implantation, the descriptors selected as most relevant for the present study were the following:

- **Geology, Geomorphology and Hydrogeology** - The interference of the Project with the local geomorphology was analysed, namely through its potential interference with geological elements of particular interest. This descriptor, taking into account the type of project being analysed and the area of implementation, was considered to be of medium relevance;

- **Surface Water Resources,** insofar as they are articulated and integrated into the drainage system of the study area, functioning as natural receiving media for run-off water. This environmental factor was considered to be of medium relevance;

- **Land Use** - the existing interferences, both in the construction phase and in the operation phase, with the Project, were analysed in order to identify potential changes in terms of uses. This was considered a descriptor of medium relevance given the spatial interference that the Project will imply;

- **Ecology/biodiversity (Fauna, Flora and Habitats)** - potential areas of special interest were analysed, including habitats relevant to conservation. From the flora point of view, the location and characterisation of the main floristic formations was carried out. In terms of fauna, the characterisation and seasonal distribution of the different species of terrestrial fauna was carried out, namely amphibians, reptiles, mammals and birds. Taking into account the typology of the project, special attention was given to birds and bats. In the case of birds, the movements of species relevant to conservation in the study area were also mapped. As for bats, activity data were collected at height and at ground level, and potential shelter sites were also prospected in the surroundings of the study area. This descriptor was considered of high relevance, which is justified by the location of the area and the typology of the project under analysis. An ecosystem service analysis was also carried out;

- **Heritage** - As there are no significant references to archaeological heritage and relevant cultural heritage in the study area, this descriptor is considered to be of low relevance;

- **Society and economy** - This type of project always has two important effects at the socio-economic level: on the one hand, they are projects that generate wealth at the level of municipalities and populations in general, but on the other hand, they are not always consensual in terms of their acceptance by the populations, as they potentially affect current uses of space and resources in the area. It was considered a descriptor with high relevance;

- **Sound Environment** - Since this is a type of project that generates noise permanently throughout the operation phase, given the location and characteristics of the Project, this descriptor was considered to be of high relevance;

- **Landscape** - The modification of land use patterns will inevitably give a new biophysical and visual reality to the landscape, especially during the exploration phase. The aspects associated with the change in the characteristics of the intervention site were analysed in a clear and concise manner. Landscape was recognised as a highly relevant descriptor in this study;

- **Waste Management** - Taking into account that a project of this nature involves the production of significant amounts of waste for the construction of the Project, it will be necessary to provide a set of measures that allow an adequate management of the same waste produced, it is considered as a descriptor of medium environmental relevance in this study;

- **Climate and Climate Change** - Although no appreciable impacts on climate from the Project are expected, aspects related to potential change in local and regional meteorology have been analysed. Issues related to climate change and the contribution of the Project in this regard are also assessed. This environmental factor is therefore considered to be of low relevance to the overall assessment of the Project;

- **Air Quality** - Since, although no significant impacts are expected during the construction phase, when carrying out the planned activities, this environmental factor is therefore considered to be of low relevance for the overall assessment of the Project. It should be noted, however, that this environmental factor assumes greater relevance during the operation phase of the Project resulting from the indirect positive impacts arising from the use of renewable energy to the detriment of energy using fossil fuels and the emissions of air pollutants that result from it.

5 RATIONALE AND OBJECTIVES OF THE ACTIVITY

5.1 FRAMEWORK FOR THE ACTIVITY IN MOZAMBIQUE

In Mozambique, the potential for utilising wind energy, even on a small scale, is considerable and substantial in terms of replacing fossil fuels.

The success of wind farms as a renewable energy source is related to their technological reliability, low maintenance costs and, above all, their balanced relationship with the environment, where environmental impacts are generally low.

The following are some favourable factors for its development:

- Lack of fuel transformation, and appreciable energy consumption;
- Low waste generation in the operation phase;
- Reduced environmental impact compared to other non-renewable energy sources.

Compared to a thermal power plant, energy production by wind farms does not cause any emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_2), carbon dioxide (CO_2), particulates, slag and coal ash (if the fuel is coal).

This project is part of the environmental and energy policies advocated not only in the country, but also worldwide, in order to enable the fulfilment of international commitments, in particular those related to the limitation of Greenhouse Gas (GHG) emissions, with special emphasis on the targets established in the Paris Agreement, and resulting from the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21), signed by Mozambique on 22 April 2016.

There is no doubt that the promotion of renewable energies assumes particular importance in this international context, taking into account the objectives and targets to which the country is committed, with a view to progressively reducing external energy dependence, as well as reducing the carbon intensity of its economy.

The valorisation of renewable energies and the promotion of improved energy efficiency are fundamental instruments and unavoidable options, in order to make it possible to fulfil the commitments made.

In 2009, the Government of Mozambique, aware of the importance of promoting renewable energy as a way of contributing to the fight against climate change, approved the New and Renewable Energy Development Policy, establishing as one of the strategic priorities for implementation the assessment of new and renewable energy resources. In this context of resource assessment, the Policy and, subsequently, the New and Renewable Energy Development Strategy, approved in 2011, established as measures to be developed, namely, the mapping of hydro, wind, solar, biomass, geothermal and maritime potential, as well as the identification and mapping of the places of occurrence. It is in this context that the Atlas of Renewable Energies of Mozambique emerges, which responds to one of the strategic priorities defined in the Policy and Strategy of the Government of Mozambique.

According to the Energy Sector Strategy (approved by Resolution 10/2009 of 4 June), in Mozambique "*the existing potential for electricity generation, estimated at 12 000 MW in the hydro component, corresponding to 60 000 GWh/year, equivalent to 216 000 TJ/year, plus 500 MW based on natural gas and 5 000 MW on coal, is quite high. However, it will take some time for electricity to replace biomass fuels because the country is large and rural population centres are scattered. Currently only 13.2% of the population has access to electricity. However, the country is aiming for a set of energy solutions that take into account this concrete reality, which include the intensification of electricity use in areas served by the national grid and, in remote areas, hybrid solutions using sustainable biomass, solar, wind, hydro resources.*"

The strategy also states that "*The current situation characterised by a power deficit in the SADC (Southern African Development Community) region of around 4 000 MW, combined with the expected socio-economic growth, indicates the need for an additional 1 200 to 2 000 MW per year, which is a motivating factor for Mozambique to expand its production capacity for the domestic market and for export. The power generation plan has to fulfil the growing domestic needs and promote exports to the regional market, in particular within the Southern African Power Pool (SAPP)*".

In this sense, one of the most relevant policy guidelines for the energy area is the "*dissemination of new and renewable energies*". To this end, the Strategy for the Energy Sector foresees the realisation of "*a Production Master Plan focused on meeting the needs of the evolution of the national load, which favours the use of renewable hydro, solar, wind and biomass energies*".

At the resource level, as can be seen in the Atlas of Wind Potential of Mozambique (framed in the Atlas of Renewable Energies of Mozambique), the National Territory has a medium-low intensity wind regime with speeds predominantly between 4 and 6 metres per second at 80 metres altitude, with the exception of the southern part of the country and the high areas in the Centre and North of the country where the winds reach higher values. The greatest wind potential is found in the provinces of Maputo, Tete, coastal Sofala, Inhambane and Gaza, where the average wind recorded exceeds 7 metres per second.

In Figure 5.1, which presents the wind resource in Mozambique, it can be seen that the area where the installation of the Namaacha Power Plant is planned is one of the areas with the greatest wind potential in the entire National Territory.

The genesis of the Namaacha Power Plant Project is the conviction that wind energy, although it cannot solve all the problems of electricity generation due to its essential characteristic that it only produces as long as there is wind, will nevertheless play a decisive role in the national and international energy context of the future.

According to the map of the power transmission network produced by Electricidade de Moçambique (EDM), shown in Figure 5.2, there is no power generation centre in the region where the Project is located.

In the work carried out to assess Mozambique's potential for renewable energy, in addition to assessing and characterising the potential for electricity production from each of the existing renewable resources, the Project went further, having identified and studied several hundred projects at the level of technical and economic pre-feasibility. In this context, due to its privileged morphology, Montes Libombos was identified as a reference area, even though there are no substations in its neighbourhood with the capacity to receive the energy produced, as shown in Figure 5.3. There is indeed a current capacity identified, but it should be noted that it is obtained by a connection to a substation relatively far from the Project, which requires the implementation of a large project, in order to dilute the cost of installing the power line that will flow the energy produced in it.

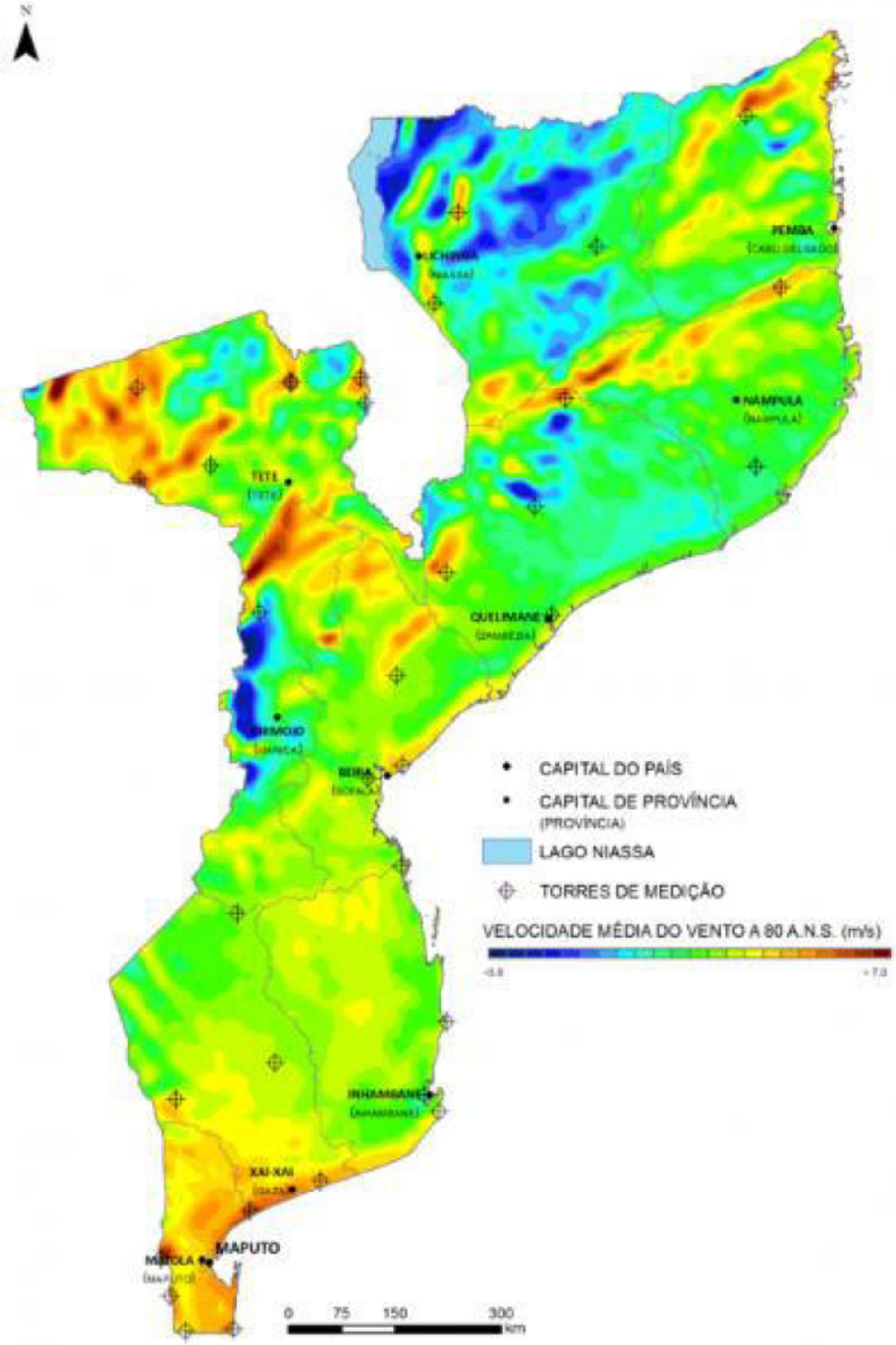


Figura 5.1 – Potencial eólico em Moçambique (Fonte: Atlas das Energias Renováveis de Moçambique).

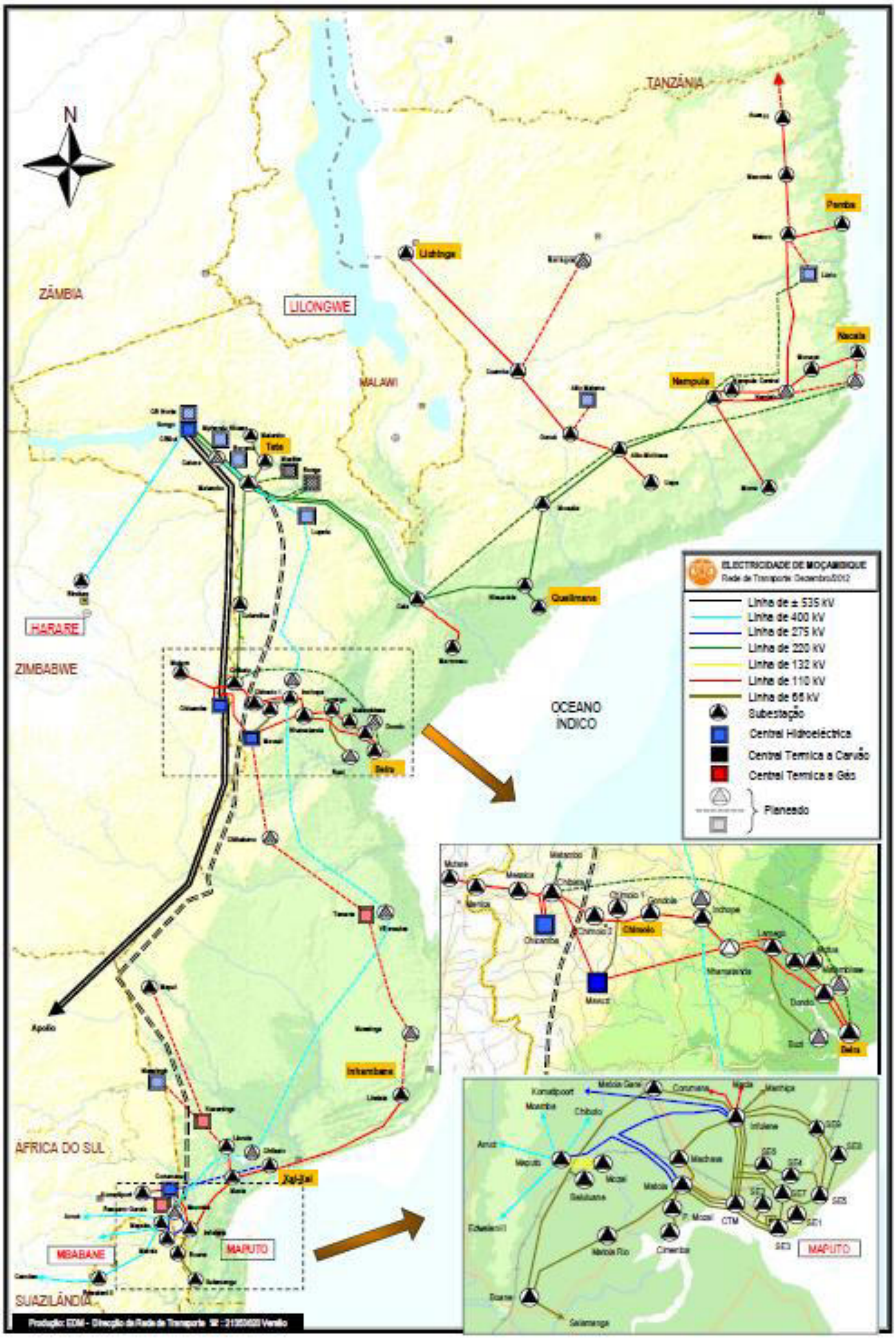


Figura 5.2 – Rede Nacional de Transporte de Energia (Fonte: EDM –s/e)

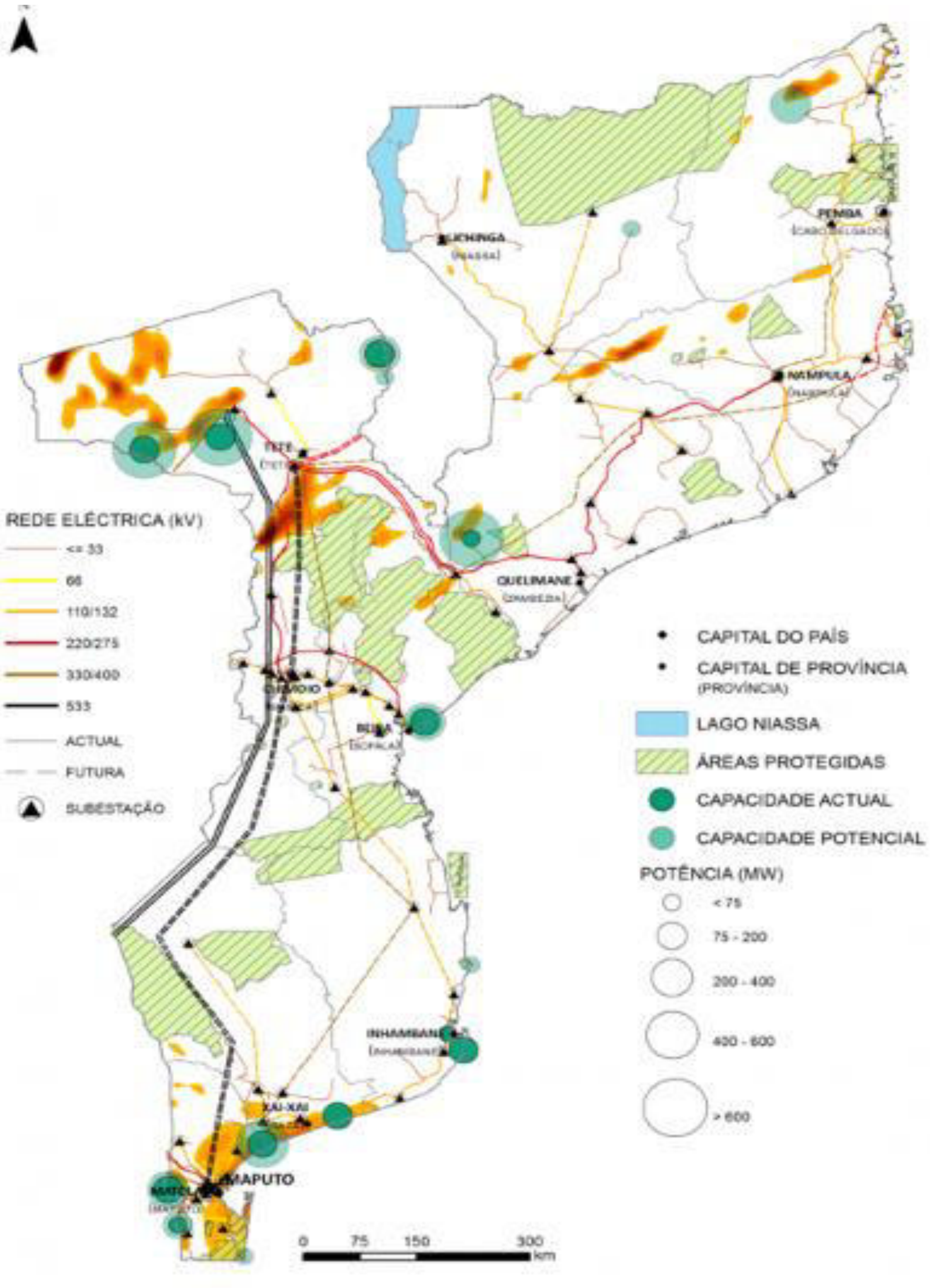


Figura 5.3 - Locais identificados como os mais adequados para desenvolvimento de projectos eólicos (Fonte: Atlas das Energias Renováveis de Moçambique)

5.2 PROJECT OBJECTIVES

The Namaacha Power Plant Project aims to produce electricity from a renewable and non-polluting source - wind, contributing to the diversification of the country's energy sources and to the fulfilment of the commitments established in the environmental and energy policies advocated not only in the country, but also worldwide.

It is also intended to produce and supply the energy needed in the southern region of Mozambique through the national grid for 25 years.

The connection line to the national grid is still being defined and will be the subject of its own Environmental Impact Study.

It is planned to install a total power of 63 MW, with an estimated annual production of around 193 400 MWh.

5.3 CONTRIBUTION TO GHG REDUCTION

The Namaacha Power Plant will have an estimated annual production of 193 400 MWh/year. Producing the same amount of energy (193 400 MWh/year) in a "conventional" way would require an annual coal consumption of about 52 626 tonnes or 30 187 million cubic metres of natural gas.

By estimating emissions, it can be said that the Project's planned farm will contribute to the non-emission of about 65,350 tonnes of CO_2 into the atmosphere per year, when compared to the equivalent energy production using natural gas, or to the non-emission of about 154,658 tonnes of CO_2 per year, considering that the fuel used would be coal.

5.4 SUMMARY OF THE ENVIRONMENTAL BENEFITS OF THE PROJECT

In Mozambique, the potential for utilising wind energy, even on a small scale, is considerable and substantial in terms of replacing fossil fuels.

The success of wind farms as a renewable energy source is related to their technological reliability, low maintenance costs and, above all, their balanced relationship with the environment, where environmental impacts are generally low.

The following are some favourable factors for its development:

- Lack of fuel transformation, and appreciable energy consumption;
- Low waste generation in the operation phase;
- Reduced environmental impact compared to other non-renewable energy sources.

Compared to a thermal power plant, energy production by wind farms does not cause any emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_2), carbon dioxide (CO_2), particulates, slag and coal ash (if the fuel is coal).

6 PROJECT DESCRIPTION

6.1 LOCATION

The Namaacha Power Plant is located in the south of Mozambique, near its border with South Africa and Swaziland, in Montes Libombos, district of Namaacha, Maputo province, relatively close to the urban settlement of Namaacha village.

Maputo province is the southernmost of Mozambique's provinces. It is bordered to the north by the province of Gaza, to the east by the Indian Ocean and the city of Maputo, to the south by the South African province of KwaZulu-Natal and to the west by Swaziland and the Mpumalanga province of South Africa.

Namaacha district, which is located in the Centre Interior part of Maputo Province, is bordered to the North by Moamba district, to the West by South Africa and Swaziland, to the South and South East by Matutuíne district and to the East by Boane district. The district headquarters is in the village of Namaacha. The Project Area (AID) is outside the area of the municipality of Namaacha.

Figure 1.1 shows the framework and location of the Project at various scales (national and regional) and Figure 1.2 shows the Project site on a digital orthophoto at a scale of 1:25 000.

The proposer already has a DUAT which is presented in Annex 2.

6.2 ACTIVITY DESCRIPTION

6.2.1 Overall Project Composition

The Namaacha Power Plant, which aims to produce electricity from a renewable and non-polluting source - wind, consists of the installation of 15 wind turbines with a unit power of 4.2 MW, in the vicinity of the village of Namaacha, with a total power of 63 MW.

The location of the connection of the Power Plant to the electricity grid has not yet been defined. Two connection options are being studied, one to the Boane substation (66 kV) and the other to the Belulane substation (275 kV). The choice of the substation to be connected will result from grid connection studies to identify the best location for this connection.

From a technical point of view, the project consists of the following structural elements: wind turbines, internal electrical cable network (underground), access and control building/substation.

Table 6.1

Number of wind turbines, length of cable trays and trenches

Number of wind turbines	Cable trays to be built (m)	Cable trays to benefit (m)	Cable trenches (m)
15	9 136	5 192	14 328

Most of the equipment that makes up the Wind Power Plant is expected to arrive in Mozambique by sea, the nearest port of reference to the Project being the Port of Maputo. From this point, the equipment will be transported by lorries to the Project site. The planned route will be via the EN2 from Maputo through Boane to the village of Namaacha. This road, which is a privileged access route to the border post (border with Swaziland), has characteristics suitable for the transport of materials and equipment necessary for the installation of the Project, and no intervention is foreseen on it

The following is a summary description of each of these elements:

6.2.1.1 General characteristics of a wind turbine

A wind turbine has the following basic constitution:

- Tower;
- "Nacelle" or Cabin;
- Generator set;
- Mechanical and primary drive systems;
- Three wing profiles forming the rotor blades;
- Control, regulation, braking and safety systems;
- Electrical installations;
- Other equipment and accessories necessary for its proper functioning.

The wind turbine basically consists of a conical tubular structure, which supports at the top a unit called a cabin or nacelle, inside which the equipment is housed, including the generator, which is driven by a rotor consisting of three blades. Figure 6.1 shows the appearance of a wind turbine.

The turbine shaft drives a generator, installed inside the cabin, also installed on top of the tower, consisting of a steel structure with a fibre fairing.

The tower consists of a conical tubular structure made up of three steel sections with corrosion protection. The height of the tower, measured at the rotor axis, is 105 metres. The top of the tower houses the generator set, the multiplier box and various complementary equipment.

At the base of the tower, inside, there will be the transformer station.

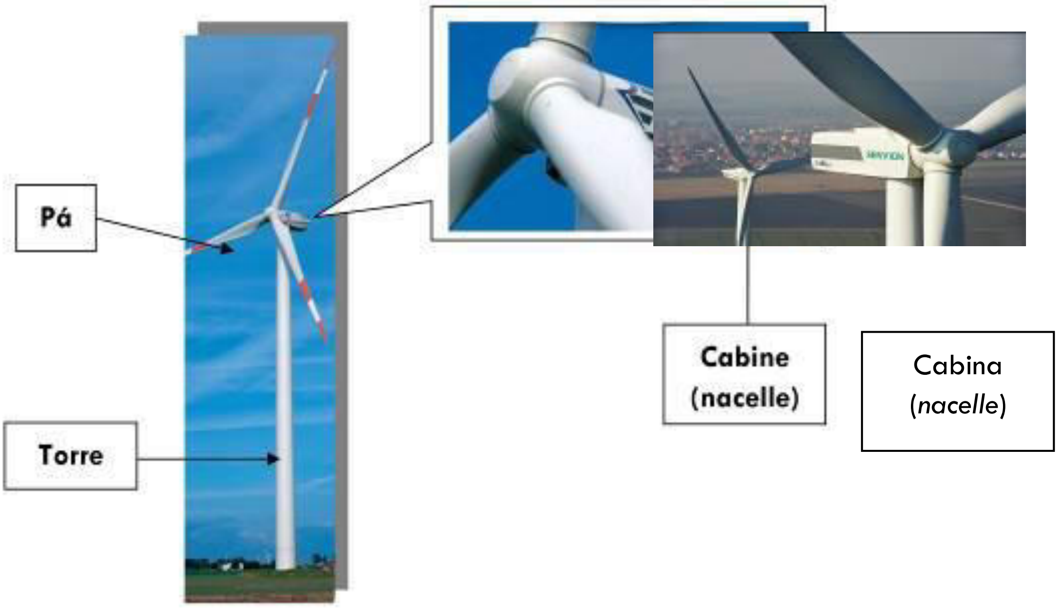


Figura 6.1 – Constituição principal de um aerogerador (Fonte: Senvion)

A cabina será apoiada em base móvel, através de rolamentos, que lhe permite a orientação adequada à direcção do vento, comandada por um sistema de controlo de posição e accionada por motores eléctricos. Os sistemas de medida meteorológica, afectos aos sistemas de regulação, designadamente cata-ventos e anemómetros, instalados no exterior das cabinas serão equipados com dispositivos contra a formação de gelo, de forma a evitar a avaria ou o mau funcionamento dos mesmos.

Os aerogeradores serão do tipo eixo horizontal, de 3 pás e potência unitária de 4,2 MW.

Quanto a dimensões, a torre terá uma altura de 105 m (altura do veio ao solo) com um diâmetro de rotor de 150 m.

Na base de uma torre está prevista uma porta que dá acesso a uma escada que permite subir a torre pelo interior, protegido contra as intempéries. Esta escada é dotada de um sistema de protecção. Cada segmento da torre está equipado com plataformas e iluminação de emergência.

A energia eléctrica produzida pelos aerogeradores é conduzida para o seu posto de transformação onde será elevada para a tensão nominal da rede eléctrica interna do parque (33 kV).

As características gerais dos aerogeradores previstos a instalar são as indicadas no Quadro 6.2.

Table 6.2

General Data of the Wind Turbines (Tower, Turbine and Generator)

Position of rotation axis	Horizontal
Height of rotation axis	105 m
Rotor diameter	150 m
Number of blades	3
Maximum turbine power	4,2 MW
Wind speed for rated power	7,5 m/s (Class II)
Start-up wind speed	3m/s
Stopping Speed	22,5m/s
Generator type	DFIG

The main types of materials that make up a wind turbine are: Polyester resin reinforced glass fibre (blades); Polyester resin reinforced glass fibre coated steel (cab); Carbon steel, galvanised/metallised and painted with anti-corrosion paint (tower).

The aim is to minimise the visual impact of wind turbines by painting their components in a colour that allows them to be integrated into the landscape as far as possible and by taking care to avoid an excessive percentage of paint gloss, opting for colours suitable for this purpose. According to international experience, practically all wind turbines that have been installed, at least in the last 10 years, are painted with dull paint (matt paint), with a colour that generally corresponds to an off-white grey.

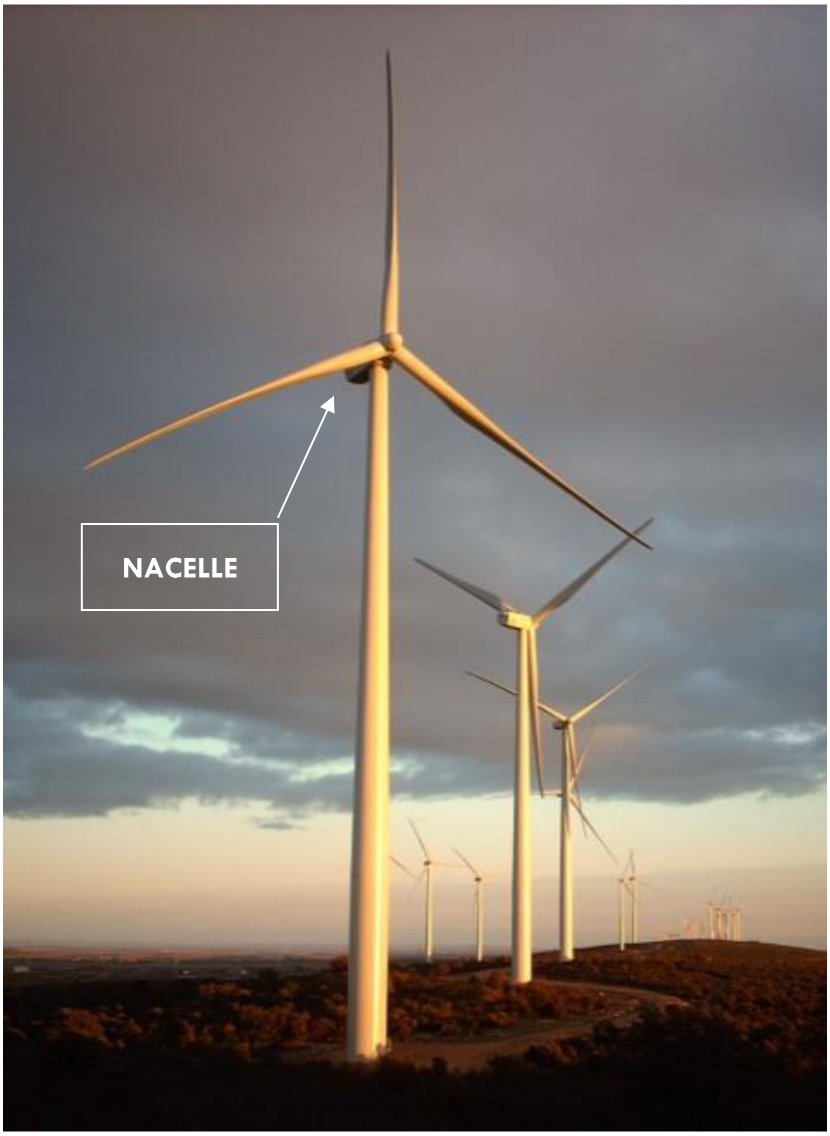


Figure 6.2 - Aspect of a wind power plant similar to the one planned (Source: Senvion)

6.2.1.2 Platform for wind turbine assembly

For the assembly of the wind turbines, it is planned to build a platform next to the foundation of each wind turbine, with adequate dimensions, for the parking of vehicles to transport the components of the wind turbines and for the handling of the main components of these, using high capacity cranes.
The platforms executed to assemble the wind turbines (construction phase), in terms of configuration, will be maintained throughout the lifetime of the Project, as it may eventually be necessary to replace some equipment such as wind turbine blades in the later operating phase. However, in the final construction phase, after the wind turbines have been installed, landscape restoration work will be carried out on these platforms in order to minimise the impact on the landscape and prevent possible erosion (see

Photos 4.5 and 4.6).

Thus, in order to reduce the impact on the landscape, after the wind turbines have been erected, the platforms will be covered with vegetable soil, leaving only an access to the wind turbines and a ring around them with a tout-venant pavement and wide enough for a light vehicle to go around it, and for fire safety reasons, it will not be necessary, under any circumstances, to waterproof the land.

Photographs 4.5 and 4.6 - Example of working platform adjacent to a wind turbine, on the left during the assembly phase and on the right after landscaping

6.2.1.1 Internal Electricity Network

The cable network will interconnect the towers, through the respective transformer substations (PT), with a radial configuration, connecting the wind turbines to the substation.

These cables will be installed in trenches to be developed, in the initial sections along the accesses planned to be built for the installation of the wind turbines, as well as along the accesses planned to benefit up to the substation to be built.

6.2.1.1 Access roads

In the general case of the construction of a wind power plant, two distinct situations must be considered in this context: one is the access to the areas where the wind power plant is located from national/municipal roads, and the other is the paths in the area affected by the wind power plant for access to the various infrastructures and equipment that make up the wind power plant, namely the wind turbines and the control building/substation.

In any case, the size of the components of the wind turbines to be transported and the material means to be moved, in particular cranes, recommend the need for access roads to be free of steep slopes, of adequate width and free of curves of tight radius.

Access to the ridge where the Namaacha Power Plant will be located will be from the village of Namaacha. Within the Wind Power Plant, access to the wind turbine sites will be realised, whenever possible, through existing paths. The existing paths will be widened to allow the passage of the necessary equipment. From these paths, new access roads will be built to allow access to the wind turbine site.

The access roads will have the accessibility characteristics that are necessary to ensure during the construction phase and during the lifetime of the project for maintenance actions. The geometric characteristics of the route of the paths vary fundamentally according to the type of use and orography of the terrain on which they will be implanted.

Aggregates left over from earthmoving will be used for the construction of the wind turbine mounting platforms or for the attenuation of depressions in the longitudinal layout of the new paths.

The existing and planned paths are shown in Figure 1.2.

6.2.1.2 Control building/substation:

The Namaacha Power Plant will have a control building and an attached substation. The control building will house all the control and protection devices, and will also have areas for offices, storage and sanitary facilities. The building will be of simple construction (see Figure 6.3).

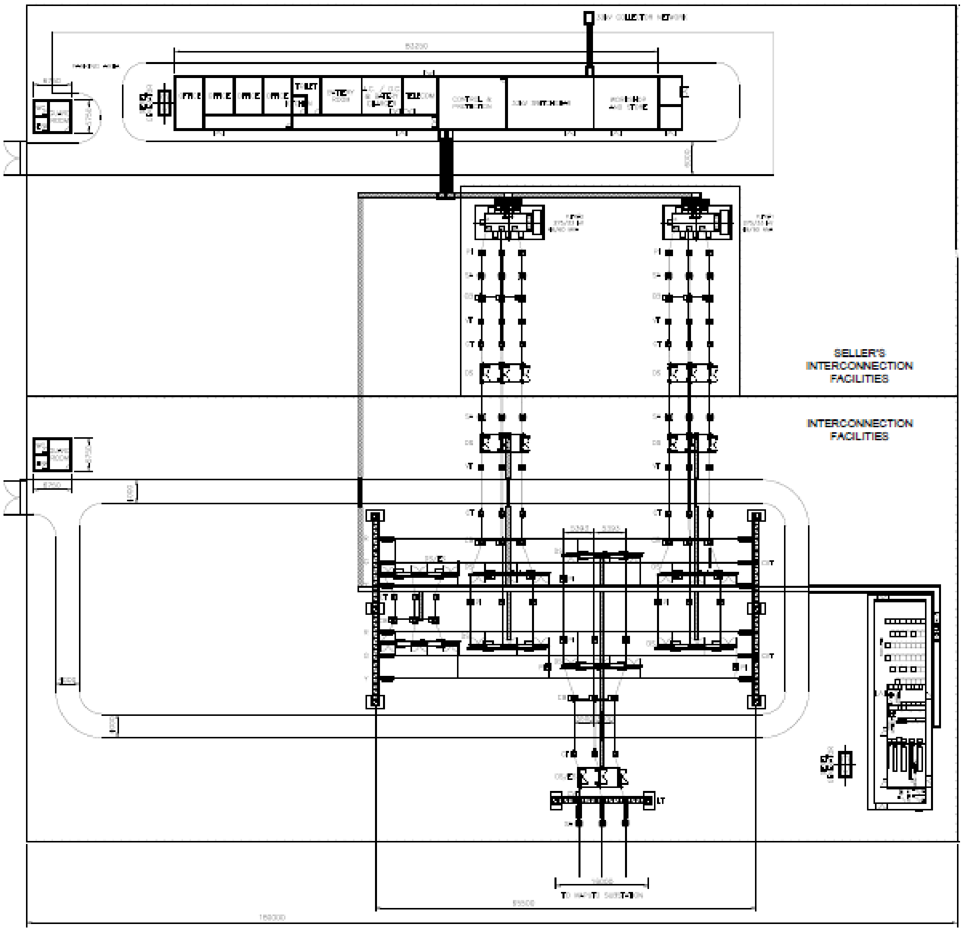


Figure 6.3 - Control Building/Substation Layout.

The Namaacha Power Plant will not be fenced, but only a fence around the control building/substation is foreseen for safety reasons.

6.2.1.1 Earth moving

The overall earthmoving required for the implementation of the various components of the Project will be around 22 800 m^3.

6.3 PROJECT PROGRAMMING

Construction of the Project is expected to commence in the third quarter of 2021 and construction will last for 15 months.

The planned operating phase ("lifetime") of the Power Plant Project is 25 years.

6.4 OVERALL INVESTMENT

The planned investment for the first phase of the Namaacha Power Plant is about 110 million dollars estimated at 8,122,400,000.00 Meticais with the indicative exchange rate of 1 USD = 73.84 Meticais.

6.5 CONSTRUCTION PHASE

6.5.1 Introduction

During the construction phase, it is recognised that the following impact-generating actions will need to be carried out, Photographs 6.1 to 6.4 show some aspects of the construction of the power plant:

- Movement of persons, machinery and vehicles assigned to the works;
- Transport of various materials for construction (concrete, gravel, tout-venant, among others);
- Site installation and utilisation;
- Construction of the control building/substation;
- Rehabilitation of existing paths and opening of new paths for access to the wind turbine site from Namaacha (deforestation/stripping, removal and storage of topsoil, excavation/earth moving/compaction), execution of drainage system (construction of drainage ditches and hydraulic crossings), and paving (gravel and tout-venant);
- Temporary storage of earth and materials resulting from excavations (gravel, rock, vegetable soil, among others);
- Opening of the trenches for the installation of the electrical and communications cables for the interconnection of the wind turbines to the Wind Power Plant Substation, installation of the cables, and closing of the trenches;
- Opening of the trenches for the foundations of the wind turbine towers;
- Concreting the foundation masses of the wind turbine towers;




Photos 6.1 to 6.4 - Construction aspects of a wind power plant

- Execution of the platforms for the assembly of the wind turbines;
- Transport and assembly of wind turbines (tower, cabin and blades); and
- Environmental regeneration of the intervened areas.

6.5.2 Site Installation

For the construction of the Namaacha Power Plant, only one construction site will be required, with an area of approximately 600 m^2, to be located between the T7 and T8 wind turbines (see Figure 1.2). This location can be changed on site provided that this change is authorised by the environmental monitoring team.

The area allocated to the construction site (600 m^2) includes, in addition to support containers, an area for the temporary storage of various materials, such as waste and aggregates, and a parking area for vehicles and machinery assigned to the work.

The construction site and any additional support areas will be decommissioned at the end of the construction phase. All the intervened areas will be completely cleaned and subsequently naturalised, in accordance with the minimisation measures presented in the corresponding chapter.

6.5.3 Civil engineering works

In order to connect the wind turbines to the substation, trenching is required for the installation of the electrical cables and the control and command cables necessary for the operation of the wind turbines (see Photos 6.5 and 6.6).

Photos 6.5 and 6.6 - Example of trench for electrical cable installation.

The execution of the foundations of the wind turbines presupposes the execution of excavations and concreting and is carried out in stages as shown in the set of photos.

In the case of the Project under analysis, the masses for the foundations of the towers will be identical to what is shown in the following set of photos.

After the execution of the wind turbine foundation masses, the working platforms are prepared for their assembly. For this purpose, it is necessary to remove vegetation and the live soil layer, if applicable, and to regularise the pavement, using the material left over from the opening of the pit for the execution of the foundation masses.

Photos 6.7 and 6.14 show a platform for mounting a wind turbine (on the left, during the construction phase, on the right, the same platform after landscaping).

Photos 6.7 to 6.12 - Example of wind turbine tower foundation execution.

Photos 6.13 and 6.14 - Working platform adjacent to a wind turbine, on the left during the assembly phase and on the right after landscaping

Civil works will also be carried out on the building including the control building/substation (see Figure 6.3).

The following area of intervention is projected for the construction of the control building/substation:

- Area to be waterproofed: 2,25 ha.

6.5.4 Wind turbine assembly

Once the working platforms have been completed, it is possible to start assembling the wind turbines themselves, for which it is necessary to use cranes, as already mentioned, of the type shown in Photos 6.15 to 6.16.

Photos 6.15 to 6.16 - Example of occupying a platform for wind turbine assembly.

The towers are prefabricated and transported to the site in sections. They will also be assembled (see photos 6.17 to 6.21) using cranes which will be transported to the site.

The cabins are then transported and assembled, with the necessary equipment inside, and the blades on top of the towers.

Photos 6.17 to 6.21 - Example of wind turbine tower assembly

6.5.5 Substation Construction

All equipment and building will follow national and international standards and will be equipped with:

- Medium Voltage Switchgear;
- Power Transformer (Auxiliary Services);
- Auxiliary Services Transformer;
- Auxiliary Services Board;
- Control Board.

The following equipment will also be outside the building following national and international standards:

- High Voltage Apparatus;
- Measuring Equipment.

A building will also be constructed around the Substation.

The substation building is expected to use chemical toilets, with watertight tanks for the effluent generated. This will be equipped with an automatic fire detection and extinguishing system. The detection centre is programmable to process the information from the detectors. A security system will be installed to detect intrusions from the central station.

The output will be aerial, on the High Voltage network.

6.5.6 Effluents, waste and emissions

In Mozambique, the Constitution of Republic and Law No. 20/97 of 1 October - Environment Law *grants all citizens the right to live in a balanced environment as well as the duty to defend it* (MICOA, 2012).

In this sense, Decree No. 13/2006 of 15 June was published - Regulation on Waste Management, which in its article 7 states that all entities, public or private, which carry out activities related to waste management, must prepare a waste management plan for the waste they manage.

This Decree states that, in matters of waste management, it is the responsibility of:

- The Ministry for the Coordination of Environmental Action (MICOA) to issue and disseminate mandatory rules on the procedures to be followed in the field of waste management; to carry out environmental licensing of waste storage and/or disposal facilities or sites; to monitor compliance with the provisions of this Regulation as well as the rules on waste management; to ensure public participation in the licensing process, as well as access to relevant information on waste management.

- Municipalities, in the areas under their jurisdiction, approve specific rules on waste management; set tariffs for the provision of services to the public through their own means, namely in the field of waste collection, deposit and treatment; Approve procedures for the removal, treatment and deposit of solid waste, including hospital and toxic waste; Licence establishments engaged in the management of hazardous or toxic waste.

With regard to emissions and effluents, the Regulation on Environmental Quality Standards and Effluent Emission provided for in Decree No. 18/2004 of 2 June, as amended by Decree No. 67/2010 of 31 December, stands out. This regulation defines the environmental quality and effluent emission standards for receiving water bodies, technologies, systems and treatment methods. It regulates the disposal of industrial effluent liquid into the receiving environment, which must be carried out through an appropriate organisation. The final effluent must be discharged in compliance with certain emission or discharge standards. This requires that the location of the discharge or emission point be determined during the environmental licensing process so that there is no change in the quality of water in the receiving body.

In the case of the Namaacha Power Plant, the developer will be responsible for managing the waste and effluents produced, both in the construction phase and in the subsequent operating phase of the project, implementing for this purpose a management plan duly adapted to the activity and the reality of the place where the Project will be located.

The following emissions are expected to be generated from the outset, without prejudice to others being identified in the subsequent EIA phase:

Effluents:

- Waste water from site sanitary facilities; and
- Waste water from concreting, paving and construction operations.

Accidental spills of oils, fuels and related products may also occur, however, provided that the minimisation measures proposed in the EIA are properly implemented, this situation will be avoided.

The following treatments/final destination of the effluents produced are expected from the outset:

- With regard to the sanitary facilities of the construction site, removable sanitary facilities will be used, which, if they drain into a septic tank, will be watertight; and
- For wastewater resulting from construction operations such as concreting operations, retention basins will be created, of a size adjusted to the expected effluents, in strategic locations, so that the sedimentation process is adequate. In the specific case of this project, a retention basin (2 m x 2 m) will be opened next to each wind turbine, and at the end of the foundation concreting, all the material will be incorporated into the respective platform.

Waste:

- Urban solid waste from the construction site;
- Plant debris from land clearing/decapping; and
- Plastics, wood, cardboard/paper, metals, machine oils, lubricants, contaminated waste, electrical and electronic waste, frames, formwork, among other materials resulting from the various construction works.

Temporary storage of waste will be carried out in the designated site areas or in any complementary site support areas.

In terms of surplus aggregates and topsoil, the following is expected:

- The aggregates from the excavations will be fully incorporated into the necessary embankments along the planned paths and on the wind turbine platforms;

- The vegetal soil will be stored next to the intervened areas, in places that are as flat as possible and far from water lines, for later use in the renaturalisation of these areas.

The following final destinations are envisaged for the waste generated:

- Municipal solid waste from the site will be placed in a specific location, suitably prepared to function as a mini-composting plant, and the resulting product can be used as fertiliser for the region's farmland;

- Waste such as plastics, wood, metals, machine oils, lubricants, contaminated waste, electrical and electronic waste, and other products common on any construction site, will be properly conditioned within the site, in specific containers for this purpose, and whenever justified, transported to an appropriate final destination, in accordance with the guidelines that may be stipulated by the environmental authorities; and

- The plant waste resulting from the deforestation/decapping of the land will be crushed and integrated into the plant soil that will be used in the recovery of the areas to be renaturalised.

The Waste Management Plan to be adopted during the construction phase of the Namaacha Power Plant can be found in the Environmental Management Plan (see Annex 5).

Emissions

It is also important to mention the expected emissions, for which no management actions are foreseen, as follows:

- Increase in continuous and punctual noise levels due to the use of machinery and vehicle traffic for transporting people, materials and equipment;
- Dust resulting from excavation operations and the movement of vehicles and equipment; and
- Gases emitted by vehicles and heavy machinery used on site.
- In terms of surplus aggregates and topsoil, the following is foreseen:
- The aggregates from the excavations will be fully incorporated into the necessary embankments along the planned paths and on the wind turbine platforms;
- The vegetal soil will be stored next to the intervened areas, in places that are as flat as possible and far from water lines, for later use in the renaturalisation of these areas.

6.5.7 Landscape restoration of intervened areas

On completion of the works, the areas affected will be restored. Upon completion of the civil works and the installation of the wind turbines, the intervened areas will be landscaped, namely the accesses, the wind turbine installation area, the construction areas of the trenches for the installation of the electrical cables as well as other areas that may eventually be intervened during construction.

The restoration of the intervened areas aims to minimise the impact on the landscape, the re-establishment of native vegetation and the covering of the soil, in turn minimising the erosive action of winds and rains which will be more intense if the soil is left bare.

In the context of landscape restoration, the following actions during the construction phase stand out:

- Deforestation and soil stripping works should be limited to strictly necessary areas, which have been previously marked out. Areas adjacent to the areas to be intervened by the project, even if they can be used as support areas, should not be cleared or stripped;

- The topsoil existing in the areas to be deforested and stripped will, when not immediately reused in the works, be deposited for later use in the areas degraded by the works, and the soils must be protected with impermeable covers, thus avoiding their mobilisation by the wind and erosion and dragging by rainwater;

- The deposit, even if temporary, of waste will be avoided, by ensuring, from the outset, its collection and its proper final destination.

At the end of the works, the following actions stand out:

- Soil decompaction of the areas affected by the works will be carried out;

- The phytosociological characteristics of the region and the soil and ecological conditions will be taken into account in the vegetation restoration actions in the areas affected by the works;

- At the end of the works, all temporary constructions, waste, rubble and other materials will be removed.

The Proposed Recovery Plan for the intervened areas, which integrates the above considerations, is presented in the EMP.

6.5.8 Manpower

It is estimated that the number of workers, among the various Contractors (civil construction, electromechanics, transport team, assembly), Inspection Teams, Owner, among others, is about 250 workers.

6.5.9 Materials and energies used

For the activities involved in the construction phase, it will be necessary to use various types of materials common in construction works, namely concrete, gravel, sand, iron, steel plates, among others.

As far as wind turbines are concerned, the main types of materials that constitute them are:

- Glass fibre reinforced with polyester resin (blades);
- Glass fibre reinforced polyester resin coated steel (cabin);
- Carbon steel, galvanised/metallised and painted with anti-corrosion paint (tower).

The main types of energy used in the construction phase are diesel combustion engines for machinery (vehicles, cranes and caterpillars) and some equipment.

6.6 OPERATION PHASE

6.6.1 Introduction

The operation of a wind power plant is based on the following main actions:

- Presence of wind turbines;
- Presence of control building/substation;
- Presence of paths;
- Operation of wind turbines;
- Maintenance and repair of equipment, paths and drainage system; and
- Electricity generation.

They are fully automatic machines. They are commissioned when the wind speed reaches about 3 m/s and the generator is then connected to the grid.

It is envisaged in the equipment to be selected not only that the rotational speed will be variable, but also that the angle of attack of the blades will also be variable, since the combination of these two factors allows the machine to be highly adapted to the wind speed, maximising the power that the wind turbine can provide.

Wind turbines are equipped with an automatic guidance system. This system tends to align the axis of the system with the direction of the wind in order to obtain the maximum possible power. The movement is done by a crown wheel on a circular gear, through electric motors. O guidance system has its own braking system, consisting of hydraulic disc brakes.

Throughout the operating period, regular maintenance operations are carried out on the wind turbines to repair or replace components.

With undetermined frequency, repairs may be necessary due to fortuitous causes, essentially related to adverse conditions of nature.

6.6.2 Automatic control system

The wind turbines have a control system that allows them to operate fully automatically. There is a control room in the control building where the data from the wind turbines will be transmitted. There will be communications equipment and computer facilities to visualise the information received and process it, not only in terms of operation, but also in terms of archiving, analysis, statistics and issuing commands.

6.6.3 Access roads

The access roads built for the construction and assembly of the Power Plant will be maintained during its useful operating life, and will be improved whenever the conditions of use or meteorological conditions so require.

6.6.4 Foreseeable effluents, waste and emissions

Effluents:

- Oils and related products used to lubricate the various components of the wind power plant.

Waste:

- Replaced parts or pieces of equipment; and
- Materials left over from maintenance (filters, lubricant containers, etc.).

Emissions:

- Noise from traffic associated with the operation of the Project;

- Noise from equipment repair and replacement operations; and
- Noise emitted by the operation of wind turbines.

The collection and disposal of effluents and waste produced during the operation phase will be the responsibility of the company operating the wind power plant, which must ensure that they are transported to an appropriate final destination, in accordance with the guidelines stipulated by the environmental authorities.

6.6.1 Manpower

It is estimated that the operation of the Namaacha Power Plant will create around 20 jobs.

6.6.2 Materials and energies produced

The installation of 15 wind turbines of 4.2 MW unit power is estimated to produce an average annual output of about 193,4 GWh.

6.7 DECOMMISSIONING PHASE

6.7.1 Introduction

Once the useful life of the power plant has been completed (about 25 years), it may be renovated and/or rehabilitated in order to continue operating for a new useful life, or it may be decommissioned and dismantled if the economic conditions of operation, in view of the costs involved, so determine.

Considering the period of useful life, it is difficult to predict the framework that will then exist. Nevertheless, it is foreseeable that a series of operations will be carried out, which will intervene fundamentally at the following levels:

- Dismantling of wind turbines;
- Demolition or conversion of the Control Building/Substation;
- Removal and transport of materials and equipment; and
- Landscape restoration.

The assembly and maintenance platform, because it is not coated or waterproofed, and is expected to receive herbaceous cover over much of its length, is expected to be fully integrated into the surrounding terrain by the time the project is decommissioned.

The constituent elements of each wind turbine will be dismantled and sent to an appropriate final destination. In fact, a large proportion of the basic materials used can be recycled (about 95% of the components of a wind turbine can be recycled). Examples include steel and copper that can be remelted, lubricating oils and oils from hydraulic circuits and transformers that can be valorised. With regard to the wind turbine foundation, since the permanence of this structure does not represent any danger or threat to the surrounding environment, it will not be necessary to remove it, but only to cover it with materials obtained on site.

Lastly, the access roads that run towards the wind turbines will remain. The type of access adopted, without any coating, will suffer a process of degradation over the useful life of the project, possibly delayed by conservation operations that are carried out in the meantime. They may therefore be maintained, if this solution appears to be the most favourable for the population, or they may be renaturalised.

The entire intervention area will be subject to landscape restoration in order to return it to the natural conditions it currently enjoys or, alternatively, to make it compatible with the natural setting that will occur in that time horizon.

Upon completion of the operations described, it is understood that a situation reasonably close to that which currently prevails at the Project site will be restored, with no element remaining in the area that could give rise to any risks to the environment or to the surrounding populations.

In the decommissioning phase the effluents, waste and emissions will be of the same nature as those originating in the construction phase.

6.8 IDENTIFICATION AND CHARACTERISATION OF ALTERNATIVES

6.8.1 Alternatives: Project Phase

Regarding the different Project alternatives, two distinct types can be considered: the zero alternative, and the alternatives of different options to be taken still during the design phase.

Regarding the different options, in this type of project the process of choosing alternatives is somewhat restricted. The installation of a wind turbine results from the possibility of gathering wind resource, on land that can be used to install the necessary equipment, made available for this purpose, and the possibility of interconnection to the public grid to supply the electricity produced. In other words, the entire process leading to the construction of a wind power plant and its associated projects is an iterative exercise of location proposals for wind turbines depending on the wind resource data, the environmental constraints that are identified, the technical restrictions in terms of construction, the availability of areas for the installation of the Wind Power Plant and also, not least, the impact on the financial viability of the project of some of the proposed solutions.

With this underlying framework, and in order to better understand the reasons that lead to the choice of a particular site, it is important to emphasise that, due to the installation costs of this type of project and the costs and revenues of its operation, it appears that the minimum profitability is only achieved in sites where the average annual wind speed is high.

The combination of the factors mentioned above led to the choice of the area planned for the installation of the Project, namely the area identified in Figures 1.1 and 1.2. In the next phase of the EIA, a detailed characterisation of this area will be made, optimising the implementation of the various infrastructures that make up the Project, respecting the constraints identified in the EIA and seeking to minimise the interventions to be carried out.

The study of the "no implementation" alternative - zero alternative - will allow us to understand the evolution of the current situation in the event that the Project under study does not materialise. In this case, other plans for the area where the Project is to be implemented are unknown, i.e. no changes to the current situation are expected. Even so, this will be an aspect to be explored in the subsequent stages of the EIA preparation process.

This Project will bring undeniable environmental benefits from a global perspective, when the Project is seen as a utilisation of a natural, renewable, endogenous energy resource, which contributes to reducing the emission of pollutants responsible for situations such as the greenhouse effect, climate change and acid rain, meeting the requirements of the New and Renewable Energy Development Strategy, as already presented in Chapter 4 of the justification of the importance of the Project. It will also bring social benefits by improving electricity supply, with the consequent benefits arising from this.

From an economic point of view, there are also benefits, not only those arising from the exploitation itself, but also those generated during the construction phase at local level, and at regional level, through the mobilisation of human and material resources associated with the work.

In summary, for the reasons stated above, and knowing the impacts that this type of activity generates, from the outset, it is considered that the **zero alternative** should not prevail, that is, the Project should be implemented, unless elements are identified, to be deepened in the EIA, that induce such significant impacts affecting the quality of the ecological and / or social environment where it is inserted, that make it unfeasible. In relation to the alternatives in the **project phase**, localisation alternatives could be discussed and evaluated for the general solution designed, weighing up the affectation of the ecosystem services present, taking into account, on the one hand, the importance of conserving natural areas, and on the other, the preservation of housing and farms, which from a social point of view are very important. The maintenance of a safeguard distance to sensitive receptors is also a relevant issue, due to the fact that wind turbines produce noise throughout their operating phase, and cause shade in their neighbourhood when the sun is visible, causing discomfort when the rotating blades cut off sunlight, causing a sun/shade flashing effect.

6.8.2 Alternative: Construction Phase

In the **construction phase**, the alternatives relate mainly to options related to the management of the works, namely:

- Site and miscellaneous storage areas;
- Access roads to the works site;
- Origin of materials needed for construction works, such as concrete, tout-venant, gravel, among other materials and raw materials;
- Final destination of waste generated, including that resulting from deforestation operations.

6.8.3 Alternative: Operation Phase

With regard to the **operation phase**, no alternatives with impacts considered significant that merit analysis are identified. Once the solution to be implemented has been chosen, and after its construction, in the operating phase only the appropriate management of waste resulting from exceptional maintenance or repair actions should be noted, for which final destination alternatives will be evaluated.

6.8.4 Alternative: Decommissioning Phase

For the **decommissioning phase**, various alternatives can be adopted, ranging from simple abandonment of the infrastructure, to its complete removal, including demolition of the control building/substation, or conversion of the infrastructure, e.g. by using the control building/substation for other purposes.

7 DESCRIPTION OF THE CURRENT STATE OF THE ENVIRONMENT

7.1 METHODOLOGY USED

The Current State Characterisation is a description of the environment in a given area, which is likely to be changed by the Project under study.

Thus, the general criterion adopted was to develop the characterisation of the affected environment according to the importance of the potential impacts, and the description should be particularly developed for the factors considered relevant and identified as such.

To this end, bibliographical and expert information was used, provided by the knowledge of the experts involved in the different valences under analysis, complemented, in specific terms, by the basic information provided by the Proponent, by the data collected in the field work carried out and by the elements obtained in the context of the consultation carried out with the various entities. The following speciality items were therefore considered for analysis:

- Climate;
- Climate change;
- Geology, geomorphology and hydrogeology;
- Surface water resources;
- Soils and land use capability;
- Land use;
- Ecology;
- Air quality;
- Waste management;
- Sound environment;
- Archaeological, Architectural and Ethnographic Heritage;
- Demography, settlement, society, health and economy;
- Landscape;
- Environmental Risks.

7.2 CLIMATE

7.2.1 Climatological framework

The characterisation of the climate in the project region is based on information from the National Institute of Meteorology (INAM), namely the Precipitation Atlas of Mozambique, the Atlas of Renewable Energy of Mozambique and the Statistical Yearbook 2013 of Mozambique.

The project area belongs to the district of Namaacha, in the province of Maputo, and is located in an area of high altitude, around 500 - 600 m.

According to the Köppen classification, the climate of the project area is Tropical Humid (AW) and modified by altitude. To the north and east, the climate is Dry Steppe (BS). There are two well-defined seasons throughout the year, a warm, high rainfall season between October and April and a cooler, drier season between May and September.

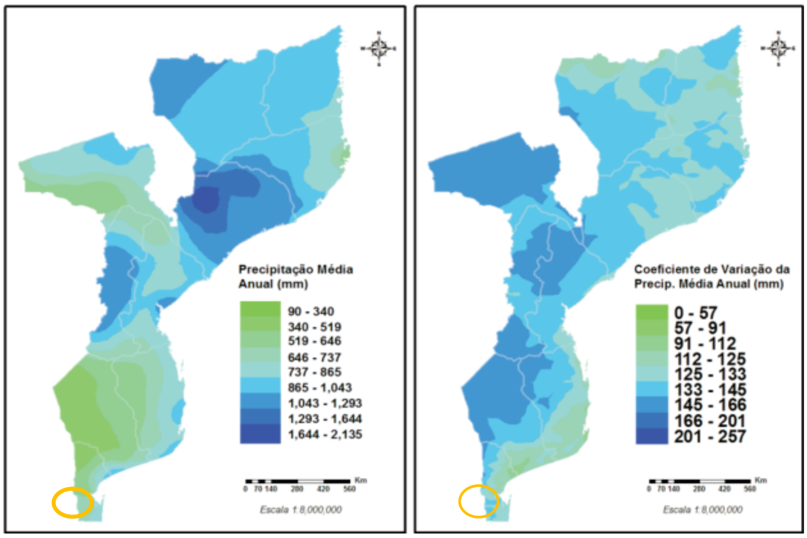
7.2.2 Rainfall

According to the Precipitation Atlas of Mozambique, the spatial distribution of mean annual rainfall in Mozambique shows a large variation both along its latitudinal extension as well as from the coast to the interior (see Figure 7.1). The northern and central zones receive overall the highest amounts of annual rainfall, with values above 1 000 mm, while the southern zone receives the lowest amounts with values generally below 1 000 mm.

Contributing to this variation are the different factors that influence rainfall in Mozambique, namely atmospheric systems and topography. The high rainfall values observed in the northern part are essentially associated with the intertropical convergence zone. This system migrates to the southern hemisphere between the months of November and March and reaches its maximum position in Mozambique around 15° S between the months of January and February (Waliser and Gautier, 1993 *in* INAM, 2018).

By analysing Figure 7.1, rainfall in the study area region varies between a minimum of 519mm and a maximum of 737mm.

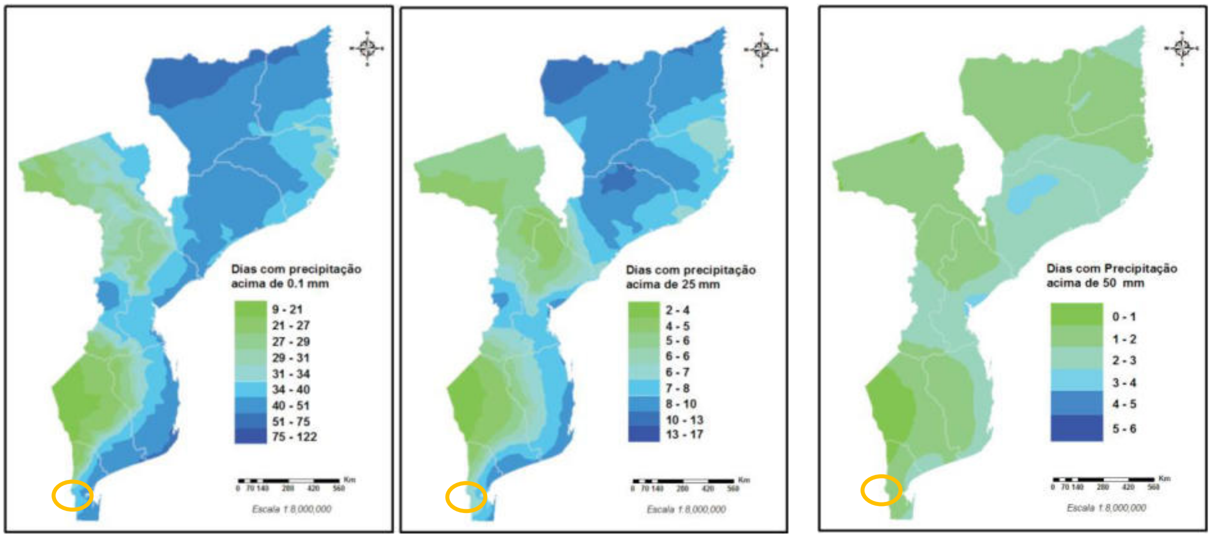
Figure 7.2 shows the average number of days with rainfall intensity above 0.1, 25 mm or 50 mm. The study area experiences about 34 to 40 days of precipitation above 0.1 mm per day annually. Rainfall events above 25 mm in the region occur between 6 and 7 days per year, while events above 50 mm occur between 1 and 2 days per year. The mapping of the annual frequency of rainfall events above 50 mm allows the identification of areas at higher risk of climate extremes.



Location of the study area

Source: Precipitation Atlas of Mozambique (INAM, 2018)

Figure 7.1 - Distribution of average annual cumulative rainfall and coefficient of variation (mm).



Source: Precipitation Atlas of Mozambique (INAM, 2018)

Figure 7.2 - Average number of days with rainfall intensity equal to or greater than 0.1, 25 mm and 50 mm.

The rainfall statistics table for Maputo shows the value of 691.6 mm of average annual rainfall (see Table 7.1). According to the WebGis Mozambique website, the study area has an annual average ranging from 409 to 655 mm, which corresponds to the values recorded in the Precipitation Atlas of Mozambique and represented in Figure 7.1.

Table 7.1

Average monthly and annual rainfall in Maputo

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
mm	262,1	34,3	38,3	69,0	18,4	1,2	2,0	7,9	10,3	58,7	65,0	124,4	691,6

Source: *Statistical Yearbook 2013*

7.2.3 Air temperature

Namaacha has an average annual temperature of 20.2°C (Tembe, C. et al., 2013). The temperature remains relatively constant throughout the year, with rainfall peaks associated with the HUMID months (see Figure 7.3). Although slight, the thermo-pluviometric variation in Maputo, about 50 km from the planned area for the wind power plant, corresponds to the variation recorded in the country, where there is an inverse relationship between temperature and rainfall: warmer seasons have higher rainfall and colder seasons have lower rainfall. This year, 2013, there is a peak in January associated with a cyclone in southern Mozambique.

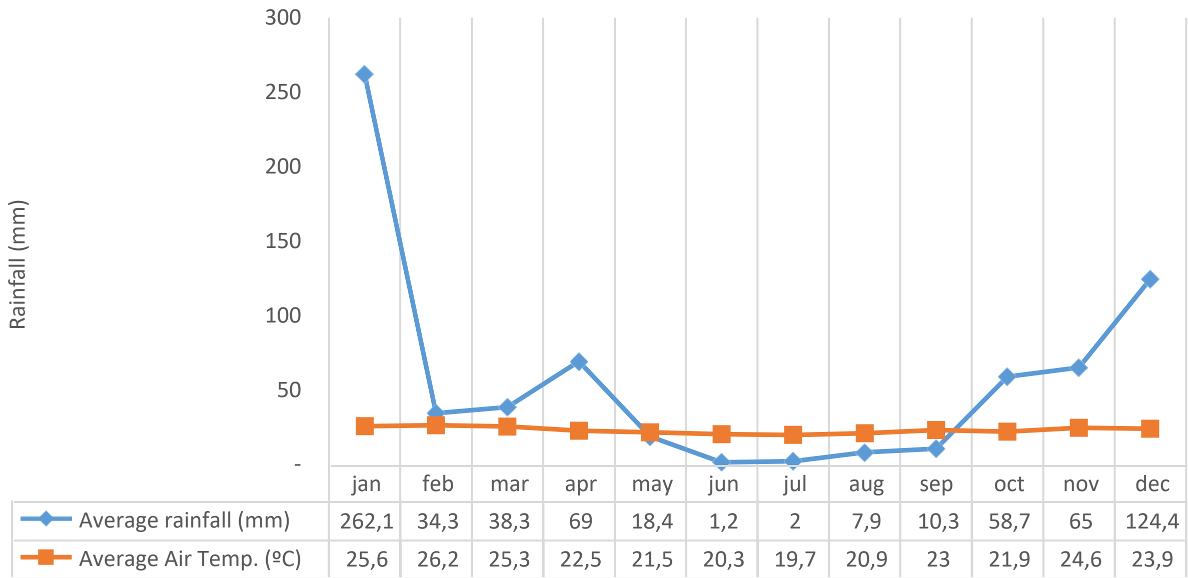


Figure 7.3 - Maputo monthly thermo-pluviosity, 2013

7.2.4 Relative air humidity

Relative air humidity defines the degree of vapour saturation in the atmosphere and is given by the ratio between the mass of water vapour that exists in a given volume of humid air and the mass of water vapour that would exist if the air were saturated at the same temperature, at a given location and time. The chance of precipitation increases as the relative humidity approaches 100%.

The annual average value of relative air humidity for Maputo is 76.5%, with the wettest month being January, associated with the cyclone that affected southern Mozambique during this month, and the driest month being June. The average monthly relative air humidity values for Maputo are around 76.5 % (see Table 7.2).

Table 7.2

Monthly average relative air humidity in Maputo

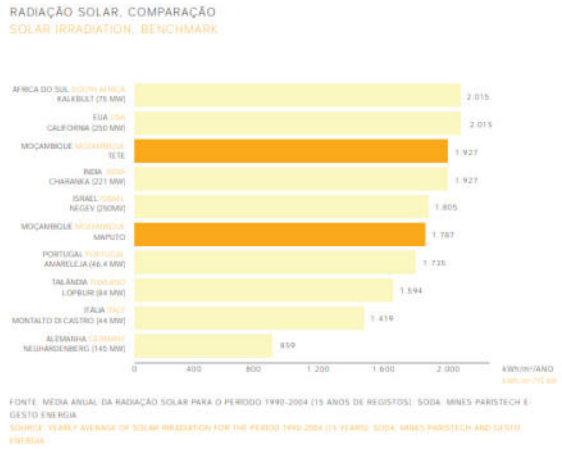
	Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
%	84,0	76,0	74,0	75,0	76,0	72,0	78,0	75,0	70,0	78,0	78,0	82,0

Source: *Statistical Yearbook 2013*

7.2.5 Solar Resource

The availability of the solar resource in a country varies mainly depending on the atmosphere, geometry and the movement of the planet relative to the sun, and is mostly associated with the morphology of the terrain, i.e. variations in elevation, slope, exposure and shading. Mozambique has a good solar resource, consistent throughout the territory and stable throughout the year (Mozambique Renewable Energy Atlas, 2015).

Maputo province has a high global radiation of 1 787 kWh/m^2/year when compared to the photovoltaic potential of good sites in Europe and Asia, and is very close to some of the best sites in the world, such as South Africa and California, both with average annual solar radiation of 2 015 kWh/m^2/year (see Figures 7.4 and 7.5).



Location of study area

Source: Mozambique Renewable Energy Atlas (2013)

Figure 7.4. Average Annual Solar Radiation: Comparison.

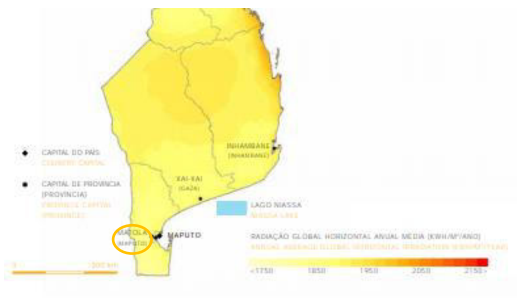
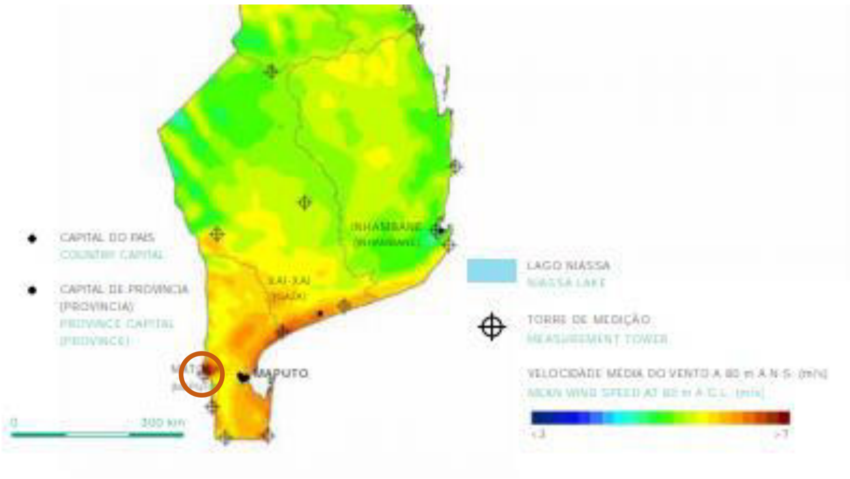


Figure 7.5. Mozambique Solar Potential Atlas

7.2.6 Wind

In general, Mozambique has a medium-low wind regime with prevailing speeds between 4 and 6 m/s at 80 metres above ground level, with the south and higher altitude areas reaching higher wind speeds (Mozambique Renewable Energy Atlas, 2015).

According to the Mozambique Wind Potential Atlas (2015), the study area is one of the zones with the highest wind potential, as can be seen from Figure 7.6, with wind speeds above 7 m/s.



Location of study area

Source: Mozambique Renewable Energy Atlas, (2015)

Figure 7.6 - Mozambique Wind Potential Atlas

7.3 CLIMATE CHANGE

7.3.1 General Considerations

Globally, southern Africa is one of the most vulnerable regions to the impacts of climate change. Observed temperature changes are greater than increases in other parts of the world (IPCC, 2013); projections indicate a 3.4°C increase in annual temperature (up to 3.7°C in spring) when comparing the period 1980-1999 with the period 2080-2099.

Average land surface warming in southern Africa is likely to exceed average global land surface temperature increases in all seasons. Current climate variability and vulnerability to extreme events such as floods and droughts is high, as are a range of other stressors such as lack of water availability, land degradation, desertification and biodiversity loss, which consequently constrain food security and development (Lotz-Sisitka and Penny Urquhart, 2014).

Climate change will exacerbate many of these problems which strongly affect regional livelihoods, often based on subsistence agriculture, but will also impact regional economies, which are often dependent on natural resources.

7.3.2 Evolution of climate variables in Mozambique

Analysing historical change in Mozambique is made difficult by significant regional variations in climate, as well as natural variability on time scales of 10 years or more. However, there is clear evidence that temperatures have increased, following the global trend (USAID, 2012).

Based on studies by INGC (2009) a warming trend is already well established in Mozambique, although not uniform across the country, with average annual temperatures increasing by 0.6°C between 1960 and 2006. Over the same period, the number of hot days per year increased by 25 per cent, while cold days decreased by 14 per cent; the number of hot nights increased, while cold nights decreased. The average annual temperature is projected to increase by between 1.0 and 2.8°C by 2060, and between 1.4 and 4.6°C by 2090, with higher rates of warming inland compared to areas near the coast. The INGC report, 2009 points out that if global mitigation efforts are insufficient, temperatures could rise by between 2 and 2.5° C by 2050, and between 5 and 6° C by 2080.

The rainy season in Mozambique lasts from November to April, bringing about 150 to 300 mm of rainfall per month in the north and 50 to 150 mm per month in the south. Mean annual rainfall decreased by an average of 2.5 mm per month per decade between 1960 and 2006, with the largest decreases occurring in December, January and February (6.3 mm per month per decade). This is despite the increase in precipitation recorded in the northern region. Rainfall variability has increased in the South and Central regions since the 1990s, while the number of heavy rainfall events has increased between 1960 and 2006. There are indications of a later onset of the rainy season and an increase in the length of the drought. Projected average annual rainfall is not expected to change significantly, but dry season rainfall (June to November) is projected to fall by about 15 per cent, while rainfall in the wet season (December to February) is projected to increase by about 34 per cent. The proportion of rainfall occurring in extreme events is projected to increase by 15 per cent by 2090. In all zones, increases in evaporation are likely to be larger than increases in rainfall during the dry season (months JJA and SON[1]), indicating that the dry season will become drier by about 2055 and even drier by 2090 (INGC, 2009).

7.3.3 Key impacts and vulnerabilities

According to the 2009 United Nations Global Disaster Risk Reduction Assessment, Mozambique is the third most exposed African country to climate-related hazards, having experienced 68 natural disasters in 50 years. suffered 68 natural disasters in 50 years. Droughts occur frequently in the southern and central regions, ranging from four to seven per decade. The country has a high level of vulnerability to floods, rising sea levels and increasing tropical cyclones. Although climate risks differ for different agro-ecological regions, in general, flood risk in river basins and flood plains is expected to increase, notably in the South, while coastal areas in the Central Region will be strongly affected by more intense cyclones. Sea level rise and associated coastal erosion pose an immediate threat while the increase in disaster risk along the coast is expected to occur progressively, however the consequences of the impacts are expected to increase exponentially (Lotz-Sisitka and Penny Urquhart,2014).

These predicted impacts make Mozambique extremely vulnerable to climate change, particularly as much of the population lives in low-lying coastal areas with weak and non-resilient infrastructure, and heavily dependent on local natural resources (e.g. agriculture and fisheries) for their livelihoods. Alternating flood and drought events will affect the ability of farmers and fishers to grow crops and fish consistently, which is likely to affect food security, malnutrition and sustainable profitability. In addition, sea level rise and associated saltwater intrusion could affect aquaculture availability, the viability of coastal mangrove systems and contaminate water sources already under water stress. Droughts, floods and higher temperatures will also negatively affect human health and forest ecosystems. Extreme events will significantly affect already precarious infrastructure and damage or destroy coastal ecosystems and livelihoods (USAID, 2012).

Mozambique, as a signatory of the United Nations Framework Convention on Climate Change (UNFCCC) since 1995, has assumed some actions to be developed in the mitigation of greenhouse gas (GHG) emissions, as well as in the adaptation of its development policies in order to respond to the impacts of Climate Change (CC) and promotion and cooperation in fields such as scientific, technological, technical and socio-economic research, systematic observation, education, training and information of the public and encouragement of their broad participation in the CC process, including non-governmental organisations (NGOs). Mozambique is also a signatory of the Hyogo Action Plan (2005-2015), which guides the main actions for disaster risk reduction, including climate risks (MICOA, 2012).

Figure 7.7 shows the severity of the impacts of climate change on the various sectors of activity. It is observed that the impacts that will affect more sectors and with greater intensity are Floods and Tropical Cyclones. On the other hand, the sectors most vulnerable to the different expected impacts are water resources, agriculture, food security, biodiversity and human settlements. these sectors are quite interdependent, thus further enhancing the impacts. It is also important to emphasise the high impact of sea level rise in coastal areas and the increase in average sea temperature on the fisheries sector. Analysing in particular the infrastructure and energy sectors, which are more directly related to this Project, we highlight the occurrence of Floods, Tropical Cyclones and Droughts, with moderate to high impacts expected in these sectors.

The project area is located in southern Mozambique, Maputo province, Namaacha district and according to existing climate data, analysed by the World Food Programme, the southern region and particularly Maputo will suffer the greatest changes from the point of view of the increase in maximum temperature, decrease in minimum temperature and also with significant changes in the rainfall regime, particularly during the summer periods (SON and MAM[2]). The climate change scenarios for the coming decades (2046 to 2065), developed by the INGC (2009), show an intensification of the impacts on temperature and evapotranspiration, however, the southern region being the one in which there is greater severity in terms of changes in precipitation compared to the northern region.

Sector/área	Impactos das MC						
	Mudança nos padrões de temperatura atmosférica	Mudança nos padrões de precipitação	Secas	Cheias	Ciclones tropicais	Subida do nível de água do mar	Aumento da temperatura média do mar
Recursos hídricos	•••	•••	•••	•••	•••	••	•
Infra-estruturas		•		•••	•••	••	
Agricultura	••	•••	•••	•••	•••	•	
Segurança alimentar	••	•••	•••	•••	•••	•	
Florestas	••	•••	•••	••	•••	•	
Indústria		•	•••	•••	•••	•	
Energia		•	••	•	••		
Saúde	••	•	••	••	••	•	•
Turismo	••	•	••	••	•••	•	•
Transportes	••	•		•••	•••	••	
Biodiversidade e áreas de conservação	••	•••	•••	•••	•••	•	••
Zonas costeiras	•	•	•	•••	•••	•••	••
Assentamentos humanos	••	••	•••	•••	•••	•••	•
Pesca		•	•	•	••	••	•••

Chave: ••• Elevado; •• Moderado; • Baixo (ou não conhecido)

Source: MICOA, 2012

Figure 7.7 - Climate Change Impacts by Sector/Area

[2] SON – September, October and November MAM – March, April and May

7.4 GEOLOGY, GEOMORPHOLOGY AND HYDROGEOLOGY

7.4.1 Methodology

The characterisation of the reference situation is carried out on the basis of project elements, documentation and specific cartography related to morphology, geology, tectonics and seismicity.

Local reconnaissance was also considered where contact was made with the reality of the terrain and some images were captured to illustrate the most expressive situations of the territory where the Project is located.

7.4.2 Topography and Geomorphology

The Project is located in southern Mozambique, Maputo Province, Namaacha District, about 2 km from the border with South Africa, in the geomorphological unit *Terras Altas* of the Libombos Chain Complex.

This unit is marked by the Libombos mountain range, which extends in a north-south direction, having its highest point at about 800 m, on Mount Mponduíne (confluence point of the border limits of Mozambique, Swaziland and South Africa).

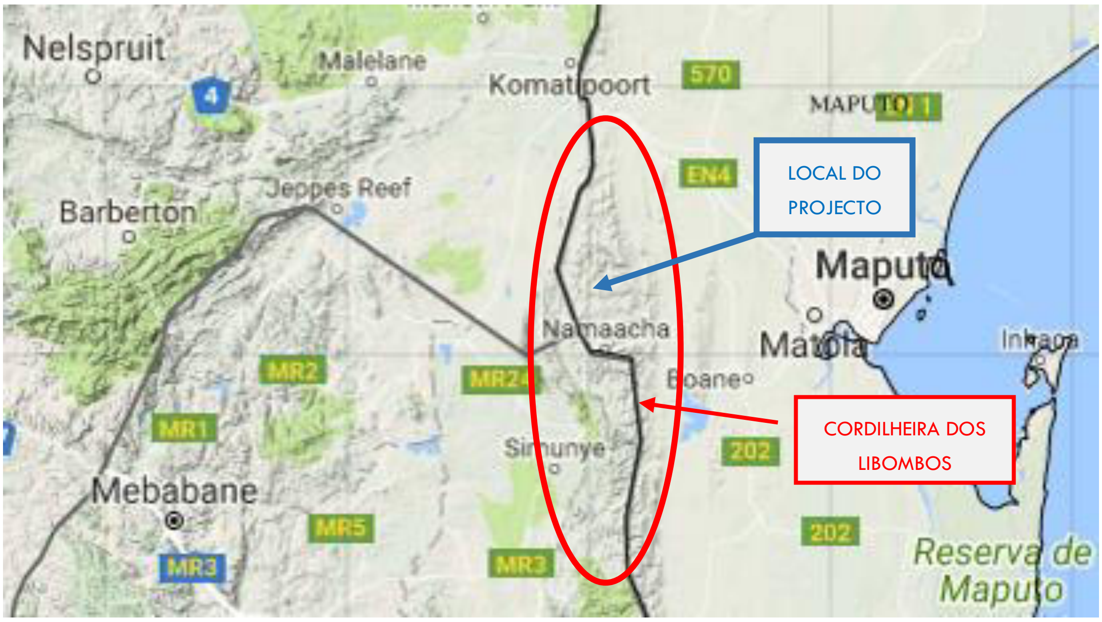


Figure 7.8 - Regional morphological framework (Source: WebGIS Mozambique - Embrapa, s/e)

The Montes Libombos are a volcanic mountain range that stretches between the South African provinces of KwaZulu-Natal and Limpopo, crossing Swaziland in its eastern part, giving its name to the Lubombo district and giving its mountainous appearance to the neighbouring Mozambican districts of Namaacha and Moamba, close to the South African border. Lubombo district and giving the mountainous appearance of the neighbouring Mozambican districts of Namaacha and Moamba, close to the border with South Africa, stretching some 800 km long by 100 km wide.

The Montes Libombos mountain range, with a general north-south development, at a more local scale has an undulating relief, where flattened ridges are interspersed with relatively deep water lines. It is on one of these ridges that the Namaacha Power Plant is planned to be installed (see Figures 7.9 and 7.10).

Figure 7.9 - Landform of the Namaacha Power Plant site (Source: Google Earth satellite image) (s/e).

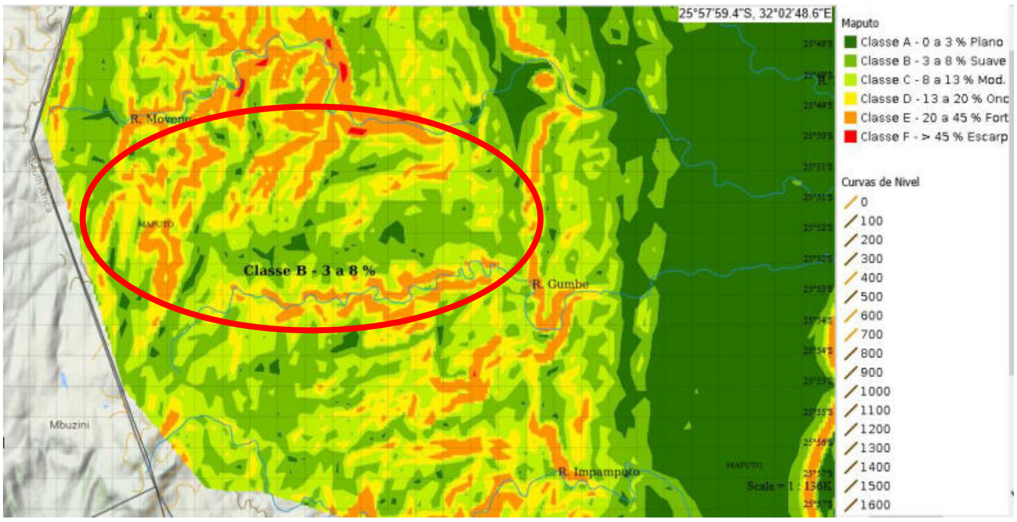


Figure 7.10 - Slopes in the area where the Namaacha Power Plant is located (Source: WebGIS Mozambique developed by Embrapa) (s/e)

At the regional level, the elevation corresponding to Libombos Mountains (where the Namaacha Power Plant is planned to be installed) stands out from its surroundings (see Photo 7.1).

Photo 7.1 - View towards Montes Libombos from the surroundings

The area of the Wind Power Plant is developed on a plateau surface along two ridges, with a W-E direction for an extension of about 7 km and with a N-S direction for an extension of about 6 km, with altitudes between 500 m in the eastern sector and 600 m in the western sector.

The N-S ridge slopes gently to the north, with altitudes ranging from 554 m at the northern limit to 620 m to the south. In the central sector of this ridge the altitude is 607.8 m at the Balene geodetic marker.

The W-E ridge slopes gently to the east, with altitudes ranging from 607.8 m at the Balene geodetic marker in the western sector to 506 m at the Bije geodetic marker near the eastern boundary where the electricity substation is planned to be located. In the central sector of this ridge the altitude is 572 m at Alto Ciguene.

The hydrographic network in some places carves the plateau surface defining small valleys, with greater expression in the northern sector of the N-S ridge (R. Maxongoluluane) and in the eastern sector of the W-E ridge (tributaries of the Mixumene, Mitesandene, Libunzene, Macuabane rivers).

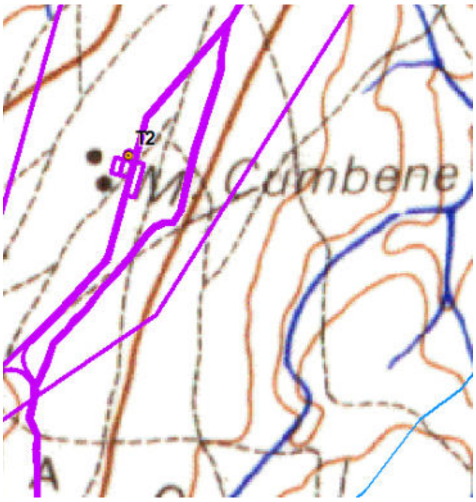
7.4.3 Geology

In the context of the geology of south-western Mozambique, the study area is part of a vast strip of north-south orientation of volcanic nature in southern Mozambique, corresponding entirely to the Umbelúzi Formation, of Jurassic age (JrU), represented by Rhyolites, according to the Geological Map of Mozambique at scale 1:1 000 000 (DNG 2008).

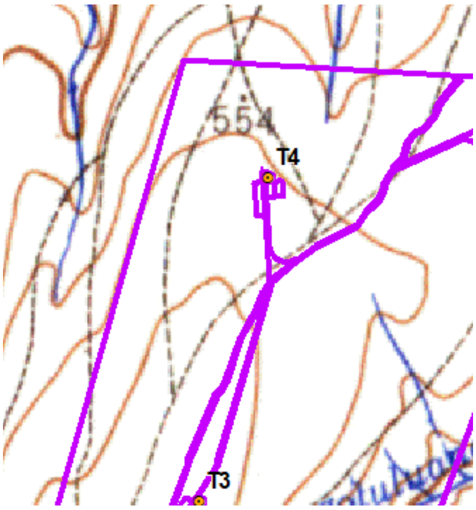
This belt, with a length of about 425 km and between 3 and 23 km wide, overlies the Sabi River Formation, composed of basalts.

According to the Explanatory Note of the aforementioned geological map, the Umbelúzi Formation corresponds to a succession of dacitic and rhyolitic rocks, comprising high-grade ignimbrites, with intercalations of pyroclastic ash deposits and lava flows. They cover a large part of the mountains that make up the Libombos mountain range.

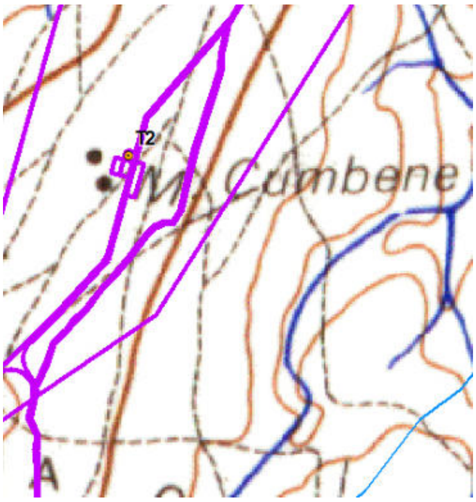
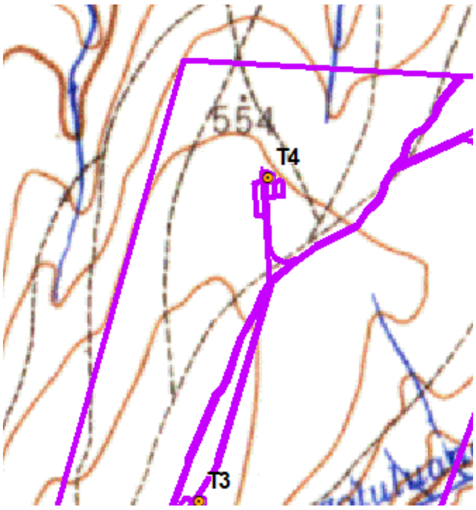
In the local reconnaissance carried out in October 2019, it was observed the existence of high stoniness on the plateau surface of the study area, with outcrops of volcanic rock, consisting of rock fragments of varying dimensions. The following photographs illustrate the surfaces covered by rock fragments.

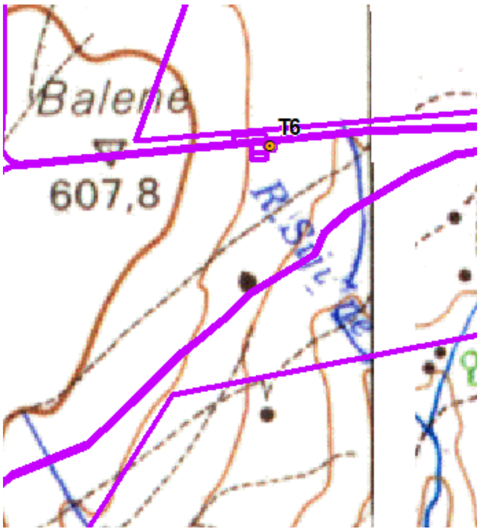


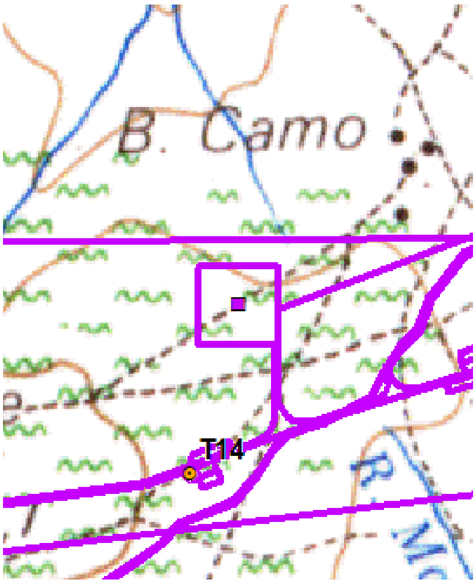
Superfície planáltica no local do aerogerador T2 com fragmentos de rocha



Local do aerogerador T4 com afloramentos de rocha

	 Superfície planáltica no local do aerogerador T2 com fragmentos de rocha
	 Local do aerogerador T4 com afloramentos de rocha

	 Afloramento rochoso a sul do aerogerador T6 junto ao acesso principal da Central Eléctrica Eólica
	 Superfície plana no local do aerogerador T15 com fragmentos rochosos de pequena dimensão dispersos



Superfície plana no local da Subestação com afloramentos rochosos de pequena dimensão

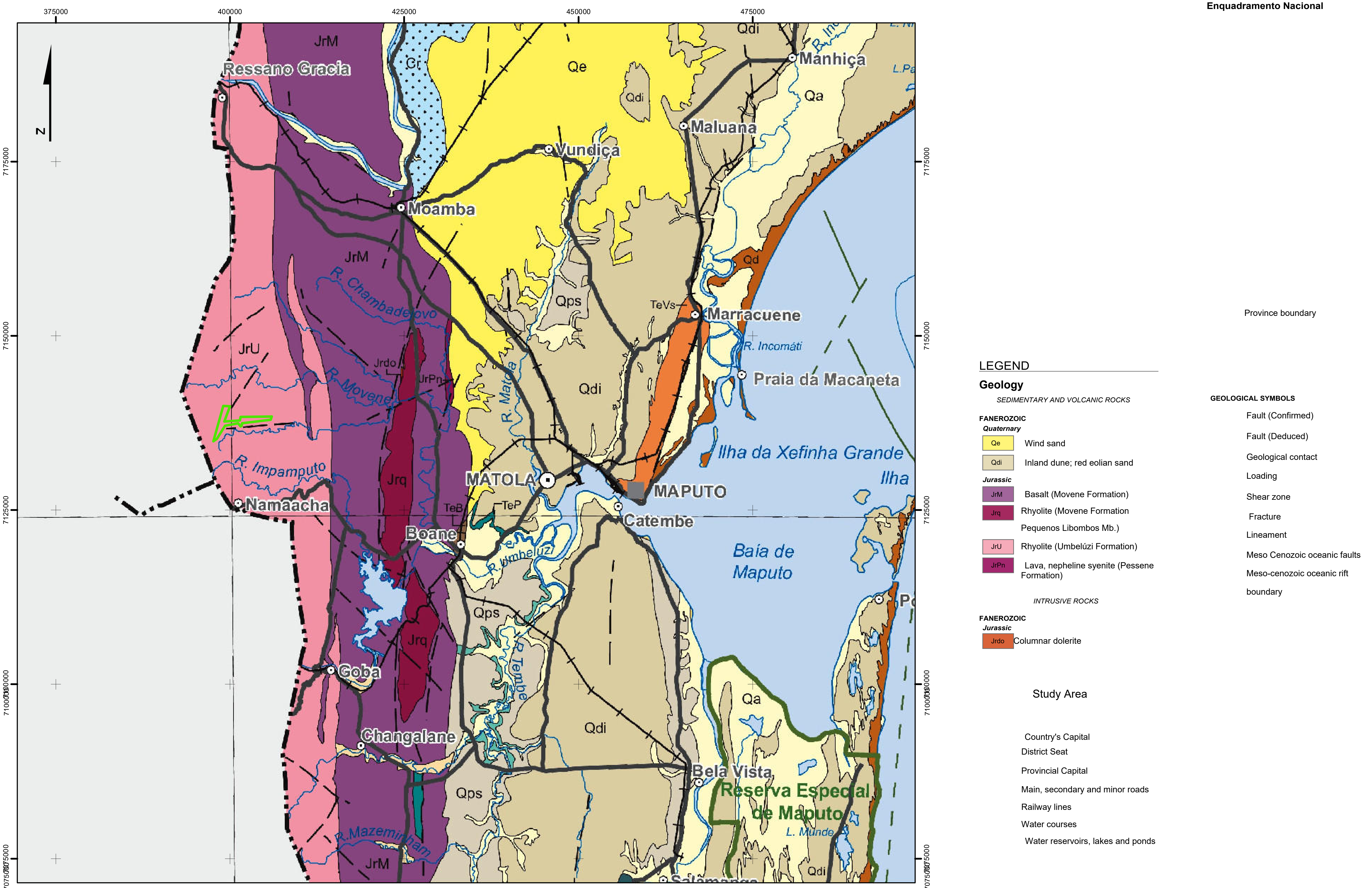
Figure 7.11 - Examples of the flat morphology of the study area with illustration of rock outcrops and stoniness

According to the geological map, the study area lies in a zone compartmentalised by two probable faults, with a W-E direction to the south of the study area and a NE-SW direction in the alignment to the north of the N-S sector of the study area (Figure 7.12 Geology). The fault identified to the south of the study area appears to correspond to the alignment of the Mangave River given the coincidence of its W-E alignment. These probable faults do not intersect the study area. Figure 7.12 shows the extract from the Geological Map of Mozambique at scale 1:1 000 000 (DNG, 2008), with the location of the study area.

7.4.1 Seismicity

According to the seismic intensity map of central and eastern Africa on the modified Mercalli scale[3] (UNESCO, 2007), the study area is located in a seismic zone of grade VI. According to this scale, grade VI earthquakes are considered "quite strong" and are generally felt by the entire population of the region and cause cracks in masonry built with weak materials such as adobes and weak mortars.

[3] The modified Mercalli scale has 12 degrees of seismic intensity. Grade I intensity corresponds to earthquakes with imperceptible effects and grade XII to earthquakes with almost total damage.



Source: Extract from the Geological Map of Mozambique, National Directorate of Geology of Mozambique, 2008

Scale 1:500 000

0 5 10 15 20 km

Projection System: WGS 1984
Units: metres
EPSG: 32736

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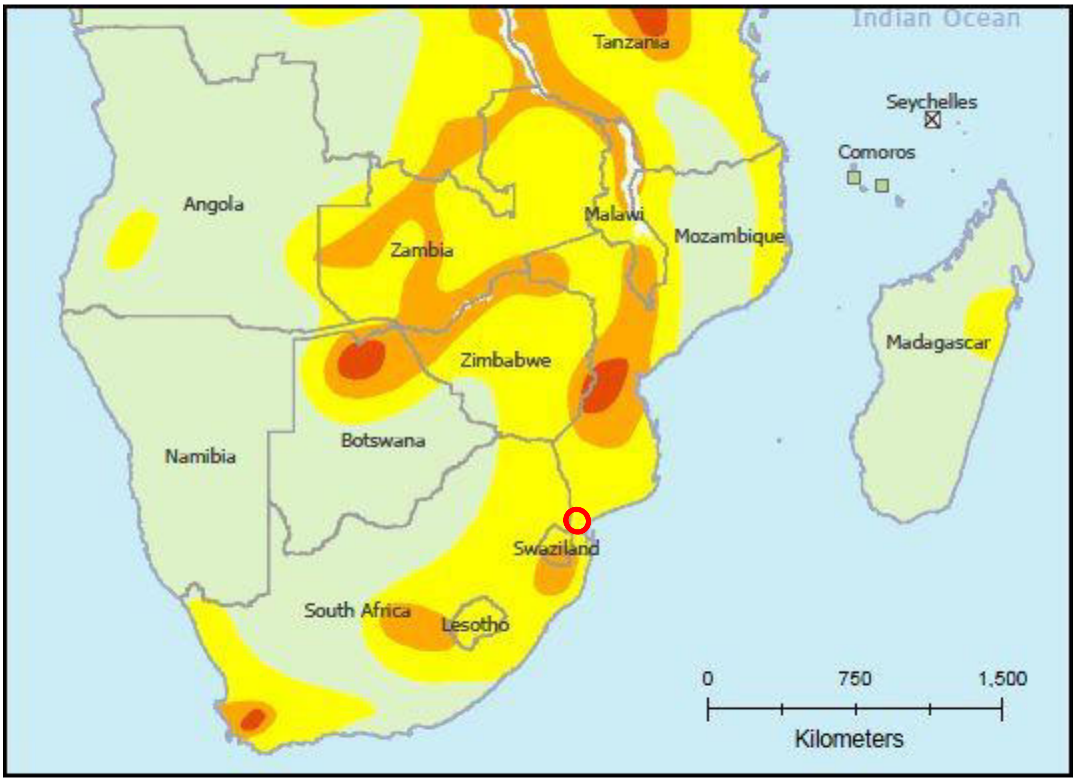
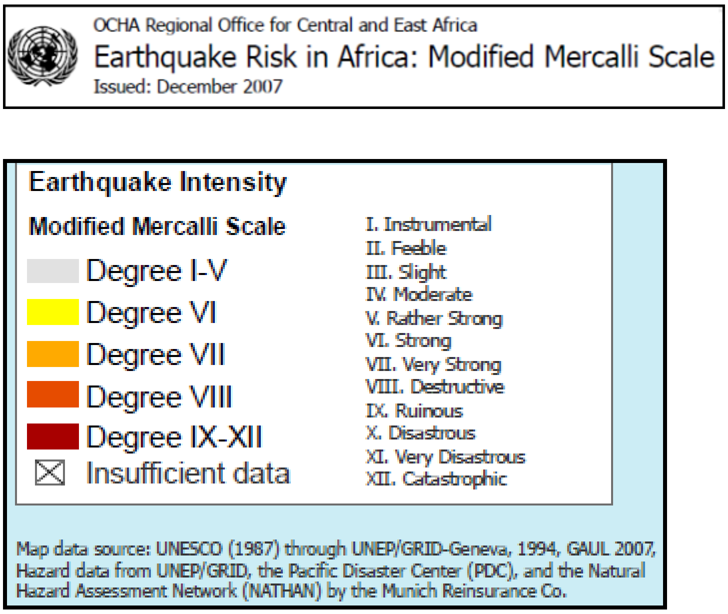
Environmental Impact Assessment of the Namaacha Power Plant

Figure 7.12 - Geological Framework of the Study Area.

Figure 7.13 shows an extract from the aforementioned seismic intensity map of central and eastern Africa, noting that the study area falls within a zone of low to moderate vulnerability to earthquakes.



Source: UNESCO, 2007



According to USGS data (2006a), Mozambique has had a more or less constant seismic activity, at least over the last 33 years. Figure 7.14 illustrates the seismic activity in Mozambique, and shows that the Namaacha area has no relevant seismic activity.

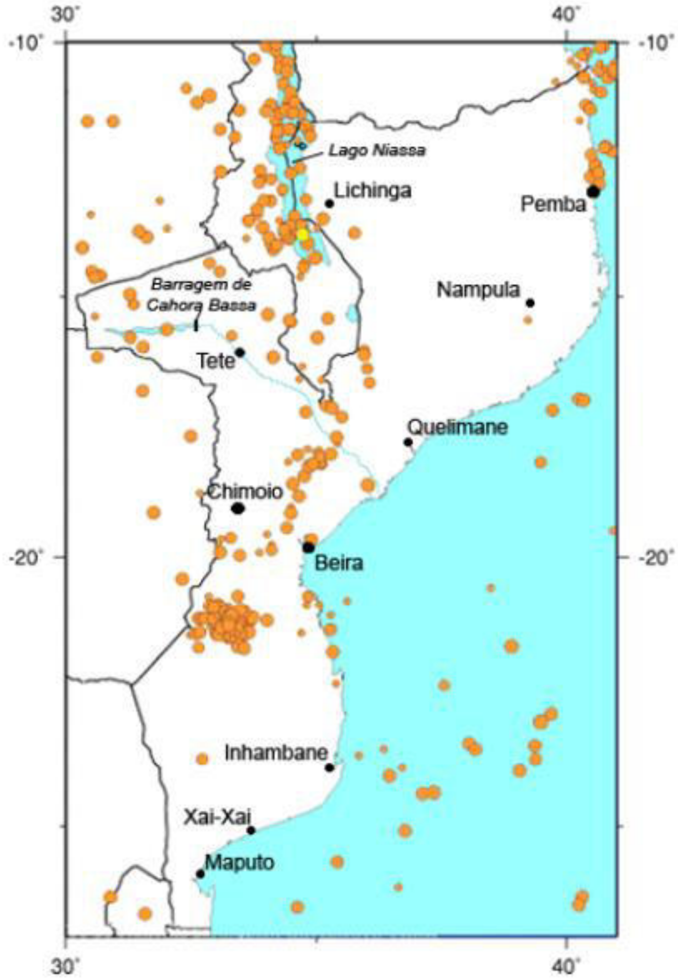


Figure 7.14 - Distribution of seismic activity (representation of epicentres) in Mozambican territory, between 1973 and September 2006 (adapted from USGS, 2006) (s/e)

7.4.2 Mineral Resources

In terms of mineral resources, the district of Namaacha has a high potential as a result of the diversity of rocks in the Libombos mountain range, with the extraction of stone (slabs, stone for construction), sand, clay and lime. No mineral exploration has been identified in the area where the power plant is planned to be installed.

Figure 7.15 shows an extract of the map of mining concessions in the Namaacha region, where it can be seen that the study area does not overlap with areas with a prospecting and exploration licence or mining concession.

According to the Mozambique Mining Cadastre Portal consulted on 20 October 2019, to the south-southwest of the study area, a concession assigned to the company Sociedade Águas Montemor, for the exploitation of Mineral Water, with cadastral number 173 C, covering about 214.01 ha. The concession application was submitted on 14 December 1999 and is currently in force according to information consulted on the portal (marked in green in Figure 7.15).

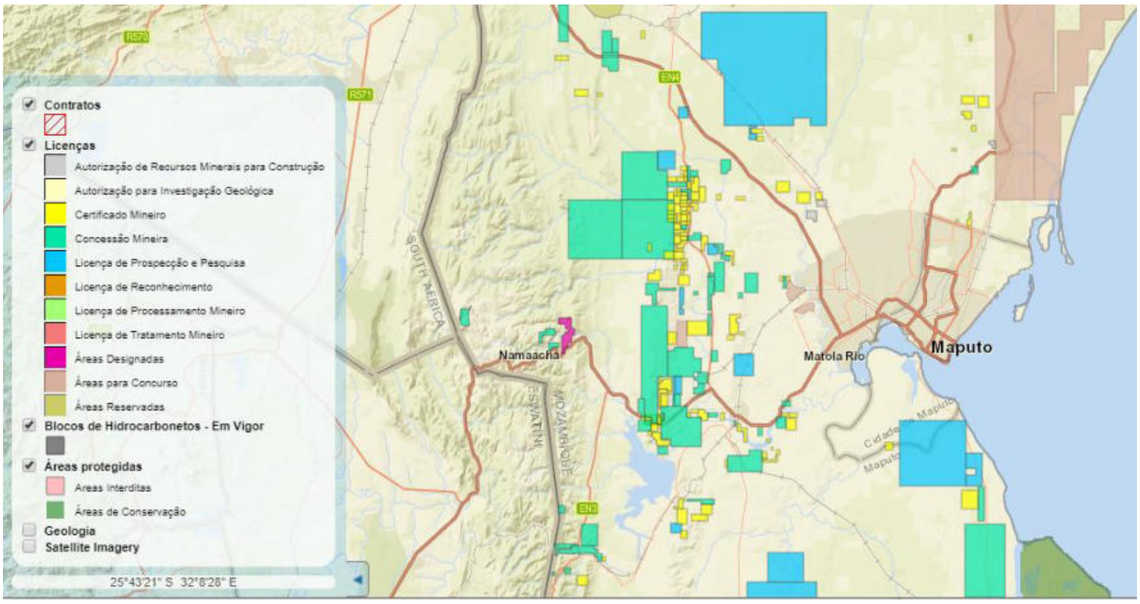
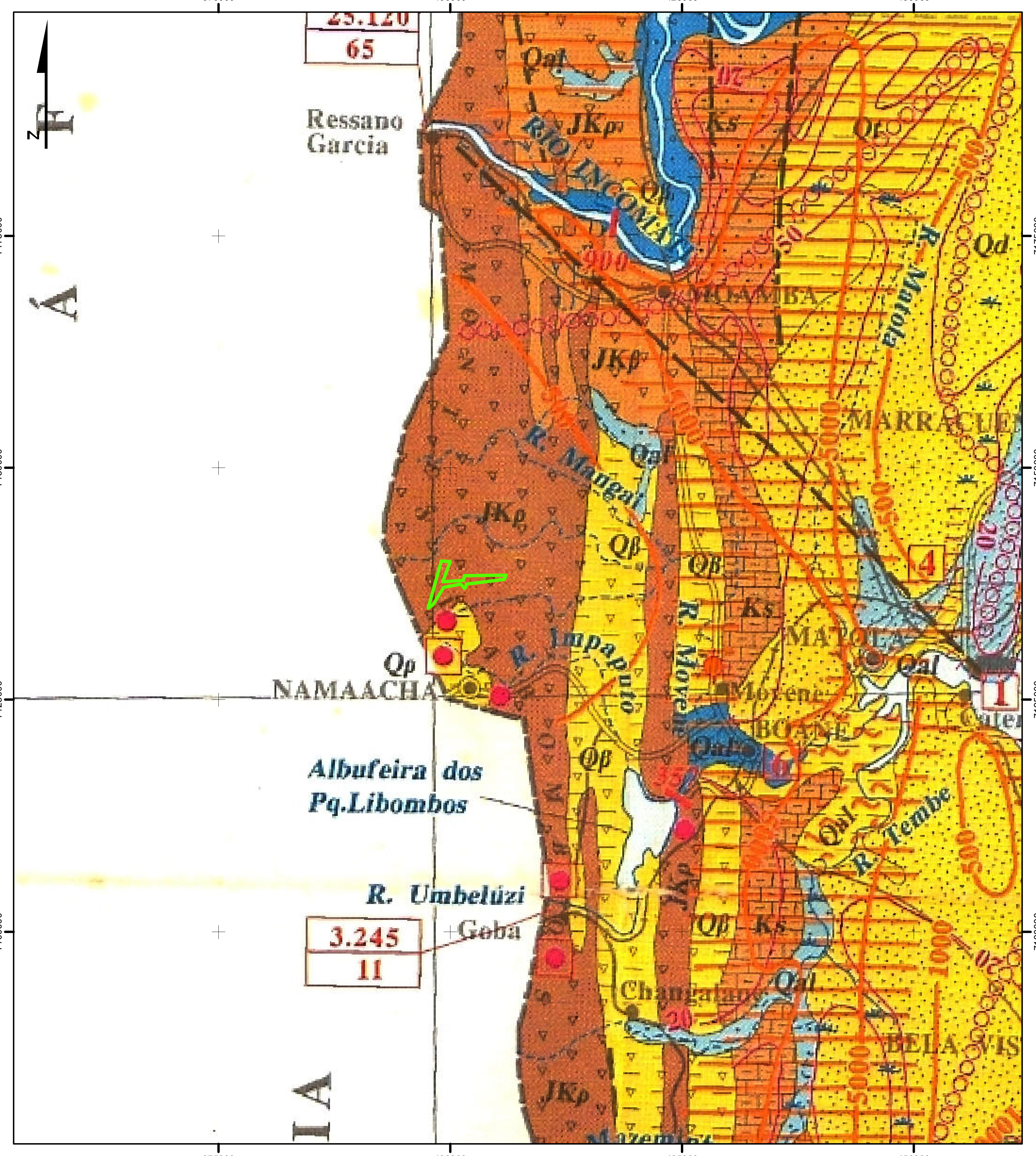


Figure 7.15 - Prospecting and exploration licences and mining concessions in the Namaacha region. Consultation on 20 October 2019 (http://portals.flexicadastre.com/mozambique/pt/)

7.4.3 Hydrogeology

The Hydrogeological Map of Mozambique at 1:1 000 000 scale (DNA, 1987), shows the scarcity of groundwater of acceptable quality in the territory. Only 17% of the country's area has groundwater with flow rates and mineralisations above 3 m^3/h and below 1500 mg/l respectively, values normally acceptable for domestic consumption.

The study area is located in Hydrogeological Province 2 (Volcanic Terrain) in a narrow N-S strip close to the border with South Africa and Swaziland in southern Mozambique (see Figure 7.18), in an area of very low to zero permeability, practically devoid of groundwater, with limited productivity (flow generally less than 1 m^3/h), according to the Hydrogeological Map of Mozambique (see Figure 7.16).



LEGENDA

Área de Estudo

I. OCORRÊNCIA DE ÁGUAS SUBTERRÂNEAS

C. ÁREAS COM AQUÍFEROS LOCAIS (INTERGRANULARES OU FISSURADOS) DE PRODUTIVIDADE LIMITADA OU ÁREAS SEM ÁGUA SUBTERRÂNEA SIGNIFICATIVA

PERMEABILIDADE

FRACA A MUITO FRACA — C.1-ÁREAS COM AQUÍFEROS LOCAIS CONTÍNUOS OU DESCONTÍNUOS DE PRODUTIVIDADE LIMITADA (GERALMENTE Q<5 m³/h). Nas áreas de rochas cristalinas, a ocorrência de água está limitada às zonas de alteração ou fracturação das rochas duras subjacentes (espessura de alteração geralmente entre 20 e 50 m).

Qβ,Qρ — Eluviões relacionados com a zona de alteração e/ou fracturação de rochas extrusivas

MUITO FRACA A NULA — C.3-ÁREAS MONTANHOSAS, SEM MANTO DE ALTERAÇÃO SIGNIFICATIVO E PRACTICAMENTE DESPROVIDAS DE ÁGUAS SUBTERRÂNEAS (GERALMENTE Q<1 m³/h); O seu aparecimento está relacionado, em geral, com nascentes. Zonas de falhas e cones de vertentes podem corresponder a zonas de excepção geralmente mais produtivas.

JKτ,JKρ JKβ — Rochas extrusivas: fonólitos, traquitos e rochas afins(τ); riólitos (ρ); basaltos (β)

IV ÁGUA SUPERFICIAL

Curso de água sazonal

CAPTAÇÕES E OBRAS

Captação de nascente

Fonte: Extracto da Carta Hidrogeológica de Moçambique, escala 1/1 000 000, folha sul, DIrecção Nacional de Águas, 1987

Escala: 1:500 000
0 20 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.16 - Localização da Área de Estudo sobre extracto da Carta Hidrogeológica de Moçambique

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ESTUDOS E PROJECTOS LDA

The emergence of groundwater in volcanic terrain is generally related to springs. Fault zones and slope cones may correspond to more productive exception zones.

In general, volcanic formations are not very productive and are of limited extent. Their productivity depends mainly on the thickness and texture of the mantle of alteration, and the occurrence of groundwater is closely linked to the fractures and diaclases that the rocks present since the mantle of alteration is very thin.

In the subdivision of the Volcanic Terrain Domain where the study area is located (Group C3), the alteration mantle that supports the superficial aquifer is poorly developed, with an average thickness of around 6 m (DNA, 1987). The rhyolites, which constitute the massif where the study area is inserted, are not very promising for the existence of groundwater, since they are generally devoid of the surface alteration mantle and outcrops of the rock are frequent.

The recharge of the hydrogeological system is direct, through the infiltration of rainwater.

In the study area, a well was identified about 400 m south of the planned site for wind turbine No. 6, close to the main access to be regularised (see Figure 7.17).

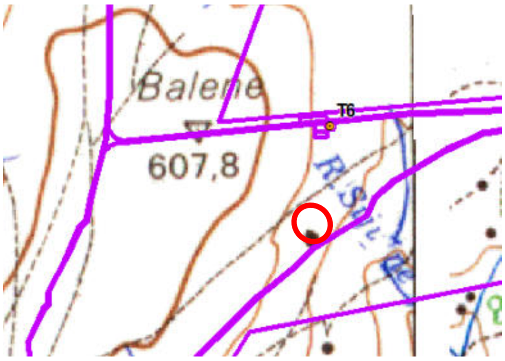
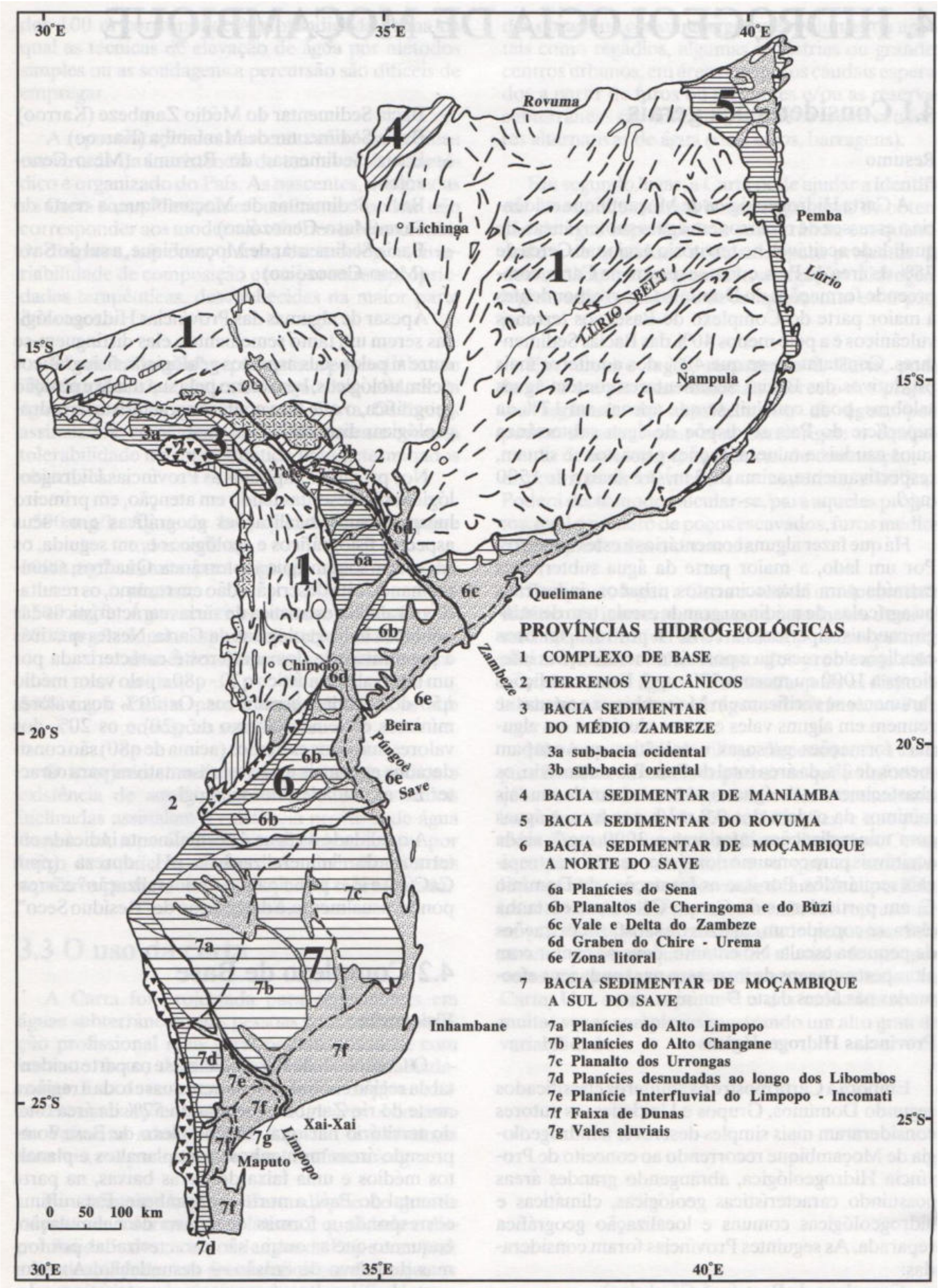


Figure 7.17 - Location of the well identified in the study area about 400 m south of wind turbine T6

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS, LDA



Source: Mozambique Hydrogeological Chart Explanatory Note. DNA, 1987.

Figure 7.18 - Hydrogeological Provinces of Mozambique.

Taking into account the lithological composition of the medium, with weak to very weak permeability in the alteration mantle zone, the vulnerability of the hydrogeological system is considered to be low.

The groundwater from the rhyolites is quite good, with mineralisation of less than 500 mg/l and low hardness (<10 ppm $CaCO_3$). Its composition is sodium chloride to sodium bicarbonate.

Near Namaacha there is exploitation of spring water from fractured rhyolites, corresponding to the exploitation of Mineral Water with the cadastre number 173 C referenced above.

7.5 SURFACE WATER RESOURCES

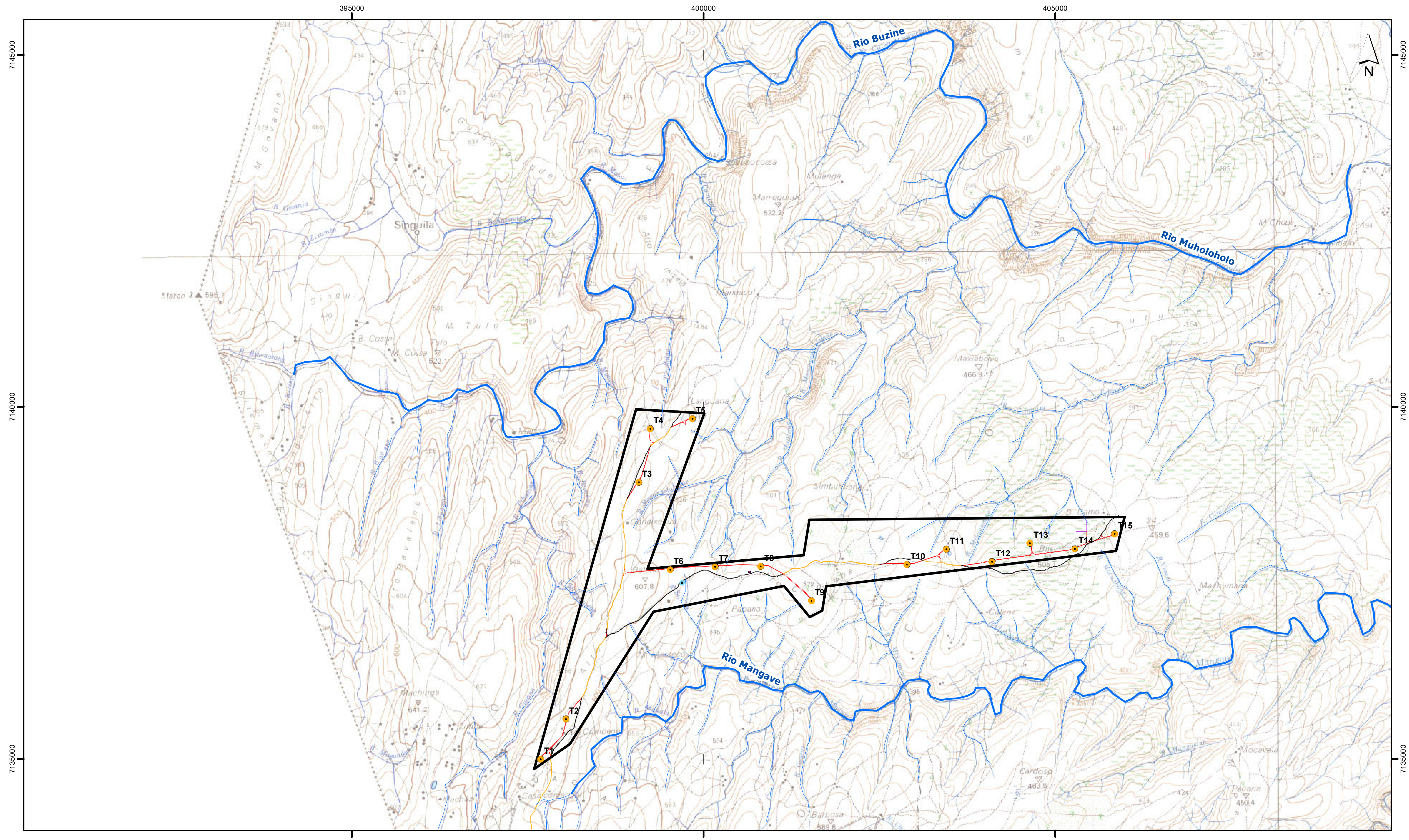
7.5.1 Hydrological Framework

The south of Mozambique is characterised by the presence of lowlands, with poorer soils, and a landscape characterised by the existence of savannas. The layout of the landforms in the territory determines the flow of water, with rivers running in a predominantly west-east direction, and watercourses that are scarce in the south of the country are abundant in the north (Dias, 2008).

The main rivers in southern Mozambique are the Save, Limpopo, Incomati, Umbelúzi and Maputo, whose current beds are carved out of the volcanic rocks of the Libombos and are characterised by beds that are too wide for the current river flow, corresponding to past periods with a wetter climate than the present. In these rivers, the average slope of the longitudinal river profiles is very weak, sub-flat in the lowlands (Moreira, 1999).

Namaacha district has two river basins: the Umbelúzi Basin and the Maputo Basin, corresponding to the main rivers in the district. There are other watercourses such as the Kalichane, Changalane, Mabenga, Movene and many springs that form waterfalls.

The Wind Power Plant project is located in the Movene River sub-catchment, which in turn is a tributary of the Umbelúzi River, with a perennial flow regime (see Figure 7.19). Figure 7.20 shows the sub-catchments of the Umbelúzi.



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:50 000

0 1 000 2 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

LEGENDA

- Área de Estudo
- Aerogerador
- Estaleiro
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)
- Poço

Rede hidrográfica

- Linhas de água perenes / permanentes
- Linhas de água efémeras / intermitentes

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.19 - Recursos Hídricos Superficiais

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Source: (Albino, 2012)

Figure 7.20 - Map of sub-basins of the Umbelúzi.

The Umbelúzi River Basin has a total area of 5 460 km^2 divided into 3 140 km^2 in Swaziland, 80 km^2 in South Africa and 2 240 km^2 in Mozambique, corresponding to 58%, 1% and 41% respectively.

At a more detailed scale, the Wind Power Plant is located on a ridge that runs between two very distinct watercourses, namely the Mangave River to the south and the Muholoholo River to the north. These two rivers are in turn tributaries of the Gumbe and Mabele rivers respectively. The last two are tributaries of the Movene River.

The morphology and type of soil in the area of direct influence of the Project make infiltration difficult. There are a number of small watercourses that provide drainage to the two watercourses that run north and south of the ridge where the Project is planned (see Figure 7.19). These are ephemeral headwater streams, with no significant runoff, which only flow during or immediately after periods of heavy rainfall and only carry surface runoff.

7.5.2 Water Availability

The maximum flow of perennial rivers in the region occurs between the months of November and March, while the minimum flow occurs between the months of July and October. However, since it rains throughout the year, the main water lines always have water. In the area of direct influence of the Project, watercourses are temporary, flowing only during or immediately after periods of heavy rainfall and only carrying surface runoff.

7.5.3 Floods

Mozambique periodically experiences severe flooding. Since 2000, when the worst floods on record occurred in Mozambique, southern Mozambique has been badly affected by rising flows caused by heavy rainfall, cyclones, earthquakes and tropical storms, which are becoming increasingly frequent.

7.5.4 Water use and infrastructure

Water supply in Namaacha district is poor. Small water supply systems exist in the larger settlements, but have experienced operational problems. In some areas, the nearest improved sources are between eighteen and thirty kilometres away.

At 35 km to the south-west, the Umbeluzi River suffers a bottleneck that was used for the construction of the Pequenos Libombos Dam, built with the purpose of managing the water regime, capturing water during the rainy season to supply the city of Maputo (capital of the country), the industrial area of the municipality of Matola and the agricultural area of the district of Boane, especially during the dry season (Albino, 2012). The Pequenos Libombos section drains an area of 3900 Km^2 of which 800 km^2 are located in Mozambique.

In the village of Namaacha the water supply system does not reach all communities, resorting for example to the use of boreholes for water collection. The water level in the shallow wells varies between 1.5 and 9.3 metres deep in this area, with an average of 3.8 metres (Muchimbane, 2010) (see Photo 7.2).

Photo 7.2 - Shallow well in the study area.

In the Area of Direct Influence, there is no piped water, the population fetches water at least 5 km away in a lower part of the mountain. Some livestock farmers carry water from the village for their animals.

7.5.5 Water Quality

Diffuse pollution sources originating from agro-livestock, and point sources of pollution due to the absence of basic sanitation infrastructures, may contribute to the transport of pollutant loads, during precipitation events, to water lines (to the north and south) that are located outside the area of direct influence.

7.5.6 Applicable legislation

7.5.6.1 Legal Framework

The right to use and benefit from regularised, non-regularised raw water (rivers and lakes) or underground water (boreholes, wells and springs), with the exception of common uses, i.e. without the use of mechanised means, depends on the authorisation to open boreholes and on licensing or concession, which means that no one should use surface or underground raw water with the use of mechanised means without being licensed.

The application for a borehole authorisation (for groundwater) or a licence (for surface water) should be made at the headquarters of Ara Sul - Regional Administration of Southern Waters or at the Basin Management Unit where the project has or will take place.

Licensing of private water use (private uses are those that use a siphon or any mechanised means) is regulated by the Water Law, Law no. 16/91 of 3 August, and by the Licences and Concessions Regulation, Decree no. 43/2007 of 30 October (created under Article 204(1)(f) of the Constitution of the Republic in conjunction with Article 75 of Ministerial Diploma no. 16/91 of 3 August). °1 of Article 204 of the Constitution of the Republic in conjunction with Article 75 of Law no. 16/91, of 3 August), using the models of water licences and concessions approved in Ministerial Diploma no. 7/2010, being conferred by the water resources management entity, which in the South region is the Regional Administration of Southern Waters (ARA-Sul).

Chapter III of the Regulation on Environmental Quality Standards and Effluent Emission, approved by Decree No 18/2004 of 2 June 2004, frames the parameters that define the quality of water in the public domain according to their categories. According to Article 12 of the said Regulation, water quality categories are established to allow the determination of appropriate treatment schemes. The categories established are: i) Waters for human consumption purposes; ii) Waters for agro-livestock purposes; iii) Waters for fish farming purposes; iv) Waters for recreational purposes; and v) Waters for food processing, alcoholic and non-alcoholic beverages.

Quality control is carried out by the competent authorities through periodic and regular analyses that allow frequent adaptation of the treatment processes according to the parameters established by this Regulation. The Ministry for the Co-ordination of Environmental Action is responsible for co-ordinating health surveillance actions consisting of:

- Assess the condition of facilities and operation of water collection and supply systems;
- Monitor the safety and operational conditions of the facilities;
- Assess the risk to public health from water quality;
- Carry out targeted analyses and studies to assess risk factors; and
- Communicate to the entities managing the water collection and supply systems the measures to be taken to reduce or eliminate the risks to public health.

In Article 16 of the Regulation on Environmental Quality Standards mentioned above, the discharge of pollutants and industrial liquid effluents are addressed. According to the Regulation, the final destination of discharges of industrial liquid effluents into the receiving environment must be made through an appropriate outfall for this purpose, and the final effluent discharged must comply with the emission or discharge standards set out in Annex III of the same referred to.

To enable the control and maintenance of the permissible levels of pollutant concentrations in environmental components, it is necessary to establish environmental quality and effluent emission standards. The standards for the emission of liquid effluents by industries are described in Annex III of the above-mentioned Regulation.

If the receiving environment is the ocean, it must be ensured that the water quality after the discharge of the effluent complies with the standards set out in Annex V.

The location of the point of emission or discharge of the effluent must be determined in the context of the environmental licence, avoiding alterations in the quality of the waters of the receiving environment and making it impossible to use its waters for other purposes. The discharge of domestic effluents into the receiving environment must comply with the standards set out in Annex IV (Table 7.3) of the same Regulation.

Table 7.3

Domestic liquid effluent emission standards referred to in Annex IV of the Regulation on Environmental Quality and Effluent Emission Standards

Parameters	Maximum permissible value	Units
Colour	Dilution 1:20	Presence/absence
Smell	Dilution 1:20	Presence/absence
pH, 25°C	6,0 – 9,0	Sorensen Scale
Temperature	35	°C
Chemical oxygen demand (COD)	150,0	mg/l O_2
Total suspended solids (TSS)	60,0	mg/l
Total phosphorus	10,0	mg/l
Total nitrogen	15,0	mg/l

7.5.6.2 Licensing of the uses

With regard to the licensing of the use of surface water resources, there is a set of requirements for obtaining a licence and concession for the use and exploitation of raw water and effluent discharges, approved in Decree No. 43/2007, of 30 October, represented in Table 7.4.

Table 7.4

Documents and information to be submitted in licence applications

Specifics	Requirements
Application for a licence or concession for the use and exploitation of raw water/ effluent discharges	• Identification of the owner or representative of the company; • Duly completed water use application form; • Business registration certificate; • Proof of the right to use and exploit the land (DUAT), even if provisional • Environmental licence for areas _ 100ha or other activities that by their nature pollute the environment • Location map/Sketch • Company by-laws or Official Gazette._ <u>Additional data:</u> • **Livestock:** indicate the number and type of animals; • **Agriculture:** indicate the area to be irrigated and the type of crop, • **Fish farming:** indicate the area and volume of water reservoirs; • **Industry**: indicate the activity, description of the installations, quantification of the effluents to be produced, means of treatment to be used and assessment of their environmental impact; • **Recreational industry**: indicate types, medium, equipment and present EIA study; • **Effluent discharge:** Identify the surface water or aquifer where it takes place and where to route if discharged on land; indicate the type, composition, volume and pre-treatment of the effluent.
Requirements for obtaining the concession for the use and exploitation of raw water and effluent discharge	In addition to the requirements set out under the heading "Application for a licence or concession for the use and exploitation of raw water/discharges of effluents", the application for a concession for the use and exploitation of raw water must comply with the Regulations described in Article 65 of Decree No. 43/2007, of 30 October, and it is therefore necessary for the application for a concession to be accompanied by the following information: • Location of the source of abstraction (geographical coordinates), level quotas, nature and periods of use, maximum volume to be utilised and minimum to be allowed to flow downstream; • Water volume measurement instruments; • Detailed description of the works to be carried out for the abstraction of water; • Authorised servitudes and temporary occupations, their duration and compensation to be paid for their establishment; • Description of possible flooding areas and their consequences; • Main works to be carried out to safeguard third party rights; • Deadline for commencement and completion of works and for commencement of operation.

For the implementation of the licensing and concession activities for the use and exploitation of raw water and discharge of effluents, it is important to consider the rights and duties of users, as well as the responsibility of ARA-Sul.

Thus, the user has the right to private use, which gives the holder the possibility, within the stipulated period, to make the use determined for him, and he may therefore carry out the appropriate works and, under the terms laid down, temporarily occupy neighbouring land and construct the necessary easements. This right is granted subject to pre-existing uses and the rights of third parties. If there is a shortage of abstraction and adduction equipment, an unforeseeable decrease in the flow or volume of water being used, or a miscalculation in the assessment of the flow, the user is entitled to a reassessment of the possibility of use. Modifications to the characteristics of the licence or concession may only be made with the prior and express authorisation of the granting authority.

In contrast, the general obligations of users are to:

- Respect the conditions laid down in the advisory act of entitlement;
- Use water in a rational and economical way, giving it only the defined destination;
- Make timely payment of the stipulated tariffs and financial charges;
- Participate in tasks of common interest, in particular those aimed at preventing the deterioration of the quantity and quality of water and soil;
- Provide the information requested, comply with the guidelines issued by the competent authorities and submit to the necessary inspections;
- Ensure the minimisation of environmental impact and, in particular, ensure water quality;
- espect the rights of other legitimate water users.

ARA-Sul's responsibilities are as follows:

- Planning, ensuring availability and balanced distribution of water resources (surface and groundwater).
- Control the use and utilisation of surface and groundwater, effluent discharge and other activities affecting water resources.

- Granting of usage rights and the imposition of related fees.
- Design, construction and operation of hydraulic infrastructures.
- Authorisation and inspection of hydraulic infrastructure.
- Provision of technical services for the public and private sectors.
- Collection and management of hydrological data.

The Regional Water Administration prepares notices or communications for the evaluation of the request with an invitation addressed to all those who may be prejudiced by the granting of the request. According to Article 31 of the said Regulation, if within 15 days there are no complaints that fulfil the requirements described in Article 33, the decision is taken into consideration:

- Whether sufficient water resources are available;
- Whether the use and exploitation or discharge of effluent does not affect existing water management plans and programmes;
- Whether it does not involve the use of reserve or protected waters depending on the need to supply water to the population for human consumption, fulfilment of sanitary needs and protection of the environment;
- Whether it does not affect water quality and pre-existing rights.

7.6 SOILS AND USE CAPACITY

7.6.1 Methodological Framework

The work carried out to characterise the soils present in the Namaacha Power Plant study area was based on the Soil Chart for Maputo Province at 1/1 000 000 scale of INIA/DTA and its explanatory legend. As for the land use capacity, the explanatory legend of the soil map and the WebGIS of Mozambique developed by Embrapa were used as a basis, namely the drainage map and the agricultural suitability maps.

7.6.2 Soils

The Namaacha Power Plant site is located in the Southern Interior Semi-arid agro-ecological zone.

The predominant soils in the Namaacha region, and specifically in the area for the implementation of the Project, according to the soil chart for Maputo Province, are:

- RI - Lithic rhyolitic soils (*Eutric Leptosols*);
- RI + RV - Lithic rhyolitic soils (*Eutric Leptosols*) + Red rhyolitic soils (*Ferric Lixisols*);

Lithic rhyolitic soils are characteristically Karroo, yellowish brown, topsoil over altered rock, with a sandy loam and sandy loam texture, with a depth of less than 30 cm over altered rock and with moderate drainage.

Red rhyolitic soils are characteristically Karroo rhyolite soils, dark reddish brown, variable depth, sandy loam and clay loam texture, soils between 30 and 150 cm deep over altered rhyolite with good to moderate drainage.

Figure 7.21 illustrates the type of soils that occur in the area surrounding the Namaacha Power Plant Project site. IR dominates much of the project area, with only a small area to the south of the project site near the Gumbe River comprising the IR + RV soil complex.

Figure 7.21 and Photo 7.3 illustrate the type of soils that occur in the area where the Namaacha Power Plant will be located.

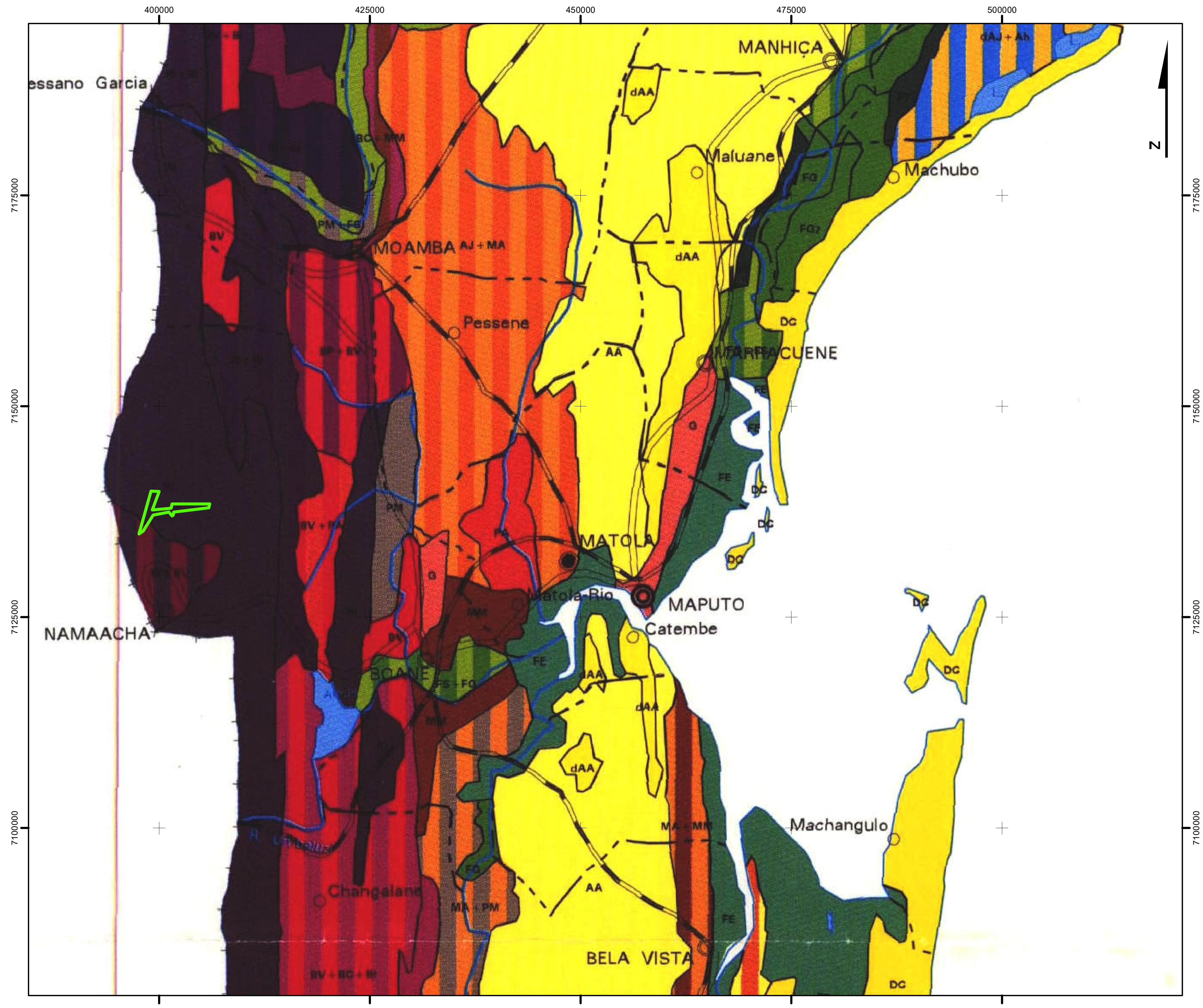
Photo 7.3 - Appearance of soils in the Namaacha Power Plant site area

7.6.3 Soil Use Capacity

In terms of Soil Use Capability, also called by the explanatory legend of the soils as Land Aptitude, in the intervention area for the implementation of the Namaacha Power Plant Project, the lithic rhyolitic soils, present as main agricultural limitation, the depth of the soil. As for the agricultural suitability for rainfed (adapted from the USDA system), this is considered with suitability for forest and nature reserve, having as main limitation the topography and depth.

In the agricultural suitability for irrigation (adapted from the USBR system), this is not recommended, it is considered potentially, having as main limitation the topography, coarse fragments of the surface and the depth of the soils.

As for the red rhyolitic soils, at the site of the Namaacha Power Plant Project, the main agricultural limitations are erosion (slopes) and soil depth (<1 m). Regarding the agricultural suitability for rainfed (adapted from the USDA system), it is considered moderately suitable, with the main limitation being topography and soil depth. As regards the agricultural suitability for irrigated land (adapted from the USBR system), it is considered marginally suitable, with topography and soil depth as the main constraints.



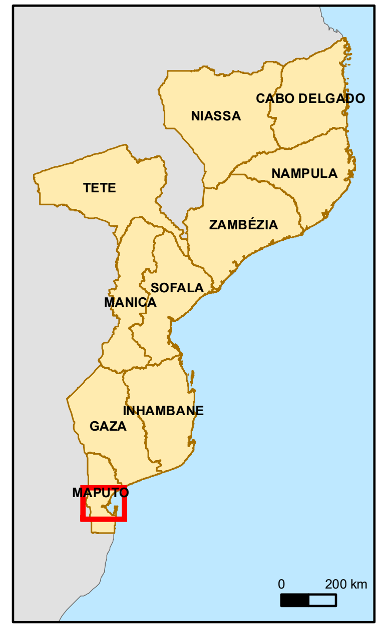
Fonte: Extrato da Carta de Solos da Província de Maputo, escala 1:1 000 000, INIA/DTA, 1994

Escala 1:500 000

0 10 20 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

Enquadramento Nacional



Limite de Província

LEGENDA

Área de Estudo

Unidades Pedológicas

Solos rioliticos liticos (Eutric Leptosols)

Solos rioliticos liticos (Eutric Leptosols)
+
Solos Rioliticos Vermelhos (Ferric Lixisols)

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Figura 7.21 - Unidades Pedológicas

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Taking into account the regional context, as far as agricultural practices are concerned, these soils in the work carried out by the company Embrapa (WebGIS Mozambique), were considered with the following suitability:

- No suitability for maize, soya, cassava, rice, groundnuts and cotton.

In other words, although there are water resources available (it rains all year round), the soils are poor, and consequently not suitable for agriculture. In fact, there are only a few fields near the village of Macuacua, and in the rest of the territory there is uncontrolled deforestation and burning, which has already caused problems of aridity in some areas.

7.7 SOIL USE

In the Area of Direct Influence, and in its closest surroundings, the observed occupation is predominantly natural, although marked by the artificialisation caused by human presence, namely by the use for various activities, such as agriculture and grazing.

The field work in the study area allowed to verify that the vegetation is degraded, being visible in some places marks of several burnings that are still noticeable in the terrain. The main vegetation in the study area is savannah of trees and/or shrubs with some patches of forest, and there are still remnants of the main species of the original vegetation. This vegetation type occurs at moderate altitudes, between 350 and 800 m (see Photo 7.4 and 7.5).

Photo 7.4 - View to Area of Direct Influence.

Photo 7.5 - View to Area of Direct Influence.

The legend adopted in the characterisation of the Area of Direct Influence seeks to reflect the main uses to which the land in that area is currently subject. As major classes, "Artificialised areas", "Agricultural areas", "Forest areas" and "Natural and semi-natural areas" were considered (see Figure 7.22). The typologies of the identified areas are described below, as well as the main subclasses that integrate them.

Table 7.5 shows the total and relative areas of each land use class and subclass for the Area of Direct Influence of the Namaacha Power Plant. These can be seen in Figure 7.22, where the current land uses are mapped.

Table 7.5

Soil use classes and subclasses in the Area of Direct Influence

Soil uses	**Area (ha)**	%
Artificialised areas	**10,42**	**1,2%**
Social areas	2,51	0,3%
Paths	7,91	0,9%
Agricultural areas	**45,2**	**5,3%**
Farms	45,2	5,3%
Forest areas	**7,77**	**0,9%**
Tropical and subtropical moist broadleaved forests	7,77	0,9%

Table 7.5 (Continued)

Soil use classes and subclasses in the Area of Direct Influence

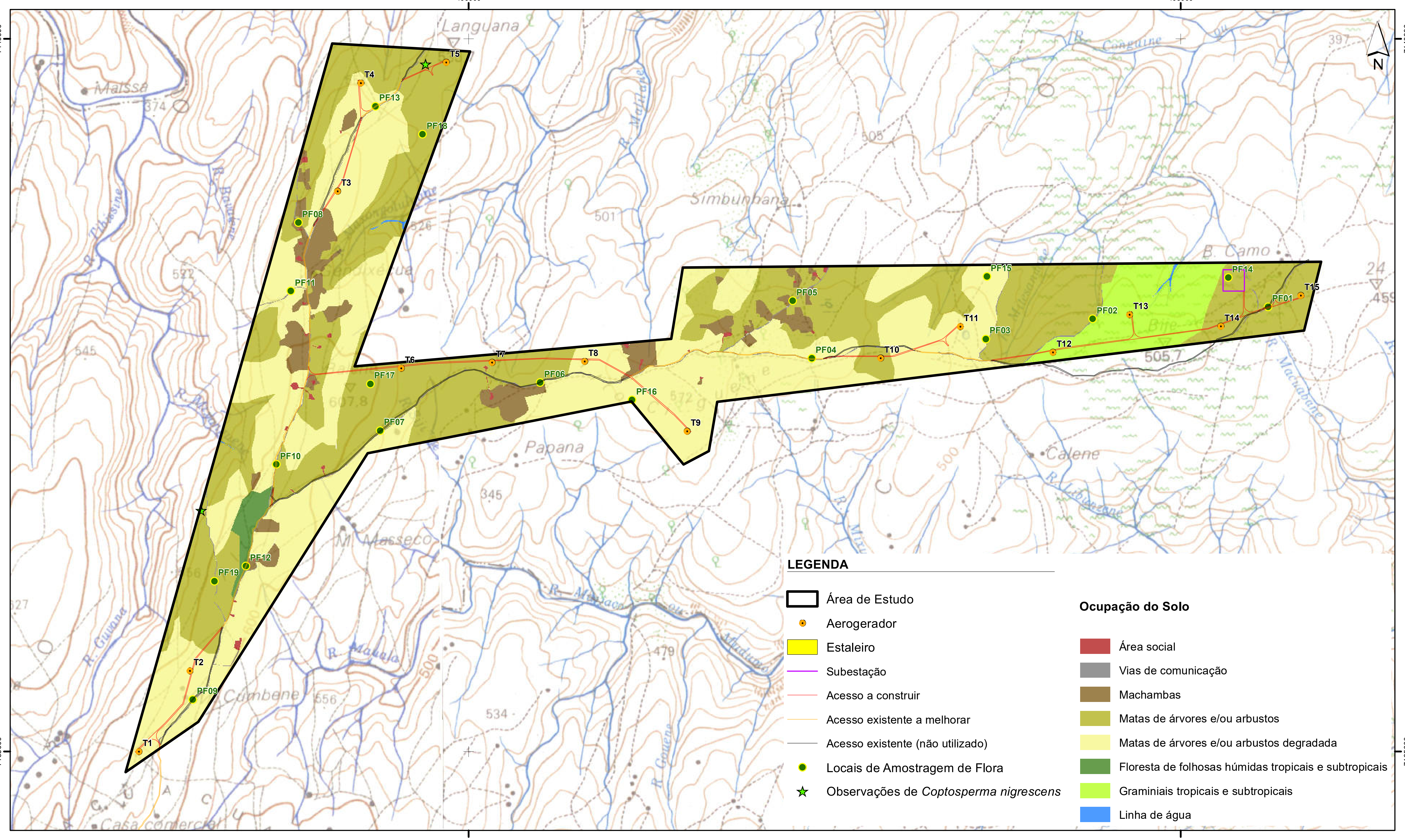
Soil uses	Area (ha)	%
Natural and semi-natural areas	**791,73**	**92,6%**
Tropical and subtropical graminaceous	52,05	6,1%
Water line	0,73	0,1%
Tree and/or shrub thickets	372,58	43,6%
Degraded Tree and/or shrub thickets	366,37	42,8%
Total	**855,12**	**100,0%**

In the Area of Direct Influence, the occupation class "Natural and semi-natural areas" predominates, with approximately 791.73 ha. approximately 791.73 ha, which corresponds to about 92.6% of the area.

The dominant subclasses are "Tree and/or shrub thickets" and "Degraded Tree and/or shrub thickets", namely with 86.4% occupation of the area, followed by the subclasses "Tropical and subtropical graminaceous" and "Farms" that present 6.1% and 5.3% occupation of the study area, respectively.

Artificialised areas

In the study area, the subclasses "Social areas" and "Paths" were identified. The social areas correspond to the dwellings that are scattered along the existing paths, the paths being dirt and without any drainage system (see Photographs 7.6 and 7.7). Some of these dwellings are for permanent use, others are temporary and are used for stays in the context of grazing.



Fonte: Extracto da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000

0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Figura 7.22 - Ocupação do Solo e Locais de Amostragem de Flora

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Photo 7.6 - Subclass "Social areas"

Photo 7.7 - Subclass "Paths"

Agricultural areas

In this class were identified the farms, which consist of small agricultural plots, where rainfed agriculture is practised with subsistence crops located next to the paths and in the surroundings of some of the dwellings. The main crops observed in the Area of Direct Influence include maize, sweet potato, cassava, millet, various types of beans, pumpkins and watermelon (see Photo 7.8). Some cattle and goat grazing was also observed (see Photo 7.9).

Photo 7.8 - Subclass "Farms"

Photo 7.9 - Presence of livestock

Forest areas

This class contains only the subclass "Tropical and subtropical moist broadleaved forests". This subclass is presented in the form of a small patch that is located next to a path in the southwestern part of the Area of Direct Influence. It corresponds to a remnant patch of forest that has been subject to some disturbance, namely vegetation cutting, but still retains its characteristic specific composition (see Photo 7.10).

Photo 7.10 - Subclass "Tropical and subtropical moist broadleaved forests".

Natural and semi-natural areas

Four subclasses "Tropical and subtropical graminaceous", "Water line", "Tree and/or shrub thickets" and "Degraded tree and/or shrub thickets" were identified in this subclass (see Photos 7.11 to 7.14).

The subclass "Tropical and subtropical graminaceous" is dominated by herbaceous species that are mostly located on sandy soils and with the presence of rocks.

As for the subclass "Water line", only two small water lines with a temporary and torrential character were identified, with scarce vegetation on their banks.

The subclass " Tree and/or shrub thickets" is composed mainly of acacia species in tree/shrub layer and in some areas the presence of *Combretum sp.* species is also observed, also in tree/shrub layer. The tree/shrub strata are not very dense, covering about 50% of the area. Acacia species are resilient and regenerate after disturbances, namely cutting, fire or grazing.

As for the sub-class "Degraded tree and/or shrub thickets" identified in the Area of Direct Influence, it corresponds to acacia woodland in a degraded phase. This class is closely associated with the economic activity of grazing. The presence of cattle demonstrates the maintenance of the tradition of livestock breeding, not only for domestic consumption, but also for the use of animal traction. Nowadays it is also beginning to be observed for commercial use (see Photo 7.9).

Photo 7.11 - Subclass "Tropical and subtropical graminaceous"

Photo 7.12 - Subclass "Tree and/or shrub thickets"

Photo 7.13 - Subclass "Tree and/or shrub thickets"

Photo 7.14 - Subclass "Degraded tree and/or shrub thickets"

7.8 ECOLOGY

7.8.1 Methodology

The characterisation of the ecological systems in the study area was carried out using bibliographic consultation and field prospection. The methodologies used in this study follow international best practices in wind farm impact assessment, namely the general recommendations of the following documents: "Environmental, Health and Safety Guidelines for Wind Energy" (IFC, 2015), "Minimum Requirements for Avifaunal Impact Assessment for Wind Energy Facilities" (BirdLife South Africa &

& Endangered Wildlife Trust, 2013) and "Best Practice Guidelines for assessing and monitoring the impact of wind energy facilities" (IFC, 2015) & Endangered Wildlife Trust, 2013) and "Best Practice Guidelines for assessing and monitoring the impact of wind energy facilities on birds" (Jenkins *et al.*, 2015).

7.8.1.1 Literature review

The literature review provided a more complete list of species for the study area, making it possible to overcome the limitations of sampling methods that do not allow the detection of all species actually present in the study area. The main bibliographic sources used to obtain the floristic and faunistic lists of the study area are listed in Table 7.6.

Table 7.6
Main bibliographical sources used

Group	Source
Flora and vegetation	Flora of Mozambique (Hyde *et al.*, 2019)
	Wild Flowers of Southern Mozambique (Bandeira *et al.*, 2007)
	Southern African Plant Red Data List (Izidine & Bandeira, 2002)
Amphibians and reptiles	Field Guide to Snakes and Other Reptiles in Southern Africa (Branch, 1998)
	Frogs and Frogging in South Africa (Carruthers & du Preez, 2011)
	The reptile database (Uetz *et al.*, 2019)
	Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland (Bates *et al.*, 2014)
Birds	Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world (HBW & BirdLife International, 2018)
	The Atlas of the Birds of Sul do Save, Southern Mozambique (Parker, 1999)
	Southern African Bird Atlas Project 2 (University of Cape Town, 2019)
	Endemic Bird Areas (Birdlife International, 2019a)
	eBird (eBird, 2019)
	Vulture strongholds and key threats: a mapping exercise to guide vulture conservation in Africa (Buij *et al., in prep*).
	Multi-species Action Plan to Conserve African-Eurasian Vultures (Botha *et al.*, 2017)
	African Raptor DataBank (Habitat INFO, 2019)
Non-flying mammals	Mammals of Southern Africa (Stuart & Stuart, 2015)
Bats	Bats of Southern and Central Africa (Monadjem *et al.*, 2001)
All the groups	IUCN RedList (IUCN, 2019)

The source of the terminology and nomenclature used for each faunal group varies, as listed below:

- Flora and vegetation: Flora Zambesiaca (Kew, 2019);
- Amphibians and reptiles: IUCN RedList (IUCN, 2019) and Catalogue of Life (Roskov et al., 2019);
- Birds: Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world (HBW & BirdLife International, 2018);
- Non-flying mammals: IUCN RedList (IUCN, 2019);
- Bats: IUCN RedList (IUCN, 2019) e Bats of Southern and Central Africa (Monadjem et al., 2001).

7.8.1.2 Expert consultation

Given the high vulnerability of birds and bats to the impacts associated with the installation of wind farms and the limited public information available for this community in Mozambique, international experts working with threatened species (i.e., with conservation status "Critically Endangered" (CR), "Endangered" (EN) and "Vulnerable" (VU), according to IUCN, 2019, potentially present in the study area, were consulted in order to complete the baseline information for the bird community. Table 7.7 shows the researchers consulted in this context, who provided data relevant to this study.

Table 7.7
Researchers consulted

Researcher/Entity	Expertise
Dr. Andre Botha (Endangered Wildlife Trust), South Africa	Vultures and other threatened species
Dr. Matt Pretorius (Endangered Wildlife Trust), South Africa	Lesser flamingo
Prof. Ara Monadjem (Eswatini University), Eswatini	Cape Goba vulture colony and bat shelters
Dr. Chris Kelly (Wildlife ACT), South Africa	Vultures and other threatened species
Prof. Arjun Amar & Dr. Megan Murgatroyd (Fitzpatrick Institute of African Ornithology, University of Cape Town), South Africa	Martial eagle and other threatened species

7.8.1.3 Field surveys

Sampling frequency

Table 7.8 shows the expected sampling seasons for each of the ecological groups sampled.

Table 7.8

Sampling planned in the Namaacha Power Plant study area

Activities	2018			2019								
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flora and vegetation												
Inventories												
Amphibians and reptiles												
Camarooing, day and night transects												
Birds												
Birds in general												
Birds of prey and other gliders												
Waterbirds												
Nests survey												
Night birds												
Non-flying mammals												
Day and night transects												
Bats												
Automatic detection												
Active detection												
Shelter survey												
Nebula nets												

- Flora and vegetation

Flora and vegetation were sampled in the dry season, campaign carried out between 26 and 29 October 2018, and wet season, campaign carried out between 17 and 20 February 2019. Vegetation was primarily mapped in the dry season and then adjusted based on the landscape observed in the wet season.

- Amphibians and reptiles

The herpetofauna was sampled in the dry season, campaign carried out between 26 and 29 October 2018, and wet season, campaign carried out between 17 and 20 February 2019.

- Birds

Regarding the inventory of the bird community in the field, 6 sampling campaigns were carried out between October 2018 and August 2019, on the dates mentioned in Table 7.9, which correspond to the characterisation of the baseline situation.

Table 7.9

Dates of bird sampling

Year	Month	Dates
2018	October	26 to 29
	December	8 to 10
2019	February	17 to 20
	April	24 to 26
	June	25 and 26
	August	20 to 22

The sampling period encompasses the breeding season of most threatened species with resident phenology in the region (Table 7.10) and the period of occurrence of the steppe eagle (*Aquila nipalensis*) as a migratory species, which will only be present in the region between October and April. It also includes the dry season (October, June and August) and the wet season (December, February and April), with a similar number of campaigns.

Table 7.10

Breeding season for threatened species potentially resident in the region

Common name	Scientific name	Breeding season
Secretary bird	*Sagittarius serpentarius*	All year round
White-headed vulture	*Trigonoceps occipitalis*	May to October
Hooded vulture	*Necrosyrtes monachus*	June to September
White-backed Vulture	*Gyps africanus*	April to September
Cape Vulture	*Gyps coprotheres*	April to July
Lappet-faced vulture	*Torgos tracheliotos*	May to September
Martial eagle	*Polemaetus bellicosus*	January to August
Tawny eagle	*Aquila rapax*	April to July
Southern ground hornbill	*Bucorvus leadbeateri*	August to January

Sampling took place as planned, with the exception of the sampling of transect 14, aimed at the passerine group, which could not be carried out in April and June.

- Non-flying mammals

Non-flying mammals were sampled in the dry season, campaign carried out between 26 and 29 October 2018, and the wet season, campaign carried out between 17 and 20 February 2019.

- Bats

Taking into account the scarcity of information on bats in Mozambique, for the inventory of species and determination of activity in the study area, a set of complementary techniques was selected in order to obtain as much information as possible. Thus, acoustic sampling with manual detectors (at ground level), acoustic sampling with automatic detectors (at ground level at height), sampling with nebula nets and prospection of shelters were carried out.

In the acoustic sampling with automatic detectors, six campaigns were carried out between October 2018 and March 2019, sampling seven nights per month (Table 7.11).

In the case of the shelter survey, acoustic sampling with hand-held detector and nebula nets, two sampling campaigns were carried out, one in the dry season (October) and one in the wet season (February).

Table 7.11

Dates of bat sampling

Sampling type	Month/Year	Sampling period	No. of nights sampled
Acoustic detection at ground level	October 2018	25/10 to 26/10	2
	February 2019	18/2 to 19/2	2
Acoustic detection with automatic detectors	October 2018	26/10 to 2/11	7
	November 2018	10/11 to 17/11	7
	Decembre 2018	1/12 to 8/12	7
	January 2019	7/1 to 14/1	7
	February 2019	1/2 to 8/2	7
	March 2019	1/3 to 8/3	7
	April 2019	1/4 to 8/4	7
Nebula nets	October 2018	27/10	1
	February 2019	20/2	1
Shelter survey	October 2018	28/10	-
	February 2019	18/2 to 20/2	-

- Ecosystem services

Data were collected to support the assessment of ecosystem services in all field trips carried out, but more systematically in the campaigns carried out between 26 and 29 October 2018, and between 17 and 20 February 2019.

Sampling sites

- Flora and vegetation

Flora surveys were carried out at a total of 19 sites (see Figure 7.22). Other species observed on the routes between sampling sites were also recorded. The vegetation units present in the study area were identified, characterised and mapped throughout the study area during the fieldwork.

- Amphibians and reptiles

The herpetofauna was sampled based on 13 short transects of about 100 m, six long transects of about 500 m and three night transects (see Figure 7.23). The presence of water points in the study area was prospected, only one water point was found that allowed the realisation of amphibian sampling, as identified in subchapters 7.4.3 and 7.5.4, (see Figure 7.23). All observations made along the routes between sampling sites were also recorded.

- Birds

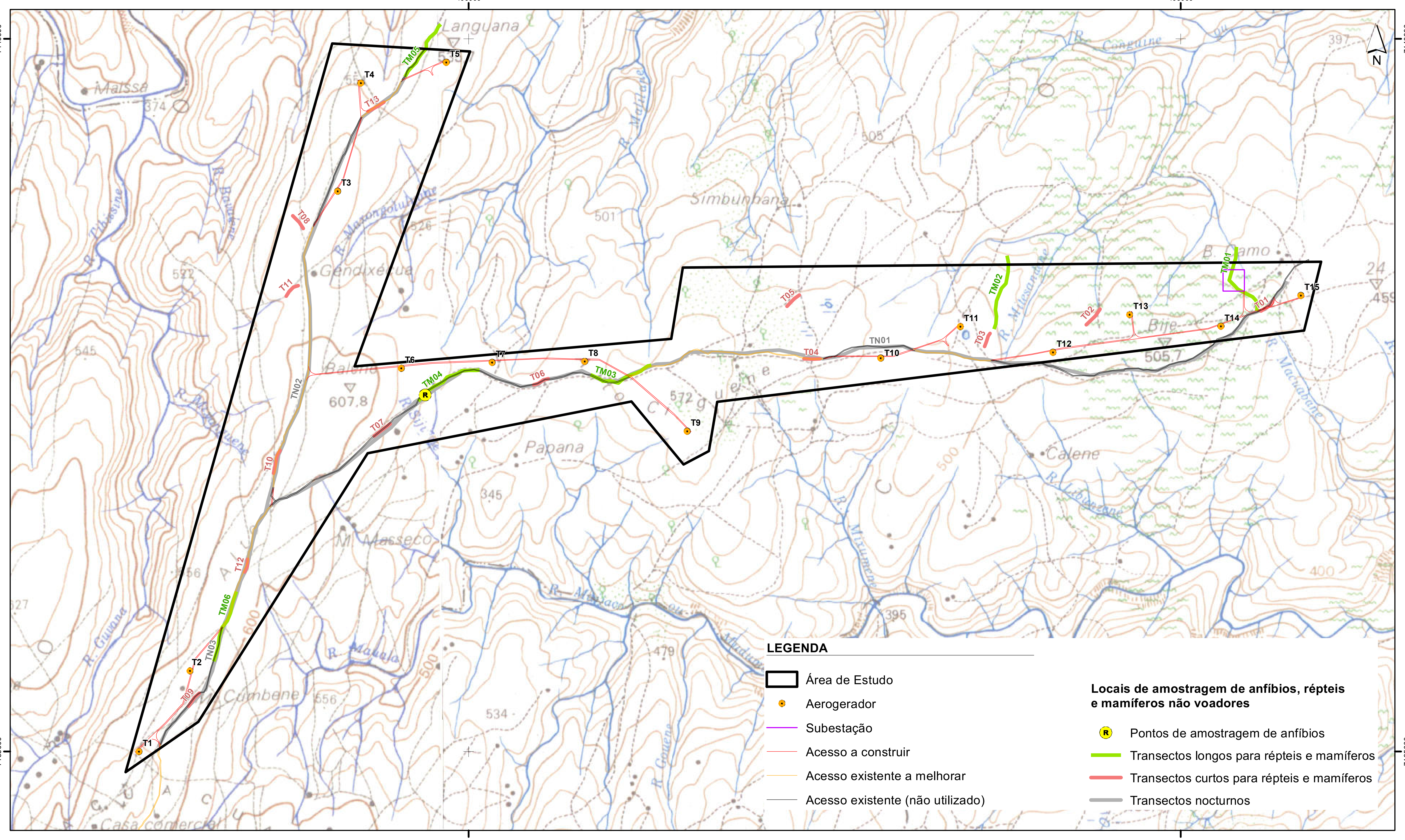
The inventory of the bird community on the ground was carried out using specific sampling methods for each group of species susceptible to wind farm impacts: passerines, birds of prey and other gliding birds, water birds and night birds.

Passerines (birds in general)

For the sampling of passerines (and other birds in general) 14 pedestrian transects were carried out (Figure 7.24) distributed among the different vegetation types according to their representativeness (percentage cover) in the study area (Bibbly et al., 2000) - most transects sampled areas of acacia woodland, degraded acacia woodland, acacia and C*ombretum* spp. woodland, agricultural and graminial areas.

Birds of prey and other gliders

Birds of prey and other gliders were sampled using observation points, which, given the relatively gentle terrain of the study area, were placed on the highest points of the terrain so that the entire surrounding area could be seen (Hardey *et al*., 2006) (Figure 7.24). At least one of the observation points in the western part of the study area provided a good view of the narrower and relatively less disturbed valley in this area.



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000

0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.23 - Locais de Amostragem de Anfíbios, Répteis e Mamíferos não Voadores

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In all campaigns, an effort was made to search for breeding sites of these species throughout the study area and nearby surroundings, where particular attention was paid to large trees, areas with denser vegetation and rocky valleys (as mentioned above).

Waterbirds

Waterbird sampling was carried out at an observation point located at a small dam (with artificialised banks) about 3.5 km south of the study area boundary (Figure 7.24), as it was concluded that there were no permanent water bodies or humid zones suitable for use by waterbirds in the project area. However, it should be noted that there are several small to large dams within a 30 km radius of the study area, namely two small dams about 3.5 and 4 km to the south-west near Mbuzini (South Africa), which were not monitored due to logistical issues related to their location in neighbouring countries and/or because they are distant. The most representative water bodies surrounding the study area are a medium-sized dam and associated humid zone about 14 km to the west, near Masibekela (South Africa); the "Pequenos Libombos" dam about 24 km to the south-east, near Mafuta (Mozambique); the Sand River (RAMSAR site) and Mnjoli dams about 27 km and 39 km south-west, respectively, between Tjaneni and Mliba (Eswatini), and the Driekoppies dam about 47 km north-west, near Schulzendal (South Africa). Also noteworthy is the presence of the Komati River about 18 km to the west in South Africa, the Matola River about 37 km to the east in Mozambique, the Incomati River about 37 km to the north in Mozambique, and the mouth of the Umbuluzi River about 44 km to the southeast, near Maputo Bay in Mozambique.

Nocturnal birds

The sampling of nocturnal birds was carried out on 3 road transects distributed over the different vegetation types throughout the study area (Figure 7.24).

- Non-flying mammals

Non-flying mammals were sampled on the basis of 13 short transects of about 100m, six long transects of about 500m and three night transects (see Figure 7.23). All observations made along the routes between sampling sites were also recorded.

- Bats

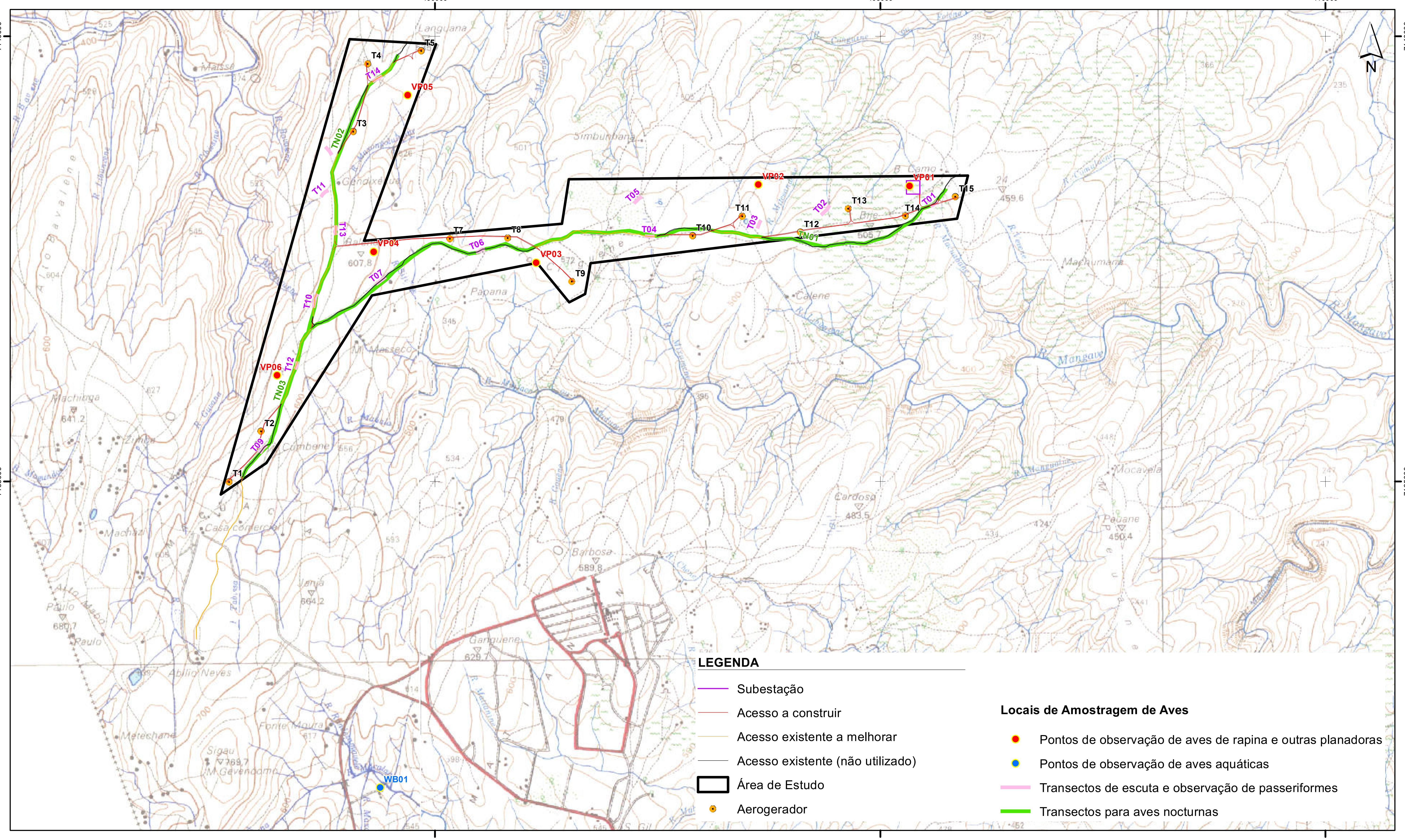
Acoustic sampling with a hand-held detector was carried out at ground level, at 22 fixed points distributed throughout the study area to cover the main vegetation units (Figure 7.25).

It should be noted that the morphology of the area is quite homogeneous, so the small differences that exist were not taken into account in the distribution of sampling sites. In addition, although there are no real forest patches in the study area, some of the points were located next to small groups of trees and/or corridors of shrubby vegetation, vegetation typologies frequently used by several bat species, such as those of the genera *Hipposideros and Rhinolophus*.

At the time of the fieldwork, there was no meteorological mast in the study area, so the acoustic sampling with automatic detectors was carried out on a mast located about 3km south of the study area (Figure 7.25), with the microphones placed at two different heights (3 and 30m high). Taking into account the lack of riparian vegetation in the study area, water lines or ponds, the sampling with nebula nets was carried out on existing paths, in areas where the vegetation structure originates corridors (Figure 7.25). The selection of sites also took into account the results of the acoustic sampling previously carried out.

- Ecosystem services

Information was collected mostly on production services throughout the study area by observation of traditional uses, but also from the population, namely the régulo, neighbourhood secretary and other inhabitants on the basis of non-systematic informal interviews with the population carried out during the fieldwork.



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:40 000

0 0,5 1 1,5 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.24 - Locais de Amostragem de Aves

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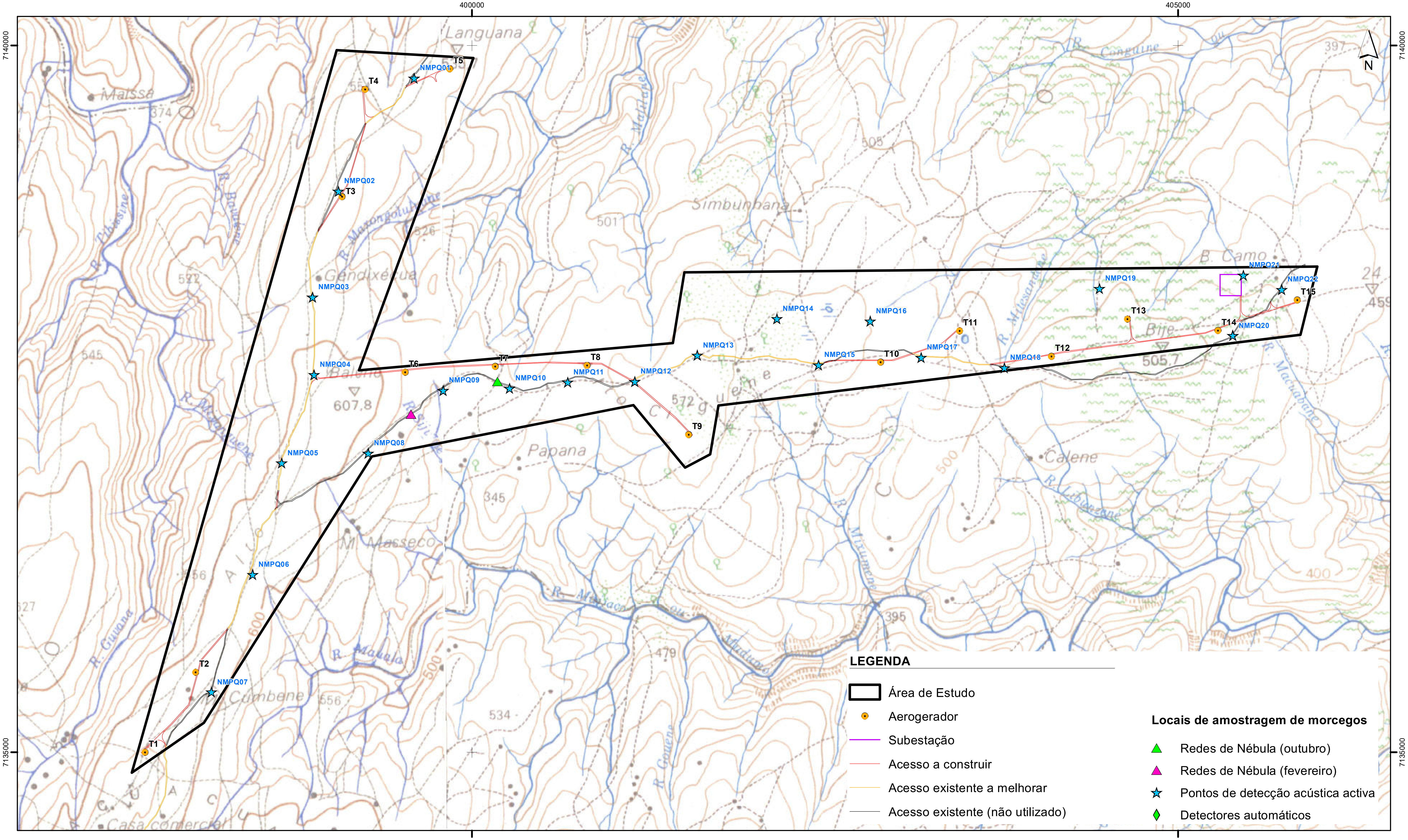

Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000

0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

T01717_14_V0_Fig7_25.mxd(A3)

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.25 - Locais de Amostragem de Morcegos

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Sampling techniques

- Flora and vegetation

The flora of the study area was sampled using two methods: long linear transects of 500 m and short transects of about 100 m in length. The transects were distributed across the different vegetation units present in the study area.

In each transect the flora species present were inventoried and the degree of coverage of each of the strata present (arboreal, shrub, herbaceous and bare soil) was recorded. Whenever it was not possible to identify the species in the field, they were collected and taken to the herbarium of Eduardo Mondlane University in Maputo for further identification based on other specimens in the collection and reference works, such as Flora Zambesiaca. All species, both those identified in the field and those identified in the herbarium, were integrated in the flora list presented in this document.

The vegetation of the study area was mapped and characterised in terms of the dominant species that make up each vegetation unit and their conservation status.

- Amphibians and reptiles

Amphibians were sampled by visual prospection and water point camaroeing present in the study area.

Reptile sampling was carried out on the basis of long linear transects of 500 m and short transects of about 100 m in length. Along these transects dry areas with exposed rocks, mature trees with holes in their trunks and under rocks were surveyed.

Both amphibians and reptiles were also sampled along night transects travelled by car at low speed, about 10 km/h, along which the presence of amphibians and reptiles crossing or resting on paths was surveyed.

- Birds

The sampling methodology varied according to the species group, as described below. It is also noted that, in addition to the observations collected during the implementation of these specific methodologies, all species observed during the periods that the technical team remained in the field were also recorded.

Passerines (birds in general)

The bird surveys in general consisted of pedestrian transects about 100m long and lasting 10 minutes, which allowed adequate detection of all birds using these open spaces dominated by herbaceous vegetation, in particular passerines but also all other species.

In each sampling campaign, the observer travelled to the beginning of each transect with the aid of GPS and, before starting the count, remained still and silent for a few minutes, in order to allow the return of birds potentially scared away by his presence (Sutherland, 1996). He then walked each transect at a maximum speed of 2 km/h during the census period and recorded, with the aid of binoculars, all birds observed and heard, by species and respective number of individuals, by distance class to the transect (<50 m; 50-100 m; >100m) (Bibby et al., 2000). The following parameters were also collected per transect: date and time of the transect, observer, duration of the count and abiotic conditions during the transect (temperature, wind direction and speed, presence of rain and cloudiness).

All sampling was carried out during the periods of highest passerine activity, i.e. the first 3 to 4 hours after sunrise and the LAST hour before sunset (Bibby *et al*., 2000).

Birds of prey and other gliders

Sampling of birds of prey and other gliders was based on the realisation of observation points lasting 1 hour, with no fixed distance limit, in order to determine the use of the study area by this group.

At each sampling and campaign point, all birds observed and their movements in the study area were recorded with the aid of binoculars and a telescope. For each observation, the species and the number of individuals observed, their age and sex, their behaviour, flight height and direction, as well as movement mapping were recorded. The following parameters were also collected per observation point: date and time of the observation, observer and abiotic conditions (temperature, wind direction and speed, presence of rain, cloudiness and visibility).

All observation points were carried out during the hottest hours of the day, with the exception of the hours of extreme heat, since the formation of rising thermal currents begins, which are used by this group to move in the field.

All areas with potential for nesting of these species were also pre-identified in GIS and prospected in the field in all sampling campaigns, but no nests or evidence of breeding were detected in the study area.

Waterbirds

Waterbird sampling was carried out for at least 15 minutes at the small dam in the vicinity of the study area in all sampling campaigns. With the aid of binoculars and telescope, all waterbird observations were recorded, including the species and number of individuals, but also movements to and from the water body. The date and time of sampling, the duration of sampling, the observer and the abiotic conditions under which the transect was carried out (temperature, wind direction and speed, presence of rain, cloudiness and visibility) were also noted.

Nocturnal birds

Sampling of nocturnal birds was carried out once in each season (dry and wet) on nocturnal road transects of approximately 3.5 km, 4.7 km and 7 km in length, at reduced speed, to allow recording of all birds observed and heard. For each observation the species and the number of individuals were recorded. The date and time of sampling, the observer and the abiotic conditions in which the transect was carried out (temperature, wind direction and speed, presence of rain, cloudiness and visibility) were also recorded.

These samplings started at least 15 minutes after sunset and ended up to two hours after sunset.

- Non-flying mammals

Non-flying mammals were sampled based on long linear transects of 500 m and short transects of about 100 m in length. Along these transects, signs of presence such as droppings, footprints, carcasses or tracks were searched for.

This faunal group was also sampled using night transects travelled by car at low speed, about 10 km/h, along which the presence of mammals was surveyed using torches.

- Bats

As mentioned above, the scarcity of data on bats in Mozambique led to the use of several complementary techniques in the sampling of this faunal group, in order to determine which species are present in the study area and their activity. The following is a brief description of the techniques used.

Acoustic detection with hand-held detectors

Acoustic detection with hand-held detectors was carried out at ground level, at several points distributed throughout the study area. These samplings took place at night, over a maximum period of 4 hours, starting 30 minutes after sunset. Sampling at each point lasted 5 minutes.

A Pettersson Elektronick AB model M500-384 USB microphone (frequency range 10 to 160 kHz; sampling frequency up to 384 kHz) coupled to a laptop computer with the BatSound Touch 1.3 programme, also from Pettersson Elektronik AB, was used for these samples. Sampling was carried out by continuously recording the 5 minutes.

At the beginning of each sampling, temperature and wind data (intensity and orientation) were also collected at ground level with a SKYMATE SM-18 pocket anemometer from Speedtech Instruments and a compass.

Acoustic detection with automatic detectors

In the acoustic detection with automatic detectors, Wildlife Acoustics equipment was used, namely two detectors, model SM4BAT FS (see Photo 7.15) and two SMM-U2 microphones. As previously mentioned, the equipment was installed on a meteorological mast, with the microphones sampling two different heights (3 and 30 m above the ground), being orientated towards the study area.

Photograph 7.15 - Automatic detectors installed on the meteorological mast

Sampling took place throughout the night, starting 30 minutes before sunset and ending at sunrise, and the detectors were programmed to record all detected contacts, i.e. with no interval between two consecutive recordings, in files of a maximum duration of 3 seconds. The settings of the detectors were as follows:

- Gain: 12dB;
- Filter below 16kHz: no;
- Sampling rate: 384kHz;
- Minimum duration: 1.5ms;
- Maximum duration: none;
- Minimum trigger frequency: 10kHz;
- Trigger intensity: 12dB;
- Trigger window: 3s;
- Maximum duration: 3s.

Mist nets

Sampling with nebula nets was carried out at two different sites. As previously mentioned, given the lack of vegetation types in the study area that are most suitable for this type of sampling (ponds and small watercourses, riparian vegetation corridors, corridors in forested areas, etc.), they were carried out on the paths, in areas where the vegetation originates small corridors (Figure 7.26, Figure 7.27). The results of the acoustic sampling carried out previously were also taken into account.

Nylon nets of 6 and 9 m in length were used (16x16 mm mesh nets, with 5 pockets and 2.5 m high, Ecotone models 716/6 and 176/9). Sampling took place during the first 3 hours after sunset.

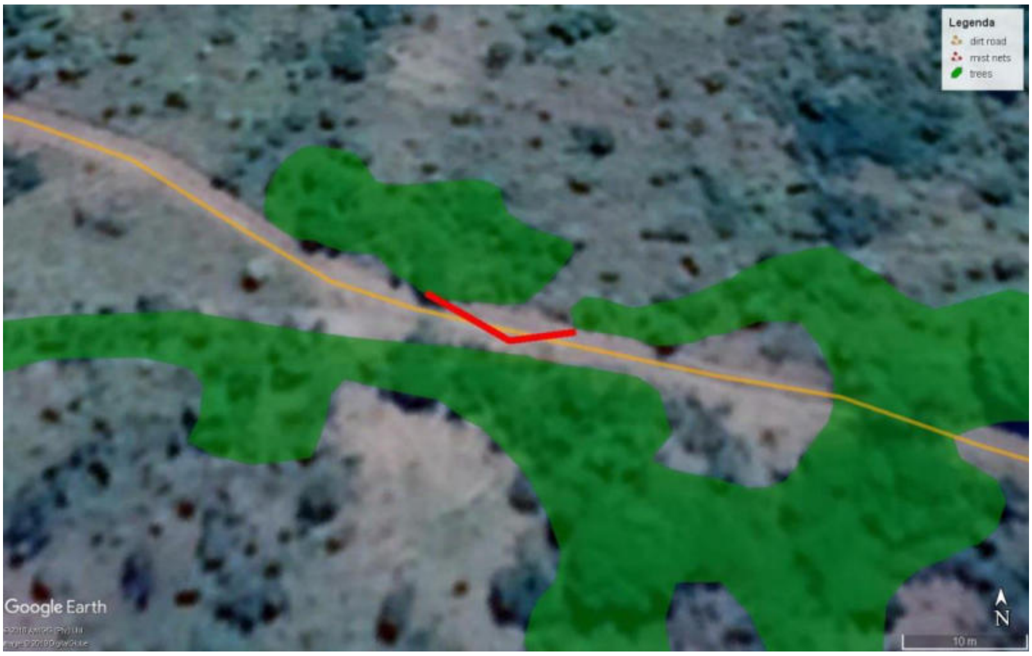


Figure 7.26 - Nebula net sampling scheme used in the October 2018 campaign (s/e)

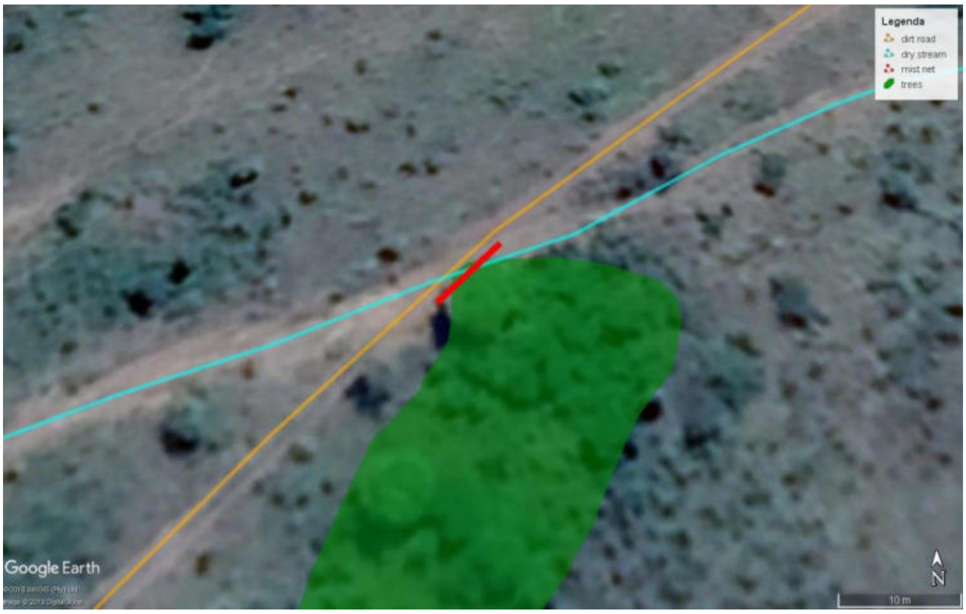


Figure 7.27 - Nebula net sampling scheme used in the February 2019 campaign (s/e)

Shelter survey

With regard to shelters, sampling was directed towards abandoned human constructions, larger trees and small forest patches existing in the study area and surroundings.

The survey of the sites to be sampled was done by consulting aerial photography (Google Earth), interviews with the local population and transects by car and on foot. Whenever possible, visits were made to the potential shelters referenced, with the aim of detecting the presence of bats and signs of their presence on site (guano, corpses, etc.).

- Ecosystem services

Information regarding production ecosystem services was collected from surveys of the local population.

Data analysis and processing techniques

- Flora and Vegetation

The collected information regarding the vegetation units was entered into a GIS environment in order to allow the production of a final cartography of the entire study area.

For each sampling site and identified vegetation unit the total specific richness (number of species), number of sensitive species (threatened or endemic) and number of alien species will be calculated.

- Herpetofauna

SSpecies richness (number of species) and abundance per sampling site will be calculated.

- Avifauna

Passerines (birds in general)

In order to characterise the avifauna community present in the study area, the parameters evaluated, in particular the passerines, were the relative abundance per species, per season and per biotope (mean number of individuals up to 100 m distance from the transects) and the relative specific richness per season and per biotope (mean number of species up to 100 m distance from the transects).

Birds of prey and other gliders

For the characterisation of the community of birds of prey and other gliders that use the study area, the absolute abundance per species (average number of contacts per season), relative abundance per point and season (average number of contacts per point) and relative specific richness per point and season (average number of species per point) were analysed, but a spatial analysis was also carried out in GIS, which allowed the mapping of the most used areas by species, by behaviour and by flight height.

Waterbirds

Parameters assessed for waterbirds were limited to total abundance (number of individuals) and total specific richness (number of species).

Nocturnal brids

For nocturnal birds, only total abundance (number of individuals) and total specific richness (number of species) were also calculated, with mapping of the respective observations.

- Non-flying Momofauna

For each daytime transect carried out, the Kilometre Index of Abundance (KIA) will be calculated, which consists of the number of traces/individuals per kilometre. The specific richness will also be calculated for each of the transects sampled.

- Bats

Acoustic detection with hand-held detectors

The recordings were analysed using Batsound 4.4 software from Pettersson Elektronick AB. In a first step, sequences with bats present were selected, and the presence of at least two pulses with a maximum interval of two seconds between consecutive pulses was considered as a sequence. The sequences were then divided into three-second portions and analysed to identify the species present. To this end, using the software, characteristic parameters of the sound pulses were obtained (Table 7.10), which allow comparison with reference bases.

- Frequency of maximum energy (FmaxE, kHz) - frequency emitted with the highest intensity;
- Frequency range (BW, kHz) - difference between maximum frequency (Fmax) and minimum frequency (Fmin);
- Pulse duration (Δtp, ms) – time interval between the start and end of a pulse;
- Inter-pulse interval (INT, ms) - time interval between the start of one pulse and the start of the next pulse;
- Frequency type - frequency modulated (FM - short duration pulses where there is a rapid variation in frequency over time), quasi-constant frequency (QCF - pulses that maintain a quasi-constant frequency over time) or combinations of the two (FM-CF or CF-FM - pulses that have portions with a sudden variation in frequency, followed or preceded by potions of quasi-constant frequency over time).

Acoustic detection with automatic detectors

In view of the large number of recordings that the automatic detectors produce and the fact that a large proportion of these recordings are only noise, it was necessary to screen the recordings with noise from those with bats. This sorting was carried out manually using Kaleidoscope 5.1.9 software from Wildlife Acoustics and Batsound 4.4 from Pettersson Elekctronik AB.

The high number of bat files to be analysed meant that on the days with the highest number of recordings, it was not possible to analyse all the recordings made, and it was decided to estimate the number of contacts that occurred and the species detected, based on samples of the recordings made on those days.

The selection of the days on which all recordings or only one sample were analysed took into account a maximum limit of 6300 files for analysis in the 6 months sampled, to be distributed proportionally among the detectors at ground level and at height, based on the following criteria:

- Firstly, the proportion of bat files obtained at ground level (58%) and at height (42%) was determined;
- The relative proportion of files to be analysed at ground level and at height was then determined, based on a joint ceiling of 6300 (respectively 3641 and 2659 files);
- Subsequently, the maximum number of files to be analysed per day at ground level and at height was determined, and the number of files dividing the days on which all files were analysed from those on which only one sample was analysed (85 files at ground level, 62 files at height) was defined;
- On days with sample analyses, samples were selected by stratified random selection procedures using the programme R v3.2.0, as described in Cochran (1977), Lohr (1999) and Pereira (2001);
- On those days, the species present and the number of contacts from unanalysed files was estimated based on the proportion of recordings analysed on that day;

The analysis of the selected files followed the method already described for hand-held detectors, i.e. obtaining characteristic parameters of the sound pulses using the Batsound 4.4 software and comparing them with reference data.

- Ecosystem services

Ecosystem services are divided into four categories (MEA, 2005; de Groot, 2006; IPIECA & OGP, 2011):

- Supporting or base services: include primary productivity, nutrient cycle, carbon cycle and soil formation, which are necessary for ecosystem functioning and support for the other ecosystem service categories. The effect of ecosystem services on human well-being is only realised by their impact on other services in the long term;

- Production services: these include material goods, such as food, water, fuel, fibre and genetic resources, which are obtained directly from ecosystems. Since they are obtained directly most of these services have a commercial value;

- Regulatory services: these include water purification, soil and erosion protection and regulation of ecosystem disturbances (droughts, floods or fires) and diseases, which are related to ecosystem functions and contribute to ecological processes and life support;

- Cultural services: include spiritual enrichment, cognitive development, religious values, recreational experiences and aesthetic values, which humans derive from knowledge, experience and relationship with the natural environment. These services are closely related to human values, identity and behaviour.

The assessment of ecosystem services considers the regional relevance of each service according to the functions or benefits provided (MEA, 2005; EEA, 2010) (Table 7.12). Each identified vegetation unit/habitat was categorised according to its importance for each ecosystem service. Vegetation units/habitats were ranked according to the following scale: E - high; M - medium; B - low; or NA - not applicable. The classification was made taking into account the data collected in the field as well as the experience of the technician responsible for it.

Table 7.12

Services and goods obtained from ecosystems and their functions and benefits (MEA, 2005)

Ecosystem services	Ecological processes	Benefits
Support services		
Primary production and photosynthesis	Transformation of sunlight, water, minerals and carbon dioxide into living organisms	Existence of plants, lichens, algae and all organisms that depend on them
Soil formation	Transformation of rock into available minerals and physical support for plants, fungi and bacteria	Supporting complex habitats and ecosystems
Water and nutrient cycles	Production and recycling of water and nutrients (minerals, carbon, phosphorus, nitrogen, …)	Maintaining complex habitats and ecosystems and the wide biodiversity associated with them
Production Services		
Food		
Hunting	Availability and variety of game species	Game meat, bush meat, fur
Wild foods	Availability and variety of wild foods	Roots, berries, edible plants, nuts
Fishing	Availability and variety of fish and other marine foods	Fish and seafood
Grazing/livestock	Availability and variety of livestock species, domestic animals	Meat, dairy products, eggs, fertilisers, fur
Agriculture	Availability and variety of crops and orchards	Agricultural areas, orchards, grazing land
Honey	Bee colonies	Honey, wax, pollen, propolis
Endogenous natural resources		
Fresh water	Filtration, retention and storage of fresh water	Fresh water for drinking, hygiene, irrigation, industrial processes and energy production
Endogenous forest products		
Wood	Availability and variety of forests, woodlands, savannas, mangroves	Wood, coal, firewood, fuel, building materials
Other non-timber forest products	Availability and variety of forests, woodlands, savannas, mangroves	Various fibres, palm leaves, …
Resins	Availability and variety of forests, woodlands, savannas, mangroves	Resins

Table 7.12 (Continued)

Services and goods obtained from ecosystems and their functions and benefits (MEA, 2005)

Ecosystem services	Ecological processes	Benefits
Plant and animal resources		
Genetic resources	Genetic information of animals and plants with potential use in biotechnology and other technological developments	Product development, conservation of plant and animal varieties, bio-trade
Medicinal and related resources	Diversity of plants and animals that can be used in medicine and cosmetics	Medicines, ointments, cosmetics, bio-trade
Regulatory services		
Cycles		
Soil protection and erosion control	Prevention of erosion, maintenance of arable soil and its productivity. Role of vegetation root matrix and soil microorganisms in soil retention, rock weathering and organic matter accumulation	Arable soil productivity, prevention of soil degradation and saline intrusion, natural maintenance of soil productivity
Water regulation	Flood regulation and leaching, water storage and retention, reservoir and aquifers, nutrient transport	Water for drinking, irrigation, hygiene, transport, food production, disease control
Nutrient regulation	Role of habitats in nutrient storage and recycling	Soil fertility, water quality
Pollination	Role of habitats in pollen production and pollinator conservation	Pollination of wild and cultivated plants, fruits
Local climate regulation	Temperature and local evapotranspiration/transpiration rates, greenhouse gas emissions and sequestration	Microclimate regulation, carbon sequestration
Debugging		
Soil bioremediation	Bioremediation of soils through ground covers and biodiversity, mitigation of potential sources of contamination	Soil conservation, restoration, fertility and biodiversity
Treatment of pollutants and contaminants	Green infrastructure capable of removing contaminants and mitigating pollution	Soil conservation, restoration, fertility and biodiversity
Water purification	Wetlands, meanders. Filtration and decomposition of organic matter	Water quality, biodiversity conservation, disease prevention
Air quality	Forests, mangroves, orchards, tree corridors, swamps	Air quality (particulates, fumes, gases), disease prevention, liveability of settlements, quality of life.

Table 7.12 (Continued)

Services and goods obtained from ecosystems and their functions and benefits (MEA, 2005)

Ecosystem services	**Ecological processes**	**Benefits**
Prevention		
Flood prevention/control	Green infrastructure capable of minimising sudden rises in water/sea levels, wetlands, meanders, mangroves, marshes	Decreased flood risk, reduced costs/impacts associated with this type of natural disaster
Wildfire control	Ability to mitigate or prevent large fires, through soil use, natural barriers and selective grazing	Decreased fire risk, reduced costs/impacts associated with this type of natural disaster
Prevention/control of diseases and pests	Habitat mosaics with areas less susceptible to diseases/pests, land use in rural areas, decoy crops for diseases/pests, reservoirs of natural aids	Pest and disease control with reduced herbivory and mortality
Control of invasive species	Habitat management and restoration, prescribed fire, selective harvesting/hunting	Habitat conservation agricultural land management, resource management
Habitats		
Manutenção de habitats	Habitat funcional para actividades humanas, gestão florestal e rural, planeamento do uso do solo	Conservação de espécies com valor alimentar, medicinal, cinegético, para turismo
Areas of high conservation value	Protection and conservation of EN and CR plant, animal and habitat species, maintenance of genetic and biological diversity	Biodiversity conservation, landscape integrity, biosecurity, ecosystem health
Cultural services		
Recreational activities	Diversity and quality of land use for recreational activities	Leisure, sports, outdoor activities, related economic activities, ...
Tourism	Diversity and quality of land use for tourism/ecotourism activities	Leisure, sports, outdoor activities, related economic activities, ...
Education	Diversity and quality of land use for cultural and educational activities	Education, cultural activities and development, related economic activities
Scientific research	Diversity and quality of land use for scientific activities	Scientific research and knowledge development activities, related economic activities

- Critical habitat classification

The vegetation units/habitats present in the study area were classified according to the IFC PS6 guidelines (IFC, 2012[a]) as modified, natural and/or critical.

Modified habitats correspond to areas hosting non-native animal and plant species or areas in which human activities have substantially altered the primary ecological functions of the area as well as the specific composition, such as agricultural areas, forest plantations or waterproofed areas.

Natural habitats correspond to areas where plant and animal communities are mostly composed of native species and where the primary ecological functions of the ecosystem are still present.

Habitats classified as critical are those with high biodiversity value and may be modified or natural habitats. Critical habitats must fulfil at least one of the following criteria:

- Habitat of high importance for species classified as "Critically Endangered" (CR) or "Endangered" (EN);
- Habitat of great importance for endemic or restricted distribution species;
- Habitat supporting globally significant concentrations of migratory or congregatory species;
- Threatened or unique ecosystems;
- Areas associated with key evolutionary processes.

Each of the first three criteria is divided into two quantitative sub-criteria (tiers). A habitat is considered critical when it fulfils one of these sub-criteria. The sub-criteria are described below in Table 7.13.

Table 7.13

Sub-criteria for critical habitat classification (IFC, 2012a)

Criterion	Sub-criterion 1	Sub-criterion 2
1. Species CR or EN	• Habitat harbouring ≥ 10% of the global population of a species or subspecies CR or EN, where such species are known to occur regularly and where the habitat can be considered a discrete management unit for the species. • Habitat with known presence, regular occurrence of CR or EN species, where the habitat is one of the 10 or fewer discrete management units for the species globally.	• Habitat that supports regular occurrence of a single individual of a CR species and/or habitat that harbours regionally significant concentrations of a an EN species and where the habitat can be considered a discrete management unit for the species or subspecies. • Significantly important habitat for a wide-ranging CR or EN species, and/or where the distribution of populations is not well known and where the loss of such habitat may represent a long-term impact on the survival of the species.

Criterion	Sub-criterion 1	Sub-criterion 2
		• Suitable habitat containing regionally or nationally important concentrations of EN, CR or equivalent regionally or nationally listed species.
2. Endemic species[4]/ of restricted distribution[5]	• Habitat that harbours ≥ 95% of the global global population of an endemic or restricted species and where that habitat can be considered a discrete management unit for the species.	• Habitat harbouring ≥ 1% but < 95% of the global population of an endemic or restricted species where that habitat can be considered a discrete management unit for the species, based on available information or expert opinion. species, based on available information or expert judgement.
3. Migratory[6]/ congregatory species[7]	• Habitat that harbours, on a cyclical or regular basis, ≥ 95% of the global population of a migratory or congregatory of a migratory or congregatory species at a given point in the species' life cycle and where that habitat can be considered a discrete management unit for the species.	• Habitat that harbours, on a cyclical or regular basis, ≥ 1% but < 95% of the global population of a migratory or congregatory species at a given point in the species' life cycle, based on available information or expert judgement. • For birds, habitat that meets the definition of BirdLife International's Criterion A48 for congregatory and/or Ramsar Criterion 5 or 6 for the identification of wetlands of international importance[9]. • For widely distributed species, a threshold of ≥5% of the global population should be considered for both terrestrial and marine species. • Source location/origin contributing ≥ 1% of global population recruitment.

In addition to the main criteria already mentioned, IFC PS6 also considers secondary criteria which relate to areas of high biodiversity value and which may harbour relevant values. Secondary criteria should be assessed on a case-by-case basis, these include the following:

A. Essential areas for the reintroduction of CR and EN species, refuge areas for these species and habitat used by them in periods of stress;

B. Ecosystems of recognised and significant importance for CR or EN species for climate change adaptation processes;

C. Concentrations of VU species where their classification is uncertain and where the current status may be CR or EN;

[4] The following species are considered to be endemic to Mozambique.
[5] Defined as: species with an extent of occurrence of 50000 km^2 or less for terrestrial vertebrates, extent of occurrence of 100000 km^2 or less for marine species. For freshwater species there is no defined extent of occurrence.
[6] Refers to any species in which significant numbers of its population move cyclically or predictably from one geographical area to another (IFC, 2012b).
[7] Refers to species in which a large gathering of individuals occurs at a certain period of their life cycle (IFC, 2012b).
[8] BirdLife International, 2014b
[9] RAMSAR, 2014b

D. Areas of primary, ancestral or pristine forest, or other areas with exceptional levels of specific diversity;

E. Landscape areas or ecological processes essential to the maintenance of the critical habitat (e.g. aquifers, erosion, fire or flood control areas);

F. Habitat essential for the survival of keystone species;

G. Areas of high scientific value, such as those containing new species or species little known to science (IFC, 2012b).

7.8.2 Protected and sensitive areas

The study area overlaps with an Endemic Bird Area (EBA) called the South-east African Coast which encompasses the coastal plains of south-eastern Mozambique, northern Natal and the extreme south-eastern Transvaal in South Africa, and eastern Eswatini. The classification of this EBA is based on the presence of species of restricted distribution (as defined by BirdLife Internationsl), namely Rudd's Apalis (*Apalis ruddi*), Neergaard's sunbird (*Cinnyris neergaard*), rose-breasted sandpiper (Hypargos margaritatus) and lemon-breasted canary (*Crithagra citrinipectus*). These species are resident in the EBA area. The distribution and status of these species in Mozambique is still largely unknown (Birdlife International, 2018). Most of these species are classified as "Least Concern" (LC), with the exception of Neergaard's sunbird which is classified as "Near Threatened" (NT) (IUCN, 2018).

In addition to the aforementioned EBA, it is also worth mentioning the presence of Important Bird Areas (IBA) in the surroundings of the study area (considered a radius of 50km), namely:

- IBA Hlane and Mlawula Reserves (Eswatini) about 31 km south of the study area;
- IBA Changelane River Gorge about 49 km south of the study area;
- IBA Kruger National Park and adjacent areas (South Africa) about 50 km north of the study area.

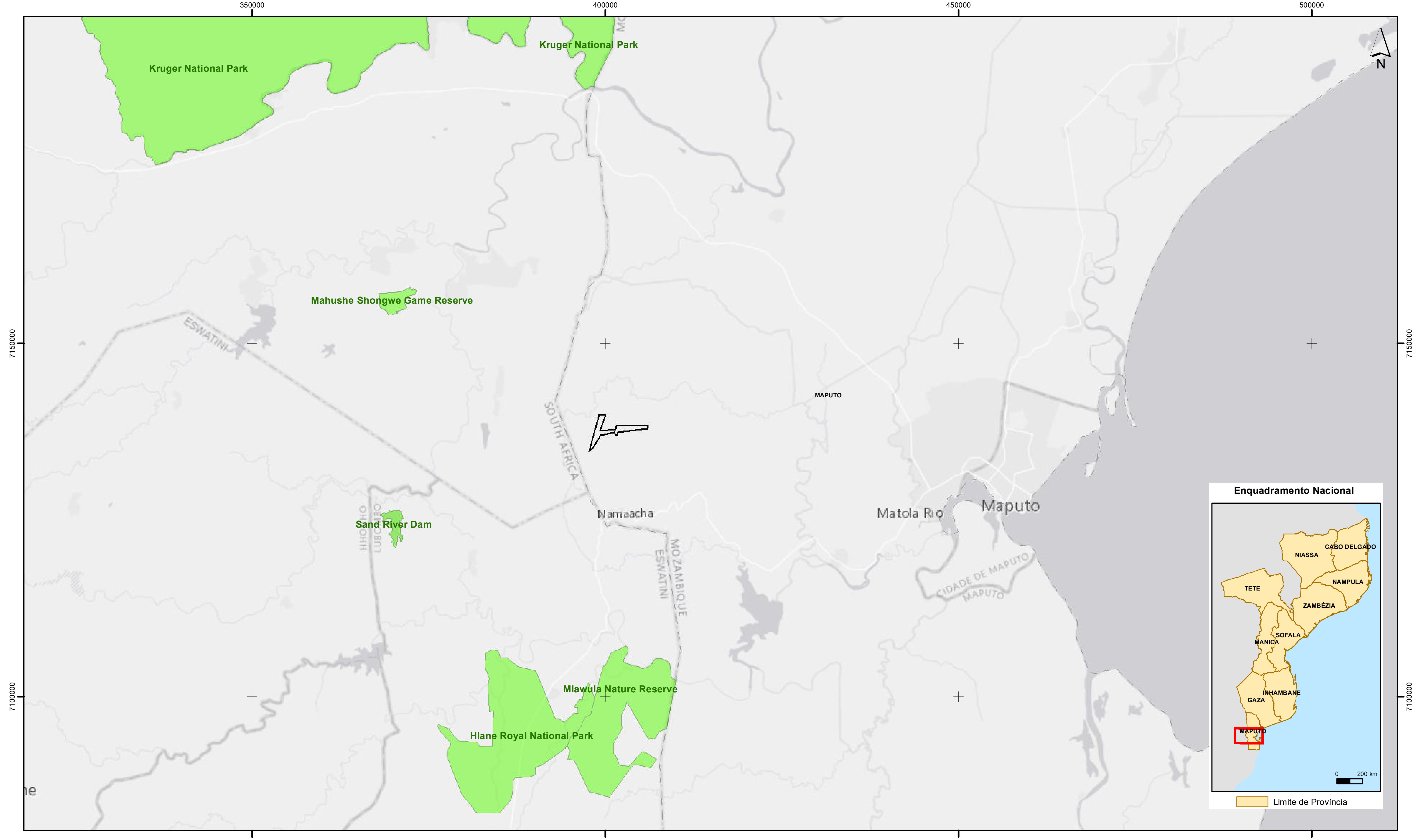
It should also be noted that in the surroundings of the study area (considered a radius of 50 km) there are protected areas, namely:

- Ramsar site Sand River Dam (Eswatini) about 31 km south-west of the study area;

- Mlawula Nature Reserve (Eswatini) about 32 km south of the study area;
- Royal Hlane National Park (Eswatini) about 35 km south of the study area;
- Mahushe Shongwe Reserve (South Africa) about 35 km north-west of the study area;
- Kruger National Park (South Africa) about 50 km north of the study area (Figure 7.28).

The study area is also part of the Maputaland-Pondoland-Albany biodiversity hotspot. This hotspot encompasses a region that harbours great biological diversity, stretching from the east coast to the west coast of the Indian Ocean. It is estimated that this region harbours around 8100 plant species, 1900 of which are endemic to the region. This hotspot is also home to 200 mammal species (8 endemic and 5 CR), 631 bird species (14 endemic and 25 threatened), 225 reptile species (63 endemic), 73 amphibians (24 endemic) and 73 freshwater fish (20 endemic) (Critical Ecosystem Partnership, 2011).

The eastern part of the study area is also encompassed in the Maputuland Coastal Forest Mosaic ecoregion which, according to the World Wildlife Fund (WWF), is a threatened ecoregion. It encompasses about 30300 km2 and various habitats such as dry forests, swamps, grasslands, wetlands and estuaries. This ecoregion is home to at least 2,500 plant species, 470 bird species, 112 reptile species, 45 amphibian species and 67 freshwater fish species (WWF, 2019).



Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Escala 1:500 000

0 10 20 km

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

LEGENDA

Área de Estudo

Áreas Protegidas

T01717_14_V0_Fig7_28.mxd(A3)

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.28 - Enquadramento da Área de Estudo
face às Áreas Protegidas na envolvente

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA

7.8.3 Flora and vegetation

7.8.3.1 Framework

The study area covers two biomes: tropical and subtropical woodlands, savannas and grasslands; and tropical and subtropical moist broadleaved forests. The tropical and subtropical woodlands, savannas and grasslands biome is the most comprehensive biome on the African continent and encompasses those areas whose natural vegetation would comprise grasslands, woodland savannas, mosaic of humid savannah and woodland, and scrublands. The tropical and subtropical humid hardwood forest biome covers areas originally occupied by humid forests and heterogeneous mosaics of these forests and other habitats (Burgess *et al.*, 2004).

The study area also crosses two ecoregions: Maputaland Coastal Forest Mosaic and Zambezian and Mopane Forests.

The Maputaland Coastal Forest Mosaic is an ecoregion that extends over 30200km2 from the Changane River (Mozambique) to the Umfolosi River (South Africa) and whose conservation status is critical. The vegetation of this ecoregion is complex and very diverse. In the Libombos mountains, particularly in the deepest and wettest valleys, the forest is represented in the tree layer by species such as *Chrysophyllum viridifolium, Homalium dentatum, Combretum kraussii* and various species of *Ficus, Celtis and Strychnos* sp. The under cover of these forests includes species such as *Buxus natalensis, Englerophytum natalense* and *Rothmannia globosa* (Burgess *et al.*, 2004).

The Zambezian and Mopane Forests cover 473 300 km2, covering much of inland south-eastern Africa, and are classified as relatively stable. This ecoregion overlaps with the Zambezian centre of regional endemism, encompassing *Colophospermum mopane* forests and woodlands and undifferentiated Zambezian forests and grasslands. Mopane woodlands occur in pure form, but the following species often occur in association with them: *Kirkia acuminata, Dalbergia melanoxylon, Adansonia digitata, Combretum apiculatum, C. imberbe, Acacia nigrescens, Cissus cornifolia* and *Commiphora* spp. The herbaceous layer of mopane forests can vary greatly, and the following species may be present: *Aristida* spp., *Eragrostis* spp., *Digitaria eriantha, Brachiaria deflexa, Echinochloa colona, Cenchrus ciliaris, Enneapogon cenchroides, Pogonarthria squarrosa, Schmidtia pappophoroides, Stipagrostis uniplumis* and *Urochloa* spp. (Burgess *et al.*, 2004).

Five phytogeographical zones or floristic regions are defined for Mozambique, namely: (i) Swahilian regional centre of endemism, (ii) Swahilian-Maputaland regional transition zone, (iii) Maputaland-Pongoland regional mosaics, (iv) Zambezian regional centre of endemism and (v) Afro-montane centre of endemism (White, 1983; Burgess & Clarke, 2000; van Wyk & Smith, 2001).

The Maputaland-Pondoland regional mosaic occurs mainly in Maputo extending from the Limpopo River to South Africa (Port Elizabeth) and encompassing the Libombos Hills as well as part of Essuatíni. The coastal zone is composed of parabolic dunes with Cretaceous and Tertiary marine sediments. The Maputaland centre of endemism is known to have about 230 plant species endemic to Mozambique and northern South Africa (Wyk & Smith, 2001). In addition to the richness of endemic species, this region has two typical vegetation types, namely shrubby graminial and sand forest, which in turn have a higher number of endemic species (Wyk & Smith, 2001). The study area is part of the Libombos mountain chain and thus part of the Maputaland endemic zone.

7.8.3.2 Flora

The floristic list for the study area comprises 314 species of flora, distributed among 87 families (Annex 3 - Appendix 3.1). The best represented families in the study area are the following: Fabaceae with 30 species, Asteraceae with 27 species, Cyperaceae with 19 species (Figure 7.29). During the field view it was possible to confirm the presence of 201 species in the study area.

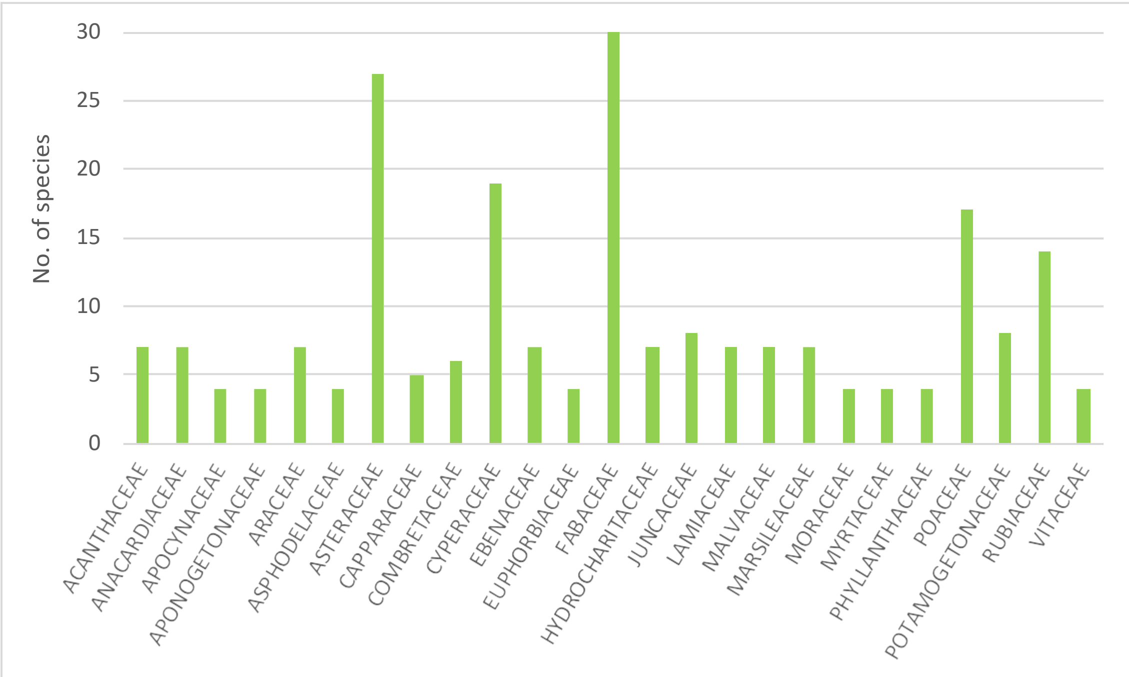


Figure 7.29 - Best represented floristic families in the study area

Among the species listed, there are no threatened species (VU, EN or CR), and the species listed are classified as species listed are classified as "Least Concern" (LC) or are not assessed (IUCN, 2019).

Only one endemism is listed for the study area: *Coptosperma nigrescens*. The presence of the species was confirmed during the fieldwork, however, only very occasionally in less disturbed sites (see Figure 7.22).

Species of interest as timber producers occur in the study area (Regulation of Law no. 10/99, of 7 July), namely: five species of 1st class timber (*Combretum imberbe, Diospyros dichrophylla, Diospyros inhacaensis, Diospyros villosa* and *Afzelia quanzensis*), four species of 2nd class timber (*Sclerocarya birrea, Terminalia phanerophlebia, Albizia adiathifolia* var. *adianthifolia* and *Trichilia emetica*), four species of 3rd class timber (*Celtis africana, Syzygium cordatum, Phyllanthus reticulatus* e *Vitex* sp.) plus 11 species of 4th class timber.

It should be noted that a total of 18 alien species are listed and confirmed for the study area, about 6% of the species listed for the area (see Table 7.14).

Most of the exotic species present in the study area are of agricultural interest, such as cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), maize (*Zea mays*) or beans (*Phaseolus vulgaris*), and medicinal, such as *Centela asiatica* and *Gymnosporia heterophylla*.

However, some of the alien species exhibit invasive behaviour. *Lantana camara* stands out as the most common invasive alien species in the study area, occupying mainly old fields, and the edge of fields, paths and settlements. Also *Agave sisalana, Opuntia ficus-indica* and *Psidium guajava* show invasive behaviour in the study area.

Table 7.14
Alien species listed and confirmed for the study area

Family	Scientific Name
AGAVACEAE	*Agave sisalana*
APIACEAE	*Centela asiatica*
APOCYNACEAE	*Catharanthus roseus*
CACTACEAE	*Opuntia ficus-indica*
CARICACEAE	*Carica papaya*
CASUARINACEAE	*Casuarina equisetifolia*
CELASTRACEAE	*Gymnosporia heterophylla*
CONVOLVULACEAE	*Ipomoea batatas*
CURCUBITACEAE	*Citrullus lanatus*
EUPHORBIACEAE	*Manihot esculenta*
FABACEAE	*Phaseolus vulgaris*
LAMIACEAE	*Lantana camara*
MYRTACEAE	*Eucalyptus sp.*

Family	Scientific Name
MYRTACEAE	*Psidium guajava*
PINACEAE	*Pinus* sp.
POACEAE	*Cympopogon citratus*
POACEAE	*Zea mays*
PROTEACEAE	*Grevillea robusta*

Among the sampling sites, NF14 (acacia woodland) stands out as the one with the highest specific richness, with a total of 45 species/site, followed by NF09 (degraded acacia woodland) with 35 species/site, and NF04 (degraded acacia woodland) with 30.5 species/site. On the other hand, in NF15 (degraded acacia woodland) the lowest number of species was recorded, with only 8.5 species/site (see Figure 7.30).

Alien species are present in most of the sampled sites, except in NF07, NF16, NF17 and NF18. Noteworthy are sites NF11 (degraded acacia woodland), with four alien species/site, and NF08 (fields and acacia woodland), with three alien species/site (see Figure 7.30).

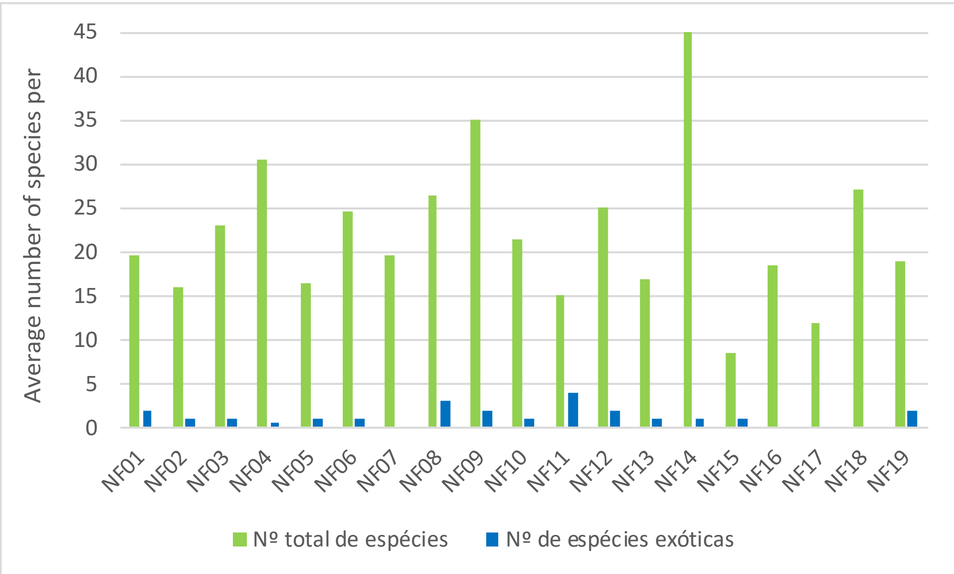


Figure 7.30 - Total and alien species specific richness at sampling sites

7.8.3.3 Vegetation

The fieldwork in the study area allowed us to verify that the vegetation is degraded, although there are still remnants of the main species of the original vegetation. According to Wild & Barbosa (1967) and Wild & Fernandes (1967) the main vegetation in the study area is savannah of trees and/or shrubs with some patches of forest. This vegetation type occurs at moderate altitudes between 350-800 m, dominantly found between Namaacha and Goba. The main species in this vegetation type include

Pterocarpus rotundifolius, Bauhinia galpinii, Sclerocarya birrea, Mundulea sericea and Ziziphus mucronata, all in shrub form (Wild & Barbosa, 1967).

Currently the study area is occupied by communities of *Acacia* spp. and *Combretum* spp. However, the species that constituted the original vegetation are occasionally present, with emphasis on *P. rotodunfolius*. The species *Bauhinia galpinii* and *Sclerocarya birrea* sometimes occur in the form of small clusters.

Nine vegetation units were then identified in the study area: acacia woodland, degraded acacia woodland, acacia and *Combretum* spp. woodland, *Combretum* spp. woodland, forest remnant, water line, graminial, agricultural areas and artificialised areas.

As mentioned above, the vegetation in the study area is disturbed, so the most abundant vegetation unit is degraded acacia woodland, which accounts for about 41% of the area. This is followed by acacia woodland which represents about 32% of the area and acacia and *Combretum* spp. woodland which corresponds to about 12% of the area (see Figure 7.31 and Table 7.15).

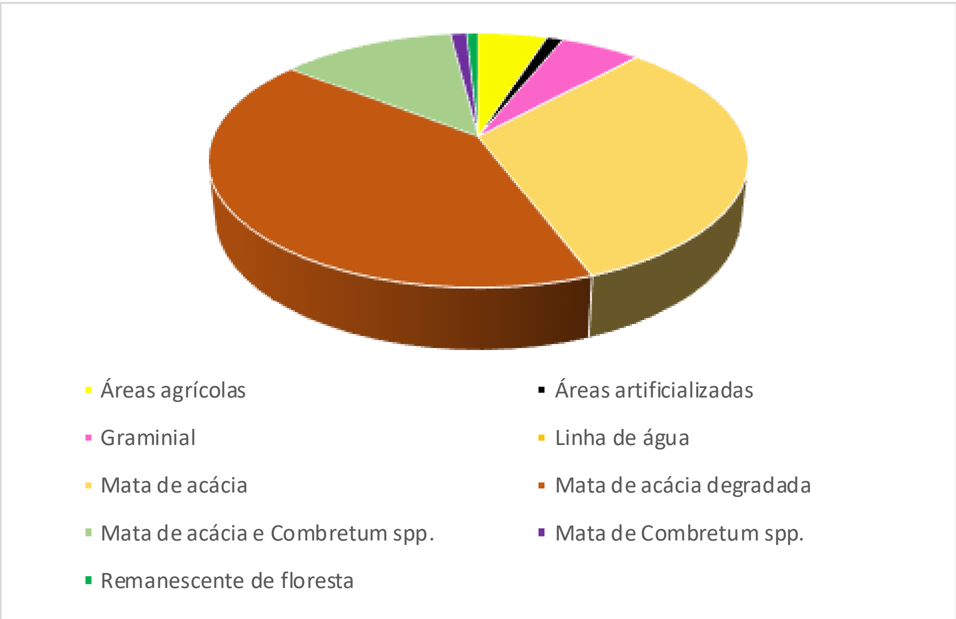


Figure 7.31 - Representativeness of vegetation units in the study area

Table 7.15

Area and percentage occupied by each vegetation unit in the study area

Vegetation units	Area (ha)	%
Acacia woodland	260,55	30,5%
Degraded acacia woodland	366,35	42,8%
Acacia and *Combretum* spp. woodland	101,48	11,9%
Combretum spp. woodland	10,43	1,2%
Forest remnant	7,77	0,9%
Water line	0,74	0,1%
Graminial	52,05	6,1%
Agricultural areas	45,21	5,3%
Artificialised areas	10,49	1,2%
Total	**855,12**	**100**

The nine vegetation units identified in the study area are described below.

Acacia woodland

This vegetation unit is dominated by acacia species, namely *Acacia tortilis, Acacia karoo, Acacia burkei, Acacia borleae* and *Acacia nilotica*. These are particularly resilient species, regenerating after disturbance, namely by vegetation cutting, fire or grazing. In areas mapped as acacia woodland the tree/shrub layer covers 50% or more of the area.

Photos 7.16 and 7.17 - Acacia woodland in the study area

Degraded acacia woodland

This is the most common vegetation unit in the study area and represents a stage of degradation of the acacia woodland, and in these patches the vegetation covers less than 50% of the area.

Photo 7.18 - Degraded acacia woodland in the study area

Combretum spp. woodland

This vegetation unit is poorly represented in the study area. It is similar in structure to acacia woodland, but dominated by *Combretum* sp. species, namely *Combretum imberbe* and *Combretum hereroense Combretum zeyheri* and *Combretum molle*. Also in these patches the tree/shrub cover corresponds to at least 50%.

Acacia woodland and Combretum spp.

These areas are in all respects similar to Acacia and *Combretum spp.* woodlands, however there is no clear dominance of either genus, thus Acacia sp. and *Combretum spp.* appear as co-dominants.

Forest remnant

The vegetation unit called forest remnant is represented by only one patch, in the south-western part of the study area. This patch of forest remnant is subject to some disturbance, namely vegetation cutting, however it retains its characteristic specific composition, namely by the presence of the species *Mimosops obovata, Canthium inerme, Zathoxylum humile, Sideroxylon inerme* and *Mystroxylon aethiopicum*. Most of these species are at a height consistent with the shrub layer.

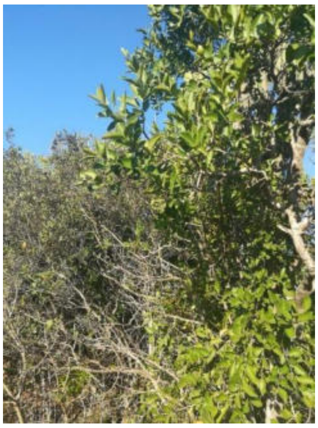


Photo 7.19 - Dense area of forest remnant in the study area

Water line

Temporary run-off watercourses were identified, flowing only during or immediately after periods of heavy rainfall and carrying only surface run-off, with sparse vegetation on the banks.

Graminial

This vegetation unit is dominated by herbaceous species of the Poaceae family and occurs mainly in areas with mostly sandy soils, but with the presence of rocks. The main species observed in this vegetation unit are *Themeda triandra, Eragrostis superba* and *Hyparrhenia* sp. Rupicolous species were also observed, such as *Asplenium* sp.

Photo 7.20 and 7.21 - Graminial in the study area in both sampling seasons

Agricultural areas

Agricultural areas are represented by small subsistence farming plots (machambas) located next to paths. The main crops observed in the study area include: maize (*Zea mays*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), millet (*Panicum sp.*), various types of beans, including nhemba bean (*Vigna unguiculata*), pumpkins and watermelon (*Citrullus lanatus*).

Photo 7.22 - Farm with maize cultivation in the study area.

Artificialised areas

Artificialised areas in the study area comprise roads, paths and dwellings. In these areas vegetation is sparse.

Photos 7.23 and 7.24 - Dwellings and paths in the study area

7.8.4 Fauna

7.8.4.1 Freshwater fishes

A total of 56 freshwater fish species potentially occur in the study area, distributed among 18 families (Annex 3 - Appendix 3.2), the best represented family being Cyprinidade with 18 species (Figure 7.32).

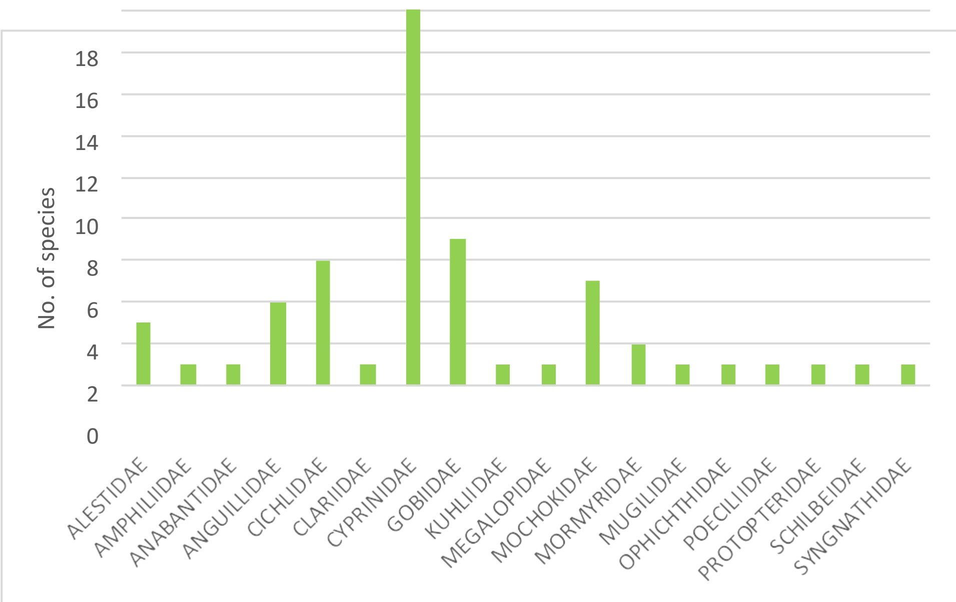


Figure 7.32 - Freshwater fish families potentially present in the study area

Among the freshwater fish species potentially present in the study area are three threatened species, two classified as "Endangered" (EN), *Chetia brevis* and *Silhouettea sibayi*; and one classified as "Vulnerable" (VU), *Chiloglanis emarginatus* (UICN, 2019). There are also three species of restricted distribution: *Hydrocynus vittatus, Barbus sp. nov. 'viviparus cf. Mozambique'* and *Croilia mossambica*; and seven migratory species *Anguilla bengalensis* ssp. *labiata, A. bicolor* spp. *bicolor, A marmorata, A. mossambica, Barbus radiatus, Kuhlia ruprestris* and *Pisodonophis boro*.

7.8.4.2 Amphibians

A total of 45 amphibian species were listed for the study area (Annex 3 - Appendix 3.3) distributed among 11 families. The most representative amphibian families are Hyperoliidae and Pyxicephalidae, both with 10 species (Figure 7.33). During the fieldwork it was possible to confirm the presence of three species of amphibians in the study area: *Sclerophrys garmani, Sclerophrys gutturalis* and *Schismaderma carens* (see Photos 7.25, 7.26 and 7.27).

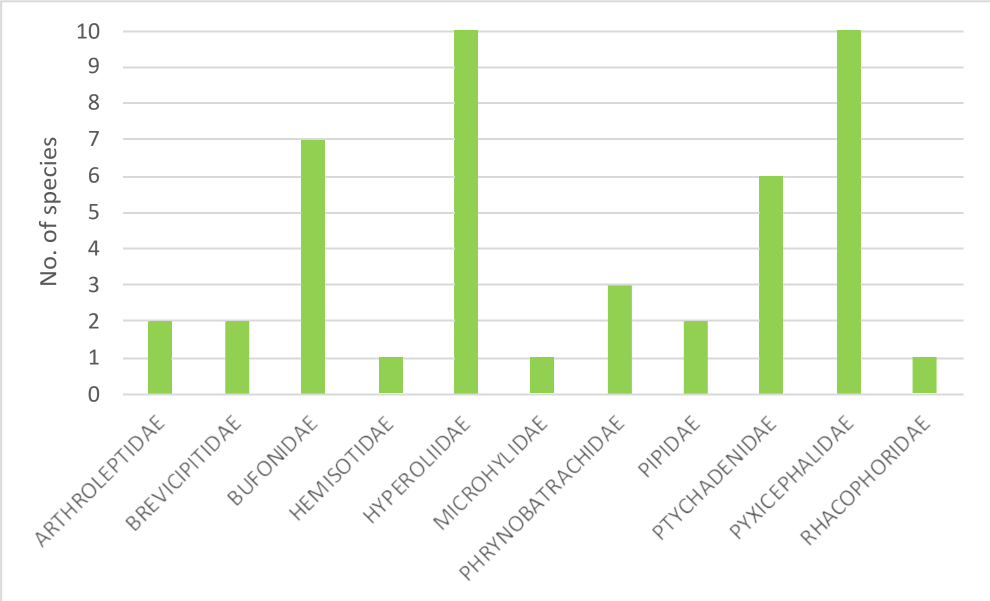


Figure 7.33 - Families of amphibians listed for the study area

All species listed for the study area are classified as "Least Concern" (LC) (IUCN, 2019). However, the potential presence of a species with a restricted distribution should be noted: *Ptychadena taenioscelis*.

The confirmed amphibian species were observed only on the night transects and no amphibians were observed at the identified waterpoint.

Photos 7.25, 7.26 and 7.27 - Amphibian species observed in the study area: a) *Sclerophrys garmani*, b) *Sclerophrys gutturalis*, c) *Schismaderma carens*

7.8.4.3 Reptiles

It was possible to list for the study area a total of 93 reptile species (Annex 3 - Appendix 3.4) distributed among 21 families. The best represented reptile families are Lamprophiidae with 18 species, Colubridae with 11 species and Elapidae with eight species (Figure 7.34). During the field visits it was possible to confirm the presence of seven species: *Trachylepis striata, Trachylepis varia, Platysaurus maculatus, Chondrodactylus turneri, Nucras holubi, Psammophis subtaeniatus* and *Kinixys natalensis*.

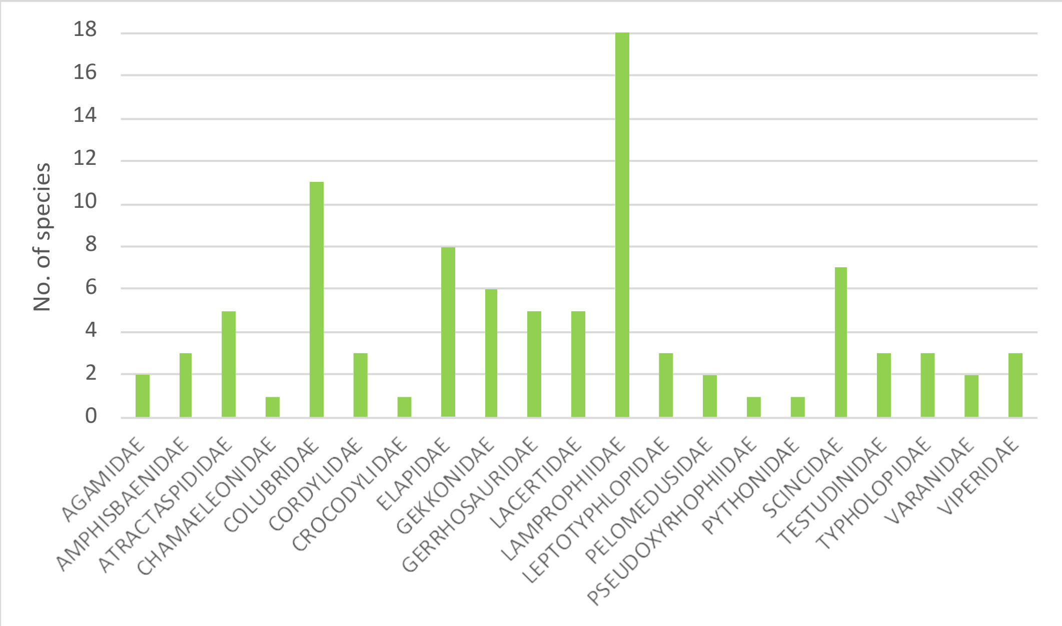


Figure 7.34 - Reptile families listed for the study area

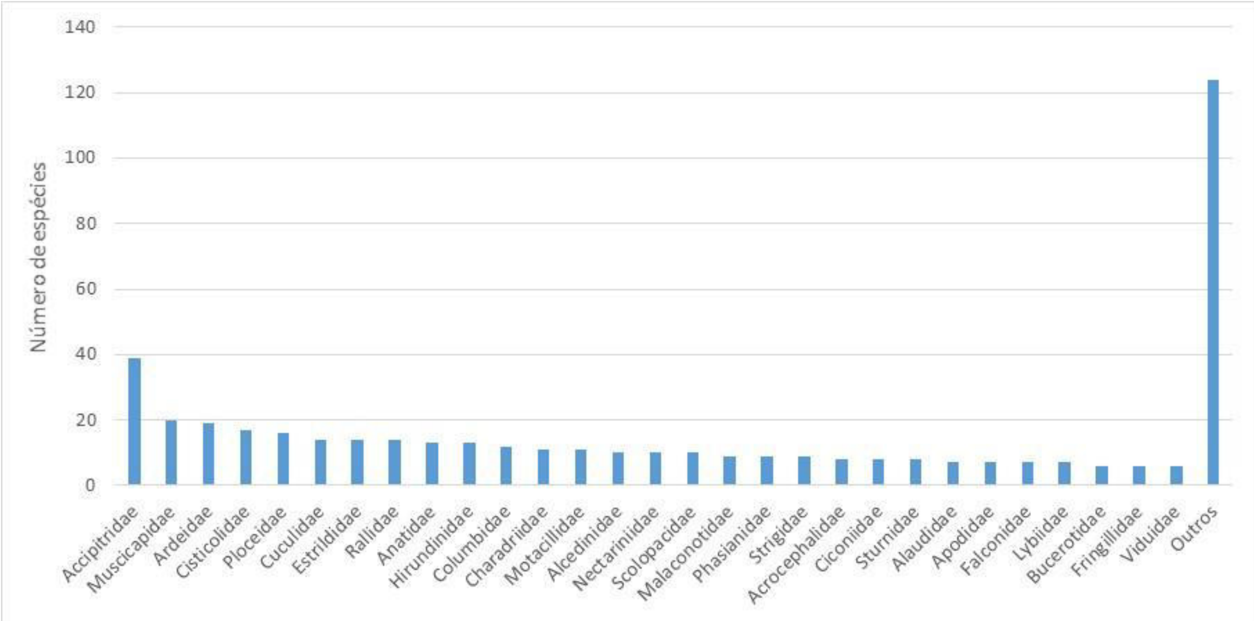
Among the reptile species listed for the study area, only one is threatened: Kinixys natalensis, classified as "Vulnerable" (VU) (IUCN, 2019), and the presence of the species was confirmed in the field. It is also important to mention the presence of a reptile species classified as "Near Threatened" (NT): *Leptotyphlops telloi* (IUCN, 2019). Nine species of reptiles with restricted distribution are also listed for the study area.

According to the Regulation of the Forestry and Wildlife Law n°10/99, of 7 July, hunting of crocodile (*Crocodylus niloticus*) and the lizards *Varanus albigularis* and *Varanus niloticus* is allowed, and python is protected (*Python natalensis*).

Most of the reptile observations were made outside the systematic sampling transects. It is also relevant to mention that four observations of reptiles concern individuals run over on paths.

7.8.4.4 Birds

The avifauna list for the study area comprises 464 species - about 48% of the species found in the wild in southern Africa (Sinclair et al., 2011) - belonging to 85 families distributed over 25 orders (Annex 3 - Appendix 3.5). Half of the diversity is represented by 15 bird families, mostly passerines and raptors. The most represented families are: Accipitridae, with 39 species of birds of prey; Muscicapidae, with 20 species of hornbills, flycatchers and other related species. Ardeidae, with 19 species of herons; Cisticolidae, with 17 species of weasels and others, and Ploceidae, with 16 species of weavers (Figure 7.35).



Among the list, there are 18 endemic species, confined to southern Africa, such as the ferruginous shrike (*Laniarius ferrugineus*) and the fritillary flycatcher (*Melaenornis silens*), and also 13 quasi-endemic species, restricted to southern Africa, such as the eastern bat lark (*Mirafra fasciolata*) and the lemon-breasted canary (*Crithagra citrinipectus*).

According to the extent of occurrence (EOO) reported by IUCN (2019), no listed species has a restricted distribution according to IFC (2015) criteria (i.e. terrestrial vertebrates whose EOO is less than or equal to 50,000km^2). According to Birdlife International (2019), Rudd's apalis (*Apalis ruddi*), Neergaard's hummingbird (*Cinnyris neergaard*), rose-breasted guinea fowl (*Hypargos margaritatus*) and lemon-breasted canary (*Crithagra citrinipectus*) are restricted in distribution, which justified the classification of the South-East African Coast Endemic Bird Area (EBA), which covers part of the study area.

Only about 20% of the species are on the "List of protected animals in Mozambique whose hunting is not allowed" in the Regulation of the Forestry and Wildlife Law (Decree No. 12/2002, of 6 June).

Regarding population trends of the listed species, most are in a stable situation (about 51%), however, about 31% are in decline, namely passerines, birds of prey and lithic birds, such as the Mozambique canary (Crithagra mozambica) or the brown copper eagle (Circaetus cinereus).

Most species are resident, but about 32% are total migrants (i.e., make regular movements beyond breeding areas), 3% are nomadic (i.e., make movements in response to sporadic resources in time and space) and 2% are highland migrants (i.e., make cyclical movements to low or high altitudes). Around 27% are dispersive congregatory species (i.e. they aggregate in significant numbers at a given location and over a given period of their life cycle, then disperse over a wider area).

The species list is largely composed of birds that can be found in a variety of biotopes in the study area (about 39%), with about 22% relying on woodland, 10% on forest, 8% on grassland, 5% on wetlands and 2% on artificial biotopes, and may use these open spaces as shelter, for breeding and/or for feeding.

Of the birds inventoried, 22% have confirmed occurrence in the study area, as they were detected during the field sampling carried out between October 2018 and August 2019 (Appendix 3.5). The results obtained during the bird censuses per campaign are presented in Appendix 3.8. About 59% are likely to occur, as their preferred biotopes of occurrence are present in the project area, and about 19% are unlikely to occur, as they have a preference for aquatic biotopes, namely swamps, humid grasslands, shallow water bodies with shallow and muddy banks, with riparian, palustrine, emergent and/ or floating vegetation, whose availability is low or non-existent in the study area and its immediate surroundings. Noteworthy is the presence of the small dam with relatively deep water, artificialised banks and no floating vegetation, about 3.5km south of the study area boundary, and the possible temporary presence of humid depressions in the graminial areas (given the occasional presence of Cyperus sp.), which may be occasional attractants for less demanding species associated with aquatic biotopes or with higher humidity.

During the fieldwork, the presence of 102 species was recorded in the study area and its immediate surroundings. Data collected from transects and sampling points targeting the different bird groups most vulnerable to wind farm impacts (passerines, raptors and other gliding birds, waterfowl and nocturnal birds) allowed the calculation of relative abundance and specific richness for the study area and the identification of the most abundant species during one year and in the two seasons under study (dry and humid).

Passerines (and other birds in general)

Through the passerine sampling methodology it was concluded that abundance was slightly higher during the dry season, with 9.6 birds on average per transect (8.6 birds/transect in the wet season), namely during the month of October, during which 12.3 birds/transect were recorded on average. The lowest abundance was obtained during August, with 6.4 birds on average per transect (see Figure 7.36). Specific richness followed a similar trend, with the highest number of species being recorded during October, with 2.5 species on average per transect, and the lowest being recorded during August, with an average of 1.6 species/transect, however, the richness values for both seasons are similar: 1.4 and 1.3 species on average per transect during the wet and dry seasons, respectively (see Figure 7.36).

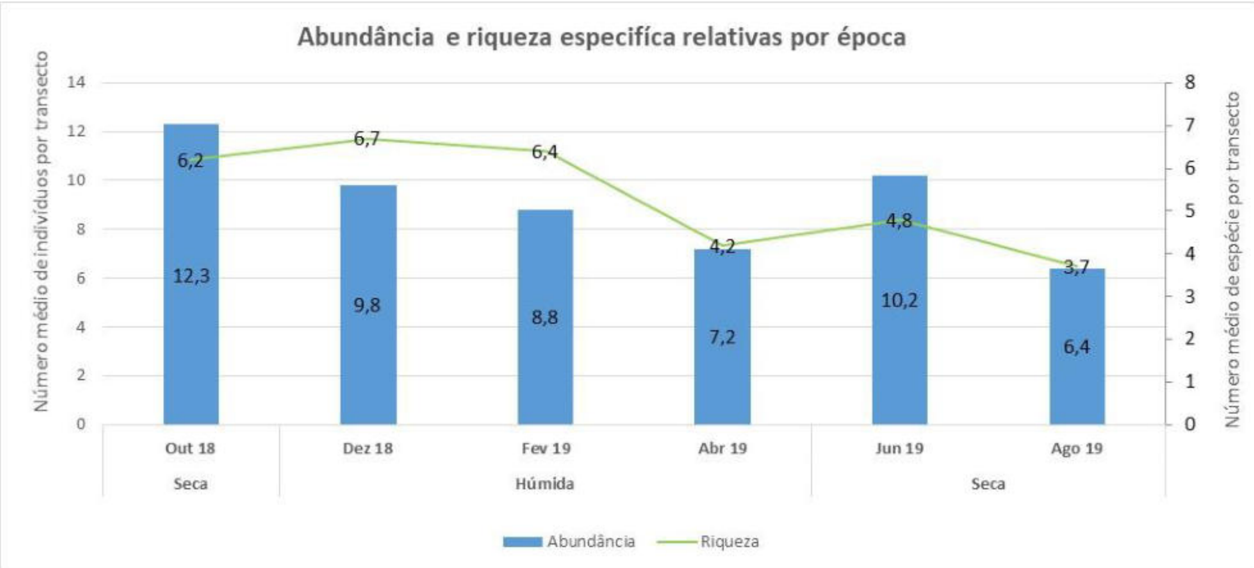


Figure 7.36 - Abundance and relative richness by season on passerine transects in the study area

The transects with the highest abundance were T10, T08 and T12, all located in the extreme west of the study area, over the most steeply sloping valley, with mean values between 13.2 and 17.5 birds/transect. Transects T10 and T08, as well as T09 also located in the extreme west, also showed high values of specific richness, between 6.5 and 6.7 species/transect. T02, located at the eastern end of the study area, recorded the lowest average values of abundance and specific richness, with 4.2 birds/transect and 0.2 species/transect realised.

Regarding the biotopes of the study area, the *Combretum* sp. thickets and the forest remnant recorded the highest mean specific abundance and richness, with 15.3 birds and 6.1 species per transect in the thickets and 13.2 birds and 5.5 species per transect in the forest (see Figure 7.37). The higher number of birds in these biotopes is particularly associated with the detection of several flocks of Bronze mannikin (*Spermestes cucullata*) with between 10 and 40 individuals during the dry season (June). It is also noteworthy that the transects in degraded acacia woodland obtained a relatively high abundance value in the dry season, with 10.8 birds/transect. Graminial was the biotope that obtained the lowest average abundance and specific richness, with 4.2 birds and 3 species per transect (see Figure 7.37).

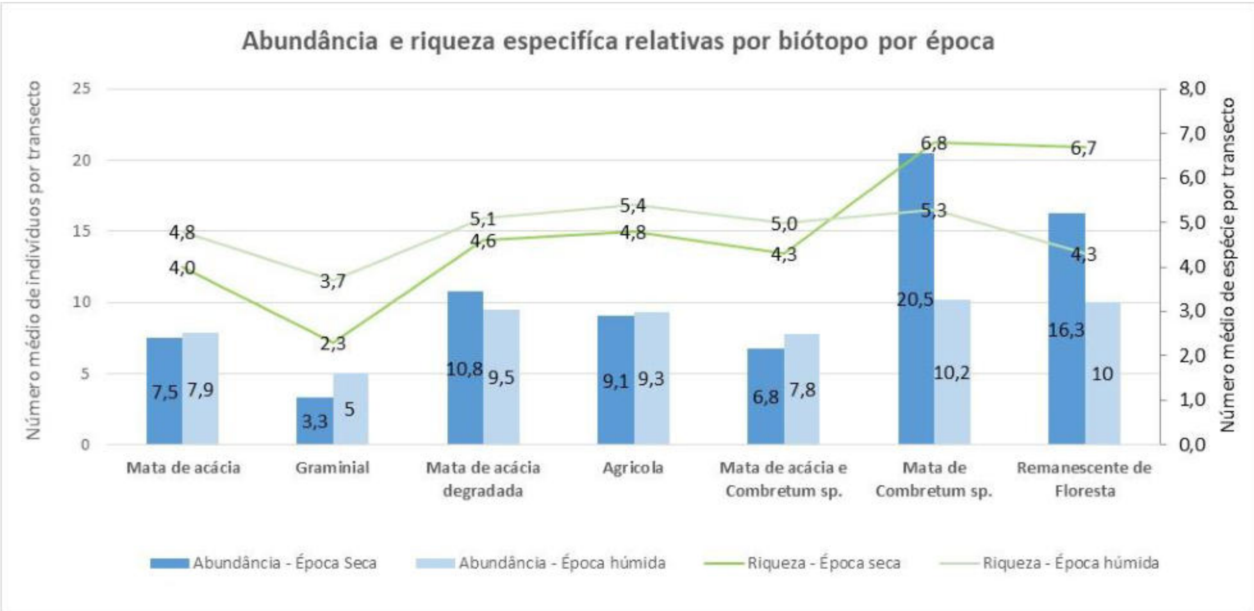


Figure 7.37 - Abundance and relative richness by biotope and season in passerine transects in the study area

The most abundant species according to this methodology were the southern Common bulbul (*Pycnonotus barbatus*), with 0.89 birds on average per transect; the Rufous-naped lark (*Mirafra africana*), with 0.87 birds on average per transect; Barn swallow (*Hirundo rustica*), with 0.60 birds on average per transect; Bronze mannikin, with 0.56 birds on average per transect; and Neddicky (*Cisticola fulvicapilla*), with 0.52 birds on average per transect (Table 7.16). 16). All these species are characteristic of the most representative biotopes of the study area. None of the species detected through this methodology has conservation status.

Table 7.16

Relative abundance (average number of individuals) per species in a 100m buffer around the sampling transects of the passerine bird community (birds in general)

Common name	**Scientific name**	**Relative abundance**		
		Dry season	**Wet season**	**Total**
Helmeted guineafowl	*Numida meleagris*	-	0,05	0,02
Common quail	*Coturnix coturnix*	0,05	-	0,02
Red-billed francolin	*Pternistis sp.*	0,05	-	0,02
Shelley's francolin	*Scleroptila shelleyi*	0,05	0,02	0,04
Ring-necked dove	*Streptopelia capicola*	0,07	0,07	0,07
Little swift	*Apus affinis*	0,49	-	0,24
Jacobin Cuckoo	*Clamator jacobinus*	0,02	0,05	0,04
Klaas's cuckoo	*Chrysococcyx klaas*	-	0,02	0,01
Diederik cuckoo	*Chrysococcyx caprius*	-	0,24	0,12
African harrier-hawk	*Polyboroides typus*	0,02	-	0,01
Brown snake eagle	*Circaetus cinereus*	-	0,02	0,01
Dark chanting goshawk	*Melierax metabates*	0,05	-	0,02
Speckled mousebird	*Colius striatus*	0,29	-	0,15
Red-faced mousebird	*Urocolius indicus*	-	0,05	0,02
Trumpeter hornbill	*Bycanistes bucinator*	0,05	-	0,02
Eurasian hoopoe	*Upupa epops*	-	0,02	0,01
European bee-eater	*Merops apiaster*	-	0,17	0,09
Brown-hooded kingfisher	*Halcyon albiventris*	0,02	0,02	0,02
Lesser honeyguide	*Indicator minor*	0,02	-	0,01
Common Kestrel	*Falco tinnunculus*	0,02	-	0,01
Chinspot batis	*Batis molitor*	0,22	0,24	0,23
Black-backed puffback	*Dryoscopus cubla*	0,07	-	0,04
Brown-crowned tchagra	*Tchagra australis*	0,02	0,05	0,04
Orange-breasted bushshrike	*Chlorophoneus sulfureopectus*	0,02	-	0,01
Southern boubou	*Laniarius ferrugineus*	-	0,05	0,02
Red-backed shrike	*Lanius collurio*	-	0,24	0,12
Southern fiscal	*Lanius collaris*	0,37	0,15	0,26
Southern black tit	*Melaniparus niger*	0,02	0,02	0,02
Rufous-naped lark	*Mirafra africana*	1,07	0,66	0,87

Common name	Scientific name	Relative abundance		
		Dry season	Wet season	Total
Flappet lark	*Mirafra rufocinnamomea*	0,17	0,29	0,23
Lark sp.	-	0,17	0,05	0,11
Long-billed crombec	*Sylvietta rufescens*	-	0,02	0,01
Green-backed camaroptera	*Camaroptera brachyura*	0,02	0,15	0,09
Common chiffchaff	*Camaroptera sp.*	0,07	-	0,04
Red-faced cisticola	*Cisticola erythrops*	0,05	-	0,02
Grey-winged francolin	*Scleroptila afra*	0,05	-	0,02
Wailing cisticola	*Cisticola lais*	0,10	-	0,05
Francoli sp.	-	-	0,02	0,01
Croaking cisticola	*Cisticola natalensis*	-	0,32	0,16
Neddicky	*Cisticola fulvicapilla*	0,44	0,61	0,52
Zitting cisticola	-	0,05	0,05	0,05
Tawny-flanked prinia	*Prinia subflava*	0,27	0,27	0,27
Lesser striped swallow	*Cecropis abyssinica*	0,02	0,02	0,02
White-throated Swallow	*Hirundo albigularis*	-	0,02	0,01
Barn swallow	*Hirundo rustica*	0,83	0,37	0,60
Sombre greenbul	*Andropadus importunus*	0,15	0,37	0,26
Yellow-bellied greenbul	*Chlorocichla flaviventris*	-	0,02	0,01
Common bulbul	*Pycnonotus barbatus*	0,76	1,02	0,89
Lark sp.	-	0,05	0,07	0,06
Arrow-marked babbler	*Turdoides jardineii*	0,12	-	0,06
Cape starling	*Lamprotornis nitens*	0,10	0,22	0,16
Violet-backed starling	*Cinnyricinclus leucogaster*	-	0,02	0,01
Spotted flycatcher	*Muscicapa striata*	-	0,02	0,01
Fiscal flycatcher	*Melaenornis silens*	0,02	-	0,01
African stonechat	*Saxicola torquatus*	0,05	-	0,02
Amethyst sunbird	*Chalcomitra amethystina*	-	0,07	0,04
Scarlet-chested sunbird	*Chalcomitra senegalensis*	0,05	0,05	0,05
Southern double-collared sunbird	*Cinnyris chalybeus*	0,02	-	0,01
White-bellied sunbird	*Cinnyris talatala*	0,17	0,12	0,15
Sunbird	*Cinnyris sp.*	-	0,10	0,05
Sunbird	-	0,34	0,29	0,32
Red-collared widowbird	*Euplectes ardens*	-	0,24	0,12
Spectacled weaver	*Ploceus ocularis*	0,10	-	0,05
Red-billed firefinch	-	-	0,07	0,04

Common name	Scientific name	Relative abundance		
		Dry season	Wet season	Total
Green-winged pytilia	*Pytilia melba*	-	0,05	0,02
Common waxbill	*Estrilda astrild*	0,24	-	0,12
Common waxbill	-	-	0,10	0,05
Bronze mannikin	*Spermestes cucullata*	1,12	-	0,56
Pin-tailed whydah	*Vidua macroura*	-	0,05	0,02
Long-tailed paradise whydah	*Vidua paradisaea*	0,34	0,27	0,30
House Sparrow	*Passer domesticus*	0,05	-	0,02
African pipit	*Anthus cinnamomeus*	-	0,05	0,02
Anthus	-	-	0,02	0,01
Yellow-throated longclaw	*Macronyx croceus*	0,05	-	0,02
Lemon-breasted canary	*Crithagra citrinipectus*	0,05	-	0,02
Yellow-fronted canary	*Crithagra mozambica*	0,07	0,15	0,11
Yellow canary	*Crithagra flaviventris*	0,12	0,29	0,21
Streaky-headed seedeater	*Crithagra gularis*	0,07	0,02	0,05
Yellow-throated seedeater	*Crithagra sp.*	-	0,17	0,09
Yellow-throated seedeater	-	0,24	0,24	0,24
Golden-breasted bunting	*Emberiza flaviventris*	0,05	-	0,02
Cinnamon-breasted bunting	*Emberiza tahapisi*	-	0,15	0,07

Birds of prey and other gliders

The sampling methodology for birds of prey and other gliders allowed concluding that the abundance and specific richness of this group in the study area were relatively low, but higher during the wet season (contrary to what was found for passerines). During the wet season, 0.8 contacts were recorded on average per point (0.5 contacts per point in the dry season), namely in the month of December, during which 1.2 contacts were recorded on average per point. However, during the month of October in the dry season, 1.3 contacts were also recorded on average per point. No raptors or other gliders were observed during August (see Figure 7.38). Specific richness followed a similar trend, with the highest average number of species being recorded during the wet season, at 0.4 species/spot, particularly in December (0.7 species/spot), but in October during the dry season 0.8 species were also recorded on average per spot (see Figure 7.38).

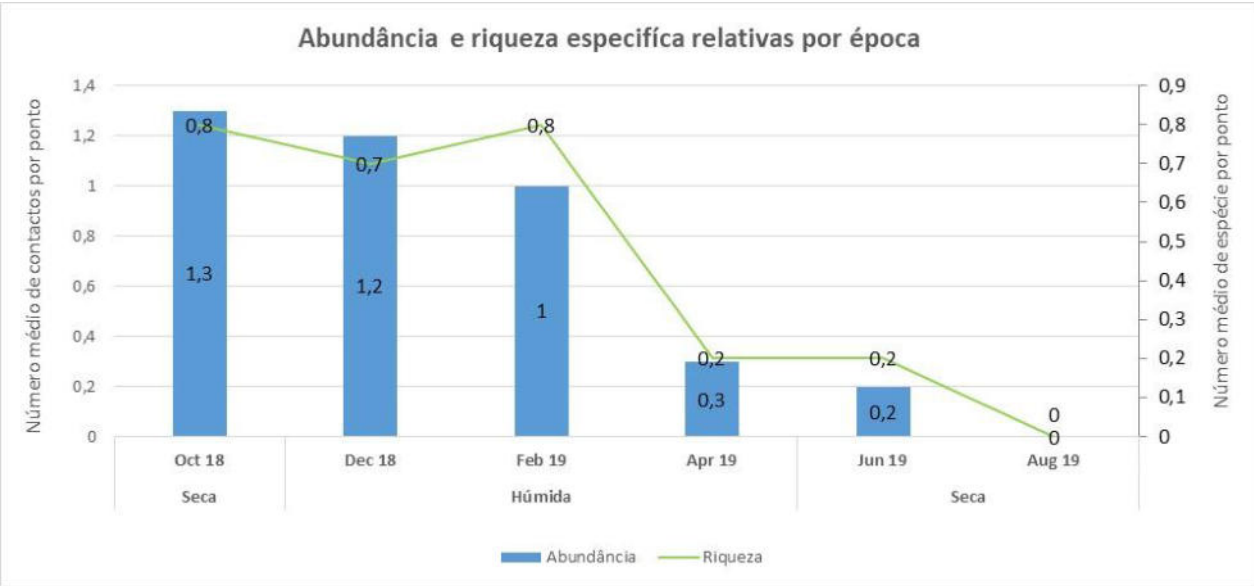


Figure 7.38 - Abundance and relative richness by season of birds of prey and other gliders in the study area

The sampling points with the highest average number of contacts and species were VP01 and VP02, at the eastern end of the study area, in more or less degraded acacia woodland and graminial, both with 1.2 contacts and between 0.8 and 1 species of birds of prey and other gliders per point, particularly during the wet season, during which the highest average number of contacts and species was achieved (2 contacts and 1.7 species per point). Point VP03 was the one that registered the lowest number of contacts and species (0.2 contacts and 0.2 species/point), particularly during the wet season, during which no contacts with this group of birds were obtained. Point VP06 also obtained a low average number of species (0.2 species/point).

In the total of the samplings carried out using this methodology, only 24 contacts were obtained with 7 species of birds of prey and other gliders in the study area (Table 7.12). The highest absolute number of contacts was recorded for the Brown snake eagle (*Circaetus cinereus*), with 5 contacts; the Dark chanting goshawk (*Melierax metabates*), with 4 contacts, and the Bateleur (*Terathopius ecaudatus*), which has Near Threatened conservation status, also with 4 contacts (Table 7.12). The record of 2 contacts with the Martial eagle (*Polemaetus bellicosus*) in the wet season stands out, since this species has Vulnerable conservation status.

Table 7.17

Absolute abundance (number of contacts) of birds of prey and other gliders in the study area during observation points targeting this community.

Common name	Scientific name	IUCN Status	Relative abundance		
			Dry season	Wet season	Total
Bateleur	*Terathopius ecaudatus*	**NT**	2	2	4
Black-chested snake eagle	*Circaetus pectoralis*	LC	0	1	1
Brown snake eagle	*Circaetus cinereus*	LC	2	3	5
Martial eagle	*Polemaetus bellicosus*	**VU**	0	2	2
Dark chanting goshawk	*Melierax metabates*	LC	3	1	4
Black Kite	*Milvus migrans*	LC	1	1	2
Common kestrel	*Falco tinnunculus*	LC	0	2	2
Unidentified species		-	1	3	4
	Total		9	15	24

Regarding the types of flight in the study area, the species observed were mostly in hunting activity (about 58% of the movements), but birds were also observed in passage (about 21%), perched (about 13%), in circular flights and in gliding flights (each with about 4.2%) (see Figure 7.39). Regarding flight heights, most flights took place above the wind turbine blades, at more than 180m (about 29%), at the height of the wind turbine blades, between 105 and 180m (about 21%), and below the wind turbine blades, up to 30m from the ground (about 21%).

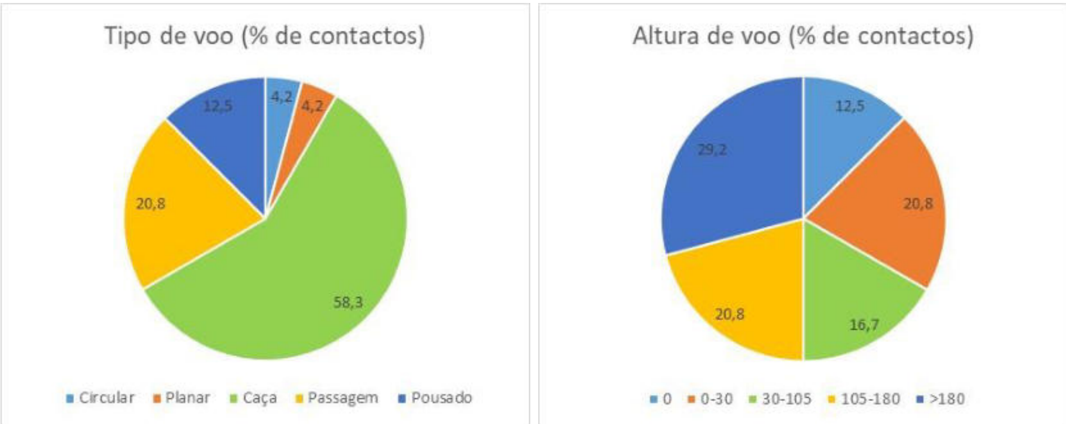


Figure 7.39 - Types and flight heights of birds of prey and other gliders in the study area during the observation points directed at this community.

Movements of birds of prey and other gliders were recorded regularly across the study area (see Figure 7.40), but no birds of this group were detected in the far south-west.

There was a concentration of 3 movements of brown crowned eagle on hunting and passage flights in October and December around wind turbine T6; one movement of Common kestrel (Falco tinnunculus) was also observed in this area. There was also a concentration of movements around the control building/sub-station and wind turbines T14 and T15, in an area of more or less degraded acacia woodland and graminial, which includes one of the observations of martial eagle, with Vulnerable status; the other record was obtained about 1.2km north-east of this area. In this area, movements of Black Kite (Milvus migrans) in gliding flight and Black-chested snake eagle (Circaetus pectoralis) in hunting flight were also recorded, as well as a roosting Brown snake eagle, in addition to 2 hunting movements of an unidentified species (see Figure 7.40). The movements of a dancer eagle (Near Threatened status) were detected in the extreme north-west in passage near wind turbine T4; in the south-west area 2 birds in hunting flight, between wind turbines T6 and T2; and in the centre of the study area, in circles, between wind turbines T9 and T10 (see Figure 7.40).

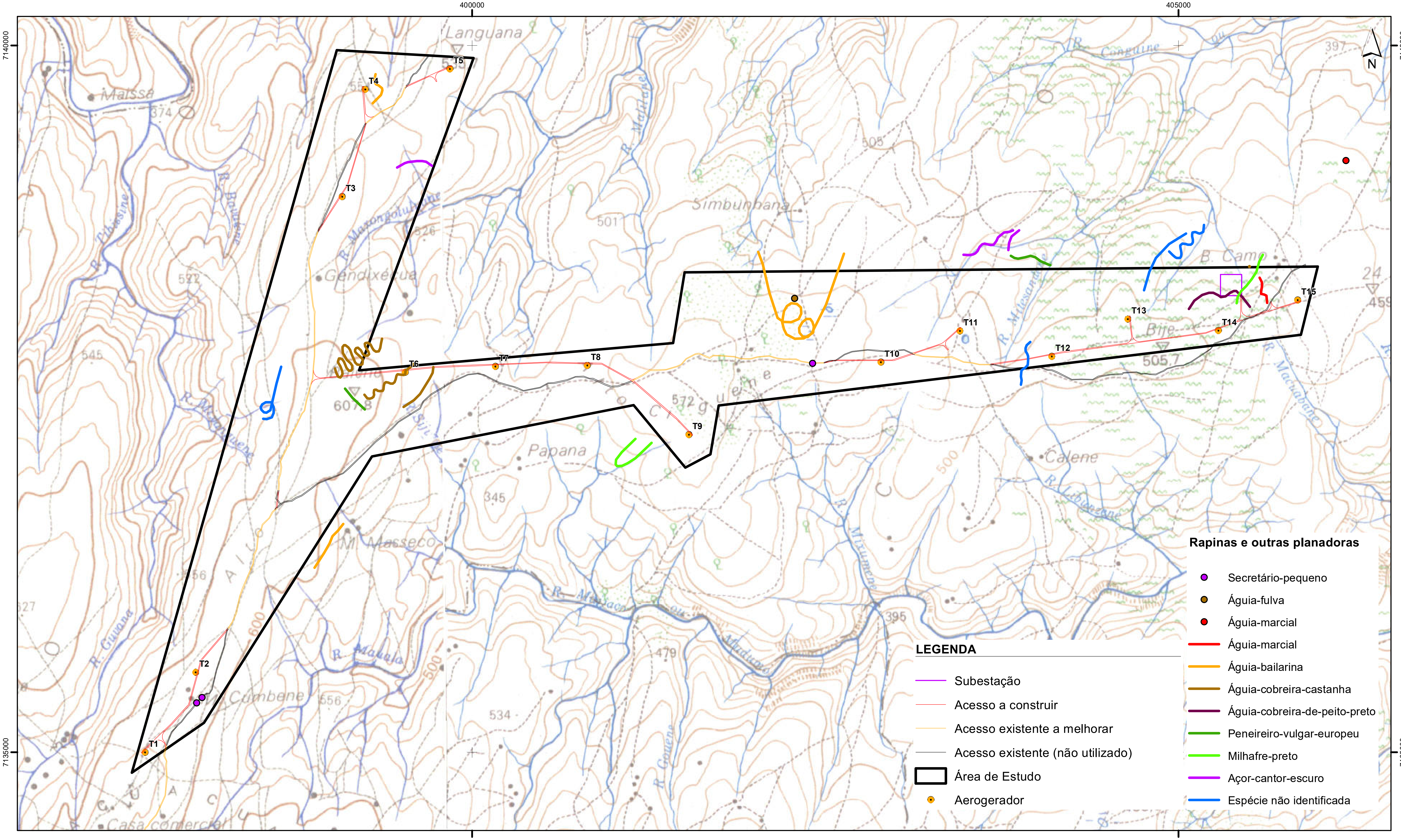
Although efforts were made to locate possible nesting areas in the study area and its immediate surroundings, no nests of birds of prey and other gliders were found. However, it should be noted that during the passerine sampling, one adult, one sub-adult and one African harrier-hawk (*Polyboroides typus*) were observed during the dry season (October) on transects T04 and T09, which may indicate the reproduction of the species in the vicinity.

Water birds

Waterbird sampling was carried out in the small reservoir south of the study area and allowed the detection of only 3 birds that were using the area as a resting place: a Black-headed heron (*Ardea melanocephala*) and a Great cormorant (*Phalacrocorax carbo*), both in December, in the wet season, and a Cattle egret (*Bubulcus ibis*) in June, in the dry season. None of these species has threatened conservation status.

Nocturnal birds

The sampling of nocturnal birds carried out in October (dry season) and February (wet season) allowed 11 observations to be recorded associated with 3 species of this group, all at the western end of the study area: the barn owl (*Tyto alba*), with one observation in February north of wind turbine T2, the Square-tailed nightjar (*Caprimulgus fossii*), with 9 observations in both months between wind turbines T5 and T2, and the Spotted thick-knee (*Burhinus capensis*), with 2 observations south-west of wind turbine T6 in both months. None of these species has threatened conservation status (see Figure 7.41).



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000

0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.40 - Movimentos de Aves de Rapina e Outras Planadoras durante a realização dos Pontos de Amostragem dirigidos a esta comunidade

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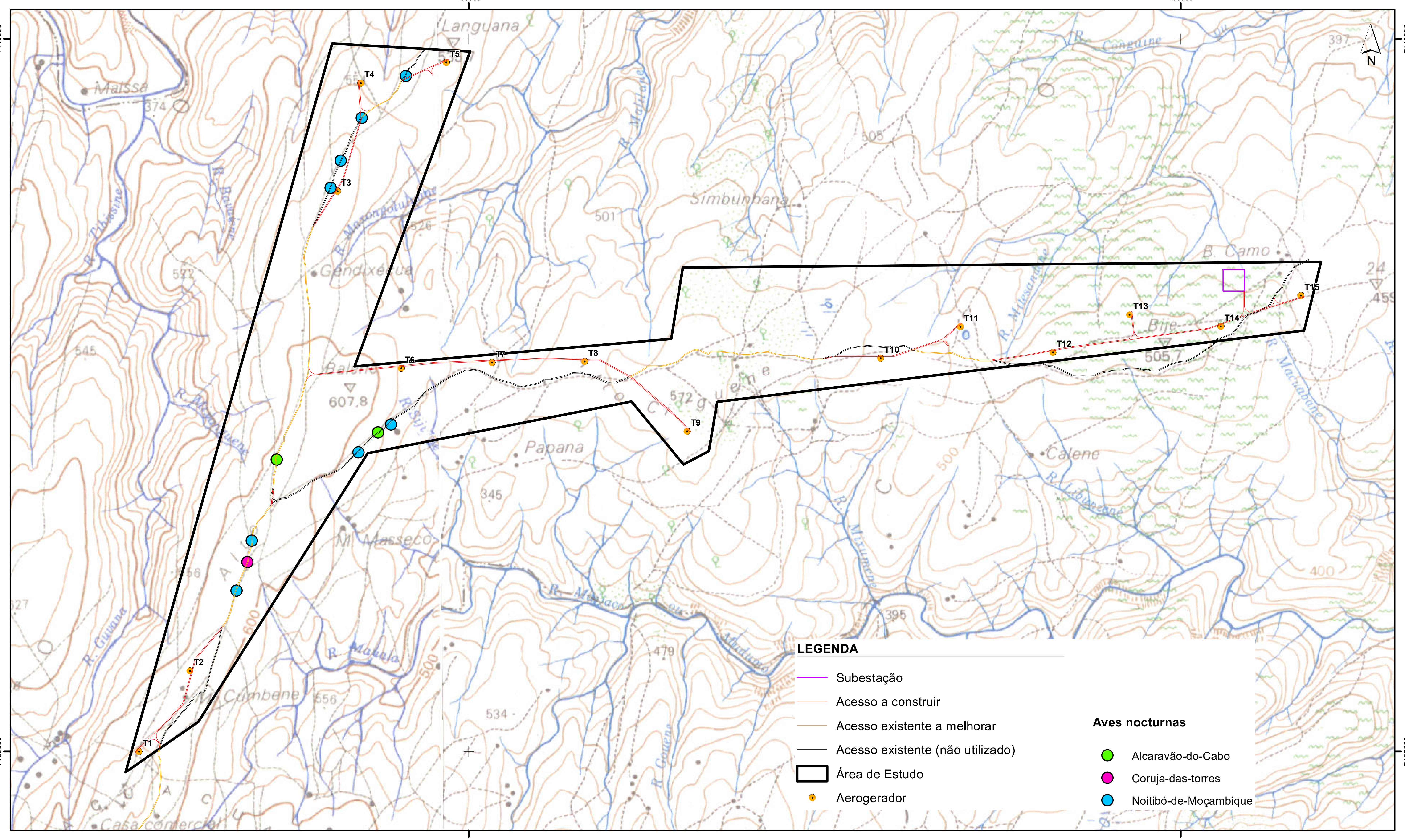

Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000

0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.41 - Aves nocturnas observadas durante os transectos de amostragem dirigidos a esta comunidade

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Species with conservation status

According to the IUCN Red List (IUCN 2019), 13 species with unfavourable conservation status are listed for the study area: 3 species classified as Critically Endangered, 4 species Endangered and 6 species classified as Vulnerable (Table 7.18). There are also 8 species classified as Near Threatened (Annex 3).

Table 7.18

Species with threatened conservation status with potential or confirmed presence in the study area (legend: IUCN status - CR - Critically Endangered; EN - Endangered; VU - Vulnerable; EDGE species - Position in the classification; Main biotope of occurrence: HZ - Humid zones, F - Forest; V - Various; G - Graminial; R - Rocky areas; M - Woodlands; Ma - Scrub, D - Desert; Type of occurrence in the study area: C - Confirmed; P - Probable; PP - Unlikely).

Common name	Scientific name	IUCN status	EDGE	Main biotope	Type of occurrence
Grey crowned crane	*Balearica regulorum*	**EN**	158	ZH e F	PP
Slaty egret	*Egretta vinaceigula*	**VU**	462	ZH	PP
Secretarybird	*Sagittarius serpentarius*	**VU**	86	V	P
White-headed vulture	*Trigonoceps occipitalis*	**CR**	58	V	P
Hooded vulture	*Necrosyrtes monachus*	**CR**	38	V	P
White-backed vulture	*Gyps africanus*	**CR**	133	V	P
Cape Vulture	*Gyps coprotheres*	**EN**	-	G e R	P
Lappet-faced vulture	*Torgos tracheliotos*	**EN**	209	G e M	P
Martial eagle	*Polemaetus bellicosus*	**VU**	419	M	C
Tawny eagle	*Aquila rapax*	**VU**	-	Ma e M	C
Steppe eagle	*Aquila nipalensis*	**EN**	386	G e M	P
Southern ground hornbill	*Bucorvus leadbeateri*	**VU**	214	M, Ma, G, F e ZH	P
Sooty falcon	*Falco concolor*	**VU**	-	D	PP

Among these species, only 2 are confirmed for the study area as they were observed during field sampling:

- The martial eagle, as described above, was observed on 2 occasions in activity and hunting at the eastern end of the study area, around the control building/substation and the wind turbines T14 and T15 and about 1.2 km to the north-east, in December (wet season); it is an uncommon breeding resident in open woodland areas (Parker, 1999);

- The Tawny Eagle (*Aquila rapax*), a species with Vulnerable conservation status, was observed outside the methodologies applied to the different groups, corresponding to a bird in flight between wind turbines T9 and T10, in October (dry season); it is a rare resident scavenger species, which can be observed in woodland areas and occurs more regularly in areas where there are healthy populations of large herbivores; its numbers have declined dramatically due to food shortages, poaching and poisoning (Parker, 1999).

There are 3 species whose probability of occurrence is reduced, since the presence and extent of their preferred biotopes of occurrence are reduced or non-existent in the study area and its close surroundings, such as:

- The Grey-crowned Crane (*Balearica regulorum*), with conservation status Endangered, is a resident species closely associated with wetlands, where it can nest, but it also feeds in nearby dry biotopes, such as graminials, open woodlands and agricultural fields; the Bird Atlas of Southern Save (Southern Mozambique) identifies the presence of the species in the border square between Mozambique and South Africa, probably associated with the wetlands that exist there (e.g. Mazibekela, ca. 10 km west of the study area), Mazibekela, about 14 km west of the study area) (Parker, 1999);

- The Slaty egret (*Egretta vinaceigula*), with Vulnerable conservation status, is a resident species that occurs in floodplains, marshes and temporary surface water wetlands; it tends to avoid open bodies of water, so it prefers to utilise areas with high cover of emergent vegetation, where it feeds at depths of less than 10 cm (IUCN, 2019);

- The Sooty falcon (*Falco concolor*), with Vulnerable conservation status, is a migratory species in the study area, occurring between October and April (wet season); it migrates from the eastern Sarah Desert and the Arabian Peninsula where it breeds to the coastal scrublands of south-east Africa, being observed most frequently near mangroves and estuaries; it migrates mostly alone, in pairs or in small groups; during the migration season, it feeds on insects on graminials and open areas with trees (Parker, 1999; IUCN, 2019).

Although the study area may not have a high attractiveness to be used by these species, their possible presence in passage cannot be excluded, since there are wetlands with conditions to harbour aquatic species in the extended surroundings of the study area, and the areas of graminial and open woodlands may be on the migration route of the dusky falcon.

The remaining 8 species are likely to occur in the study area:

- The Secretarybird (*Sagittarius serpentarius*), with Vulnerable status, is a nomadic species that can occur in grasslands, from plains to open woodlands, but can also feed in agricultural areas (Parker, 1999); it is one of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (Ralston Paton *et al.*, 2017);

- The White-headed Vulture (*Trigonoceps occipitalis*), with Critically Endangered status, is a resident scavenger species, which can occur in woodland areas; it feeds on carcasses of smaller animals, so it seems to have been less affected than other scavengers with regard to food shortages; Parker (1999) also reports that there is no evidence of seasonal movements and that the estimated population for Mozambique is 50 breeding pairs; it is one of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (Ralston Paton *et al.*, 2017);

- The Critically Endangered Hooded Vulture (*Necrosyrtes monachus*) is a rare resident scavenger species; Parker (1999) estimates that the population in Mozambique does not exceed 5 breeding pairs, with occasional increase by visitors from Kruger National Park (South Africa);

- The Critically Endangered White-backed Vulture (*Gyps africanus*) is an uncommon resident scavenger species that may occur in areas of woodland where significant numbers of large herbivores are present; Parker (1999) reports that there is no evidence of seasonal movements and that the estimated population for Mozambique will not exceed 100 breeding pairs; some marked birds currently move close to the study area, but apparently avoid the study area, moving slightly to the west (Kelly, *com. pess.*);

- The Cape Vulture (*Gyps coprotheres*), with Endangered status, is a migratory scavenger species, endemic to southern Africa, which had a breeding population of 6 pairs in the Libombos Mountains near Goba (Mozambique) in 2002 (Monadjem, *com. pess.*); the birds were feeding along the border with Eswatini, as feeding opportunities in this part of Mozambique were very limited due to the scarcity of large herbivores and livestock (Parker, 1999).); the birds fed along the border with Eswatini, as feeding opportunities in this part of Mozambique were very limited due to the scarcity of large herbivores and livestock (Parker, 1999); it is one of the most vulnerable species to the impacts of wind energy according to observed impacts in South Africa and species characteristics (Ralston Paton *et al.*, 2017);

- The Lappet-faced vulture (*Torgos tracheliotos*), with Endangered status, is a rare resident scavenger species that can occur in woodland areas; Parker (1999) reports that there is no evidence of seasonal movements and that the Mozambican population will be less than 10 breeding pairs, with occasional increase by visitors from the Kruger National Park (South Africa); it is one of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (Ralston Paton *et al.*, 2017);

- The steppe eagle (*Aquila nipalensis*), with Endangered status, is a rare migratory species that can occur in woodland areas; it feeds on winged termites after rains and is attracted to colonies of red-billed quelea (*Quelea quelea*); Parker (1999) states that the number of birds in the region should not exceed 50;

- Southern ground hornbill (*Bucorvus leadbeateri*), with Vulnerable status, is an uncommon resident species, which can occur in arid forest areas, where it can form family groups of up to 6 birds; Parker (1999) estimates that the Mozambican population will not exceed 600 birds; it has disappeared from densely humanised areas due to hunting; it is one of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (Ralston Paton *et al.*, 2017).

According to WSP (2019), the study area lies in an important corridor for bird movements along Montes Libombos mountain range, and between the Kruger National Park (and further north) and northern Zululand province, both in South Africa.

According to data available from the African Raptor DataBank (Habitat INFO, 2019), the study area is part of the Kruger Complex Stronghold, which is the largest aggregation of vulture habitats in southern Africa, providing vital feeding areas for the Cape Vulture, and is also important for the Hooded Vulture, White-backed Vulture and White-headed Vulture, among others. The study area is in an area of occurrence for 6 species of vultures and movements of marked vultures suggest a high utilisation corridor to the west of the study area, with movements in the project area. Energy infrastructure, development plans and poisoning are the major threats to these habitats.

Although most large herbivores have been eliminated outside the protected areas, some food may be available in the study area for scavenging birds, namely wild animals such as small antelopes, monkeys and wild boars, but also domestic animals associated with the presence of livestock, where the predominant species are cattle and goats.

7.8.4.5 Non-flying mammals

It was possible to list for the study area a total of 75 species of non-flying mammals (Annex 3 - Appendix 3.6) distributed among 21 families. The best represented families of non-flying mammals are Bovidae with 14 species, Muridae with 12 species and Herpestidae with eight species (see Figure 7.42). During the field visits it was possible to confirm the presence of ten species: Red forest duiker (*Cephalophus natalensis*), Southern reedbuck (*Redunca arundinum*), Vervet monkey (*Chlorocebus pygerythrus*), Common dwarf mongoose (*Helogale parvula*), Banded mongoose (*Mungos mungo*), Scrub hare (*Lepus saxatilis*), bushpig (*Potamochoerus larvatus*), Greater cane rat (*Thryonomys swinderianus*), Rusty-spotted genet (*Genetta maculata*) and African civet (*Civettictis civetta*).

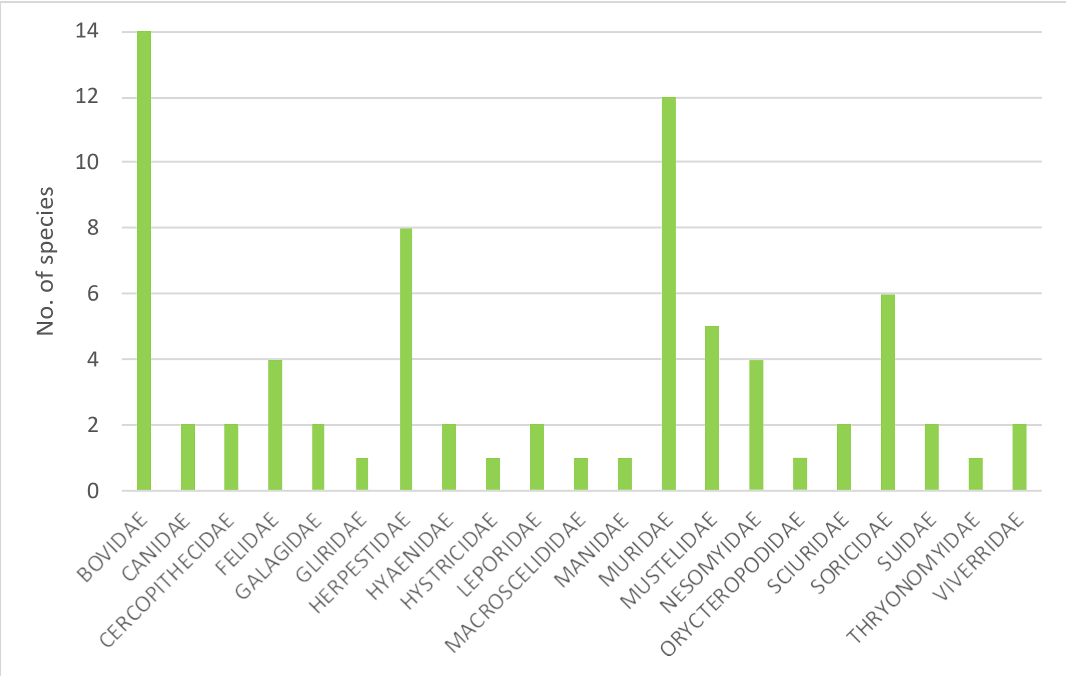


Figure 7.42 - Families of non-flying mammals listed for the study area.

Among the non-flying mammal species listed for the study area, two are threatened: the leopard (*Panthera pardus*) and the Ground pangolin (*Smutsia temminckii*), both classified as "Vulnerable" (VU) (IUCN, 2019). It is also important to mention the presence of two species classified as "Near Threatened" (NT): the African clawless otter (*Aonyx capensis*) and the Spotted-necked otter (*Hydrictis maculicollis*) (IUCN, 2019).

Two species of migratory non-flying mammals are also listed for the study area: the Blue wildebeest (*Connochaetes taurinus*) and the Common eland (*Tragelaphus oryx*); and seven species of congregatory habits: the impala (*Aepyceros melampus*), the Blue wildebeest, the Common eland, the Vervet monkey, the Chacma baboon (*Papio ursinus*), the Mohol bushbaby (*Galago moholi*) and the Spotted hyena (*Crocuta crocuta*).

According to the Regulation of the Forestry and Wildlife Law nº10/99, of 7 July, the hunting of 21 species of non-flying mammals listed for the study area is allowed, and another 27 species of flying mammals potentially present in the area are protected.

Eight species were identified based on the traces observed along the daytime transects, and in addition to these, one rodent was also observed, which could not be identified at the specific level. T03 was the one with the highest abundance with an average QAI of 85 traces/km, followed by transects T07 and T09 with an average QAI of 35 traces/km each (see Figure 7.43). In 10 of the 19 transects the QAI values were higher in the dry season and in only six of the 19 sampled transects the QAI values were higher in the wet season (see Table 7.19).

With regard to specific richness, the values vary little between seasons and transects, but the highest average specific richness recorded in transects T06, T08 and TM03 of 2 species/season stands out (see Figure 7.43 and Table 7.19).

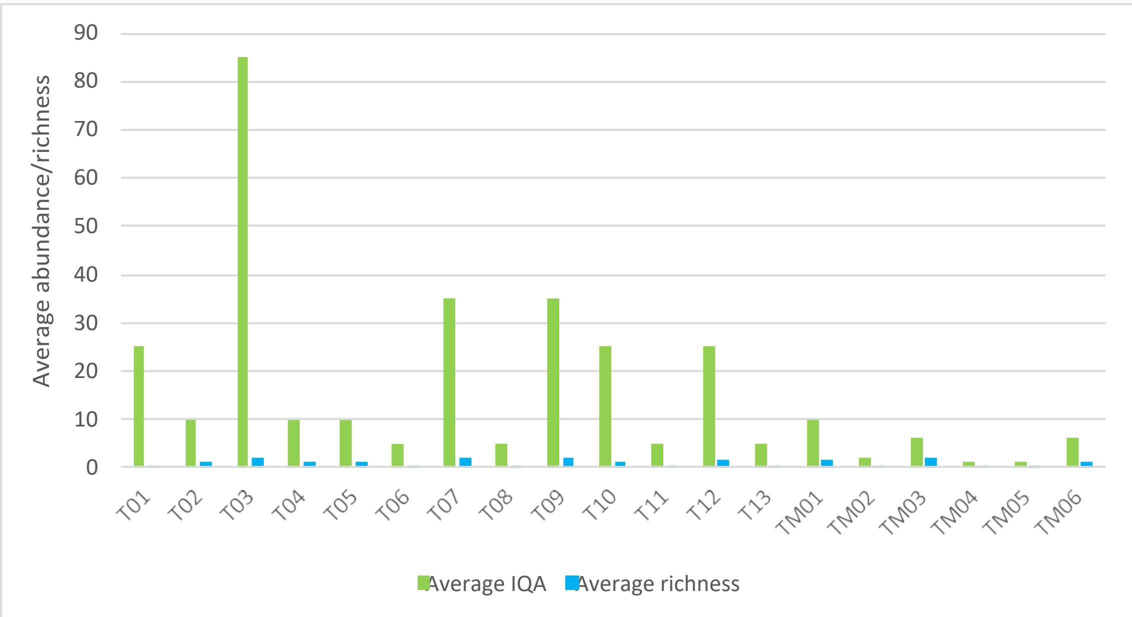


Figure 7.43 - Average kilometre index of abundance and specific richness per transect.

Table 7.19

Index of kilometre abundance (IQA) and specific richness by season and mean, by transect sampled.

Transect	IQA			Specific richness		
	Dry season	Wet season	Average	Dry season	Wet season	Average
T01	0	50	25	0	1	0,5
T02	10	10	10	1	1	1
T03	90	80	85	1	3	2
T04	10	10	10	1	1	1
T05	20	0	10	2	0	1
T06	10	0	5	1	0	0,5
T07	60	10	35	3	1	2
T08	10	0	5	1	0	0,5
T09	30	40	35	2	2	2
T10	30	20	25	1	1	1
T11	0	10	5	0	1	0,5
T12	30	20	25	2	1	1,5
T13	0	10	5	0	1	0,5
TM01	12	8	10	2	1	1,5
TM02	0	4	2	0	1	0,5
TM03	10	2	6	3	1	2
TM04	0	2	1	0	1	0,5
TM05	0	2	1	0	1	0,5
TM06	10	2	6	1	1	1

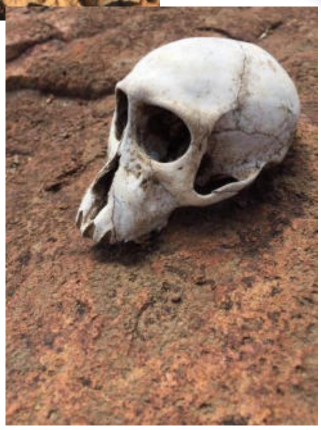
During the night transects only two species were observed, the hare and the striped mongoose, and the number of contacts recorded was low, as was the specific richness (see Table 7.20).

Table 7.20

Total number of contacts and specific richness per season and average, per night transect sampled

Night transect	Total No. of contacts			Richness		
	Dry	Wet	Average	Dry	Wet	Average
TN01	2	4	3	1	2	1,5
TN02	0	2	1	0	1	0,5
TN03	5	0	2,5	1	0	0,5





Photos 7.28, 7.29 and 7.30 - Some traces of non-flying mammal species recorded in the study area: a) hare latrine, b) wild pig footprint, c) blue-faced monkey skull

7.8.4.6 Bats

A total of 29 bat species were listed for the study area (Annex 3 - Appendix 3.7) distributed among eight families. The best represented bat families are Vespertilionidae with 10 species and Molossidae with seven species (see Figure 7.44). During the fieldwork it was possible to confirm the presence of 13 bat species: Sundevall's roundleaf bat (*Hipposideros caffer*), Cape horseshoe bat (*Rhinolophus capensis*), Ansorge's free-tailed bat (*Chaerephon ansorgei*), Midas free-tailed bat (*Mops midas*), Large-eared free-tailed bat (*Ortomops martiensseni*), Egyptian free-tailed bat (*Tadarida aegyptiaca*), *Miniopterus natalensis*, Long-tailed house bat (*Eptesicus hottentotus*), Welwitsch's bat (*Myotis welwitschii*), Cape serotine (*Neoromicia capensis*), banana resotine (*Neoromicia nana*), *Pipistrellus hesperidus* and African yellow bat (*Scotophilus dinganii*).

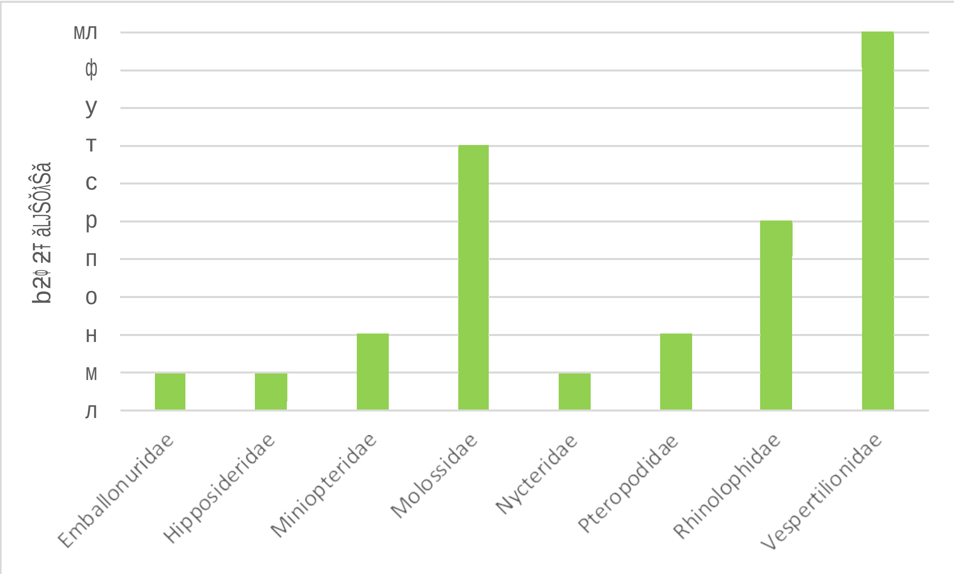


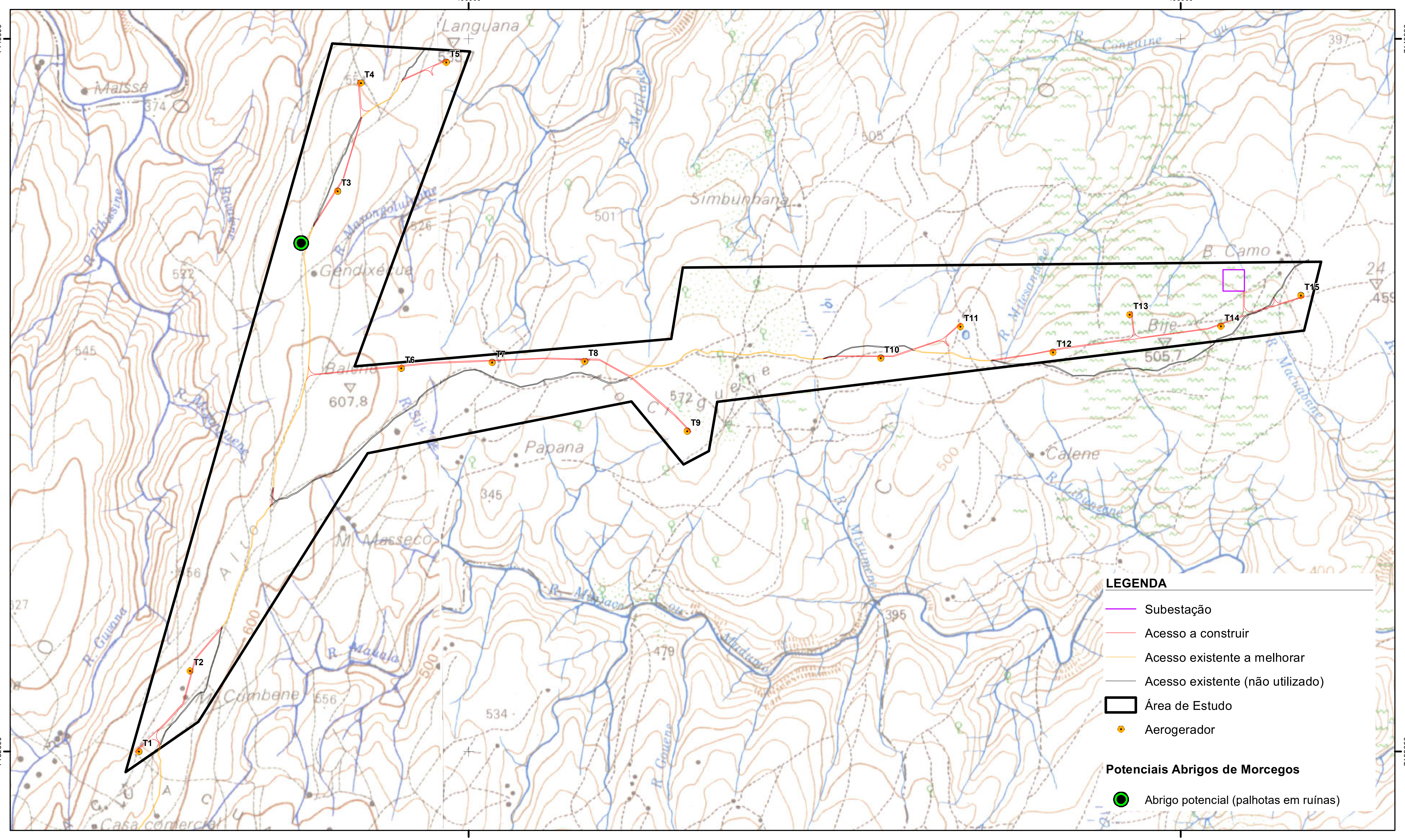
Figure 7.44 - Bat families listed for the study area

No threatened bat species were listed for the study area, however, the presence of the Long-eared Free-tailed Bat, a species classified as "Near Threatened" (NT) (IUCN, 2019), should be noted. Among the listed species, there is an endemic species (South Africa): Cape horseshoe bat, and a congregatory species: Cafeteria leaf-nosed bat.

Five potential shelter sites were visited, only one of them within the study area (see Figure 7.45).

They were only found in one location, in an unfinished building next to the Libombos Hotel. In October 2018 about 30 fruit bats with young, possibly *Epomophorus wahlbergi* or *Epomophorus crypturus*, were observed in the shelter on the upper floors of the building. These were also observed in the shelter in February 2019, but without young.

Iso in October 2018, a colony of 14,000 to 16,000 individuals of *Miniopterus natalensis* was identified in one of the basement rooms of the abandoned building. A few dozen individuals of the same species were found in other rooms of the basement and about seven individuals of the leaf-nosed bat in the Cafeteria. Also the interior of the bricks of one of the rooms of the basement of the building seemed to have bats inside (of unidentified species).



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:25 000
0 0,5 1 km

Sistema de Projeção: WGS 1984
Unidades: metros
EPSG: 32736

T01717_14_V0_Fig7_45.mxd(A3)

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.45 - Potenciais locais de Abrigo de Morcegos na Área de Estudo

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Photos 7.31, 7.32 and 7.33 - Bat species observed in the surroundings of the study area: a) Epomophorus wahlbergi/Epomophorus crypturus,
b) colony of Miniopterus natalensis, c) Hipposideros caffer

7.8.5 Conflicts with wildlife

Human-wildlife conflicts tend to occur in environments where local communities coexist with wildlife utilising the same resources.

In the district of Namaacha between 2 and 4 people were killed or injured due to encounters with crocodiles, and there was no crop damage resulting from the presence of wild animals between 2006 and 2008 (Le Bel *et al.*, 2011).

Taking into account the scarce presence of water bodies in the study area and the apparent absence of large mammals, according to the results of the sampling carried out, the occurrence of human-wildlife conflicts in the study area is considered unlikely.

The presence of monkeys in the study area may result in minor conflicts as these animals have a tendency to steal food. The potential presence of jackals, genets, civets, pythons, varan lizards and sea eagles in the study area may also result in some conflict due to the killing of small domestic animals, especially chickens.

7.8.6 Ecosystem services

7.8.6.1 Support services

Support services are those necessary for the production and functioning of the other ecosystem services, these include soil formation, photosynthesis, primary production, nutrient and water cycles. All other ecosystem services depend on and develop from the support services.

All vegetation units contribute to support services except artificialised areas (see Table 7.21).

Table 7.21

General assessment of the importance of different vegetation units for support services.

Support services	**Photosynthesis & primary production**	**Soil formation**	**Nutrient and water cycles**
Acacia woodland	E	M	M
Degraded acacia woodland	M	M	M
Acacia woodland and *Combretum* spp.	E	M	M
Combretum spp. woodland	E	M	M
Forest remnant	M	M	M
Water line	E	E	E
Graminial	E	E	E
Agricultural areas	E	B	M
Artificialised areas	NA	NA	NA

7.8.6.2 Production services

Production services include goods obtained from ecosystems, such as food, fibre, fuel, genetic resources, biochemicals, natural medicines, substances used in pharmaceuticals, raw materials for crafts or construction, and freshwater sources.

The most important vegetation units for production services are Acacia woodland and *Combretum* spp. and *Combretum* spp. woodland (see Table 7.22).

Table 7.22

General assessment of the importance of different vegetation units for production services

Production	Food production						Endogenous natural resources	Endogenous forest products			Plant and animal resources	
	Hunting	**Wild foods**	**Fishing**	**Grazing/livestock**	**Agriculture**	**Honey**	**Fresh water**	**Timber**	**Other non-timber forest resources**	**Resins**	**Genetic resources**	**Medicinal and related resources**
Acacia woodland	E	E	NA	M	B	B	NA	M	M	B	M	E
Degraded acacia woodland	M	M	NA	E	B	B	NA	M	M	B	M	M
Acacia woodland and *Combretum* spp.	E	E	NA	M	B	B	NA	E	M	B	M	E
Combretum spp. woodland	E	E	NA	M	B	B	NA	E	M	B	M	E
Remnant forest	E	M	NA	B	B	B	NA	E	M	B	E	E
Water line	B	B	B	NA	NA	NA	E	B	B	B	M	B
Graminial	M	B	NA	E	B	B	NA	B	E	B	M	B
Agricultural areas	M	B	NA	E	E	B	NA	B	B	B	B	M
Artificialised areas	NA	NA	NA	M	M	NA	NA	NA	NA	NA	B	NA

Food production

According to the informal interviews conducted, the population in the study area hunts monkeys, goats and small antelopes (such as Red forest duiker or Southern reedbuck) and hares. Hunting is mostly an activity that supports the diet of the local community, although the excess may be sold in the village as bushmeat. Some villagers also hunt small birds using slingshots for food.

Local communities also collect wild foods, mostly fruits and nuts. According to the informal interviews conducted, fruits of the following species are collected and eaten green: *Capparis tomentosa*, *Malabar plum* (*Syzygium cumini*), *Pappea capensis*, *Mimusops zeyheri* and *Manilkara discolor*. The seeds of Strychnos madagascariensis are dried, pounded and then mixed into food. Marula nuts (*Sclerocarya birrea*) are collected, crushed and fermented to produce an alcoholic drink widely consumed by the local population. Wild foods are collected for consumption only and have no commercial value.

Photos 7.34, 7.35 and 7.36 - Some of the wild foods utilised by the local population according to information from residents: a) fruits of *Mimusops zeyheri*, b) marula nuts collected; c) Malabar plum.

Although there is a water line in the study area, it is small and temporary, so the local population does not exploit this resource in terms of fishing.

Livestock rearing is one of the main activities in the study area according to the interviews conducted, with mainly cows and goats being reared. Some areas are even fenced and designated for grazing, but the most common is to observe cattle grazing in the grasslands and open areas of the woodlands (see Photo 7.37). Also according to the interviews conducted, the livestock raised in the study area is mostly for sale and not for own consumption.

Photo 7.37 - Cows grazing in open area of acacia woodland

The agriculture present in the study area is traditional and subsistence, and according to field observations and interviews with residents the main crops are maize (*Zea mays*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*) and millet (Panicum sp.). Other vegetables such as beans (*Phaseolus vulgaris*), Cowpea (*Vigna unguiculata*), pumpkins and watermelons (*Citrullus lanatus*) are also grown on the fields. Some fruit trees, such as pawpaw (*Carica papaya*) and guava (*Psidium guajava*), are also found near the houses. According to the interviews carried out, it is mentioned that there is also occasional production of Indian pennywort for sale.

According to local reports, maize is sometimes fermented to produce an alcoholic beverage in addition to its food use.

Photos 7.38 and 7.39 - Two of the main crops in the study area: maize and cassava

The local population does not collect honey or derived products (such as wax or propolis).

Endogenous natural resources

Freshwater sources in the study area are scarce, with much of the local population fetching water from a rudimentary 'well' (see Photo 7.40) that holds water all year round. The location and perenniality of the "well" was indicated by a local inhabitant.

Photo 7.40 - Freshwater source in the study area

Endogenous forest resources

According to the interviews conducted, local communities actively harvest timber in the forested areas. The wood collected is mainly used for house construction, with wood mainly from *Combretum* spp. being utilised.

Wood is also collected for charcoal production, which is also an important economic activity in the study area according to residents. The main species used for charcoal production are: *Asystasia* sp., *Acacia burkei, Acacia karoo, Acacia tortilis subsp. heteracantha* and *Dombeya cymosa*. Wood is also collected for cooking and heating fires by local people.

The wood of Afzelia quanzensis is collected for the production of pestles and the palms (Hyphaene coriacea and Phoenix reclinata) for making mats, doors and windows.

Grass is an important local raw material used for the roofs of houses (see Photo 7.41) and for making baskets. While sisal (Agave sisalana) is used to produce ropes.

Photo 7.41 - Example of a house made of local wood and grass in the study area

No local plant resins are collected or used in the study area.

Plant and animal resources

According to interviews conducted, it is concluded that the local population uses some plant species for medicinal uses: aloe (Aloe sp.) and Lippia javanica are used to treat skin problems; Abrus precatorius subsp. africanus is used to treat fever and cough; Senna petersiana is used to treat malaria, Gymnosporia heterophylla and *Elephantorrhiza elephantina* are used to relieve menstrual pain and diarrhoea, *Antidesma venosum* and *Pappea capensis* are used to treat abdominal pain.

It should also be noted that the species *Cymbopogon excavatus* and *Cympopogon citratus* are used as insect repellents.

7.8.6.3 Regulation services

Regulation services correspond to the benefits obtained from ecosystem regulation processes, such as air quality regulation, climate regulation, water regulation, erosion control, water purification, disease and pest regulation, pollination and natural disaster regulation.

The most important vegetation unit for regulation services is the forest remnant, as it corresponds closest to the original vegetation and as such to the equilibrium point of the ecosystem (see Table 7.23).

Table 7.23

General assessment of the importance of different vegetation units for regulation services

Regulation services	**Cycles**	**Soil protection and erosion control**	**Water cycle regulation**	**Nutrient cycle regulation**	**Pollination**	**Local climate regulation**	**Debugging**	**Soil bioremediation**	**Pollutant and contaminant treatment**	**Water purification**	**Air quality**	**Prevention**	**Flood control**	**Wildfire control**	**Disease & pest prevention & control**	**Control of invasive species**	**Habitats**	**Habitat maintenance**	**Areas of high conservation value**
Acacia woodland		M	B	M	E	M		a	a	a	9		a	a	a	a		a	.
Degraded acacia woodland		M	B	M	M	M		a	a	.	a		a	.	.	.		.	.
Acacia woodland and *Combretum* spp.		M	B	M	E	M		a	a	a	9		a	a	a	a		a	.
Combretum spp. woodland		M	B	M	E	M		a	a	a	9		a	a	a	a		a	.
Remnant forest		M	B	M	E	E		a	a	a	9		a	a	a	a		9	a
Water line		M	E	B	B	B		.	.	9	.		9	a	.	.		a	.
Graminial		B	B	M	M	B		.	.	.	.		a	.	.	.		.	.
Agricultural areas		B	B	B	E	B		.	.	.	.		.	.	b !	b !		.	.
Artificialised areas		NA	NA	NA	B	NA		b !	b !	b !	.		b !	b !	b !	b !		b !	b !

7.8.6.4 Cultural services

Cultural services refer to non-material benefits obtained from ecosystems, such as spiritual enrichment, cognitive development, reflection, recreational experiences and aesthetic values, including landscape.

The most important vegetation units for cultural services are grassland and acacia woodland for their contribution to the typical landscape (see Table 7.24).

Table 7.24
General assessment of the importance of different vegetation units for cultural services

Cultural services	Recreational activities	Tourism	Education	Scientific research
Acacia woodland	M	E	M	E
Degraded acacia woodland	M	M	M	B
Acacia woodland and *Combretum* spp.	M	M	M	M
Combretum spp. woodland	M	M	M	M
Remnant forest	E	M	M	M
Water line	E	M	M	M
Graminial	M	E	M	E
Agricultural areas	B	B	M	B
Artificialised areas	B	B	B	B

7.9 AIR QUALITY

7.9.1 Introduction and legislation

Air pollution refers to the existence of certain pollutants in the atmosphere at levels that adversely affect human health, the environment, and cultural heritage (buildings, monuments and materials).

The concentrations of pollutants in ambient air depend essentially on the factors: quantities emitted, meteorological conditions and local topography which condition their dispersion, transport, wet or dry deposition and chemical transformations. Air quality thus results from a complex balance between direct emissions of pollutants into the atmosphere and a series of processes to which the pollutants are subjected. Atmospheric phenomena play a major role in the processes of dispersion and transport of pollutants in the atmosphere, and pollution levels can vary considerably from one day to the next, even when the quantities of pollutants emitted are identical.

According to Article 7 of Chapter II of the Regulation on Environmental Quality and Effluent Emission of Decree No. 18/2004 of 2 June, amended by Decree No. 67/2010 of 31 December, the fundamental parameters that characterise air quality, so that it maintains its self-depuration capacity and does not have a significant negative impact on public health and the ecological balance, are described in Table 7.25.

Table 7.25

Air Quality Standards

Parameter (μg/m³)	Sampling time										
	10 Minutes	15 Minutes	30 Minutes	1 hour		8 hours		24 hours		Annual arithmetic mean	
				Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Sulphur dioxide (SO_2)	500	-	-	800	-	-	-	100	-	40	-
Nitrogen Dioxide (NO_2)	-	-	-	190	-	-	-	-	-	10	-
Carbon Monoxide	-	100 000	60 000	30 000	-	10 000	-	-	-	-	-
Ozone	-	-	-	160	-	120	-	50	-	70	-
Total Suspended Particulates	-	-	-	-	-	-	-	150	-	60	-

Decree No. 67/2010 of 31 December 2010 also approved the integration into this Regulation of Annex 1A (Air Quality Standards - Inorganic and Organic Carcinogenic Air Pollutants) and Annex 1B (Substances with Odorous Properties) (see Tables 7.26 and 7.27).

Table 7.26

Air Quality Standards - Inorganic and Organic Carcinogenic Air Pollutants

Parameter (μg/m³)	Sampling time					
	30 Minutes	1 Week	24 hours		Annual arithmetic mean	
			Primary	Secondary	Primary	Secondary
Lead	-	-	-	-	0,5	-
Manganese	-	-	-	-	0,05	-
Mercury	-	-	-	-	1	-
Arsenic	-	-	-	-	$3x10^{-3}$	-

Parameter ($\mu g/m^3$)	Sampling time					
	30 Minutos	1 Week	24 hours		Annual arithmetic mean	
			Primary	Secondary	Primary	Secondary
Chrome	-	-	-	-	$9,6x10^{-1}$	-
Nickel	-	-	-	-	$4x10^{-2}$	-
Benzene	-	-	-	-	$4,4x10^{-6}$	-
Formaldehyde	0,01	-	-	-	-	-
Styrene	0,28	-	-	-	-	-
Toluene	-	0,26	-	-	-	-
Tetrachloroethylene	-	-	0,25	-	-	-

Annex 1B, of Decree No. 67/2010 of 31 December, on the treatment of atmospheric quality, states that "the open-air burning of solid waste, liquids or any other combustible material is prohibited, provided that it causes environmental degradation. (...), the installation and operation of household and industrial incinerators, except hospital incinerators, is prohibited. If necessary, the installation and operation of automatic equipment for the measurement of the quantities and qualities of the pollutants emitted may be required. (...) it is also prohibited, the emission of odourous substances into the atmosphere in quantities that may be perceptible outside the limits of the area of ownership of the emitting source. This emission shall be checked by accredited officers" (see Table 7.27).

Table 7.27

Substances with odourous properties.

Substances	**ppm/vol**
Ammonium	46,80
Bromine	0,047
Chlorine	0,314
Methylene chloride	214,0
Carbon bisulphite	0,210
Phenol	0,047
Perchloroethylene	4,680
Carbon tetrachloride	21,48

According to Article 9 of Chapter II of the Regulation on Environmental Quality and Effluent Emission of Decree 18/2004 of 2 June, emissions of air pollutants by mobile sources or motor vehicles must comply with the maximum permissible emission limits (see Table 7.28). Local authorities may adopt additional regulatory measures to improve air quality in their urban areas.

Table 7.28
Maximum permissible air pollutant emission limits for mobile sources or motor vehicles

Type of Vehicle	Assumed fuel economy km/litre	CO_2	NO_x	SQOVNM	CO	N_2O	Particles	Lead
Passenger cars	5,1	3188	6,05	3,09	6,29	0,08	0,06	-
Diesel vans	4,3	3188	7,17	4,11	7,96	0,08	0,10	-
Heavy-duty diesel lorries	2,2	3188	42,86	7,63	21,80	0,08	0,26	-
Motorbikes	12,8	3172	32,30	11,1	40,5	0,08	5,6	-

SQOVNM - Non-methyl volatile organic chemical substance

In Mozambique, there are also regulations for substances that affect the ozone layer, through Decree No. 24/2008 of 1 July. This regulation aims to establish rules on the import and export, transit and destruction of ozone-depleting substances and equipment containing them, with a view to preventing or minimising their negative impacts on the environment".

7.9.2 Framing in the study area (AID and AII)

In the District of Namaacha there is no relevant industry that could be a source of air pollution. Road traffic, although not significant, may cause emissions of polluting substances such as CO, NOx, hydrocarbons, particles and CO_2, which have implications for human health and the environment.

In the village of Namaacha and in the area of direct influence of the Project there are no industries.

The area of direct influence is characterised by being a predominantly natural terrain, although marked by the artificialisation caused by human presence, namely, by the use of this area for various activities such as agriculture and grazing, thus existing some dwellings. Part of these dwellings are considered permanent, since there are families living there, other dwellings are considered temporary occupation, since in some parts of the year they are inhabited. There are also some occasional dwellings around the area of direct intervention of the Project.

According to the survey carried out, there are no fixed sources of air pollution in the AII and AID of the Project.

As far as road traffic is concerned, traffic on the EN2 may be a source of pollution, but it is of low intensity (it is more intense during the periods coinciding with the daily commuting of the population, i.e. during the early hours of the morning and at the end of the day) and the road is located about 10 km from the IDA.

People in the AID and AII commute to Namaacha village on foot, by hitchhiking, by bicycle, bymotorbike and very few by car.

Road traffic is considered to be a source of air pollution in the area, and contributes to higher concentrations of particulate matter and vehicle exhaust fumes. It is considered, however, that due to the low volumes of traffic recorded, this source of air pollution will be insignificant.

The characteristics of the Project do not justify an in-depth analysis of air quality parameters, so the approach adopted was based on a qualitative analysis.

The Project's AID and AII are characterised by being essentially natural areas, and partly rural. According to the survey carried out, no fixed sources of air pollution were identified, such as industrial facilities or roads with heavy associated traffic, thus inferring a good air quality in the Project area.

7.10 WASTE MANAGEMENT

7.10.1 General considerations and legal framework

In this Chapter, a characterisation of the issues related to waste management is carried out, taking into account the waste found in the study area, as well as a brief legal framework with regard to this descriptor.

The Constitution of the Republic of Mozambique and Law No. 20/97 of 1 October - the Environment Law - *grant all citizens the right to live in a balanced environment and the duty to defend it.*

The legal framework for the accountability of Mozambican municipalities in the management of municipal solid waste is supported by Law No. 2/97 of 18 February where, in Article 6, it defines that the attributions of local authorities respect the own, common and specific interests of their respective populations (MICOA (2006) cited in Fernando, 2013).

At national level, the following legal diplomas related to urban solid waste management stand out:

- Decree no. 94/2014, of 31 December, approved the Regulation on Urban Solid Waste Management;
- Decree no. 83/2014, of 31 December, approved the Regulation on Hazardous Waste Management;
- Technical Directive for the implementation and operation of sanitary landfills, 2010;
- Integrated Urban Solid Waste Management Strategy;
- Decree No. 8/2003 of 18 February - Regulation on the management of bio-medical waste.

Decree No. 94/2014, of 31 December - Regulation on the management of urban solid waste, establishes the rules for the management of municipal solid waste in the territory of Mozambique and is applicable to all natural and legal persons, public and private who are involved in the production and management of municipal solid waste or industrial and hospital waste equivalent to municipal waste.

Excluded from the scope of the Regulation are (i) hazardous industrial waste, (ii) biomedical waste, (iii) radioactive waste, (iv) effluent emissions and discharges, (v) waste water and (vi) other waste subject to specific regulation.

In its Article 4 this Decree establishes the general principles of waste management, namely:

- *"a) Self-sufficiency principles - urban solid waste management operations should preferably take place on national territory, minimising transboundary movements of waste;*
- *b) Management responsibility principle - the management of urban solid waste is an integral part of the life cycle of materials and is the responsibility of the respective producer and/or holder;*
- *c) Principle of prevention and reduction - the priority objective of urban solid waste management is to avoid and reduce the generation of waste and its harmful character, and waste management should also avoid or at least reduce the risk to human health and the environment caused by waste without using processes or methods that may have adverse effects on the environment;*
- *d) Waste management hierarchy principle - urban solid waste management should respect the following order of priorities with regard to management options - prevention and reduction, reuse, recycling, other forms of recovery and disposal - and should always use the best available technologies at economically sustainable costs, in order to allow for the extension of the life cycle of materials;*
    - *e) Principle of citizen responsibility - it is the duty of the citizen to contribute to the pursuit of the*

principles and objectives referred to in this Regulation by adopting preventive behaviour in terms of waste generation, as well as practices that facilitate its reuse and recovery;

- *f) Principle of protection of human health and the environment - It is a priority objective of urban solid waste management to avoid and reduce risks to human health and the environment by ensuring that the generation, collection, transport and treatment of waste are carried out using processes or methods that are not likely to generate adverse effects on the environment, such as pollution of water, air, soil, impacts on fauna and flora, noise, odours or damage to the landscape;*

- *g) Polluter-pays principle - it is the duty of the polluter to bear the costs of repairing the damage he has caused to the environment; principle that is part of environmental law."*

Urban solid waste management competences are divided between the Ministry that oversees the Environment Sector and the Municipal Councils and District Governments in their respective areas of jurisdiction.

Urban solid waste is classified according to the Mozambican Standard NM339 - Solid Waste - Classification. This Decree covers urban waste, special waste, bio-waste, bulky domestic waste, commercial domestic waste, industrial domestic solid waste assimilated to urban waste and hospital solid waste assimilated to domestic waste.

All public and/or private entities carrying out activities related to the management of urban solid waste are obliged to draw up and implement an integrated management plan for the urban solid waste they manage, containing at least the information in Annex I of the Regulation.

Annex 5 presents the Environmental Management Plan (Waste Management Plan) with more detailed information.

From the moment of its approval by the Municipal Assemblies and District Governments, the Plan is valid for a period of five years and may be updated if justified.

All facilities for the treatment and final disposal of urban solid waste are subject to prior environmental licensing under the Regulation on the Environmental Impact Assessment Process. A list of authorised operators is provided in Annex 5.

Urban solid waste and hazardous waste management companies are subject to prior environmental licensing, in accordance with Decree No 54/2015 of 31 December, described in Chapter III. According to this Regulation, the environmental licensing process consists of three stages:

- Issuance of the Provisional Environmental Licence, issued after approval of the EPDA for EIA;
- Issuance of the Environmental Installation Licence, issued after approval of the Environmental Impact Study and submission of the Resettlement Plan;
- Issuance of the Environmental Operating Licence, issued after verification/inspection of full compliance with the EIA versus constructed enterprise and full implementation of the Resettlement Plan, if required.

The entities responsible for the management of municipal solid waste carry out actions that must be controlled by it, fulfilling their obligations and duties, from producers to transporters and operators. Therefore, according to Article 11 of Decree No. 94/2014, of 31 December, the following are obligations of producers, transporters and operators of USW:

- Minimise USW production;
- Train workers involved in waste handling on health, safety and environmental issues;
- Ensure the segregation and packaging of waste into different categories in accordance with the provisions of Article 14 of this Regulation;
- Ensure the treatment of USW before its proper final disposal;
- Ensure the protection of all workers involved in USW management against accidents and diseases resulting from their exposure to the risk of contamination;
- Ensure that the transport of waste is carried out properly, ensuring that there is no dispersal of waste along the route to the final destination;

- Ensure that waste disposal, both on and off site, does not have a negative impact on the environment or on public health and safety;

- Keep a detailed annual record of the origins, quantities and types of waste handled, transported, treated, recovered or disposed of.

The entities responsible for waste management must inform the Municipal Council or District Government in the event of accidental spillages of municipal solid waste, as well as the measures taken, within 24 hours of the incident.

The specific methods or processes for collecting and transporting USW are established by the Municipal Councils or District Governments, in accordance with the legislation in force, and the competent authorities are free to adopt the collection and transport system that they find technically most appropriate for each situation and type of waste to be collected.

The transport of waste must be done in appropriate vehicles, in order to minimise the risks to the workers involved, the general public and the environment. The routes, frequencies and schedules for the collection and transport of waste are defined and approved by the Municipal Councils or District Governments, which must subsequently be informed to the residents or population of the area of jurisdiction about the places and times of placement and collection of waste.

The selective collection system must be approved by the Municipal Councils or District Governments, and the waste must be separated according to the following categories:

- Organic matter;

- Paper or cardboard;

- Rubble;

- Plastic;

- Glass;

- Metal;

- Textiles;

- Rubber;

- Bulky household waste;
- Special wastes.

The system for the treatment and recovery of urban solid waste is established and approved by the Municipal Councils or District Governments.

The final disposal of urban solid waste complies with the operational standards established by the Ministry that oversees the Environment Sector and must be carried out in sanitary or controlled landfills.

Decree No. 83/2014, of 31 December - Regulation on hazardous waste management establishes the rules for the generation and management of hazardous waste in the territory of Mozambique and is applicable to all natural and legal persons, public and private involved in the management of hazardous waste and the import, distribution and marketing of used and new expired tyres.

Excluded from the scope of the Regulation are (i) biomedical waste, (ii) radioactive waste, (iii) effluent emissions and discharges other than those with hazardous characteristics as defined in Annex III to the Regulation, (iv) waste water other than those with hazardous characteristics as defined in Annex III to the Regulation, and (v) other hazardous waste subject to specific regulation.

The Ministry overseeing the Environment Sector holds the competences for hazardous waste management.

Hazardous waste is classified according to the different types of activity in accordance with Annex IX of the Regulation and, for export purposes, is classified in accordance with Annex X of the Regulation.

Associated with this waste is a list of prohibitions and obligations on the part of producers, transporters and operators of hazardous waste, described in Annexes 7 and 8 of Decree No 83/2014 of 31 December, summarised in Table 7.29 below.

Table 7.29

Prohibitions and obligations for producers, transporters and operators of hazardous waste

Prohibitions	Obligations
Article 7 of Decree 83/2014 of 31 December: • The recycling and use of plastic packaging and materials contaminated by agrochemicals and obsolete chemicals, except for packaging where the concentration of active ingredients is below the limits defined in Annex IX(3); • The recycling and use of plastic packaging and materials contaminated by pesticides and obsolete chemicals for the manufacture of household utensils and all drinking water pipes; • The import of empty packaging contaminated by agrochemical products and obsolete chemicals; • The import, distribution and marketing of all types of used tyres and new expired tyres on the national market, with the exception of tyres with dimensions equal to or greater than 750R/16 within the deadline, including tyres used in aviation.	Article 8 of Decree 83/2014 of 31 December: • Ensure compliance with the general principles of hazardous waste as set out in Article 4 of the Directive; • Minimise the generation of hazardous waste; • Ensure proper segregation and packaging of the different categories of waste; • Ensure that all waste to be transported carries minimal potential risk of contamination to the workers involved, the general public and the environment; • Ensure proper treatment of waste prior to disposal, using good practice and recommended technological options; • Ensure that the temporary storage and disposal of waste, both on and off site, does not have a negative impact on the environment or on public health and safety. • Ensure the protection of all workers involved in the handling of hazardous waste from accidents and illnesses resulting from their exposure to contamination risks; • Train its employees on health, safety and the environment; • Inform, within 24 hours, the Ministry overseeing the Environment Sector in the event of accidental hazardous waste spills; • Provide the public with accessible information on product reuse and recycling options.

Installations and equipment intended for the preliminary storage, transport, deposition, treatment, recovery or disposal of hazardous waste are subject to prior environmental licensing, under the terms of the Regulation on the Environmental Impact Assessment Process.

In addition to the licences legally required of operators and transporters of hazardous waste, they must submit an application for certification to carry out their activities to the Ministry that oversees the Environment Sector, which must approve applications for certification within 15 days of receipt of the application, after hearing the opinion of the Ministries that oversee the Health, Labour and Transport Sectors.

Within 10 days, any changes and/or updates to the information provided at the time of submission of the certification applications must be communicated to the Ministry that oversees the Environment Sector, accompanied by the respective documentation described in Annex I - A of Decree No. 83/2014, of 31 December and summarised in Table 7.30. Certifications must be renewed every every five years by submitting the renewal to the Ministry that oversees the Environment Sector, within 45 days before the date of expiry.

Table 7.30

Information to be included in the application for hazardous waste operator certification

Operators	Transporters
• Full identification of the operator; • Taxpayer number (NUIT); • Hazardous Waste Management Plan; • Documents proving ownership, by the applicant, of facilities for waste management operations; • Documents proving possession, authorization note or certified copy of the contract with the owners or managers of the site for the final disposal of hazardous waste authorizing the operator to use the site for the final disposal of hazardous waste, mentioning the period of validity of the contract or note of authorization; • Proof of the existence of appropriate protective equipment for carrying out the activity and of a health plan covering all workers involved in hazardous waste management operations; • Documentation referred to in paragraphs g) and h) of the NUIT, in cases where the operator is simultaneously the transporter.	• Full identification of the transporter; • Taxpayer number (NUIT); • Hazardous waste transport operations plan, in accordance with the rules and procedures set out in Annex VIII, without prejudice to the provisions of the specific legislation in force; • Proof of ownership documents, authorization note or certified copy of the contract with the owners of the installations for parking the respective hazardous waste transport vehicles, mentioning the validity period of the contract or authorization note; • Detailed sheet containing information on the place of departure, time, type of waste, quantities and final destination of the transported waste and number and expiration date of the certification of the operators involved; • Proof of the existence of appropriate protective equipment for carrying out the activity and of a health plan covering all workers involved in hazardous waste transport operations; • Number, type, technical specifications, capacity and identification of the vehicles to be used in carrying out this activity; • Declaration, under oath, that the vehicles for the transport of hazardous waste to be certified will not be used for another type of load, or request for authorization to use these vehicles for the transport of other types of load to be specified, with an indication that this activity does not present any risk of contamination for the other types of cargo transported; • Declaration, under oath, that the hazardous waste transported in the exercise of its activity has as its final destination the place indicated in the form referred to in point 5 above.

The Ministry that oversees the Environment Sector shall dispatch the renewal request referred to within 15 days from receipt of the request, and the respective certificate shall be issued upon payment of a fee in accordance with the provisions of Article 19 of Decree No. 83/2014, of 31 December.

All public and/or private entities carrying out activities related to the management of hazardous waste must draw up, before the start of their activity, a Hazardous Waste Management Plan, containing at least the information set out in Annex II of the Regulation (see Annex 5).

Hazardous waste must be segregated according to the classification in Annexes III and IX of the Regulation (see Annex 5).

Hazardous waste must be identified in accordance with Annexes III and IV of the Regulation, and packaging must comply with the rules in Chapter III.

Packaging

The process of identifying and packaging hazardous waste, as well as its transport, should be in accordance with the international principles and standards assumed by the country in international conventions on hazardous waste management.

The packaging of this waste must be carried out in accordance with technical standards established by specific instructions, and must at least be contained in containers capable of withstanding normal storage and transport operations, which remain hermetically sealed in such a way as to prevent their contents from escaping to the outside, must not be damaged by their contents, must not form hazardous substances after contact with their contents and must be duly identified with the symbols provided for in Annex IV to this Regulation.

Collection

The collection of hazardous waste is the sole responsibility of the producers. Therefore, any producer and holder of hazardous waste must entrust their waste to a private or public collection service that carries out the operations and is duly licensed to carry out these activities.

When collecting hazardous waste, a manifest in Annex VI must be completed in quadruplicate stating the quantity, quality and destination of the waste collected. Of the four copies required, one should be kept by the waste generator, one by the waste carrier, one by the waste receiver and the last one should be sent to the Ministry overseeing the Environment Sector every six months.

Transport

The movement of hazardous waste must be analysed in two different situations, according to Articles 15 and 16 of Decree No. 83/2014, of 31 December: When it happens inside the facilities of the producing entity and when it happens outside the facilities of the producing entity.

When hazardous waste is moved within the production organisations, its generation, conditioning, storage and treatment must be carried out using appropriate equipment or vehicles with a base and walls capable of containing it. All equipment used must be washed and decontaminated properly, and the water resulting from this washing must be treated in accordance with the legislation in force.

When the hazardous waste is moved outside the premises of the producer, it must be carried out with the necessary adaptations, obeying the provisions of the Road Traffic Code, if carried out on public roads. This movement of hazardous waste can only be done by transporters duly certified by the Ministry that oversees the Environment Sector or by the armed forces, in compliance with the specific legislation on the matter.

If the movement is transboundary through national territory, an agreement is required with the constraints imposed by Resolution 18/96 of 28 November, which ratified the Basel Convention on transboundary movement of hazardous wastes and their disposal, the instructions on the matter being approved by the Ministry overseeing the Environment Sector.

Treatment, Disposal and Deposition

According to Article 17 of Decree No. 83/2014, of 31 December, entities involved in the treatment, disposal, deposition and/or energy recovery of hazardous waste must carry out a risk assessment during the development or revision of the Waste Management Plan, demonstrating the environmental feasibility of the operation to be adopted for the specific case, determining the most advisable disposal option.

Where the most advisable disposal option is to landfill hazardous waste, this should be done in industrial landfills. The co-processing of hazardous waste in cement kilns should only take place when the objective is the utilisation of alternative materials and energy recovery.

Any entities involved in the hazardous waste disposal process must review their Hazardous Waste Management Plan every five years, with the aim of achieving the technically and scientifically advisable disposal method.

Organisations involved in the treatment, disposal, deposition and/or energy recovery of hazardous waste must demonstrate, through a risk assessment process carried out during the development or revision of the waste management plan, the environmental feasibility of the operation to be adopted for the specific case, in accordance with Annex V of the Regulation.

It is also important to highlight the aforementioned technical directive for the implementation and operation of sanitary landfills, drawn up in 2010, which aims to provide municipalities in the country with a manual of procedures to help implement and operationalise sanitary landfills or controlled landfills.

Annex 5 presents the Environmental Management Plan (Waste Management Plan) with more detailed information.

7.10.2 Characterisation of Indirect and Direct Intervention Areas (AII and AID)

7.10.2.1 Namaacha Village

Namaacha's solid waste management situation has several shortcomings.

There is a local rubbish dump in the village. And rubbish collection is done daily door to door.

There is no waste littering the streets of the village (see Photo 7.42).

Photo 7.42 - View of Namaacha village streets (no scattered waste observed)

7.10.2.1 Areas of Direct Project Intervention

In the area of direct influence of the Project, no dumpsites or areas with deposited waste were observed (see Photo 7.43), and it is common practice to bury waste.

Photo 7.43 - View of the Project area surroundings (no scattered waste)

7.11 SOUND ENVIRONMENT

7.11.1 General considerations

The sound environment is an important descriptor of the quality of the environment, which is directly reflected in the quality of life of the population, and noise is one of the main causes of degradation of the quality of the environment in residential settlements. Noise pollution occurs when, in a given environment, sound alters the normal condition of hearing. Although it does not accumulate in the environment like other types of pollution, noise pollution causes various damages to human beings and to the quality of life of populations.

Noise is a level of discomfort that depends on the characteristics of the sound and the susceptibility of the receiver, which is caused by a set of human activities such as industry, construction, among others. The World Health Organisation (WHO) considers that a sound should have a limit of 50 dB (decibels - unit of measurement of sound) so that it does not cause harm to humans.

As far as Mozambique is concerned, the noise descriptor is mentioned in the Regulation on Environmental Quality Standards and Effluent Emission - Decree no. 18/2004, 2 June, Article 20, point 1. No. 18/2004, of 2 June, Article 20, point 1, which states that "the permissible noise levels to safeguard public health and quiet will be established taking into account the source of noise emission", point 2 indicates that "without prejudice to the provisions of special legislation, the Minister for the Coordination of Environmental Action will establish, after hearing the sectors of activity supervision, by ministerial order, the noise emission standards."

There is, however, no specific legislation in force for the prevention and control of noise pollution, aimed at safeguarding human health and the well-being of populations, for example by setting exposure limit values. In addition to the WHO guidelines, the criteria set out in the IFC - International Finance Corporation environmental guidelines, according to which impacts on environmental noise should not exceed the levels shown in Table 7.31, or result in a maximum increase in the noise levels characterising the (existing) reference acoustic framework by more than 3dB, at the nearest location to the identified sensitive receptor, are also considered applicable.

Table 7.31

Níveis de ruído de acordo com as "Guidelines for Community Noise", World Health Organization (WHO), 1999

Receiver	One Hour LAeq [dB(A)]	
	Day 7:00-22:00	Night 22:00-07:00
Environmental Conditions	Maximum increase in base levels of 3 dB at the location closest to the off-site receiver	
Residential/Institutional/Educational	55	45
Industrial/Commercial	70	70

7.11.2 Setting within the Project study area

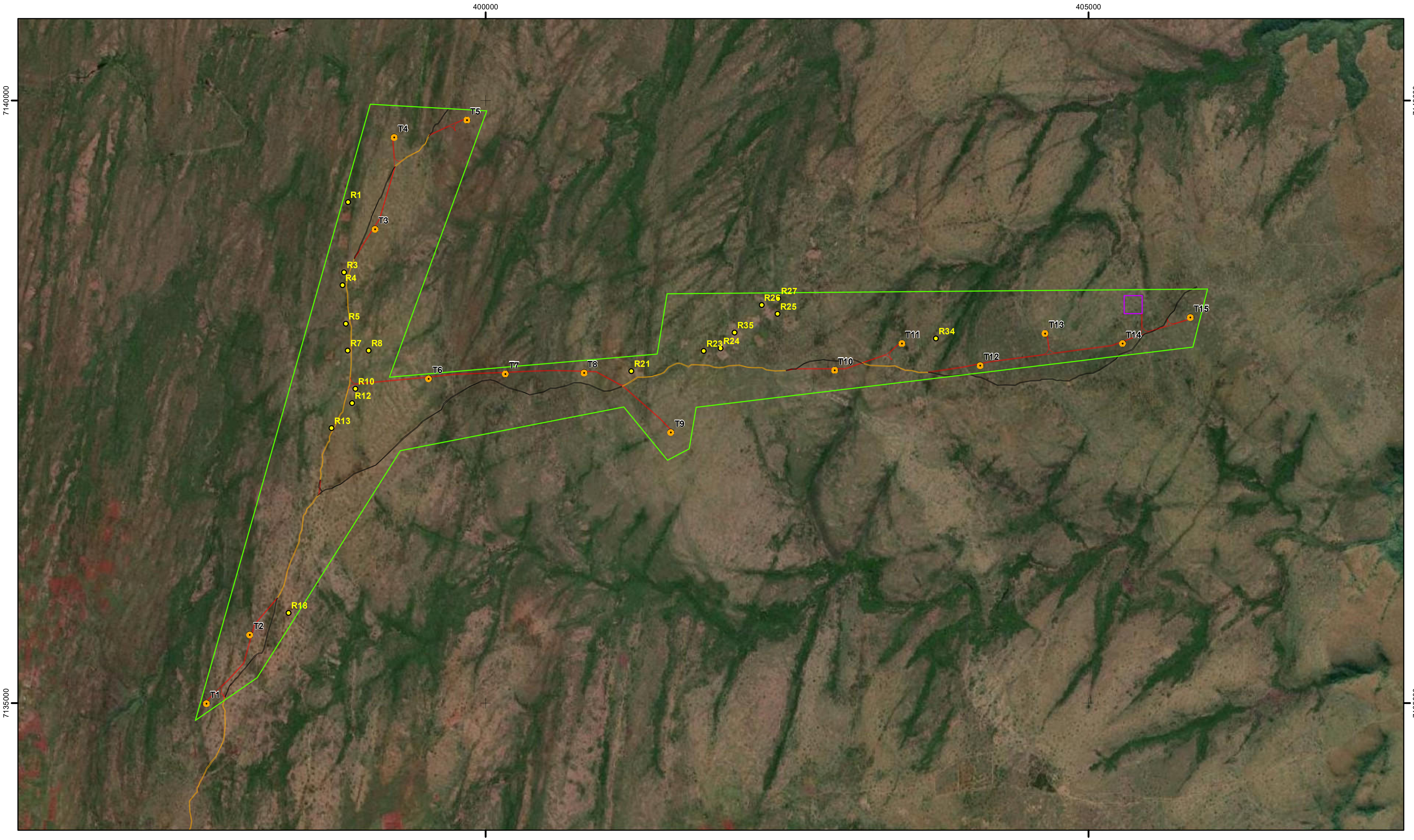
The study area is located in a rural environment, where the reference acoustic framework is generally conditioned by natural sources and some agricultural activities carried out in small fields and only for family subsistence. Road traffic is practically non-existent and has no impact on residual noise.

In order to better characterise the reference acoustic framework, in situ measurements were made using a LARSON DAVIS model LxT2 digital precision integrating sound level meter, equipped with a LARSON DAVIS model PRMLXT2 microphone. Table 7.32 shows the results of the acoustic survey carried out. Figure 7.46 shows the identification of the main sensitive receptors present in the Project area and the location of the noise measurement points. It should be noted that only residential buildings where households are confirmed to be permanently resident were considered as sensitive receivers. Reference should also be made to the existence of a church, which is also included in the acoustic assessment of the operation of the project.

Several dwellings were identified, namely in the settlement of Macuacua, located around the main access to the Project intervention area. Likewise, the presence of other isolated dwellings is observed throughout much of the study area. Several fields were also observed, many of them associated with dwellings and some areas for grazing. Of the dwellings identified, some are made of precarious material (reeds and straw), others of conventional material (blocks and zinc sheets) and fewer in masonry.

The measurement system was calibrated in the field before the measurements with a BRÜEL & Kjær model 4231 calibrator.

The duration of each measurement was adjusted so that the integration time was considered representative of the current situation, given the characteristics of the acoustic signal(s) in the environment to be characterised.



Fonte: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGENDA

- Área de Estudo
- Aerogerador
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)
- Receptores Sensíveis (habitações isoladas ou pequenos núcleos habitacionais)

Escala 1:30 000

0 500 1 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

T01717_14_V0_Fig7_46

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Figura 7.46 - Localização dos Receptores Sensíveis

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All measurements were made with the sound level meter mounted at a height of approximately 1.20 metres above the ground. The measurements were carried out on 21 September 2017, during the daytime period only.

The measurement parameter recorded in the measurements was the energy parameter LAeq, by definition weighted by the "A" mesh. The statistical parameters L50 and L90 were also recorded to complete the assessment of the acoustical reference framework (see Table 7.32).

Table 7.32
Acoustic survey

POINT	PHOTO	DAYTIME			OBSERVATIONS
		LAeq	L50	L90	
1		42,8	35,4	32,8	Natural and rural noise sources
2		40,7	39,8	31,9	Natural and rural noise sources
3		51,2	47,0	40,2	Noise from road traffic and urban activities

It should be noted that measurement spots 1 and 2 are located in the Project area, while measurement spot 3 was carried out in the village of Namaacha, thus allowing a comparison between a rural and a more urban scenario.

The results obtained at measurement spots 1 and 2 reflect a typical rural reference noise level, largely conditioned by natural sources, well below the values recommended by the WHO. Regarding measurement spot 3, as it is located in an urban environment, the contribution of some anthropogenic sources, namely road noise, was evident. It should be noted that National Road 2 crosses the village of Namaacha and is the main access route to Maputo, as well as to the border with Swaziland. Even so, the values obtained for the LAeq parameter are below the limits recommended by WHO for residential areas.

7.12 ARCHAEOLOGICAL, ARCHITECTURAL AND ETHNOGRAPHIC HERITAGE

The characterisation of "heritage" in this study is based on an analysis of built heritage with historical or heritage value. The analysis carried out focused on the heritage elements included, according to Mozambican legislation, as "cultural heritage".

In fact, Law No. 10/88 of 22 December 1988 determines the legal protection of the tangible and intangible assets of Mozambican cultural heritage, defining "cultural heritage" as "the set of tangible and intangible assets created or integrated by the Mozambican people throughout history, with relevance to the definition of Mozambican cultural identity. Cultural heritage is composed of immaterial and material cultural goods. It is also important to mention Decree No. 27/94, of 20 July, which creates the Regulation for the Protection of Archaeological Heritage.

This heritage includes assets created or integrated by the Mozambican people throughout history, and relevant to the definition of Mozambican cultural identity. Examples of this heritage are monuments, churches, groups of buildings, ancient manuscripts, objects of popular or local art, endowed with expressive value for the collective memory of the people, for history, archaeology, palaeontology and science in general. Natural elements or protected landscapes are also protected by this law, due to their cultural value.

Buildings constructed for religious practice are also considered an integral part of cultural heritage.

The methodology followed for the treatment of this descriptor included a bibliographic and archive survey of previous research: mainly for the cultural heritage component, but also for the socio-demographic description of the study area. It also included cartographic analysis through the observation of satellite images and aerial photographs to inventory existing resources and try to locate areas with possible archaeological sites. Conversations were also held with community leaders to gather information.

The EIA also noted the need to implement Performance Standard 8 (PS 8) on Cultural Heritage, of the International Finance Corporation (IFC).

This PS, like other similar ones, complements but does not replace the requirements of the applicable national law. PS 8 aims to protect cultural heritage from adverse impacts of project activities, support its preservation and promote equitable sharing of benefits from the use of this cultural heritage. The requirements of PS 8 apply to cultural heritage regardless of whether or not it is legally protected or previously disturbed.

The area of direct influence of the Project (AID) is largely in a natural state, but traces of ancient and recent anthropogenic pressures can be observed. A Christian church was found on the project site (see Photograph 7.44). It should be noted that the most significant element in the surroundings of the AID is the monument/museum in honour of Samora Machel, located to the west of the study area, but already in South African territory.

Photo 7.44 - Christian Church within the Area of Direct Influence (AID)

In this case the identified church is considered as a cultural heritage occurrence.

7.13 DEMOGRAPHY, SETTLEMENT, SOCIETY, HEALTH AND ECONOMY

7.13.1 General considerations

The socio-economic characterisation was based on data available on the website of the National Institute of Statistics of Mozambique. Data from the last census in 2017 (provisional data) were used whenever possible. Other cartographic and bibliographic sources were also considered.

The socio-economic presentation focuses mainly on the District of Namaacha, the village of Namaacha and whenever possible on the area of direct influence of the Project, since it is at these levels that the socio-economic impacts resulting from the installation of the Namaacha Power Plant Project will be felt most intensely. However, it is complemented with a more comprehensive framework at the level of Maputo Province, since it is also important to assess the effect of the activity in a regional context.

Whenever possible, the analysis is carried out at four different scales, at the level of the Province (Maputo), at the level of the district (Namaacha), municipality of Namaacha (village) and at the level of the area of direct influence (AID) of the Project. The latter is presented in a separate subchapter (7.13.8), and particular importance has been given to the identification of buildings, infrastructures and equipment located there, since the construction and operation of the Project may eventually interfere with the daily life of the population and the activities that take place there. However, socio-economic data on the population in the AID are limited, so the analysis is essentially qualitative.

Within the scope of this descriptor, the team also paid attention to the issues framed by the IFC as "Indigenous Peoples", and the relevance of applying this assessment was evaluated. It was found, however, that under the provisions of the IFC, in the area of influence of the Project, either directly or indirectly, no groups are identified that can be framed in this typology of community.

7.13.2 Territory and demography

Mozambique, officially the Republic of Mozambique, is a country located in south-eastern Africa, bordered to the east by the Indian Ocean and bordered to the north by Tanzania; to the north-west by Malawi and Zambia; to the west by Zimbabwe and to the south-west by Swaziland and South Africa. It is divided into 11 provinces, namely Niassa (capital: Lichinga); Cabo Delgado (capital: Pemba); Nampula (capital: Nampula); Zambézia (capital: Quelimane); Tete (capital: Tete); Manica (capital: Chimoio); Sofala (capital: Beira); Inhambane (capital: Inhambane); Gaza (capital: Xai-Xai); Maputo (capital: Matola) and Maputo City (capital: Maputo).

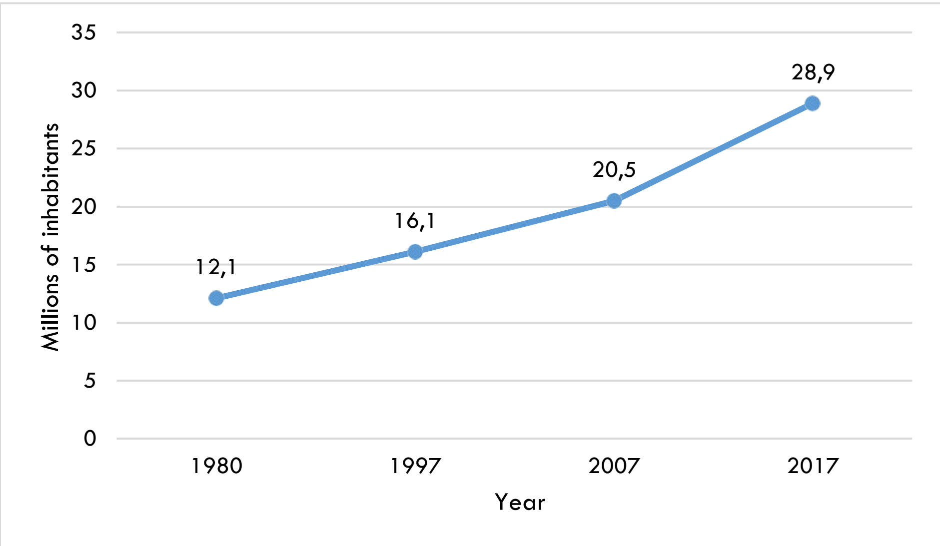
The provinces are divided into districts, the districts are subdivided into administrative posts and these into localities, the lowest level of local state administration.

The analysis at the administrative level "province" will be according to the 2017 census data (provisional data) and the information of the 2017 statistical yearbook. Regarding the administrative level "district", this level, considered as the main pole of planning and socio-economic development of the country, as such, and in order to respond to the needs of statistical information for the planning and evaluation of development programmes, INE launched a series of publications, which contain the sociodemographic statistics at the level of districts of the Province. The information was produced based on the final results of the III General Census of Population and Housing of 2007, whose document is "Statistics of the District of Namaacha - November 2013".

7.13.2.1 General characterisation - Mozambique

Mozambique has 28.8 million inhabitants, of which 15.061 million are women and 13.800 million are men, according to preliminary census results (IV General Census of Population and Housing of Mozambique). The country is located in the south-east of the African continent, bordered to the north by Tanzania, to the north-west by Malawi and Zambia, to the west by Zimbabwe, to the south-west by Swaziland and South Africa and to the east by the Indian Ocean.

The following figure shows the evolution of the population from 1980 to 2017. It can be seen that the population has been increasing, especially in the last 10 years (between 2007 and 2017), when the population increased by 8.4 million inhabitants.



Source: INE, 2019

Figure 7.47 - Evolution of the total population, in millions of inhabitants (1980, 1997, 2007 and 2017 censuses).

Economic growth, fuelled by political stability, sound macroeconomic management, reconstruction and structural reforms, has been bolstered by an increase in major foreign investments in the dynamic energy and natural resources sectors. The country has become a world reference destination for the development of the mining and natural gas industry. In addition to its natural resources, Mozambique's long coastline positions the country as a natural gateway for inland neighbouring countries to reach global markets (World Bank, 2013).

However, this growth trajectory has not been accompanied by poverty reduction and employment and livelihood generation (World Bank, 2013).

7.13.2.2 General characterisation - Maputo Province

The province of Maputo, is the second smallest in Mozambique in terms of area, with a surface area of 26 058 km2, it is the fourth province with the largest population. The province is divided into 8 districts and has. The capital of the province is the city of Matola. Maputo province is bordered to the north by Gaza province, to the east by the Indian Ocean and Maputo city, to the south by South Africa (KwaZulu-Natal province) and to the west by Swaziland and South Africa (Mpumalanga province).

This province, with an estimated population density of 96.2 inhabitants/km^2 (see Table 7.33). Maputo Province had the highest relative population growth, with a 60.7 % increase in population between 2007 and 2017.

Table 7.33

Maputo Province General Data, 2017

Description	Mozambique	Maputo Province
Surface (km^2)	799 380	26 058
Total Population (No.)	28 861 863	2 507 098
Population Density (No./km^2)	36,1	96,2

Source: Census 2017 (provisional data) INE, 2019

7.13.2.3 General characterisation - Namaacha District

The following characterisation gives an idea of the level of development of the District of Namaacha, sometimes making a comparison with the existing data at the level of the Province of Maputo, which allows a framework in the regional socio-economic context.

Regarding the geographical location of Namaacha District, it is bordered to the North by Moamba, to the South by Matutuíne, to the East by Boane and Matutuíne and to the West by the Republic of South Africa and the Kingdom of Swaziland.

Namaacha District covers an area of 2 144 km^2. With a population of 53 428 inhabitants in 2017 (Census 2017, provisional data), its population density is about 33.12 inhab/km^2, which is quite low compared to the population density of Maputo province, with about 71.33 inhab/km^2. Most of the district's population, however, is concentrated in the capital, where more than 40% of its population lives. According to local information, the main cause of this concentration of population in the district capital was the prolonged civil war that led to internal displacement.

Namaacha District consists of two Administrative Posts: Namaacha Headquarters Administrative Post with five localities (Kala-Kala, Chimuchuanine, Impaputo, Mafuiane and Matsequenha) and Changalane Administrative Post with four localities (Changalane Headquarters, Mahelane, Michangulene and Goba) (Namaacha District Diagnosis, 2012).

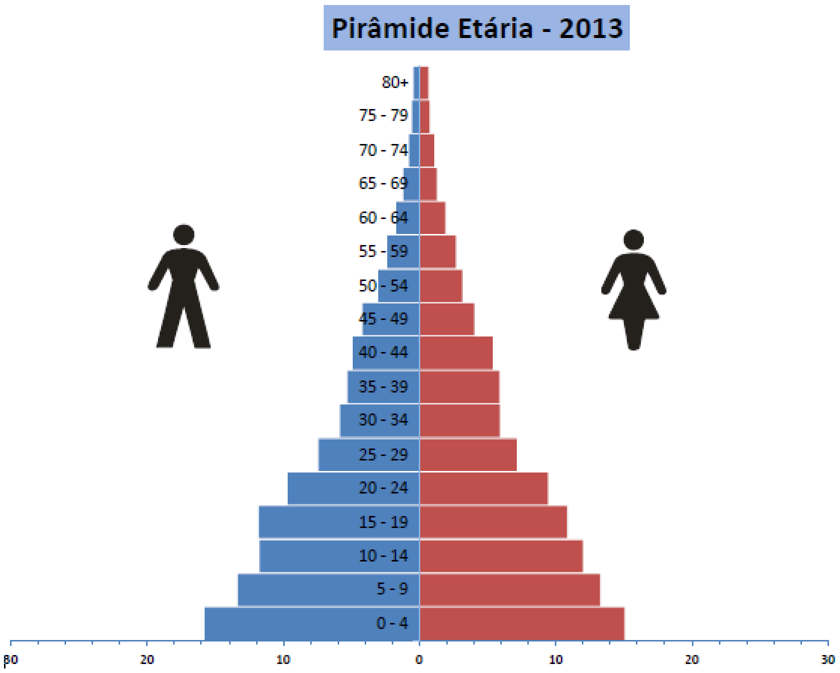
According to the Namaacha District Statistics data of November 2013, the population was equally distributed by gender, with 50.7% female and 49.3% male. This division is seen in all age groups, as can be seen in Figure 7.48.

Table 7.34

Housing, households and population, Maputo Province, 2017

Districts	**Housing**	**Households**	**Population**		
			Total	**Men**	**Women**
Total	613,648	602,957	2,507,098	1,178,487	1,328,611
Matola	367,772	374,546	1,616,267	752,852	863,415
Boane	60,995	54,953	210,498	102,041	108,457
Magude	14,794	14,583	63,691	29,879	33,812
Manhica	57,197	50,131	208,466	97,739	110,727
Marracuene	62,511	59,366	230,530	109,925	120,605
Matutuíne	12,304	12,473	44,834	21,924	22,910
Moamba	24,657	23,243	83,879	40,350	43,529
Namaacha	13,418	13,662	48,933	23,777	25,156

Source: Census 2017 (provisional data) INE, 2019



Source: INE, 2013 - Namaacha District Statistics - November 2013

Figure 7.48 - Distribution of the population of Namaacha district by age class and sex

The Namaacha District has the village of Namaacha as its headquarters (see Photos 7.45 and 7.46). This district is crossed by the EN2, which gives access to Swaziland and provides a direct link to the town of Boane, which in turn connects to Maputo City, passing through the town of Matola.

Photo 7.45 - Namaacha Village - Namaacha Village Municipal Council

Photo 7.46 - Namaacha Village

7.13.3 Education

Education is a key instrument for the improvement of living conditions, being fundamental for the materialisation of civil, political, economic and social rights, as well as for the reduction of inequalities in a population. In Maputo province, as far as education and qualification are concerned, It should be noted that educational levels should be taken into account, but also the available infrastructure. Several data on the sector are presented below ("Mozambique Statistical Yearbook", 2017).

Table 7.35

Primary Education, 2017

	1st Grade level (1-5)				2nd Grade level (6-7)			
Region	Schools	Students		Teachers	Schools	Students		Teachers
Mozambique	12 522	M	2 460 792	42 517	7 454	M	416 499	8 305
		HM	5 101 521	85 136		HM	891 010	28 597
Maputo (Province)	472	M	141 302	3 393	322	M	45 698	861
		HM	288 659	5 353		HM	88 176	2 410

Source: INE, 2018 (Statistical Yearbook 2017- Mozambique)).

Table 7.36

General Secondary Education, 2017

	1st Cycle (8-10)				2nd Cycle (11-12)			
Region	Schools	Students		Teachers	Schools	Schools		Teachers
Mozambique	539	M	286 824	3 706	262	M	68 428	1 291
		HM	580 511	15 819		HM	134 727	6 571
Maputo (Province)	35	M	37 337	414	21	M	8 840	113
		HM	65 779	1 295		HM	14 960	402

Source: INE, 2018 (Statistical Yearbook 2017- Mozambique)

Table 7.37

Technical-Vocational Education, 2017

Region	Schools (Basic and Medium)	Total for basic and medium levels	
		Alunos	Professores
Mozambique	171	84 216	5 467
Maputo (Province)	16	7 372	1 220

Source: INE, 2018 (Statistical Yearbook 2017- Mozambique)

Table 7.38

Higher education - Total students enrolled, graduates and new entrants, in Mozambique 2017

Scientific field	Enrolled	Graduated	New entrants
Total (Public & Private)	200 649	19 197	54 950

Source: INE, 2018 (Statistical Yearbook 2017- Mozambique)

Table 7.39

Literacy Units, 2017

Region	Literacy Units
Mozambique	2 576
Maputo (Province)	102

Source: INE, 2018 (Statistical Yearbook 2017- Mozambique)

In terms of the level of education completed in Maputo province, it is noted that of the total population aged 10 years and above, 62% have completed some level of education, mostly primary level. Of the population aged 15 years and above, 81% is literate and 53% of those aged 3 years and above, declared that they attended or had previously attended the primary level of education (IV RGPH, 2017).

In terms of existing education infrastructure, Namaacha District has the lowest number of schools in Maputo Province, with a total of 65 public schools (including primary, secondary and a teacher training college) and 4 public schools (primary and secondary). There is no University in Namaacha District (Statistical Yearbook, 2017).

The majority of the population (56 %) in the district is literate and 61 % of people aged 5 years and above, predominantly men, attend or have attended primary level of education, most of whom reside in the Namaacha Headquarters Administrative Post (Namaacha District Diagnostic, 2012). The dominant mother tongue is Xichangana.

Photo 7.47 - Example of a School in Namaacha District

In the village of Namaacha, the following educational facilities and their respective number of students stand out (see Table 7.40).

Table 7.40

Number of teaching facilities and students

Schools	Students
EP1- Germantine	108
EP1- Chimuchuanine	156
EP1- Macuacua	76
EP1- Matianine A	150
EP1- Matianine B	450
EP1- Ndonguene	86
EPC-Cocomela	245
EPC- Graça Machel	739
EPC- Mugado	845
Colégio Maria Auxiliadora (Salesianos)	2534
Anexa do IFPN	250
E.S.Namaacha	2302

There is a large dropout from school due to the distances travelled and starting very early to do other activities such as Mukhero (carrying loads to South Africa and Swaziland) for selling and buying goods in these countries).

Within the direct area of influence, there are no school buildings

7.13.4 Sectors of economic activity

7.13.4.1 Background

Independent Mozambique inherited a fragile colonial economic structure that was asymmetrical between the various regions of the country. The policy established in the early years of national independence was based on a centrally planned socialist economy. With the adaptation of a Structural Adjustment Programme from 1987 onwards, the country has been experiencing remarkable economic growth.

In a context like Mozambique, where few urban areas and few sectors of the economy are highly specialised or capital intensive, economic and social interaction between rural and urban areas remains an important component of a successful development policy.

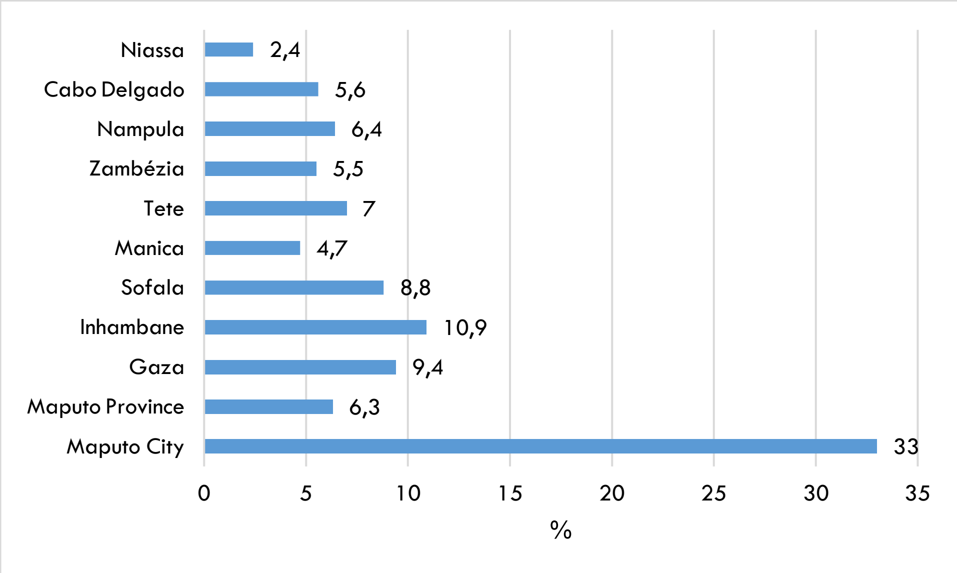
Given Mozambique's urbanisation rates, it is important to recognise the dynamics of economic and social change at the peri-urban interface, as urban areas grow and transform. The notion of a 'peri-urban interface' refers not only to the fringes of the municipality, but also to a context in which rural and urban characteristics tend to co-exist, in physical, environmental, social, economic and institutional terms (World Bank, 2009).

7.13.4.2 Maputo Province

Maputo province, from the point of view of resources, has great possibilities in two opposing lines of development (tourism and agriculture).

Maputo Province, due to its beaches, nature reserves, monuments and historical sites, has a great natural and cultural tourism potential, being considered the fifth tourist destination of Mozambique. Business tourism is one of the tourism segments that most favours Maputo Province, especially in the Districts of Matola and Boane (the latter is located on the road between Maputo City and Namaacha District) (Government of Maputo Province, 2016).

Maputo Province is the fourth province with the lowest number of beds in Mozambique in 2018 (see Figure 7.49). Regarding the number of overnight stays (foreigners and nationals), Maputo Province is the third province with the highest number of overnight stays in 2018 (10.4%), only behind Inhambane Province (25.9%) and Maputo City (42%) (Tourism Statistics, 2018).

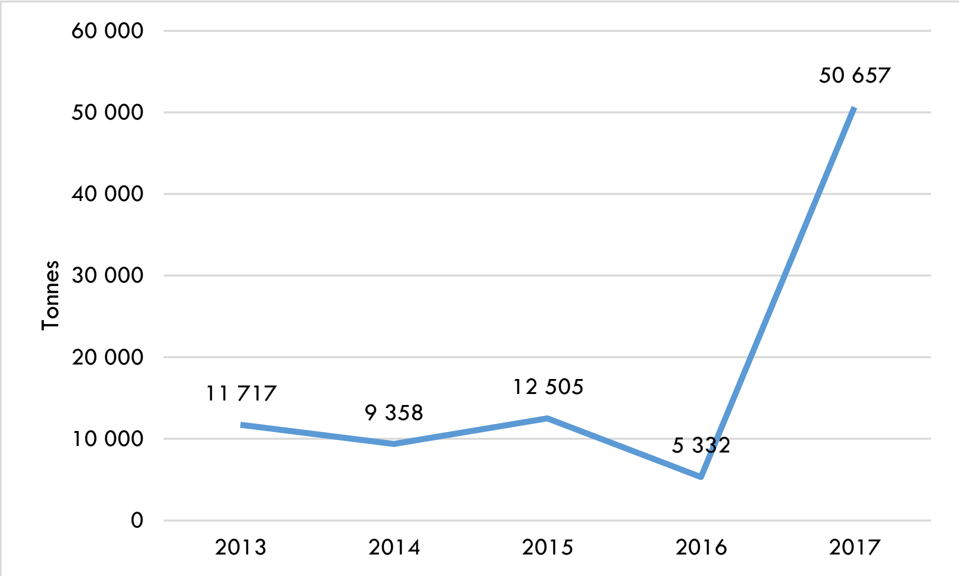


Source: INE, 2019 (Adapted from Tourism Statistics, 2016-2018)

Figure 7.49 - Number of beds by province in 2018

The economy is dependent on the agricultural sector. There are some economic activities of some importance, energised by the production of maize, peanuts, beans, sweet potatoes, cassava and also the production of cattle, sheep, goats and poultry production (Maputo Provincial Brochure, 2017). The Province has a good potential in agriculture, and has been increasing its agricultural and livestock production (Government of Maputo Province, 2017).

Fishing is another sector of great importance in Maputo Province (see Figure 7.50), especially shrimp, fish and crab, which represent about 3%, 84% and 5% of the total catch in the province for the year 2017 (Maputo Province Statistical Yearbook, 2017).

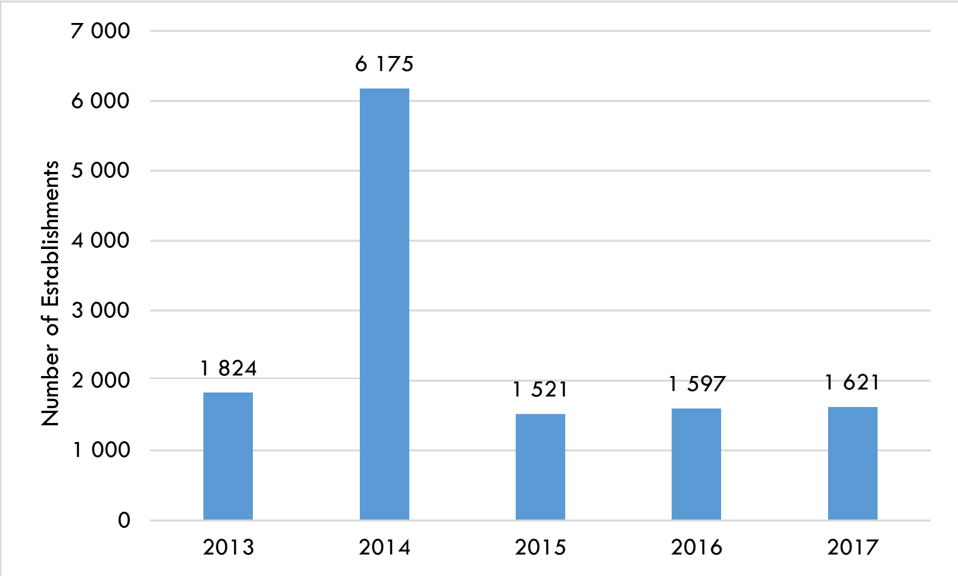


Source: INE, 2019 (Adapted from the Statistical Yearbook of Maputo Province, 2017)

Figure 7.50 - Catch quantities of artisanal fisheries between 2013 and 2017

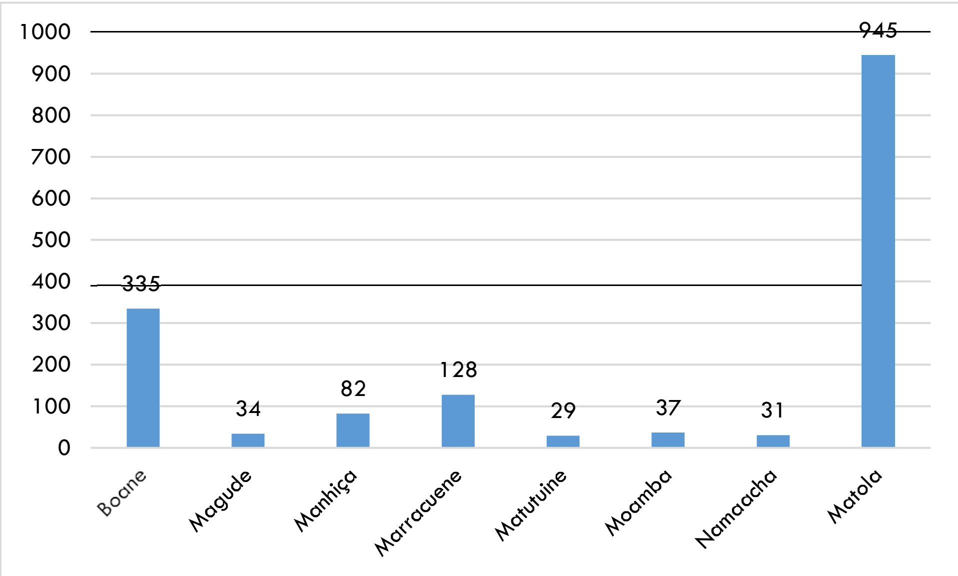
Regarding the manufacturing industry, it is the basic metallurgical industry, namely the sourcing and primary processing of non-ferrous metals that is most important in terms of production values (about 94%) (Maputo Province Statistical Yearbook, 2017).

At the level of commerce, according to the Provincial Directorate of Industry and Commerce of Maputo Province, the number of business establishments between the years 2013 and 2017 remained relatively constant, with the exception of the year 2014 (see Figure 7.51), which was observed in all districts of the province. Figure 7.52 presents the distribution of the commercial network in the various districts of Maputo Province for the year 2017.



Source: INE, 2019 (Adapted from the Statistical Yearbook of Maputo Province, 2017)

Figure 7.51 - Evolution of the commercial network in Maputo Province (2013-2017)



Source: INE, 2019 (Adapted from the Statistical Yearbook of Maputo Province, 2017)

Figure 7.52 - Distribution of the commercial network in Maputo Province, by district, in 2017

The following table presents the cumulative number of unemployed in Mozambique and Maputo Province. As can be seen, about 49 % of the unemployed in Mozambique are looking for a new job, while in Maputo Province, the unemployed looking for a new job represent more than 80 %.

Table 7.41

Cumulative number of registered unemployed persons by province, by sex and category, 2017

Region	Recorded unemployment			Category	
	Sex			First employment	New employment
	Men and Women	Men	Women		
Mozambique	179 018	133 288	45 730	91 039	87 979
Maputo (Province)	17 022	12 484	4 538	3 344	13 678

Source: Mozambique Statistical Yearbook – 2017. INE, 2018

7.13.4.3 Namaacha district and Namaacha village

The main economic opportunities for the residents of Namaacha district remain agriculture and related activities such as the trading of agricultural goods and services. Family farms of 1 ha are practised for growing varieties of vegetables (see Photos 7.48 e 7.49). As for livestock, it stands out not only because it is developed for subsistence, but also for trade (Diagnosis of the District of Namaacha, 2012).

Photo 7.48 - Example of a farm in Namaacha District

Photo 7.49 - Presence of livestock in Namaacha District

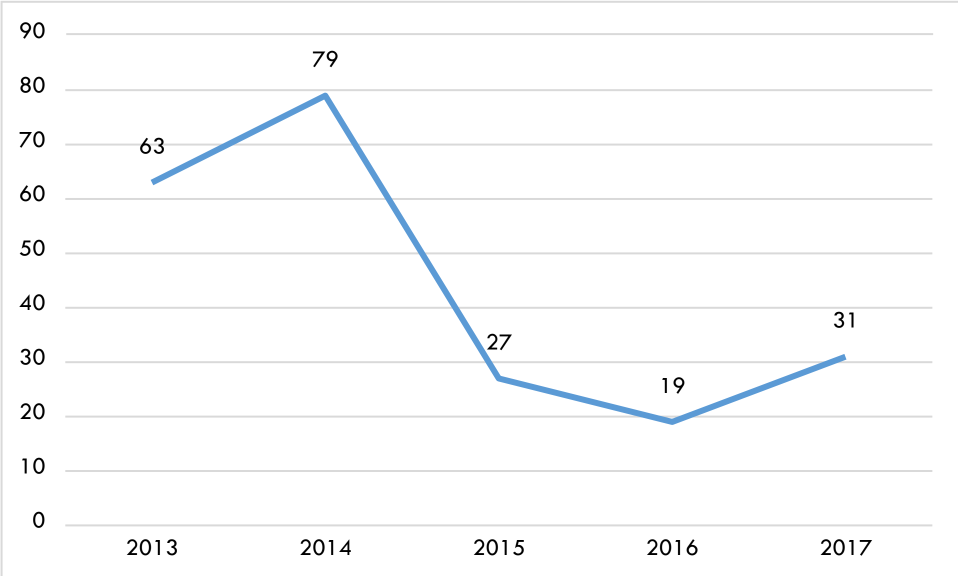
Although agriculture is considered the main activity in the district, in the higher areas the soils are thin and shallow, rocky, with little capacity to retain water, and consequently unsuitable for agriculture. For this reason, one of the most practised activities in Namaacha is firewood cutting and charcoal making. In the alluvial plain regions (river banks and foothills of the Libombos mountain range) there are already clayey and very fertile soils, with good water retention capacity, and as such, anthropic pressure resulting from the search for arable land for new crops, with the destruction of natural vegetation, is very evident there.

In their agricultural practices, local inhabitants use traditional means and manual cultivation techniques. In general, agriculture is practised on family farms of 1 hectare and in a crop consociation regime based on local varieties, with the use of animal traction and tractors in some regions of the District of Namaacha.

One of the main activities is Mukhero, which consists of carrying bales containing clothes, shoes cigarettes to be sold in South Africa or Swaziland, another activity involves the sale of charcoal, as well as the purchase of sugar, oil, plastic chairs, mattresses and beds in Swaziland and South Africa to be sold in the village of Namaacha.

In addition to the main agricultural activity, there are trade and tourism activities, but on a smaller scale. Tourism is mainly due to the climate and landscape.

Namaacha District has lost commercial establishments since 2014, according to the Provincial Directorate of Industry and Commerce of Maputo Province (see Figure 7.53). In 2017, commercial establishments in Namaacha represented only 2% of the establishments in Maputo Province (Statistical Yearbook of Maputo Province, 2017).



Source: INE, 2019 (Adapted from the Statistical Yearbook of Maputo Province, 2017)

Figure 7.53 – Number of commercial establishments.

The district is also rich in natural and mineral resources. The district has resources of shale, stone aggregate (gravel), bentonite and gemstone (Namaacha District Statistics, 2013).

The municipality of Namaacha (Namaacha village), the district headquarters, classified as urban, is very dynamic (see Photo 7.50). As is generally the case in urban centres, monetary sources of income are more important here than in rural areas.

Photo 7.50 - Dynamics of Namaacha village (Road EN2)

Namaacha village is well known for its waterfalls and green hills (see Photo 7.51). In the centre of the village of Namaacha, it is possible to find the Sanctuary of Our Lady of Fatima, where thousands of pilgrims from various parts of the country meet in the month of May (see Photo 7.52).

Source: http://ritaemmozambique.blogspot.com/2006/06/carinho-amizade-e-amor.html

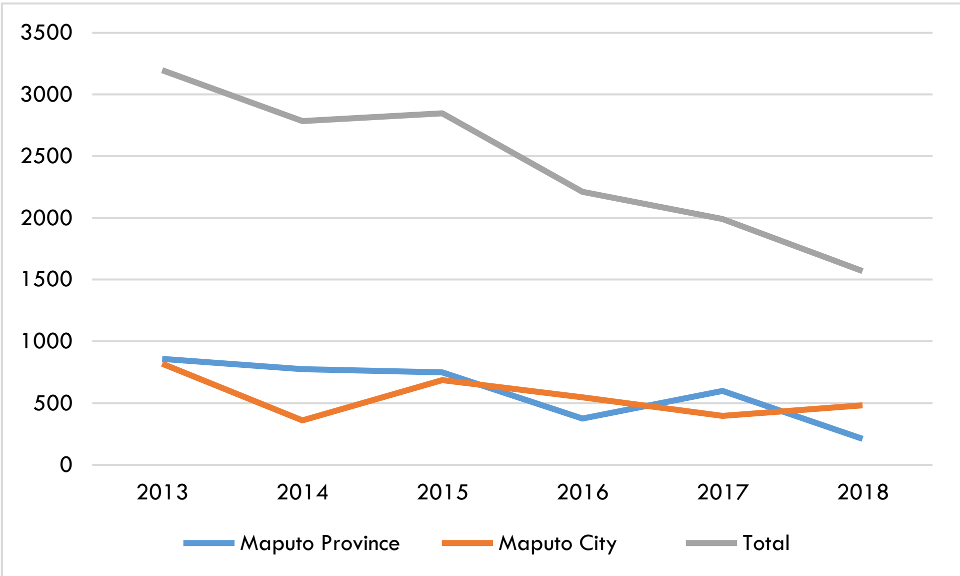
Photo 7.51 - Namaacha waterfalls

Trade is mainly due to the proximity of the village of Namaacha to its neighbouring countries, South Africa and Swaziland, the relative proximity to the city of Maputo (about 75 km away), and the good existing road axis that ensures a good connection between them (EN2-Maputo-Buane and Boane-Namaacha-Border Post). In the village there are several restaurants and hotels, one of which has a casino, and the offer is reinforced by the presence of holiday homes belonging to various companies and institutions.

7.13.5 Accessibility

Maputo Province had, in 2018, the second smallest network of surfaced roads (691 km, only ahead of Sofala Province) and has the smallest network of unpaved roads (901 km) in Mozambique, according to the MOPH, National Road Directorate 2018 (Road Accident Statistics, 2018).

According to PRM (Republic of Mozambique Police Force) current statistics, in 2018 Maputo Province is the second province with the highest percentage of road accidents in Mozambique (13.4%), only behind Maputo City (with 30.7% of the total accidents in Mozambique). However, the number of accidents recorded by the police has been decreasing between the years 2013 and 2018 (see Figure 7.54) (Statistics of Road Traffic Accidents, 2018).



Source: INE, 2019 (Adapted from Road traffic accident statistics, 2018)

Figure 7.54 - Road accidents recorded by the police between 2013 and 2018

The increase in the number of vehicles in Mozambique may be influencing the high number of road accidents. In 2018, 37.6% of heavy vehicles and 39.3% of light vehicles in the country belonged to Maputo Province. In Maputo City, 36.6% of heavy vehicles and 44.8% of light vehicles in Mozambique were located (Road Accident Statistics, 2018. Speeding, poor pedestrian crossing, drink driving and mechanical deficiencies in vehicles remain the main causes of road accidents according to the Mozambique police (Road Accident Statistics, 2018).

The District has about 166 kilometres of roads classified as main, secondary and tertiary (Neves, 2015).

Access routes are mainly by road, although there is rail transport in Boane (belonging to the Goba-Maputo line, and allowing connection from north to south of the country, including connection to Swaziland, South Africa and Zimbabwe). The District of Namaacha is crossed by the EN2, which gives access to Swaziland and also allows direct connection with the Cities of Maputo, Matola and Boane.

In Namaacha village people have daily buses to Maputo. The roads are tarmac or paved and in relatively good condition.

In Namaacha District, namely close to the study area, the roads are predominantly dirt (see Photo 7.53). In terms of locomotion, the most used means is the bicycle, 13.7% of households own a bicycle, and only 0.8% and 3.3% own a motorbike and a car, respectively (Namaacha District Statistics, 2013).

Photo 7.53 - Example of a dirt road in Namaacha District

As far as air transport is concerned, the nearest airport is in the city of Maputo.

7.13.6 Society and infrastructure

The social structure of the communities is organised by a hierarchy, namely:

- Heads of block (every 10 houses form 1 block);
- Head of locality;

- Secretary;
- Ruler;
- Head of Post.

Representatives of the structures play an important role in conflict resolution, as well as in looking after the lands and boundaries of their communities' areas. The structures that hold traditional power serve as a bridge between the population and the local state administration.

In the AID, AII, as well as in the village of Namaacha most people are from Namaacha, but there are many people from Inhambane, as well as from Maputo, Gaza and the north of the country.

The majority of the population is Christian, however, there are Protestants who go to the Anglican and Nazarene churches, Muslims, although in smaller numbers.

In 2012, Namaacha District had 8 health facilities, namely 1 Health Centre and 7 Health Posts.

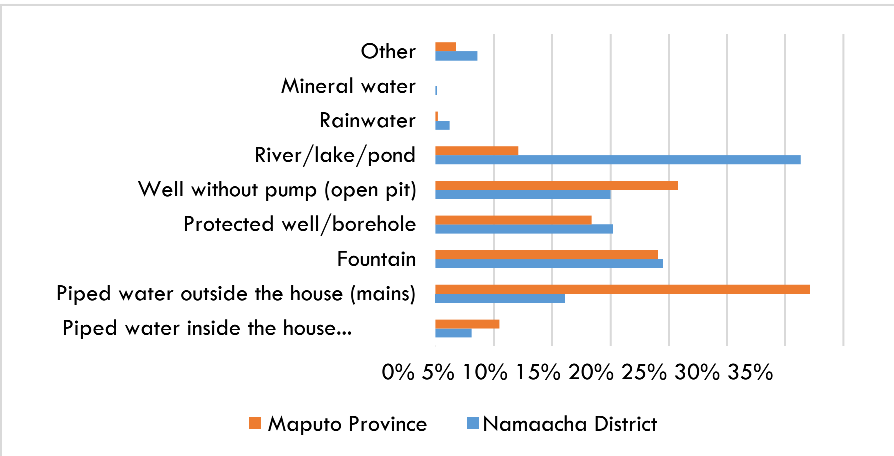
Most of the houses in Namaacha District are covered with zinc sheeting (about 68%), but there are still quite a few houses covered with grass/colmo/palm thatch (about 25%). The most used materials in the walls of the houses in the district are reed/bamboo/palm (about 34%), cement block and mortared sticks (both materials account for about 27% of the houses in the district) (See Photographs 7.54 and 7.55) (Namaacha District Statistics, 2013).

Photo 7.54 - Example of houses in Namaacha District with cement block walls and zinc sheet roofing

Photo 7.55 - Example of a house in Namaacha District with roof and walls made of reed/bamboo/palm trees

This is slightly different from the situation in Maputo Province, where more than 55% of the houses are built with cement blocks, and more than 83% are covered with zinc sheets. In terms of flooring, cement is the most used material, with around 44% of houses in Namaacha District using cement as flooring, while this figure rises to over 68% in Maputo Province. In the flooring of houses in Namaacha District and Maputo Province, adobe is still widely used (about 32% and 16%, respectively) and some dwellings do not have any type of flooring (about 21% and 12%, respectively) (Namaacha District Statistics, 2013).

Regarding the distribution of water source in Namaacha District and Maputo Province, it is found that in the year 2007, more than 31% of households obtained water from river/lake/pond, and only about 3% had piped water inside the house (mains). In Maputo Province, more than 32% of households obtained piped water outside the house (mains) and about 6% had piped water inside the house (Namaacha District Statistics, 2013) (see Figure 7.55).

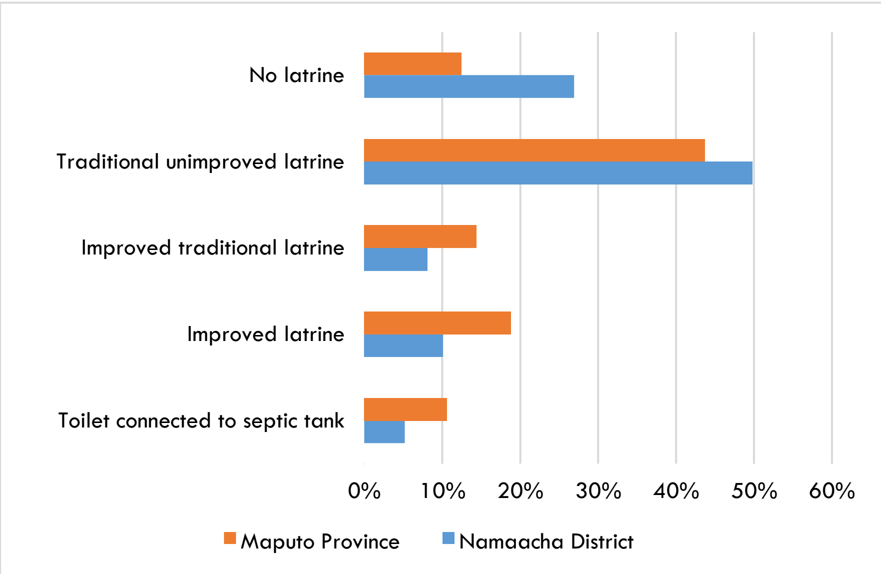


Source: INE, 2019 (Adapted from Namaacha District Statistics, 2013)

Figure 7.55 - Water distribution in Namaacha District and Maputo Province

Photo 7.56 - Example of a well in Namaacha District

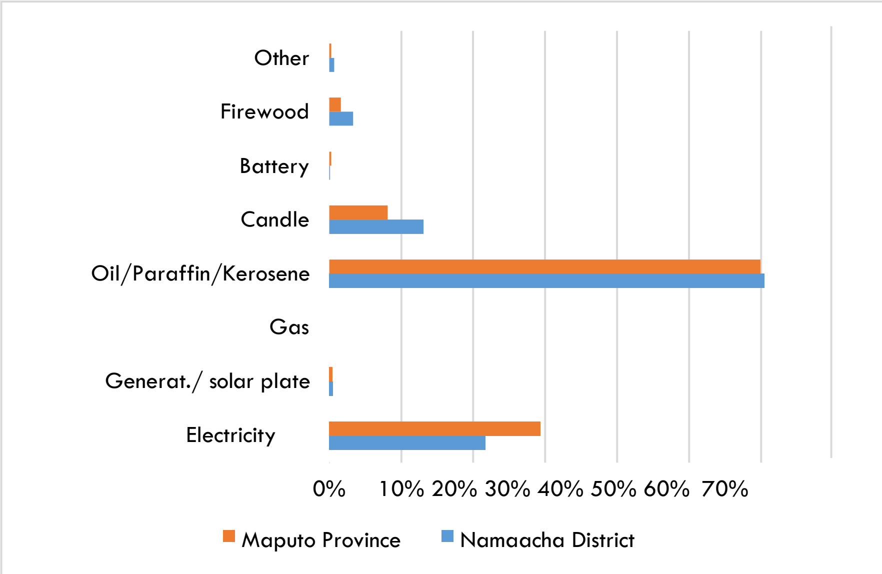
Regarding the type of sanitation service for the year 2007, in Namaacha District almost 50 % of the households used traditional unimproved latrine. The situation in Maputo Province was similar, with about 44 % of households using this type of sanitation service (Namaacha District Statistics, 2013) (see Figure 7.56).



Source: INE, 2019 (Adapted from Namaacha District Statistics, 2013)

Figure 7.56 - Types of sanitation services in Namaacha District and Maputo Province

The main source of energy in Namaacha District and Maputo Province in the year 2007 was Petroleum/Paraffin/Kerosene (about 61 % and 60 % respectively). Only about 22 % of households in Namaacha District and 30 % in Maputo Province were served by electricity (Namaacha District Statistics, 2013) (see Figure 7.57).



Source: INE, 2019 (Adapted from Namaacha District Statistics, 2013)

Figure 7.57 - Energy sources in Namaacha District and Maputo Province

The nearest source of electricity to the study area is the Maputo Thermal Power Plant (see Table 7.42). Purchased electricity over the years has been decreasing, as has its importation. However, the supply has also decreased (see Table 7.43).

Power is supplied by the EDM grid (Electricidade de Moçambique).

Table 7.42

Electricity produced by EDM by region, 2013 – 2017 (GWh)

Region	2013	2014	2015	2016	2017
Mozambique	251,1	318,4	157,6	82,7	316,9
South	83,5	83,8	75,3	50,0	48,7
Inhambane (Temane)	28,9	32,6	36,1	36,7	37,2
Xai - Xai	0,1	0,1	0,6	-	-
Corumana	54,4	51,1	23,9	-	11,6
Maputo (CTM)	**-**	**0,0**	**14,7**	**13,2**	**-**

Source: INE, 2018 (Statistical Yearbook 2017 - Mozambique)

Table 7.43

Electricity supply, 2013 - 2017 (GWh)

Year	Total	Production	Import	Purchased energy
2013	4 444	251	109	4 084
2014	4 859	318	190	4 351
2015	4 856	158	99	4 599
2016	4 352	83	103	4 167
2017	3 819	317	84	3 418

Source: INE, 2018 (Statistical Yearbook 2017 - Mozambique)

The village of Namaacha is provided with telephone connections, both fixed and mobile, as well as telegraph and radio connections. Internet access is available via fixed and mobile networks. There is also a branch of the Mozambique Post Office (Neves, 2015).

7.13.7 Human health

Environmental health has traditionally focused on issues such as water supply and sanitation, air and water pollution control, waste management, chemical and food safety, radiation protection, climate change, noise, housing quality, occupational health and community health.

There is, however, a growing awareness that a broader approach to the "determinants" of environmental health is beneficial to Public Health, defining it as "the art and science of preventing disease, prolonging life and promoting health through the organised efforts of society".

The scope of health issues that can be addressed by environmental assessments (with environmental impact studies) is thus broad, including concerns as diverse as traffic accidents, social cohesion, or psychological problems such as the stress caused by commuting, but can also reflect on the capacity of public policies and institutions.

Violence, crime, prostitution, social helplessness, are phenomena that are very much associated with urban areas which, in the case of Namaacha, are not a certainty, but are a possibility. The main difficulties/problems include early motherhood, HIV/AIDS, polygamy and the associated social and health issues, the role of women in society, old age, sexual violation, alcoholism and lethargy.

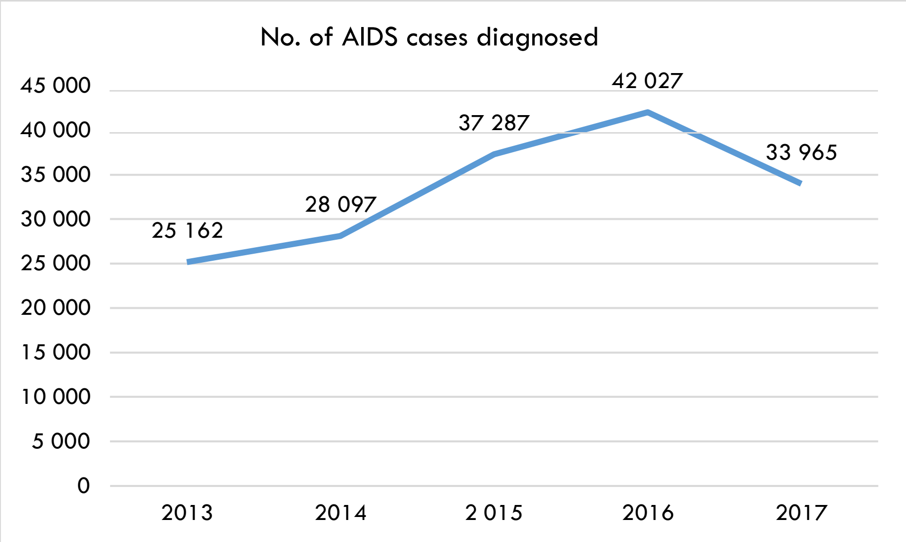
In 2017, Maputo Province had a total of 103 Health Facilities. Of these Health Facilities, 1 Central and Provincial Hospital, 3 Rural and General Hospitals, 92 Health Centres and 7 Health Posts. In that same year, the availability of hospital beds in Maputo Province was 171/10 000 inhabitants, the availability of beds in maternity hospitals was 7.20/10 000 women of childbearing age and there were about 576.5 inhabitants/health technical staff (Maputo Province Statistical Yearbook, 2017).

As previously mentioned, in Namaacha district, for the year 2012, there were 7 Health Centres and 1 Health Post. In the same year there were a total of 75 general beds and 35 maternity beds. In 2011, there were 1.5 beds per 1,000 inhabitants, which shows a weak health infrastructure in the district (Statistics of Namaacha District, 2013).

Photo 7.57 - Example of a Health Post in Namaacha District

The diseases with the highest incidence in Namaacha are malaria, diarrhoea, vomiting, skin diseases, all of which are highly associated with poor hygiene conditions, as well as sexually transmitted diseases.

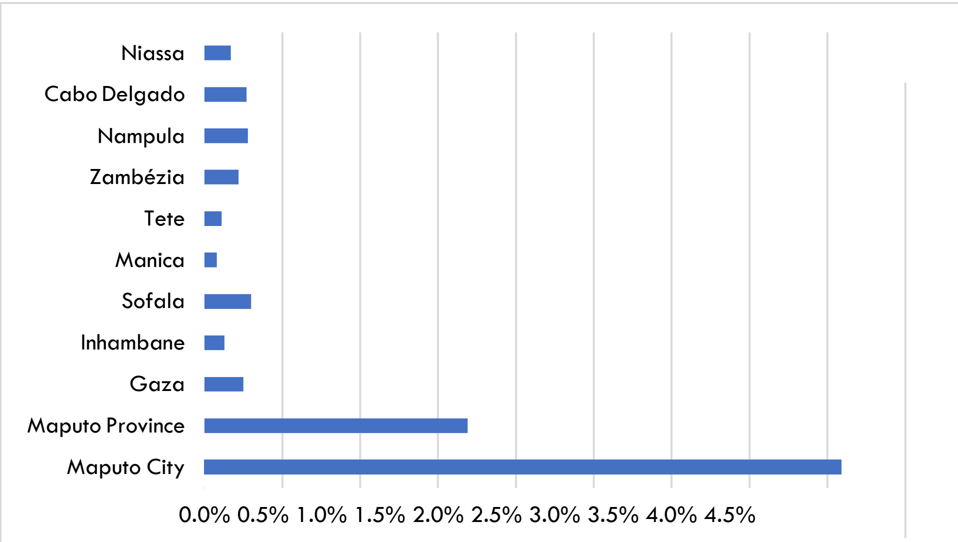
According to the Provincial Directorate of Health, 166 538 cases of AIDS/HIV were diagnosed in Maputo Province between 2013 and 2017 (Maputo Province Statistical Yearbook, 2017). Figure 7.58 shows the evolution of the number of cases diagnosed in the period 2013-2017. In the district of Namaacha, in 2019, 328 women with AIDS/HIV were covered by the Sentinel Post (Ministry of Health, 2011).



Source: INE, 2018 (Adapted from the Statistical Yearbook of Maputo Province, 2017)

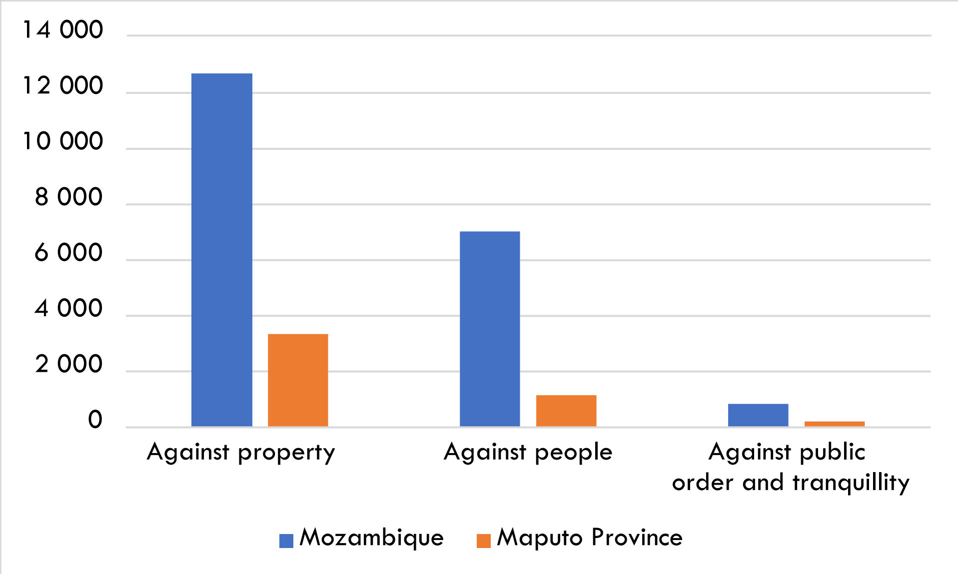
Figure 7.58 - Evolution of the number of AIDS cases diagnosed between the years 2013 and 2017 in Maputo Province

Regarding the crime rate recorded by police authorities per 100,000 inhabitants in Mozambique in 2017 (see Figures 7.59 and 7.60), Maputo Province recorded the second highest crime rate in Mozambique (around 17 %), only behind Maputo City (with around 41%).



Source: INE, 2019 (Adapted RGPH 2017, provisional data)

Figure 7.59 - Crime rate recorded by police authorities by province per 100,000 inhabitants, Mozambique 2017



Source: INE, 2018 (Adapted from Mozambique Statistical Yearbook – 2017)

Figure 7.60 - Types of crime in 2017 in Mozambique and Maputo Province

7.13.8 Characterisation of Indirect and Direct Intervention Areas

In the region surrounding the project area, agriculture and grazing are the dominant activities, i.e. the main sector of activity is based on a rural matrix. The urbanisation rate, which is around 30%, is concentrated in the village of Namaacha and peripheral areas (see Photos 7.58 and 7.59).

Photo 7.58 - Study area with natural landscape

Photo 7.59 - Dwellings with associated fields in the surroundings of the study area

At a more local scale of analysis (Area of Direct Influence) the state of the land is predominantly natural, that is, a landscape marked by naturalness is observed, however with the presence of some intrusive elements resulting from the human occupation of this territory.

In the District of Namaacha are referenced industries with environmental impacts due to their misuse / mode of exploitation of the natural resources concerned, namely: mineral water abstraction, quarries (rock extraction) and sand pits (sand extraction), however, in the area of implementation of the Project (AID) and surrounding area (AII), no industrial activities were identified.

Within the AID, several fields were observed, many of them associated with dwellings and areas for grazing. Of the dwellings identified, some are made of precarious material (reeds and straw), others of conventional material (blocks and zinc sheets) and fewer in masonry. Photos 7.60 to 7.63 show examples of these occurrences. A church was also identified within the AID.

s for the roads, they are dirt and in poor condition. In the AID to the village of Namaacha, people move on foot, hitchhiking, bicycle, motorbike and few by car. There is no regular transport outside the village of Namaacha. With regard to the roads surrounding the study area, the roads are all dirt roads, some of which are more than 3 metres wide.

The current uses of the territory by the local population include the cultivation of fields and grazing.

Photos 7.60, 7.61, 7.62 and 7.63 - Examples of dwellings within the study area

In the surroundings of the AID is the settlement of Macuacua, its dwellings are more concentrated along the main road that runs in a south-north direction.

From the survey carried out, which is in Annex 4, it appears that there are 28 houses in the area of direct influence, of which 20 are inhabited and eight are uninhabited or even in ruins. There are 20 fields, of which 15 are in use and 5 are inactive. There are 10 corrals, nine in use and one deactivated, and a church. The location of these is shown in the same Annex.

A total of 72 people live in these houses.

At the level of basic infrastructure in the settlement of Macuacua there is no electricity, water supply network or sanitation. There are only a few wells/boreholes that ensure the supply to the local population. The presence of livestock demonstrates the maintenance of the tradition of raising livestock, not only for domestic consumption, but also for the use of animal traction.

7.13.9 Public consultation

A first Public Consultation was held in February 2019 and took place with the presence of the Proponent's representative, Mr Pedro Coutinho, the Environmental Consultants (from the company responsible for the EPDA, Matos, Fonseca & Associados -Mozambique) Margarida Fonseca, Nuno Matos, Sandra Gouveia and José Gravata, the representatives of the Government of the Republic of Mozambique, namely the Mayor of Namaacha, Mr Elias Munguambe, of the District Government of Namaacha, Ms Suzete Alberto Dança, of the District Directorate of Planning and Infrastructure, of the District Directorate of Planning and Infrastructure, Ms Deolinda Saíde, of the Maputo Provincial Directorate of Mineral Resources and Energy, Mr Pedro Caixote, the EDM representative, Leopoldo Khadyhale.

Also present were the Technicians of the District Directorate of Planning and Infrastructure, Graziela Lopes Menete, Cecília João Carlos Uqmusse Luís Jacinto Mondlane, representing the National Directorate of Environment, the Technicians, Atália Muvelo and Rosalina Niquice, of the Provincial Directorate of Land, Environment and Rural Development of Niassa, the Technician Maria da Glória Morais, as well as other representatives of the Local Community such as the Head of the Locality Adriano Fondo, the Regulo Filimone Malhalela (see Photo 7.64).

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Photo 7.64 - 1st Public Consultation (February 2019)

According to the information obtained, the basis of the economy is agriculture and there is a lot of unemployment in the District of Namaacha and in the localities closest to the area of direct intervention. Concerns centre on the difficulty of accessing the AID to continue to develop agriculture and grazing, and also what will be the social responsibility of the Project, since children have to travel long distances to school, and the health infrastructure is reduced.

Another concern regarding the Namaacha Power Plant Project relates to the procurement procedures and their transparency. It was also questioned how the electricity produced will be distributed to the localities of the District of Namaacha (see Annex 4 - Report of the 1st Public Consultation).

Subsequently, the 2nd Public Consultation was held in December 2019, which was also attended by the representative of the Proponent, the representatives of the Government of the Republic of Mozambique, the Government of the District of Namaacha, the District Directorate of Planning and Infrastructure, the Provincial Directorate of Mineral Resources and Energy of Maputo, the Representative of EDM.

Also present were technicians from the District Directorate of Planning and Infrastructure, the National Directorate of Environment, the Provincial Directorate of Land, Environment and Rural Development of Maputo, as well as other representatives of the Local Community. The main issues raised were related to employment, contracting regime and the entire social impact of the project (see Annex 5 - Report of the 2nd Public Consultation).

7.14 LANDSCAPE

7.14.1 Methodology

The methodology used for the characterisation of the landscape reference situation for the Namaacha Power Plant Project area aimed to know and understand the territory, namely its dynamics, its functioning, as well as its visual outcome.

Thus, an objective characterisation was carried out initially with the study of the structuring elements of the territory and the study of the functioning and participation of each element in the space and, subsequently, a more subjective characterisation corresponding to the characterisation and evaluation of the visual result of the territory - landscape.

According to Cancela d'Abreu et al. (2002) the landscape is a complex and dynamic system, which presupposes the interaction and joint evolution of different natural and cultural factors, determining and being determined by the global structure, resulting in a particular configuration, namely regarding morphology, land use, vegetation cover, built occupation, presence of water, to which corresponds a certain character.

After analysing each landscape factor and its pattern of influence, an integrated analysis was carried out in order to identify and learn about specific patterns of territorial organisation, manifested in different visual forms, defining homogeneous landscape unit ("UHP") and landscape sub-units.

This analysis was based on the current land uses and land cover according to the aerial photography analysis, crossed with the land cover information collected in fieldwork, as well as the altimetric elements (contour lines and datum points), slopes and slope orientations (see Figures 7.61, 7.62 and 7.63).

A characterisation of the aesthetic elements of the landscape was carried out, such as shape, proportion of its elements, scale, texture and colour, level of diversity and visual quality, according to the methodology proposed by the Countryside Commission - Landscape assessment. In addition to these variables, the non-aesthetic quality of the landscape was also analysed.

Based on the UHP, a visual and scenic characterisation of the landscape was carried out through its most striking elements, visual scenic quality, visual absorption capacity and its main cultural components.

At the landscape level, the study area (Area of Indirect Influence) considered thus corresponds to a buffer of 2 km around the project elements, defined as the limit area where it will be possible to distinguish the elements to be built and where it is possible to analyse the project in relation to its surroundings, without taking into account parameters related to the observation conditions, namely climatic conditions and the time of day at the observation. The working scale adopted was 1/25 000.

7.14.2 Landscape Structural Organisation

Knowledge of the structural organisation of the territory is the key to understanding the landscape. For this reason, it seeks to find organisational patterns (landscape units), through their functional and visual differentiation, which are studied according to a discretisation of their structural factors, studying them individually, understanding their patterns of influence for the dynamics of each landscape unit in particular and for the whole landscape in general.

The Landscape study area falls within the district of Namaacha, located to the south-east of Maputo Province, 76 km from Maputo city, bordering to the west with the Republic of South Africa and the Kingdom of Swaziland, to the north with the District of Moamba, to the east with the District of Boane and to the south with the District of Matutuíne.

The region is covered by a tropical humid climate, considered mild with an average annual temperature of 21°C and rainfall occurs about 60% between November and March. The landscape study area is covered by several tributary water lines of the Gumbe and Movene rivers.

The landscape study area is located on one of the ridges that constitute the Libombos Mountains, which form a mountain range with undulating relief that stands out from the surrounding landscape (see Photograph 7.65 and 7.66).

Photo 7.65 - General view of Montes Libombos from the surroundings

Photo 7.66 - General view - area of direct influence

In terms of the road network, this is composed entirely of dirt tracks, which give access to the dwellings, fields existing next to the tracks and the settlement of Macuacua, located in the westernmost part of the landscape study area.

With regard to natural values, and as already mentioned at the level of ecology, the study area overlaps with an Endemic Bird Area (EBA) called the South-east African Coast which encompasses the coastal plains of south-eastern Mozambique, northern Natal and the extreme south-eastern Transvaal in South Africa, and eastern Eswatini. It is also included in the Maputaland-Pondoland-Albany biodiversity hotspot. This hotspot encompasses a region that harbours great biological diversity, stretching from the east coast to the west coast of the Indian Ocean.

Analysing the Landscape study area, it is observed that the relief is shaped with gentle to moderate slopes, of undulating landform, at elevations varying, approximately, between 266 m and 704 m. On the ridges the slopes are mostly less than 5°, being these greater on the slopes surrounding the water lines.

This landscape in the study area is characterised as being relatively homogeneous which, however, does not present uninteresting characteristics, since, like the vast framing areas, it conveys to observers an image that still preserves some naturalness (albeit altered) and some calm. It is a moderately open landscape, which "lives" off the undulating area in which it is inserted, gaining some visual and scenic interest.

7.14.3 Landscape characterisation

According to the location of the landscape study area and its biophysical framework, an integrated analysis was carried out, with the aim of identifying and knowing specific patterns of territorial organisation, manifested in different visual forms, defining Homogeneous Landscape Unit (HPU) and Landscape Subunits (SP).

Thus, as a first hierarchical level and according to the biophysical framework, it was considered that the area under study of the Landscape falls within the UHP "**Montes Libombos**" and as hierarchical levels of greater detail, the following landscape sub-units are considered: "Valleys", "Transition slopes" and the "Macuacua and Alto Ciguene ridges".

The UHP "**Montes Libombos**", as previously mentioned, extends in a north-south direction, with its highest point at about 800m, on Mount M'ponduíne. The flattened surface slopes down to the east, with several rivers cutting through the mountains in a west-east direction. The town of Namaacha stands out in this HPU, which is located on a plateau of the Montes Libombos mountain range. The main places of natural, tourist and religious interest here are the Namaacha Waterfalls and the Sanctuary of Our Lady of Fatima, inaugurated on 29 August 1944 and where a pilgrimage is held on 13 May each year.

In the UHP "**Montes Libombos**" the following **SPs** are associated, which are part of the landscape study area (see Figure 7.64):

- The "Valleys" sub-unit has an altimetry of less than 400 m, with a gentle to moderate slope, located in the surroundings of the main water lines present in the landscape study area, namely, the Buzine River, the Maxongogololuane River, a tributary of the Maxongogololuane River, the Conguine or Folene River, the Mangave River and its tributaries. In these valleys the landscape is of a natural character. There is no project infrastructure here.

  The sub-unit "Transition slopes", presents an altimetry that varies between 400 m and 550 m, with varied slopes, being more accentuated in the surroundings of the valleys and softer in the surroundings of the ridges. Here we can already visualise the existence of anthropogenic anthropogenic "marks", which alter the character of the natural landscape, namely some dwellings, fields and dirt tracks. It is a landscape that is mostly homogeneous and characterised by the presence of a forest quite altered by human influence, which is represented today by undifferentiated vegetation, dominated by shrub/acacia woodlands, the presence of some tropical and subtropical hardwood forest and tropical and subtropical graminials. Due to its physiographic nature and vegetation cover, it presents some exposure in visual terms, due to some human presence. Part of the infrastructures that integrate the Namaacha Power Plant Project are located in this subunit.

- The "Macuacua and Alto Ciguene Ridge" sub-unit has an altimetry of more than 550 m, with mostly gentle slopes. Here we can already see the existence of more anthropogenic "marks", which alter the character of the natural landscape, where the settlement of Macuacua stands out, with the presence not only of houses, fields and dirt tracks, but also churches, a school, a health post and some water abstractions. There are also several dirt tracks that develop randomly along the entire ridge, which also give the natural landscape a mark of artificialisation resulting from the anthropogenic pressure that is felt. Due to the greater human presence, these ridges are more visually exposed. Most of the infrastructures that make up the Namaacha Power Plant Project are located in this sub-unit.

Thus, based on fieldwork, available cartography and photographic elements, a visual perception analysis was carried out based on the visual attributes and SPs identified in the landscape study area, thus proceeding to an assessment of Landscape Visual Quality, Visual Absorption Capacity and respective Landscape Visual Sensitivity.

7.14.3.1 Visual Landscape Quality

The landscape is the most immediately recognisable expression of the general state of the surrounding environment. A biologically balanced, aesthetically well planned, culturally integrated and environmentally healthy territory will result in a high quality landscape, which will be immediately perceptible by its qualitatively recognised visual characteristics.

Visual quality is the result of the scenic manifestation of the territory determined by the presence of the main structural factors of the space and the dynamics that these inter- and intra-related factors provide.

In analysing the landscape quality of the study area, a qualitative landscape assessment criterion (weighting) was defined based on the visual attributes of the landscape, the visual values and the visual intrusions existing in the intervention area, taking into account the main existing land uses.

Thus, a landscape was considered to have higher visual quality the higher the existing visual values, the lower the existing visual intrusions and the better the visual attributes. To assess the Visual Quality of the Landscape (VQL) (see Table 7.44 and Figure 7.65), the average of the three parameters was calculated, categorising the result as follows:

- 1 - Reduced visual quality;
- 2 - Medium visual quality;
- 3 - High visual quality.

Table 7.44
Landscape Visual Quality Assessment

Main land uses	Visual Quality
Social area	1
Paths	1
Agricultural areas	2
Tropical and subtropical graminials	2
Woodlands of trees and/or shrubs	3
Degraded woodlands of trees and/or shrubs	2
Wet tropical and subtropical hardwood forests	3
Watercourses	3

Regarding the landscape study area, it was found the presence of some visual values that diversify it and contribute to its visual quality of high scope, where some of the main classes of land uses stand out, such as woodlands of trees and/or shrubs, wet tropical and subtropical hardwood forests and the existing watercourses with the presence of riparian vegetation.

As for visual intrusions, these are considered a negative factor to be taken into account in the visual analysis and is related to the presence of elements foreign to the landscape such as structures or infrastructures that by their location, height, volumetry, colour or architectural quality, among other types of factors, compromise the quality of the landscape, diminishing its visual value and tourist attraction capacity and consequently its economic value, in this way, only the paths and the social areas (dwellings) were considered.

The landscape in question can thus be considered to have a certain homogeneity, punctually monotonous, being a landscape similar to most of the surrounding areas, thus not assuming itself as a landscape of particular rarity or richness. It is a landscape that, even maintaining characteristics of naturalness is, in fact, a landscape marked by human presence.

Overall, the landscape study area is considered to be of high VQL to an observer (see Figure 7.65), although it currently shows some anthropogenic action, however, there is still a certain biological balance due to the formations there, with some variation in terms of shape and colour.

7.14.3.2 Visual Absorption Capacity

The capacity for visual absorption takes into account several factors that influence an individual to have or not, depending on their location, the ability and perception to visualise the constituent elements of the Project.

In the Landscape study area 166 potential observation points were selected, located at existing

dwellings, road network and potential existing cultural, religious and touristic sites of interest. For each observation point a visual basin (radius of 2 km) was generated at the average height of an ordinary observer, with an average height at the observer's eye level of 1.65m, to analyse its visual absorption capacity of the landscape in the study area (see Figure 7.66).

According to the 166 selected potential observation points, only 24 observation points with overlapping visual basins were obtained. Taking into account this value, the following Visual Absorption Capacity classes were defined:

- o High (visible pixel from 0 to 5 observation points with overlap);
- o Average (pixel visible from 6 to 15 observation points with overlap);
- o Reduced (visible pixel of > 15 observation points with overlap).

In the study area of the landscape there is a greater area with high to medium CAV to human activities, this situation is due to the type of orography present, namely the altimetry with little to moderate slopes, thus originating smaller visual amplitudes. However, the areas where the relief is relatively higher the observer can obtain a greater visual amplitude, taking into account the type of land occupation.

At the Namaacha Power Plant site it varies between high, medium and reduced.

The high absorptive capacity allows the introduction of new elements to lead to minor visual conflicts with the surroundings, however, the introduction of these project elements will be noticeable in the immediate vicinity and they are more vulnerable to change.

In this regard, it should be noted that the methodology adopted always points to the most unfavourable scenario as it does not consider, with the exception of relief, the existence of other visual barriers such as built elements, vegetation, visual acuity of the observer (also greatly influenced by the distance observer/object observed), colour and shape of the object that can contribute to its lesser or greater concealment.

7.14.3.3 Landscape Visual Sensitivity

Based on the intersection of the Landscape Visual Quality and the Landscape Visual Absorptive Capacity, it is possible to determine the greater or lesser sensitivity to potential visual impacts resulting from the implementation of the Project, which according to Table 7.45. Thus, the respective Weighting Matrix is presented.

Table 7.45

Landscape Visual Sensitivity - Weighting Matrix

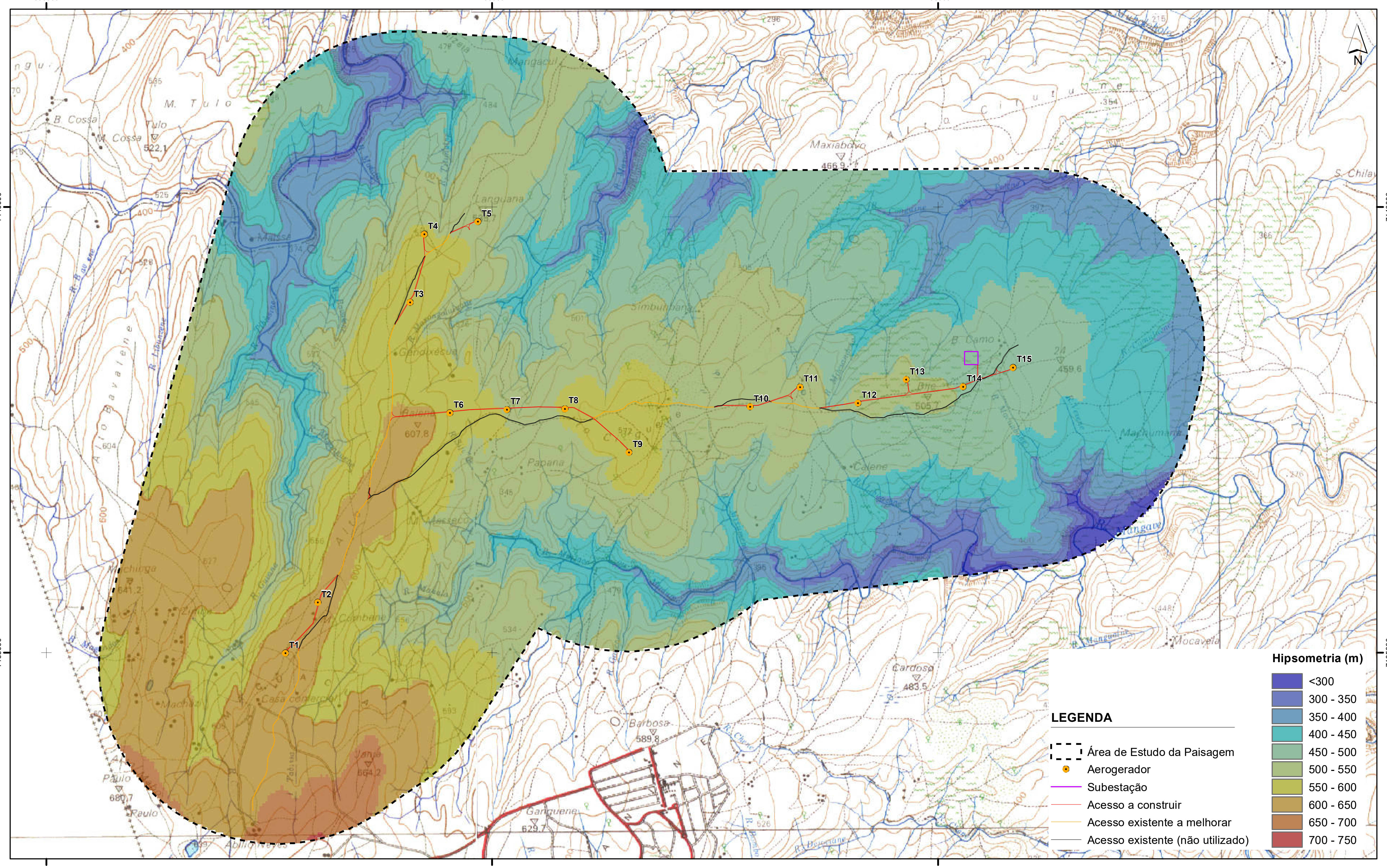
QVP\CAV	High (1)	Medium (2)	Reduced (3)
Reduced (1)	1	2	3
Medium (2)	2	4	6
High (3)	3	6	9

According to the parameters, the Landscape is assessed according to the following qualitative classes:

- High Sensitivity (7 a 9)
- Medium Sensitivity (3 a 6)
- Reduced Sensitivity (1 a 2)

From the analysis of the cartography elaborated (see Figure 7.67), it appears that the vast majority of the study area of the landscape under analysis has a medium SVP classification, however, it appears that there are still areas with a high SVP classification.

The areas of medium SVP, in general, correspond to areas of medium and high visual landscape quality, but due to the reduced accessibility and visual incidence, they are of medium visual sensitivity.



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:40 000

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Unidades: metros
EPSG: 32736

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Figura 7.61 - Hipsometria

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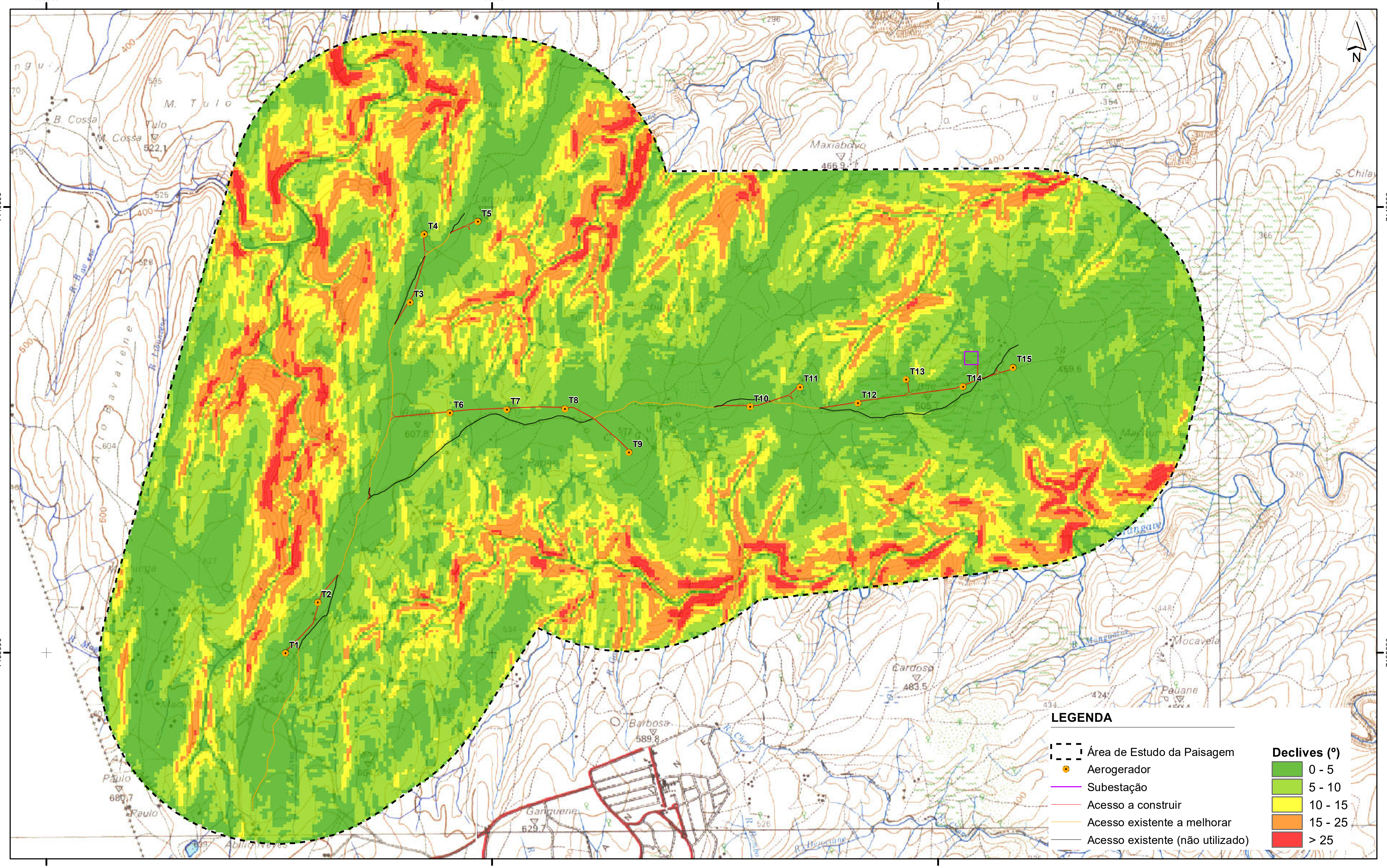

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Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Figura 7.62 - Declives

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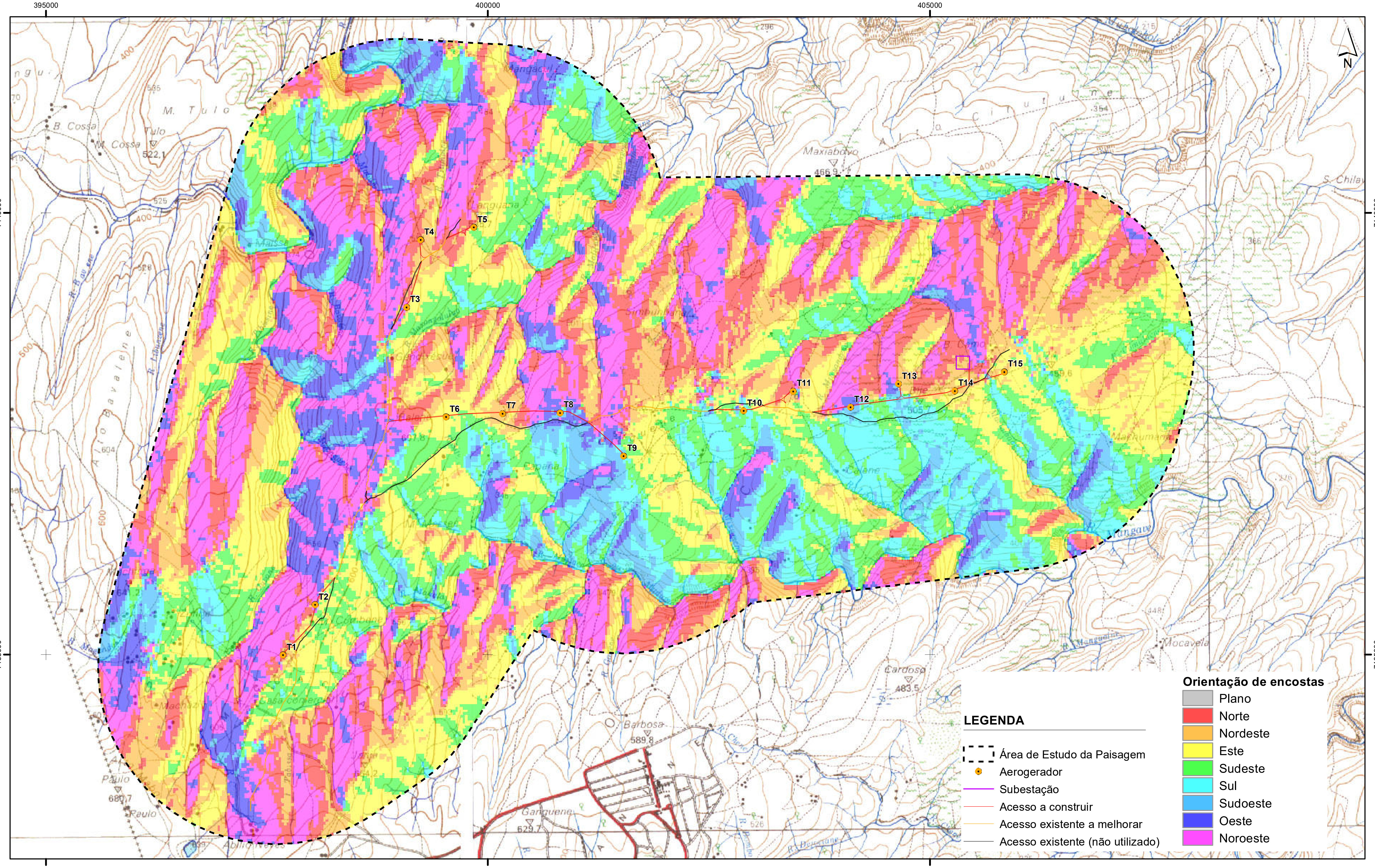

Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

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Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Figura 7.63 - Orientação de Encostas

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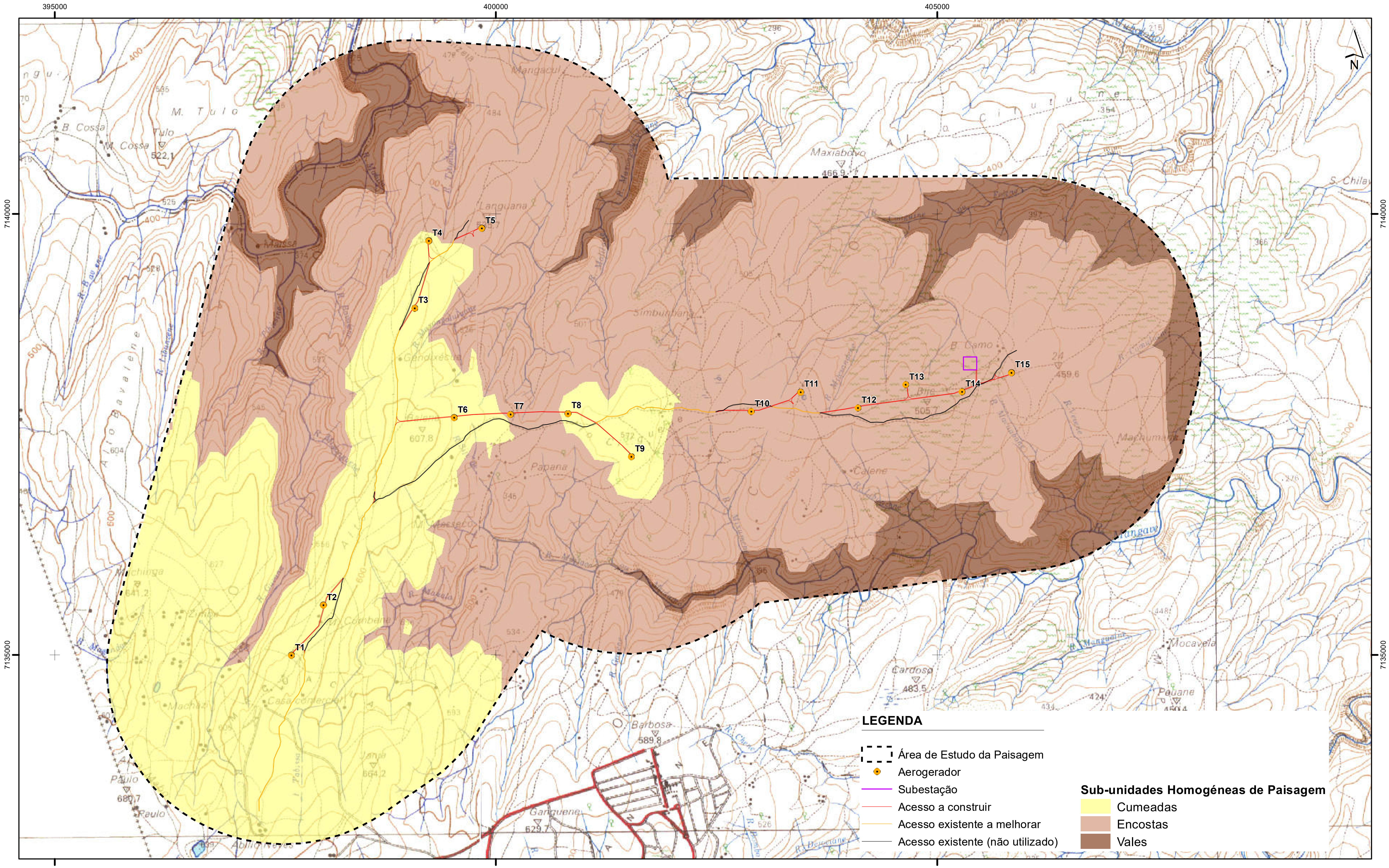

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Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.64 - Sub-unidades Homogéneas de Paisagem

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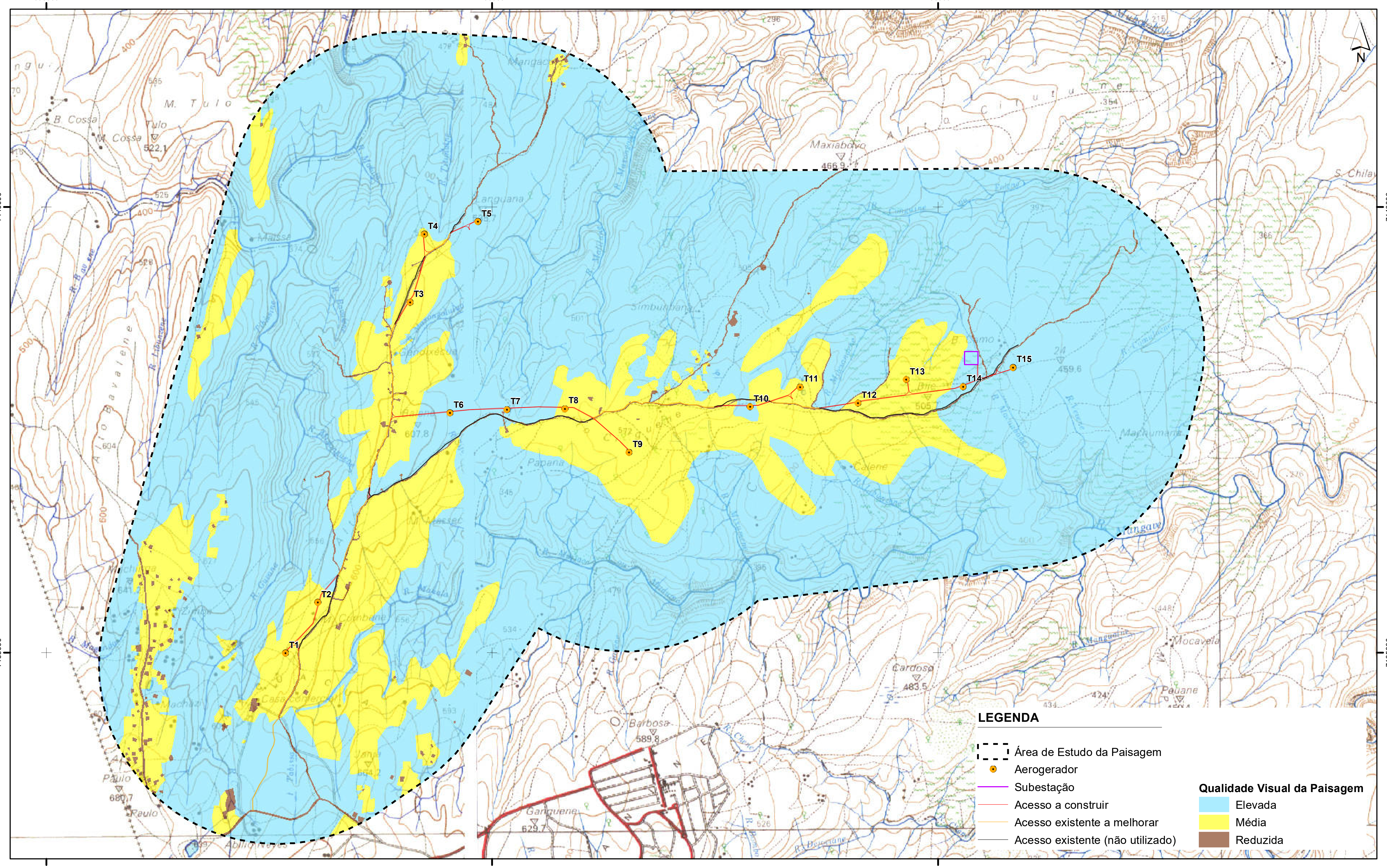

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Escala 1:40 000

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Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Figura 7.65 - Qualidade Visual da Paisagem

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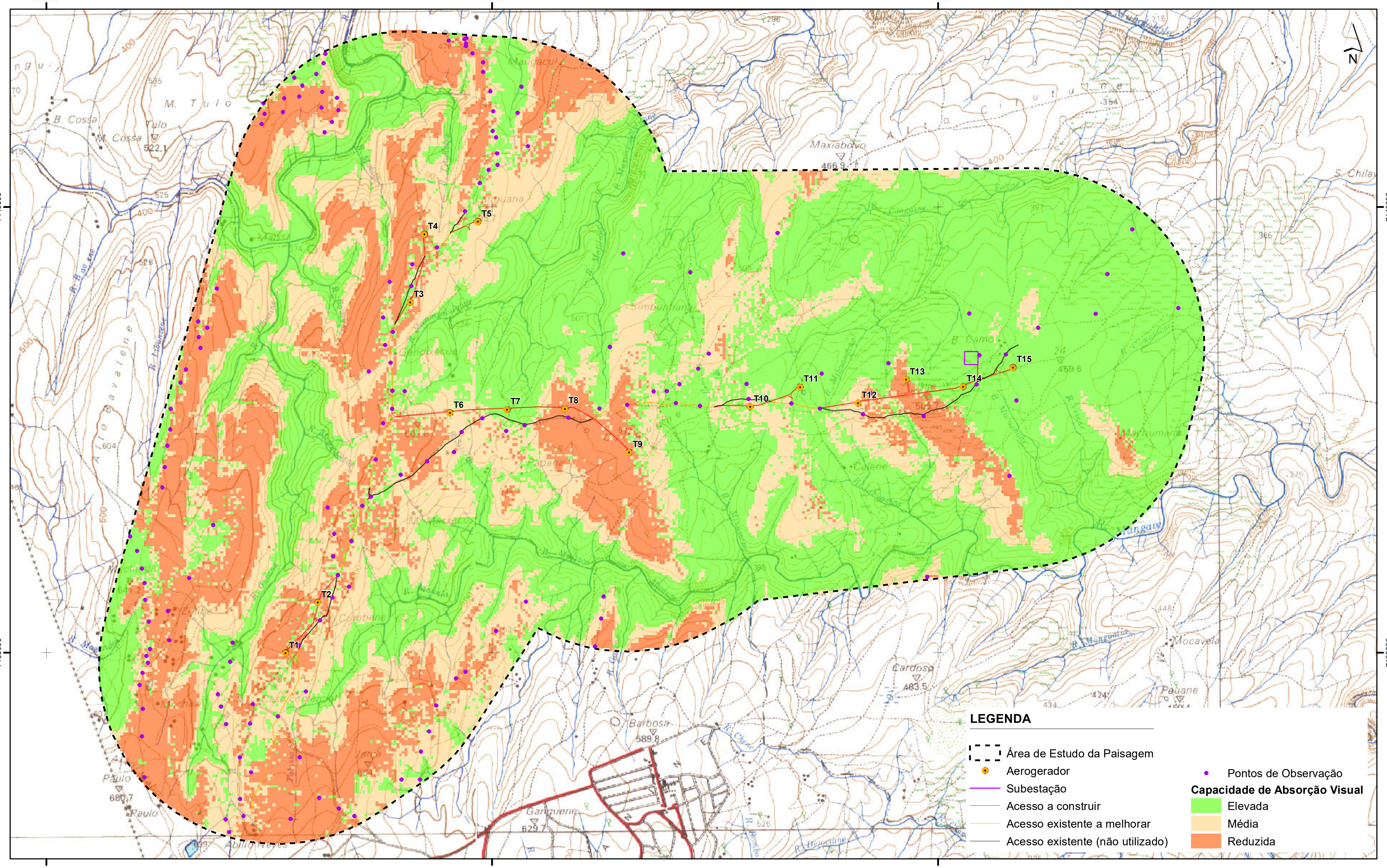

Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.66 - Capacidade de Absorção Visual

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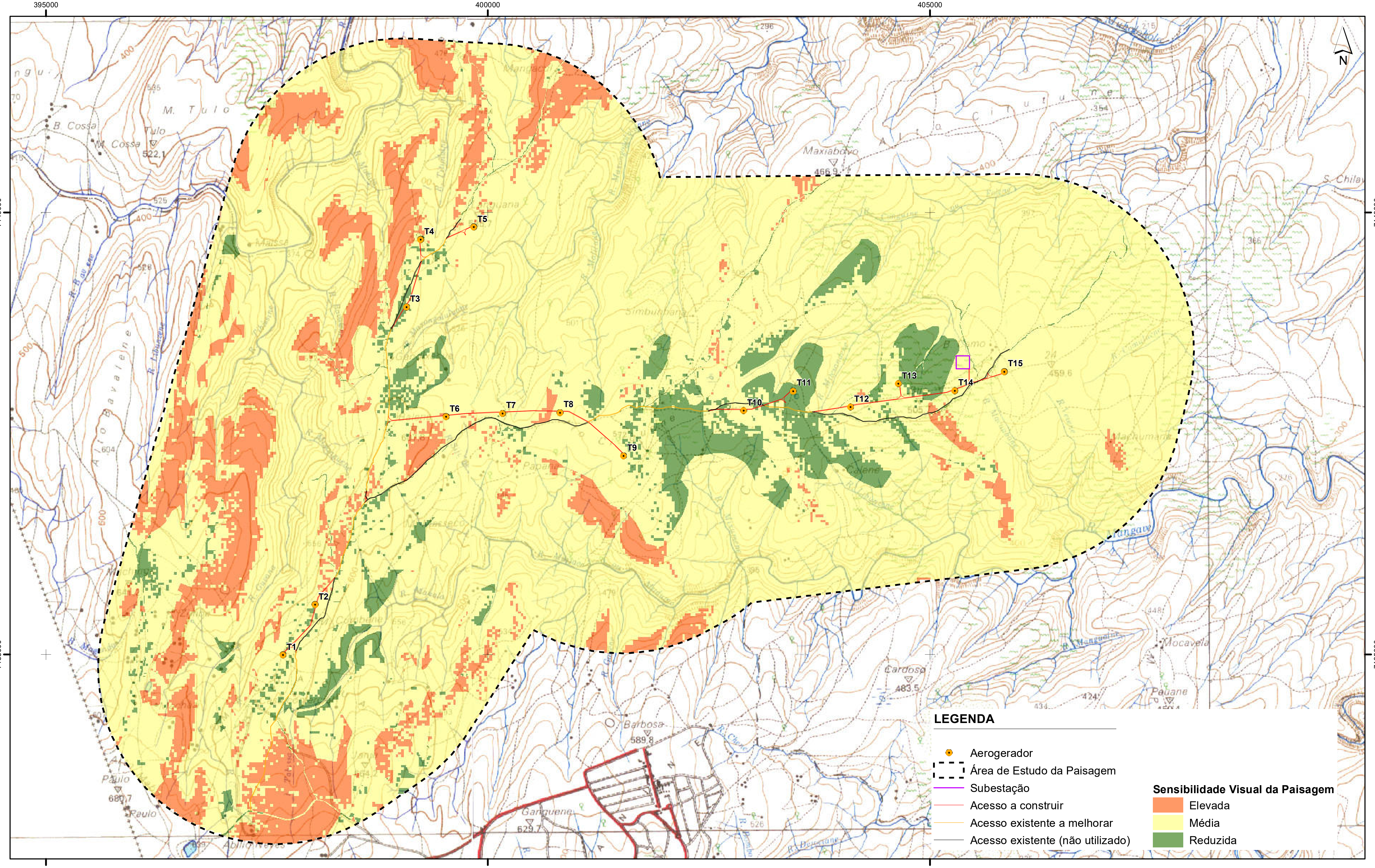

Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:40 000

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Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 7.67 - Sensibilidade Visual da Paisagem

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8 EVOLUTION OF THE ENVIRONMENTAL STATE WITHOUT THE PROJECT

The identification of the evolution of the state of the environment without the Project, that is, the projection of the reference situation, is a highly complex element in the preparation of environmental studies. The difficulties in characterising the current situation are multiplied when we consider its potential evolution in the absence of the Project. In fact, the current state of knowledge does not facilitate a prospective analysis of the referential evolution of the environment, although in the area in question, taking into account its characteristics, this analysis can be simplified.

In terms of the evolution of the area where the Namaacha Power Plant Project is located, in the absence of the project, the geomorphological evolution will point to a general lowering of the surface by normal erosion processes, with the rocky outcrops standing out. The geology and soils will maintain their natural processes of evolution. Regarding hydrogeology, it is not expected that groundwater availability will evolve in the direction of its utilisation, given the low productivity of the environment and no groundwater abstraction related to the construction and operation of the Wind Power Plant.

However, at the level of the circumstantial variables of the territory, which result from human intervention, it is more difficult to predict what changes may eventually occur, among other aspects at the level of land occupation, and consequently at the level of other factors directly related to it, such as landscape, ecological systems, among others.

Currently, the area planned for the implementation of the Power Plant and its surroundings, presents a relative anthropic presence, marked mainly by the existence of land used for agriculture and grazing.

Thus, it is considered that, from the point of view of the occupation and use of the soil, and having knowledge of how the evolution of this territory has been in the last years, where it is observed in the surroundings an increasing occupation by agricultural areas, the evolution of the studied area may occur in a direction of construction of diverse infrastructures, which may have a polluting character.

At present, for the area affected by the Project, there is no knowledge of any other type of interest beyond the current uses already described in the reference situation.

9 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

9.1 METHODOLOGY AND CRITERIA FOR ANALYSING AND ASSESSING IMPACTS

9.1.1 Methodology

This chapter presents the methodology for assessing the environmental impacts of the construction and operation of the Project, taking into account four key steps:

1. Impact description - All identified impacts were described on the basis of the current state of the environment, presented in Chapter 7. Once the technical description of each impact was completed, it was characterised analytically by applying the descriptors presented in Table 9.1. Each impact was assigned a scale in each of the descriptors, i.e. for each impact the type of impact was defined (positive/negative; direct/indirect/secondary). The extent, duration, reversibility and likelihood of each impact was also defined;

2. Impact assessment - For each impact identified, a degree of significance was assigned according to the criteria described in Table 9.2. The degree of significance of each impact was assigned by evaluating and defining two essential aspects: The magnitude of the impact and the sensitivity of the resource or receptor suffering the impact. After characterising the magnitude of the impact and the sensitivity of the receiving environment, the respective degree of significance was assigned according to Table 9.3;

3. Mitigation measures - In order to comply with IFC requirements, minimisation measures have been presented where possible. According to the IFC hierarchy, the focus is on avoiding impacts, but where this is not possible, impacts should be minimised and residual impacts that remain should be compensated for;

4. Residual impact assessment - After all acceptable and technically feasible minimisation measures have been identified, the residual impact has been assigned a significance level. The process of assigning the significance level is the same as described above in point 2, taking into account the reduction of the impact (or increase if positive) after the implementation of the recommended minimisation measures.

Table 9.1

Description of impact

Descriptor	Scale	Explanation
Nature of impact	Positive	Impact that represents an improvement on the baseline situation or introduces a positive change.
	Negative	Impact that represents an adverse change from the baseline situation, or introduces a non-desirable factor.
	Direct	Impact that arises directly from activities that are an integral part of the project (e.g. new infrastructure).
	Indirect	Impact that arises indirectly from activities that are not an integral part of the project (e.g. noise due to vehicle and machinery movements).
	Secondary	Secondary or change-induced impacts due to the Project (e.g. employment opportunities due to materials and labour requirements).
Scope	Site	The impact will be limited to the construction site.
	Local	The impact will be limited to the local area.
	Regional	The impact will be limited to the region.
	National	The impact will be national.
	International	The impact will be international.
Duration	Temporary	The impact is expected to be of very short duration (days) and/or intermittent/occasional.
	Short-term	The impact is expected to be short-lived (0 to 5 years).
	Medium-term	The impact is expected to last 5 to 15 years.
	Long-term	The impact will prevail during the lifetime of the project. It will disappear when the project finalises operations, i.e. decommissioned (typically >15 years).
	Permanent	Impact that causes a permanent and irreversible change to the affected recipient or resource.
Probability	Unlikely	The impact is not likely to happen.
	Likely	There is a possibility that the impact will occur.
	Very likely	It is very possible that the impact will happen.
	Certain	The impact will occur regardless of any prevention measures.
Reversibility	Immediate	The impact is immediately reversible.
	Reversible	The impact is reversible within 2 years after the cause of it is removed.
	Irreversible	The activity will lead to an impact that in all practical terms will be permanent.

Table 9.2

Magnitude of impact and vulnerability of the receiving environment

Descriptor	Definition	Scale	Explanation
Magnitude of impact	Describes the intensity of the expected change in the resource/receptor as a result of the impact	Insignificant	The impact is minimal and will have no effect on the environment.
		Reduced	Impact is reduced and will result in processes continuing in a modified form. Reduced changes to the environment. No involuntary resettlement. Good information and high awareness of potential environmental factors influencing the impact. High degree of confidence.
		Moderate	The impact is moderate and processes will be significantly altered and may be temporarily disrupted. Moderate changes to the environment. Limited involuntary resettlement and economic displacement. Reasonable amount of information and relatively good awareness of potential environmental factors influencing the impact. Reasonable degree of confidence.
		High	The impact is high and results in complete destruction of patterns and permanent interruption of processes. Destruction of rare or endangered species. Impairment of the character or quality of important historic, archaeological, architectural or aesthetic resources or community/neighbourhood character. Negative effects on vulnerable or disadvantaged communities. Involuntary resettlement and substantial economic displacement. Limited information and insight into the potential environmental factors influencing the impact. Low level of confidence.

Table 9.2 (Continued)

Magnitude of impact and vulnerability of the receiving environment

Descriptor	Definition	Scale	Explanation
Sensitivity	The importance of the environmental attribute in question, the distribution of the change in time and space. The magnitude of the change and the feasibility with which the change was predicted or measured	Low	Disturbance of degraded areas with little conservation value or no importance as a resource for humans. Affected species are not listed or protected. The importance of a resource or environmental attribute is based on technical or scientific knowledge or appreciation of critical resource characteristics.
		Medium	Disturbance of areas with local or regional conservation value or potential use for humans. Segments of the public recognise the importance of an environmental resource or attribute. Public recognition may take the form of support, conflict or opposition. Public action may be expressed formally or informally. The environment is susceptible to change.
		High	Disturbance of areas with regional or national conservation value and an important resource for humans. The importance of an environmental resource or attribute is recognised by law, plans or policy statements of government agencies or private groups. The environmental resource affected is significant. The environment is sensitive to change.

Table 9.3

Impact significance matrix

Significance		Sensitivity		
		Low	Medium	High
Magnitude	Insignificant	Insignificant	Negligible	Negligible
	Reduced	Negligible	Reduced	Moderate
	Moderate	Reduced	Moderate	High
	High	Moderate	High	High
	Positive impacts			
	Reduced	Negligible	Reduced	Moderate
	Moderate	Reduzido	Moderate	High
	High	Moderate	High	High

Table 9.4 below provides a description of each significance level.

Table 9.4

Description of the degrees of significance of impacts

Impact classification	Description
Negative impacts	
Insignificant	The receiving environment will not be affected by the activity. Impacts do not require further assessment.
Negligible	The effect of an activity on the amenity environment is not significant enough to be observed. Impacts do not require minimisation and are not a concern in decision-making processes.
Reduced	Detectable changes in the baseline situation, other than natural variations, are expected, but no impairment, degradation or damage to the function and value of the resource/receptor is expected. The significance of impacts is within the applicable parameters.
Moderate	Moderate significance indicates that an impact may reach the threshold of legal limits. Substantial impacts are anticipated that may result in lasting changes to the baseline situation. These impacts are a priority for minimisation in order to prevent or reduce the significance of the impact.
High	A high level of significance means that legal limits or standards have been exceeded, or impacts of high magnitude have occurred on highly sensitive environments or affected people. Residual impacts with high significance may be considered a fatal flaw of the project. High residual impacts should subsequently be avoided or minimised to avoid severe impacts on the receiving environment.

Table 9.4 (Continued)

Description of the degrees of significance of impacts

Impact classification	Description
Positive impacts	
Reduced	Impacts of low significance are perceptible but do not permanently and radically improve the receiving environment or benefit the people affected. There is compliance with all standards and legislation.
Moderate	Positive impacts are experienced and result in measurable improvements over the baseline situation. There is compliance with all standards and legislation.
High	Impacts of high significance that deliver substantial benefits where large improvements are realised over an extended period of time. There is compliance with all standards and legislation.

Cumulative impacts were also identified and assessed using the same steps as the impact assessment process. Cumulative impacts arise from the combination of several impacts from the same or other existing projects, future projects and/or developments defined at the time the impact and risk identification process was carried out.

When the identification and assessment of the impact and minimisation measures was finalised, a summary table was built with all the relevant information. Table 9.5 represents the model that will be used in the assessment of each impact.

Table 9.5

Impact assessment framework template

[Impact]			
[Description of Impact]			
Project phase	Pre-Construction/Construction/Operation		
Nature of Impact	Direct/Indirect/Secundary; Positive/Negative		
Scope	Site/Local/Regional/National/International		
Probability	Unlikely/Likely/Very likely/Certain		
Duration	Temporary/Short-term/Medium-term/Long-term/Permanent		
Reversibility	Immediate/Reversible/Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Insignificant/Reduced/Medium/High	[Summary of mitigation measures]	Insignificant/Reduced/Medium/High
Sensitivity	Low/Medium/High		Low/Medium/High
Classification of Significance	(*)		(*)

Legend:

	(*)
Negative	Insignificant
	Negligible
	Reduced
	Moderate
	High
Positive	Reduced
	Moderate
	High

9.1.2 Activities potentially generating impacts

The main activities potentially generating environmental impact are grouped into the following phases:

- Project Construction;
- Project Operation and Maintenance;
- Project Decommissioning.

The activities identified in each of the phases are as follows:

- Project Construction
  - Installation and operation of construction site;
  - Clearing and arrangement of the area;
  - Construction of access roads;
  - Opening and closing of trenches for the installation of electrical cables between wind turbines and the substation;
  - Assembly of the various electrical equipment of the Wind Power Plant;
  - Execution of the platforms for the assembly of the wind turbines;
  - Concreting the foundation masses of the wind turbine towers;

- Transport and assembly of wind turbines (tower, cabin and blades);
- Construction of the control building/substation;
- Movement of persons, machinery and vehicles assigned to the works;
- Transport of various construction materials (concrete, gravel, tout-venant, etc.);
- Recovery/landscape integration of the intervened areas.
- It is emphasised that, in general, the main impacts relate to the use of natural and non-infrastructured areas, with little land movement.

- Project Operation and Maintenance
  - Operation and running of the Power Plant, producing electricity;
  - Maintenance and repair of equipment (including substation) and access roads.

In the operation phase, there is a maintenance of the impacts that occurred in the construction phase regarding the implantation of the Plant and its presence.

- Project Decommissioning:
  - Dismantling of the Wind Power Plant;
  - Transportation of equipment and materials;
  - Landscape restoration.

The environmental impacts associated with the decommissioning phase of the Project are considered similar to those involved in the construction phase, although generally less significant. In fact, the activities mentioned as generating environmental impacts in the decommissioning phase, have, in their entirety, a parallel with the construction phase, generating in all aspects, impacts with a lower significance and in smaller numbers.

The impacts associated with the dismantling of wind turbines are identical to those portrayed in the assembly phase. At this stage, waste will be generated, which through proper management will not have a significant impact on the environment. It should be noted that the percentage of recycling of the constituent materials of a wind turbine is high, and the manufacturers of the wind turbine components themselves contribute from the outset to the economic balance of the waste management cycle, and this cost is usually included in the price of these components for which complete end-of-life management is ensured.

The transportation of equipment and materials also generates impacts similar to those generated in the construction phase. Proper organisation of material transport and machinery movements during the decommissioning phase means that the impacts associated with this activity will not be significant.

With regard to landscape restoration, it is considered that this will have beneficial impacts on the environment, since the original conditions observed prior to the installation of the wind turbines will be restored.

Therefore, it is considered that the impacts generated in the decommissioning phase will be similar to those identified in the construction phase although mostly less significant than those observed in the first phase.

9.2 CRITERIA FOR QUANTIFICATION OF DIRECTLY AFFECTED AREAS

9.2.1 General Considerations

For the assessment of environmental impacts, it is essential, in addition to identifying the activities associated with the Project that will cause environmental impacts, to quantify the extent of the areas that will be affected.

The definition of the different study areas, depending on the environmental factors under analysis, has already presupposed a prior knowledge of the scope of the expected impacts, based on the experience of this type of projects and the effects they cause in the area where they are located. However, for those descriptors whose effects are felt directly in the restricted study area, and which result from the effects felt in the areas directly affected, it is now important at this point to present the criteria for quantifying these areas.

The application of these criteria allows estimates of areas to be intervened, and these areas show significant differences between the construction phase and the operation phase, with a substantially smaller area being allocated in the operation phase compared to that observed during the construction phase.

The areas considered in the construction phase and which are broken down by type of infrastructure in the following sections include, in addition to the areas directly affected by excavation and backfilling actions, the adjacent areas for the movement of machinery and the deposit of materials, equipment and debris resulting from general earthmoving (rock, gravel, vegetated earth).

9.2.2 Areas Affected by Project Construction

- **CABLE TRENCH**

When the trench is developed along an existing access, a **3.5m strip is allocated** from the access lane. This strip corresponds to the trench and the adjacent area where the "cordon" of material removed from the trench is placed, with separation from the vegetated land. In this case, the backhoe loader can drive along the existing access and does not need any lane to drive on.

When the cable trench is developed in natural ground, a **6 m strip is allocated**.

Photos 9.1 and 9.2 - Example of cable trenching along an existing access (left) and in natural ground (right)

- **ACCESS ROADS**

The access roads to be built may have cable trenches installed parallel to them. For these cases, the area to be affected by the access road is added to the quantification of the area to be affected by the cable trench. In this situation, the **total area to be allocated is considered to be approximately 8 metres (4.5 metres for the access road to be built plus 3.5 metres for the cable trench)**.

In the case of the roads to be upgraded, there is a lane for the movement of machinery, which corresponds to the existing road that is to be upgraded, with the addition of about 2 m for the widening of the road. To this widening is added the **allocation of a 3.5m strip** from the lane (**2m for the widening plus 3.5m for the cable trench). The total allocation strip for these cases is about 5.5m**.

The area to be allocated **will be about 101 654 m².**

- **WIND TURBINE PLATFORM AND FOUNDATION**

Each foundation will have about 20 m² and its respective platform about 363 m², plus a **3 m wide surrounding strip for a machine to circulate in the adjacent area**, the total area to be affected by the construction of the foundation of a wind turbine and its platform is approximately 594 m².

To this allocation is added two platforms to support the construction of the wind turbines (crane installation and materials storage) whose area is about 2 935 m².

Considering the total deployment area of the set of three elements (platform plus two construction support platforms), the total area to be affected by the construction of a wind turbine is approximately 3 529 m².

In the case of the Project in question the area allocated will be **of 52 382 m².**

- **CONSTRUCTION SITE**

In order to carry out the construction work for the power station, it will be necessary to set up a construction site which will occupy an area approximately 20 metres wide and 30 metres long.

The construction site will be located between the T7 and T8 wind turbines (see Figure 1.2).

Thus, the **total area to be allocated for the installation of the construction site will amount to 600 m².**

- **CONSTRUCTION OF CONTROL BUILDING/SUBSTATION**

For the construction of the control building/sub-station**, an allocation of 22 500 m².**

9.2.3 Areas Affected in the Operation Phase of the Project

As already mentioned in the Project description, a large part of the areas intervened in the construction phase will be renaturalised, leaving only those that are occupied by the Project's definitive infrastructures that are located above ground level, namely: the 15 wind turbine towers and their respective circular service paths, the paths that will give access to the new wind turbines and the control/substation building, and the control/substation building, in **an area of approximately 76 300 m²**, about 7.6 ha.

9.3 CLIMATE AND CLIMATE CHANGE

9.3.1 Construction phase

No significant impacts are identified in the construction phase.

9.3.2 Operation phase

In the context of the growing pressure to develop the exploitation of renewable energies, associated with the increase in the industrial sector, wind energy is considered the most viable alternative for the production of electricity, compared to the use of fossil fuels (Couto & Couto, 2007). It is also considered the fastest growing energy source in the world, at a rate of 28.6% per year (Impacto, 2015).

Studies on climate change resulting from the operation of large wind farms are still scarce, as the implementation of this type of project is still relatively recent. The utilisation of this energy source for electricity generation on a commercial scale started just over 30 years ago, driven by the global oil crisis of the early 70s (Azevedo *et al.*, 2016).

Projected changes in temperature and precipitation are not expected to impact the project.

In the case under study, climate impacts will be associated with the non-existence of fossil fuel burning in electricity generation, which would give rise to the emission of greenhouse gases and global warming.

Thus, with regard to the climate effects associated with the increase in the greenhouse effect and, in particular, the increase in temperature on a global scale, this Project generates, with the production of energy through a renewable source without resorting to the emission of greenhouse gases, positive impacts, but given the size of the Project, they will be of small magnitude, insignificant, of national scope, certain, permanent, reversible, immediate and direct.

The following tables summarise the impacts described above (Table 9.6).

Table 9.6

Reduction of fossil fuel consumption

Climate			
Reduction of fossil fuel consumption			
Project Phase	Operation		
Nature of Impact	Direct; Positive		
Scope	National		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	Not applicable	Reduced
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Reduced

9.3.3 Decommissioning phase

As with the construction phase, no significant impacts are expected at this stage of the project.

9.4 GEOMORPHOLOGY, GEOLOGY AND HYDROGEOLOGY

9.4.1 Geology and Geomorphology

9.4.1.1 Construction phase

During the construction phase, one of the actions will be to clear the area, leaving the soil bare and subject to erosion processes due to water erosion, especially during heavy rainfall, with the consequent movement of soil into the water network. However, given the low slope of the land, it is not expected that significant gullies and soil movement will occur.

Thus, the earthworks for the construction of the wind turbine mounting platforms and respective access roads and cable trenches, will locally modify the morphology of the terrain due to the creation of small slopes. It is considered a negative impact, of small magnitude, certain, temporary (since the morphology of the land will be practically restored after completion of the works) and reversible in part (except in the area of the wind turbine platforms, substation and access roads), but minor and strictly local in scope.

The opening of the trenches for the installation of the electrical cables connecting the wind turbines to the substation, which will run parallel to the access roads to be built/improved, will cause small changes in the local morphology, although temporary (it will cease with the closing of the trenches), with little local significance. The opening of the trenches will follow the morphology of the terrain and will not cause significant topographical changes.

The most significant affectations correspond to the new access roads to be built, in an extension of about 14 497 m, and to the construction of the platforms for the assembly of the wind turbines and the substation. Given the topography of the area of wind turbines T4 and T5, a little steeper than in other areas, it is assumed that the slopes may have a slightly greater expression.

Thus, the morphological changes resulting from the construction of the access roads and platforms will constitute a negative, minor, certain, permanent and strictly local impact. It should also be noted that most of the interventions will occur in practically flat areas, without the need to create significant slopes, making the impact very minor.

It should also be noted that erosion processes and soil erosion may occur during the construction phase, although it is assumed that they will have a reduced expression given the almost flat morphology of most of the places where there will be earth movement, the small thickness of the soil alteration layer and the rocky outcrops and stoniness in the intervention areas for topographic regularisation on the platforms and access roads to be created.

The tables below summarise the impacts described above (Tables 9.7 and 9.8)

Table 9.7

Artificialisation of local patterns in the study area

Geology			
Artificialisation of local patterns in the study area			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Reduce the area of intervention as much as possible and avoid building on rocky outcrops;	Negligible

Table 9.7 (Continued)

Artificialisation of local patterns in the study area

<table>
<tr><th colspan="4">Geology</th></tr>
<tr><td colspan="4">Artificialisation of local patterns in the study area</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td></td><td></td><td rowspan="3">2. Exposure of bare soil and earth movements should be reduced during peak rainfall periods to minimise should be reduced during periods of higher rainfall to minimise water-borne erosion and the consequent transport of sediment into the river network;
3. Excavations for cable trenches and other excavations necessary for the foundations of the control centre should be stopped during periods of high rainfall and precautions should be taken to ensure the stability of the slopes and to avoid ravines;
4. Soil decompaction should be carried out in easement areas and other sites used temporarily during the construction phase, thereby facilitating recharge of the hydrogeological system.</td><td></td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.8

Erosion due to deforestation of the area

<table>
<tr><th colspan="4">Geology</th></tr>
<tr><td colspan="4">Erosion due to deforestation of the area</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Moderate</td><td rowspan="3">1. Exposure of bare soil and earthmoving should be reduced during periods of higher rainfall to minimise water-borne erosion and consequent sediment transport to the river network draining the study area;
2. Area clearing and earthmoving should be carried out only in the necessary area and reduced during periods of higher rainfall.</td><td>Reduced</td></tr>
<tr><td>Sensibility</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>Reduced</td></tr>
</table>

9.4.1.2 Operation phase

In the operation phase, the impacts resulting from the artificialisation of the forms will remain, mainly due to the presence of the wind turbines and the corresponding installation platforms and the new access roads, which will be negative, permanent and irreversible, but of little significance and strictly local in scope.

9.4.1.3 Decommissioning phase

In the decommissioning phase, there will be impacts resulting from the dismantling of the equipment, which will cause some allocations, partly similar to those of the construction phase, although of lesser magnitude and significance. However, the restoration of the natural conditions of the land before the intervention will return the area to its pre-existing characteristics, ceasing the minor negative impacts identified in the construction phase.

It is accepted that the decompaction of the wind turbine platforms would be the least impactful intervention, and that the intervention to eliminate the accesses would be the most impactful, it being desirable that they be maintained to serve other purposes and to avoid further earth movement. In the case of the regularisation of the access strip, the spreading of the landfill sites should be confined to the contiguous areas.

9.4.2 Hydrogeology/Groundwater Resources

9.4.2.1 Construction phase

It is not expected that the works inherent to the construction phase of the Namaacha Power Plant will cause the intersection of water tables, given that the excavations necessary for the installation of the various structures will reach a small depth, of the order of 3 m in the case of the foundations of the wind turbines, and given the volcanic nature of the very unproductive geological formations, as well as the high topographic position of the intervention area on top of a practically flat relief. Thus, interference with the water table of the aquifer unit is not expected.

Although a well has been identified on the slope to the south of the site planned for the installation of wind turbine No. T6 (400 m to the south), next to the path to be built, it is not expected that the excavations necessary for the construction of the access will intersect areas of preferential water circulation in such a way as to interfere with the productivity of that well.

During the transport and handling of oils and fuels to the intervention area, accidental spills may occur, which may affect the hydrogeological system. However, care during transport and safety recommendations will help to minimise this possibility. In the event of an accidental spillage, it is considered a negative impact, unlikely, minor in view of the small volumes involved and local in scope.

Thus, the negative impacts on groundwater are uncertain, but it is considered that a possible occurrence would be immediately contained according to the measures and precautions to be considered during the construction phase.

During the construction phase, the movement of vehicles and machinery in the area of the Park will lead to soil compaction, modifying the natural conditions of infiltration. The presence of the platforms, the construction site in the construction phase, and the new access roads to the wind turbines, which will continue in the operation phase, will reduce the area of infiltration of rainwater, and it is expected that in the operation phase the area to be occupied by these interventions will be significantly lower, given the regularisation of the areas surrounding the access roads and platforms.

The decrease in water infiltration, either by reducing the porosity of the soils or by reducing the infiltration area, will cause a change in the recharge area of the aquifer unit of the study area, and it is not expected that the whole aquifer system will be affected. It is therefore considered that this decrease is a negligible impact.

The site has septic tanks, or another system such as removable toilets, for the waste water produced on the premises, and it is also not expected that any affectation of the local hydrogeological system could occur.

The following tables summarise the impacts described above (Table 9.9 and 9.10)

Table 9.9

Accidental spillages of oils and fuels

Hydrogeology/Groundwater Resources			
Accidental spillages of oils and fuels			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Less likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Ensure proper temporary storage of waste generated; 2. Containment/retention of any run-off/spillages should be provided; 3. It is not permissible to deposit waste, even temporarily, on the banks, beds of water lines and areas of maximum infiltration.	Reduced
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Reduced

Table 9.10

Reduction of water infiltration

<table>
<tr><th colspan="4">Hidrogeologia/Recursos Hídricos Subterrâneos</th></tr>
<tr><td colspan="4">Reduction of water infiltration</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Longo-term</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. The installation of the wind turbines and cable network should avoid the marshy areas in the centre and west of the study area, as well as a safe distance from the Muandá River;

2. Soil decompaction should be carried out in easement areas and other sites used temporarily during the construction phase, thereby facilitating recharge of the hydrogeological system.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

9.4.2.2 Operation phase

The waterproofing of the land is carried out in small areas associated with the platforms of the wind turbines, the substation and the access roads to be built, not determining a significant reduction in the recharge area of the aquifer. It is therefore considered that the reduction of the infiltration area will not globally affect the recharge of the hydrogeological system and therefore the groundwater body where it is located.

During the maintenance operations of the equipment and infrastructure of the Namaacha Power Plant there may also be accidental spillages of oils and/or fuels, which are very unlikely and will be immediately contained in accordance with the safety systems in place at the wind farm, so it is not considered that any spillage could cause a significant negative impact on groundwater quality.

Therefore, at this stage, no negative impacts on groundwater are considered to occur.

The following tables summarise the impacts described above (Table 9.11 and 9.12)

Table 9.11

Reduction of water infiltration

<table>
<tr><th colspan="4">Hidrogeologia/Recursos Hídricos Subterrâneos</th></tr>
<tr><td colspan="4">Reduction of water infiltration</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Restore natural infiltration conditions by decompacting and aerating the soil.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.12

Accidental spillages of oils and fuels

<table>
<tr><th colspan="4">Hydrogeology/Groundwater Resources</th></tr>
<tr><td colspan="4">Accidental spillages of oils and fuels</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Less likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Moderate</td><td>1. Consideration should be given to emergency and safety plans to deal with any accidental spills that may affect the hydrogeological environment of the study area;</td><td>Reduced</td></tr>
<tr><td>Sensitivity</td><td>Low</td><td rowspan="2">2. In the event of an accidental spillage, the affected soil layer should be removed immediately and sent for treatment to an appropriate licensed facility.</td><td>Low</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

9.4.2.3 Decommissioning phase

During the decommissioning phase, the waterproofed areas, platforms and accesses to the wind turbines and substation will be eliminated, which will contribute to the almost complete restoration of the original conditions of infiltration, and consequently of recharge of the groundwater body. At the same time, the possibility of possible groundwater contamination due to accidental spills will also be eliminated, which will be positive.

9.5 SURFACE WATER RESOURCES

9.5.1 Construction phase

As a result of the actions arising from the construction of the Project, identified in Chapter 9.1.2, the following negative effects are possible:

- Potentiation of the risk of erosion, or its increase when this phenomenon already exists, with consequent increase in sediment transport. High loads of solid material lead to the filling of floodbeds and the obstruction of natural or artificial passages and bottlenecks in watercourses;

- Contamination of water lines, with possible spillages of oils or other polluting substances, or by improper storage of solid waste.

The filling of floodbeds and obstruction of natural or artificial passages and bottlenecks of water lines may result from cleaning activities in the area where the works are located, which essentially involve deforestation, removal of the topsoil and earthworks. If precipitation occurs, erosion phenomena may occur, producing sediments that may flow into the water lines, causing their turbidity, affecting their quality. It is assumed that a direct, local, probable, temporary, reversible, moderate, low sensitivity and low significance negative impact is generated. In most cases, the water lines are far from the areas to be intervened and the size of the interventions to be carried out are small. Although the existing watercourses in the project area have zero flow, in the event of heavy rainfall, the torrential regime increases the likelihood of any runoff reaching the water environment.

During the construction phase it is necessary to ensure that existing water lines in the study area are not obstructed by undue deposition of materials resulting from excavations.

In dry periods and on windy days, the same effect may occur, due to the deposition of dust associated with the movement of machinery and vehicles.

Situations involving the adoption of incorrect solutions or the use of insufficiently designed facilities for the drainage and treatment of urban waste water and solid waste produced on site, as well as accidental occurrences associated with deficiencies in the transport, containment, storage or handling of fuels, lubricants, bitumen or other chemicals to be used, may correspond to a deterioration in the quality of water resources if minimisation measures are not adopted. These impacts will be negative, direct, local, unlikely, temporary, reversible, of low magnitude, medium sensitivity and low significance.

It is noted that the occurrence of construction phase impacts on water resources is directly dependent on the behaviour of the contractor on site and is considered to be easily minimised provided that the respective proposed minimisation measures are properly implemented.

The following tables summarise the impacts described above:

Table 9.13

Filling of floodbeds and obstruction of natural or artificial watercourse crossings and bottlenecks

Recursos Hídricos Superficiais			
Filling of floodbeds and obstruction of natural or artificial watercourse crossings and bottlenecks			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Clearing and general earthmoving works should be scheduled to minimise the period of time that soils are left bare and should preferably take place in the dry season;	Reduced

Table 9.13 (Continued)

Filling of floodbeds and obstruction of natural or artificial watercourse crossings and bottlenecks

<table>
<tr><th colspan="4">Surface Water Resources</th></tr>
<tr><td colspan="4">Filling of floodbeds and obstruction of natural or artificial watercourse crossings and bottlenecks</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Sensitivity</td><td>Low</td><td rowspan="2">2. Ensure natural drainage;
3. The site area should not be waterproofed, with the exception of places for handling and storing polluting substances;
4. Carry out temporary crossings of water lines in such a way as not to cause obstruction to the normal flow of water.</td><td>Low</td></tr>
<tr><td>Classification of the degree of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.14

Contamination of water lines, with possible spillages of oils or other polluting substances, or by improper storage of solid waste

<table>
<tr><th colspan="4">Surface Water Resources</th></tr>
<tr><td colspan="4">Contamination of water lines, with possible spillages of oils or other polluting substances, or by improper storage of solid waste</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Unlikely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td>1. It is recommended that oil and fuel handling operations take place in the specifically designed construction site area and waste oils are stored in suitable, leak-proof containers;</td><td>Insignificant</td></tr>
</table>

Table 9.14 (Continued)

Contamination of water lines, with possible spillages of oils or other polluting substances, or by improper storage of solid waste

Surface Water Resources			
Contamination of water lines, with possible spillages of oils or other polluting substances, or by improper storage of solid waste			
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Sensitivity	Medium	2. It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage, the affected soil layer should be removed immediately and the oil disposed of to an appropriate final destination; 3. In the event of accidental spillage outside substance storage areas, a layer of absorbent material should be applied immediately and removal of affected soil to appropriate disposal should be arranged; 4. The discharge of water resulting from the cleaning of concrete mixers should be carried out in places approved by the environmental monitoring team.	Medium
Classification of the degree of Significance	Reduced		Negligible

9.5.2 Operation phase

There will be no impacts on hydrology during the operation phase.

In terms of water quality, the potential impacts are related to accident situations, resulting from maintenance operations where new and used oils will be handled, whose accidental discharge could cause contamination situations that, ultimately, will reach the water environments. This impact is considered negative, direct, local, unlikely, temporary, reversible, of low magnitude, medium sensitivity and low significance.

As the design of the accesses within the project area will be in tout-venant or other suitable material, surface runoff will tend to increase, also leading to reduced infiltration. It is a direct, local, certain, long-term, reversible, low magnitude, medium sensitivity and low significance negative impact.

The tables below summarise the impacts described above:

Table 9.15

Contamination of water resources by oils or other polluting substances

Surface Water Resources			
Contamination of water resources by oils or other polluting substances			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Unlikely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Oil handling operations should take place in an area specifically designed for that purpose and prepared to contain any spillages; 2. It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be removed immediately and the spillage directed to a suitable location; 3. In the event of accidental spillage outside the areas intended for the storage of substances and maintenance of equipment, removal of the affected soil to an appropriate destination to be indicated by the entity responsible for environmental supervision shall be provided.	Insignificant
Sensitivity	Medium		Medium
Classification of the degree of Significance	Reduced		Negligible

Table 9.16
Increased surface runoff/Reduced infiltration

<table>
<tr><th colspan="4">Surface Water Resources</th></tr>
<tr><td colspan="4">Increased surface runoff/Reduced infiltration</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Long-term</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. If erosive phenomena are identified, corrective solutions should be implemented, to be studied on a case-by-case basis, to erosion control.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

9.5.3 Decommissioning phase

In this phase the impacts will be similar to those of the construction phase.

9.6 SOILS AND USE CAPACITY

9.6.1 Construction phase

During the construction phase, given the land use at the site, the main actions that could potentially cause impacts at this level are the following:

- Land clearing/deforestation actions;
- Stripping actions;
- Excavation and earthmoving actions;
- Deployment and occupation of infrastructure to support the works;
- Implementation of the project infrastructure (wind turbine foundations and platforms; internal electrical cable network; control building/substation; access and construction site);

- Movement of machinery and vehicles assigned to the work.

Overall, the main impacts on soils are negative and local in scope, resulting mainly from the occupation of lithic rhyolitic soils (Rl) and the minor occupation in the soil complex of lithic rhyolitic soils (Rl) and red rhyolitic soils (RV), due to the installation of the definitive elements in the Namaacha Power Plant and the presence of temporary elements such as machinery and material deposit sites.

The lithic rhyolitic soils have agricultural suitability classes for rainfed with suitability for forest and nature reserve and agricultural suitability classes for irrigated land, the latter is not recommended. As for the red rhyolitic soils, the dryland suitability classes are considered moderately suitable and the irrigated suitability classes are considered marginally suitable.

Given the reduced suitability of the soils in general and because they are soils that due to the type of existing occupation already support sporadically some movement, taking into account the deforestation and stripping of the topsoil in the area of implantation of the Plant, it is considered that the allocation of soils translates into a negative impact, minor, certain, of small magnitude, reversible, of local scope and minimisable.

During the construction phase, occasional soil contamination may occur as a result of accidental oil and/or fuel spills resulting from machinery maintenance. These possible occurrences may have negative impacts, but they are of low significance depending on the soils present and the expected size of the occurrence, local in scope, uncertain and of low magnitude. However, the likelihood of their occurrence and the severity of their effects can be minimised if the proposed minimisation measures are considered (see Chapter 11).

The movement of machinery, vehicles and people and the installation of the construction site will cause soil compaction. This impact is negative, certain, reversible in the construction site area and in the areas occupied by the construction support infrastructures, minor and reversible.

It is also considered that the soils of areas destined for the parking of machinery, accumulation of construction waste, deposit of construction materials, may be affected, constituting negative impacts, although minor, of small magnitude, of local scope, temporary and reversible. These impacts are also minimisable.

Finally, in addition to these direct impacts mentioned above, negative indirect impacts must be considered during the construction phase. Earthmoving, construction site activity and the movement of vehicles and machinery will have a temporary negative impact through the emission of dust and exhaust gases and their subsequent deposition on vegetation. However, this impact is considered to be minor as it is limited to a small area and is reversible in the short term.

The following tables summarise the impacts described above (see Tables 9.17 to 9.21)

Table 9.17

Deforestation and stripping of topsoil

Soils and Use Capacity			
Deforestation and stripping of topsoil			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles; 2. In order to avoid situations where the soil remains uncovered for long periods of time, surfacing work should take place immediately after a stripping action. These actions should be carried out successively in small sections, in order to avoid stripping large areas at once; 3. Controlled removal of all spoils from stripping operations shall be ensured. Clearing/deforestation necessary for the implementation of the Project, which may be used for soil fertilisation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.18

One-off soil contamination

Soils and Use Capacity			
One-off soil contamination			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Consideration should be given to emergency and safety plans to deal with any accidental spills that may affect the hydrogeological environment of the study area; 2. The waste produced must be properly stored and sent to the appropriate destination.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.19

Soil compaction

Soils and Use Capacity			
Soil compaction			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Adequate decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.20
Change of land use due to the parking of machinery, deposit and accumulation of construction waste

<table>
<tr><th colspan="4">Soils and Use Capacity</th></tr>
<tr><td colspan="4">Change of land use due to the parking of machinery, deposit and accumulation of construction waste</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Adequate decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.21
Deposition of dust and gases on vegetation

<table>
<tr><th colspan="4">Soils and Use Capacity</th></tr>
<tr><td colspan="4">Deposition of dust and gases on vegetation</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Indirect; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Reduce the number of haulage lorries required by carefully planning construction material needs;

2. Do not leave vehicles running or idling on site for longer than the minimum time necessary to complete site activities.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

9.6.2 Operation phase

In the operation phase, the negative impacts identified, predicted and assessed in relation to the construction phase and considered to be permanent, will be maintained.

The installation of infrastructure and equipment will have reversible impacts on the soil. At this stage, the areas of implementation that correspond to impermeable soil areas are essentially the foundations of the wind turbines, the substation and the structures that support the fence surrounding the substation, which correspond in total to very small areas.

As for the access roads with drainage systems, since they are made of natural terrain and material that allows water to flow and infiltrate into the soil, they are not considered as waterproofed areas. It is therefore considered a negative impact, of reduced magnitude and significance due to the small spatial expression of the allocation.

As the foundations of the wind turbines have a low land use, they do not prevent the recovery of the land and consequently the regeneration of the vegetation cover. These areas will have to be maintained in order to avoid vegetation growth that could generate shading. It is considered that this action generates a negative impact, although of reduced magnitude due to the small spatial expression of the allocation and the possible reuse of soils.

It should be noted that in this phase there will be a significant reduction of the area affected in the construction phase, which corresponds to the areas occupied by the construction site and the areas necessary for the manoeuvre of the wind turbine assembly machines and the strips of land along which the trenches were opened for the installation of the cables connecting the wind turbines of the Namaacha Power Station. In these areas, recovered with the vegetated land stripped during the construction phase, some of the pre-existing activities or uses may be resumed, thus reducing the magnitude and spatial scope of the allocation.

Thus, in the operation phase, the negative impacts associated with the permanent destruction of the soil, already quantified in the construction phase, remain, emphasising the fact that the situation influences the current land uses during the useful life of the Project.

However, in the event of the need for repair or replacement of wind power equipment and infrastructure, it may be necessary to use large cranes, and consequently, to use the renaturalised platforms at the end of the construction phase, thus constituting a negative impact, of small magnitude, insignificant, local, likely, temporary, reversible, immediate, direct, and minimisable, by actions of recovery/renaturalisation of the platforms after completion of the works.

During maintenance or repair/replacement of materials and equipment, accidental spillages of oils and/or fuels may occur as a result of these operations. These will need to be immediately contained in accordance with the proposed minimisation measures. The proper disposal of waste resulting from the operation phase is also a crucial factor in minimising impacts.

In view of the above, it is considered that negative impacts may be generated from the handling of the waste expected to be generated in this phase, but the magnitude and significance of these impacts will depend on the situations that occur. They will be local, unlikely, temporary, reversible, immediate and direct impacts, and will be minimisable, or even avoidable, with the correct application of the proposed measures, especially with regard to the packaging and proper disposal of the waste produced.

The tables below summarise the impacts described above (see Tables 9.22 to 9.25).

Table 9.22

Soil waterproofing

Soils and Use Capacity			
Soil waterproofing			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Reduced	1. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.23

Change of soil structure due to maintenance and repair of equipment

Soils and Use Capacity			
Change of soil structure due to maintenance and repair of equipment			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. No need for implementation of minimisation measures is advocated.	Insignificant
Sensitivity	Low		Low
Classification of Significance	Insignificant		Insignificant

Table 9.24

Soil contamination due to oil and/or fuel spills

Soils and Use Capacity			
Soil contamination due to oil and/or fuel spills			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Unlikely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Reduced	1. Consideration should be given to emergency and safety plans to deal with any accidental spills that may affect the hydrogeological environment of the study area; 2. In the event of an accidental spillage, the affected soil layer should be removed immediately and sent for treatment to an appropriate licensed facility.	Insignificant
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Insignificant

Table 9.25

Renaturalisation of the intervened areas

<table>
<tr><th colspan="4">Soils and Use Capacity</th></tr>
<tr><td colspan="4">Renaturalisation of the intervened areas</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Positive</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="2">Improvement measures</td><td>Moderate</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>1. Establish the surfaces to be renaturalised in perfect connection with the natural terrain and in such a way as to avoid erosive phenomena and enhance the establishment of vegetation</td><td>Moderate</td></tr>
</table>

9.6.3 Decommissioning phase

In the decommissioning phase, the complete removal of all equipment and facilities of the Namaacha Power Plant will return the soils in the intervention area to their pre-existing natural characteristics, after the appropriate recovery actions.

The renaturalisation of the intervened areas will have a positive impact on soil fixation and improve the vegetation cover, which would otherwise be at the mercy of erosive agents to a much greater extent. It is therefore expected that the restored soils will regain their productive potential, albeit reduced, resulting in a positive impact that is likely to be minor and local in scope.

Decommissioning activities involving excavation and earthmoving will impact on increased soil erosion similar to the construction phase.

The proposed minimisation measures, which are recommended for consideration, will mitigate the potential negative impacts identified above.

9.7 SOIL USE

9.7.1 Construction Phase

This project involves a change in land occupation, converting mainly the areas of woodland of trees and/or shrubs and degraded woodland of trees and/or shrubs, by an occupation of platforms and foundations of the wind turbines (and the surrounding strip), the opening of new paths, the improvement of existing paths and the opening of cable trenches, promoting an artificialisation of the occupation of the territory. Table 9.26 summarises the foreseeable allocations in the construction phase in terms of land occupation.

Table 9.26

Allocations of land occupation

Land occupation - Construction phase	Study area	Total infrastructure		Wind turbines (Foundation + Platform)		Access to be built (with cable trench)		Access to benefit (with cable trench)		Substation	
	(ha)	(ha)	%	(ha)	%	(ha)	%	(ha)	%	(ha)	%
Infrastructure/Study area relation	**855.12**	**17.65**	**2.1%**	**5.24**	**0.6%**	**7.31**	**0.9%**	**2.86**	**0.3%**	**2.25**	**0.3%**
Artificialised areas	**10.42**	**1.22**	**11.7%**	**0.01**	**0.1%**	**0.15**	**1.5%**	**1.05**	**10.1%**	**-**	**-**
Social areas	2.51	-	-	-	-	-	-	-	-	-	-
Paths	7.91	1.22	15.4%	0.01	0.1%	0.15	1.9%	1.05	13.3%	-	-
Agricultural areas	**45.2**	**0.26**	**0.6%**	**-**	**-**	**0.14**	**0.3%**	**0.11**	**0.2%**	**-**	**-**
Farms	45.2	0.26	0.6%	-	-	0.14	0.3%	0.11	0.2%	-	-
Forest areas	**7.77**	**0.04**	**0.5%**	**-**	**-**	**-**	**-**	**0.04**	**0.5%**	**-**	**-**
Humid tropical and subtropical hardwood forests	7.77	0.04	0.5%	-	-	-	-	0.04	0.5%	-	-
Natural and semi-natural areas	**791.73**	**16.14**	**2.0%**	**5.23**	**0.7%**	**7.01**	**0.9%**	**1.65**	**0.2%**	**2.25**	**0.3%**
Tropical and subtropical grasses	52.05	1.79	3.4%	0.70	1.3%	1.10	2.1%	-	-	-	-
Water line	0.73	-	-	-	-	-	-	-	-	-	-
Woodlands of trees and/or shrubs	372.58	7.63	2.0%	2.09	0.6%	2.97	0.8%	0.32	0.1%	2.25	0.6%
Degraded woodlands of trees and/or shrubs	366.37	6.72	1.8%	2.44	0.7%	2.94	0.8%	1.33	0.4%	-	-

This change of occupation will have negative impacts on the landscape setting of the study area, these potential allocations are presented in the specific chapter of this descriptor (subchapter 9.14). Therefore, from the point of view of land occupation, this change has a negative impact through an artificialisation of the territory, even if it is insignificant of a small magnitude. This impact is local, direct, permanent and reversible when the farm is dismantled.

However, it should be noted that the main economic activities of the population of the study area are agriculture "farms" and grazing, occupation class "Degraded woodlands of trees and / or shrubs", which will have an impact during the construction phase of 0.6% and 1.8%, respectively, and as such, it is considered a negative impact, local, certain, temporary, reversible of reduced magnitude and significance, but minimisable (see Table 9.26). This impact is also analysed in sub-chapter 9.13.1.

The main activities that occur at this stage, and which by their nature are likely to cause changes in land occupation, are as follows:

Wind Production System - Implantation of the platforms and foundations for the wind turbines and opening/closing of trenches for underground cables connecting to the substation.

- These interventions will affect the study area as a result of the implantation of the platforms and foundations of the wind turbines and by the margin of surrounding space for the manoeuvre that the installation requires, that is, the movement of machinery and the construction processes will affect these areas. These alterations are considered to be minor and of reduced magnitude, minimisable by recovery/renaturalisation actions of the respective areas after the works have been completed.

- The project envisages the connection of the wind turbines to the substation. Thus, it is necessary to open trenches for the installation of electrical interconnection cables, these trenches will be filled and recovered at the end of the cable installation. However, and taking into account that these areas will be covered, the allocation is considered to be a negative impact, direct, of small magnitude and little significance, temporary, reversible and local in scope.

Construction and improvement of access roads with drainage system and cable network connecting to the substation.

- It will be necessary to build and improve the access roads to the wind turbines and the substation. These accesses will be served by a drainage system and will be accompanied by cable trenches between the wind turbines and the substation.

- The project envisages this connection by buried cables linking the wind turbines to the substation. Thus, it is necessary to open trenches for the installation of electrical interconnection cables. However, and taking into account that these areas will be covered, the impact is considered to be a direct negative impact, of small magnitude and little significance, temporary, reversible and local in scope.

- Regarding the Substation, the main impacts on land occupation and land use will be negative, local, certain, direct, irreversible, since they are definitive elements of the project during its useful life.

Moving earth and machinery and temporary storage of earth and materials

- The movement of machinery and earthmoving necessary for the works may cause damage to the land occupation, the worst case scenario being the unnecessary destruction of vegetation, which is not expected to be of great significance. Regarding the temporary deposit of materials, the resulting impact is also not expected to be significant as the most appropriate locations will be chosen. Thus, the impact resulting from these two actions, although negative, direct and immediate, will be of low magnitude, minor, temporary, reversible and local in scope.

The tables below summarise the impacts described above (see Tables 9.27 to 9.32).

Table 9.27

Artificialisation of the territory

Soil use			
Artificialisation of the territory			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles;	Negligible

Table 9.27 (Continued)

Artificialisation of the territory

Soil use			
Artificialisation of the territory			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Sensitivity	Medium	2. In order to avoid situations where the soil remains uncovered for long periods of time, the works should be properly planned, i.e. immediately after a stripping action the coating works should take place. These actions should be carried out successively in small sections, in order to avoid stripping large areas at once;	Medium
Classification of Significance	Reduced	3. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.	Negligible

Table 9.28

Change of soil structure (movement of machinery and construction processes)

Soil use			
Change of soil structure (movement of machinery and construction processes)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thereby facilitating the regeneration of soils and vegetation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.29

Change of soil structure (opening and closing of trenches)

<table>
<tr><th colspan="4">Soil use</th></tr>
<tr><td colspan="4">Change of soil structure (opening and closing of trenches)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles;
2. Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control flows in the areas of works, with a view to reducing their erosive capacity;

3. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.30

Change of the soil structure (opening and closing of trenches for interconnection cables during construction and upgrading of access roads)

Soil use			
Change of the soil structure (opening and closing of trenches for interconnection cables during construction and upgrading of access roads)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles; 2. Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control flows in the areas of works, with a view to reducing their erosive capacity; 3. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.31

Change of soil structure (Substation)

<table>
<tr><th colspan="4">Soil use</th></tr>
<tr><td colspan="4">Change of soil structure (Substation)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Irreversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles;
2. Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control flows in the areas of works, with a view to reducing their erosive capacity;
3. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.32

Change of soil structure (earth and machinery movement and temporary deposit of earth and materials)

Soil use			
Change of soil structure (earth and machinery movement and temporary deposit of earth and materials)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. The layers of vegetated earth or live earth resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles; 2. Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control flows in the areas of works, with a view to reducing their erosive capacity; 3. Controlled removal of all spoils from stripping, deforestation and clearing operations necessary for the implementation of the Project shall be ensured and may be used for soil fertilisation; 4. Proper decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils and vegetation.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

9.7.2 Operation phase

It should be noted that in this phase there will be a significant reduction of the area affected in the construction phase, which corresponds to the areas occupied by the construction site and the areas necessary for the manoeuvre of the wind turbine assembly machines and the strips of land along which the trenches were opened for the installation of the cables connecting the wind turbines of the Namaacha Power Plant. In these areas, recovered with the vegetated land stripped during the construction phase, some of the pre-existing activities or uses may be resumed, thus reducing the magnitude and spatial scope of the allocation.

The foreseeable areas of allocation during the operation phase at the land occupation level correspond to a total area of occupation of 7.6 ha, which corresponds to approximately 43% of the area affected during the construction phase.

About 1 221 m2 of agricultural area (allocation of farms) and about 22 455 m2 of grazing area (allocation of degraded woodlands of trees and/or shrubs) will be affected in the operation phase, which indicates a reduction in allocation compared to the construction phase. In the case of occupation of the class "farms" there will be an allocation of 0.2 %, while in the area of occupation of the class "Degraded woodlands of trees and / or shrubs" the allocation will be 0.6%. It is thus considered a negative, local, certain, permanent, reversible impact of reduced magnitude and significance, but minimisable.

In a normal operating situation, with the maintenance actions of the wind turbines, it is not expected that the occupation of the land will suffer negative impacts, since there is no need to intervene any new areas, nor to circulate or carry out any other type of operations outside the access roads, including the ring road that develops around the wind turbines.

Thus, in the operation phase, the negative impacts associated with permanent soil destruction, already quantified in the construction phase, remain, emphasising the fact that this situation does not influence current soil uses.

9.7.3 Decommissioning phase

In the decommissioning phase, the complete removal of all equipment and facilities of the Namaacha Power Plant will return the soils in the intervention area to their pre-existing natural characteristics, after the appropriate recovery actions.

The renaturalisation of the intervened areas will have a positive impact on the fixation and improvement of the vegetation cover, which would otherwise be at the mercy of erosive agents to a much greater extent. It is therefore expected that the recovered soils will regain their productive potential, albeit reduced, resulting in a positive impact that is likely to be minor and local in scope.

9.8 ECOLOGY

9.8.1 Construction Phase

9.8.1.1 Flora and Vegetation

The deforestation, forest clearance, excavation and earthworks planned for the areas where the platforms, foundations, cable trenches and access roads are located will lead to the destruction of the vegetation present in these areas. The construction site will also temporarily affect the vegetation.

The impact of vegetation destruction is characterised as negative, direct, certain and short-term. The magnitude of the impact is low because the areas to be affected are small, with the exception of the destruction of areas of acacia woodland for the construction of the substation, which constitutes an impact of moderate magnitude, and its significance is reduced. It should also be noted that the area of the platforms will be recovered after construction, so the impact on this area is only temporary.

Deforestation, afforestation, excavation and earthworks planned for the project areas will also lead to the destruction of flora specimens. The impact of the destruction of flora specimens is characterised as negative, direct, certain and short-term. The magnitude of the impact is reduced as the areas to be affected are small and of reduced significance.

Also, the movement of heavy machinery and vehicles during the construction of the associated farm could possibly result in the damage or death of tree species in the surrounding vegetation due to careless handling of machinery. This impact is considered to be negative, temporary, local, unlikely, immediate, direct, reversible, of reduced magnitude, minor and minimisable.

Earthmoving, excavation, moving of machinery and other vehicles will be responsible for the suspension of dust, production of combustion gases and other polluting substances. The above actions may also contribute to the deterioration of soil and water quality through the accidental spillage of potentially polluting or toxic substances.

The suspension of dust will consequently lead to its accumulation on the surface of the leaves of the plants present in the surroundings of the works. This accumulation affects the photosynthesis, respiration and transpiration rates of the plants and favours the entry into the leaf cells of phytotoxic gases, which may lead to plant disease or death (Farmer, 1993).

The increased presence of combustion gases and other pollutants in the air may cause plants in the vicinity of the site to suffer necrosis and changes in leaf colour, reduced growth rates and premature leaf drop (Sikora, 2004).

The increased presence of pollutants and deterioration of soil quality may result in indirect effects on plants in the Project vicinity, including changes in pH, changes and/or decrease in the microorganism community, increased risk of erosion, decreased growth rates and lower fertility (Mishra *et al.*, 2016). Also, deterioration of water quality may result in indirect effects on plants present in the Project surroundings, including overgrowth of some (nitrophilous) species, changes in pH and/or death of some species (Owa, 2014).

The impact of degradation of vegetation in the surroundings due to dust emission, deterioration of soil, air and water quality is characterised as negative, indirect, likely in the case of dust suspension and deterioration of air quality, unlikely in the case of deterioration of soil and water quality (since it could only happen in case of an accident), and medium term. The magnitude of the impact is reduced as well as its significance.

It should also be noted that another factor in vegetation degradation is fire and that the presence of machinery and increased movement in the project area could lead to an increased risk of fire, however it is considered that with good practice and appropriate safety measures being followed for the operation of equipment, this is an unlikely impact.

The increase in the number of vehicles and earthmoving in the project area may facilitate the dispersal of species that previously did not exist in the areas adjacent to the project or invasive species already present in the vicinity. Confirmation of the presence of invasive alien species of flora in the vicinity of the study area is potential for this impact to occur.

The impact of favouring invasive species is characterised as negative, indirect, uncertain and medium to long term. The magnitude of the impact is reduced as earth and vehicle movements will be restricted to the project area. This is an impact of limited significance.

The environmental restoration of the temporarily intervened areas has a positive impact on the flora and vegetation, allowing the vegetation in the intervened areas to be restored and recovered only temporarily. This is a positive, permanent, local, certain, long-term, direct, reversible, reduced magnitude and minor impact.

9.8.1.2 Fauna

The expected impacts on fauna from the implementation of this project will mostly result from activities causing habitat loss and increased disturbance.

The installation of the construction site, as well as the temporary deposit of land and materials, are actions that will lead to the temporary destruction of habitat for fauna. This is a negative impact, temporary, local, certain, immediate, direct, reversible, of reduced magnitude considering that the area to be affected is small, of little significance.

The removal of vegetation cover is foreseen in the areas where the wind turbine platform, cable trenches and access roads are to be placed. It is expected, however, that fauna species will find similar habitats in contiguous areas. As such it is considered that this is a negative impact, permanent, local, certain, immediate, direct, reversible, of reduced magnitude, minor and minimisable.

During the baseline characterisation work, no bird nesting sites were detected in the study area, however, it is possible that common species use the various biotopes of the study area to build their nests, such as the African harrier-hawk (*Polyboroides typus*), a species with conservation status of Least Concern, whose field observations may indicate breeding in the study area or nearby surroundings (e.g., in a tree, rocky outcrop), and small species, whose nests are more difficult to detect. All biotopes may also be utilised by several bird species for feeding, including birds of prey and other gliders, which may see their hunting areas reduced. The impact may be more significant for species with unfavourable conservation status.

The elimination of areas of acacia woodland, C*ombretum* sp. and mixed open and graminial woodland, with herbaceous vegetation up to 1 metre high, may affect more terrestrial species, which prefer to walk rather than fly, particularly the Secretarybird (*Sagittarius serpentarius*) (which may nest in the tops of small acacia trees) and the Southern ground hornbill (*Bucorvus leadbeateri*) (which nests in cavities in the ground), both of which have Vulnerable status.

In the case of the martial eagle (*Polemaetus bellicosus*) and the Tawny eagle (*Aquila rapax*), both with Vulnerable status and confirmed for the study area, and the vultures, with Critically Endangered and Endangered status and occasional probable occurrence, they may use the open areas to hunt and feed, as their preferred food is available (from wild to domestic animals, including carcasses), but these areas are not expected to constitute an important part of their territories, as their occurrence does not appear to be regular in the study area.

Since the study area and surrounding area offer other areas of similar habitat for potentially affected species, it is considered that the possible affectation of nesting and feeding areas resulting from the destruction of vegetation cover during the construction phase will have a negative nature, direct, local, certain, permanent, reversible, immediate, reduced magnitude, and may be minor for species without unfavourable conservation status, but significant to very significant for species whose populations are threatened.

If the works are carried out at night, noise and lights may also affect chiropteran activity in the area, and the movement of motor vehicles and machinery may result in some road kills. This will be a direct impact, of a negative nature, local influence, unlikely to occur, temporary in duration, irreversible, immediate and of a reduced magnitude and low significance.

The movement of machinery and heavy vehicles during the construction phase, as well as the deforestation works, will lead to disturbance, including noise and vibrations, resulting in an exclusion effect on fauna, especially birds and mammals, reducing faunal diversity. This effect will not be limited to the intervened area, but will extend to neighbouring areas. This impact is considered to be negative, temporary, local, probable, immediate, direct, reversible, of reduced magnitude, minor and minimisable.

Increased levels of disturbance will also result in the degradation of habitats present in the surroundings of the project area. This impact is considered to be negative, temporary, local, probable, immediate, indirect, reversible, of reduced magnitude, minor and minimisable.

The circulation of heavy machinery and vehicles will also lead to an increased risk of trampling, especially on less mobile species such as amphibians, reptiles and micromammals. This impact is considered to be negative, temporary, local, probable, immediate, direct, irreversible, of reduced magnitude, minor and minimisable by the establishment of speed limit measures.

The environmental restoration of the temporarily intervened areas has a positive impact on fauna, allowing the return of some fauna species to those areas that were only temporarily intervened, minimising the exclusion effect caused. This is a positive, permanent, local, certain, long-term, indirect, reversible, reduced magnitude and minor impact.

9.8.1.3 Ecosystem services

The loss of areas of some vegetation units implies the loss of ecosystem services, especially production services, the loss of areas of acacia and *Combretum* spp. woodland, *Combretum* sp. woodland and acacia woodland is related to the loss of game, wild food and natural medicines. The destruction of areas of acacia and *Combretum* spp. woodland and *Combretum* sp. woodland also constitutes a loss of timber. The impact of agricultural and grassland areas corresponds to losses of agricultural production and grazing for livestock.

In general, small areas of these vegetation units will be lost and therefore the magnitude of the impact is low, with the exception of the loss of acacia woodland due to the construction of the substation which represents an impact of moderate magnitude. This is still a negative, direct, certain, short-term impact and given the presence of areas of the same vegetation unit in the surrounding area and their rapid capacity for regeneration of low significance.

The loss of graminial area is also emphasised due to its importance in terms of support and cultural services. However, taking into account that only a small area of this vegetation unit will be affected, the magnitude of the impact is considered low, although it is negative, indirect and certain, its significance is low.

Two of the most relevant vegetation units for supporting and regulating services are the forest remnant and the water line, which will not be affected, or will be affected only marginally, as is the case for the forest remnant.

It is also worth mentioning the loss of acacia woodland and the importance of this vegetation unit in terms of cultural services, including landscape. In this case, although the area destroyed is small, the magnitude of the impact will be moderate considering that the traditional acacia woodland landscape will be replaced by structures visible in this typical landscape. This is a negative, local, direct, certain impact of moderate magnitude, medium sensitivity and moderate significance.

The tables below summarise the impacts described above (Table 9.33 to 9.36).

Table 9.33

Vegetation destruction

Ecology – Flora and vegetation			
Vegetation destruction			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats; 2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve the largest number of trees and shrubs; 3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 4. All tree and shrub species that do not affect the execution of the work should be safeguarded;	Insignificant
Sensitivity	High		High

Table 9.33 (Continued)

Vegetation destruction

Ecology – Flora and vegetation			
Vegetation destruction			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Moderate	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.34

Destruction of flora specimens

<table>
<tr><th colspan="4">Ecology – Flora and vegetation</th></tr>
<tr><td colspan="4">Destruction of flora specimens</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Short-term</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="2">1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats;
2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible;
3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);
4. All tree and shrub species that do not affect the execution of the work should be safeguarded;</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
</table>

Table 9.34 (Continued)

Destruction of flora specimens

Ecology – Flora and vegetation			
Destruction of flora specimens			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.35
Damage or death of tree species in the surrounding vegetation due to careless handling of machinery

<table>
<tr><th colspan="4">Ecology – Flora and vegetation</th></tr>
<tr><td colspan="4">Damage or death of tree species in surrounding vegetation</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Unlikely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="2">1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats;
2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible;
3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);
4. All tree and shrub species that do not affect the execution of the work should be safeguarded;</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
</table>

Table 9.35 (Continued)
Damage or death of tree species in the surrounding vegetation due to careless handling of machinery

Ecology – Flora and vegetation			
Damage or death of tree species in surrounding vegetation			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Unlikely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.36

Degradation of surrounding vegetation due to dust emissions, deterioration of soil, air and water quality

Ecology – Flora and vegetation			
	Degradation of vegetation in surroundings		
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Likely (dust suspension and deterioration of air quality); Unlikely (deterioration of soil and water quality)		
Duration	Medium-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats; 2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible; 3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 4. All tree and shrub species that do not affect the execution of the work should be safeguarded;	Insignificant
Sensitivity	Medium		Medium

Table 9.36 (Continued)

Degradation of surrounding vegetation due to dust emissions, deterioration of soil, air and water quality

Ecology – Flora and vegetation			
	Degradation of vegetation in surroundings		
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Likely (dust suspension and deterioration of air quality); Unlikely (deterioration of soil and water quality)		
Duration	Medium-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.37

Favouring invasive species

<table>
<tr><th colspan="4">Ecology – Flora and vegetation</th></tr>
<tr><td colspan="4">Favouring invasive species</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Indirect; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Unlikely</td></tr>
<tr><td>Duration</td><td colspan="3">Mediu-term; Long-term</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible;
2. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);
3. All tree and shrub species that do not affect the execution of the work should be safeguarded;
4. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds);
5. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats;
6. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.38

Environmental restoration of the intervened areas on a permanent basis

Ecology – Flora and vegetation			
Environmental restoration of temporary intervention areas			
Project Phase	Construction		
Nature of Impact	Direct; Positive		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Insignificant	1. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 2. Carry out landscape restoration as soon as possible after the end of operations on the areas concerned; 3. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats.	Insignificant
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.39

Temporary destruction of fauna habitat

Ecology – Fauna			
Temporary destruction of fauna habitat			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats; 2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible; 3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 4. All tree and shrub species that do not affect the execution of the work should be safeguarded;	Insignificant
Sensitivity	Medium		Medium

Table 9.39 (Continued)

Temporary destruction of fauna habitat

Ecology – Fauna			
Temporary destruction of fauna habitat			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.40

Removal of vegetation cover

Ecology – Fauna			
Removal of vegetation cover			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats; 2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible; 3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 4. All tree and shrub species that do not affect the execution of the work should be safeguarded;	Insignificant
Sensitivity	Medium		Medium

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Table 9.40 (Continued)

Removal of vegetation cover

Ecology – Fauna			
Removal of vegetation cover			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.41

Affected chiropter activity in the area (due to nocturnal activity)

Ecology – Fauna			
Affected chiropter activity in the area			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Unlikely		
Duration	Temporary		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Concentrate works in time, especially those that cause the greatest disruption; 2. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 3. If the use of explosives is necessary, pre-cutting techniques and the use of micro-retarders should be used, thus attenuating the intensity of the vibrations produced; 4. Plan the timing of the works to minimise impacts on the different species of species relevant to this area.	Insignificant
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.42

Decrease in faunal activity

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Decrease in faunal activity</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Concentrate works in time, especially those that cause the greatest disruption;
2. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);
3. If the use of explosives is necessary, pre-cutting techniques and the use of micro-retarders should be used, thus attenuating the intensity of the vibrations produced;
4. Plan the timing of the works to minimise impacts on the different species of species relevant to this area.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.43

Degradation of the habitats present in the surroundings of the project intervention area

Ecology – Fauna			
Degradation of the habitats present in the surroundings of the project intervention area			
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats; 2. Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve as many trees and shrubs as possible; 3. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness); 4. All tree and shrub species that do not affect the execution of the work should be safeguarded;	Insignificant
Sensitivity	Medium		Medium

Table 9.43 (Continued)

Degradation of the habitats present in the surroundings of the project intervention area

Ecologia – Fauna			
	Degradation of the habitats present in the surroundings of the project intervention area		
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	Reduced	5. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds); 6. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats; 7. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.	Negligible

Table 9.44

Trampling, especially on less mobile species such as amphibians, reptiles and micromammals

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Trampling, especially on less mobile species such as amphibians, reptiles and micromammals</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Irreversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Concentrate works in time, especially those that cause the most disruption;
2. Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);
3. If the use of explosives is necessary, pre-cutting techniques and the use of micro-retarders should be used, thus attenuating the intensity of the vibrations produced;
4. Plan the timing of the works to minimise impacts on the different wildlife species relevant to this area.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.45

Environmental restoration of temporarily intervened areas

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Environmental restoration of temporarily intervened areas</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Positive</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">Improvement measures
1. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds);
2. Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats.</td><td>Reduced</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Reduced</td></tr>
</table>

9.8.2 Operation phase

9.8.2.1 Flora and Vegetation

Few additional impacts on flora and vegetation are expected during the operation phase.

Vehicle movements in the car park may be responsible for the suspension of a small amount of dust, production of combustion gases and other polluting substances. This is an impact that has also been identified for the construction phase and whose expected effects are similar to those described for that phase, however the magnitude is expected to be even lower, so this is a very minor impact.

As identified in the construction phase, the presence of vehicles in the area of the park may act as a facilitator for the dispersal of invasive species. However, at this stage vehicle movements will be minor and as such this is a very minor impact.

9.8.2.2 Fauna

During the construction phase the most significant impacts are mortality and disturbance (crowding out effect) of birds and bats.

Bird mortality at a wind power plant is one of the main impacts arising from this type of project. The risk of bird collision with wind turbines is associated with complex interactions between several factors, such as species characteristics (morphology, sensory perception, phenology, behaviour and abundance), wind turbine location (landscape, flight patterns, food availability and weather conditions) and wind power plant characteristics (wind turbine type and configuration, lighting) (Marques *et al.*, 2014).

Ferrer *et al.* (2011) reports that there is no linear relationship between the frequency of birds observed and the mortality found in wind farms, but there are some species whose vulnerability is known, such as birds of prey that hunt at blade height, birds with poor manoeuvrability (e.g. vultures), migratory birds that are unaware of the location of wind turbines and species with fast and erratic flights. The location of wind turbines is crucial as a measure to minimise collision mortality, and several studies have shown that wind turbines located near slopes increase the risk of collision, as these are the areas where thermal currents are formed and used by larger birds to move and hunt.

However, at the level of wind power plant configuration, studies suggest that there are several factors, difficult to isolate, acting on collision risk: some studies show that in-line configuration is safer, suggesting that birds interpret the row of wind turbines as a barrier they should avoid (Smallwood & Thellander, 2004), however, other studies show that a perpendicular configuration of wind turbines to the most frequent flight paths may be responsible for a high collision risk (Hötker *et al.*, 2006). Smallwood & Thellander (2004) also report that single wind turbines, at the ends of rows, near clearances in those rows (which increase the permeability of the barrier to bird passage; Cárcamo et al., 2011) and at the edges of groups of wind turbines kill disproportionately more birds at a large wind farm (Altamont Pass) in the USA, but De Lucas et al. (2012) found no differences in Eurasian griffon vulture (*Gyps fulvus*) mortality in the position of wind turbines in a row at wind farms located on a major migration/dispersal route (Tarifa) in Spain.

As mentioned in the baseline situation, the study area is located in an important corridor for bird movements along the Montes Libombos mountain range in a north-south or south-north direction (WSP, 2019), which reveals a configuration of the wind turbines in a line perpendicular to the preferred flight paths, which may increase the risk of collision.

More than half of the 20 most vulnerable species to wind energy impacts in South Africa (Ralston Paton *et al.*, 2017) (Table 9.46) may occur in the study area, one of which is confirmed - the martial eagle (Vulnerable status), whose mortality has already been recorded on two occasions at the same wind farm (Jeffreys Bay), which seems to be related to the absence of exclusion effect of these areas, i.e., the species continued to use and nest successfully after the installation of wind turbines, with several movements close to these infrastructures (Taylor *et al.*, 2015). The collision risk of this species with the wind turbines in the study area should be considered high, as it was observed hunting in acacia woodland in the far east, close to wind turbines T14 and T15.

Table 9.46

"Top 20" of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (adapted from Ralston Paton et al., 2017; Pfeiffer & Ralston Paton, 2018), as well as the type of occurrence in the study area

Common Name	Scientific Name	Confirmed Mortality	Occurrence in the study area
Cape Vulture	*Gyps coprotheres*	Yes	Likely
Bearded vulture	*Gypaetus barbatus*	NA	-
Verreaux's eagle	*Aquila verreauxii*	5	-
Martial eagle	*Polemaetus bellicosus*	2	Confirmed
Wattled crane	*Bugeranus carunculatus*	NA	-
Black harrier	*Circus maurus*	5	-
Great white pelican	*Pelecanus onocrotalus*	0	Less likely
Southern bald ibis	*Geronticus calvus*	NA	-
Yellow-billed stork	*Mycteria ibis*	NA	Likely
Black stork	*Ciconia nigra*	NA	Less likely
Blue crane	*Anthropoides paradiseus*	3	-
White-headed vulture	*Aegypius occipitalis*	NA	Likely
Secretarybird	*Sagittarius serpentarius*	0	Likely
Ludwig's bustard	*Neotis ludwigii*	NA	-
Grey crowned crane	*Balearica regulorum*	NA	Less likely
Taita falcon	*Falco fasciinucha*	NA	-
Southern ground hornbill	*Bucorvus leadbeateri*	NA	Likely

Table 9.46 (Continued)

"Top 20" of the most vulnerable species to wind energy impacts according to observed impacts in South Africa and species characteristics (adapted from Ralston Paton et al., 2017; Pfeiffer & Ralston Paton, 2018), as well as the type of occurrence in the study area

Common Name	Scientific Name	Confirmed Mortality	Occurrence in the study area
Cape cormorant	*Phalacrocorax capensis*	1	-
Lappet-faced vulture	*Aegypius tracheliotus*	NA	Likely
Pink-backed pelican	*Pelecanus rufescens*	NA	Less likely

The Cape Vulture (*Gyps coprotheres*) (Endangered status) is considered the most vulnerable species to the impacts of wind farms in South Africa (Ralston Paton *et al.*, 2017), and mortality has already been recorded (Pfeiffer & Ralston Paton, 2018). This scavenger species occurs on five wind farms in South Africa, and it is noteworthy that livestock carcass management plans are underway on some of them to limit food availability and decrease collision risk (Ralston Paton *et al.*, 2017). The nearest Cape Vulture breeding colony to the study area was located in 2002 approximately 40km to the south, close to the Goba border (Mozambique), and no more recent data is available. According to the guidelines for the assessment, monitoring and mitigation of wind energy impacts on the Cape Vulture population in South Africa (Pfeiffer & Ralston Paton, 2018) and recent studies on the size of conservation and feeding areas around nesting colonies (Venter *et al.* 2019), the study area should be considered as a high sensitivity area for the species, as it is located within 50 km of the Goba colony (consisting of 6 pairs in 2002).

There is no known evidence of wind farm mortality of the other vulture species potentially present in the study area, including the white-headed vulture (*Aegypius occipitalis*) (Critically Endangered status) and the Lappet-faced vulture (*Aegypius tracheliotus*) (Endangered status) also listed as most vulnerable to wind farm impacts in Africa, however, their vulnerability to collision with wind turbines is recognised, notably of the griffon vulture in Europe (e.g., de Lucas *et al.* 2008; Barrios & Rodriguez 2004; de Lucas *et al.*, 2012). In one of the wind farms studied, about 54% of the flight time of these birds was at the height of the wind turbine blades (Ralston Paton *et al.*, 2017). For threatened species with high longevity such as vultures, Carrete *et al.* (2009) and Kuijken (2009) have shown that low rates of additional mortality (due to very low levels of spatial overlap) and very small reductions in the survival rate of territorial and non-territorial individuals associated with wind farms can have significant impacts on their population viability.

According to the Multi-Species Action Plan for the Conservation of Euro-African Vultures (Botha *et al*., 2017), the development of wind energy projects is one of the threats to vulture conservation in Africa, as the potential expansion areas of these projects are coincident with the distribution areas of these species (Habitat INFO, 2019; Buij *et al*., in prep). Thus, although vultures have not been recorded in the study area and there is no evidence of the area being frequently utilised by these species, the risk of collision cannot be neglected.

With regard to the other species listed as vulnerable to the impacts of these infrastructures, there is no evidence of collision with wind turbines and their occurrence is not confirmed in the study area, but the risk cannot be neglected either, namely for species belonging to the orders Accipitriformes (such as the secretary), Bucerotiformes (such as the Southern ground hornbill) and Ciconiiformes (such as storks), which have characteristics that enhance their vulnerability to collision (Thaxter *et al.,* 2017).

In addition, the Bateleur (*Terathopius ecaudatus*) (Near Threatened status) and the Tawny eagle (Vulnerable status), both confirmed to be present in the study area, as well as the white-backed vulture (*Gyps africanus*), the crowned eagle (*Stephanoaetus coronatus*) (Near Threatened status), lesser flamingo (*Phoeniconaias minor*) (Near Threatened status), complete the "Top 30" of species most vulnerable to wind energy impacts according to observed impacts in South Africa and species characteristics (Ralston Paton *et al*., 2017).

Thus, it is considered that collision mortality with wind turbines of bird species with unfavourable conservation status in the study area will be a negative, direct impact with the potential to be transboundary if it affects populations of Critically Endangered species (such as vultures), unlikely for species that do not regularly occur in the study area but likely for Bateleur, martial eagles and Tawny eagles that already use the project area, permanent, irreversible, immediate, moderate to high magnitude, and significant to very significant for Critically Endangered species. However, for more common, non-status species, but including species with higher vulnerability to collision (such as swallows and Common Kestrel), this impact is negative, direct, local, probable, permanent, irreversible, immediate, low magnitude and negligible.

Accessibility to the park area for maintenance purposes may lead to situations of mortality due to trampling (e. g. of individuals of species with reduced mobility), however it is not expected that these situations will be common, as circulation will be restricted to maintenance vehicles. This impact is characterised as being negative, unlikely, temporary, local, immediate, irreversible, of low magnitude, minor and minimisable.

In the case of bats, mortality is caused by collision with wind turbines or due to internal injuries caused by sudden decompression (barotrauma) (Amorim, 2009; Amorim *et al.*, 2012; Arnett *et al.*, 2013a; Baerwald *et al.*, 2008; Eurobats, 2013; Jones *et al.*, 2009; Rodrigues *et al.*, 2015; Rydell *et al.*, 2010a; Rydell *et al.*, 2012).

At this stage mortality is the main impact (Arnett *et al.*, 2013a; Rodrigues *et al.*, 2015; Rydell *et al.*, 2012). Although the exact factors that increase the risk of mortality of chiroptera in wind turbines are not yet known, the following hypotheses are put forward:

- The concentration of insects near wind turbines, due to the creation of linear corridors in forested areas, thermal inversion after storms, the presence of low clouds and the attraction effect caused by the colour of the wind turbines themselves (Ahlén, 2003; Long *et al.*, 2010b; Rydell *et al.*, 2010b; Rydell *et al.*,2016);

- Confusion between tall trees and wind turbines, leading to the latter being used as a resting area, as shelter or even as a mating area (Ahlén, 2003; Cryan, 2008);

- Acoustic disorientation, due to the poor quality of the echoes reflected by the wind turbine blades, or the sounds emitted by them (Ahlén, 2003; Kunz *et. al.*, 2007; Long *et al.*, 2009; Long *et al.*, 2010a; Long *et al.*,2010b);

- The electromagnetic disturbance caused by wind turbines (Kunz *et al.*, 2007);

- The possibility that migrating individuals reduce the rate at which they emit ultrasound, so they may not detect the blades or even the wind turbines (Ahlén, 2003);

- The high speeds reached at the tip of the blades, which make it difficult or even impossible for chiropters to detect them (Ahlén, 2003; Kunz *et al.*, 2007; Rydell *et al.*, 2010a; Rydell *et al.*, 2017).

Mortality will have a direct negative impact, predominantly local in influence, certain in occurrence, permanent in duration, irreversible, immediate, low in magnitude but potentially moderate, and can therefore be categorised overall as not very significant.

Another of the most common impacts of wind farms on the bird and chiropteran community is disturbance of species, associated not only with the operation of wind turbines, but also with the movement of vehicles and people in these currently undisturbed areas, which increases human presence and noise, and can manifest itself in different ways, It can result in changes in patterns of use of the area (including adaptation or removal from the area due to exclusion effects), changes in behaviour, changes in community composition, both in abundance and richness, and changes in breeding patterns and success, particularly for birds (Drewitt & Langston, 2006; Madders & Whitfield, 2006; Marques *et al.*, 2018; Pearce-Higgins *et al.*, 2009).

Disturbance caused by the operation of wind turbines may constitute a barrier to their natural movements between feeding, breeding and resting areas and may cause birds to move to less suitable biotopes, which may reduce their ability to survive and reproduce. On the other hand, if birds continue to utilise the more disturbed area due to possible habituation to the presence of the infrastructure, their hunting success may be compromised and the risk of collision with wind turbine blades increases. Both effects are also an indirect form of habitat loss (Madders & Whitfield, 2006).

For birds that are more vulnerable to collision with wind turbines, distancing and exclusion from wind turbine areas can also be considered a positive impact as it can decrease the risk of collision.

Human presence associated with the movement of vehicles and people in the study area may increase due to the opening of access roads that were previously unavailable, consequently increasing human disturbance.

There is little information on the species potentially affected by this impact, but it is expected that those species most sensitive to human presence and crowding out will be the most affected. In the case of the species inventoried for the study area, it is noteworthy that the sea eagle (Vulnerable status) is particularly discrete and tends to avoid contact with humans, but appears not to be susceptible to the exclusion effect potentially caused by wind turbines (Taylor *et al.*, 2015).

Thus, it is considered that the disturbance of the bird community in the area of the development under study, with regard to bird species with unfavourable conservation status, will be a negative impact, permanent, local, unlikely for species that do not have regular occurrence in the study area but likely for Bateleur, martial eagle and Tawny eagle that already use the project area, permanent, reversible, immediate to long term, low magnitude (as the study area does not appear to be of high importance for these species and there are other similar biotopes around), and of minor significance. For the more common species without status, this impact is negative, direct, local, certain, permanent, reversible, immediate, low magnitude and of minor significance.

During the operation of a Wind Power Plant, changes in chiropteran activity may also occur due to the presence of wind turbines or habitat changes, especially when these occur in forested areas (Rodrigues *et al.,* 2015; Rydell *et al.*, 2012). The response of chiropters to these disturbance factors is not always negative.

In reality there are cases where activity has increased near the wind turbines and along deforested corridors (Bach 2002 in Bach & Rahmel, 2004), and others where activity has peaked near the wind turbines (Amorim *et al*., 2012; Brinkmann *et al.,* 2011).

Taking these factors into account, it can be considered that the change in chiropteran activity derived from habitat changes and the presence of wind turbines, is a negative, direct impact, of local influence, unlikely occurrence, permanent duration, reversible in the long term, immediate of moderate magnitude, which results as not significant in global terms.

9.8.2.3 Ecosystem services

In the operation phase, the increase in access and consequently people in the study area could lead to overexploitation of some ecosystem services, with charcoal possibly being the most affected, as well as hunting and timber (both for firewood and construction). This will be a medium-term, indirect, negative impact of moderate magnitude, as new access facilitates the presence of more people throughout the study area, and of moderate significance.

The increase in vehicles and people in the study area could also lead to an increase in the degradation of ecosystem services, especially those provided by forests in a better state of conservation. This is an indirect, long-term negative impact of moderate magnitude, as the new accesses facilitate the presence of more people and vehicles throughout the study area, and of moderate significance.

The tables below summarise the impacts described above (Table 9.47 to 9.52).

Table 9.47

Mortality of bird species with unfavourable conservation status due to collision with wind turbines in the study area

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Mortality of bird species with unfavourable conservation status</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Irreversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats;
2. If there is considerable mortality of sensitive bat species, or very considerable mortality of other species, more direct mortality risk minimisation measures should be assessed, such as the use of acoustic deterrents to ward off chiropterans (Arnett et al., 2013b).</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.48
Mortality of bird species without unfavourable conservation status by collision with wind turbines in the study area

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Mortality of bird species without unfavourable conservation status</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Irreversible</td></tr>
<tr><th></th><th>Impacts with no Mitigation Measures</th><th>Mitigation Measures</th><th>Residual Impact</th></tr>
<tr><td>Magnitude</td><td>Insignificant</td><td rowspan="3">1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats;
2. If there is considerable mortality of sensitive bat species, or very considerable mortality of other species, more direct mortality risk minimisation measures should be assessed, such as the use of acoustic deterrents to ward off chiropterans (Arnett et al., 2013b).</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Negligible</td><td>Negligible</td></tr>
</table>

Table 9.49

Chiropteran mortality

Ecology – Fauna			
Chiropteran mortality			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats; 2. If there is considerable mortality of sensitive bat species, or very considerable mortality of other species, more direct mortality risk minimisation measures should be assessed, such as the use of acoustic deterrents to ward off chiropterans (Arnett *et al.*, 2013b).	Reduced
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Reduced

Table 9.50

Disturbance of the bird community in the area of the development under study, with regard to bird species with unfavourable conservation status

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Disturbance of the bird community in the area of the development under study (birds with status)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>High</td><td>High</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>Negligible</td></tr>
</table>

Table 9.51

Disturbance of the bird community in the area of the development under study, with regard to common bird species

Ecology – Fauna			
Disturbance of the bird community in the area of the development under study (common birds)			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Likely		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Insignificant	1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats.	Insignificant
Sensitivity	Medium		Medium
Classification of Significance	Negligible		Negligible

Table 9.52

Change in chiropter activity due to habitat changes and the presence of wind turbines

<table>
<tr><th colspan="4">Ecology – Fauna</th></tr>
<tr><td colspan="4">Change in chiropter activity due to habitat changes and the presence of wind turbines</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Unlikely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Moderate</td><td rowspan="3">1. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats;

2. If there is considerable mortality of sensitive bat species, or very considerable mortality of other species, more direct mortality risk minimisation measures should be assessed, such as the use of acoustic deterrents to ward off chiropterans (Arnett et al., 2013b).</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>Negligible</td></tr>
</table>

9.8.3 Decommissioning phase

The impacts of the decommissioning phase will be highly dependent on the final destination of the development.

If decommissioning consists of removing the infrastructure, the impacts will be of the same nature as during the construction phase. But if the choice is to abandon the development, environmental impacts will result from the abandoned structures and the degradation of the surrounding area, the magnitude of which will depend largely on the occupation of the surrounding area at the time.

The reconversion of the utilisation for other purposes may also be considered, but due to its location and characteristics, it is not foreseen, at the outset, an occupation with great utility, but it is a subject that should be studied in more detail in the EIA phase.

The above impacts will be assessed in more detail during the Environmental Impact Assessment phase, based on a better understanding of the characteristics of the Project and its location. In addition to these impacts, other impacts may arise during the Environmental Impact Assessment phase, which will be duly assessed.

9.9 AIR QUALITY

9.9.1 Construction phase

During the construction phase there will be negative impacts on air quality, both due to the construction process and the movement of machinery, and due to the increase in vehicle traffic required to transport materials and workers.

The impacts will be felt in the areas surrounding the construction site and work fronts and in the areas surrounding the routes for transporting materials and workers needed for the work and any leftover land to its final destination.

The land preparation process will be moderate, with emphasis on access (existing firebreaks to be improved) and the execution areas where the buildings will be installed.

The soil stripping phase will result in the emission of particles that, due to their coarse granulometry, will be deposited on the ground, at short distances from the site, so it is not expected that impacts of relevant significance will occur.

The temporary increase in vehicle traffic at the project site during this phase will also contribute to an increase in emissions of pollutants typical of this type of source (mainly NOx and CO) into the atmosphere. The construction phase will last approximately 15 months, and throughout the contract the circulation of vehicles will fluctuate, although it is expected that the first months, due to the transport of materials to the construction site, will coincide with the highest volume of traffic associated with the contract.

The greatest disturbances are expected mainly on the EN2, which is the main access to the work area, and later by a dirt road, will be the routes used for the transport of materials and equipment, whose displacement will imply some traffic conditioning, and in the villages next to this road, including the village of Namaacha, the impacts associated with exhaust emissions will be felt, although in a residual way. These impacts are, however, likely to be minimised.

It should, however, be noted that within the AID there are several dwellings, and it is these households that will suffer the greatest disturbance in relation to mainly particulate emissions (resulting from earthmoving and vehicle transport) as well as exhaust emissions.

The impact is considered to be negative, of medium magnitude, minor, local and regional in scope, certain, temporary (during the construction phase), reversible, immediate and direct.

According to the IFC EHS Guidelines, despite the minor impact on air quality during the construction phase, monitoring will be required before and during the construction phase. The Air Quality Monitoring Plan is described in the Environmental Management Plan (see Annex 5).

The table below summarises the impact described above (Table 9.53)

Table 9.53

Emission of greenhouse gases and particulates

Air quality			
Emission of greenhouse gases and particulates			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local & Regional		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Reduce the number of lorries needed by carefully planning construction material requirements; 2. Reduce vehicle speeds and in the case of lorries carrying powdery material, this should be covered; 3. Do not leave vehicles running or idling on site for longer than the minimum time necessary to complete the activities on site.	Negligible
Sensitivity	Low		Low
Classification of Significance	Reduced		Negligible

9.9.2 Operation phase

There are no significant negative impacts associated with the operation phase of the Project.

It is important to emphasise the indirect positive impacts that the Project, by its nature, will have on air quality. In Chapter 5, the importance of this Project in the environmental and energy policies advocated in Mozambique was highlighted, as well as in the fulfilment of international commitments, in particular those related to the limitation of Greenhouse Gas (GHG) emissions.

The following analysis consists of accounting for CO_2 emissions avoided over the project's useful life, compared to other energy production alternatives.

The Namaacha Power Plant will have an estimated annual production of 193 400 MWh/year. To produce the same amount of energy in a "conventional" way would require an annual consumption of coal of about 52 626 tonnes or 30 187 million cubic metres of natural gas.

By estimating emissions, it can be said that the park foreseen in the Project will contribute annually to the non-emission of about 65 350 tonnes of CO_2 into the atmosphere, when compared to the equivalent energy production using natural gas, or the non-emission of about 154 658 tonnes of CO_2, per year, considering that the fuel used would be coal.

Although indirect, the impact resulting from the present Project for the production of "clean" energy from a renewable source can be classified as positive, of moderate magnitude, significant, with influence on a national scale, certain, permanent (during the useful life of the Project), reversible, immediate.

The table below summarises the impact described above (Table 9.54).

Table 9.54

Reduction of greenhouse gas emissions

Air quality			
Reduction of greenhouse gas emissions			
Project Phase	Operation		
Nature of Impact	Indirect; Positive		
Scope	National		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Moderate	Not applicable	Moderate
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Moderate

9.9.3 Decommissioning phase

The decommissioning phase of the Projects, during the removal of infrastructure, will have impacts equivalent to those of the construction phase, i.e. localised, temporary and irreversible, ceasing upon completion of the works. After the removal of the infrastructure, the impacts will cease.

Should the decommissioning phase occur with the abandonment of the infrastructure, no impacts on air quality are expected.

9.10 WASTE MANAGEMENT

9.10.1 General considerations

Waste management is not exactly an environmental factor that will be impacted by the implementation of the Project, but it is a component that should be assessed as it has an influence on the various factors under analysis.

A good knowledge of the waste management at the site of a given project enables appropriate management measures to be defined that contribute significantly to minimising impacts. In addition, it is also important to be aware of the waste (type of waste and quantities) involved, as this is central to the choice of final destination according to local and regional availability.

This chapter has already identified the actions associated with the implementation of the Project that are likely to generate impacts. In the impact assessment that follows, only an analysis of the waste produced associated with the various activities expected in each phase is carried out, within the framework of the characterisation carried out in the chapter on the characterisation of the reference situation.

9.10.2 Construction phase

In the absence of a specific diploma for construction and demolition waste, its management must be carried out under the Regulation on the management of solid urban waste (where rubble is included) and under the Regulation on the Management of Hazardous Waste, when it comes to hazardous waste produced on site.

In the construction phase, waste-generating Project actions are related to land clearing and preparation activities, the necessary deforestation actions and the actual construction activities, consisting basically of construction waste, metal, electrical, cardboard and paper waste, plastics, urban solid equivalents and used oils, among others.

It is not possible to identify the exact type and quantity of waste to be generated during construction.

In qualitative terms, experience in works with a similar typology points to a typology of waste potentially produced at this stage, as presented below.

The waste that will potentially be generated could be hazardous and non-hazardous waste. Non-hazardous waste will be, for example: organic: (e.g. food waste; green waste from deforestation); recyclable (e.g. iron/metals; plastics; glass, paper and cardboard packaging); non-recyclable and undifferentiated (e.g. rubble; brick/concrete/stone waste; urban solid waste (comparable to urban) (toilets/offices).

In relation to hazardous waste, it may occur in the form of used oils and lubricants, fuel waste, batteries, accumulators and other equipment containing lead, mercury, cadmium or other heavy metals, paints and varnishes, adhesives, waste from pressure equipment (e.g. spray cans and aerosols), contaminated textiles, waste packaging of chemicals and detergents, among others.

Improper management of this waste could lead to contamination of soil, groundwater and surface water.

In addition to this waste, there will be material resulting from earthworks. The project's land balances indicate that excavation materials will be reused on site. Excavation and landfill volumes are expected as a result of the construction of the foundations and mounting platforms of the wind turbines, the paths to be benefited and built, the opening of cable trenches, and the construction of the control building / substation. The leftover land will be applied in the construction of the wind turbine mounting platforms and the land resulting from the excavation of the cable trenches will be used again for its covering, so the associated impacts will be minor, of moderate magnitude, local scope and minimisable.

Regarding the deforestation residues, it is assumed that the expected quantities are of reduced magnitude. Some of these residues are incorporated into vegetable soil, in order to be integrated into the areas to be rehabilitated after construction.

In the case of waste oils and solvents, resulting from likely maintenance of construction equipment and vehicles, as hazardous waste, if improperly disposed of, will also lead to significant negative impacts of medium magnitude. In the handling operations of these wastes, the occurrence of spillages and accidents should be taken into account. These risks of contamination are substantially reduced by taking appropriate measures (see Chapter 11).

In the event of oil or other hazardous waste spills on non-waterproofed sites, these soils must always be removed, resulting in a significant negative impact of varying magnitude, depending on the importance of the spill, local and regional, permanent, but minimisable.

The adoption of correct waste management techniques, such as proper transport and disposal of waste, in line with its hazard level (see Chapter 11), substantially reduces these impacts.

During the construction phase, urban solid waste and other similar waste will also be generated, mainly from the presence of workers on site. The impacts associated with the generation of this waste are minor, of small magnitude, local in scope, but temporary and minimisable, taking into account that they will be deposited in appropriate containers and will be collected with adequate periodicity.

At the end of the construction phase, and with the work completed, the construction site will be dismantled and all the waste and leftover materials that have been produced and stored will be removed. Here, the possibility of reusing them on another site or similar activity should be considered.

Overall, the negative impacts associated with the construction phase can be significant, of moderate to high magnitude and of local to regional scope, if the waste is not properly managed and is abandoned or deposited in places without technical conditions and unlicensed. It should be noted that the situation of urban solid waste management in Namaacha is poor, without adequate collection and disposal of waste, so the support structure at this level is deficient.

The contractor to whom the work is awarded will be responsible for managing the waste properly and in accordance with the legislation in force (Regulation on Urban Solid Waste Management, approved by Decree No. 94/2014 of 31 December and the Regulation on Hazardous Waste Management, approved by Decree No. 83/2014 of 31 December).

Waste shall be sent to appropriately licensed companies as described in subchapter 7.10.1 and Annex 5.

It should comply with the measures proposed in Chapter 11 and transposed into the Environmental Management Plan so that these impacts are substantially reduced.

The tables below summarise the impacts described above (Table 9.55 to 9.58).

Table 9.55

Waste from surplus land

Waste management			
Waste from surplus land			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Inerts resulting from the excavation operations should be deposited in the surroundings of the sites from which it was removed, to be used later in the backfilling operations.	Low
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.56

Production of construction and demolition waste

<table>
<tr><th colspan="4">Waste management</th></tr>
<tr><td colspan="4">Production of construction and demolition waste</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. The waste resulting from the various construction works (cardboard, plastic and metal packaging, frames, formwork, among others) must be temporarily stored in a container in the construction site area, for later transport to an authorised location;

2. The segregated waste must be collected daily from the work fronts and temporarily stored on site, properly conditioned and in places specifically prepared for this purpose;

3. The site for the temporary waste storage facility should be clearly defined and labelled for this purpose. Access to this site should be restricted. Waste should be segregated and stored separately according to its characteristics and final destination. The storage locations for the different types of waste must be identified. The storage of waste on site must be carried out under appropriate conditions, as established in the applicable legislation in force;

4. Select companies for the treatment and final destination of the different segregated waste that are included in the lists of units accredited for this purpose;

5. Provide the site with waste collection equipment in number, capacity and type, appropriate to the waste produced;

6. Remove and properly dispose of solid and liquid waste produced on site.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.57

Spillage of hazardous waste (e.g. oils and solvents) on permeable soils

Waste management			
Spillage of hazardous waste (e.g. oils and solvents) on permeable soils			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local & Regional		
Probability	Unlikely		
Duration	Permanent		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Moderate	1. All waste classified as hazardous, such as waste oils, lubricants, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate location. The construction/implementation of a retention basin should be considered in order to minimise the impact of any spills. Subsequently, they should be taken for appropriate treatment by a company licensed for this purpose;	Reduced
Sensitivity	Medium	2. The temporary storage of waste oils and fuels should be carried out in a waterproofed and covered place, with an accidental spillage retention basin, separating used hydraulic and motor oils for differentiated management. Containers should be clearly labelled on the outside as to the different types of oil;	Medium
Classification of Significance	Moderate	3. The rejection of any type of waste into water lines or soil should be prohibited. Hazardous waste must be managed individually, in accordance with the law.	Reduced

Table 9.58

Production of urban solid waste or equivalent

<table>
<tr><th colspan="4">Waste management</th></tr>
<tr><td colspan="4">Production of urban solid waste or equivalent</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Urban solid waste and similar waste must be collected daily from the work fronts and temporarily stored on site, properly conditioned and in places specifically prepared for this purpose;

2. The location of the temporary waste storage facility should be clearly defined and identified for this purpose. Urban solid waste should be segregated and stored separately according to its characteristics. The storage places for the different types of waste must be identified. The storage of waste at the construction site must be carried out under appropriate conditions, as established in the applicable legislation in force;

4. Select companies for the treatment and final destination of the different segregated waste that are included in the lists of units accredited for this purpose;

5. Provide the site with waste collection equipment in number, capacity and type, appropriate to the waste produced.</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

9.10.3 Operation phase

he operation phase of a project of this nature does not generate any type of waste in its regular activity. In the operation phase, the production of waste associated with the various infrastructure and equipment maintenance activities is expected.

The adoption of appropriate waste management practices in accordance with the proposed measures and the legislation in force will contribute to reducing the significance of the associated impacts. Therefore, the impacts identified are considered to be minor and minimisable.

The waste expected to be produced in the operation phase is packaging waste; absorbents, cleaning cloths, municipal solid waste and similar, mineral oils, engine, transmission and lubrication. The maintenance of the Wind Power Plant will also produce some used oils, namely resulting from the substation building, building where the foundations of the equipment support structures will be located). This waste must be sent to an entity duly authorised for this purpose. The incorrect management of this waste will result in significant negative impacts, of reduced magnitude, local and permanent.

With the adoption of sound waste management practices (see Chapter 11) these, although still negative, will be reduced in significance.

Hazardous waste associated with maintenance activities must be treated and sent to a duly licensed final destination by those responsible for its management.

Thus, the waste for which the Project operator is responsible, namely hazardous waste produced during the maintenance activities of the enterprise, must be stored in technically appropriate containers and locations and delivered to companies accredited by the entity responsible for the environment, for the transport and management of the waste in question.

In this context, given the principle of adopting correct waste management practices, i.e. that the waste will be sent to an appropriate final destination, and that its transport will be carried out by an authorised carrier, and that the respective final destinations will be licensed for this purpose, the associated impacts are minor, of small magnitude, local in scope and minimisable if the measures proposed in the chapter are adopted. The non-adoption of these practices may have significant negative impacts, although of reduced magnitude since the quantities of waste to be produced will be low.

Also in this case, the adoption of a Waste Management Plan framed in the Environmental Management Plan for the operation phase, aimed at maintenance activities, in the operation phase is fundamental for the control and minimisation of environmental impacts associated with the production of this type of waste.

The following tables summarise the impacts described above (Table 9.59 and 9.60).

Table 9.59

Waste generation (municipal or equivalent, construction and hazardous) due to poor management

<table>
<tr><td colspan="4">Waste management</td></tr>
<tr><td colspan="4">Waste generation (municipal or equivalent, construction and hazardous) due to poor management</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Moderate</td><td rowspan="3">1. The forwarding to a duly authorised final destination of the waste generated in these operations.</td><td>Reduced</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>Reduced</td></tr>
</table>

Table 9.60

Production of hazardous waste (impacts related to transport and treatment)

<table>
<tr><td colspan="4">Waste management</td></tr>
<tr><td colspan="4">Production of hazardous waste (impacts related to transport and treatment)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Likely</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Moderate</td><td rowspan="3">1. The forwarding to a duly authorised final destination of the waste generated in these operations.</td><td>Reduced</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>Reduced</td></tr>
</table>

9.10.4 Decommissioning phase

The decommissioning phase of the Projects, during the removal of the infrastructure, will entail impacts equivalent to those of the construction phase. Taking into account that some of the wind turbine materials are recyclable, these impacts will be reduced.

If the decommissioning phase occurs with the abandonment of the infrastructure, no waste generation is expected and therefore the impacts will be zero.

9.11 SOUND ENVIRONMENT

9.11.1 Construction phase

It is in the construction phase that temporary noisy activities occur, which are associated with the emission of sound levels due to the activities characteristic of these phases, highlighting the use of machinery, movement of lorries and excavation operations.

Due to the specific characteristics of the work fronts and the construction site, namely the existence of a large number of noise sources whose location in space and time is difficult to determine with rigour, it is usual to carry out only a generic quantitative approach to the associated sound levels, based on the legal statute regarding the noise emission of equipment for outdoor use.

Table 9.61 shows the distances corresponding to equivalent A-weighted continuous sound levels of 65 dB(A), 55 dB(A) and 45 dB(A) considering:

- Punctual sound sources;
- A homogeneous and quiescent propagating medium;
- The sound power limit values laid down in Annex V to Decree-Law 221/2006 of 8 November.

Depending on the number of equipment to be used - in total and of each type - and the obstacles to sound propagation, the values shown in Table 9.61 may increase or decrease significantly.

In any case, it is expected that at less than 10 metres from the construction site the equivalent continuous sound level, weighted A, of the Particular Noise, will be higher than 65 dB(A), since according to measurements carried out at about 10 metres away from construction sites and typical construction sites, and according to bibliographic data, values less than or equal to 75 dB (A) are usual, in general, for the equivalent continuous sound level, and occasional values of about 90 dB (A), when extremely noisy operations occur.

Table 9.61

Distances corresponding to L_{Aeq} of 65 dB(A), 55 dB(A) and 45 dB(A) (construction phase)

Type of equipment	P: actual installed power (kW); Pel: electrical power (kW); m: appliance mass (kg); L: cross-sectional thickness (cm)	Distance to source [m]		
		L_{Aeq} =65	L_{Aeq} =55	L_{Aeq} =45
Compactors (vibratory rollers, vibratory plates and vibratory crushers)	P≤8 8<P≤70 P>70	40 45 >46	126 141 >146	398 447 >462
Dozers, loaders and excavator-loaders, with continuous track	P≤55 P>55	32 >32	100 >102	316 >322
Dozers, loaders and excavator-loaders, wheeled; dumpers, graders, loader-type compactors, console stackers w/ combustion engine, mobile cranes, compactors (non-vibrating rollers), spreader-finishers, hydraulic pressure sources	P≤55 P>55	25 >26	79 >81	251 >255
Excavators, hoists, construction winches, motor hoes	P≤15 P>15	10 >10	32 >31	100 >99
Hand hammers, breakers and drills	m≤15 15<m≤30 m>30	35 ≤52 >65	112 ≤163 >205	355 ≤516 >649
Tower cranes	-	-	-	-
Welding and power generating sets	Pel≤2 2<Pel≤10 Pel>10	≤12 ≤13 >13	≤37 ≤41 >40	≤116 ≤130 >126
Compressors	P≤15 P>15	14 >15	45 >47	141 >147
Lawn mower, weed mower, hedge trimmer	L≤50 50<L≤70 70<L≤120 L>120	10 16 16 28	32 50 50 89	100 158 158 282

During the construction phase, it is expected that the traffic associated with the transport of equipment, materials and machinery assigned to the work will have some expression. In fact, due to the size of the project, it is expected that the transport of the various equipment of the Namaacha Power Plant will exceed 80 heavy vehicles per day, mainly during the first three months of the work. After the earthmoving works, opening of the cabins and concreting, it is foreseeable that the traffic of heavy vehicles will decrease and will be largely confined to the transport of the various components of the wind turbines. Still in terms of road traffic access to the site, in addition to the transport of materials and equipment, light vehicles are expected to access the site to transport workers and some machinery, and it is estimated that this will not exceed 30 vehicles per day, with a greater incidence at the beginning and end of the day. It should also be noted that at this stage of the process the exercise of estimating road traffic assigned to the construction of the Project is relatively imprecise since the equipment suppliers and contractors have not yet been defined, and this choice may condition the logistics associated with the transport of materials and equipment. The road traffic forecast described above allows us to conclude that there will be an increase in residual noise, which may generate an increase of approximately 3 to 4 dB(A) in the acoustic reference framework, with special incidence in the various receptors that have been identified along the access to the Project intervention area. This increase is also felt, although to a lesser extent, on the route that crosses the village of Namaacha (EN2 road). Thus, it is considered that the impact generated by the increase in road traffic assigned to the construction phase is assumed to be negative, significant and of moderate magnitude. Nevertheless, the significance of the impact assumes a variation over time, since periods of higher and lower traffic are expected.

In turn, in terms of the operation of the machinery assigned to the work and the various construction actions, depending on the number of pieces of equipment to be used - in total and of each type - and the obstacles to sound propagation, noise levels can increase or decrease significantly. Of the sensitive receptors identified, most are located at distances greater than 300 m from the nearest construction site. Considering the continuous operation of various equipment assigned to the various construction actions, and establishing that the particular noise resulting from the sum of these sources does not exceed 95dB in situ, assuming the absence of reflection and attenuation factors resulting from obstacles in the propagation medium, the noise near these receptors will assume sound pressure levels in the order of 35 dB(A), levels below the limits established by WHO. It should be noted that this analysis is limited to the daytime period, coinciding with the work schedules.

According to the criteria defined above, as a result of the construction actions carried out on the various work fronts, and assuming adequate impact management through the applicability of the mitigation measures set out in Chapter 11, negative, minor, low magnitude, direct, certain and temporary impacts are expected on most of the sensitive receptors identified.

The following tables summarise the impacts described above (tables 9.62 and 9.63).

Table 9.62

Noise generated by road traffic for transport of materials, equipment and workers

Ambient Noise			
Noise generated by road traffic for transport of materials, equipment and workers			
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Reduce the amount of lorry movements required by carefully planning construction material needs; 2. Do not leave vehicles running or idling on site for longer than the minimum time necessary to complete site activities	Reduced
Sensitivity	Low		Low
Classification of Significance	Moderate		Reduced

Table 9.63

Noise generated by the various construction activities on the different site fronts

Ambient Noise			
Noise generated by the various construction activities on the different site fronts			
Project Phase	Construction		
Nature of Impact	Indirect; Negative		
Scope	Local		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Noise and vibration awareness actions for all on-site personnel, including subcontractors as part of the general worksite induction.	High
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Reduced

9.11.2 Operation phase

9.11.2.1 Methodology

The prediction of sound levels resulting from the activities associated with the operation phase was carried out through sound modelling and noise map generation.

The noise map and sound level predictions were calculated considering the guidelines contained in the document "Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure, version 2" (WG-AEN, 2006).

The noise map and the predictions of sound levels were obtained through a calculation model where the calculation method for industrial noise was applied: NP 4361-2:2001, «*Acoustics - Attenuation of sound in its propagation in the open air. Part 2: General method of calculation*».

The Noise Map was obtained for the noise indicators L_d, L_e, L_n e L_{den} calculated at a height above ground of 1.5 metres. The prediction of the sound levels was obtained for the locations where the measurements were made at the measurement height, in order to be able to calculate the sound levels by performing the logarithmic sum of the residual noise and the particular noise.

For the creation of the digital terrain model, the base cartography included the terrain altimetry (contour lines) and in meteorological terms the percentages of average annual occurrence of meteorological conditions favourable to noise propagation were adopted.

The surrounding area of the Namaacha Power Plant is composed of areas where the soil is soft (forest and agricultural areas) and areas where the soil is hard (settlements). In the modelling, porous soil was considered throughout the surrounding area except for the settlements where hard soil was considered.

CadnaA (Computer Aided Noise Abatement) software from DataKustik GmbH was used for the modelling.

9.11.2.2 Results

The operating phase is characterised by the normal operation of the wind turbines installed at the Wind Power Plant. The project includes the construction of 15 wind turbines of 4.2 MW (rated power) with a height of 105 metres and the maximum sound power of the wind turbine is 104.9 dB(A).

For the modelling of the particular noise of the operation phase, it was considered that the wind turbines operate continuously during all periods, thus obtaining the most unfavourable conditions, in terms of noise generation, of the operation of the wind power plant. Figure 9.1 shows the particular noise map associated with the operation of the wind turbines.

Likewise, and since only measurements were carried out to characterise the reference acoustic framework in the daytime period (residual noise) and only at two points in the Project intervention area, a more conservative acoustic assessment resulting from the operation of the wind turbines is made below, assuming the following assumptions:

1) All identified receptors are considered to have the same residual noise for the daytime period recorded at measurement point 2, i.e. 40,7 dB(A);
2) All identified receivers are considered to have the same residual noise for the night time, and it is assumed that, in the absence of measurements during this reference period, they have sound pressure levels very close to those recorded for the 90th percentile at measurement point 2, i.e. 31.9 dB(A).

The ambient noise sound levels for the operational phase are presented in Table 9.64 and result from the logarithmic sum of the sound levels corresponding to the baseline situation (according to the assumptions listed above) and the sound levels corresponding to the particular noise (determined by modelling), for the sites assessed in the baseline situation.

As can be seen from the results obtained, the operation of wind turbines will, in most cases, contribute to an increase in sound levels at the identified receptors, with increases in residual noise of more than 3 dB(A) being recorded at many receptors, particularly at night, above the recommendations set out in the World Health Organisation's Guidelines for Community Noise (WHO) (1999).

Table 9.64

Expected sound levels for the operating phase of the Namaacha Power Plant

Sensitive receptor			Residual Noise (R.R.)		Particular Noise (R.P.)		Ambient Noise (R.A) R.A.=R.P. + R.R.1		Increase in Residual Noise	
			Daytime	Night Time	Daytime	Night Time	Daytime	Night Time	Daytime	Night Time
	Nearest WT	Dist. to nearest WT (m)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
R01	T3	314	40,7	31,9	38,3	38,3	42,7	39,2	2	7
R03	T3	440	40,7	31,9	36,1	36,1	42,0	37,5	1	6
R04	T3	538	40,7	31,9	34,8	34,8	41,7	36,6	1	5
R05	T3	821	40,7	31,9	30,7	30,7	41,1	34,4	0	2
R07	T6	709	40,7	31,9	33,0	33,0	41,4	35,5	1	4
R08	T6	548	40,7	31,9	34,8	34,8	41,7	36,6	1	5
R10	T6	612	40,7	31,9	33,3	33,3	41,4	35,7	1	4
R12	T6	665	40,7	31,9	32,6	32,6	41,3	35,3	1	3
R13	T6	902	40,7	31,9	29,8	29,8	41,0	34,0	0	2
R18	T2	368	40,7	31,9	37,0	37,0	42,2	38,2	2	6

Table 9.64 (Continued)

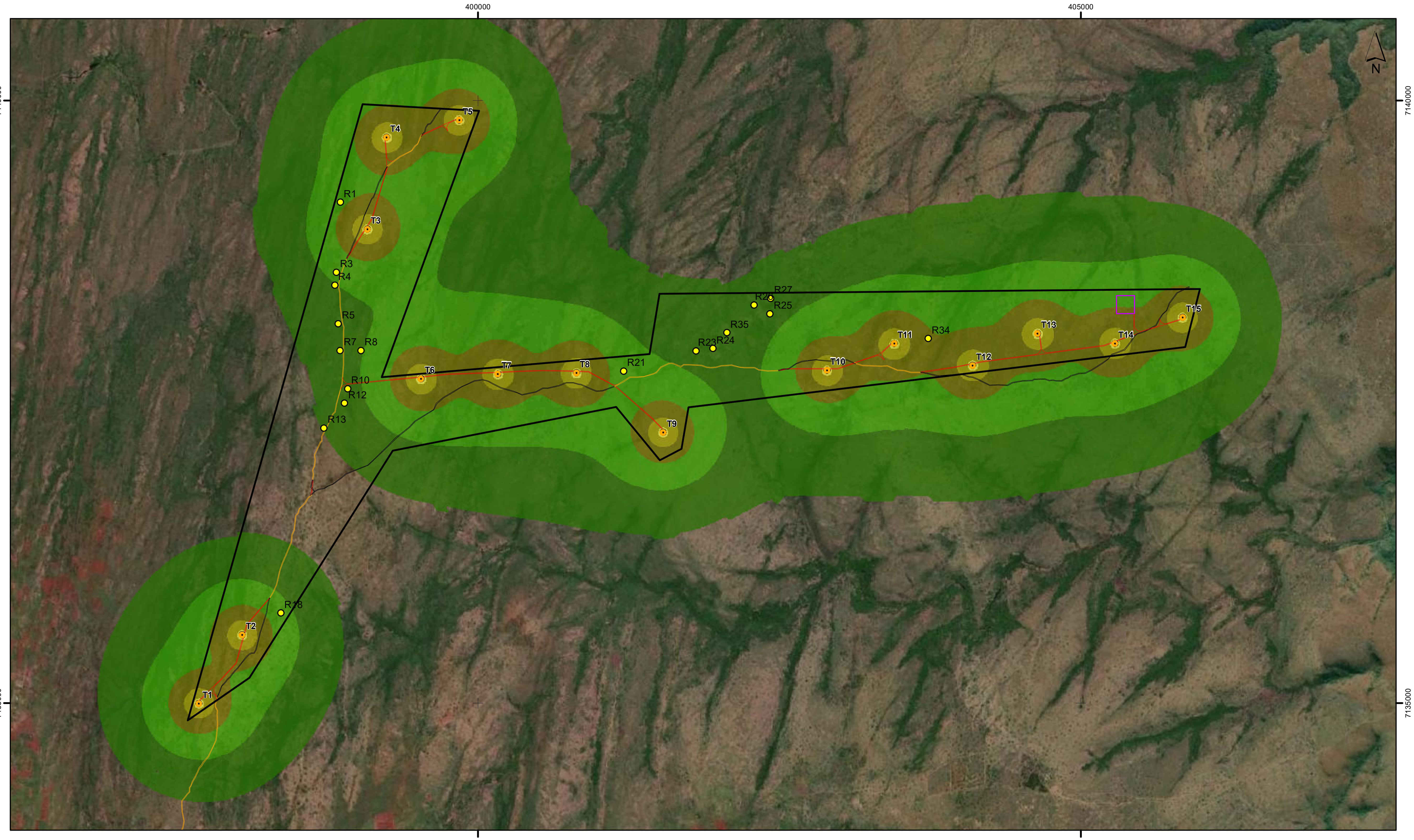
Expected sound levels for the operating phase of the Namaacha Power Plant

Sensitive receptor			Residual Noise (R.R.)		Particular Noise (R.P.)		Ambient Noise (R.A) R.A.=R.P. + R.R.1		Increase in Residual Noise	
			Daytime	Night Time	Daytime	Night Time	Daytime	Night Time	Daytime	Night Time
	Nearest WT	Dist. to nearest WT (m)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
R21	T8	393	40,7	31,9	36,9	36,9	42,2	38,1	2	6
R23	T9	727	40,7	31,9	32,4	32,4	41,3	35,2	1	3
R24	T9	808	40,7	31,9	31,6	31,6	41,2	34,8	1	3
R25	T10	663	40,7	31,9	33,5	33,5	41,5	35,8	1	4
R26	T10	810	40,7	31,9	32,1	32,1	41,3	35,0	1	3
R27	T10	757	40,7	31,9	32,5	32,5	41,3	35,2	1	3
R29	T1	480	40,7	31,9	34,9	34,9	41,7	36,7	1	5
R34	T11	288	40,7	31,9	40,8	40,8	43,8	41,3	3	9
R35	T10	844	40,7	31,9	32,4	32,4	41,3	35,2	1	3

(1) Logarithmic sum of sound levels.

Permanent housing

Church



Fonte: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Escala 1:30 000

0 500 1 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

LEGENDA

- Área de Estudo
- Aerogerador
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)
- Receptores Sensíveis

Ruído particular dB(A)

- 50<Ln<55
- 45<Ln<50
- 40<Ln<45
- 35<Ln<40
- <35

T01717_14_V0_Fig9_1

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 9.1 - Mapa de RuÍdo Particular

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This scenario is likely to have a very significant negative impact on sensitive receptors, where the reference acoustic level is altered and increased by more than 3 dB(A). Due to their proximity to the wind turbines to be implemented, receptors R1, R3, R4, R7, R8, R9, R10, R18, R21, R25, R29 and R34 deserve special attention.

The magnitude of the impact is assumed to be moderate because ambient noise levels in the presence of the particular noise will nevertheless remain, for most of the sensitive receptors identified, below the limits set by the WHO for the daytime and night-time period, 55 dB(A) and 45 dB(A) respectively.

In view of the results obtained, it is considered that this situation should be followed up with the implementation of a detailed Monitoring Plan to assess the impacts identified (see Annex 5).

The following table summarises the impacts described above (Table 9.65).

Table 9.65

Noise generated by wind turbine operation

Ambient Noise			
Noise generated by wind turbine operation			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	High		Insignificant
Sensitivity	High		Low

Table 9.65 (Continued)

Noise generated by wind turbine operation

Ambient Noise			
Noise generated by wind turbine operation			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Classification of Significance	High	1. Relocation of wind turbines and/or resettlement of sensitive receptors exposed to noise levels above WHO limits. 2. Compensation for individuals and families whose dwellings are exposed to noise levels above the limits imposed by the WHO.	Reduced

9.11.3 Decommissioning phase

The decommissioning phase of the Projects, during the removal of infrastructure, will have impacts equivalent to those of the construction phase, i.e. localised, temporary and irreversible, ceasing upon completion of the works. After the removal of the infrastructure, the impacts will cease.

Should the decommissioning phase occur with the abandonment of the infrastructure, no impacts on the sound environment are expected.

9.12 ARCHAEOLOGICAL, ARCHITECTURAL AND ETHNOGRAPHIC HERITAGE

A consultation was carried out with the communities affected by the Project to identify possible occurrences of cultural heritage, only one church was identified within the AID. This church will not be directly affected by this Project.

However during the construction phase the developer will maintain continuous access to this cultural site or in the last instance provide an alternative access route to ensure safe access for people attending the church.

No significant impacts on heritage are therefore expected

Although no archaeological site has been identified within the intervention area, the existence of underground archaeological elements cannot be ruled out, so the minimisation measures include the procedure to be adopted in case some of these elements are found on site.

9.13 DEMOGRAPHY, SETTLEMENT, SOCIETY, HEALTH AND ECONOMY

9.13.1 Construction phase

In a place with little economic activity and dynamics, as is the case of the study area, any new enterprise/investment generates expectations of dynamising the economy and other processes arising from it, such as attracting new businesses, population settlement, installation or provision of new services.

The value of the investment to be realised will inevitably have a positive impact on the local and regional economy, mainly because it will be made in a region with a real lack of investment.

One of the main economic impacts of this type of project lies in the dynamisation of economic activity on a local scale, as well as in the benefits it could bring to the population, resulting from the need to drive vehicles, the need for fuelling services, equipment, materials and goods, the supply of construction materials (cement, wood, etc.), food and drink, as well as the provision of services.

New jobs are expected to be created, with an estimated 250 direct labourers assigned to the project.

The increase in activity and employment generated during the construction phase, both directly and indirectly through the dynamisation of the local economy, translates into a positive, significant, small and temporary impact.

Regional economic activity will also benefit during the construction phase as a result of the dynamisation of the construction materials market. The mobilisation of construction companies and suppliers of materials and equipment are examples of the economic gains that the Project will bring. These impacts will be positive, significant, of moderate magnitude, certain, indirect, short-term and reversible at the regional level.

On the other hand, it is also important to identify the negative impacts expected to occur during the construction process of the Project. These impacts will be mainly related to the discomfort that the actions associated with the work may generate in the affected populations, such as the inhabitants and workers of the village of Namaacha and the residents of the houses in the AID and AII.

In general, there will be an increase in vehicle traffic, heavy and commercial vehicles, in the accesses to the works and on the roads, which will lead to an increase in pollutant emissions into the atmosphere, as well as noise, leading to a generalised change in the well-being of communities, not only in the intervention area but also in its surroundings, mainly affecting the population settlements and private dwellings arranged along the different access roads in the vicinity of the project area. This impact is considered to be negative, of low magnitude, insignificant, local, certain, temporary, reversible, immediate and direct.

Access to the study area of the future Namaacha Power Plant in the construction phase will be via the National Road 2 (EN2) to the village of Namaacha and then by a dirt road that will serve as access to the AID.

The operations mentioned above will lead to a natural increase in the circulation of machinery and vehicles assigned to the works which may deteriorate these roads, affecting their normal use by local populations. This impact is considered to be negative, of low magnitude, insignificant, local, certain, temporary (during the works phase), reversible, immediate and direct.

Another negative impact relates to the possible ability to access or utilise areas currently used by residents (mainly in the AID) for agropastoral and/or subsistence activities (agriculture and grazing).

During the construction phase, these areas will be affected by 0.6% in the case of fields and about 1.8% in the case of pasture areas. It is considered a local, certain, temporary, reversible negative impact of low magnitude and significance, but minimisable.

The foreseeable increase in the population (site workers) could generate an increase in economic activities in the surrounding region, which would be a positive, significant, certain, permanent impact of moderate magnitude, with direct effects on the regional economy and with repercussions on the national economy. There are, however, some risks associated with the entry of new workers into the region, related to the increase of phenomena such as prostitution, drugs and violence. These aspects may constitute significant negative impacts, but they can be minimised if the developer and the municipality monitor these social issues properly.

As previously mentioned these projects usually involve the introduction of 'outsiders' directly into communities for at least a short period (construction phase). For many rural areas this can considerably increase the local population and place stress on existing health services. In addition to proponents having to put in place appropriate systems to deal with health impacts and emergency management resulting from incidents, the capacity of local health services should also be considered. The increased influx of people requiring treatment for unexpected illnesses or accidents can put a strain on local healthcare services (such as the local hospital) within a region, particularly where there are shortages in the healthcare workforce.

The tables below summarise the impacts described above (Tables 9.66 to 9.72)

Table 9.66

Increased employment in the region

Socioeconomy			
Increased employment in the region			
Project Phase	Construction		
Nature of Impact	Direct and Indirect; Positive		
Scope	Local and Regional		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Hiring principles and procedures should prioritise the hiring of skilled local workers, contributing to local job and wealth creation; 2. Procurement policies should ensure the principle of gender equality. 3. Training should be provided for workers in order to promote their skills;	Moderate

Table 9.66 (Continued)

Increased employment in the region

Socioeconomy			
Increased employment in the region			
Project Phase	Construction		
Nature of Impact	Direct and Indirect; Positive		
Scope	Local and Regional		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Sensitivity	Medium	4. Where there are local expectations of employment that cannot be met by the Project, the limited availability of places should be made known to stakeholders through local authorities and community representatives; 5. For each position, the exact number of jobs available, the period applicable and the remuneration to be awarded for each type of work should be disclosed;	High
Classification of Significance	Moderate	6. Hiring requirements should be transparent, following pre-established and recognised criteria, and properly advertised before the start of the recruitment process and respected by the contractor so as not to limit application opportunities; 7. Local workers should be trained as much as possible to perform semi-skilled tasks in order to reduce the number of workers hired from outside for this purpose.	High

Table 9.67

Improvement of regional economic activity (building materials market)

Socioeconomy			
Improvement of regional economic activity (building materials market)			
Project Phase	Construction		
Nature of Impact	Indirect; Positive		
Scope	Regional		
Probability	Certain		
Duration	Short-term		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Favour, whenever possible, the procurement of services from local or regional companies, thus fostering permanent and indirect employment derived from the operation of the Wind Power Plant.	High
Sensitivity	Medium		Medium
Classification of Significance	Moderate		High

Table 9.68

Increased discomfort for the population of the region

Socioeconomy			
Increased discomfort for the population of the region			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Reduced	1. Notify people living in and visiting the areas most affected by the works of the timescale of the works, particularly to avoid constraints due to increased vehicle traffic.	Negligible

Table 9.68 (Continued)

Increased discomfort for the population of the region

<table>
<tr><th colspan="4">Socioeconomy</th></tr>
<tr><td colspan="4">Increased discomfort for the population of the region</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td rowspan="2">2. Create safety areas with limited access and properly signposted, in order to reduce the risk of accidents, by the approach of people to the work area;
3. Among local workers there should be a group responsible for communication with the community, which will be particularly important in cases of conflict.</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.69

Deterioration of roads

<table>
<tr><th colspan="4">Socioeconomy</th></tr>
<tr><td colspan="4">Deterioration of roads</td></tr>
<tr><td>Project Phase</td><td colspan="3">Construction</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Minimisation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td>1. Specific roads/routes and timetables should be defined for the movement of heavy goods vehicles involved in the construction of the Wind Power Plant in order to reduce pressure on other roads and congestion at peak traffic times;</td><td>Negligible</td></tr>
</table>

Table 9.69 (Continued)

Deterioration of roads

Socioeconomy			
Deterioration of roads			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Sensitivity	Medium	2. Where necessary, repair roads damaged during the construction phase.	Medium
Classification of Significance	Reduced		Negligible

Table 9.70

Difficulty in accessing existing agropastoral farms and occupation of areas currently used by residents for agropastoral farming

Socioeconomy			
Difficulty in accessing existing agropastoral farms and occupation of areas currently used by residents for agropastoral farming			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Minimisation Measures	Residual Impact
Magnitude	Reduced	1. Where necessary, implement the resettlement process of the farms agreed with the users; 2. Improvement of existing or alternative access roads in order to provide access to the farms.	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Reduced

Table 9.71

Increased economic activities in the surrounding region (accommodation and catering)

Socioeconomy			
Increased economic activities in the surrounding region (accommodation and catering)			
Project Phase	Construction		
Nature of Impact	Direct; Positive		
Scope	Regional and National		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Favour, whenever possible, the procurement of local or regional services, thus fostering the greatest added value for the local economy.	High
Sensitivity	Medium		Medium
Classification of Significance	Moderate		High

Table 9.72

Introduction of negative habits in the local population

Socioeconomy			
Introduction of negative habits in the local population			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Likely		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Among local workers there should be a group responsible for communication with the community, which will be particularly important in cases of conflict;	Reduced
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Reduced

9.13.2 Operation phase

Positive impacts:

In the operation phase, the positive impacts associated with the justification of the Project itself are expected.

The possibility of supplying electricity produced at the Namaacha Power Plant, with an annual production of 193 400 MWh/year, will constitute a significant positive impact, of moderate magnitude, certain (it will occur during the operation phase of the Plant), permanent, of national scope, taking into account that it will contribute to reduce the current external dependence regarding the supply of fossil fuels for electricity production.

This positive impact is in line with the objectives set by the Government of Mozambique under various international agreements for the reduction of greenhouse gases.

It is estimated that the Government of Mozambique will receive taxes associated with this Project for 25 years (period of operation of the Power Plant), which is a positive, significant and nationwide impact.

It should also be noted that the operating costs of the Namaacha Power Plant and its maintenance involve the purchase of various materials (such as raw materials and lubricants) and services, including the maintenance of roads. These costs will benefit the local economy, with positive effects on the population and economic activities, being a positive, minor, temporary, local impact.

The creation of jobs at this stage is also considered as a positive impact. The operation of a wind power plant requires a technical team to assist with monitoring and maintenance. For this purpose, jobs are created. With 20 jobs expected, this is considered a positive impact, small in magnitude, but in a region where there is little employment, significant.

The developer will support and finance activities for the social development of that region which will also translate into a significant positive impact.

Negative impacts:

It is understood that the main negative impacts are those arising from the possible inconvenience of the Namaacha Power Plant on inhabited and productive areas, namely in terms of noise caused by the operation of the Plant, visual intrusion and the intermittent overshadowing effect of the blades, which may have repercussions in terms of health.

Noise and landscape issues have been dealt with in their own chapters for these descriptors (noise environment and landscape).

With regard to overshadowing, studies were carried out, the details of which are presented in Annex 4.2, and are summarised as follows.

The overshadowing, commonly known as shadow flicker, occurs when the sun is positioned behind an operating wind turbine. As the shadows of the moving rotor blades fall on the same point, they create the intermittent shadow flicker effect.

This effect is potentially problematic when it occurs on "sensitive receptors" such as homes, schools, hospitals or other places usually occupied during daytime hours. In this regard, the International Finance Corporation (IFC) recommends following the guidelines for wind energy in the Environmental, Health, and Safety Guidelines (EHS Guidelines), the most recent edition of which is dated 7 August 2015.

It should be noted that within the AID several dwellings (with permanent and temporary occupation) were identified, some are isolated and others are more agglomerated, a church was also identified. These dwellings as well as the church are considered buildings of high socioeconomic vulnerability.

The maximum exposure times of sensitive receptors to the effect should not exceed 30 hours per year or 30 minutes per day on the worst day of the worst-case scenario (described below). In order to assess the impact of shadow flicker, sensitive receptors located within 1500m of wind turbines and their architectural features were inventoried.

The distance threshold at which a receptor can be affected is considered to be equal to 10x the rotor diameter. It is especially relevant to know the location, dimensions and orientation of the doors and windows of the buildings. These sensitive receptors, duly characterised, were loaded into a computer model together with the wind turbines, also according to the specific characteristics of each model, and also the Digital Terrain Model.

Another modelling parameter would be the climatic one (insolation, wind speed and quadrant, etc), resulting from statistical data, however and according to the already mentioned "EHS Guidelines", it is important to study the most unfavourable scenario. In this scenario, the computer model assumes that the sun is always out (from sunrise to sunset), that the wind allows the constant operation of the wind turbines and that their blades are always perpendicular to the sun's rays.

The model used was WindPRO from EMD International, which is a world leader in wind farm modelling. The modelling results in the sensitive receptor allocation tables and hour/year and minute/day allocation maps shown in Annex 4.1.

Nineteen sensitive receptors were identified (dwellings and a church), the description and location of which is shown in Annex 4.2. Of these, nine have exposure values above the maximum allowed: R7, R13, R18, R21, R23, R24, R27, R34 and R35. Three are affected but without exceeding maximum exposure times: R5, R25 and R26. The remaining seven are not affected at all: R1, R3, R4, R8, R10, R12 and R29. Figures 9.2 and 9.3 show the results of these simulations.

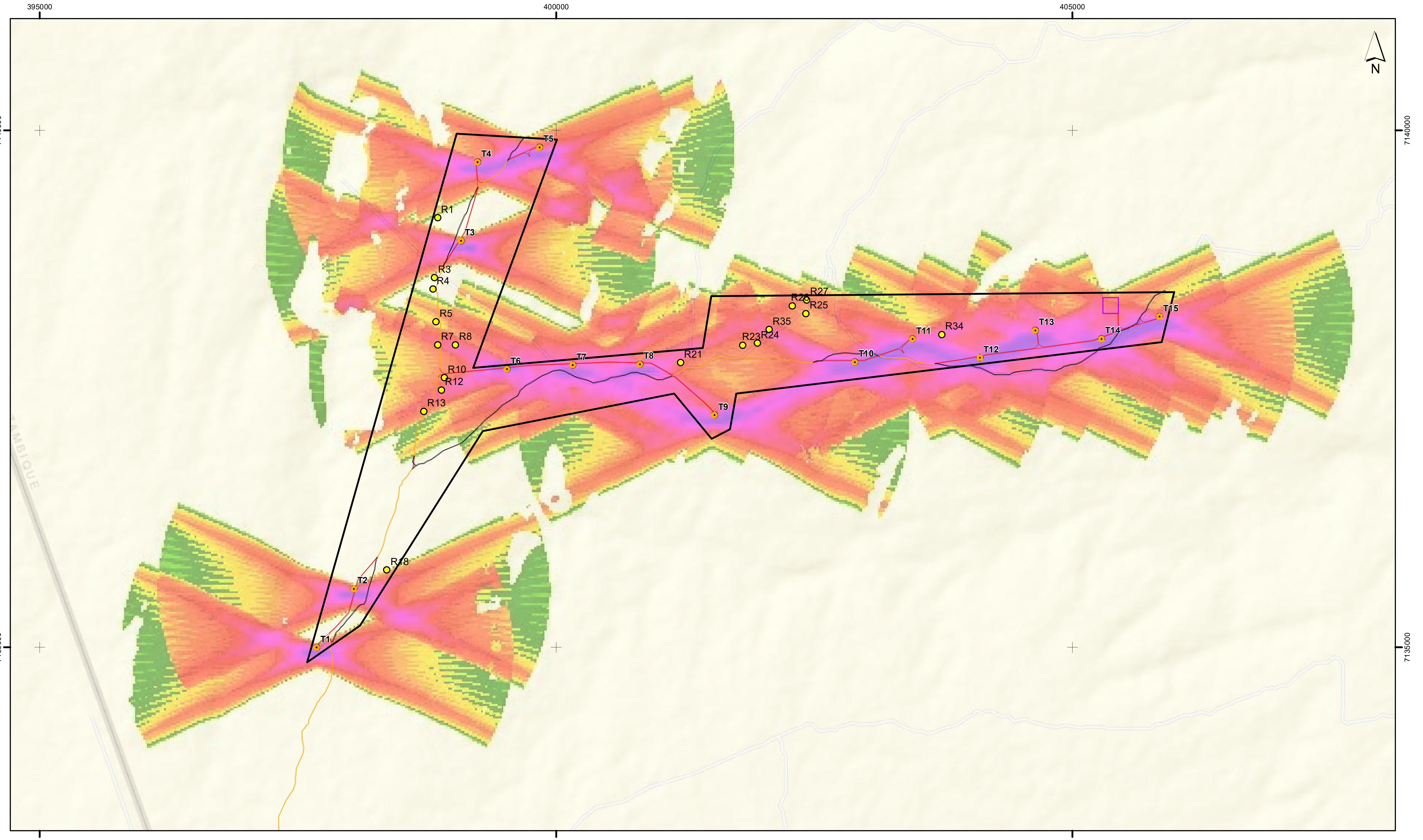
Of the buildings of high socio-economic vulnerability mentioned above, it should be noted that the houses closest to the wind turbines, in addition to the impact they suffer in terms of noise and the overshadowing caused by the rotation of the wind turbine blades, there is a risk of falling components during their operation, so there is a need to relocate the inhabitants of these houses. This impact is negative, direct, local, long-term, certain, reversible, of high magnitude and very significant. The process of resettlement / relocation of people / families is covered in the Environmental Management Plan and in the chapter of minimisation measures of this EIA.

The following tables summarise the impacts described above (Table 9.73 to 9.78)

Table 9.73

Reducing external energy dependence

Socioeconomy			
Reducing external energy dependence			
Project Phase	Operation		
Nature of Impact	Direct; Positive		
Scope	National		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	Not applicable	Moderate
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Moderate



Fonte: Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

LEGENDA

- Aerogerador
- Área de Estudo
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)
- Receptores Sensíveis

Shadow flicker (dias/ano)

- 1,0 - 30,0 Days
- 30,0 - 60,0 Days
- 60,0 - 100,0 Days
- 100,0 - 200,0 Days
- 200,0 - 366,0 Days

Escala 1:35 000

0 500 1 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

T01717_14_V0_Fig9_2

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Figura 9.2 - Áreas afetadas pelo efeito Shadow flicker (dias / ano)

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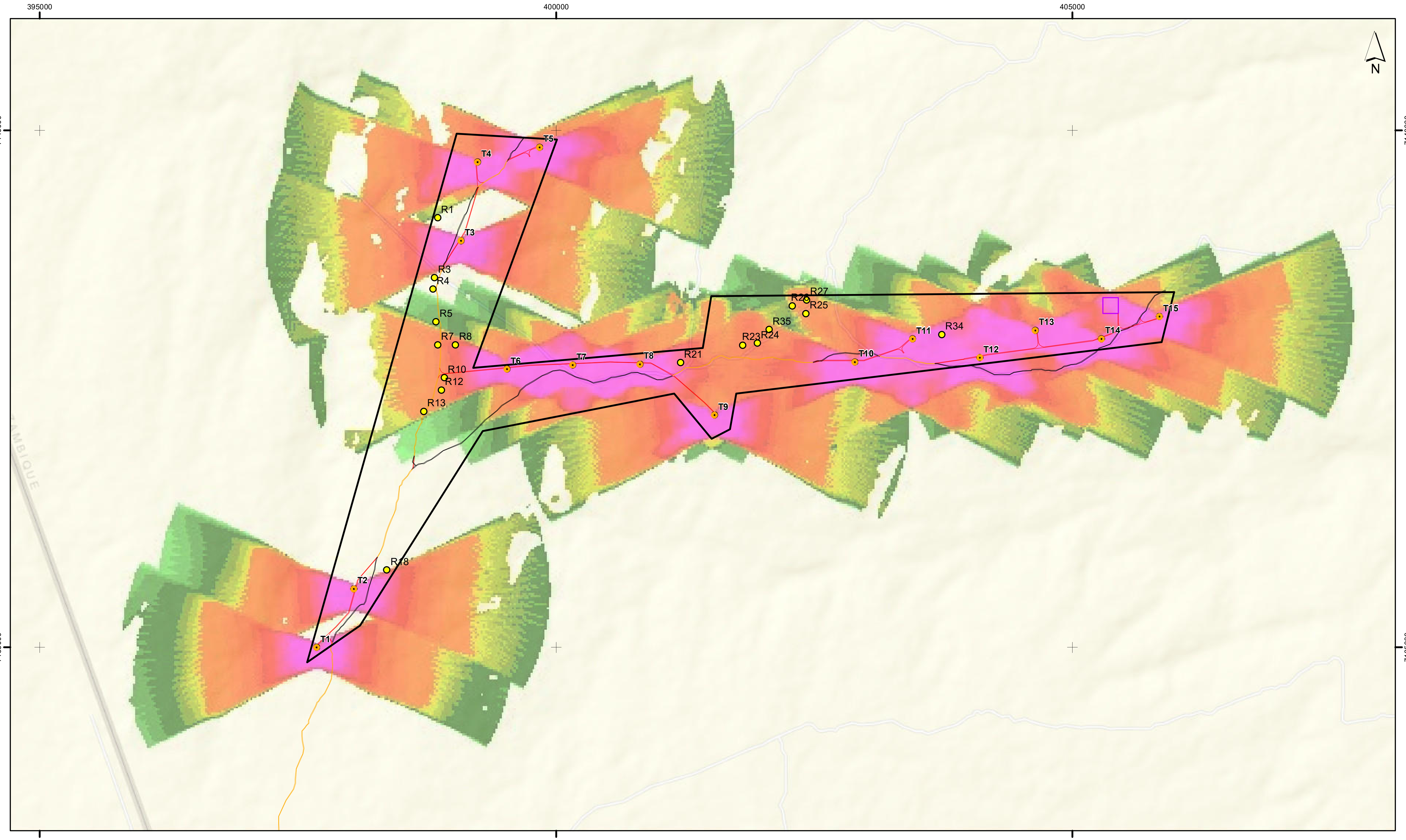

Fonte: Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

LEGENDA

- Aerogerador
- Área de Estudo
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)
- Receptores Sensíveis

Shadow flicker (minutos/dia)

- 0,1 - 15,0 Minutes
- 15,0 - 30,0 Minutes
- 30,0 - 60,0 Minutes
- 60,0 - 120,0 Minutes
- 120,0 - 1 440,0 Minutes

Escala 1:35 000

0 500 1 000 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

T01717_14_V0_Fig9_3

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 9.3 - Áreas afetadas pelo efeito Shadow flicker (minutos / dia)

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Table 9.74

Improvement of Mozambique's economy

Socioeconomy			
Improvement of Mozambique's economy			
Project Phase	Operation		
Nature of Impact	Direct; Positive		
Scope	National		
Probability	Certain		
Duration	Permanent		
Reversibility	Immediate		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Favour, whenever possible, the procurement of services from local or regional companies, thereby fostering permanent and indirect employment derived from the operation of the Wind Power Plant.	High
Sensitivity	Medium		Medium
Classification of Significance	Moderate		High

Table 9.75

Improvement of the local economy (building materials)

Socioeconomy			
Improvement of the local economy (building materials)			
Project Phase	Operation		
Nature of Impact	Direct; Positive		
Scope	Local		
Probability	Certain		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Favour, whenever possible, the procurement of services from local or regional companies, thereby fostering permanent and indirect employment derived from the operation of the Wind Power Plant.	High
Sensitivity	Medium		Medium
Classification of Significance	Moderate		Moderate

Table 9.76

Job creation

<table>
<tr><td colspan="4">Socioeconomy</td></tr>
<tr><td colspan="4">Job creation</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Positive</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Favour, whenever possible, the procurement of services (maintenance, supply of materials, supply of goods and services) from local or regional companies, thus fostering permanent and indirect employment derived from the operation of the Wind Power Plant.
2. Hiring principles and procedures should, as far as possible, prioritise the hiring of qualified local workers, contributing to local job and wealth creation;
3. Hiring policies should ensure the principle of gender equality;
4. Training should be provided for workers in order to promote their skills.</td><td>Moderate</td></tr>
<tr><td>Sensitivity</td><td>High</td><td>High</td></tr>
<tr><td>Classification of Significance</td><td>Moderate</td><td>High</td></tr>
</table>

Table 9.77

Social development

<table>
<tr><th colspan="4">Socioeconomy</th></tr>
<tr><td colspan="4">Social development</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Positive</td></tr>
<tr><td>Scope</td><td colspan="3">Local and Regional</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Temporary</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Involve local community representatives in the management of the support and funding that will be given to social development activities that will be implemented in co-ordination with the District and local government.</td><td>Moderate</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>High</td><td>High</td></tr>
</table>

Table 9.78

Affecting dwellings (nuisance through shadow effect and noise)

<table>
<tr><th colspan="4">Socioeconomy</th></tr>
<tr><td colspan="4">Affecting dwellings (nuisance)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Permanent</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>High</td><td rowspan="3">1. Rehousing of families or persons living in these houses;
2. Compensation thereof.</td><td>Insignificant</td></tr>
<tr><td>Sensitivity</td><td>High</td><td>Low</td></tr>
<tr><td>Classification of Significance</td><td>High</td><td>Insignificant</td></tr>
</table>

9.13.3 Decommissioning phase

In the decommissioning phase, if a new wind power plant is not built, the positive impacts generated during its operation will cease. In the event that the waste to be generated after the closure of the Namaacha Power Plant is not properly managed, the negative environmental impacts identified before its construction (baseline situation) will probably be repeated with a detrimental effect on the well-being of the population. In addition, the employment and economic activity generated by the operation activity (even if not significant) will disappear, resulting in a negative impact, not significant.

However, since in place of the Namaacha Power Plant, there may be a new quality infrastructure/space for community enjoyment, it is considered that this phase may also generate positive impacts.

9.14 LANDSCAPE

9.14.1 General considerations

In this chapter, the foreseeable impacts on the landscape resulting from the construction, operation and decommissioning phases of the Namaacha Power Plant are assessed, taking into account that its implementation will imply a possible alteration or destruction of elements that contribute to the existing landscape quality, as well as the introduction of elements foreign to the landscape. However, the project, despite causing changes in the landscape, these will be local in scope.

With the construction of the Power Plant, there will be changes in the landscape that, directly or indirectly, will result in impacts of different magnitude and significance.

The impacts felt depend both on the characteristics of the area to be intervened and on the type of interventions to be carried out, so analysing these factors together makes it possible to predict the impacts at landscape level. The impacts felt depend both on the characteristics of the area to be intervened (landscape quality, visual absorption and landscape sensitivity) and on the type of interventions to be carried out, so that only by analysing these factors together is it possible to predict the impacts at landscape level.

Thus, both at the structural level (changes in the elements that constitute the basic components of the landscape, causing disturbances or even sensitive changes in the landscape) and at the level of visual impact, direct impacts are expected in a first phase, by imposing foreign elements on the landscape and then indirectly, impacts caused by the destruction of constituent components of the landscape that today contribute to its harmony and visual quality.

To support the assessment of the Project's impacts on the landscape, Figure 9.4 was prepared, showing the visual basin of the Namaacha Power Plant (wind turbines, roads to be benefited and built and the Substation) in the landscape study area (surrounding area of 2 km), taking into account the fieldwork carried out, the Digital Terrain Model and the visibilities of the surroundings. The classification of the areas concerned in terms of Landscape Visual Quality (LVQ) and Landscape Visual Sensitivity was also used, as presented in Table 9.79.

Table 9.79 visualises the relationship between each element of the Project to be constructed and Visual Quality and Sensitivity. It is assumed that the impact will be more significant the higher the Quality and Visual Sensitivity of the affected areas.

Table 9.79

Identification of Landscape Visual Quality (LVQ) and Landscape Visual Sensitivity, by Project Component

Project Elements	LVQ	CAV	SVP
Wind turbine T1 (Platform and Foundations)	Medium	Reduced	Medium; Reduced
Wind turbine T2 (Platform and Foundations)	Medium	Medium; High	Medium; Reduced
Wind turbine T3 (Platform and Foundations)	Medium	Medium; High	Medium; Reduced
Wind turbine T4 (Platform and Foundations)	Medium	Reduced	Medium
Wind turbine T5 (Platform and Foundations)	High	Medium; High	Medium
Wind turbine T6 (Platform and Foundations)	High	Reduced; Medium	Medium; High
Wind turbine T7 (Platform and Foundations)	High	High	Medium
Wind turbine T8 (Platform and Foundations)	Medium	Reduced	Medium
Wind turbine T9 (Platform and Foundations)	Medium	Reduced	Medium
Wind turbine T10 (Platform and Foundations)	High	Medium; High	Medium
Wind turbine T11 (Platform and Foundations)	Medium	High	Reduced
Wind turbine T12 (Platform and Foundations)	Medium	Reduced; Medium	Medium
Wind turbine T13 (Platform and Foundations)	Medium	Reduced	Medium

Table 9.79 (Continued)
Identification of Landscape Visual Quality (LVQ) and Landscape Visual Sensitivity, by Project Component

Project Elements	LVQ	CAV	SVP
Wind turbine T14 (Platform and Foundations)	High	High	Medium
Wind turbine T15 (Platform and Foundations)	High	High	Medium
Existing paths to be upgraded and built with cable trenches	Reduced; Medium & High	Reduced; Medium; High	Medium
Substation	High	High	Medium

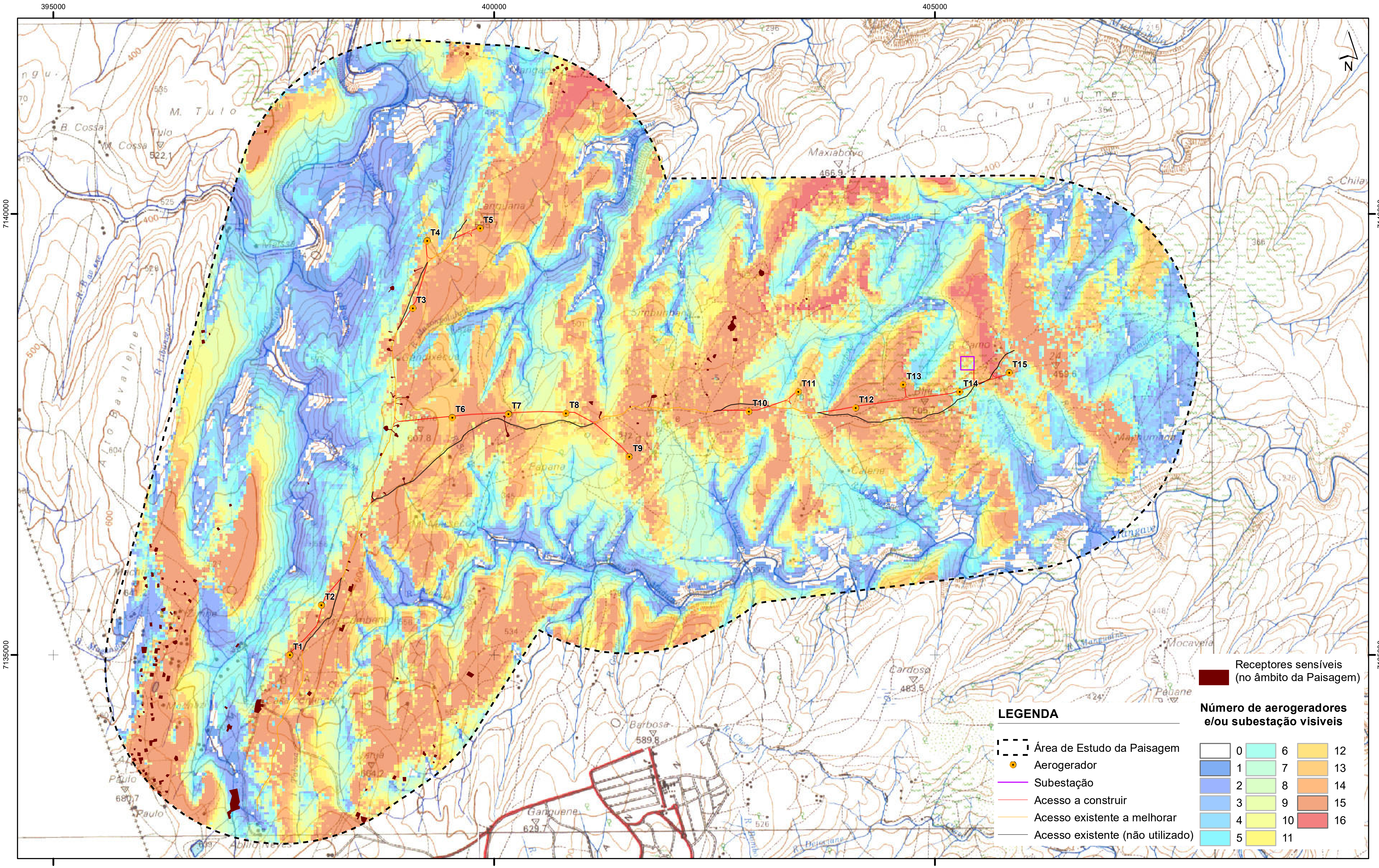
The impact analysis presented considers a detailed assessment of the consequences of the installation of the Project on the Landscape, identifying, on a case-by-case basis, the potential impacts that will arise from the actions associated with the implementation of the Project, in the construction and operation phases.

9.14.2 Construction phase

The disturbances of the construction phase are directly related to a visual intrusion in the landscape, with particular incidence on observers outside the site, resulting from a spatial and functional disorganisation of the landscape with disturbance in the visual manifestation of the territory, mainly due to actions of construction and improvement of the access road; execution of the foundations of the wind turbines and platforms necessary for their assembly; installation of the wind turbines; construction of the Substation; implantation of the construction site, and execution of the trenches for installation of the electrical cables.

The circulation of machinery and personnel assigned to the work will, in itself, constitute a factor of visual intrusion (causing disorganisation and disturbance of the space). The production and emission of dust in the air is also one of the negative aspects resulting from this activity, which will have effects on the landscape.

On the one hand, with the introduction of elements foreign to the landscape, namely heavy machinery, construction materials and construction site, a visual intrusion effect will be felt. On the other hand, with the actions related to the execution of deforestation, soil stripping and earthmoving, a disorganisation of the functionality of the landscape will be felt in the area surrounding the Power Station with disturbance in the visual manifestation of the territory. The impacts resulting from these disturbances are considered to be negative, insignificant given the size of the Park, temporary and reversible.



Fonte: Extrato da Carta Militar de Moçambique, escala 1/50.000, folhas n.º A1187, A1188 e A1189, DIrecção Nacional de Geografia e Cadastro

Escala 1:40 000

0 500 1 000 1 500 m

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

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Figura 9.4 - Bacia Visual do Projeto

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At this stage of construction, in terms of visual impacts, these will be felt around the working area, with a greater incidence on the assembly, as this will become very noticeable in the existing dwellings closest to the project and the settlement of Macuacua. This impact is considered to be negative, local, but of moderate significance. It will be of moderate magnitude. However, it is not considered that the "structure" of the landscape will be affected.

Thus, it is considered that the Power Plant under study generates some visual conflicts during the construction phase, but they are considered to be minor, since there will be no significant changes in the structuring components of the territory (soil, relief and geology) and, consequently, in the character of the Landscape, in particular that apprehended by possible observers located in the surroundings of the project.

It should also be noted that most of the impacts arising from this phase are temporary and minimisable. These disturbances can be mitigated through some preventive measures, avoiding the disturbance of unnecessary areas during the installation of the Wind Power Plant, contributing to a quick and effective recovery of the landscape after the construction phase.

The tables below summarise the impacts described above (see Tables 9.80 and 9.81).

Table 9.80

Change in structural elements of the landscape (machinery, materials and construction site)

Landscape			
Change in structural elements of the landscape (machinery, materials and construction site)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact

Landscape			
Magnitude	Reduced	1. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (other than for the installation of the wind turbines). This will prevent erosion and infestation by unwanted species (exotic and weeds);	Negligible
Change in structural elements of the landscape (machinery, materials and construction site)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Sensitivity	Medium	2. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report;	Medium
Classification of Significance	Reduced		Negligible

Table 9.81

Change in landscape elements (Macuacua settlement and scattered dwellings in the surroundings)

Landscape			
Change in landscape elements (Macuacua settlement and scattered dwellings in the surroundings)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	High	1. Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (other than for the installation of the wind turbines). This will prevent erosion and infestation by unwanted species (exotic and weeds);	Moderate

Table 9.81 (Continued)

Change in landscape elements (Macuacua settlement and scattered dwellings in the surroundings)

Landscape			
Change in landscape elements (Macuacua settlement and scattered dwellings in the surroundings)			
Project Phase	Construction		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Temporary		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Sensitivity	Reduced	2. Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report. Trees should be planted in the area not occupied by the panels in order to compensate for the trees cut down;	Reduced
Classification of Significance	Moderate		Reduced

9.14.3 Operation phase

During the operation phase, the expected impacts on the landscape are related to the presence of the new infrastructures installed at the Namaacha Power Plant and to a new local occupation.

In fact, it is at this stage that the process of adapting the landscape to the new reality will take place, resulting from the introduction of new built elements into the landscape, namely the presence of the Namaacha Power Plant.

In terms of reading the landscape from outside to inside (considering the Namaacha Power Plant site as the focal point), its presence inevitably induces a loss of natural scenic value of the landscape. It should be emphasised, however, that from a landscape point of view, wind turbines are elements of subjective appreciation. Currently, there is already a concern to develop studies to minimise the impact at this level, changing the shape of the wind turbines themselves, even their colour, in order to allow a better landscape integration. But the presence of wind turbines, sometimes in places where human intervention is reduced, usually leads to divergent opinions on the resulting aesthetic effect. As far as infrastructure is concerned, the wind turbines, access roads and the substation will stand out in the landscape.

The substation will be small in size so no significant visual impacts are expected and will only be seen in its immediate surroundings.

Regarding the access roads, since they mostly correspond to the improvement of existing paths and the construction of small sections, they will be integrated as a structuring element of the landscape, which will also serve as a use for the existing dwellings in the nearest surroundings. For this reason, it is considered that the impacts of the accesses on the landscape will be negative, insignificant, of reduced magnitude and of local scope tending to null with the passage of time.

Regarding the wind turbines, they will stand out in the immediate surroundings due to the type of structure, causing negative visual impacts of moderate magnitude and significance (see Figure 9.2).

It should be noted, with regard to the Namaacha Power Plant, that overall, as is the case with most Wind Farms (as they are generally located in the higher areas and therefore more exposed), most of the existing dwellings in a 2km surrounding area will have visual accessibility over it (see Figure 9.2). The fact that there are few settlements and dwellings in the surrounding area with visual accessibility to the landscape sub-units is a major contributing factor.

The wind turbines, although prominent in the landscape, making the landscape character more managed and less natural, will induce a high visual intrusion. In addition, dwellings with visual accessibility over the Project are located less than 1 kilometre away, with the wind turbine being very noticeable in the landscape. The settlement of Macuacua will also have visibility over the Project, but at a distance greater than 1 km. As can be seen in Figure 9.2, as the dwellings in this settlement move further away from the Project, the number of visible wind turbines reduces.

The study area in general consists mostly of the ridge tops and transition slopes. On these ridges, scattered settlement and dwellings are already present, mostly located to the west of the landscape study area, and thus with visual capacity over the Project. These dwellings, however, as well as their agricultural and livestock activities, make the landscape character somewhat more managed and less natural, inducing visual intrusion. As such, the negative impact is considered to be of moderate magnitude and moderate significance.

It should also be noted that there are parameters that directly influence the perception of the landscape and/or visualisation of the wind turbines from the surrounding settlements and which, due to software limitations, have not been taken into account.

In this way, the analysis carried out was the most unfavourable for the Project, since it did not consider a series of factors that attenuate the visual capacity of potential observers, such as the existence of visual barriers resulting from the different land uses of the surroundings and the Project site itself, the distance between observer/object observed, the visual acuity of potential observers and the adverse weather conditions for viewing the Project, which in this particular area is quite significant.

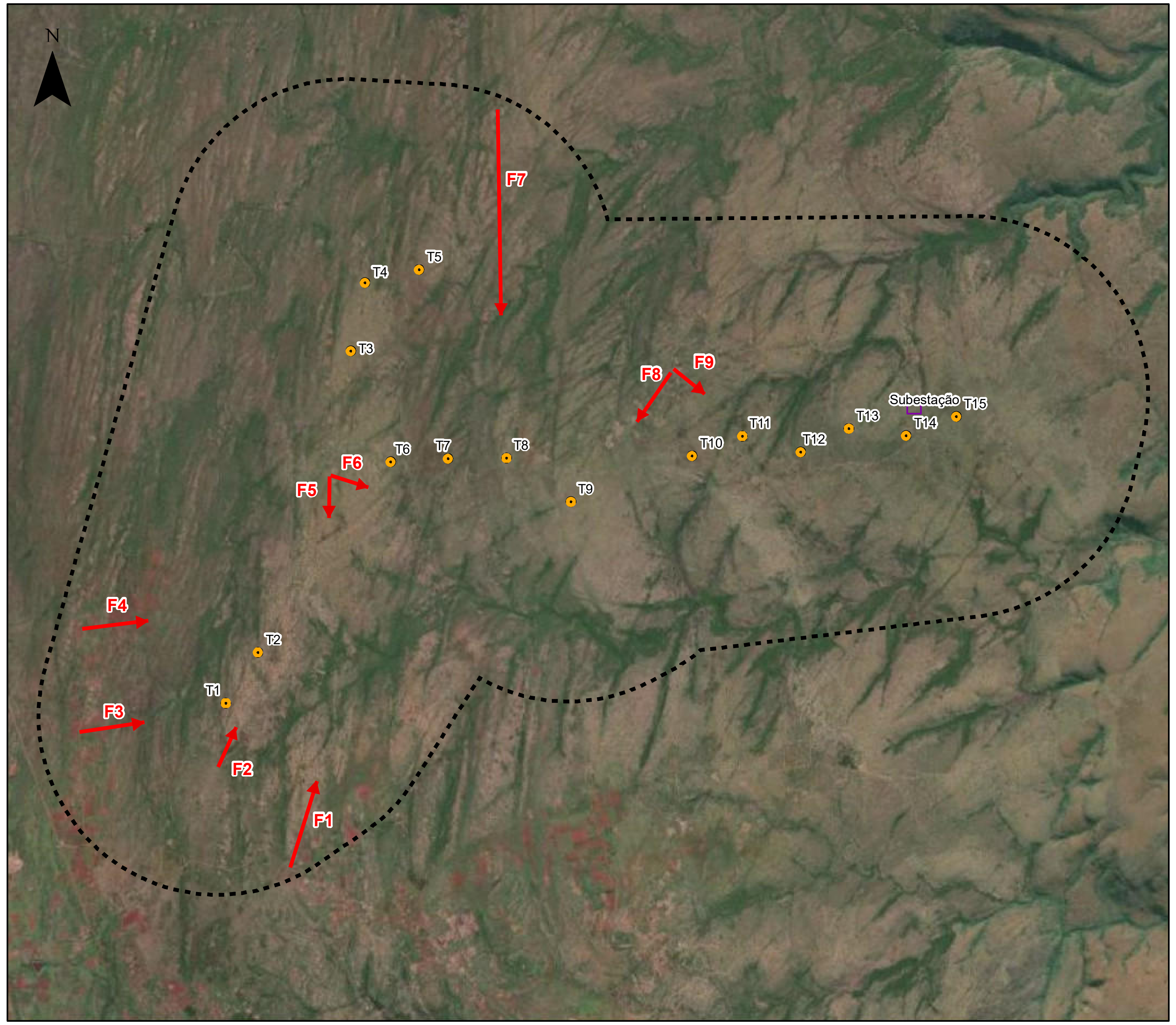
Therefore, it is considered that the results obtained in terms of visualisation of the Project, even if they do not indicate significant negative impacts, are overestimated.

This analysis showed that the concentration of potential observers occurs mostly in areas of Medium Landscape Sensitivity, identifying at this level some critical situations from a landscape point of view.

As part of the baseline situation, social areas within the landscape study area were identified and could be considered as sensitive receptors according to the methodology applied. This area, where it was considered that the resulting impacts could be considered significant, covered 2 km around the wind turbines, the area where the observer visualises the wind turbine with greater clarity and where it is a dominant element in the landscape, which could result in significant affectations in the landscape.

That said, it is also important to note that the project is located close to the border with South Africa and Swaziland. Taking into account the nearest major settlements, Mbuzini (South Africa), Lomahasha (Swaziland) and Namaacha (Mozambique), at distances of approximately 4 km, 7.5 km and 8.5 km respectively, it is considered that the Project's wind turbines, although noticeable from time to time, do not constitute a dominant feature. In addition, its apprehension depends on weather conditions, namely cloudiness, luminosity, and also the topography of the terrain. It is therefore considered that there will be no significant negative impacts at the transboundary level that warrant further detailed analysis.

Although the wind turbines stand out in the landscape, making the character of the landscape more anthropic and less natural, they will not induce a high visual intrusion. This is reinforced by the fact that most of the villages with visual accessibility to the Project are located at a distance of more than 3 km, where the wind turbine, although visible, is not the dominant element for the observer's attention. Figure 9.5 shows the visual simulation of the wind turbines in Google Earth and the orientation of the visualisations of the simulation images.



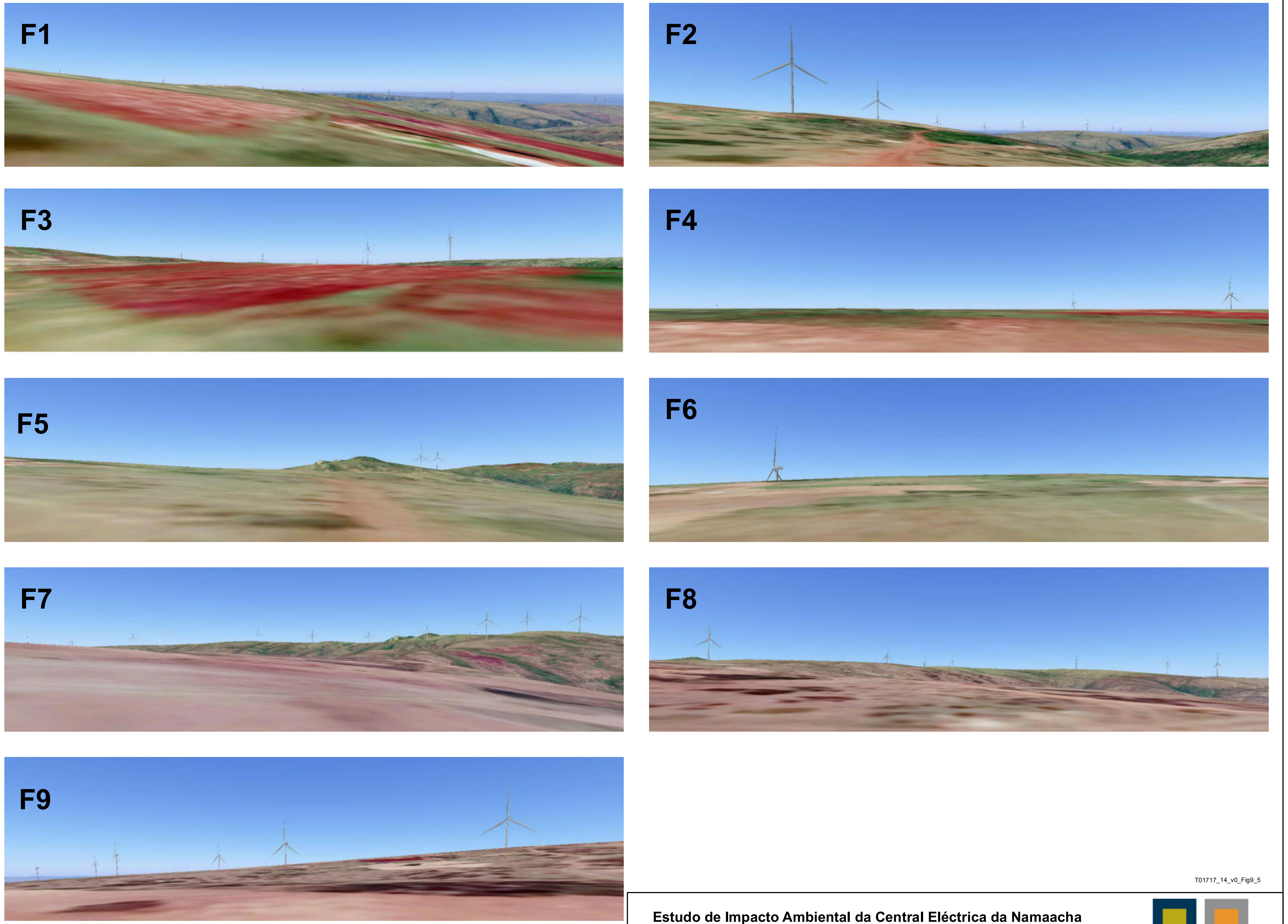
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Escala: 1/60 000

0 2 km

LEGENDA

- Área de estudo da paisagem
- Aerogerador
- Subestação
- Sentido da Imagem



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Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 9.5 - Simulação visual em google earth dos aerogeradores e orientação da visualização das imagens.

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ESTUDOS E PROJECTOS LDA

Photo 9.3 - Photomontage of the approximate location of wind turbines T1 to T3 from the access road to the south of the Power Plant (access between Macuacua settlement and Namaacha Village)

The tables below summarise the impacts described above.

Table 9.82

Change in the structural elements of the landscape (access roads and trenches)

<table>
<tr><th colspan="4">Landscape</th></tr>
<tr><td colspan="4">Change in the structural elements of the landscape (access roads and trenches)</td></tr>
<tr><td>Project Phase</td><td colspan="3">Operation</td></tr>
<tr><td>Nature of Impact</td><td colspan="3">Direct; Negative</td></tr>
<tr><td>Scope</td><td colspan="3">Local</td></tr>
<tr><td>Probability</td><td colspan="3">Certain</td></tr>
<tr><td>Duration</td><td colspan="3">Long-term</td></tr>
<tr><td>Reversibility</td><td colspan="3">Reversible</td></tr>
<tr><td></td><td>Impacts with no Mitigation Measures</td><td>Mitigation Measures</td><td>Residual Impact</td></tr>
<tr><td>Magnitude</td><td>Reduced</td><td rowspan="3">1. Maintenance of natural regeneration of vegetation</td><td>Negligible</td></tr>
<tr><td>Sensitivity</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Classification of Significance</td><td>Reduced</td><td>Negligible</td></tr>
</table>

Table 9.83

Change in structural elements of the landscape (Substation)

Landscape			
Change in structural elements of the landscape (Substation)			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Maintenance of natural regeneration of vegetation	Negligible
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Negligible

Table 9.84

Change in the structural elements of the landscape (Wind turbines)

Landscape			
Change in the structural elements of the landscape (Wind turbines)			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Maintenance of natural regeneration of vegetation	Moderate
Sensitivity	Medium		Reduced
Classification of Significance	Moderate		Reduced

Table 9.85

Project Visibility (Wind turbines)

Landscape			
Project Visibility (Wind turbines)			
Project Phase	Operation		
Nature of Impact	Direct; Negative		
Scope	Local		
Probability	Certain		
Duration	Long-term		
Reversibility	Irreversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Moderate	1. Paint the wind turbines in opaque white colour.	Moderate
Sensitivity	High		Moderate
Classification of Significance	High		Moderate

Table 9.86

Renaturalisation of the intervened areas

Landscape			
Renaturalisation of the intervened areas			
Project Phase	Operation		
Nature of Impact	Direct; Positive		
Scope	Local		
Probability	Likely		
Duration	Permanent		
Reversibility	Reversible		
	Impacts with no Mitigation Measures	Mitigation Measures	Residual Impact
Magnitude	Reduced	1. Establish the surfaces to be renaturalised in perfect connection with the natural terrain and in such a way as to avoid erosive phenomena and enhance the establishment of vegetation.	Moderate
Sensitivity	Medium		Medium
Classification of Significance	Reduced		Moderate

9.14.4 Decommissioning phase

In the decommissioning phase of the Namaacha Power Plant at the end of its useful life, with the complete removal of all equipment and facilities and subsequent landscape restoration, it will return the landscape in the intervention area to its pre-existing natural characteristics, after the appropriate restoration actions. In fact, after the removal of all the equipment and the covering of the wind turbine footings, the adjacent service areas, the new access sections, and the substation with vegetable soil, the intervened areas will naturally recover their original characteristics, allowing the land that had previously been occupied to become available in the short term and restore its natural characteristics.

The impacts in the decommissioning phase will mainly result from the disruption caused by the movement of people, vehicles and machinery as described in the construction phase and the demolition/removal actions of all infrastructure, the magnitude of the impact being highly dependent on the final solution adopted,

The promotion of vegetation recovery after project decommissioning is a positive impact resulting from the dismantling of all equipment and facilities and the restoration of the affected areas previously occupied. This is an impact that favours the establishment in the restored areas of vegetation that is present in contiguous areas, although this is naturally a slow process.

9.15 CUMULATIVE IMPACTS

There are no planned projects that could have cumulative impacts with the Namaacha Power Plant Project. However, this project cannot be dissociated from Mozambique's strategy for the development of renewable energies, where it has, together with other projects, cumulative positive impacts, at national and regional level.

In fact, the genesis of the Namaacha Power Plant Project is the conviction that wind energy, although it cannot solve all the problems of electricity generation due to its essential characteristic that it only produces while there is wind, will nevertheless play a decisive role in the national and international energy context of the future.

The Project is thus aligned with the Government's Electrification Strategy, which aims to ensure universal access to energy by 2030. The scope of this strategy includes on-grid and off-grid energy projects.

10 RISK ANALYSIS

10.1 INITIAL CONSIDERATIONS

The present chapter consists of an analysis of the environmental risk related to the Namaacha Power Plant Project based on bibliographic collection as well as on the expert analysis of the team involved. The project in question, due to its typology and characteristics, does not present high risks for the environment and populations. The analysis presented reflects extreme situations of external origin, with negative effects, but also addresses the risks associated with the construction and operation activities of the Project.

10.2 METHODOLOGICAL FRAMEWORK

Risk is the product of the probability of occurrence of a given undesired event by the effect it may cause on a given population or structure. Therefore, in risk analysis processes, hazards must first be identified, and then the risks of the identified hazards must be assessed, bearing in mind both the probability of occurrence of those hazards and the severity of the damage that this event, when it occurs, may cause.

Risk assessment leads to the prioritisation of risks - according to certain scales, which can be defined by simple methods - through a matrix that jointly uses the ranking as to the probability of occurrence of hazards with the ranking as to the severity of their consequences.

The risk analysis carried out for the Namaacha Power Plant is therefore intended to identify incidents likely to have an impact on the environment and to qualify, compare and prioritise the risks associated with them for the significant activities inherent in each phase of the Project, thus enabling the corresponding minimisation measures to be structured.

It should be noted that the analysis carried out focused on three different types of risk factors:

- Those whose occurrence may lead to negative impacts on the environment,
- Those whose occurrence may essentially involve disturbances in the course of the works and affect human lives or material goods outside the construction work;
- Those whose occurrence is associated with the vulnerability of the Project itself, weighing the risks to the Project.

In order to achieve the intended objectives, the following methodological steps were established:

- Assessment of the target system and boundary definition;
- Hazard identification and accident scenario development;
- Estimation of the typology of effects or consequences resulting from the identified events for the population, environment and material goods;
- Estimation of the probability of occurrence of the events and their effects, taking into account the proposed prevention and minimisation measures;
- Risk assessment;
- Definition/identification of minimisation measures/means of control.

In this framework, the Hazards for the construction and operation phases have been identified, each of which can be attributed to causes external or internal to the Project, some of which are common to the operation and construction phases:

- Occurrence of natural phenomena (earthquakes, floods, thunderstorms, fires, snowfall, heat waves, cold waves, droughts) - Construction and operation phase;
- Acts of vandalism - Construction and operation phase;
- Circulation of vehicles outside and inside the development area - Construction and operation phase;
- Storage and handling of fuels, oils and other chemicals - Construction and operation phase;
- Faults during maintenance (fires, spillages, vehicle accidents) - Operation phase;
- Accidents causing SF6 (sulphur hexafluoride) emissions - Operation phase.

The following risk analysis is carried out according to the probability of occurrence of that risk and its severity.

Regarding the probability of occurrence, this was defined from 1 to 5, according to the criteria presented in Table 10.1 and according to the project phase in which they may occur.

The severity of the risk will be translated in terms of impacts, i.e. in terms of severity and reversibility of impacts, and has been categorised from 1 to 5 according to Table 10.1.

Table 10.1

Criteria for environmental risk assessment

Phase	Parameter	n	Level
Construction / Operation	Severity (s)	- No or insignificant environmental damage. No or insignificant economic damage. No damage to human health	1
		- Little reversible environmental damage, with easy restoration of natural balance. Some economic damage. Negligible damage to human health.	2
		- High reversible environmental damage with costs to restore the natural balance. High economic losses. - Consumption of renewable natural resources. Mild damage to human health	3
		- Severe reversible environmental damage, with high costs of restoring the natural balance. High economic losses. - Consumption of non-renewable natural resources. Serious damage to human health	4
		- Irreversible damage to the environment and human health. - High consumption of natural resources, renewable and/or non-renewable. Very high economic losses. - Sensitive receptor medium.	5
Operation	Probability (p)	- more than 10 years	1
		- up to once/10 years	2
		- up to once/5 years	3
		- up to once/year	4
		- at least once/semester	5
Construction	Probability (p)	- more than 6 months	1
		- up to once/semester	2
		- up to once/quarter	3
		- up to once/month	4
		- at least once/week	5

Significance is calculated using the following expression:

$$significance\ result\ (r) = 2s \cdot p$$

Environmental impacts resulting from risk situations will therefore be categorised according to the criteria in Table 10.2.

Table 10.2

Criteria for classifying environmental risks

Interpretation of Results	Environmental Risk Classification
$R < 10$	Not Significant
$R \geq 10$	Significant

All environmental risks classified as significant, or others considered relevant, should be subject to analysis and action planning to control, minimise and/or eliminate their origin.

According to the risk classification, appropriate measures should be implemented in order to achieve the defined objectives.

Table 10.3 shows the type of measures to be taken, depending on the impact classification obtained.

Table 10.3

Level of Action, depending on the classification of environmental risks

Environmental Risk Classification	Action Description
Not Significant	Maintain good practices and risk control measures
Significant	Control, minimise and/or eliminate until risk controlled

10.3 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Table 10.4 summarises the hazard identification and risk classification for the Namaacha Power Plant described in the assessment in the following sub-chapters.

10.3.1 Occurrence of natural phenomena

- Earthquakes

According to the map of seismic intensity of central and eastern Africa on the modified Mercalli scale (UNESCO, 2007), the study area is located in a seismic zone of grade VI. According to this scale, grade VI earthquakes are considered "quite strong" and are generally felt by the entire population of the region and cause cracks in masonry built with weak materials such as adobes and weak mortars. The Namaacha area has no relevant seismic activity.

The risk of an earthquake occurring is considered not significant, both in construction and operation, since, although in the event of occurrence, its consequences are serious (level 4 - Table 10.1), which could lead to serious material and human damage with high costs of restoring the natural balance and high economic damage, its probability of occurrence is considered very low, level 1 (see Table 10.1).

- Floods

The occurrence of floods and inundations at the site of the park would necessarily bring adverse consequences, even taking into account the adoption of watertight and adequate equipment to resist inclement weather. However, given the characteristics of the study area, the probability of occurrence is considered to be nil, which is why it is not considered to be included in Table 10.4.

- Thunderstorms

The occurrence of thunderstorms at the Project site may have adverse consequences, even taking into account the adoption of adequate equipment to withstand bad weather. Fires may occur and objects may fall from the wind turbine as a result of lightning strikes.

In the event of a lightning strike, there may be a risk of it coming into contact with elements that may be energised, such as lightning rods. Incandescent objects may also fall and cause fires in the surroundings.

The risk of thunderstorm is considered not significant in the construction phase since the probability of occurrence is low (level 1) although it has a high severity level (level 4). In the case of the exploitation phase the risk is considered significant, the probability of occurrence is higher than the construction phase, being considered level 2 according to the criteria of Table 10.1, and a level of severity (level 4), which may lead to irreversible damage to the environment, with a high consumption of natural resources, renewable and/or non-renewable.

- Cold waves and snowfall

The probability of a snowfall or cold wave occurring in this region of the country is considered to be zero in the risk analysis, especially if one considers the climate projections that point to a generalised increase in minimum temperatures and a decrease in the occurrence of cold days and nights. Thus the risk associated with snowfall is not included in the description presented in Table 10.4.

- Heat waves and droughts

Contrary to what is considered for snowfalls, the probability of occurrence of heat waves and drought periods is high and, given climate projections, will tend to increase. However, the consequences for the project are considered to be nil and therefore the risk is considered to be nil and is not presented in Table 10.4 either.

However, the contribution of heat waves and droughts to the creation of favourable conditions for the ignition and spread of wildfires should be noted, and this risk is described and assessed autonomously, being considered as significant.

10.3.2 Acts of vandalism

The occurrence of acts of vandalism at the Power Plant, in addition to resulting in situations of destruction of materials and equipment, can cause fire situations with the consequences inherent to them. In the event of any, immediate and effective detection and action must be taken at the source of the fire.

However, the fire risk associated with wind farms is no greater than any other type of electrical installation or power generation plant, and protection against lightning strikes and surges is provided, reducing the likelihood of fire in this way.

Also considered are fires originating outside the Project, which may be due to acts of vandalism, but also to natural causes, especially potentiated by the increase in average temperatures, the occurrence of heat waves and periods of drought, this being a region where fires are historically burned.

The consequences of a fire, either on site or during operation, are severe, resulting in contamination of air quality, soil and water quality, serious material damage and resource consumption, and may even cause irreversible damage to human health.

This risk is therefore categorised as significant overall in the operation phase since its probability of occurrence is level 2 and its consequences are considered to be level 4 overall (see Table 10.4), with serious damage to the environment and human health. In the construction phase, it is not considered significant since, although the consequences remain, the probability is 1.

10.3.3 Vehicle movement and equipment operation

During the construction phase there will be a great diversity and quantity of machinery, vehicles and equipment in operation and in circulation.

Poorly maintained site machinery and equipment can lead to air, water and soil pollution from oil and fuel spills, uncontrolled gaseous emissions and significant noise emissions.

On the other hand, collisions between vehicles can result in various accidents that jeopardise the surrounding environment, such as:

- Danger of fuel spillage, with contamination of the soil on which it falls, which, depending on the area affected and the quantity of fuel spilled, could have a significant effect;
- Danger of fire, with consequent explosion of the fuel tank, which could jeopardise the health of the workers on site and the integrity of the structures built so far.

In this framework, this risk is considered as significant in the construction phase, since it was considered with a probability of level 3 and with severity of level 2 (see Table 10.4).

In the operation phase, vehicles will also circulate, although less frequently, and accidents may occur that cause fuel spillage or explosions, although the latter with a lower probability. This risk is considered as not significant, since it was considered with a probability of level 1 and with severity of level 2 (see Table 10.4).

10.3.4 Storage and handling of fuels, oils and other chemicals

The activities to be carried out during the construction of an infrastructure of this type imply the need for various types of maintenance during the construction phase, which is why the storage of oils and other types of lubricants is justified. Thus, at this stage, safety rules must be complied with, which must be previously established in a specific document.

On the other hand, fuels, whether liquid or gaseous, are materials that present a high risk of fire and explosion and can also, in certain circumstances, be a source of poisoning. These risks are interdependent on each other and can trigger what is commonly known as the "domino effect".

In addition to the risks associated with storage, the risks arising from a possible spill can also be considered. The characteristics of the soil at the site, in particular its permeability, could lead to contamination of soils and local groundwater and surface water resources. The degree of contamination induced will obviously depend on the properties and quantity of the spilled substance.

These spills, when made near ignition sources, may also cause small fires and consequently explosions, depending on the substances involved.

Thus, the hazards associated with the storage of fuels and oils and other chemicals can be divided into the danger of fires and explosions and the danger of spillages of the substances into the environment.

The risks associated with the hazards mentioned above are distinguished by the consequences inherent in each of them. Thus, the occurrence of fires and explosions is considered to have a lower probability (level 2) but more serious consequences (level 4), resulting in a significant risk (Table 10.4).

The risk of spillages has a higher probability of occurrence (level 3) and less severe consequences (level 2), which also results in a significant risk (Table 10.4).

These risks are significantly reduced by the adoption of minimisation measures which are presented in Table 10.4 and referred to at the end of this chapter.

For the case of the operation phase, these risks are considered to be negligible.

10.3.5 Faults during maintenance actions

- Fire occurrence

During the operation phase, the fire risk associated with the operation of a wind power plant is very low. Even in the event of an electrical fault (short-circuit), the protections provided will lead to its immediate elimination, since the project design will incorporate the technical standards and safety regulations applicable to electrical installations that will be submitted for approval by the competent licensing authority.

However, these situations, in addition to constituting a risk for workers and the general population (which should be safeguarded in accordance with the legislation in force, namely in emergency plans), may be associated with contamination of air, water and soils.

Thus, the risks associated with the occurrence of a fire are of very low probability (level 1), also because it is considered that the equipment and facilities will be equipped with all the fire detection and fighting instruments, which will be subject to preventive maintenance, with medium consequences (level 3), resulting in a non-significant risk (Table 10.4).

- Spillages of oils and other chemicals

During maintenance activities, spillages may occur as a result of vehicle accidents or mishandling of materials and products.

These situations are considered to be of low probability (2) and low severity (2) since the spillages, if they occur, will not be of significant size in relation to the type of equipment involved, resulting in a non-significant risk.

- Vehicle accident

During maintenance activities, accidents may occur with vehicles, which may cause air, water and soil pollution due to oil and fuel spills.

These situations are considered to be of very low probability (1) and also low severity (2) since the spillages, if they occur, will not be of significant size in relation to the type of equipment involved, resulting in a non-significant risk.

- Accidents causing SF6 (sulphur hexafluoride) emissions

During operation and maintenance, damage to circuit breakers may accidentally result in the release of SF6 (sulphur hexafluoride). This gas, under normal pressure and temperature conditions, is a non-flammable, colourless, odourless, non-poisonous, chemically stable gas that operates in a closed circuit. Replacement/recycling operations of this gas are usually carried out by the manufacturers on their own premises, the quantities found in each piece of equipment are very small.

It is a gas with a high global warming potential and therefore, even in small quantities, it has some impact at this level. Thus, it was considered a low probability (1) but with a medium severity (2) since despite its high global warming potential, 23,500 times higher than that of CO_2, it is found in very small quantities.

10.4 MINIMISATION MEASURES

In general terms, the following recommendations apply to all assessed risks and their implementation will reduce risks:

Construction phase:

- Development of a Safety and Health Plan (in accordance with applicable legislation);

- Development of an Emergency Plan, which provides for action in the event of environmental risk situations;
- Development of an Environmental Management Plan;
- Implementation of an Environmental Monitoring Plan;

Operation phase:

- Development of an Emergency Plan, which provides for action in the event of environmental risk situations;
- Development of an Environmental Management Plan, including the control of vegetation in the surroundings;
- Development of a Preventive Maintenance Plan;
- Implementation of a Security and Surveillance System.

Table 10.4

Summary of Hazard Identification and Risk Assessment

Type of cause	Project Phase	Hazard	Consequences	Risk Assessment			Significance	Measures
				P	S	CR		
Natural phenomena	Construction	Earthquake Occurrence	Severe environmental damage. Damage to the various infrastructures that make up the Wind Power Plant, namely breakage of structures that can lead to fires, oil spills and other chemical products, with a direct impact on the environment.	1	4	8	NS	Emergency Procedures; Observance and compliance with legal and regulatory criteria regarding the construction processes to be adopted.
	Operation			1	4	8	NS	Emergency Procedures; Observance and compliance with legal and regulatory criteria regarding the construction processes to be adopted. Implementation of a Preventive Maintenance Plan.
	Construction	Thunderstorm occurrence	Severe environmental damage. Damage to the various infrastructures that make up the Wind Power Plant, namely breakage of structures that can lead to fires, oil spills and other chemical products, with a direct impact on the environment.	1	4	8	NS	Definition of emergency procedures on site by contractors and included in the Site Safety Plan. Implementation of the Construction Site Environmental Monitoring Plan.
	Operation			2	4	16	S	Facility Safety Plan including procedures for fire prevention and fighting and minimisation of environmental impacts through the implementation of the Environmental Management System.
Acts of Vandalism	Construction	Fire occurrence	Severe environmental damage. Damage to the various infrastructures that make up the Wind Power Plant, which as a result of the fire may lead to oil and other chemical spills, emissions of atmospheric pollutants with a direct impact on soil, water and atmosphere.	1	4	8	NS	Health and Safety Plan for the site; Site surveillance system. Procedures for action in case of emergency. Environmental monitoring of the works

Type of cause	Project Phase	Hazard	Consequences	Risk Assessment			Significance	Measures
				P	S	CR		
	Operation	Fire occurrence	Severe environmental damage. Damage to the various infrastructures that make up the Wind Power Plant, which as a result of the fire may lead to oil and other chemical spills, emissions of atmospheric pollutants with a direct impact on soil, water and atmosphere.	2	4	16	S	Facility Safety Plan including procedures for fire prevention and fighting and minimisation of environmental impacts through the implementation of the Environmental Management System.
Circulation of vehicles outside and inside the Wind Power Plant area	Construction	Vehicle accidents and collisions	Reduced reversible environmental damage, with easy restoration of the natural balance. Spillages resulting from accidental situations between vehicles resulting in soil, water and air contamination.	3	2	12	S	Definition of emergency procedures on site by contractors and included in the Site Safety Plan. Implementation of the Construction Site Environmental Monitoring Plan.
	Operation			1	2	4	NS	Minimisation of environmental impacts through the implementation of the Environmental Management System.
Storage and handling of fuels, oils and other chemicals	Construction	Fire and explosion occurrence	Damage to the various infrastructures that make up the Wind Power Plant, which as a result of the fire may lead to oil and other chemical spills, emissions of atmospheric pollutants with a direct impact on soil, water and atmosphere.	2	4	16	S	Site Safety and Health Plan; Waste Management Plan and Environmental Monitoring
		Occurrence of spillages	Reduced reversible environmental damage, with easy restoration of the natural balance.	3	2	12	S	Waste Management Plan and Environmental Monitoring

Type of cause	Project Phase	Hazard	Consequences	Risk Assessment P	Risk Assessment S	Risk Assessment CR	Significance	Measures
Storage and handling of fuels, oils and other chemicals	Operation	Fire and explosion occurrence	Damage to the various infrastructures that make up the Wind Power Plant, which as a result of the fire may lead to oil and other chemical spills, emissions of atmospheric pollutants with a direct impact on soil, water and atmosphere.	1	4	8	NS	Site surveillance and safety system. Definition of emergency procedures on site by contractors and included in the Site Safety Plan. Implementation of the Environmental Monitoring Plan on site.
Storage and handling of fuels, oils and other chemicals	Operation	Occurrence of spillages	Reduced reversible environmental damage, with easy restoration of the natural balance.	2	2	8	NS	Site surveillance and safety system. Definition of emergency procedures on site by contractors and included in the Site Safety Plan. Implementation of the Environmental Monitoring Plan on site.
Faults during maintenanc e actions	Operation	Fire occurrence	Severe environmental damage. Damage to the various infrastructures that make up the Wind Power Plant, namely breakage of structures that can lead to fires, oil spills and other chemical products, with a direct impact on the environment.	1	4	8	NS	Environmental Management System, Emergency Plan; Awareness Raising
Faults during maintenanc e actions	Operation	Spillages of oils and other chemicals	Reduced reversible environmental damage, with easy restoration of the natural balance. Spillages resulting from accidental situations between vehicles resulting in soil, water and air contamination.	2	2	8	NS	Environmental Management System including emergency procedures; Observance and compliance with legal and regulatory criteria relating to worker safety and Implementation of Preventive Maintenance Plan

Type of cause	Project Phase	Hazard	Consequences	Risk Assessment			Significance	Measures
				P	S	CR		
		Vehicle accidents	Reduced reversible environmental damage, with easy restoration of the natural balance. Spillages resulting from accidental situations between vehicles resulting in soil, water and air contamination.	1	2	4	NS	Minimisation of environmental impacts through the implementation of the Environmental Management System.
Faults during maintenance actions	Operation	Affecting circuit breakers resulting in SF6 emissions	Gas emissions with high global warming potential.	1	2	4	NS	Maintenance Plan. Environmental Management System including emergency procedures

P – Probability; S – Severity; CR – Risk Classification; S – Significative; NS – Non-Significant

10.5 RISKS ASSOCIATED WITH WORKERS

During the construction phase of the project, it is extremely important to make all those involved aware of the associated risks, since assembly requires additional knowledge and care due to the specific nature of the work involved. The need therefore arises to develop a Health and Safety Plan.

Its main objective is to ensure that a Safety and Health Policy is in place for the site, taking into account the following key points:

- Risk avoidance;
- Assess risks that cannot be eliminated;
- Tackle risks at source;
- Adapt the work to the human being, especially with regard to the design of workstations and the choice of work equipment and methods;
- Take into account the state of technical evolution;
- Replace what is hazardous with what is hazard-free or less hazardous;
- Plan prevention with a coherent system integrating technical expertise, work organisation, working conditions and the influence of environmental factors on work;
- Prioritise collective prevention measures over individual protection measures;
- Adequately train and inform all workers.

Comply with all applicable legislation and international standards with regard to Safety and Health.

In general, the activities involved in the construction of the project are associated with the organisation of the construction site, the erection of foundations and wind turbines, as well as the construction of the substation. Each of these activities carries associated risks.

10.5.1 Risks Associated with Site Organisation

- Run-over;
- Collision;
- Fall at the same level;
- Falling objects;
- Cuts;
- Noise exposure;
- Entanglement;
- Electrocution;
- Fire;
- Burns;
- Poisoning.

10.5.2 Risks associated with the installation of foundations and wind turbines

- Falls at different levels;
- Falls from a height;
- Falling objects;
- Cut or bruise;
- Irons on stand-by;
- Noise exposure;
- Crushing;
- Entanglement;

- Ergonomic;
- Chemical;
- Biological;
- Contact with live parts;
- Electrical contact;
- Fire;
- Burns.

10.5.3 Risks associated with substation erection

- Fire;
- Explosion;
- Burns;
- Entanglement;
- Crushing;
- Ergonomic;
- Cut and bruise;
- Irons on stand-by;
- Formwork breakage;
- Shock with objects;
- Fall from a height;
- Fall at the same level;
- Biological;

- Noise exposure;
- Poisoning (SF6);
- Electrical contact.

It should be noted that prior to the construction phase, the Health and Safety Plan (HSP) will be developed, which describes the preventive measures that must be complied with, namely the Health and Safety Sheets and the Operational Instructions, which must be consulted during the construction phase, in order to avoid the identified risks.

The adaptations to the design PSS, during the construction phase, should include the identification of all risks not foreseen in the design PSS, due to new construction techniques, materials, machinery, etc., and should indicate the methodologies to eliminate/minimise these risks, and it is also desirable to draw up new operational instructions if the new tasks to be carried out have a medium/high degree of complexity.

11 MINIMIZATION MEASURES

11.1 GENERAL CONSIDERATIONS

The measures proposed in this Chapter aim to reduce the magnitude and significance of the identified impacts and compensate for their negative effects, where possible.

The main aspects associated with the minimisation of impacts on most of the descriptors, arising from the construction phase of the Project, are associated with the correct management of the work fronts and construction site, applying transversally to several descriptors and therefore being addressed in a separate sub-chapter, however, they are also referred to for each of the descriptors in which this is relevant.

Very relevant in this project are the measures that were defined during the EIA and that were taken into account in the definition of the final layout of the Plant, which allows to reduce, and even eliminate, the main impacts identified. The measures for the design phase are labelled "**MFP**", those for the construction phase are labelled "**MFC**" and those for the operation phase are labelled "**MFE**".

11.2 MEASURES FOR THE PROJECT PHASE

At this stage of project development, although the following measures have already been considered in the definition of the Plant layout, it is recommended that they be maintained in the definition of the execution project:

MFP.1 – If possible, move wind turbines away from dwellings, leaving a protective area of at least 400 m around the wind turbine;

MFP.2 - exposed to noise levels above WHO limits and IFC standard limits for the shadow effect;

MFP. 3 - Implement the process of resettlement/relocation of persons/families whose housing is exposed to noise levels above the limits imposed by the WHO and the limits of the IFC standards regarding the shadow effect;

MFP.4 - Moving the wind turbines away from the church, leaving a protective area around it and ensuring access to it;

MFP 5 - Maintain continuous access to the church wherever possible or as a last resort provide an alternative access route to ensure safe access for people attending the church;

MFP.6 – Design paths should, where possible, utilise existing paths in the study area;

11.3 GENERAL MEASURES

This Chapter considers the Minimisation Measures that cut across the different descriptors and are associated with specific worksite activities such as the management of work fronts and construction sites and, after the work, the recovery of areas affected by the worksite.

11.3.1 Preparation phase prior to the execution of the works

MFC.1 - Disseminate the programme of execution of the works to the populations concerned, in particular the population living in the surrounding area. The information provided should include the purpose, nature, location of the works, the main actions to be carried out, their timetable and any impact on the population, in particular the impact on accessibility;

MFC.2 - Implement a public service mechanism to clarify any doubts and address any complaints;

MFC.3 - Carry out environmental and safety training and awareness-raising activities for the workers and foremen involved in the execution of the works regarding the actions likely to cause environmental impacts and the minimisation measures to be implemented, in particular the rules and precautions to be taken during the works (included in the Environmental Management Plan and the Safety and Health Plan) (PSS));

MFC.4 - Draw up a Work Plan of all the works assigned to the contract that includes, among other relevant aspects of the contract, the phases foreseen for earthmoving, for clearing and deforestation actions and for the crossing of water lines;

MFC.5 - Draw up a Landscape Integration Plan for the Works, in order to ensure the appropriate landscape framework that guarantees the attenuation of the visual affectations associated with the presence of the works and their integration into the surrounding area;

MFC.6 - Implement the Works Environmental Monitoring Plan, consisting of the planning of the execution of all elements of the works and the identification and detailing of the minimisation measures to be implemented during the execution phase of the works, and their respective timetable;

MFC.7 - Correctly signpost accesses to the intervention area with speed reduction indications. Properly signpost the 30km/h speed limits within the works area.

11.3.2 Setting up the site and stockpiling materials

MFC.8 - The location of the construction site, if different from the one foreseen in this EIA, should be chosen avoiding areas within 50 m of permanent water lines, avoiding the destruction of tree species;

MFC.9 - The site should be organised in the following areas:

- Social areas (support containers for the technical teams present on site);
- Waste disposal: two types of containers should be placed - containers intended for Urban Solid Waste and similar and container intended for construction waste;
- Storage of polluting materials (oils, lubricants, fuels): this area should be properly dimensioned, waterproofed and covered so as to prevent overflows and that, in the event of accidental spillage, contamination of adjacent areas does not occur (it should have a drainage system for a watertight retention basin);
- Car and equipment parking; and
- Deposition of construction materials.

MFC.10 - The construction site should be fenced off, or if this is not possible, the area allocated to it should be marked off with visible signs. Warning signs should be placed on the fencing, including the safety rules to be observed and the schedule of works;

MFC.11 - The construction site and the different work fronts must be equipped with all the necessary materials and means to respond to environmental incidents/accidents, including accidental spillages of polluting substances. They must be waterproofed and with effective drainage, easily accessible;

MFC.12 - Access by personnel not assigned to the works must be avoided or, if possible, prohibited. Therefore, the intervention areas that intersect public roads and paths must be signposted in accordance with the municipal traffic regulations, and whenever justified, fenced off;

MFC.13 - Measures should be adopted in the field of information signalling and traffic regulation on the roads crossed by the Work Site, aiming at safety and information during the construction phase, complying with the National Regulations in force and the best international rules on the subject. international rules on the matter;

MFC.14 - A rainwater drainage system should be established around the construction site area.

11.3.3 Deforestation, cleaning and stripping of soils

MFC.15 - The deforestation and soil stripping works should be limited to the areas strictly necessary for the execution of the works, and the vegetation cover of each intervention area should be restored as soon as the earthworks (which are expected to be minor) are completed, particularly in the excavation and embankment areas. This measure is particularly important in the areas of the working platforms for the construction of the control building and the substation and in the construction sites of the foundations of the power line supports. In this way, some potential direct affectations of the subsurface hydrogeological system of local scope will also be taken care of;

MFC.16 - Prior to earthmoving works, strip the live earth and store it in pargas for later re-use in areas affected by the works;

MFC.17 – The pargas of topsoil from surface stripping should not exceed two metres in height and should be located in the vicinity of the sites from which the topsoil was removed, on flat, well-drained areas, for later use in reclamation actions;

MFC.18 - Plant biomass and other waste resulting from these activities should be reused wherever possible;

MFC.19 - Earthmoving and machinery movements should, as far as possible, favour the use of existing accesses or those less sensitive to soil compaction and waterproofing, avoiding the movement of machinery indiscriminately over the entire site.

11.3.4 Excavations and earthmoving

MFC.20 - Excavation and backfill works should be started as soon as the soil is clean, avoiding repetition of actions on the same areas;

MFC.21 - Land clearing and stripping, earthmoving and exposure of bare soil should, where possible, be reduced during periods when heavy rainfall is most likely to occur, to minimise waterborne erosion and the consequent transport of sediment to major water lines;

MFC.22 - The execution of excavations and embankments should be interrupted during periods of high rainfall and precautions should be taken to ensure the stability of the slopes and to avoid landslides;

MFC.23 - Where possible, use materials from excavations as backfill material in order to minimise the volume of surplus land (to be transported outside the intervention area);

MFC.24 - Excavation materials that cannot be utilised, or are in excess, should be stored in suitable storage facilities;

MFC.25 - In areas where works are carried out that may affect water lines, measures should be implemented to minimise interference with the water regime, pre-existing vegetation cover and bank stability. The natural flow of the water line should never be interrupted. All interventions in the water domain that are necessary during the course of the work must be previously licensed;

MFC.26 - During the temporary storage of earth, it must be protected with waterproof coverings. The height of earth piles should be such as to ensure their stability.

11.3.5 Construction and rehabilitation of access roads

MFC.27 - Favour the use of existing paths to access the construction sites. If new access roads or improvements to existing access roads are required, the works should be carried out in such a way as to minimise changes in land use outside the areas that will subsequently be occupied by the access road;

MFC.28 - Ensure correct compliance with safety regulations and signalling of works on public roads, taking into account safety and minimising disruption to the activities of the population;

MFC.29 - Non-waterproofing materials should be used for the access roads to be built;

MFC.30 - Ensure that paths or access roads in the vicinity of the Project area are not obstructed or in poor condition, enabling their normal use by the local population;

MFC.31 - Where traffic diversions are expected to be necessary, submit the respective modification plans in advance to the competent authority for authorisation;

MFC.32 - Ensure the regular cleaning of access roads and the area affected by the work, in order to avoid the accumulation and re-suspension of dust, either by the action of the wind or by the action of the circulation of vehicles and work equipment;

MFC.33 - Any work at night should be avoided.

11.3.6 Movement of vehicles and operation of machinery

MFC.34 - When crossing inhabited areas, moderate speeds should be adopted in order to minimise dust emissions;

MFC.35 - Ensure that dusty or particulate materials are transported in suitable vehicles with the load covered to prevent the dispersion of dust;

MFC.36 - Ensure that construction methods and equipment are selected that give rise to the least possible noise;

MFC.37 - Ensure that only equipment that is in a good state of repair/maintenance is present on site;

MFC.38 - Carry out maintenance and periodic overhaul of all machinery and vehicles assigned to the work, in order to maintain normal operating conditions and ensure the minimisation of gaseous emissions, risks of soil and water contamination, and in order to comply with noise emission standards. Ensure that the noisiest operations carried out in the vicinity of dwellings are restricted to the daytime and on working days;

MFC.39 - Parking areas for machinery and vehicles must be paved or waterproofed;

MFC.40 - Regular and controlled sprinkling of water, especially during dry and windy periods, in the work areas and in the accesses used by the various vehicles, where the production, accumulation and re-suspension of dust may occur;

MFC.41 - Structural and construction solutions for bodies and buildings, and installation of soundproofing systems for equipment and/or buildings housing the noisiest equipment, should be adopted to ensure compliance with the limits set out in the IFC standards.

11.3.7 Product, effluent and waste management

MFC.42 - Implement the Waste Management Plan and the respective minimisation measures contained therein, in accordance with the provisions of the EMP;

MFC.43 - Ensure the correct temporary storage of the waste produced, according to its typology and in accordance with the legislation in force. Provision must be made for the containment/retention of any run-off/spillages. It is not permissible to deposit waste, even temporarily, on the banks, beds of water lines and areas of maximum infiltration;

MFC.44 - Open burning of hazardous waste is prohibited;

MFC.45 - Waste produced in social areas and comparable to urban solid waste must be deposited in containers specifically designated for this purpose and must be sent to an appropriate final destination to be agreed with the municipality;

MFC.46 - Construction and demolition waste and similar non-hazardous industrial waste shall be sorted and separated into its recyclable components and subsequently recovered;

MFC.47 - Used oils, lubricants, paints, adhesives and resins should be stored in suitable, leak-proof containers and then sent to an appropriate final destination, preferably recycling;

MFC.48 - Keep an up-to-date record of the quantities of waste generated and their final destinations, based on the documentation provided for in the legislation;

MFC.49 - Ensure proper final disposal of domestic effluent from the site, collection in tanks or watertight pits;

MFC.50 - The product storage area and the car parking area must be drained into a retention basin, sealed and isolated from the natural drainage network, in order to prevent accidental spills of oils, fuels or other hazardous products from contaminating soil and water. This retention basin must be equipped with a hydrocarbon separator;

MFC.51 - The storage of fuels and/or other polluting substances is only permitted in watertight containers, properly secured and within the site area prepared for that purpose. Containers must be clearly identified and labelled to indicate their contents;

MFC.52 - Whenever a chemical spill occurs on the ground, the contaminated soil should be collected, if necessary with the aid of a suitable absorbent product, stored and sent for final disposal or collection by a licensed operator;

MFC.53 - If generators are used in the course of the work, to supply electricity to the site, for testing the wind turbines or for other purposes, they must be properly conditioned to avoid contamination of the soil;

MFC.54 - Maintenance and washing of machinery and vehicles should not be carried out in the project area. If indispensable, conditions must be created to ensure that the soil is not contaminated.

11.3.8 Final phase of works execution

MFC.55 - Decommission the area allocated to the works for the execution of the project, with the dismantling of the construction sites and removal of all equipment, support machinery, material deposits, among others. Carry out the cleaning of these sites, at the very least restoring them to the conditions that existed before the work began;

MFC.56 - Part of the area around each of the wind turbine assembly platforms should be restored, leaving only one road around each wind turbine, necessary for the circulation of vehicles assigned to maintenance operations;

MFC.57 - Restore paths and roads used as access to sites under construction;

MFC.58 - Ensure the reinstatement and/or replacement of any existing infrastructure, equipment and/or services in the areas under construction and adjacent areas, which are affected during the course of the works;

MFC.59 - Ensure the unblocking and cleaning of all hydraulic drainage elements that may have been affected by the construction works;

MFC.60 - Re-establish and restore the landscape of the degraded surrounding area, if applicable, through reforestation with native species and the re-establishment of natural infiltration conditions, with the decompaction and aeration of the soils;

MFC.61 - Carry out landscape restoration of borrow pits, if materials from outside the intervention area are found to be necessary.

The following are the measures considered to be of a specific nature.

11.4 GEOLOGY AND HYDROGEOLOGY

11.4.1 Construction phase

At the level of geology and hydrogeology, the implementation and practice of the general minimisation measures defined in sub-chapter 11.3 should be ensured. Some more specific measures are presented below.

MFC.62 - The execution of excavations and embankments should be interrupted in periods of high rainfall and due precautions should be taken to ensure the stability of the slopes and to avoid ravines and/or landslides/slips;

MFC.63 - In the vicinity of the site planned for the construction of the platforms of wind turbines No. 3 and No. 10, 11, 12, 13, 14 and 15, and their respective access roads, special care should be taken in earthmoving to avoid the dragging of soils into the hydrographic network, namely the Maxongoluluane River in the northern sector of the N-S ridge (wind turbine No. 3) and the tributaries of the Mixumene, Mitesandene, Libunzene, Macuabane rivers in the eastern sector of the W-E ridge that drain the area of wind turbines No. 10 to 15 and their access roads;

MFC.64 - Any storage of the stripped topsoil horizon, despite its reduced thickness, should be carried out in an appropriate place, duly protected by covers to prevent its mobilisation by rainwater and wind, and should be replaced later during the restoration phase of the affected areas, especially the excavation and embankment slopes of the wind turbine platforms, substation and access roads;

MFC.65 - The height of the earth heaps must ensure their stability and the cover must ensure that the soil is aerated. This measure is highly effective in protecting the soil and reduces the costs of restoring the affected sites, since it is a pedological stratum of the intervention site where seeds of local plant species are present and will easily develop. At the same time, the use of stripped soils for restoration of affected areas will avoid the use of other soils of good quality and consequently the movement of earth;

MFC.66 - The land resulting from the excavations should be used, whenever possible and if the materials have adequate geotechnical characteristics, in construction works where there is a need for landfill, namely in the need for backfill, namely in the regularisation of the platforms of the accesses to be built and in the construction and regularisation of the platforms of the wind turbines and substation;

MFC.67 - In view of the proximity of a well identified in the vicinity of the access to be regularised (approximately 400 m to the south of the site planned for wind turbine no. 6), it should be signposted and a protection and safety area demarcated to prevent it from being affected;

MFC.68 - The handling of oils during the construction phase and the maintenance of machinery must be carried out with the necessary care in order to limit possible spillages that could cause contamination of the soil and groundwater. To this end, it is recommended that these operations take place in a specifically designed area of the site, isolated from the natural drainage network and prepared (waterproofed and capped) to retain any possible spillage. In addition, it is recommended that waste oils are stored in suitable, leak-proof containers for further treatment by a licensed operator;

MFC.69 - In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be removed immediately and the spillage should be directed to an appropriate final destination. This prevents contamination of the underlying soil layers and deep penetration of the substances involved, which could also contaminate groundwater;

MFC.70 - Ensure the appropriate final destination for domestic effluents from the site, in accordance with the legislation in force, with collection in leak-proof removable devices and subsequently forwarded for treatment, thus avoiding the possibility of infiltration into the soil and potential affectation of groundwater and surface water;

MFC.71 - The discharge of the water resulting from the cleaning of the concrete mixers should be carried out in places to be indicated by the environmental monitoring team and never in places close to water lines. Depending on the site under consideration, the opening of a retention basin may be indicated, preferably in a place where the concrete mixers must pass. The retention basin should be waterproofed and may have a layer of gravel, which after some washing can be removed and used for backfill and replaced in the retention basin.

11.4.2 Operation phase

For the operation phase, the following specific minimisation measures that are currently already applied in the study area should be continued:

MFE.1 - Decommission the area allocated to the works for the execution of the project, with the dismantling of the construction sites and removal of all equipment, support machinery, material deposits, among others. Clean up these sites, at least restoring them to the conditions existing before the start of the works;

MFE.2 - In the operation phase it is recommended that all maintenance operations be carried out with due care to avoid accidental spillages of oils, fuels or other substances;

MFE.3 - Waterproofed areas should be reduced to the minimum necessary, promoting the decompaction of the soils of the work areas after completion of the works, in places where future use is not expected for maintenance actions of the enterprise. This measure will have an impact on the easier infiltration of rainwater;

MFE.4 - During the operation phase, consideration should be given to emergency and safety plans to deal with any accidental spills that may affect the hydrogeological environment of the study area.

11.5 SURFACE WATER RESOURCES

11.5.1 Construction phase

At the level of surface water resources, the implementation and practice of the general minimisation measures defined in subchapter 11.3 should be ensured. In addition, the following specific minimisation measures should be adopted:

MFC.72 - Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control the flow of water in the work areas in order to reduce their erosive capacity;

MFC.73 - Ensure natural drainage at all stages of site development;

MFC.74 - The site area should not be waterproofed, with the exception of places for handling and storing polluting substances;

MFC.75 - It is recommended that oil and fuel handling operations take place in the site area, specifically designed for that purpose, and prepared (waterproofed and capped) to be able to retain any spills;

MFC.76 - It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be immediately removed and the spillage directed to an appropriate final destination;

MFC.77 - In the event of accidental spillage outside the substance storage areas, a layer of absorbent material should be applied immediately and removal of the affected soil should be arranged to a suitable destination to be indicated by the entity responsible for environmental supervision, where no additional environmental damage will result;

MFC.78 - The discharge of water resulting from the cleaning of concrete mixers shall be carried out in places approved by the environmental monitoring team;

MFC.79 - Carry out temporary crossings of water lines in such a way as not to cause obstruction to the normal flow of water;

MFC.80 - If applicable, the necessary water abstraction licences should be applied for.

11.5.2 Operation phase

For the operation phase, the following specific minimisation measures should be adopted:

MFE.5 - Oil handling operations, in the case of maintenance and repair of structures, should take place in an area specifically designed for that purpose, and prepared (waterproofed and capped) to be able to retain any spillage;

MFE.6 - It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be removed immediately and the spillage directed to a suitable location;

MFE.7 - In the event of an accidental spillage outside the substance storage and equipment maintenance areas, a layer of absorbent material should be applied immediately and removal of the affected soils should be arranged to a suitable destination to be indicated by the entity responsible for environmental supervision, where no additional environmental damage will result;

MFE.8 - If erosive phenomena are identified, corrective solutions should be implemented, to be studied on a case-by-case basis, to control erosion;

MFE.9 - If applicable, the necessary water abstraction licences should be applied for.

11.6 SOILS AND LAND OCCUPATION

11.6.1 Construction phase

At the level of soil and land occupation, the implementation and practice of the general minimisation measures defined in subchapter 11.3 shall be ensured.

In addition, the following specific minimisation measures should be adopted:

MFC.81 - The layers of vegetable soil or live soil resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles;

MFC.82 - Carry out appropriate modelling of the slopes and cover them with vegetable soil. Place live soil to allow and stimulate the growth of native vegetation, with a view to conserving and/or rehabilitating habitats;

MFC.83 - In order to avoid situations where the soil remains uncovered for long periods of time, the works should be properly planned, i.e. immediately after a stripping action the coating works should take place. These actions should be carried out successively in small sections, in order to avoid stripping large areas at once;

MFC.84 - Controlled removal of all spoils from stripping, clearing/deforestation actions required for the implementation of the Project shall be ensured and may be used for soil fertilisation;

MFC.85 - Adequate decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils, vegetation and favouring the recovery of habitats.

11.6.2 Operation phase

In the operation phase, the main impacts on soils that can be minimised are related to the control of erosion phenomena.

11.7 ECOLOGY

11.7.1 Planning phase

Although there is no data for the study area of regular use by vultures or other species, threatened, if there are movements of these animals they will be in a north-south/south-north direction along the valley to the west of the study area. As such, wind turbines T1 and T2 are in an area of risk, as they are very close to the beginning of the slope, an area where thermals are formed that birds of prey use to rise in the landscape. For this reason, it is suggested, if possible, to relocate these 2 wind turbines.

Wind turbines T13 to T15 are also aligned north-south but further away from the valley and therefore less problematic. However, wind turbine T15 is in an area where the vegetation (acacia woodland) is recovering and harbours individuals of *Coptosperma nigrescens* so it would be advisable to avoid this area.

In general, the wind turbines that are on the east-west line are the ones that pose the least risk of mortality to fauna. However, it is recommended that, if technically possible, they should not be so far apart, because when faced with a line of wind turbines in a row, birds tend to go around the obstacles, whereas when they are far apart they tend to pass in the middle and thus increase the risk of collision.

11.7.2 Construction phase

At the level of flora, fauna and habitat, the implementation and practice of the general minimisation measures defined in subchapter 11.3 should be ensured, in addition, the following specific minimisation measures should be adopted:

MFC.86 - Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats;

MFC.87 - Avoid affecting areas of riparian vegetation;

MFC.88 - Concentrate site works in time, especially those that cause the most disruption;

MFC.89 - Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness raising);

MFC.90 - Avoid leaving roots uncovered and unprotected in trenches and excavations;

MFC.91 - Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve the largest number of trees and shrubs;

MFC.92 - The trees to be preserved and which are in the vicinity of the areas to be intervened must be identified and signposted before the start of the work and must be preserved until the end of the work that may cause damage to them;

MFC.93 - If the use of explosives proves necessary, pre-cutting techniques and the use of micro-retarders should be used, thus attenuating the intensity of the vibrations produced;

MFC.94 - Plan the timing of the works to minimise impacts on the different wildlife species relevant to this area;

MFC.95 - All tree and shrub species that do not affect the execution of the work must be safeguarded;

MFC.96 - Felling of trees with timber interest should be avoided, as well as marula trees, as they are an important source of food for the local community. Where possible, felling of these trees should be compensated by planting in a nearby area;

MFC.97 - Only the area of graminial strictly necessary should be affected;

MFC.98 - Affecting the remaining forest patch should be avoided;

MFC.99 - Affecting individuals of C*optosperma nigrescens* should be avoided;

MFC.100 - Wherever possible, the impact on agricultural areas should be avoided, minimising the loss of agricultural production services;

MFC.101 - Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds);

MFC.102 - Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats;

MFC.103 - Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.

11.7.3 Operation phase

MFE.10 - During the operation phase, maintenance actions should be carried out, namely:

- Areas that have been restored (areas that have been affected by the works or areas where environmental rehabilitation has been carried out). This will continue to prevent erosion, promote the re-establishment of vegetation units with conservation value and prevent the infestation of unwanted species such as exotic weed species;

- Accesses should be maintained to ensure a barrier to the spread of possible fires and to allow access and movement of fire-fighting vehicles;

- Watercourse protection strips: elimination of exotic weed species, correction of erosion hotspots, encouragement of natural regeneration.

MFE.11 - Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats;

MFE.12 - If considerable mortality of sensitive bat species, or very considerable mortality of other species, occurs, the adoption of more direct mortality risk minimisation measures, such as the use of acoustic deterrents to ward off chiropterans, should be assessed (Arnett *et al.*, 2013b).

11.8 LANDSCAPE

11.8.1 Construction phase

At landscape level, the implementation and practice of the general minimisation measures defined in subchapter 11.3 and the measures defined in the ecology subchapter should be ensured.

Regarding the visibility of the wind turbines, this will be a visible structure in the landscape and this aspect is not minimisable given the very characteristics and nature of the Project. However, also in this respect it can be stated that no situation of increased sensitivity has been identified.

11.8.2 Operation phase

At the level of the operation phase, the mitigation of some of the impacts on the landscape is already contemplated, since the construction areas were intervened in order to requalify their landscape. Thus, it is considered that the main landscape integration measures are limited to the maintenance of green spaces.

11.9 SOCIO-ECONOMY

11.9.1 Construction phase

The measures contained in the measures of general application to reduce noise and air emissions are also measures that are applied to promote the well-being of the population. In addition to these, the following measures are proposed:

MFC.104 - Employment principles and procedures should prioritise the hiring of skilled local workers, contributing to local job and wealth creation;

MFC.105 - Employment policies should ensure the principle of gender equality;

MFC.106 - Training should be provided for workers in order to promote their skills;

MFC.107 - In case there are local expectations for employment that cannot be met by the Project, the limited availability of places should be made known to stakeholders through local authorities and community representatives;

MFC.108 - Employment requirements should be transparent, following pre-established and recognised criteria, and properly advertised before the recruitment process starts and respected by the contractor, so as not to limit the opportunities to apply. For best impact on communities this process should be conducted with the involvement of local leaders;

MFC.109 - For each position, the exact number of jobs available, the period applicable and the remuneration to be awarded for each type of work should be disclosed;

MFC.110 - As much training as possible should be given to local workers to perform semi-skilled tasks, in order to reduce the number of workers hired from outside for this purpose;

MFC.111 - Specific lanes/routes and schedules should be defined for the circulation of heavy vehicles involved in the construction of the Namaacha Power Plant in order to reduce pressure on other roads and congestion at peak traffic times;

MFC.112 - Where necessary, repair roads damaged during the construction phase;

MFC.113 - Favour, whenever possible, the procurement of local or regional services, thus fostering the greatest added value for the local economy;

MFC.114 - Warn people living in and frequenting the areas most affected by the work about the timing of the work, especially to avoid constraints due to the increased movement of vehicles;

MFC.115 - Create safety areas with limited access and properly signposted, in order to reduce the risk of accidents, by the approach of people to the work area;

MFC.116 - There should be a group among the local workers responsible for communication with the community, which will be particularly important in cases of conflict. This group should be familiar with the Project in general and be able to properly iron out any difficulties or pass on any complaints/grievances;

MFC.117 - Develop and implement a Health and Safety Plan. This plan should include training plans for workers in the area of occupational health and safety;

MFC.118 - Provide Personal Protective Equipment (PPE) to all workers;

MFC.119 - The use of PPE will be mandatory (helmet, jacket, footwear, among others);

MFC.120 - Ensure that all construction vehicles and equipment (including mobile equipment) are suitable for the specific activity and comply with current legislation and standards. Regular maintenance of these should be carried out;

MFC.121 - All construction equipment must be operated by operators who have been previously trained and certified for this purpose;

MFC.122 - All temporary electrical installations should be assembled using the same safety specifications as for fixed electrical installations;

MFC.123 - All temporary electrical installations shall be inspected at least once a week by a competent person and this inspection shall be recorded;

MFC.124 - A competent person should be appointed for the control of temporary electrical installations on a construction site;

MFC.125 - All flammable liquids used on the construction site should be properly stored to prevent fire or explosion. The storage area should be well ventilated;

MFC.126 - Smoking will be prohibited on site and this information must be properly signposted;

MFC.127 - Suitable fire fighting equipment should be provided, this equipment should be well located and labelled on site.

11.9.2 Operation phase

MFE.13 - Favour, whenever possible, the procurement of services (maintenance, supply of materials, supply of goods and services) from local or regional companies, thus fostering permanent and indirect employment derived from the operation of the Namaacha Power Plant;

MFE.14 - Accessibility to the church which is between T6 and T2 should be ensured;

MFE.15 - Employment principles and procedures should, as far as possible, prioritise the hiring of qualified local workers, contributing to local job and wealth creation;

MFE.16 - Employment policies should ensure the principle of gender equality;

MFE.17 - Training should be provided for workers in order to promote their skills;

MFE.18 - Healthcare and safety measures shall be ensured for the workers of the Namaacha Power Plant, taking into account the specific risks of each position;

MFE.19 - Involve local community representatives in the management of the support and funding that will be given to social development activities that will be implemented in co-ordination with the District and local government.

11.10 AIR QUALITY

11.10.1 Construction phase

In terms of air quality, the implementation and practice of the general minimisation measures defined in subchapter 11.3 should be ensured.

11.10.2 Operation phase

For the operation phase, no minimisation measures are recommended to be implemented.

11.11 SOUND ENVIRONMENT

11.11.1 Construction phase

In addition to the general measures to reduce the discomfort of the population affected by construction noise, it is also recommended that the following be considered:

Noise and vibration awareness actions for all on-site personnel, including subcontractors as part of the general worksite induction;

MFC.128 - Noise and vibration awareness actions for all on-site personnel, including subcontractors as part of the general worksite induction;

MFC.129 - Reduce the amount of lorry movements required by carefully planning construction material needs;

MFC.130 - Do not leave vehicles running or idling on site for longer than the minimum time necessary to complete site activities. necessary to complete the activities on site.

11.11.2 Operation phase

MFE.20 - Regular/periodic and effective maintenance of vehicles, machinery and equipment to ensure that they are in good working order and their use does not generate excess noise/vibration;

MFE.21 - Control the speed of vehicles on the roads leading to the Namaacha Power Plant (30km/h).

11.12 ARCHITECTURAL, ARCHAEOLOGICAL AND ETHNOGRAPHIC HERITAGE

11.12.1 Construction phase

MFC.131 - Although no archaeological site has been identified within the intervention area, the existence of underground archaeological elements cannot be ruled out. The implementation of an Archaeological Fortuitous Finds Procedure will allow the safeguarding of any archaeological site or element that may be encountered during construction. Therefore, the Contractor shall implement an Archaeological Fortuitous Finds Procedure, during construction activities involving earth movements or deforestation. This Procedure should establish the methodology to be followed if a find is materialised and consider the obligation to report to the nearest Administrative Authority the identification of any element that may be classified as cultural heritage.

11.12.2 Operation phase

No measures are proposed for the operation phase.

11.13 WASTE MANAGEMENT

11.13.1 Construction phase

At the waste management level, the implementation and practice of the general minimisation measures defined in subchapter 11.3 should be ensured. In addition, the following specific minimisation measures should be adopted:

MFC.132 - The waste resulting from the various construction works (cardboard, plastic and metal packaging, frames, formwork, among others) must be temporarily stored in a container in the construction site area, for later transport to an authorised location;

MFC.133 - Waste shall be sent to appropriately licensed companies as described in subchapter 7.10 and Annex 6

MFC.134 - The segregated waste must be collected daily from the work fronts and temporarily stored on site, properly conditioned and in places specifically prepared for this purpose;

MFC.135 - Inert material from excavation operations should be deposited in the surroundings of the sites from which it was removed, to be subsequently used in backfilling operations;

MFC.136 - The site for the temporary waste storage facility should be clearly defined and labelled for this purpose. Access to this site should be restricted. Waste should be segregated and stored separately according to its characteristics and final destination. The storage locations for the different types of waste must be identified. The storage of waste on site must be done under appropriate conditions, as established in the applicable legislation in force,

MFC.137 - All waste classified as hazardous, namely waste oils, lubricants, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate place. The construction/implementation of a retention basin should be considered in order to minimise the impact of any spills. Subsequently, they should be taken for appropriate treatment by a company licensed for this purpose (list of waste operators - Annex 5);

MFC.138 - The temporary storage of waste oils and fuels should be carried out in a waterproofed and covered place, with an accidental spillage retention basin, separating used hydraulic and motor oils for differentiated management. Containers should be clearly labelled on the outside as to the different types of oil;

MFC.139 - The rejection of any type of waste into water lines or soil should be prohibited. Hazardous waste must be managed individually, in accordance with the law;

MFC.140 - Select companies for the treatment and final destination of the different segregated waste that are included in the lists of units accredited for this purpose;

MFC.141 - Provide the site with waste collection equipment in number, capacity and type, appropriate to the waste produced;

MFC.142 - Remove and properly dispose of solid and liquid waste produced on the construction site (list of waste operators - Annex 5).

11.13.2 Operation phase

For the operational phase, the following specific minimisation measures should be adopted:

MFE.22 - Waste must be stored in an appropriate manner, separating hazardous waste from non-hazardous waste, under technical conditions that prevent environmental contamination by the waste;

MFE.23 - The waste shall be sent to duly licensed companies as described in subchapter 7.10.1;

MFE.24 - The forwarding to a duly authorised final destination of the waste generated in these operations.

12 ENVIRONMENTAL MANAGEMENT PLAN

This Chapter is concerned with aspects related to the environmental monitoring and management of the Namaacha Power Plant and the procedures to be adopted in the different phases of the project.

Environmental monitoring is a concept defined in the current legislative framework for Environmental Impact Assessment and consists of a process of systematic observation and collection of data on the state of the environment or on the environmental effects caused by a project, and the respective periodic description of these effects through reports, with the aim of assessing the impacts caused by the implementation of the project and simultaneously evaluating the effectiveness of the minimisation measures provided for in the Environmental Impact Assessment procedure. The responsibility for implementing the monitoring plans lies with the developer. It is foreseen the implementation of monitoring plans in the phases prior to construction and construction, Air Quality and Sound Environment, Avifauna and Bats, in the phases prior to construction, construction and operation.

In addition, environmental management consists of the adoption of practices and procedures capable of contributing effectively to the minimisation of the negative impacts of the Project. The role of the Owner and the Contractor are crucial for a good performance in what concerns environmental management practices. To this end, three tools for the application of good practices and for the control of these good practices are produced in this EIA:

To this end, the Environmental Management Plan, prepared in accordance with Decree No. 54/2015 and IFC standards and relevant international legislation, is presented in this EIA in Annex 6.

This Plan includes the monitoring of impacts, the training plans to be developed, the communication plans, emergency, including accidents and the minimisation measures to be adopted in the different phases. It also includes:

- Environmental Monitoring Plan for the Works (PAAO);
- Waste Management Plan (WMP), and;
- Intervention Area Recovery Plan (PRAI).

The PAAO and the WMP act as a commitment by the Owner to ensure compliance with the minimisation measures set out in the Environmental Permit for the construction phase. In turn, the Owner will integrate the PAAO into the specifications of the CET construction contract, thus committing the Contractor to implement the minimisation measures contained therein.

The PAAO includes the minimisation measures for the construction phase (except the specific measures related to waste management).

The WMP integrates all minimisation measures related to waste management in the construction phase, and is, as mentioned, a complement to the PAAO.

The contractor may submit its own WMP, provided that it complies with the WMP measures included in this EIA.

The Environmental Monitoring of the Works itself will consist of an environmental technical assistance service, mainly aimed at monitoring the Contractor's implementation of the minimisation measures during the execution phase of the works. This supervision also covers archaeological monitoring.

The Environmental Monitoring of the Works should begin in the phase preceding the work, during its planning, and extend until the completion of construction, including all environmental requalification works.

The PRAI is also a complement to the PAAO. It identifies the sites where the recovery actions are to be carried out and defines how these actions are to be carried out. These actions should cover all areas that will be intervened during the work and where there will be no surface infrastructure during the operation phase, such as: the construction site and any complementary areas to support the work, access roads, the surroundings of the Substation/Control Building, the area along which the trenches were opened where the underground cables were installed, the surroundings of the wind turbine foundation sites, and the surroundings of the fence foundation sites.

The Environmental Management Plan also includes the need to develop and implement the following Plans:

- Environmental Management Plan;
- Resettlement Plan;
- Emergency Response Plan;
- Awareness Raising and Training Plan;
- Health and Safety Plan;

- Socio-economic Plan.

With regard to monitoring, it should be noted that there are areas where the acquisition of information in a systematic and controlled way, through specific monitoring actions, is of particular importance in order to ensure permanent control. This monitoring should be maintained as part of an environmental surveillance plan to identify potential impacts arising from the implementation of a given project, in order to proceed with the possible application of appropriate minimisation measures in a progressive and adjusted manner, according to the magnitude of these impacts. Gaining knowledge from monitoring plans can also contribute to the adoption of more appropriate techniques and methodologies for analysing environmental descriptors in future EIAs.

The negative environmental impacts identified for this Project are generally negligible and are further reduced by the adoption and implementation of the minimisation measures identified in the previous Chapter, focusing mainly on the construction phase. However, it is identified the need to implement Monitoring Plans in the phase prior to construction, construction and operation, for the descriptors Avifauna and Bats, and monitoring of Air Quality and noise environment only in case of occurrence of complaints by the population.

13 PUBLIC PARTICIPATION

The 1st Public Consultation was carried out on the basis of a "Draft" EPDA and ToR where it was disclosed to the public in general, and to Stakeholders (PI&A) in particular. The results of this public consultation were taken into account in the preparation of the final EPDA and ToR (which included the public consultation report in Annex 4) and which had the favourable opinion of MITADER.

Based on the opinion of MITADER and the approved ToR, the Draft EIA Report was prepared and subjected to a second public consultation in early December 2019 (see Annex 4 - Report of the 2nd Public Consultation). The results of this public consultation have been considered in the preparation of this Technical Report.

14 INFORMATION GAPS

During the preparation of this EIA, no knowledge gaps were identified that were essential for the correct assessment of the impacts arising from the Project and the proposal of the respective mitigating measures.

The existing data and those acquired in terms of targeted fieldwork were considered sufficient for a good characterisation of the baseline situation and consequent analysis of impacts and proposal of minimisation measures.

15 CONCLUSIONS

The purpose of this EIA was to assess the impacts of the implementation of the Namaacha Power Plant Project on the environmental, social and cultural factors of the area in which it is being developed, in order to enable the environmental authorities to take a decision on the possible environmental viability of the Project, and to propose appropriate measures for the Project and the site in question, with a view to minimising the negative effects and enhancing the positive effects.

The Project was born with the aim of harnessing Wind, a renewable resource, which together with other renewable natural resources that can be used for energy production, can contribute to the decarbonisation of the economy, fitting into the objectives set by the Country, in the environmental and energy policies advocated, but also at a global level, in order to enable the fulfilment of international commitments, in particular those relating to the limitation of greenhouse gas (GHG) emissions, with special emphasis on the targets set in the Paris Agreement, and resulting from the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21), signed by Mozambique on 22 April 2016.

The valorisation of renewable energies and the promotion of improved energy efficiency are fundamental instruments and unavoidable options, in order to make it possible to fulfil the commitments made.

Already in 2009, the Government of Mozambique, aware of the importance of promoting renewable energy as a way to contribute to the fight against climate change, approved the New and Renewable Energy Development Policy, having established as one of the strategic priorities for implementation the assessment of new and renewable energy resources.

In this context of resource assessment, the Policy and subsequently the Strategy for the Development of New and Renewable Energies, approved in 2011, established as measures to be developed, namely, the mapping of hydro, wind, solar, biomass, geothermal and maritime potential, as well as the identification and mapping of occurrence sites.

This project meets the country's expectations, as it is estimated to produce a quantity of energy (193.4 GWh/year) from a renewable source which, to be produced from a "conventional" source, would require an annual consumption of coal of about 52 626 tonnes or 30 187 million cubic metres of natural gas. Estimating emissions, it can be said that the Namaacha Power Plant will contribute annually to the non-emission of about 65 350 tonnes of CO_2 into the atmosphere, again if compared to the production of equivalent energy using natural gas, or the non-emission of about 154 658 tonnes of CO_2 per year, considering that the fuel used would be coal.

The Namaacha Power Plant Project is located in southern Mozambique, close to its border with South Africa and Swaziland, in Montes Libombos, Namaacha district, Maputo province, relatively close to the urban settlement of Vila da Namaacha. The total area of direct influence (AID) is about 855 hectares.

Currently, this area and its immediate surroundings have a strong anthropogenic presence, although the AID still has natural characteristics. But it is possible to see that the strong influence of human activity on the territory has altered the original landscape.

The identification of the potential environmental impacts of the Project was based on the consideration of its intrinsic characteristics and those inherent to its site, taking into account the experience and knowledge of environmental impacts caused by projects of this type and the previous experience of the technical team in carrying out environmental impact studies.

In the preparation of this Project, particular attention was paid to the existing land occupation, namely to the use that the population makes of the study area and to the search for the presence of species and habitats that reveal conservation value. It was found, however, that currently the use that the population makes of the area of direct influence is at the level of agriculture and some grazing. A church was also identified in the AID, which is considered to be a cultural element of some interest. These aspects have been taken into account whenever possible in the definition of the layout of the Power Plant.

The actions that will cause the greatest environmental impact are associated with the construction phase. However, it is considered that the expected impacts can be minimised through the adoption of mitigation measures and environmental care during the execution of the work, as indicated in the Environmental Management Plan.

As for the plant communities affected by the implementation of the Project, they are predominantly of low conservation and/or ecological value. It is expected that the Project under analysis will cause negative impacts on ecology, but these are not considered significant given the typology of the Project and the existence of replacement habitats in the surroundings.

In general, the impacts that the Project will have on the socio-economy in the construction phase will be beneficial, mainly at the local level.

Regional economic activity will benefit during the construction phase as a result of the dynamisation of the construction materials market. The mobilisation of construction companies and suppliers of materials and equipment are examples of the economic added value that the Project will bring. These impacts will be positive and significant at the regional level.

It is estimated that the Government of Mozambique will receive taxes associated with this Project for 25 years (period of operation of the Wind Power Plant), which is a significant positive impact at national level.

On the other hand, this project, with an expected investment of 310 million dollars, will have a very positive impact on the socio-economic level, with national repercussions.

Job creation in this phase is also usually considered as a positive impact. For the construction phase the number of workers will be around 250. For the operation of a power plant, a technical team is required for surveillance and maintenance assistance. For this purpose, 20 jobs are created.

The delivery of support and funding for social development activities is also a very significant positive impact. The involvement of the local community in the coordination of these supports is a relevant impact, of high magnitude and of local and regional scope.

It is understood that the main negative impacts are those arising from the possible inconvenience of the Power Plant on inhabited and productive areas (in addition to the noise levels caused, visual intrusion and the shadow effect are included). If it is not possible to relocate the wind turbines, a resettlement process should be implemented so that the families of the affected houses are compensated.

From the framework and taking into account the above, it is concluded that no critical situations were identified that could make the Project unfeasible, although some environmental concerns are justified, which could be strongly minimised by the adoption of the minimisation measures identified and proposed in this EIA. On the contrary, the positive impacts are relevant and should be enhanced, especially in terms of community involvement during the operation of the Project and the definition of training programmes.

Maputo, 23 de Novembro de 2020

Maria Margarida Rocha da Fonseca

Margarida Fonseca

Nuno Ferreira Matos

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Annex 1
CERTIFICATE OF ENVIRONMENTAL CONSULTANT

Republic of Mozambique

MINISTRY OF LAND, ENVIRONMENT AND RURAL DEVELOPMENT

ENVIRONMENTAL CONSULTANT CERTIFICATE

No. *05 / 2019*

The Ministry of Land, Environment and Rural Development (MITADER), under the Regulation on the Environmental Impact Assessment Process, approved by Decree No. 54/2015, of 31 December, certifies that Mr. (s) *Matos, Fonseca e Associados, Moçambique, Lda* is duly accredited to work as an Environmental Consultant in Mozambique.

Maputo, *01* / *02* /20*19*

Expiry date 01 / *02* /20*22*

The Minister
(Signed illegibly)

This Certificate is valid for a period of three (03) years and is governed by Decree No. 54/2015 of 31 December.

Renewal of the Environmental Consultant Certificate is conditional upon submission of an updated curriculum vitae and the original of the Consultant Certificate to be renewed.

The Environmental Consultant may not submit to the Environmental Impact Assessment Authority Environmental Impact Assessment files with expired Consultant Certificate, under penalty of a fine provided for in subparagraph a) of paragraph 4 of Article 28, of Decree No. 54/2015, of 31 December.

Address:

Province Maputo, District KaMfpumo
Av/Street Av. Patrice Lumumba, No. 747, 1st Floor- flat No. 3, Fax.
Telephone Mobile phone 863085706 / 847463111
E-mail: mfassociados@mfassociados.pt / Web: www.mfassociados.pt

Annex 2

DUAT

INDICAÇÕES DO REGISTO CADASTRAL

Extratos das inscrições e averbamentos feitos na conservatória do registo predial de ______________

A cerca do prédio descrito

Nº de Ordem	Inscrições	Averbamentos

DISPOSIÇÕES LEGAIS

TRANSCRIÇÕES DO REGULAMENTO DA LEI DE TERRAS (DECRETO N.º 66/98 DE 8 DE DEZEMBRO):

ARTº.13 – DIREITOS DOS TITULARES:

1. São direitos dos titulares do direito de uso e aproveitamento da terra, seja adquirido por ocupação, seja por autorização de um pedido:

a) Defender-se contra qualquer intrusão de uma segunda parte, nos termos da lei;

b) Ter acesso à sua parcela e aos recursos hídricos de uso público através das parcelas vizinhas, constituindo para o efeito as necessárias servidões.

2. Os requerentes ou titulares do direito de uso e aproveitamento da terra podem apresentar certidão de autorização provisória ou do título às instituições de crédito no contexto de pedidos de empréstimos.

ARTº 14 – DEVERES DOS TITULARES:

São deveres dos titulares do direito de uso e aproveitamento da terra , seja adquirido por ocupação, seja por autorização de um pedido:

a) Utilizar a terra respeitando os princípios definidos na Constituição e demais legislação em vigor e, no caso de exercício de actividades económicas em conformidade com o plano de exploração e de acordo com o definido na legislação relativa ao exercício da respectiva actividade;

b) Dar acesso através da sua parcela aos vizinhos que não tenham comunicação com a via pública ou com os recursos hídricos de uso público, constituindo para o efeito as necessárias servidões;

c) Respeitar as servidões constituídas e registadas nos termos do n.º 2 do Art.º 17 do presente regulamento e os direitos de acesso ou utilização pública com elas relacionados;

d) Permitir a execução de operações e/ ou a instalação de acessórios e equipamento conduzidas ao abrigo de licença de prospecção e pesquisa mineira, concessão mineira ou certificado mineiro, mediante justa indemnização;

e) Manter os marcos de fronteira, de triangulação, de demarcação cadastral e outros que sirvam de pontos de referência ou apoio situados na respectiva área;

f) Colaborar com os Serviços de Cadastro, Agrimensores Ajuramentados e Agentes de Fiscalização Sectorial.

Nº 2 e 3 do ARTº 30 – DEMARCAÇÃO:

2. Após a notificação, o requerente deverá proceder à demarcação no prazo de um ano, seja por via oficial, através dos Serviços de Cadastro, seja solicitando a aprovação do contrato com um agrimensor ajuramentado.

3. Findo o prazo de um ano sem que tenha sido apresentado o respectivo processo técnico e não tenha sido recebida uma justificação aceitável pelos Serviços de Cadastro, estes notificarão o requerente do iminente cancelamento da autorização provisória.

Nº 1 do ARTº 14 – TAXAS:

1. São devidas taxas de autorização e anuais, a pagar pelos requerentes e titulares do direito de uso e aproveitamento da terra.

TRANSCRIÇÕES DA LEI DE TERRAS (LEI Nº 19/97, DE 1 DE OUTUBRO)

ARTº 25 – AUTORIZAÇÃO PROVISÓRIA

1. Após a apresentação do pedido de uso e aproveitamento da terra, é emitida uma autorização provisória.

2. A autorização provisória tem uma duração máxima de cinco anos para as pessoas nacionais e de dois anos para as pessoas estrangeiras.

REPÚBLICA DE MOÇAMBIQUE

República de Moçambique

AUTORIZAÇÃO PROVISÓRIA DE USO E APROVEITAMENTO DA TERRA

Número: */024/SMP/2019/000943/1*

Província: *MAPUTO*

Distrito: *NAMAACHA*

Posto Administrativo: *NAMAACHA*

Parcela n.º: *SMP/2019/1188/0002*

Nome do titular: *Central Electrica da Namaacha, Sa*

REPÚBLICA DE MOÇAMBIQUE

República de Moçambique

AUTORIZAÇÃO PROVISÓRIA DE USO E APROVEITAMENTO DA TERRA

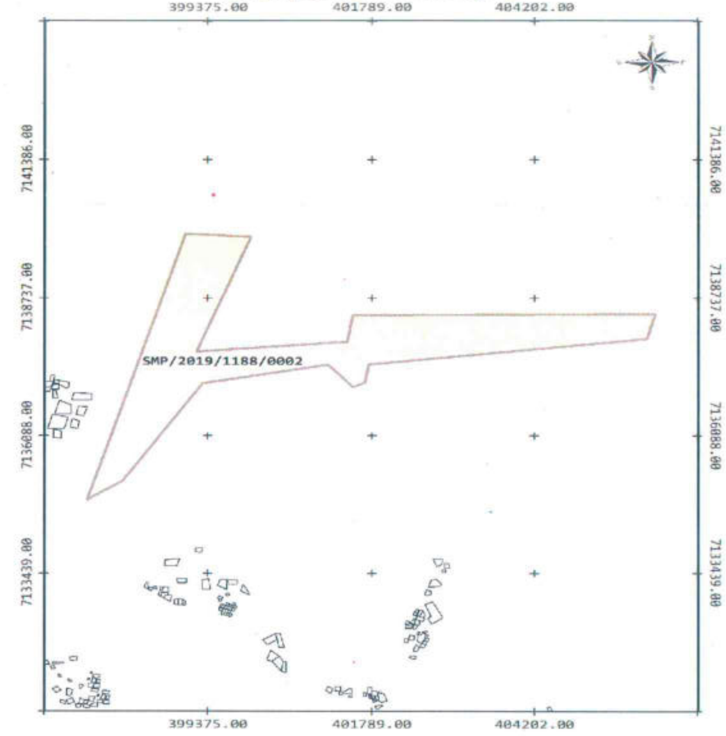
N.º do Título:	*/024/SMP/2019/000943/1*
Nome do Titular:	*Central Electrica da Namaacha, Sa*
Nacionalidade:	*Mocambicana*
Data do Despacho de Autorização Provisória:	*25/3/2019*
Parcela n.º:	*SMP/2019/1188/0002*
Com área (ha) de:	*855.6325*
Processo n.º:	*SMP/2019/000943*
Localizada na Província de:	*MAPUTO*
Distrito de:	*NAMAACHA*
Posto Administrativo de:	*NAMAACHA*
Fins de Uso e Aproveitamento:	*COMERCIO/INDUSTRIA/SERVICOS/OUTRA*
Prazo:	***28/3/2024***

Matola ____________________

O Chefe dos Serviços

Jossias Armando Cossa

Esboço de Localização



Sistema de coordenadas: WGS84 UTM Zona 36S Projeção: Transversa de Mercator   Escala 1:87 015

Nome do Requerente:
Central Electrica da Namaacha, Sa

Parcela: SMP/2019/1188/0002   Localidade: MAFUIANE

Provincia: MAPUTO   Finalidade: COMERCIO/INDUSTRIA/SERVICOS

Distrito: NAMAACHA   Área (ha): 855,6325

Annex 3

ECOLOGY

Appendix 3.1

List of flora species for the study area (Occurrence: X - potential; C - confirmed; Conservation status: LC – Least Concern [IUCN, 2019])

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
ACANTHACEAE	*Acanthospermum hispidum*	C			
ACANTHACEAE	*Asystasia sp.*	C			
ACANTHACEAE	*Barleria sp.*	C			
ACANTHACEAE	*Hygrophila auriculata*	X	LC		
ACANTHACEAE	*Hygrophila schulli*	X	LC		
ACANTHACEAE	*Hygrophila senegalensis*	X	LC		
ACANTHACEAE	*Hypoestes aristata*	X	LC		
AGAVACEAE	*Agave sisalana*	C			
ALISMATACEAE	*Burnatia enneandra*	X	LC		
ALISMATACEAE	*Limnophyton obtusifolium*	X	LC		
AMARANTHACEAE	*Alternanthera sessilis*	X	LC		
AMARANTHACEAE	*Centrostachys aquatica*	X	LC		
AMARYLLIDACEAE	*Boophane disticha*	C			
AMARYLLIDACEAE	*Crinum paludosum*	X	LC		
AMARYLLIDACEAE	*Scadoxus multiflorus*	C			
ANACARDIACEAE	*Lannea discolor*	C	LC		
ANACARDIACEAE	*Lannea zansibarica*	C			
ANACARDIACEAE	*Ozoroa obovata var. obovata*	C			
ANACARDIACEAE	*Ozoroa paniculosa var. paniculosa*	C	LC		
ANACARDIACEAE	*Sclerocarya birrea*	C			
ANACARDIACEAE	*Searsia gueinzii*	C	LC		
ANACARDIACEAE	*Searsia natalensis*	C	LC		
ANNONACEAE	*Uvaria caffra*	C			
APIACEAE	*Centela asiatica*	C			
APOCYNACEAE	*Catharanthus roseus*	C			
APOCYNACEAE	*Pachycarpus sp.*	C			
APOCYNACEAE	*Pachypodium saundersii*	C			
APOCYNACEAE	*Sarcostemma viminale*	C			
APONOGETONACEAE	*Aponogeton desertorum*	X	LC		
APONOGETONACEAE	*Aponogeton junceus*	X	LC		
APONOGETONACEAE	*Aponogeton rehmannii*	X	LC		

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
APONOGETONACEAE	*Aponogeton stuhlmannii*	X	LC		
ARACEAE	*Landoltia punctata*	X	LC		
ARACEAE	*Lemna aequinoctialis*	X	LC		
ARACEAE	*Lemna minor*	X	LC		
ARACEAE	*Pistia stratiotes*	X	LC		
ARACEAE	*Spirodela polyrhiza*	X	LC		
ARACEAE	*Stylochaeton natalensis*	C			
ARACEAE	*Zantedeschia albomaculata*	X	LC		
ARALIACEAE	*Cussonia zuluensis*	C	LC		
ARECACEAE	*Hyphaene coriacea*	C	LC		
ARECACEAE	*Phoenix reclinata*	C	LC		
ASPARAGACEAE	*Asparagus africanus*	C			
ASPARAGACEAE	*Asparagus falcatus*	C			
ASPHODELACEAE	*Aloe marlothii subsp. orientalis*	C	LC		
ASPHODELACEAE	*Aloe spicata*	C			
ASPHODELACEAE	*Aloe zebrina*	C	LC		
ASPHODELACEAE	*Haworthia sp.*	C			
ASPLENIACEAE	*Asplenium sp.*	C			
ASTERACEAE	*Acmella caulirhiza*	X	LC		
ASTERACEAE	*Adenostemma caffrum*	X	LC		
ASTERACEAE	*Adenostemma mauritianum*	X	LC		
ASTERACEAE	*Adenostemma perrotetii*	X			
ASTERACEAE	*Ageratum conyzoides*	X	LC		
ASTERACEAE	*Brachylaena discolor*	C	LC		
ASTERACEAE	*Conyza aegyptiaca*	X	LC		
ASTERACEAE	*Conyza gouanii*	X	LC		
ASTERACEAE	*Cotula anthemoides*	X	LC		
ASTERACEAE	*Crassocephalum picridifolium*	X	LC		
ASTERACEAE	*Dicoma sp.*	C			
ASTERACEAE	*Eclipta prostrata*	X	LC		
ASTERACEAE	*Enydra fluctuans*	X	LC		
ASTERACEAE	*Ethulia conyzoides*	X	LC		
ASTERACEAE	*Flaveria bidentis*	X	LC		
ASTERACEAE	*Gazania krebsiana subsp. krebsiana*	C			
ASTERACEAE	*Gerbera sp.*	C			
ASTERACEAE	*Gnaphalium polycaulon*	X			
ASTERACEAE	*Grangea maderaspatana*	X	LC		

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
ASTERACEAE	*Hilliardiella oligocephala*	C	LC		
ASTERACEAE	*Litogyne gariepina*	X	LC		
ASTERACEAE	*Pseudognaphalium luteoalbum*	C	LC		
ASTERACEAE	*Senecio madagascariensis*	C			
ASTERACEAE	*Senecio viminalis*	C			
ASTERACEAE	*Sphaeranthus peduncularis*	X	LC		
ASTERACEAE	*Vernonia colorata*	C	LC		
ASTERACEAE	*Vernonia natalensis*	C			
BIGNONIACEAE	*Kigelia africana*	C	LC		
BURSERACEAE	*Commiphora africana var. africana*	C	LC		
CABOMBACEAE	*Brasenia schreberi*	X	LC		
CACTACEAE	*Opuntia ficus-indica*	C			
CAPPARACEAE	*Boscia albitrunca*	C			
CAPPARACEAE	*Boscia foetida*	C	LC		
CAPPARACEAE	*Capparis tomentosa*	C			
CAPPARACEAE	*Maerua angolensis*	C	LC		
CAPPARACEAE	*Maerua edulis*	C			
CARICACEAE	*Carica papaya*	C			
CASUARINACEAE	*Casuarina equisetifolia*	C			
CELASTRACEAE	*Gymnosporia heterophylla*	C			
CELASTRACEAE	*Maytenus heterophylla*	C			
CELASTRACEAE	*Mystroxylon aethiopicum*	C	LC		
CELTIDACEAE	*Celtis africana*	C			
CERATOPHYLLACEAE	*Ceratophyllum demersum*	X	LC		
CERATOPHYLLACEAE	*Ceratophyllum muricatum*	X	LC		
CLUSIACEAE	*Garcinia livingstonei*	C			
COMBRETACEAE	*Combretum apiculatum*	C	LC		
COMBRETACEAE	*Combretum hereroense subsp. hereroense*	C	LC		
COMBRETACEAE	*Combretum imberbe*	C	LC		
COMBRETACEAE	*Combretum molle*	C	LC		
COMBRETACEAE	*Combretum zeyheri*	C	LC		
COMBRETACEAE	*Terminalia phanerophlebia*	C			
COMMELINACEAE	*Aneilema sp.*	C			
COMMELINACEAE	*Commelina sp.*	C			
CONVOLVULACEAE	*Ipomoea batatas*	C			

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
CUCURBITACEAE	*Cucumis zeyheri*	C			
CUCURBITACEAE	*Momordica balsamina*	C			
CURCUBITACEAE	*Citrullus lanatus*	C			
CYPERACEAE	*Ascolepis capensis*	X	LC		
CYPERACEAE	*Bolboschoenus glaucus*	X	LC		
CYPERACEAE	*Cladium mariscus*	X	LC		
CYPERACEAE	*Cyperus amabilis*	X	LC		
CYPERACEAE	*Cyperus articulatus*	X	LC		
CYPERACEAE	*Cyperus bulbosus*	X	LC		
CYPERACEAE	*Cyperus clavinux*	X	LC		
CYPERACEAE	*Cyperus colymbetes*	X	LC		
CYPERACEAE	*Cyperus compressus*	X	LC		
CYPERACEAE	*Cyperus denudatus*	X	LC		
CYPERACEAE	*Cyperus difformis*	X	LC		
CYPERACEAE	*Cyperus glaucophyllus*	X	LC		
CYPERACEAE	*Cyperus papyrus*	X	LC		
CYPERACEAE	*Cyperus rotundus*	X	LC		
CYPERACEAE	*Cyperus sphaerospermus*	X	LC		
CYPERACEAE	*Cyperus squarrosus*	X	LC		
CYPERACEAE	*Eleocharis dregeana*	X	LC		
CYPERACEAE	*Mariscus sp.*	C			
CYPERACEAE	*Schoenoplectus muricinux*	X	LC		
DIOSCOREACEAE	*Dioscorea sp.*	C			
DIPSACACEAE	*Scabiosa columbaria*	C			
DRACAENACEAE	*Sansevieria hyacinthoides*	C			
DROSERACEAE	*Drosera indica*	X	LC		
EBENACEAE	*Diospyros dichrophylla*	C			
EBENACEAE	*Diospyros inhacaensis*	C	LC		
EBENACEAE	*Diospyros villosa*	C			
EBENACEAE	*Euclea daphnoides*	C			
EBENACEAE	*Euclea divinorum*	C			
EBENACEAE	*Euclea natalensis*	C			
EBENACEAE	*Euclea undulata*	C			
EHRETIACEAE	*Ehretia amoena*	C	LC		
EHRETIACEAE	*Ehretia rigida*	C			
ERYTHROXYLACEAE	*Erythroxylum delagoense*	C			
EUPHORBIACEAE	*Euphorbia confinalis var. confinalis*	C			

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
EUPHORBIACEAE	*Jatropha sp.*	C			
EUPHORBIACEAE	*Manihot esculenta*	C			
EUPHORBIACEAE	*Tragia sp.*	C			
FABACEAE	*Abrus precatorius subsp. africanus*	C			
FABACEAE	*Acacia borleae*	C			
FABACEAE	*Acacia burkei*	C			
FABACEAE	*Acacia karoo*	C			
FABACEAE	*Acacia nilotica subsp. kraussiana*	C	LC		
FABACEAE	*Acacia tortilis subsp. heteracantha*	C			
FABACEAE	*Aeschynomene indica*	X	LC		
FABACEAE	*Afzelia quanzensis*	C			
FABACEAE	*Albizia adiathifolia var. adianthifolia*	C			
FABACEAE	*Albizia anthelmitica*	C			
FABACEAE	*Albizia versicolor*	C			
FABACEAE	*Bauhinia galpinii*	C			
FABACEAE	*Bolusanthus speciosus*	C			
FABACEAE	*Dichrostachys cinerea subsp. africana*	C	LC		
FABACEAE	*Elephantorrhiza elephantina*	C			
FABACEAE	*Eriosema sp.*	C			
FABACEAE	*Erythrina caffra*	C			
FABACEAE	*Erythrina humeana*	C			
FABACEAE	*Mundulea sericea*	C	LC		
FABACEAE	*Neptunia oleracea*	X	LC		
FABACEAE	*Ormocarpum kirki*	C	LC		
FABACEAE	*Peltophorum africanum*	C	LC		
FABACEAE	*Phaseolus vulgaris*	C			
FABACEAE	*Philenoptera violacea*	C	LC		
FABACEAE	*Schotia brachypetala*	C			
FABACEAE	*Senna petersiana*	C	LC		
FABACEAE	*Sesbania bispinosa*	X	LC		
FABACEAE	*Thephrosia sp.*	C			
FABACEAE	*Tylosema fassoglense*	C			
FABACEAE	*Vigna unguiculata*	C			
FLACOURTIACEAE	*Dovialis caffra*	C			
HALORAGACEAE	*Laurembergia repens spp. brachypoda*	X	LC		
HALORAGACEAE	*Laurembergia tetrandra*	X	LC		
HALORAGACEAE	*Myriophyllum spicatum*	X	LC		

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
HYDROCHARITACEAE	*Blyxa aubertii*	X	LC		
HYDROCHARITACEAE	*Lagarosiphon cordofanus*	X	LC		
HYDROCHARITACEAE	*Najas graminea*	X	LC		
HYDROCHARITACEAE	*Najas horrida*	X	LC		
HYDROCHARITACEAE	*Najas marina*	X	LC		
HYDROCHARITACEAE	*Najas pectinata*	X	LC		
HYDROCHARITACEAE	*Vallisneria spiralis*	X	LC		
HYPOXIDACEAE	*Hypoxis hemerocallidea*	C			
ICACINACEAE	*Apodytes dimidiata subsp. dimidiata*	C			
ISOETACEAE	*Isoetes alstonii*	X	LC		
ISOETACEAE	*Isoetes schweinfurthii*	X	LC		
ISOETACEAE	*Isoetes welwitschii*	X	LC		
JUNCACEAE	*Juncus dregeanus*	X	LC		
JUNCACEAE	*Juncus dregeanus ssp. dregeanus*	X	LC		
JUNCACEAE	*Juncus effusus*	X	LC		
JUNCACEAE	*Juncus hybridus*	X	LC		
JUNCACEAE	*Juncus lomatophyllus*	X	LC		
JUNCACEAE	*Juncus oxycarpus*	X	LC		
JUNCACEAE	*Juncus punctorius*	X	LC		
JUNCACEAE	*Juncus rigidus*	X	LC		
LAMIACEAE	*Clerodendrum glabrum*	C			
LAMIACEAE	*Hoslundia opposita*	C			
LAMIACEAE	*Lantana camara*	C			
LAMIACEAE	*Lantana rugosa*	C			
LAMIACEAE	*Leonotis leonurus*	C			
LAMIACEAE	*Lippia javanica*	C			
LAMIACEAE	*Vitex sp.*	C			
LYTHRACEAE	*Galpinia transvaalica*	C			
MALVACEAE	*Cienfuegosia drummondii*	C			
MALVACEAE	*Corchorus sp.*	C			
MALVACEAE	*Dombeya cymosa*	C			
MALVACEAE	*Grewia bicolor*	C			
MALVACEAE	*Grewia sulcata*	C			

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
MALVACEAE	*Hibiscus sp.*	C			
MALVACEAE	*Melhania forbesii*	C			
MARSILEACEAE	*Marsilea aegyptiaca*	X	LC		
MARSILEACEAE	*Marsilea coromandelina*	X	LC		
MARSILEACEAE	*Marsilea ephippiocarpa*	X	LC		
MARSILEACEAE	*Marsilea farinosa*	X	LC		
MARSILEACEAE	*Marsilea fenestrata*	X	LC		
MARSILEACEAE	*Marsilea minuta*	X	LC		
MARSILEACEAE	*Marsilea subterranea*	X	LC		
MELIACEAE	*Trichilia emetica*	C	LC		
MELIACEAE	*Turraea obtusifolia*	C			
MENISPERMACEAE	*Cissampelos mucronata*	C			
MENYANTHACEAE	*Nymphoides forbesiana*	X	LC		
MENYANTHACEAE	*Nymphoides indica*	X	LC		
MENYANTHACEAE	*Nymphoides rautanenii*	X	LC		
MORACEAE	*Ficus glumosa*	C			
MORACEAE	*Ficus natalensis subsp. natalensis*	C	LC		
MORACEAE	*Ficus sycomorus subsp. sycomorus*	C	LC		
MORACEAE	*Maclura africana*	C			
MYRTACEAE	*Eucalyptus sp.*	C			
MYRTACEAE	*Psidium guajava*	C			
MYRTACEAE	*Syzygium cordatum*	C	LC		
MYRTACEAE	*Syzygium cumini*	C	LC		
NYMPHAEACEAE	*Nymphaea lotus*	X	LC		
NYMPHAEACEAE	*Nymphaea nouchali*	X	LC		
OCHNACEAE	*Ochna sp.*	C			
OLACACEAE	*Olax dissitiflora*	C	LC		
OLACACEAE	*Ximenia americana var. microphylla*	C	LC		
OLACACEAE	*Ximenia caffra*	C			
OLEACEAE	*Jasminum fluminense*	C			
OLEACEAE	*Olea europea subsp. africana*	C			
ORCHIDACEAE	*Eulophia speciosa*	C	LC		
OROBANCHACEAE	*Cycnium tubulosum*	X	LC		
OROBANCHACEAE	*Melasma scabrum var. scabrum*	X	LC		
OROBANCHACEAE	*Striga sp.*	C			
PHYLLANTHACEAE	*Antidesma venosum*	C	LC		
PHYLLANTHACEAE	*Bridelia cathartica*	C	LC		

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
PHYLLANTHACEAE	*Flueggea verrucosa*	C			
PHYLLANTHACEAE	*Phyllanthus reticulatus*	C			
PINACEAE	*Pinus sp.*	C			
PLANTAGINACEAE	*Plantago longissima*	X	LC		
POACEAE	*Cymbopogon excavatus*	C			
POACEAE	*Cympopogon citratus*	C			
POACEAE	*Cynodon dactylon*	C			
POACEAE	*Digitaria eriantha*	C			
POACEAE	*Eragrostis ciliares*	C			
POACEAE	*Eragrostis superba*	C			
POACEAE	*Hyperthelia dissoluta*	C			
POACEAE	*Melinis repens*	C			
POACEAE	*Oryza longistaminata*	X	LC		
POACEAE	*Panicum deustum*	C			
POACEAE	*Panicum maximum*	C			
POACEAE	*Pennisetum natalense*	X	LC		
POACEAE	*Setaria incrassata*	C			
POACEAE	*Sporobolus africanus*	C			
POACEAE	*Themeda triandra*	C			
POACEAE	*Urochloa mosambicensis*	C			
POACEAE	*Zea mays*	C			
PODOSTEMACEAE	*Tristicha trifaria*	X	LC		
POLYGALACEAE	*Polygala sp.*	C			
POTAMOGETONACEAE	*Potamogeton crispus*	X	LC		
POTAMOGETONACEAE	*Potamogeton octandrus*	X	LC		
POTAMOGETONACEAE	*Potamogeton pusillus*	X	LC		
POTAMOGETONACEAE	*Potamogeton richardii*	X	LC		
POTAMOGETONACEAE	*Potamogeton schweinfurthii*	X	LC		
POTAMOGETONACEAE	*Potamogeton trichoides*	X	LC		
POTAMOGETONACEAE	*Stuckenia pectinata*	X	LC		
POTAMOGETONACEAE	*Zannichellia palustris*	X	LC		
PROTEACEAE	*Grevillea robusta*	C			

Family	Scientific Name	Occurrence	Status	Endemism	Wildlife Law Regulation
PTERIDACEAE	*Pellaea viridis*	C			
RHAMNACEAE	*Berchemia zeyheri*	C			
RHAMNACEAE	*Ziziphus mucronata subsp. mucronata*	C	LC		
RUBIACEAE	*Canthium inerme*	C			
RUBIACEAE	*Catunaregam obovata*	C	LC		
RUBIACEAE	*Coptosperma littorale*	C			
RUBIACEAE	*Coptosperma nigrescens*	C		X	
RUBIACEAE	*Gardenia volkensii subsp. volkensii*	C	LC		
RUBIACEAE	*Hyperacanthus microphyllus*	C			
RUBIACEAE	*Kraussia floribunda*	C			
RUBIACEAE	*Lagynias lasiantha*	C			
RUBIACEAE	*Paveta edentula*	C			
RUBIACEAE	*Psychotria sp.*	C			
RUBIACEAE	*Pterocarpus rotundifolius subsp. rotundifolius*	C	LC		
RUBIACEAE	*Randia rudis*	C			
RUBIACEAE	*Tarenna junodii*	C			
RUBIACEAE	*Vangueria infausta*	C	LC		
RUTACEAE	*Vepris sp.*	C			
RUTACEAE	*Zathoxylum humile*	C			
SALVINIACEAE	*Azolla pinnata*	X	LC		
SAPINDACEAE	*Pappea capensis*	C			
SAPOTACEAE	*Manilkara discolor*	C			
SAPOTACEAE	*Mimusops zeyheri*	C	LC		
SAPOTACEAE	*Sideroxylon inerme*	C			
SCROPHULARIACEAE	*Bacopa monnieri*	X	LC		
SOLANACEAE	*Solanum campylacanthum*	C			
STRYCHNACEAE	*Strychnos madagascariensis*	C	LC		
TRAPACEAE	*Trapa natans*	X	LC		
TYPHACEAE	*Typha capensis*	X	LC		
TYPHACEAE	*Typha domingensis*	X	LC		
VELLOZIACEAE	*Xerophyta retinervis*	C			
VITACEAE	*Cissus quadrangularis*	C			
VITACEAE	*Cissus rotundifolia*	C			
VITACEAE	*Rhoicissus revoilii*	C			
VITACEAE	*Rhoicissus tridentata*	C			

Appendix 3.2

List of freshwater fish species for the study area (Conservation status: LC - Least Concern, NT - Near Threatened, DD - Insufficient Information, VU - Vulnerable, EN - Endangered [IUCN, 2019])

Family	Scientific Name	Status	Restricted distribution	Migratory
ALESTIDAE	*Brycinus imberi*	LC		
ALESTIDAE	*Hydrocynus vittatus*	LC	X	
ALESTIDAE	*Micralestes acutidens*	LC		
AMPHILIIDAE	*Amphilius uranoscopus*	LC		
ANABANTIDAE	*Ctenopoma multispine*	LC		
ANGUILLIDAE	*Anguilla bengalensis ssp. labiata*	LC		X
ANGUILLIDAE	*Anguilla bicolor ssp. bicolor*	LC		X
ANGUILLIDAE	*Anguilla marmorata*	LC		X
ANGUILLIDAE	*Anguilla mossambica*	LC		X
CICHLIDAE	*Chetia brevis*	EN		
CICHLIDAE	*Oreochromis mossambicus*	NT		
CICHLIDAE	*Pseudocrenilabrus philander ssp. philander*	LC		
CICHLIDAE	*Serranochromis meridianus*			
CICHLIDAE	*Tilapia rendalli*			
CICHLIDAE	*Tilapia sparrmanii*			
CLARIIDAE	*Clarias gariepinus*	LC		
CYPRINIDAE	*Barbus afrohamiltoni*	LC		
CYPRINIDAE	*Barbus annectens*	LC		
CYPRINIDAE	*Barbus anoplus*	LC		
CYPRINIDAE	*Barbus eutaenia*	LC		
CYPRINIDAE	*Barbus paludinosus*	LC		
CYPRINIDAE	*Barbus radiatus*	LC		X
CYPRINIDAE	*Barbus sp. nov. 'viviparus cf. Mozambique'*		X	
CYPRINIDAE	*Barbus trimaculatus*	LC		
CYPRINIDAE	*Barbus unitaeniatus*	LC		
CYPRINIDAE	*Barbus viviparus*	LC		
CYPRINIDAE	*Labeo congoro*	LC		
CYPRINIDAE	*Labeo cylindricus*	LC		
CYPRINIDAE	*Labeo molybdinus*	LC		
CYPRINIDAE	*Labeo rosae*	LC		
CYPRINIDAE	*Labeo ruddi*	DD		
CYPRINIDAE	*Labeobarbus marequensis*	LC		
CYPRINIDAE	*Mesobola brevianalis*	LC		
CYPRINIDAE	*Opsaridium peringueyi*	LC		
GOBIIDAE	*Croilia mossambica*	LC	X	
GOBIIDAE	*Glossogobius biocellatus*	LC		
GOBIIDAE	*Glossogobius callidus*	LC		

Family	Scientific Name	Status	Restricted distribution	Migratory
GOBIIDAE	*Mugilogobius mertoni*	LC		
GOBIIDAE	*Oligolepis acutipinnis*	LC		
GOBIIDAE	*Redigobius dewaali*	LC		
GOBIIDAE	*Silhouettea sibayi*	EN		
KUHLIIDAE	*Kuhlia rupestris*	LC		X
MEGALOPIDAE	*Megalops cyprinoides*	LC		
MOCHOKIDAE	*Chiloglanis emarginatus*	VU		
MOCHOKIDAE	*Chiloglanis paratus*	LC		
MOCHOKIDAE	*Chiloglanis pretoriae*	LC		
MOCHOKIDAE	*Chiloglanis swierstrai*	LC		
MOCHOKIDAE	*Synodontis zambezensis*			
MORMYRIDAE	*Marcusenius pongolensis*	LC		
MORMYRIDAE	*Petrocephalus wesselsi*	LC		
MUGILIDAE	*Liza dumerili*	LC		
OPHICHTHIDAE	*Pisodonophis boro*	LC		X
POECILIIDAE	*Aplocheilichthys johnstoni*	LC		
PROTOPTERIDAE	*Protopterus annectens*	LC		
SCHILBEIDAE	*Schilbe intermedius*	LC		
SYNGNATHIDAE	*Hippichthys heptagonus*	LC		

Appendix 3.3

List of amphibian species for the study area (Occurrence: X - potential, C - confirmed; Conservation status: LC - Least Concern [IUCN, 2019])

Family	Scientific Name	Occurrence	Status	Restricted distribution
HYPEROLIIDAE	*Afrixalus aureus*	X	LC	
HYPEROLIIDAE	*Afrixalus delicatus*	X	LC	
HYPEROLIIDAE	*Afrixalus fornasini*	X	LC	
PYXICEPHALIDAE	*Amietia delalandii*	X	LC	
PYXICEPHALIDAE	*Amietia quecketti*	X	LC	
PYXICEPHALIDAE	*Amietia poyntoni*	X	LC	
ARTHROLEPTIDAE	*Arthroleptis stenodactylus*	X	LC	
BREVICIPITIDAE	*Breviceps adspersus*	X	LC	
BREVICIPITIDAE	*Breviceps mossambicus*	X	LC	
PYXICEPHALIDAE	*Cacosternum boettgeri*	X	LC	
PYXICEPHALIDAE	*Cacosternum nanum*	X	LC	
RHACOPHORIDAE	*Chiromantis xerampelina*	X	LC	
HEMISOTIDAE	*Hemisus marmoratus*	X	LC	
PTYCHADENIDAE	*Hildebrandtia ornata*	X	LC	
HYPEROLIIDAE	*Hyperolius argus*	X	LC	
HYPEROLIIDAE	*Hyperolius marmoratus*	X	LC	
HYPEROLIIDAE	*Hyperolius poweri*	X	LC	
HYPEROLIIDAE	*Hyperolius pusillus*	X	LC	
HYPEROLIIDAE	*Hyperolius tuberilinguis*	X	LC	
HYPEROLIIDAE	*Kassina maculata*	X	LC	
HYPEROLIIDAE	*Kassina senegalensis*	X	LC	
ARTHROLEPTIDAE	*Leptopelis mossambicus*	X	LC	
PHRYNOBATRACHIDAE	*Phrynobatrachus acridoides*	X	LC	
PHRYNOBATRACHIDAE	*Phrynobatrachus mababiensis*	X	LC	
PHRYNOBATRACHIDAE	*Phrynobatrachus natalensis*	X	LC	
MICROHYLIDAE	*Phrynomantis bifasciatus*	X	LC	
BUFONIDAE	*Poyntonophrynus fenoulheti*	X	LC	
PTYCHADENIDAE	*Ptychadena anchietae*	X	LC	
PTYCHADENIDAE	*Ptychadena mascareniensis*	X	LC	
PTYCHADENIDAE	*Ptychadena mossambica*	X	LC	
PTYCHADENIDAE	*Ptychadena oxyrhynchus*	X	LC	
PTYCHADENIDAE	*Ptychadena taenioscelis*	X	LC	X
PYXICEPHALIDAE	*Pyxicephalus edulis*	X	LC	
BUFONIDAE	*Schismaderma carens*	C	LC	
BUFONIDAE	*Sclerophrys capensis*	X	LC	
BUFONIDAE	*Sclerophrys garmani*	C	LC	
BUFONIDAE	*Sclerophrys gutturalis*	C	LC	
BUFONIDAE	*Sclerophrys maculatus*	X	LC	

Family	Scientific Name	Occurrence	Status	Restricted distribution
BUFONIDAE	*Sclerophrys pusilla*	X	LC	
PYXICEPHALIDAE	*Tomopterna cryptotis*	X	LC	
PYXICEPHALIDAE	*Tomopterna krugerensis*	X	LC	
PYXICEPHALIDAE	*Tomopterna marmorata*	X	LC	
PYXICEPHALIDAE	*Tomopterna natalensis*	X	LC	
PIPIDAE	*Xenopus laevis*	X	LC	
PIPIDAE	*Xenopus muelleri*	X	LC	

Appendix 3.4

List of reptile species for the study area (Occurrence: X - potential, C - confirmed; Conservation status: LC - Least Concern, NT - Near Threatened, VU - Vulnerable [IUCN, 2019]).

Family	Scientific Name	Occurrence	Status	Restricted distribution	Wildlife Law Regulation
AGAMIDAE	*Acanthocercus atricollis*	X	LC		
AGAMIDAE	*Agama armata*	X	-		
AMPHISBAENIDAE	*Monopeltis decosteri*	X	-		
AMPHISBAENIDAE	*Monopeltis sphenorhynchus*	X	-		
AMPHISBAENIDAE	*Zygaspis vandami*	X	-		
ATRACTASPIDIDAE	*Amblyodipsas concolor*	X	LC		
ATRACTASPIDIDAE	*Amblyodipsas microphthalma*	X	LC		
ATRACTASPIDIDAE	*Amblyodipsas polylepis*	X	-		
ATRACTASPIDIDAE	*Aparallactus capensis*	X	LC		
ATRACTASPIDIDAE	*Aparallactus lunulatus*	X	-		
CHAMAELEONIDAE	*Chamaeleo dilepis*	X	LC		
COLUBRIDAE	*Crotaphopeltis hotamboeia*	X	-		
COLUBRIDAE	*Dasypeltis scabra*	X	LC		
COLUBRIDAE	*Dipsadoboa aulica*	X	-		
COLUBRIDAE	*Dispholidus typus*	X	-		
COLUBRIDAE	*Meizodon semiornatus*	X	-		
COLUBRIDAE	*Philothamnus angolensis*	X	-		
COLUBRIDAE	*Philothamnus hoplogaster*	X	-		
COLUBRIDAE	*Philothamnus natalensis*	X	LC		
COLUBRIDAE	*Philothamnus semivariegatus*	X	-		
COLUBRIDAE	*Telescopus semiannulatus*	X	-		
COLUBRIDAE	*Thelotornis capensis*	X	LC		
CORDYLIDAE	*Cordylus tropidosternum*	X	-		
CORDYLIDAE	*Platysaurus maculatus*	C	LC	X	
CORDYLIDAE	*Smaug warreni*	X	LC	X	
CROCODYLIDAE	*Crocodylus niloticus*	X	LC		X
ELAPIDAE	*Dendroaspis angusticeps*	X	-		
ELAPIDAE	*Dendroaspis polylepis*	X	LC		
ELAPIDAE	*Elapsoidea boulengeri*	X	-		
ELAPIDAE	*Elapsoidea sunderwallii*	X	-		
ELAPIDAE	*Hemachatus haemachatus*	X	LC		
ELAPIDAE	*Naja annulifera*	X	-		
ELAPIDAE	*Naja melanoleuca*	X	-		
ELAPIDAE	*Naja mossambica*	X	-		
GEKKONIDAE	*Chondrodactylus turneri*	C	-		
GEKKONIDAE	*Hemidactylus mabouia*	X	-		

Family	Scientific Name	Occurrence	Status	Restricted distribution	Wildlife Law Regulation
GEKKONIDAE	*Homopholis wahlbergii*	X	LC	X	
GEKKONIDAE	*Lygodactylus capensis*	X	-		
GEKKONIDAE	*Pachydactylus maculatus*	X	LC		
GEKKONIDAE	*Pachydactylus vansoni*	X	LC		
GERRHOSAURIDAE	*Gerrhosaurus flavigularis*	X	-		
GERRHOSAURIDAE	*Gerrhosaurus major*	X	-		
GERRHOSAURIDAE	*Gerrhosaurus nigrolineatus*	X	-		
GERRHOSAURIDAE	*Gerrhosaurus validus*	X	-		
GERRHOSAURIDAE	*Tetradactylus africanus*	X	-	X	
LACERTIDAE	*Ichnotropis capensis*	X	-		
LACERTIDAE	*Ichnotropis squamulosa*	X	-		
LACERTIDAE	*Nucras holubi*	C	-		
LACERTIDAE	*Nucras intertexta*	X	-		
LACERTIDAE	*Nucras ornata*	X	-		
LAMPROPHIIDAE	*Atractaspis bibronii*	X	-		
LAMPROPHIIDAE	*Gonionotophis capensis*	X	-		
LAMPROPHIIDAE	*Gracililima nyassae*	X	LC		
LAMPROPHIIDAE	*Hemirhagerrhis nototaenia*	X	-		
LAMPROPHIIDAE	*Lamprophis fuliginosus*	X	-		
LAMPROPHIIDAE	*Lamprophis guttatus*	X	LC		
LAMPROPHIIDAE	*Lycodonomorphus obscuriventris*	X	-		
LAMPROPHIIDAE	*Lycodonomorphus rufulus*	X	-		
LAMPROPHIIDAE	*Lycophidion variegatum*	X	-		
LAMPROPHIIDAE	*Prosymna ambigua*	X	LC		
LAMPROPHIIDAE	*Prosymna bivittata*	X	-		
LAMPROPHIIDAE	*Prosymna janii*	X	LC		
LAMPROPHIIDAE	*Prosymna stuhlmannii*	X	-		
LAMPROPHIIDAE	*Psammophis brevirostris*	X	-		
LAMPROPHIIDAE	*Psammophis mossambicus*	X	-		
LAMPROPHIIDAE	*Psammophis subtaeniatus*	C	LC		
LAMPROPHIIDAE	*Pseudaspis cana*	X	-		
LAMPROPHIIDAE	*Rhamphiophis rostratus*	X	-		
LEPTOTYPHLOPIDAE	*Leptotyphlops distanti*	X	LC	X	
LEPTOTYPHLOPIDAE	*Leptotyphlops incognitus*	X	-		
LEPTOTYPHLOPIDAE	*Leptotyphlops telloi*	X	NT	X	
PELOMEDUSIDAE	*Pelusios castanoides*	X	LC		
PELOMEDUSIDAE	*Pelusios sinuatus*	X	-		
PSEUDOXYRHOPHIIDAE	*Duberria variegata*	X	LC		
PYTHONIDAE	*Python natalensis*	X	-		X
SCINCIDAE	*Acontias plumbeus*	X	LC		

Family	Scientific Name	Occurrence	Status	Restricted distribution	Wildlife Law Regulation
SCINCIDAE	*Mochlus sundevallii*	X	LC		
SCINCIDAE	*Panaspis wahlbergii*	X	-		
SCINCIDAE	*Scelotes mossambicus*	X	LC		
SCINCIDAE	*Trachylepis striata*	C	-		
SCINCIDAE	*Trachylepis depressa*	X	-		
SCINCIDAE	*Trachylepis varia*	C	-		
TESTUDINIDAE	*Kinixys natalensis*	C	VU	X	
TESTUDINIDAE	*Kinixys spekii*	X	-		
TESTUDINIDAE	*Stigmochelys pardalis*	X	LC		
TYPHOLOPIDAE	*Afrotyphlops schlegelii*	X	-		
TYPHOLOPIDAE	*Rhinotyphlops lalandei*	X	-		
TYPHOLOPIDAE	*Thyphlops fornasinii*	X	-	X	
VARANIDAE	*Varanus albigularis*	X	-		X
VARANIDAE	*Varanus niloticus*	X	-		X
VIPERIDAE	*Bitis arietans*	X	-		
VIPERIDAE	*Causus defilippii*	X	-		
VIPERIDAE	*Causus rhombeatus*	X	-		

Appendix 3.5

List of bird species for the study area (Occurrence: P - likely, PP - unlikely, C - confirmed; Endemism: E-SA - endemic to Southern Africa, QE-SA - Nearly endemic to Southern Africa; Conservation status: LC - Least Concern, DD - Insufficient Information, NT - Near Threatened, VU - Vulnerable, EN - Endangered, CR - Critically Endangered [IUCN 2019]). - Vulnerable, EN - Endangered, CR - Critically Endangered [IUCN, 2019], Migratory: MT - Total migrator, MA - Highland migrator, N – Nomadic).

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Struthionidae	*Struthio camelus*	Common Ostrich	P	LC	-	-	-	-	II
Numididae	*Numida meleagris*	Helmeted guineafowl	C	LC	-	-	-	-	-
Numididae	*Guttera pucherani*	Crested guineafowl	P	LC	-	-	-	-	-
Numididae	*Guttera edouardi*	Southern Crested Guineafowl	P	LC	-	-	-	-	-
Phasianidae	*Coturnix coturnix*	Common quail	C	LC	-	-	MT	-	-
Phasianidae	*Coturnix delegorguei*	Harlequin quail	P	LC	-	-	-	-	-
Phasianidae	*Synoicus adansonii*	Blue quail	PP	LC	-	-	-	-	-
Phasianidae	*Pternistis natalensis*	Natal spurfowl	P	LC	-	-	-	-	-
Phasianidae	*Pternistis afer*	Red-necked spurfowl	P	LC	-	-	-	-	-
Phasianidae	*Pternistis swainsonii*	Swainson's spurfowl	P	LC	-	-	-	-	-
Phasianidae	*Dendroperdix sephaena*	Crested francolin	C	LC	-	-	-	-	-
Phasianidae	*Peliperdix coqui*	Coqui francolin	P	LC	-	-	-	-	-
Phasianidae	*Scleroptila shelleyi*	Shelley's francolin	C	LC	-	-	-	-	-
Anatidae	*Dendrocygna viduata*	White-faced whistling duck	PP	LC	-	-	MT	CD	-
Anatidae	*Dendrocygna bicolor*	Fulvous whistling duck	P	LC	-	-	MT	CD	-
Anatidae	*Thalassornis leuconotus*	White-backed duck	PP	LC	-	-	-	CD	-
Anatidae	*Alopochen aegyptiaca*	Egyptian Goose	P	LC	-	-	-	CD	-
Anatidae	*Plectropterus gambensis*	Spur-winged goose	PP	LC	-	-	MT	CD	-
Anatidae	*Sarkidiornis melanotos*	Knob-billed duck	PP	LC	-	-	MT	CD	-

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Anatidae	*Nettapus auritus*	African pygmy goose	PP	LC	-	-	-	CD	-
Anatidae	*Netta erythrophthalma*	Southern pochard	PP	LC	-	-	-	CD	-
Anatidae	*Spatula hottentota*	Blue-billed teal	PP	LC	-	-	-	CD	-
Anatidae	*Anas sparsa*	African black duck	PP	LC	-	-	-	CD	-
Anatidae	*Anas undulata*	Yellow-billed duck	P	LC	-	-	N	CD	-
Anatidae	*Anas capensis*	Cape teal	P	LC	-	-	N	CD	-
Anatidae	*Anas erythrorhyncha*	Red-billed teal	PP	LC	-	-	-	CD	-
Podicipedidae	*Tachybaptus ruficollis*	Little grebe	PP	LC	-	-	MT	CD	-
Podicipedidae	*Podiceps cristatus*	Great crested grebe	PP	LC	-	-	MT	CD	-
Phoenicopteridae	*Phoenicopterus roseus*	Greater flamingo	PP	LC	-	-	MT	CD	II
Phoenicopteridae	*Phoeniconaias minor*	Lesser flamingo	PP	NT	-	-	N	CD	II
Columbidae	*Columba livia*	Rock dove	P	LC	-	-	-	-	-
Columbidae	*Columba arquatrix*	African olive pigeon	P	LC	-	-	-	-	-
Columbidae	*Aplopelia larvata*	Lemon dove	P	LC	-	-	-	-	-
Columbidae	*Streptopelia decipiens*	Mourning collared dove	P	LC	-	-	-	-	-
Columbidae	*Streptopelia semitorquata*	Red-eyed dove	C	LC	-	-	MT	-	-
Columbidae	*Streptopelia capicola*	Ring-necked dove	C	LC	-	-	MT	-	-
Columbidae	*Spilopelia senegalensis*	Laughing dove	C	LC	-	-	MT	-	-
Columbidae	*Turtur chalcospilos*	Emerald-spotted wood dove	P	LC	-	-	-	-	-
Columbidae	*Turtur tympanistria*	Tambourine dove	P	LC	-	-	MT	-	-
Columbidae	*Oena capensis*	Namaqua dove	P	LC	-	-	MT	-	-
Columbidae	*Treron calvus*	African green pigeon	P	LC	-	-	-	-	-
Columbidae	*Treron delalandii*	Grey-breasted Green Pigeon	P	LC	-	-	-	-	-
Caprimulgidae	*Caprimulgus europaeus*	European Nightjar	P	LC	-	-	MT	-	-
Caprimulgidae	*Caprimulgus pectoralis*	Fiery-necked nightjar	P	LC	-	-	-	-	-
Caprimulgidae	*Caprimulgus tristigma*	Freckled Nightjar	P	LC	-	-	-	-	-

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Caprimulgidae	*Caprimulgus fossii*	Square-tailed nightjar	C	LC	-	-	MT	-	-
Apodidae	*Telacanthura ussheri*	Mottled spinetail	P	LC	-	-	-	-	-
Apodidae	*Cypsiurus parvus*	African Palm swift	P	LC	-	-	-	-	-
Apodidae	*Apus caffer*	White-rumped swift	C	LC	-	-	MT	-	-
Apodidae	*Apus horus*	Horus Swift	PP	LC	-	-	-	-	-
Apodidae	*Apus affinis*	Little Swift	C	LC	-	-	MT	-	-
Apodidae	*Apus barbatus*	African black swift	P	LC	-	-	MT	-	-
Apodidae	*Apus apus*	Common swift	P	LC	-	-	MT	-	-
Cuculidae	*Centropus superciliosus*	White-browed coucal	C	LC	-	-	-	-	-
Cuculidae	*Centropus grillii*	Black coucal	P	LC	-	-	-	-	-
Cuculidae	*Ceuthmochares australis*	Green Malkoha	P	LC	-	-	-	-	-
Cuculidae	*Clamator jacobinus*	Jacobin cuckoo	C	LC	-	-	MT	-	-
Cuculidae	*Clamator levaillantii*	Levaillant's cuckoo	P	LC	-	-	MT	-	-
Cuculidae	*Clamator glandarius*	Great spotted cuckoo	P	LC	-	-	MT	-	-
Cuculidae	*Pachycoccyx audeberti*	Thick-billed cuckoo	P	LC	-	-	-	-	-
Cuculidae	*Chrysococcyx klaas*	Klaas's cuckoo	C	LC	-	-	MT	-	-
Cuculidae	*Chrysococcyx cupreus*	African Emerald cuckoo	P	LC	-	-	MT	-	-
Cuculidae	*Chrysococcyx caprius*	Diederik cuckoo	C	LC	-	-	MT	-	-
Cuculidae	*Cuculus solitarius*	Red-chested cuckoo	C	LC	-	-	MT	-	-
Cuculidae	*Cuculus clamosus*	Black cuckoo	P	LC	-	-	MT	-	-
Cuculidae	*Cuculus canorus*	Common cuckoo	P	LC	-	-	MT	-	-
Cuculidae	*Cuculus gularis*	African cuckoo	P	LC	-	-	MT	-	-
Heliornithidae	*Podica senegalensis*	African finfoot	PP	LC	-	-	-	CD	-
Rallidae	*Sarothrura elegans*	Buff-spotted flufftail	PP	LC	-	-	MA	-	-
Rallidae	*Sarothrura rufa*	Red-chested flufftail	PP	LC	-	-	-	-	-
Rallidae	*Sarothrura affinis*	Striped flufftail	PP	LC	-	-	MA	-	-
Rallidae	*Rallus caerulescens*	African rail	PP	LC	-	-	-	CD	-

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Rallidae	*Crex egregia*	African crake	P	LC	-	-	MT	CD	-
Rallidae	*Crex crex*	Corn crake	P	LC	-	-	MT	CD	-
Rallidae	*Porzana porzana*	Spotted crake	PP	LC	-	-	MT	CD	-
Rallidae	*Zapornia flavirostra*	Black crake	PP	LC	-	-	-	CD	-
Rallidae	*Zapornia pusilla*	Baillon's crake	PP	LC	-	-	MT	CD	-
Rallidae	*Porphyrio porphyrio*	Western swamphen	PP	LC	-	-	-	CD	-
Rallidae	*Porphyrio alleni*	Allen's gallinule	PP	LC	-	-	MT	CD	-
Rallidae	*Gallinula chloropus*	Common Moorhen	PP	LC	-	-	MT	CD	-
Rallidae	*Gallinula angulata*	Lesser Moorhen	PP	LC	-	-	-	CD	-
Rallidae	*Fulica cristata*	Red-knobbed coot	PP	LC	-	-	-	CD	-
Gruidae	*Balearica regulorum*	Grey crowned crane	PP	EN	-	-	-	CD	-
Otididae	*Lissotis melanogaster*	Black-bellied bustard	P	LC	-	-	-	-	-
Otididae	*Lophotis ruficrista*	Red-crested korhaan	P	LC	-	-	-	-	-
Otididae	*Eupodotis senegalensis*	White-bellied bustard	P	LC	-	-	-	-	-
Musophagidae	*Corythaixoides concolor*	Grey go-away-bird	P	LC	-	-	-	-	-
Musophagidae	*Gallirex porphyreolophus*	Purple-crested turaco	C	LC	-	-	-	-	-
Ciconiidae	*Leptoptilos crumenifer*	Marabou stork	P	LC	-	-	-	CD	II
Ciconiidae	*Mycteria ibis*	Yellow-billed stork	P	LC	-	-	MT	CD	II
Ciconiidae	*Anastomus lamelligerus*	African openbill	PP	LC	-	-	MT	CD	II
Ciconiidae	*Ciconia nigra*	Black stork	PP	LC	-	-	MT	CD	II
Ciconiidae	*Ciconia abdimii*	Abdim's Stork	P	LC	-	-	MT	CD	II
Ciconiidae	*Ciconia microscelis*	African woolly-necked stork	P	LC	-	-	-	CD	II
Ciconiidae	*Ciconia ciconia*	White stork	P	LC	-	-	MT	CD	II
Ciconiidae	*Ephippiorhynchus senegalensis*	Saddle-billed stork	PP	LC	-	-	-	CD	II
Threskiornithidae	*Platalea alba*	African Spoonbill	PP	LC	-	-	N	CD	-
Threskiornithidae	*Threskiornis aethiopicus*	African sacred ibis	P	LC	-	-	MT	CD	-

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Threskiornithidae	*Bostrychia hagedash*	Hadada ibis	P	LC	-	-	-	CD	-
Threskiornithidae	*Plegadis falcinellus*	Glossy ibis	PP	LC	-	-	MT	CD	-
Ardeidae	*Botaurus stellaris*	Eurasian bittern	PP	LC	-	-	MT	CD	II
Ardeidae	*Ixobrychus minutus*	Little bittern	PP	LC	-	-	MT	CD	II
Ardeidae	*Ixobrychus sturmii*	Dwarf bittern	P	LC	-	-	MT	CD	II
Ardeidae	*Calherodius leuconotus*	White-backed Night-heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Nycticorax nycticorax*	Black-crowned night heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Butorides striata*	Striated heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Ardeola ralloides*	Squacco heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Ardeola rufiventris*	Rufous-bellied Heron	PP	LC	-	-	-	CD	II
Ardeidae	*Bubulcus ibis*	Cattle egret	C	LC	-	-	MT	CD	II
Ardeidae	*Ardea cinerea*	Grey Heron	P	LC	-	-	MT	CD	II
Ardeidae	*Ardea melanocephala*	Black-headed Heron	C	LC	-	-	MT	CD	II
Ardeidae	*Ardea goliath*	Goliath heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Ardea purpurea*	Purple Heron	PP	LC	-	-	MT	CD	II
Ardeidae	*Ardea alba*	Great Egret	PP	LC	-	-	MT	CD	II
Ardeidae	*Ardea brachyrhyncha*	Yellow-billed egret	P	LC	-	-	-	CD	II
Ardeidae	*Ardea intermedia*	Intermediate Egret	P	LC	-	-	MT	CD	II
Ardeidae	*Egretta ardesiaca*	Black heron	P	LC	-	-	-	CD	II
Ardeidae	*Egretta vinaceigula*	Slaty egret	PP	VU	-	-	-	CD	II
Ardeidae	*Egretta garzetta*	Little Egret	PP	LC	-	-	MT	CD	II
Scopidae	*Scopus umbretta*	Hamerkop	P	LC	-	-	-	CD	-
Pelecanidae	*Pelecanus rufescens*	Pink-backed pelican	PP	LC	-	-	-	CD	-
Pelecanidae	*Pelecanus onocrotalus*	Great White Pelican	PP	LC	-	-	MT	CD	II
Phalacrocoracidae	*Microcarbo africanus*	Reed cormorant	PP	LC	-	-	-	CD	-

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Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant	C	LC	-	-	MT	CD	-
Anhingidae	*Anhinga rufa*	African darter	PP	LC	-	-	-	CD	-
Burhinidae	*Burhinus vermiculatus*	water thick-knee	PP	LC	-	-	-	CD	-
Burhinidae	*Burhinus capensis*	spotted thick-knee	C	LC	-	-	-	CD	-
Recurvirostridae	*Recurvirostra avosetta*	pied avocet	PP	LC	-	-	MT	CD	-
Recurvirostridae	*Himantopus himantopus*	black-winged stilt	PP	LC	-	-	MT	CD	-
Charadriidae	*Charadrius hiaticula*	common ringed plover	PP	LC	-	-	MT	CD	-
Charadriidae	*Charadrius pecuarius*	Kittlitz's plover	PP	LC	-	-	-	CD	-
Charadriidae	*Charadrius tricollaris*	three-banded plover	C	LC	-	-	-	CD	-
Charadriidae	*Charadrius marginatus*	white-fronted plover	PP	LC	-	-	-	CD	-
Charadriidae	*Charadrius mongolus*	Siberian sand plover	PP	LC	-	-	MT	CD	-
Charadriidae	*Vanellus crassirostris*	long-toed lapwing	PP	LC	-	-	-	CD	-
Charadriidae	*Vanellus armatus*	blacksmith lapwing	P	LC	-	-	-	CD	-
Charadriidae	*Vanellus lugubris*	Senegal lapwing	P	LC	-	-	MT	CD	-
Charadriidae	*Vanellus melanopterus*	black-winged lapwing	P	LC	-	-	MA	CD	-
Charadriidae	*Vanellus coronatus*	crowned lapwing	C	LC	-	-	-	CD	-
Charadriidae	*Vanellus senegallus*	African wattled lapwing	P	LC	-	-	-	CD	-
Rostratulidae	*Rostratula benghalensis*	greater painted-snipe	PP	LC	-	-	-	CD	-
Jacanidae	*Actophilornis africanus*	African jacana	PP	LC	-	-	N	CD	-
Jacanidae	*Microparra capensis*	lesser jacana	PP	LC	-	-	-	CD	-
Scolopacidae	*Calidris pugnax*	Ruff	PP	LC	-	-	MT	CD	-
Scolopacidae	*Calidris ferruginea*	curlew sandpiper	PP	NT	-	-	MT	CD	-
Scolopacidae	*Calidris minuta*	little stint	PP	LC	-	-	MT	CD	-
Scolopacidae	*Gallinago nigripennis*	African snipe	PP	LC	-	-	MA	CD	-
Scolopacidae	*Xenus cinereus*	Terek sandpiper	PP	LC	-	-	MT	CD	-
Scolopacidae	*Actitis hypoleucos*	common sandpiper	PP	LC	-	-	MT	CD	-

Family	Scientific Name	Common name	Occurrence	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Scolopacidae	*Tringa ochropus*	green sandpiper	P	LC	-	-	MT	CD	-
Scolopacidae	*Tringa nebularia*	common greenshank	PP	LC	-	-	MT	CD	-
Scolopacidae	*Tringa glareola*	wood sandpiper	PP	LC	-	-	MT	CD	-
Scolopacidae	*Tringa stagnatilis*	marsh sandpiper	PP	LC	-	-	MT	CD	-
Turnicidae	*Turnix sylvaticus*	common buttonquail	P	LC	-	-	-	-	-
Turnicidae	*Turnix nanus*	Black-rumped buttonquail	P	LC	-	-	MT	-	-
Glareolidae	*Rhinoptilus chalcopterus*	bronze-winged courser	P	LC	-	-	MT	CD	-
Glareolidae	*Cursorius temminckii*	Temminck's courser	C	LC	-	-	N	CD	-
Glareolidae	*Glareola pratincola*	collared pratincole	P	LC	-	-	MT	CD	-
Laridae	*Larus cirrocephalus*	grey-headed gull	PP	LC	-	-	MT	CD	II
Laridae	*Larus fuscus*	lesser black-backed gull	PP	LC	-	-	MT	CD	II
Laridae	*Hydroprogne caspia*	Caspian tern	PP	LC	-	-	MT	CD	II
Laridae	*Chlidonias hybrida*	whiskered tern	PP	LC	-	-	MT	CD	II
Laridae	*Chlidonias leucopterus*	white-winged tern	P	LC	-	-	MT	CD	II
Tytonidae	*Tyto alba*	barn owl	C	LC	-	-	-	-	-
Strigidae	*Glaucidium perlatum*	pearl-spotted owlet	P	LC	-	-	-	-	II
Strigidae	*Glaucidium capense*	African barred owlet	P	LC	-	-	-	-	II
Strigidae	*Otus senegalensis*	African scops owl	P	LC	-	-	-	-	II
Strigidae	*Ptilopsis granti*	southern white-faced owl	P	LC	-	-	-	-	II
Strigidae	*Asio capensis*	marsh owl	P	LC	-	-	MT	-	II
Strigidae	*Strix woodfordii*	African wood owl	P	LC	-	-	-	-	II
Strigidae	*Bubo africanus*	spotted eagle-owl	C	LC	-	-	-	-	II
Strigidae	*Bubo lacteus*	Verreaux's eagle-owl	P	LC	-	-	-	-	II
Strigidae	*Scotopelia peli*	Pel's Fishing-owl	PP	LC	-	-	-	-	II
Sagittariidae	*Sagittarius serpentarius*	secretarybird	P	VU	-	-	N	-	II
Pandionidae	*Pandion haliaetus*	Osprey	P	LC	-	-	MT	CD	II
Accipitridae	*Elanus caeruleus*	Black-winged kite	C	LC	-	-	-	-	II

Family	Scientific Name	Common name	Occurren	Status	Endemism	Restricted distribution	Migrator	Congregatory	Wildlife Law Regulation
Accipitridae	*Pernis apivorus*	European honey buzzard	P	LC	-	-	MT	CD	II
Accipitridae	*Aviceda cuculoides*	African cuckoo-hawk	P	LC	-	-	MT	-	II
Accipitridae	*Polyboroides typus*	African harrier-hawk	C	LC	-	-	-	-	II
Accipitridae	*Gypohierax angolensis*	palm-nut vulture	PP	LC	-	-	MT	-	II
Accipitridae	*Terathopius ecaudatus*	Bateleur	C	NT	-	-	-	-	II
Accipitridae	*Circaetus pectoralis*	black-chested snake eagle	C	LC	-	-	N	-	II
Accipitridae	*Circaetus cinereus*	Brown snake eagle	C	LC	-	-	MT	-	II
Accipitridae	*Circaetus fasciolatus*	Southern banded snake eagle	PP	NT	-	-	-	-	II
Accipitridae	*Trigonoceps occipitalis*	White-headed vulture	P	CR	-	-	-	-	II
Accipitridae	*Necrosyrtes monachus*	Hooded vulture	P	CR	-	-	-	-	II
Accipitridae	*Gyps africanus*	White-backed vulture	P	CR	-	-	-	-	II
Accipitridae	*Gyps coprotheres*	Cape vulture	P	EN	E-SA	-	MT	CD	II
Accipitridae	*Torgos tracheliotos*	Lappet-faced vulture	P	EN	-	-	-	-	II
Accipitridae	*Macheiramphus alcinus*	Bat hawk	P	LC	-	-	-	-	II
Accipitridae	*Stephanoaetus coronatus*	Crowned eagle	P	NT	-	-	-	-	II
Accipitridae	*Polemaetus bellicosus*	Martial eagle	C	VU	-	-	-	-	II
Accipitridae	*Lophaetus occipitalis*	Long-crested eagle	P	LC	-	-	-	-	II
Accipitridae	*Clanga pomarina*	Lesser spotted eagle	P	LC	-	-	MT	CD	II
Accipitridae	*Aquila rapax*	Tawny eagle	C	VU	-	-	-	CD	II
Accipitridae	*Aquila nipalensis*	Steppe eagle	P	EN	-	-	MT	CD	II
Accipitridae	*Aquila spilogaster*	African hawk-eagle	P	LC	-	-	-	-	II
Accipitridae	*Hieraaetus wahlbergi*	Wahlberg's eagle	P	LC	-	-	MT	-	II
Accipitridae	*Hieraaetus pennatus*	Booted eagle	P	LC	-	-	MT	CD	II
Accipitridae	*Hieraaetus ayresii*	Ayres's hawk-eagle	P	LC	-	-	MT	-	II
Accipitridae	*Kaupifalco monogrammicus*	Lizard buzzard	P	LC	-	-	-	-	II
Accipitridae	*Melierax metabates*	Dark chanting goshawk	C	LC	-	-	-	-	II
Accipitridae	*Micronisus gabar*	Gabar goshawk	P	LC	-	-	-	-	II

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Accipitridae	*Circus ranivorus*	African marsh harrier	PP	LC	-	-	-	-	II
Accipitridae	*Circus pygargus*	Montagu's Harrier	P	LC	-	-	MT	CD	II
Accipitridae	*Accipiter tachiro*	African goshawk	P	LC	-	-	-	-	II
Accipitridae	*Accipiter badius*	Shikra	P	LC	-	-	MT	-	II
Accipitridae	*Accipiter minullus*	Little sparrowhawk	P	LC	-	-	-	-	II
Accipitridae	*Accipiter ovampensis*	Ovambo sparrowhawk	P	LC	-	-	N	-	II
Accipitridae	*Accipiter melanoleucus*	Black sparrowhawk	P	LC	-	-	-	-	II
Accipitridae	*Haliaeetus vocifer*	African fish eagle	P	LC	-	-	-	-	II
Accipitridae	*Milvus migrans*	Black kite	C	LC	-	-	MT	CD	II
Accipitridae	*Buteo rufofuscus*	Jackal buzzard	P	LC	E-SA	-	-	-	II
Accipitridae	*Buteo buteo*	Common buzzard	C	LC	-	-	MT	CD	II
Coliidae	*Colius striatus*	Speckled mousebird	C	LC	-	-	-	-	-
Coliidae	*Urocolius indicus*	Red-faced mousebird	C	LC	-	-	-	-	-
Trogonidae	*Apaloderma narina*	Narina trogon	P	LC	-	-	MA	-	-
Bucerotidae	*Bucorvus leadbeateri*	Southern ground hornbill	P	VU	-	-	-	-	II
Bucerotidae	*Lophoceros nasutus*	African grey hornbill	P	LC	-	-	-	-	-
Bucerotidae	*Lophoceros alboterminatus*	Crowned hornbill	P	LC	-	-	-	-	-
Bucerotidae	*Tockus leucomelas*	Southern yellow-billed hornbill	P	LC	QE-SA	-	-	-	-
Bucerotidae	*Tockus erythrorhynchus*	Northern red-billed hornbill	P	LC	-	-	-	-	-
Bucerotidae	*Bycanistes bucinator*	Trumpeter hornbill	C	LC	-	-	-	-	-
Upupidae	*Upupa epops*	Eurasian hoopoe	C	LC	-	-	MT	-	-
Phoeniculidae	*Phoeniculus purpureus*	Green wood hoopoe	P	LC	-	-	-	-	-
Phoeniculidae	*Rhinopomastus cyanomelas*	Common scimitarbill	P	LC	-	-	-	-	-
Meropidae	*Merops bullockoides*	White-fronted bee-eater	P	LC	-	-	-	-	-
Meropidae	*Merops nubicoides*	Southern carmine bee-eater	P	LC	-	-	MT	CD	-

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Meropidae	*Merops persicus*	Blue-cheeked bee-eater	P	LC	-	-	MT	-	-
Meropidae	*Merops apiaster*	European bee-eater	C	LC	-	-	MT	CD	-
Meropidae	*Merops pusillus*	Little bee-eater	C	LC	-	-	-	-	-
Coraciidae	*Coracias naevius*	Purple roller	P	LC	-	-	MT	-	-
Coraciidae	*Coracias caudatus*	Lilac-breasted roller	P	LC	-	-	-	-	-
Coraciidae	*Coracias garrulus*	European roller	P	LC	-	-	MT	-	-
Coraciidae	*Eurystomus glaucurus*	Broad-billed roller	P	LC	-	-	MT	-	-
Alcedinidae	*Ispidina picta*	African pygmy kingfisher	P	LC	-	-	MT	-	-
Alcedinidae	*Corythornis cristatus*	Malachite kingfisher	P	LC	-	-	-	-	-
Alcedinidae	*Alcedo semitorquata*	Half-collared kingfisher	P	LC	-	-	-	-	-
Alcedinidae	*Megaceryle maxima*	Giant kingfisher	P	LC	-	-	-	-	-
Alcedinidae	*Ceryle rudis*	Pied kingfisher	P	LC	-	-	-	-	-
Alcedinidae	*Halcyon leucocephala*	Grey-headed kingfisher	P	LC	-	-	MT	-	-
Alcedinidae	*Halcyon albiventris*	Brown-hooded kingfisher	C	LC	-	-	-	-	-
Alcedinidae	*Halcyon chelicuti*	Striped kingfisher	P	LC	-	-	-	-	-
Alcedinidae	*Halcyon senegalensis*	Woodland kingfisher	P	LC	-	-	MT	-	-
Alcedinidae	*Halcyon senegaloides*	Mangrove kingfisher	P	LC	-	-	MT	-	-
Lybiidae	*Trachyphonus vaillantii*	Crested barbet	P	LC	-	-	-	-	-
Lybiidae	*Stactolaema leucotis*	White-eared barbet	P	LC	-	-	-	-	-
Lybiidae	*Pogoniulus bilineatus*	Yellow-rumped tinkerbird	P	LC	-	-	-	-	-
Lybiidae	*Pogoniulus pusillus*	Red-fronted tinkerbird	P	LC	-	-	-	-	-
Lybiidae	*Pogoniulus chrysoconus*	Yellow-fronted tinkerbird	P	LC	-	-	-	-	-
Lybiidae	*Tricholaema leucomelas*	Acacia pied barbet	P	LC	QE-SA	-	-	-	-
Lybiidae	*Lybius torquatus*	Black-collared barbet	C	LC	-	-	-	-	-
Indicatoridae	*Prodotiscus regulus*	Brown-backed honeybird	P	LC	-	-	-	-	-
Indicatoridae	*Indicator minor*	Lesser honeyguide	C	LC	-	-	-	-	-

Family	Scientific Name	Common Name	Occurrence	Status	Endemism	Restricted Distribution	Migrator	Congregatory	Wildlife Law Regulation
Indicatoridae	*Indicator variegatus*	Scaly-throated honeyguide	P	LC	-	-	-	-	-
Indicatoridae	*Indicator indicator*	Greater honeyguide	P	LC	-	-	-	-	-
Picidae	*Campethera bennettii*	Bennett's woodpecker	P	LC	-	-	-	-	-
Picidae	*Campethera abingoni*	Golden-tailed woodpecker	P	LC	-	-	-	-	-
Picidae	*Dendropicos fuscescens*	Cardinal woodpecker	P	LC	-	-	-	-	-
Picidae	*Dendropicos namaquus*	Bearded woodpecker	P	LC	-	-	-	-	-
Picidae	*Dendropicos griseocephalus*	Olive woodpecker	P	LC	-	-	-	-	-
Falconidae	*Falco naumanni*	Lesser kestrel	P	LC	-	-	MT	CD	II
Falconidae	*Falco tinnunculus*	Common kestrel	C	LC	-	-	MT	CD	II
Falconidae	*Falco amurensis*	Amur falcon	P	LC	-	-	MT	CD	II
Falconidae	*Falco concolor*	Sooty falcon	PP	VU	-	-	MT	CD	II
Falconidae	*Falco subbuteo*	Eurasian hobby	P	LC	-	-	MT	CD	II
Falconidae	*Falco biarmicus*	Lanner falcon	P	LC	-	-	-	-	II
Falconidae	*Falco peregrinus*	Peregrine falcon	P	LC	-	-	MT	CD	II
Psittacidae	*Poicephalus cryptoxanthus*	Brown-headed parrot	P	LC	-	-	-	-	-
Calyptomenidae	*Smithornis capensis*	African broadbill	P	LC	-	-	-	-	-
Oriolidae	*Oriolus larvatus*	Black-headed oriole	P	LC	-	-	-	-	-
Oriolidae	*Oriolus oriolus*	Eurasian golden oriole	P	LC	-	-	MT	-	-
Oriolidae	*Oriolus auratus*	African golden oriole	P	LC	-	-	MT	-	-
Campephagidae	*Ceblepyris pectoralis*	White-breasted cuckooshrike	P	LC	-	-	-	-	-
Campephagidae	*Ceblepyris caesius*	Grey Cuckooshrike	P	LC	-	-	-	-	-
Campephagidae	*Campephaga flava*	Black cuckooshrike	P	LC	-	-	-	-	-
Vangidae	*Prionops plumatus*	White-crested helmetshrike	P	LC	-	-	-	-	-
Vangidae	*Prionops retzii*	Retz's helmetshrike	P	LC	-	-	-	-	-

Family	Scientific Name	Common Name	Occurrence	Status	Endemism	Restricted Distribution	Migrator	Congregatory	Wildlife Law Regulation
Platysteiridae	*Batis fratrum*	Woodwards's batis	P	LC	QE-SA	-	-	-	-
Platysteiridae	*Batis molitor*	Chinspot batis	C	LC	-	-	-	-	-
Platysteiridae	*Platysteira peltata*	Black-throated wattle-eye	P	LC	-	-	MT	-	-
Malaconotidae	*Malaconotus blanchoti*	Grey-headed bushshrike	P	LC	-	-	-	-	-
Malaconotidae	*Dryoscopus cubla*	Dryoscopus cubla	C	LC	-	-	-	-	-
Malaconotidae	*Tchagra australis*	Brown-crowned tchagra	C	LC	-	-	-	-	-
Malaconotidae	*Tchagra senegalus*	Black-crowned tchagra	P	LC	-	-	-	-	-
Malaconotidae	*Nilaus afer*	Brubru	P	LC	-	-	-	-	-
Malaconotidae	*Chlorophoneus olivaceus*	Olive Bush-shrike	P	LC	QE-SA	-	MA	-	-
Malaconotidae	*Chlorophoneus sulfureopectus*	Orange-breasted bushshrike	C	LC	-	-	-	-	-
Malaconotidae	*Laniarius ferrugineus*	Southern boubou	C	LC	E-SA	-	-	-	-
Malaconotidae	*Telophorus viridis*	Gorgeous bushshrike	P	LC	-	-	-	-	-
Dicruridae	*Dicrurus ludwigii*	Square-tailed drongo	P	LC	-	-	-	-	-
Dicruridae	*Dicrurus adsimilis*	Fork-tailed drongo	P	LC	-	-	-	-	-
Monarchidae	*Trochocercus bivittatus*	Eastern Crested-flycatcher	P	LC	-	-	-	-	-
Monarchidae	*Terpsiphone viridis*	African paradise flycatcher	P	LC	-	-	MT	-	-
Laniidae	*Urolestes melanoleucus*	Magpie shrike	P	LC	-	-	-	-	-
Laniidae	*Eurocephalus anguitimens*	Southern white-crowned shrike	P	LC	QE-SA	-	-	-	-
Laniidae	*Lanius collurio*	Red-backed shrike	C	LC	-	-	MT	-	-
Laniidae	*Lanius minor*	Lesser grey shrike	P	LC	-	-	MT	-	-
Laniidae	*Lanius collaris*	Southern fiscal	C	LC	-	-	-	-	-
Corvidae	*Corvus albicollis*	White-necked raven	P	LC	-	-	-	-	-
Corvidae	*Corvus albus*	Pied crow	P	LC	-	-	-	-	-
Corvidae	*Corvus splendens*	House crow	P	LC	-	-	-	-	-
Paridae	*Melaniparus niger*	Southern black tit	C	LC	-	-	-	-	-
Remizidae	*Anthoscopus caroli*	Grey penduline tit	P	LC	-	-	-	-	-

Family	ScientIfic Name	Common Name	Occurrence	Status	Endemism	Restricted Distribution	Migrator	Congregatory	Wildlife Law Regulation
Alaudidae	*Pinarocorys nigricans*	Dusky lark	P	LC	-	-	MT	-	-
Alaudidae	*Eremopterix leucotis*	Chestnut-backed sparrow-lark	P	LC	-	-	N	-	-
Alaudidae	*Calendulauda sabota*	Sabota lark	P	LC	QE-SA	-	-	-	-
Alaudidae	*Mirafra fasciolata*	Eastern clapper lark	C	LC	QE-SA	-	-	-	-
Alaudidae	*Mirafra africana*	Rufous-naped lark	C	LC	-	-	-	-	-
Alaudidae	*Mirafra rufocinnamomea*	Flappet lark	C	LC	-	-	-	-	-
Alaudidae	*Mirafra passerina*	Monotonous lark	P	LC	QE-SA	-	N	-	-
Nicatoridae	*Nicator gularis*	Eastern nicator	P	LC	-	-	-	-	-
Macrosphenidae	*Sylvietta rufescens*	Long-billed crombec	C	LC	-	-	-	-	-
Macrosphenidae	*Sphenoeacus afer*	Cape grassbird	C	LC	E-SA	-	-	-	-
Cisticolidae	*Eremomela icteropygialis*	Yellow-bellied eremomela	P	LC	-	-	-	-	-
Cisticolidae	*Eremomela scotops*	Green-capped eremomela	P	LC	-	-	-	-	-
Cisticolidae	*Eremomela usticollis*	Burnt-necked eremomela	P	LC	-	-	-	-	-
Cisticolidae	*Apalis ruddi*	Rudd's apalis	P	LC	QE-SA	BL	-	-	-
Cisticolidae	*Apalis flavida*	Yellow-breasted apalis	P	LC	-	-	-	-	-
Cisticolidae	*Calamonastes stierlingi*	Stierling's wren-warbler	P	LC	-	-	-	-	-
Cisticolidae	*Camaroptera brachyura*	Green-backed camaroptera	C	LC	-	-	-	-	-
Cisticolidae	*Cisticola erythrops*	Red-faced cisticola	C	LC	-	-	-	-	-
Cisticolidae	*Cisticola aberrans*	Lazy cisticola	P	LC	-	-	-	-	-
Cisticolidae	*Cisticola chiniana*	Rattling cisticola	P	LC	-	-	-	-	-
Cisticolidae	*Cisticola lais*	Wailing cisticola	P	LC	-	-	MA	-	-
Locustellidae	*Scleroptila afra*	Grey-winged francolin	C	LC	E-SA	-	-	-	-
Cisticolidae	*Cisticola galactotes*	Rufous-winged cisticola	PP	LC	QE-SA	-	-	-	-
Cisticolidae	*Cisticola natalensis*	Croaking cisticola	C	LC	-	-	-	-	-
Cisticolidae	*Cisticola fulvicapilla*	Neddicky	C	LC	-	-	-	-	-

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Cisticolidae	*Cisticola juncidis*	Zitting cisticola	P	LC	-	-	-	-	-
Cisticolidae	*Cisticola aridulus*	Desert cisticola	P	LC	-	-	-	-	-
Cisticolidae	*Prinia subflava*	Tawny-flanked prinia	C	LC	-	-	-	-	-
Acrocephalidae	*Iduna natalensis*	African yellow warbler	P	LC	-	-	-	-	-
Acrocephalidae	*Hippolais olivetorum*	Olive-tree warbler	P	LC	-	-	MT	-	-
Acrocephalidae	*Hippolais icterina*	Icterine warbler	P	LC	-	-	MT	-	-
Acrocephalidae	*Acrocephalus schoenobaenus*	Sedge warbler	PP	LC	-	-	MT	-	-
Acrocephalidae	*Acrocephalus palustris*	Marsh warbler	PP	LC	-	-	MT	-	-
Acrocephalidae	*Acrocephalus scirpaceus*	Common reed warbler	P	LC	-	-	MT	-	-
Acrocephalidae	*Acrocephalus gracilirostris*	Lesser swamp warbler	PP	LC	-	-	-	-	-
Acrocephalidae	*Acrocephalus arundinaceus*	Great reed warbler	PP	LC	-	-	MT	-	-
Locustellidae	*Schoenicola brevirostris*	Fan-tailed grassbird	PP	LC	-	-	-	-	-
Locustellidae	*Bradypterus baboecala*	Little rush warbler	PP	LC	-	-	-	-	-
Hirundinidae	*Pseudhirundo griseopyga*	Grey-rumped swallow	P	LC	-	-	-	-	-
Hirundinidae	*Psalidoprocne pristoptera*	Black saw-wing	P	LC	-	-	MT	-	-
Hirundinidae	*Delichon urbicum*	Western house martin	P	LC	-	-	MT	-	-
Hirundinidae	*Cecropis abyssinica*	Lesser striped swallow	C	LC	-	-	MT	-	-
Hirundinidae	*Cecropis semirufa*	Red-breasted swallow	P	LC	-	-	MT	-	-
Hirundinidae	*Cecropis cucullata*	Greater striped swallow	C	LC	-	-	MT	-	-
Hirundinidae	*Hirundo albigularis*	White-throated swallow	C	LC	-	-	MT	-	-
Hirundinidae	*Hirundo smithii*	Wire-tailed swallow	C	LC	-	-	MT	-	-
Hirundinidae	*Hirundo rustica*	Barn swallow	C	LC	-	-	MT	CD	-
Hirundinidae	*Ptyonoprogne fuligula*	Rock martin	P	LC	-	-	MT	-	-

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Hirundinidae	*Neophedina cincta*	Banded martin	P	LC	-	-	MT	-	-
Hirundinidae	*Riparia paludicola*	Brown-throated martin	P	LC	-	-	MT	-	-
Hirundinidae	*Riparia riparia*	Sand martin	P	LC	-	-	MT	CD	-
Pycnonotidae	*Andropadus importunus*	Sombre greenbul	C	LC	-	-	-	-	-
Pycnonotidae	*Chlorocichla flaviventris*	Yellow-bellied greenbul	C	LC	-	-	-	-	-
Pycnonotidae	*Phyllastrephus terrestris*	Terrestrial brownbul	P	LC	-	-	-	-	-
Pycnonotidae	*Phyllastrephus flavostriatus*	Yellow-streaked greenbul	P	LC	-	-	-	-	-
Pycnonotidae	*Pycnonotus barbatus*	Common bulbul	C	LC	-	-	-	-	-
Phylloscopidae	*Phylloscopus trochilus*	Willow warbler	P	LC	-	-	MT	-	-
Sylviidae	*Sylvia borin*	Garden warbler	P	LC	-	-	MT	-	-
Zosteropidae	*Zosterops senegalensis*	Northern yellow white-eye	P	LC	-	-	-	-	-
Zosteropidae	*Zosterops virens*	Cape white-eye	P	LC	E-SA	-	-	-	-
Leiotrichidae	*Turdoides jardineii*	Arrow-marked babbler	C	LC	-	-	-	-	-
Buphagidae	*Buphagus erythrorynchus*	Red-billed oxpecker	P	LC	-	-	-	-	-
Sturnidae	*Creatophora cinerea*	Wattled starling	P	LC	-	-	-	-	-
Sturnidae	*Acridotheres tristis*	Common myna	C	LC	-	-	-	-	-
Sturnidae	*Onychognathus morio*	Red-winged starling	P	LC	-	-	-	-	-
Sturnidae	*Lamprotornis australis*	Burchell's starling	P	LC	QE-SA	-	-	-	-
Sturnidae	*Lamprotornis nitens*	Cape starling	C	LC	-	-	-	-	-
Sturnidae	*Lamprotornis chalybaeus*	Greater blue-eared starling	P	LC	-	-	-	-	-
Sturnidae	*Cinnyricinclus leucogaster*	Violet-backed starling	C	LC	-	-	MT	-	-
Sturnidae	*Notopholia corusca*	Black-bellied starling	P	LC	-	-	-	-	-
Turdidae	*Psophocichla litsitsirupa*	Groundscraper thrush	P	LC	-	-	-	-	-
Turdidae	*Turdus libonyana*	Kurrichane thrush	P	LC	-	-	-	-	-
Muscicapidae	*Tychaedon signata*	Brown Scrub-robin	P	LC	E-SA	-	-	-	-
Muscicapidae	*Tychaedon quadrivirgata*	Bearded scrub robin	P	LC	-	-	-	-	-

Family	Scientific Name	Common Name	Occurre n ce	Status	Endemism	Restricted Distribution	Migrator	Congregatory	Wildlife Law Regulation
Muscicapidae	*Cercotrichas leucophrys*	White-browed scrub robin	P	LC	-	-	-	-	-
Muscicapidae	*Muscicapa adusta*	African dusky flycatcher	P	LC	-	-	-	-	-
Muscicapidae	*Muscicapa striata*	Spotted flycatcher	C	LC	-	-	MT	-	-
Muscicapidae	*Agricola pallidus*	Pale Flycatcher	P	LC	-	-	-	-	-
Muscicapidae	*Fraseria plumbea*	Grey Tit-flycatcher	P	LC	-	-	-	-	-
Muscicapidae	*Fraseria caerulescens*	Ashy flycatcher	P	LC	-	-	-	-	-
Muscicapidae	*Melaenornis silens*	Fiscal flycatcher	C	LC	E-SA	-	-	-	-
Muscicapidae	*Melaenornis pammelaina*	Southern black flycatcher	P	LC	-	-	-	-	-
Muscicapidae	*Dessonornis humeralis*	White-throated Robin-chat	P	LC	E-SA	-	-	-	-
Muscicapidae	*Pogonocichla stellata*	White-starred robin	P	LC	-	-	-	-	-
Muscicapidae	*Cossypha heuglini*	White-browed robin-chat	P	LC	-	-	-	-	-
Muscicapidae	*Cossypha natalensis*	Red-capped robin-chat	P	LC	-	-	-	-	-
Muscicapidae	*Monticola explorator*	Sentinel rock thrush	P	NT	E-SA	-	-	-	-
Muscicapidae	*Monticola rupestris*	Cape rock thrush	P	LC	E-SA	-	-	-	-
Muscicapidae	*Saxicola torquatus*	African stonechat	C	LC	-	-	MT	-	-
Muscicapidae	*Thamnolaea cinnamomeiventris*	Mocking cliff chat	P	LC	-	-	-	-	-
Muscicapidae	*Oenanthe pileata*	Capped wheatear	P	LC	-	-	-	-	-
Muscicapidae	*Oenanthe familiaris*	Familiar chat	C	LC	-	-	-	-	-
Nectariniidae	*Anthreptes reichenowi*	Plain-backed sunbird	P	NT	-	-	-	-	-
Nectariniidae	*Hedydipna collaris*	Collared sunbird	P	LC	-	-	-	-	-
Nectariniidae	*Cyanomitra verreauxii*	Grey sunbird	P	LC	-	-	-	-	-
Nectariniidae	*Chalcomitra amethystina*	Amethyst sunbird	C	LC	-	-	-	-	-
Nectariniidae	*Chalcomitra senegalensis*	Scarlet-chested sunbird	C	LC	-	-	-	-	-
Nectariniidae	*Cinnyris chalybeus*	Southern double-collared sunbird	C	LC	E-SA	-	-	-	-
Nectariniidae	*Cinnyris neergaardi*	Neergaard's sunbird	P	NT	E-SA	BL	-	-	-
Nectariniidae	*Cinnyris mariquensis*	Marico sunbird	P	LC	-	-	-	-	-
Nectariniidae	*Cinnyris bifasciatus*	Purple-banded sunbird	P	LC	-	-	-	-	-

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Nectariniidae	*Cinnyris talatala*	White-breasted Sunbird	C	LC	-	-	-	-	-
Ploceidae	*Bubalornis niger*	red-billed buffalo weaver	P	LC	-	-	-	-	-
Ploceidae	*Amblyospiza albifrons*	thick-billed weaver	P	LC	-	-	-	-	-
Ploceidae	*Quelea quelea*	red-billed quelea	P	LC	-	-	-	-	-
Ploceidae	*Euplectes ardens*	red-collared widowbird	C	LC	-	-	-	-	-
Ploceidae	*Euplectes orix*	southern red bishop	C	LC	-	-	-	-	-
Ploceidae	*Euplectes axillaris*	an-tailed widowbird	PP	LC	-	-	-	-	-
Ploceidae	*Euplectes albonotatus*	white-winged widowbird	P	LC	-	-	-	-	-
Ploceidae	*Ploceus ocularis*	spectacled weaver	C	LC	-	-	-	-	-
Ploceidae	*Ploceus capensis*	Cape weaver	P	LC	E-SA	-	-	-	-
Ploceidae	*Ploceus subaureus*	eastern golden weaver	PP	LC	-	-	-	-	-
Ploceidae	*Ploceus xanthops*	Holub's golden weaver	P	LC	-	-	-	-	-
Ploceidae	*Ploceus intermedius*	lesser masked weaver	P	LC	-	-	-	-	-
Ploceidae	*Ploceus velatus*	southern masked weaver	P	LC	-	-	-	-	-
Ploceidae	*Ploceus cucullatus*	village weaver	P	LC	-	-	-	-	-
Ploceidae	*Ploceus bicolor*	dark-backed weaver	P	LC	-	-	-	-	-
Ploceidae	*Anaplectes rubriceps*	red-headed weaver	P	LC	-	-	-	-	-
Estrildidae	*Lagonosticta senegala*	red-billed firefinch	P	LC	-	-	-	-	-
Estrildidae	*Lagonosticta rhodopareia*	Jameson's firefinch	P	LC	-	-	-	-	-
Estrildidae	*Lagonosticta rubricata*	African firefinch	P	LC	-	-	-	-	-
Estrildidae	*Pytilia melba*	green-winged pytilia	C	LC	-	-	-	-	-
Estrildidae	*Hypargos margaritatus*	pink-throated twinspot	P	LC	E-SA	BL	-	-	-
Estrildidae	*Uraeginthus angolensis*	blue waxbill	P	LC	-	-	-	-	-
Estrildidae	*Estrilda perreini*	grey waxbill	P	LC	-	-	-	-	-
Estrildidae	*Estrilda astrild*	common waxbill	C	LC	-	-	-	-	-
Estrildidae	*Coccopygia melanotis*	swee waxbill	P	LC	E-SA	-	-	-	-

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Estrildidae	*Ortygospiza atricollis*	black-faced quailfinch	P	LC	-	-	N	-	-
Estrildidae	*Amandava subflava*	orange-breasted waxbill	P	LC	-	-	-	-	-
Estrildidae	*Spermestes cucullata*	bronze mannikin	C	LC	-	-	-	-	-
Estrildidae	*Spermestes bicolor*	black-and-white mannikin	P	LC	-	-	-	-	-
Estrildidae	*Spermestes fringilloides*	Magpie mannikin	P	LC	-	-	-	-	-
Viduidae	*Vidua macroura*	pin-tailed whydah	C	LC	-	-	-	-	-
Viduidae	*Vidua paradisaea*	long-tailed paradise whydah	C	LC	-	-	-	-	-
Viduidae	*Vidua funerea*	Dusky indigobird	P	LC	-	-	-	-	-
Viduidae	*Vidua chalybeata*	Village indigobird	P	LC	-	-	-	-	-
Viduidae	*Vidua purpurascens*	Purple indigobird	P	LC	-	-	-	-	-
Viduidae	*Anomalospiza imberbis*	cuckoo-finch	P	LC	-	-	-	-	-
Passeridae	*Passer domesticus*	House sparrow	C	LC	-	-	-	-	-
Passeridae	*Passer diffusus*	southern grey-headed sparrow	C	LC	-	-	-	-	-
Passeridae	*Gymnoris superciliaris*	yellow-throated bush sparrow	P	LC	-	-	-	-	-
Motacillidae	*Anthus caffer*	bushveld pipit	P	LC	-	-	-	-	-
Motacillidae	*Anthus lineiventris*	striped pipit	P	LC	-	-	-	-	-
Motacillidae	*Anthus cinnamomeus*	African pipit	C	LC	-	-	MT	-	-
Motacillidae	*Anthus vaalensis*	buffy pipit	P	LC	-	-	-	-	-
Motacillidae	*Anthus similis*	long-billed pipit	P	LC	-	-	-	-	-
Motacillidae	*Macronyx capensis*	orange-throated longclaw	P	LC	E-SA	-	-	-	-
Motacillidae	*Macronyx croceus*	yellow-throated longclaw	C	LC	-	-	-	-	-
Motacillidae	*Motacilla clara*	mountain wagtail	PP	LC	-	-	-	-	-
Motacillidae	*Motacilla capensis*	Cape wagtail	P	LC	-	-	-	-	-
Motacillidae	*Motacilla flava*	western yellow wagtail	P	LC	-	-	MT	CD	-
Motacillidae	*Motacilla aguimp*	African pied wagtail	P	LC	-	-	-	-	-
Fringillidae	*Crithagra citrinipectus*	lemon-breasted canary	C	LC	QE-SA	BL	-	-	-

Family	Scientific Name	Common Name	Occurre n ce	Status	Endemism	Restricted Distribution	Migrator	Congregatory	Wildlife Law Regulation
Fringillidae	*Crithagra mozambica*	yellow-fronted canary	C	LC	-	-	-	-	-
Fringillidae	*Crithagra flaviventris*	yellow canary	C	LC	QE-SA	-	-	-	-
Fringillidae	*Crithagra sulphurata*	brimstone canary	P	LC	-	-	-	-	-
Fringillidae	*Crithagra gularis*	streaky-headed seedeater	C	LC	-	-	-	-	-
Fringillidae	*Serinus canicollis*	Cape canary	P	LC	E-SA	-	-	-	-
Emberizidae	*Emberiza flaviventris*	golden-breasted bunting	C	LC	-	-	-	-	-
Emberizidae	*Emberiza tahapisi*	cinnamon-breasted rock-bunting	C	LC	-	-	-	-	-

Appendix 3.6

List of non-flying mammal species for the study area (Occurrence: X - potential, C - confirmed; Conservation status: LC - Least Concern, NT - Near Threatened, VU - Vulnerable [IUCN, 2019]).

Family	Scientific Name	Common Name	Occurrence	Status	Wildlife Law Regulation	Migratory	Congregatory
BOVIDAE	*Aepyceros melampus*	Impala	X	LC	Hunting		X
BOVIDAE	*Cephalophus natalensis*	Red forest duiker	C	LC	Hunting		
BOVIDAE	*Connochaetes taurinus*	blue wildebeest	X	LC	Hunting	X	X
BOVIDAE	*Kobus ellipsiprymnus*	Waterbuck	X	LC	Hunting		
BOVIDAE	*Nesotragus moschatus*	Suni	X	LC	Hunting		
BOVIDAE	*Oreotragus oreotragus*	Klipspringer	X	LC	X		
BOVIDAE	*Raphicerus campestris*	Steenbok	X	LC	Hunting		
BOVIDAE	*Raphicerus sharpei*	Sharpe's grysbok	X	LC	Hunting		
BOVIDAE	*Redunca arundinum*	Southern reedbuck	C	LC	Hunting		
BOVIDAE	*Sylvicapra grimmia*	Common duiker	X	LC	Hunting		
BOVIDAE	*Tragelaphus angasii*	Nyala	X	LC	Hunting		
BOVIDAE	*Tragelaphus oryx*	Common Eland	X	LC	Hunting	X	X
BOVIDAE	*Tragelaphus scriptus*	Harnessed bushbuck	X	LC	Hunting		
BOVIDAE	*Tragelaphus strepsiceros*	Greater kudu	X	LC	Hunting		
CANIDAE	*Canis adustus*	Side-striped Jackal	X	LC	X		
CANIDAE	*Canis mesomelas*	black-backed jackal	X	LC	X		
CERCOPITHECIDAE	*Chlorocebus pygerythrus*	Vervet monkey	C	LC	X		X
CERCOPITHECIDAE	*Papio ursinus*	Chacma baboon	X	LC	Hunting		X
FELIDAE	*Caracal caracal*	Caracal	X	LC	X		
FELIDAE	*Felis silvestris*	African Wildcat	X	LC	X		
FELIDAE	*Leptailurus serval*	Serval	X	LC	X		
FELIDAE	*Panthera pardus*	Leopard	X	VU	Hunting		
GALAGIDAE	*Galago moholi*	Mohol bushbaby	X	LC	X		X
GALAGIDAE	*Otolemur crassicaudatus*	Brown greater galago	X	LC	X		
GLIRIDAE	*Graphiurus microtis*	-	X	LC	X		
HERPESTIDAE	*Atilax paludinosus*	Marsh mongoose	X	LC	X		
HERPESTIDAE	*Helogale parvula*	Common dwarf mongoose	C	LC	X		

Family	Scientific Name	Common Name	Occurrence	Status	Wildlife Law Regulation	Migratory	Congregatory
HERPESTIDAE	*Herpestes ichneumon*	Egyptian mongoose	X	LC	X		
HERPESTIDAE	*Herpestes sanguineus*	-	X	LC	X		
HERPESTIDAE	*Ichneumia albicauda*	white-tailed mongoose	X	LC	X		
HERPESTIDAE	*Mungos mungo*	Banded mongoose	C	LC	X		
HERPESTIDAE	*Paracynictis selousi*	-	X	LC	X		
HERPESTIDAE	*Rhynchogale melleri*	-	X	LC	X		
HYAENIDAE	*Crocuta crocuta*	spotted hyena	X	LC	Hunting		X
HYAENIDAE	*Proteles cristata*	Aardwolf	X	LC	X		
HYSTRICIDAE	*Hystrix africaeaustralis*	Cape porcupine	X	LC	Hunting		
LEPORIDAE	*Lepus saxatilis*	Scrub hare	C	LC	Hunting		
LEPORIDAE	*Pronolagus crassicaudatus*	Natal red rock hare	X	LC	Hunting		
MACROSCELIDIDAE	*Petrodromus tetradactylus*	Four-toed elephant shrew	X	LC			
MANIDAE	*Smutsia temminckii*	Ground pangolin	X	VU	X		
MURIDAE	*Aethomys ineptus*	-	X	LC			
MURIDAE	*Dasymys incomtus*	-	X	LC			
MURIDAE	*Gerbilliscus leucogaster*	-	X	LC			
MURIDAE	*Grammomys cometes*	-	X	LC			
MURIDAE	*Grammomys dolichurus*	-	X	LC			
MURIDAE	*Lemniscomys rosalia*	-	X	LC			
MURIDAE	*Mastomys natalensis*	-	X	LC			
MURIDAE	*Micaelamys namaquensis*	-	X	LC			
MURIDAE	*Mus minutoides*	-	X	LC			
MURIDAE	*Mus musculus*	House mouse	X	LC			
MURIDAE	*Rattus rattus*	black rat	X	LC			
MURIDAE	*Thallomys paedulcus*	-	X	LC			
MUSTELIDAE	*Aonyx capensis*	African clawless otter	X	NT	X		
MUSTELIDAE	*Hydrictis maculicollis*	Spotted-necked Otter	X	NT	X		
MUSTELIDAE	*Ictonyx striatus*	Striped polecat	X	LC	X		
MUSTELIDAE	*Mellivora capensis*	Ratel	X	LC	X		
MUSTELIDAE	*Poecilogale albinucha*	African striped weasel	X	LC	X		
NESOMYIDAE	*Dendromus melanotis*	-	X	LC			
NESOMYIDAE	*Dendromus mystacalis*	-	X	LC			

Family	Scientific Name	Common Name	Occurrence	Status	Wildlife Law Regulation	Migratory	Congregatory
NESOMYIDAE	*Saccostomus campestris*	-	X	LC			
NESOMYIDAE	*Steatomys pratensis*	-	X	LC			
ORYCTEROPODIDAE	*Orycteropus afer*	Aardvark	X	LC			
SCIURIDAE	*Paraxerus cepapi*	-	X	LC			
SCIURIDAE	*Paraxerus palliatus*	-	X	LC			
SORICIDAE	*Crocidura cyanea*	-	X	LC			
SORICIDAE	*Crocidura fuscomurina*	-	X	LC			
SORICIDAE	*Crocidura hirta*	-	X	LC			
SORICIDAE	*Crocidura mariquensis*	-	X	LC			
SORICIDAE	*Crocidura silacea*	-	X	LC			
SORICIDAE	*Suncus lixus*	-	X	LC			
SUIDAE	*Phacochoerus africanus*	Common warthog	X	LC	Hunting		
SUIDAE	*Potamochoerus larvatus*	Bushpig	C	LC	Hunting		
THRYONOMYIDAE	*Thryonomys swinderianus*	Greater cane rat	C	LC			
VIVERRIDAE	*Civettictis civetta*	African civet	C	LC	X		
VIVERRIDAE	*Genetta maculata*	Rusty-spotted Genet	C	LC	X		

Appendix 3.7

Bat species list for the study area (Occurrence: X - potential, C - confirmed; Conservation status: LC - Least Concern, DD - Insufficient Information, NT - Near Threatened [IUCN, 2019]).

Family	Scientific Name	Common Name	Occurrence	Status	Endemism	Congregatory
Pteropodidae	*Epomophorus crypturus*	Peters's epauletted fruit bat	P	LC		
Pteropodidae	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat	P	LC		
Hipposideridae	*Hipposideros caffer*	Sundevall's roundleaf bat	C	LC		X
Rhinolophidae	*Rhinolophus blasii*	Blasius's horseshoe bat	P	LC		
Rhinolophidae	*Rhinolophus capensis*	Cape horseshoe bat	C	LC	X	
Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's horseshoe bat	P	LC		
Rhinolophidae	*Rhinolophus darlingi*	Darling's horseshoe bat	P	LC		
Rhinolophidae	*Rhinolophus simulator*	Bushveld horseshoe bat	P	LC		

Family	Scientific Name	Common Name	Occurrence	Status	Endemism	Congregatory
Emballonuridae	*Taphozous mauritianus*	Mauritian tomb bat	P	LC		
Nycteridae	*Nycticeinops schlieffeni*	Schlieffen's serotine	P	LC		
Molossidae	*Chaerephon ansorgei*	Ansorge's free-tailed bat	C	LC		
Molossidae	*Chaerephon pumilus*	Little free-tailed bat	P	LC		
Molossidae	*Mops condylurus*	Angolan free-tailed bat	P	LC		
Molossidae	*Mops midas*	Midas free-tailed bat	C	LC		
Molossidae	*Ortomops martiensseni*	Large-eared free-tailed bat	C	NT		
Molossidae	*Sauromys petrophilus*	Roberts's flat-headed Bat	P	LC		
Molossidae	*Tadarida aegyptiaca*	Egyptian free-tailed bat	C	LC		
Miniopteridae	*Miniopterus fraterculus*	Lesser long-fingered bat	P	LC		
Miniopteridae	*Miniopterus natalensis*	-	C	LC		
Vespertilionidae	*Eptesicus hottentotus*	Long-tailed house bat	C	LC		
Vespertilionidae	*Myotis welwitschii*	Welwitsch's bat	C	LC		
Vespertilionidae	*Neoromicia capensis*	Cape serotine	C	LC		
Vespertilionidae	*Neoromicia nana*	Banana serotine	C	LC		
Vespertilionidae	*Neoromicia zuluensis*	-	P	LC		
Vespertilionidae	*Pipistrellus anchietae*	Anchieta's serotine	P	LC		
Vespertilionidae	*Pipistrellus hesperidus*	-	C	LC		
Vespertilionidae	*Scotoecus albofuscus*	Light-winged lesser house bat	P	DD		
Vespertilionidae	*Scotoecus hindei/albigula*	-	P	-		
Vespertilionidae	*Scotophilus dinganii*	African yellow bat	C	LC		

Appendix 3.8

Bird census results for transects per sampling campaign

Species	October 2018													
	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14
Andropadus importunus						2	2					4	2	
Apus affinis				20	20									
Batis molitor											4	1		
Bycanistes bucinator													4	
Camaroptera sp.							2			2		2		
Crithagra sp.					2				5					
Cecropis abyssinica			2											

Species	October 2018													
	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14
Chlorophoneus sulfureopectus											2			
Cinnyris talatala								4			2	2		
Circaetus cinereus														1
Cisticola erythrops													2	2
Cisticola fulvicapilla	6		4	4		2	4	6		2	3		2	
Clamator jacobinus				2										
Coturnix coturnix	4													
Crithagra citrinipectus										4				
Crithagra gularis										6				
Crithagra mozambica										4				2
Dryoscopus cubla						4						2		
Emberiza flaviventris						4								
Falco tinnunculus														2
Hirundo rustica			4	20	20		4	10	4	2	2	2		
Lamprotornis nitens												4		
Lanius collaris					2							2		
Alaudidae			2			2						2		
Macronyx croceus				4										
Melaniparus niger									2					
Milvus migrans													1	
Mirafra africana	2	4	4				2	4		4		6	5	
Numida meleagris							1							
Passer domesticus														4
Ploceus ocularis												2	4	
Polyboroides typus				1					3					1
Pycnonotus barbatus	1			2	4				8		4	6	2	2
Scleroptila shelleyi		4												
Nectariniidae									2					
Tchagra australis										2				
Turdoides jardineii									2					
Vidua paradisaea					2	2			2					22

Species	December 2018													
	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14
Andropadus importunus	2	4				2			2					
Anthus sp.									2					
Batis molitor		4							4					
Camaroptera brachyura		2						2	2		6			
Chrysococcyx caprius			2			4	2	2	2	2	2	2		
Chrysococcyx klaas					1				2					
Cinnyris sp.		4			2		2							
Cinnyris talatala	2										2			
Circaetus cinereus						2								
Cisticola fulvicapilla				4			4	2		2	2			2
Cisticola sp.							2							2
Clamator jacobinus								4						

Species	December 2018													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Crithagra mozambica					4			2	4					
Crithagra sp.				4				10						
Emberiza tahapisi	2				4					4				
Euplectes ardens												4		
Hirundo rustica								2	2	6		4		
Lamprotornis nitens												2		
Laniarius ferrugineus			2											
Lanius collaris						2								2
Lanius collurio		4	4			2	7							
Melaniparus niger														2
Mirafra africana	4	2	4	12	4	2	2			4		6		
Mirafra rufocinnamomea	2	2	2		2		1		6					
Numida meleagris				1	4									
Pycnonotus barbatus									2	8		12		
Streptopelia capicola						2								
Upupa epops			2											
Vidua paradisaea					2			16		4				

Species	February 2019													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Andropadus importunus						2	4	2	2					
Anthus cinnamomeus										2				
Batis molitor									2				0	
Crithagra sp.								20						
Cecropis abyssinica										2				
Chrysococcyx caprius					2									
Cinnyris talatala												4		
Cisticola fulvicapilla	6		2				2		6	2	4	2		2
Cisticola natalensis				6	2	1	2	4	2	4	2		4	
Crithagra gularis						2								
Crithagra mozambica								2						
Emberiza tahapisi													2	
Euplectes ardens	2				2				4		6		2	
Halcyon albiventris													2	
Hirundo rustica							2	2	2		2	2	4	2
Lamprotornis nitens					4						4			
Laniarius ferrugineus								2						
Lanius collaris				2	2				4					
Lanius collurio														4
Alaudidae										2				2
Merops apiaster			14											
Mirafra africana		2		4						2				
Mirafra rufocinnamomea	4			2	4									
Muscicapa striata		2												
Prinia subflava			2		2	2						4		
Pycnonotus barbatus	2		2		2		2		2		4	2	4	2
Scleroptila shelleyi													2	
Phasianidae					1									

Species	February 2019													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Nectariniidae							4		2				2	
Sylvietta rufescens								2						
Urocolius indicus										4				
Vidua macroura					4									

Species	April 2019													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Andropadus importunus		2				2		2	2			2		
Anthus cinnamomeus												2		
Batis molitor			2	4						2			2	
Chalcomitra amethystina									6					
Chalcomitra senegalensis									4					
Chlorocichla flaviventris	2													
Cinnyricinclus leucogaster									2					
Cinnyris talatala													2	
Cisticola fulvicapilla			2							2	4			
Crithagra flaviventris											24			
Lagonosticta sp.							6							
Phasianidae						2								
Hirundo albigularis		2												
Lamprotornis nitens					2							2	4	
Mirafra africana	2								4					
Prinia subflava								8	2				2	
Pycnonotus barbatus			4		6		2		2	4	6	10	6	
Pytilia melba								4						
Streptopelia capicola													4	
Nectariniidae.								8		4	4			
Tchagra australis						2	2							
Acrocephalidae								4		2				
Estrilda sp.							8							

Species	June 19													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Andropadus importunus								2						
Batis molitor	2	4		2				2			2			
Chalcomitra senegalensis		2										1		
Cinnyris chalybeus												2		
Cisticola sp.								4						
Crithagra flaviventris	2											8		
Estrilda astrild								20						
Indicator minor		2												
Lamprotornis nitens								4						
Lanius collaris	2				2	2	2							
Alaudidae										2			2	
Melaenornis silens	2													
Mirafra africana	6	2	4	8				4	2	2	6	6		

Species	**June 19**													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Mirafra rufocinnamomea	6		2	4								2		
Prinia subflava		2		2	2			2						
Pternistis sp.	2									2				
Pycnonotus barbatus			4					6		2		2	2	
Spermestes cucullata										88	4			
Streptopelia capicola						2								
Nectariniidae.							2	4	2	4			4	

Species	**August 19**													
	T01	**T02**	**T03**	**T04**	**T05**	**T06**	**T07**	**T08**	**T09**	**T10**	**T11**	**T12**	**T13**	**T14**
Batis molitor	2													
Camaroptera brachyura								2						
Crithagra sp.	0			4			10		4					
Chalcomitra senegalensis								2						
Cinnyris talatala								2		4				
Cisticola fulvicapilla												4		
Cisticola lais							6	2						
Colius striatus												24		
Halcyon albiventris								2						
Lanius collaris	4					4		4		2	2			2
Alaudidae	2										2			
Melierax metabates								4						
Mirafra africana					2	2			4	4	6			
Ploceus ocularis										2				
Prinia subflava							4		4	2			4	
Pycnonotus barbatus							4			4		8	2	
Saxicola torquatus														4
Scleroptila afra						2							2	
Streptopelia capicola					2	2								
Nectariniidae.	2					2	2		2				2	
Turdoides jardineii												8		
Acrocephalidae										4				

Bird census results for birds of prey and other gliders observation points per sampling campaign

Species	**VP01**	**VP02**	**VP03**	**VP04**	**VP05**	**VP06**
October 2018						
Terathopius ecaudatus					1	
Milvus migrans			1			
Circaetus cinereus				2		
Melierax metabates		3				
Unidentified species	1					

Species	VP01	VP02	VP03	VP04	VP05	VP06
December 2018						
Milvus migrans	1					
Circaetus cinereus	1	1		1		
Falco tinnunculus				1		
Polemaetus bellicosus	2					
February 2019						
Terathopius ecaudatus						2
Circaetus pectoralis	1					
Falco tinnunculus		1				
Melierax metabates					1	
Unidentified species	1					
April 2019						
Unidentified species		1		1		
June 2019						
Terathopius ecaudatus		1				
August 2019						
sem registos						

Bird census results for waterbird observation points (WB01) per sampling campaign

Campaign	Species	No. individuals
October 2018	No records	
December 2018	*Ardea melanocephala*	1
	Phalacrocorax carbo	1
February 2019	No records	
April 2019	No records	
June 2019	*Bubulcus ibis*	1
	Gallirex porphyreolophus	1
August 2019	No records	

Bird census results for nocturnal transects per sampling campaign

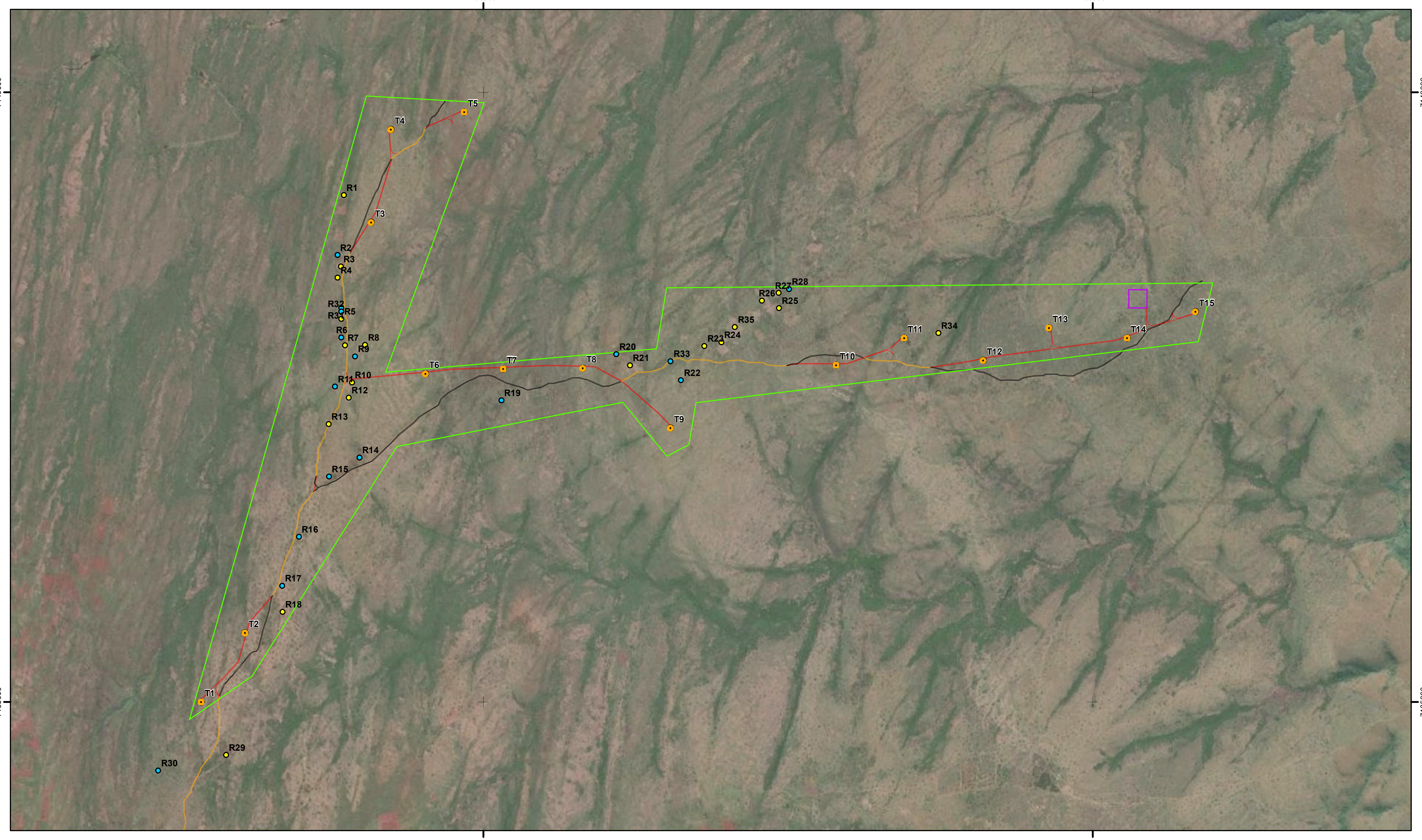
Campaign	Species	No. individuals
October 2018	*Burhinus capensis*	1
	Tyto alba	1
February 2019	*Burhinus capensis*	1

Campaign	Species	No. individuals
	Tyto alba	1
	Bubo africanus	1
	Caprimulgus fossii	8

Annex 4

SOCIO-ECONOMY

ANNEX 4.1 – SOCIAL SURVEY



Fonte: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGENDA

- Área de Estudo
- Aerogerador
- Subestação
- Acesso a construir
- Acesso existente a melhorar
- Acesso existente (não utilizado)

Casas existentes

- Habitadas
- Não habitadas

0 500 1 000 m

Escala 1:30 000

Sistema de Projeção: WGS84/UTM36S
Unidades: metros
EPSG: 32736

Estudo de Impacto Ambiental da Central Eléctrica da Namaacha

Figura 1 - Casas existentes

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA

NAMAACHA POWER PLANT PROJECT 120 MW

Summary of the Asset Survey in Project Area

Descriptions	Total	
DUAT Area (Hectares)	Hectares	855
Total Houses in Project Area	Qty	28
Total Active Houses	Qty	19
Total Inactive Houses and Ruins	Qty	15
Total Farmss	Qty	20
Total Active Farms	Qty	15
Total Inactive Farms	Qty	5
Total Corrals	Qty	10
Total Active Corrals	Qty	9
Total Inactive Corrals	Qty	1
Total number of people	Qty	72
Total Churches	Qty	1

No.	long.	lat.	Shadow effect impact	Noise impact	Inhabited house (Yes/No)	Type of house	No. of households	No. of families	House use	Photos
R1	S31°59'26"W	S25°51'45"E	No	Yes	Yes	5 houses (huts)	7	1	Dwelling	 
R2	S31°59'24"W	S25°52'01"E	NA	NA	No	1 house (hut)	0	0	Dwelling	
R3	S31°59'25"W	S25°52'04"E	No	Yes	Yes	3 houses (huts)	1	1	Dwelling	
R4	S31°59'24"W	S25°52'07"E	No	Yes	Yes	4 houses (huts)	3	1	Dwelling	
R5	S31°59'25"W	S25°52'18"E	Yes (but within recommended limits)	No	Yes	2 houses (huts) and one corral	3	1	Dwelling	
R6	S31°59'25"W	S25°52'23"E	NA	No	No	Not Applicable	0	0	Not Applicable	
R7	S31°59'26"W	S25°52'25"E	Yes	Yes	Yes	3 Huts	5	1	Dwelling	   
R8	S31°59'32"W	S25°52'25"E	No	Yes	Yes	2 houses (huts)	2	1	Dwelling	 

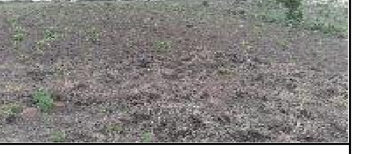
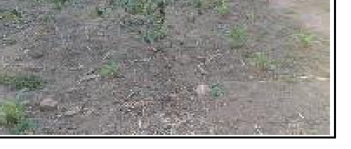
R9	S31°59'29"W	S25°52'28"E	NA	NA	No	Ruin	0	0	No Applicable	
R10	S31°59'28"W	S25°52'35"E	No	Yes	Yes	2 houses (huts)	3	1	Dwelling	
R11	S31°59'23"W	S25°52'36"E	NA	No	No	1 abandoned shop (hut)	0	0	Dwelling	
R12	S31°59'27"W	S25°52'39"E	No	No	Yes	1 house (hut)	4	1	Dwelling	 
R13	S31°59'21"W	S25°52'46"E	Yes	No	Yes	1 house (hut)	1	0	Church	 
R14	S31°59'30"W	S25°52'55"E	NA	NA	No	Type 0 cement with zinc sheet roof	0	0	Dwelling	 
R15	S31°59'21"W	S25°53'00"E	NA	NA	No	Ruin	0	0	Not Applicable	 
R16	S31°59'12"W	S25°53'16"E	NA	NA	No	Type 0 cement with zinc sheet roof	0	0	Dwelling	 
R17	S31°59'07"W	S25°53'29"E	NA	NA	No	Type 0 cement with zinc sheet roof	0	0	Dwelling	 
R18	S31°59'07"W	S25°53'36"E	Yes	Yes	Yes	Type 0 zinc-plated concrete with two external annexes (huts)	2	1	Dwelling	 

R19	S32°00'12"W	S25°52'40"E	NA	NA	No	Type 1 concrete with zinc sheet roof	0	0	Dwelling	 
R20	S32°00'46"W	S25°52'28"E	NA	NA	No	Cement poultry house with zinc sheet roof	0	0	Corral	 
R21	S32°00'50"W	S25°52'31"E	Yes	Yes	Yes	Type 0 made with zinc sheets	6	1	Dwelling	 
R22	S32°01'05"W	S25°52'35"E	NA	NA	No	Type 0 cement with zinc sheets	0	0	Dwelling	
R23	S32°01'12"W	S25°52'26"E	Yes	No	Yes	3 houses (huts)	4	1	Dwelling	
R24	S32°01'17"W	S25°52'25"E	Yes	No	Yes	3 houses (huts)	5	1	Dwelling	
R25	S32°01'34"W	S25°52'16"E	Yes (within recommended limits)	No	Yes	1 reed house	4	1	Dwelling	
R26	S32°01'29"W	S25°52'14"E	Yes (within recommended limits)	No	Yes	2 houses (huts)	4	1	Dwelling	
R27	S32°01'34"W	S25°52'12"E	Yes	No	Yes	3 houses (huts)	5	1	Dwelling	

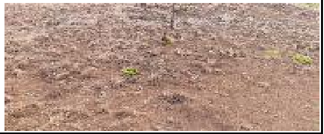
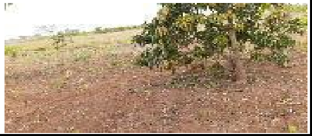
R28	S32°01'37"W	S25°52'11"E	NA	NA	No	1 house (hut)	0	0	Dwelling	 
R29	S31°58'50"W	S25°54'14"E	No	Yes	Yes	Type 2 cement and zinc sheets	5	1	Dwelling	 
R30	S31°58'30"W	S25°54'18"E	NA	NA	No	Ruins	0	0	Dwelling	 
R31	S31°59'25"W	S25°52'15"E	NA	NA	No	Coalsmith	0	0	Not Applicable	Not Applicable
R32	S31°59'25"W	S25°52'16"E	NA	NA	No	Coalsmith	0	0	Not Applicable	Not Applicable
R33	S32°01'02"W	S25°52'30"E	NA	NA	No	Ruin	0	0	Dwelling	
R34	S32°02'21"W	S25°52'23"E	Yes	Yes	Yes	1 house (hut)	4	1	Dwelling	
R35	S32°01'21"W	S25°52'21"E	Yes	No	Yes	2 houses (hut)	4	1	Dwelling	

No.	Name of Owner	State of the Corral	Type of Existing Livestock	Photos
1	**Suzete Alberto Dança**	Active	Cattle	
2	**Feliciano Josefa**	Not Active	Not Applicable	
3	**Xavier Mutuque**	Active	Cattle	
4	**Gloria Francisco**	Active	Cattle	
5	**Sanção**	Active	Cattle	

6	**Simião Mabote**	Active	Cattle	
7	**Simião Mabote**	Active	Cattle	
8	**Milagre Manhique**	Active	Cattle	
9	**Abilio das Neves**	Active	Cattle	
10	**Angelica Chiculo**	Active	Cattle	

Name of Owner	No.	Crops	State of the Farm	Photos
Sanção	**1**	In land preparation stage	Active	
Macacho	**1**	Cassava plants	Active	
Isabel Antonio Munisse	**1**	Cassava plants	Active	
Januario Nhamuche	**1**	Cassava plants	Active	
Alexandre Saimo Covele	**1**	Cassava plants	Active	
Milagre Manhique	**1**	Cassava plants	Active	

Angelica Chiculo	**1**	In land preparation stage	Active	
Alcidio Xavier Homo	**1**	Maize	Active	
Pascoal Xavier	**1**	Not Applicable	Not Active	
Vilanculos	**1**	Maize and Cassava plant	Active	
Manhiça	**1**	Inactive	Not Active	
Simão Samuel Massingue	**1**	Not Applicable	Not Active	
Tomas Wanela Nhamuche	**1**	Milho	Active	

João Francisco Macamo	**1**	Maize and Cassava plant	Active	
Xavier Mutuque	**1**	Maize	Active	
Carlota Mutuque	**1**	Maize	Active	
Feliciano Josefa Massingue	**1**	Not Applicable	Not Active	
Zacarias Massingue	**1**	Maize and Cassava plant	Active	
Antonio Alfredo Manhiça	**1**	Maize and Cassava plant	Active	
Gloria Francisco	**1**	Not Applicable	Not Active	

ANNEX 4.2 – SHADOW STUDY

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Main Result

Assumptions for shadow calculations

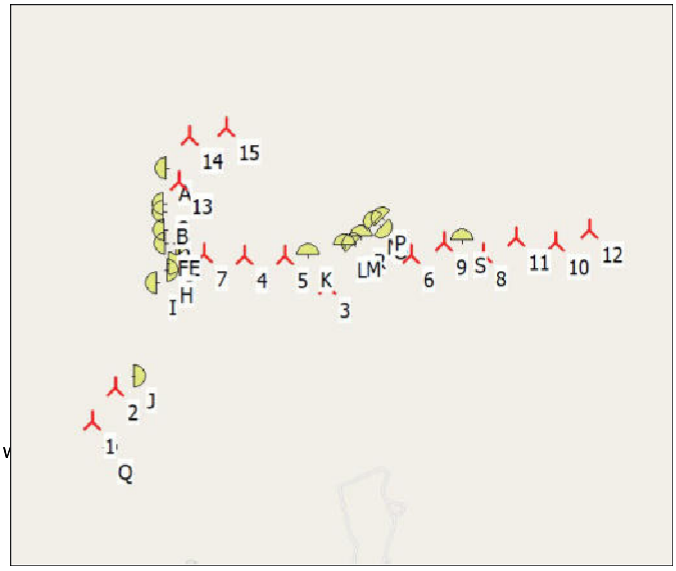
Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Elevation Grid Data Object: Namaacha_1_EMDGrid_0. v
Obstacles used in calculation
Eye height for map: 1,5 m
Grid resolution: 1,0 m

All coordinates are in
Geo [deg,min,sec]-WGS84



Scale 1:125 000
New WTG
Shadow receptor

WTGs

	Longitude	Latitude	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	31°58'42,68" E	-25°53'59,82" N	624,1	T1	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
2	31°58'55,77" E	-25°53'41,45" N	611,3	T2	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
3	32°01'01,69" E	-25°52'47,66" N	568,0	T9	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
4	32°00'12,56" E	-25°52'31,64" N	548,4	T7	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
5	32°00'35,98" E	-25°52'31,53" N	555,5	T8	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
6	32°01'50,66" E	-25°52'31,31" N	535,7	T10	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
7	31°59'48,85" E	-25°52'30,38" N	578,5	T6	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
8	32°02'34,09" E	-25°52'30,27" N	504,6	T12	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
9	32°02'10,75" E	-25°52'24,23" N	512,5	T11	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
10	32°03'16,55" E	-25°52'24,59" N	493,8	T14	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
11	32°02'53,55" E	-25°52'21,81" N	511,2	T13	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
12	32°03'36,74" E	-25°52'17,72" N	476,8	T15	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
13	31°59'33,97" E	-25°51'52,31" N	588,4	T3	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
14	31°59'39,96" E	-25°51'27,59" N	558,6	T4	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4
15	32°00'01,58" E	-25°51'23,07" N	541,9	T5	Yes	VESTAS	V150-4.2-4200	4200	150,0	105,0	1905	10,4

Shadow receptor-Input

No.	Name	Longitude	Latitude	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]	[°]		[m]
A	R1	31°59'26,01" E	-25°51'45,07" N	571,1	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
B	R4	31°59'24,24" E	-25°52'07,41" N	591,8	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
C	R3	31°59'24,75" E	-25°52'03,92" N	589,8	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
D	R5	31°59'25,16" E	-25°52'17,77" N	591,3	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
E	R8	31°59'31,88" E	-25°52'25,10" N	598,2	0,7	1,8	0,0	90,0	90,0	Fixed direction	1,8
F	R7	31°59'25,65" E	-25°52'25,03" N	599,0	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
G	R10	31°59'27,86" E	-25°52'35,38" N	605,2	0,7	1,8	0,0	90,0	90,0	Fixed direction	1,8
H	R12	31°59'26,86" E	-25°52'39,25" N	606,0	0,7	1,8	0,0	90,0	90,0	Fixed direction	1,8
I	R13	31°59'20,67" E	-25°52'45,89" N	601,9	0,7	1,8	0,0	-90,0	90,0	Fixed direction	1,8
J	R18	31°59'07,36" E	-25°53'35,69" N	601,4	0,7	1,8	0,0	90,0	90,0	Fixed direction	1,8
K	R21	32°00'50,11" E	-25°52'31,20" N	558,6	0,7	1,8	0,0	0,0	90,0	Fixed direction	1,8
L	R23	32°01'11,73" E	-25°52'25,86" N	558,3	0,7	1,8	0,0	0,0	90,0	Fixed direction	1,8
M	R24	32°01'16,83" E	-25°52'25,25" N	550,6	0,7	1,8	0,0	-45,0	90,0	Fixed direction	1,8
N	R26	32°01'29,14" E	-25°52'13,57" N	534,7	0,7	1,8	0,0	-45,0	90,0	Fixed direction	1,8
O	R25	32°01'33,87" E	-25°52'16,03" N	539,0	0,7	1,8	0,0	135,0	90,0	Fixed direction	1,8

To be continued on next page...

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Main Result

...continued from previous page

No.	Name	Longitude	Latitude	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]	[°]		[m]
P	R27	32°01'34,08" E	-25°52'11,81" N	534,1	0,7	1,8	0,0	-45,0	90,0	Fixed direction	1,8
Q	R29	31°58'50,42" E	-25°54'13,76" N	604,0	0,7	1,8	0,0	90,0	90,0	Fixed direction	1,8
R	R35	32°01'21,00" E	-25°52'21,00" N	548,0	0,7	1,8	0,0	0,0	90,0	Fixed direction	1,8
S	R34	32°02'21,00" E	-25°52'23,00" N	498,0	0,7	1,8	0,0	0,0	90,0	Fixed direction	1,8

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	R1	0:00	0	0:00
B	R4	0:00	0	0:00
C	R3	0:00	0	0:00
D	R5	6:32	43	0:12
E	R8	0:00	0	0:00
F	R7	60:22	113	0:49
G	R10	0:00	0	0:00
H	R12	0:00	0	0:00
I	R13	31:37	88	0:34
J	R18	31:42	44	0:56
K	R21	84:46	97	1:21
L	R23	33:42	64	0:54
M	R24	24:26	80	0:31
N	R26	12:46	48	0:21
O	R25	7:25	35	0:17
P	R27	31:07	90	0:25
Q	R29	0:00	0	0:00
R	R35	63:27	146	0:38
S	R34	276:05	170	2:15

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]
1	T1	0:00
2	T2	31:42
3	T9	0:00
4	T7	27:21
5	T8	105:44
6	T10	122:23
7	T6	89:07
8	T12	5:32
9	T11	273:32
10	T14	4:20
11	T13	3:43
12	T15	0:00
13	T3	0:00
14	T4	0:00
15	T5	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: A - R1

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:09	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:26	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:09	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:09	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:32	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:10	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
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	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
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27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
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	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
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	16:45		16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar

Shadow receptor: B - R4

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
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	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:26	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
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	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:32	16:44	16:57	16:16	16:38
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	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
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	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
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	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
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23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:11	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: C - R3

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:09	16:15	16:30	16:43	16:55	16:13	16:35
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	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
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11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
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	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
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	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
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	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
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	16:48	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
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	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
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	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
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29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: D - R5

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January			February			March	April	May	June	July	August	Septembe	rOctober	November			December
1	03:04			03:27		03:44 (4)	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04			02:53
	16:48			16:45	11	03:55 (4)	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08			16:30
2	03:05			03:28		03:45 (4)	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04		03:20 (4)	02:53
	16:48			16:44	10	03:55 (4)	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	1	03:21 (4)	16:31
3	03:05			03:29		03:46 (4)	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03		03:19 (4)	02:53
	16:48			16:44	9	03:55 (4)	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	3	03:22 (4)	16:32
4	03:06			03:30		03:47 (4)	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02		03:18 (4)	02:53
	16:48			16:43	8	03:55 (4)	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	4	03:22 (4)	16:32
5	03:07			03:30		03:47 (4)	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02		03:18 (4)	02:53
	16:49			16:43	7	03:54 (4)	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	6	03:24 (4)	16:33
6	03:07			03:31		03:48 (4)	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01		03:17 (4)	02:53
	16:49			16:42	6	03:54 (4)	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	7	03:24 (4)	16:34
7	03:08			03:32		03:49 (4)	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00		03:17 (4)	02:53
	16:49			16:41	4	03:53 (4)	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	8	03:25 (4)	16:34
8	03:09			03:32		03:50 (4)	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00		03:16 (4)	02:53
	16:49			16:41	2	03:52 (4)	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	9	03:25 (4)	16:35
9	03:10			03:33			03:50	05:05	05:20	05:35	05:40	05:26	04:58	04:25	02:59		03:16 (4)	02:53
	16:49			16:40			16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	10	03:26 (4)	16:36
10	03:10			03:34			03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59		03:15 (4)	02:54
	16:49			16:39			16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	11	03:26 (4)	16:36
11	03:11			03:35			03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58		03:15 (4)	02:54
	16:49			16:39			16:14	16:42	16:17	16:09	16:16	16:31	16:44	16:57	16:15	11	03:26 (4)	16:37
12	03:12			03:35			03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58		03:14 (4)	02:54
	16:49			16:38			16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	12	03:26 (4)	16:38
13	03:13			03:36			03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57		03:14 (4)	02:54
	16:49			16:37			16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	12	03:26 (4)	16:38
14	03:13			03:37			03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57		03:14 (4)	02:55
	16:49			16:37			16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	12	03:26 (4)	16:39
15	03:14			03:37			03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56		03:13 (4)	02:55
	16:49			16:36			16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	12	03:25 (4)	16:40
16	03:15			03:38			03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56		03:13 (4)	02:55
	16:49			16:35			16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	12	03:25 (4)	16:40
17	03:16			03:39			03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55		03:13 (4)	02:56
	16:49			16:34			16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	12	03:25 (4)	16:41
18	03:16			03:39			03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55		03:12 (4)	02:56
	16:49			16:34			16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	12	03:24 (4)	16:41
19	03:17		03:38 (4)	03:40			03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55		03:12 (4)	02:57
	16:49	1	03:39 (4)	16:33			16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	12	03:24 (4)	16:42
20	03:18		03:35 (4)	03:41			03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54		03:12 (4)	02:57
	16:49	9	03:44 (4)	16:32			16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	11	03:23 (4)	16:43
21	03:19		03:36 (4)	03:41			03:56	05:11	05:26	05:38	05:37	05:17	04:44	04:13	02:54		03:12 (4)	02:57
	16:48	10	03:46 (4)	16:31			16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	10	03:22 (4)	16:43
22	03:20		03:37 (4)	03:42			03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54		03:11 (4)	02:58
	16:48	11	03:48 (4)	16:30			16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	9	03:20 (4)	16:44
23	03:20		03:38 (4)	03:42			03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54		03:15 (4)	02:58
	16:48	12	03:50 (4)	16:29			16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	1	03:16 (4)	16:44
24	03:21		03:38 (4)	03:43			03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53			02:59
	16:48	12	03:50 (4)	16:28			16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25			16:45
25	03:22		03:39 (4)	03:44			03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53			02:59
	16:47	12	03:51 (4)	16:28			15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26			16:45
26	03:23		03:40 (4)	03:44			03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53			03:00
	16:47	12	03:52 (4)	16:27			15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26			16:45
27	03:23		03:41 (4)	03:45			03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53			03:01
	16:47	12	03:53 (4)	16:26			15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27			16:46
28	03:24		03:41 (4)	03:45			03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53			03:01
	16:46	12	03:53 (4)	16:25			15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28			16:46
29	03:25		03:42 (4)				05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53			03:02
	16:46	12	03:54 (4)				16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29			16:47
30	03:26		03:43 (4)				05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53			03:02
	16:46	12	03:55 (4)				16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29			16:47
31	03:27		03:44 (4)				05:01		05:31		05:32	05:07		03:05				03:03
	16:45	11	03:55 (4)				16:53		16:09		16:26	16:40		16:08				16:47
Potential sun hours	420			364			380	345	337	317	331	348	358	393	401			425
Total, worst case		138			57											197		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: E - R8

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:26	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
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26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: F - R7

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January			February			March			April	May	June
1	03:04			03:27		03:44 (7)	03:46		04:03 (4)	05:01	05:15	05:31
	16:48			16:45	47	04:31 (7)	16:24	6	04:09 (4)	16:52	16:24	16:09
2	03:05			03:28		03:45 (7)	03:47		04:04 (4)	05:02	05:16	05:32
	16:48			16:44	47	04:32 (7)	16:23	5	04:09 (4)	16:51	16:23	16:09
3	03:05			03:29		03:46 (7)	03:47		04:04 (4)	05:02	05:16	05:32
	16:48			16:44	47	04:33 (7)	16:22	3	04:07 (4)	16:50	16:22	16:09
4	03:06			03:30		03:47 (7)	03:48			05:03	05:17	05:33
	16:48			16:43	46	04:33 (7)	16:21			16:49	16:22	16:09
5	03:07			03:30		03:47 (7)	03:48			05:03	05:17	05:33
	16:49			16:43	46	04:33 (7)	16:20			16:48	16:21	16:09
6	03:07			03:31		03:48 (7)	03:49			05:04	05:18	05:33
	16:49			16:42	45	04:33 (7)	16:19			16:47	16:20	16:09
7	03:08		03:56 (7)	03:32		03:49 (7)	03:49			05:04	05:18	05:34
	16:49	5	04:01 (7)	16:41	44	04:33 (7)	16:18			16:46	16:20	16:09
8	03:09		03:52 (7)	03:32		03:50 (7)	03:50			05:04	05:19	05:34
	16:49	12	04:04 (7)	16:41	43	04:33 (7)	16:17			16:45	16:19	16:08
9	03:10		03:51 (7)	03:33		03:50 (7)	03:50			05:05	05:20	05:35
	16:49	16	04:07 (7)	16:40	43	04:33 (7)	16:16			16:44	16:18	16:08
10	03:10		03:50 (7)	03:34		03:51 (7)	03:51			05:05	05:20	05:35
	16:49	19	04:09 (7)	16:39	42	04:33 (7)	16:15			16:43	16:18	16:08
11	03:11		03:48 (7)	03:35		03:52 (7)	03:51			05:06	05:21	05:35
	16:49	22	04:10 (7)	16:39	41	04:33 (7)	16:14			16:42	16:17	16:09
12	03:12		03:47 (7)	03:35		03:52 (7)	03:52			05:06	05:21	05:36
	16:49	25	04:12 (7)	16:38	39	04:31 (7)	16:13			16:41	16:17	16:09
13	03:13		03:47 (7)	03:36		03:53 (7)	03:52			05:07	05:22	05:36
	16:49	27	04:14 (7)	16:37	38	04:31 (7)	16:12			16:40	16:16	16:09
14	03:13		03:46 (7)	03:37		03:54 (7)	03:53			05:07	05:22	05:37
	16:49	30	04:16 (7)	16:37	37	04:31 (7)	16:11			16:39	16:15	16:09
15	03:14		03:45 (7)	03:37		03:54 (7)	03:53			05:08	05:23	05:37
	16:49	32	04:17 (7)	16:36	35	04:29 (7)	16:10			16:38	16:15	16:09
16	03:15		03:44 (7)	03:38		03:55 (7)	03:54			05:08	05:23	05:37
	16:49	34	04:18 (7)	16:35	34	04:29 (7)	16:09			16:37	16:14	16:09
17	03:16		03:44 (7)	03:39		03:56 (4)	03:54			05:09	05:24	05:37
	16:49	36	04:20 (7)	16:34	32	04:28 (7)	16:08			16:36	16:14	16:09
18	03:16		03:44 (7)	03:39		03:56 (4)	03:55			05:09	05:24	05:38
	16:49	37	04:21 (7)	16:34	30	04:26 (7)	16:07			16:35	16:13	16:09
19	03:17		03:42 (7)	03:40		03:57 (4)	03:55			05:10	05:25	05:38
	16:49	40	04:22 (7)	16:33	28	04:25 (7)	16:06			16:34	16:13	16:09
20	03:18		03:42 (7)	03:41		03:58 (4)	03:56			05:10	05:25	05:38
	16:49	41	04:23 (7)	16:32	26	04:24 (7)	16:05			16:33	16:13	16:10
21	03:19		03:42 (7)	03:41		03:58 (4)	03:56			05:11	05:26	05:38
	16:48	42	04:24 (7)	16:31	23	04:21 (7)	16:04			16:32	16:12	16:10
22	03:20		03:42 (7)	03:42		03:59 (4)	03:57			05:11	05:26	05:39
	16:48	43	04:25 (7)	16:30	20	04:19 (7)	16:02			16:31	16:12	16:10
23	03:20		03:41 (7)	03:42		04:00 (4)	03:57			05:11	05:27	05:39
	16:48	45	04:26 (7)	16:29	15	04:15 (7)	16:01			16:30	16:11	16:10
24	03:21		03:40 (7)	03:43		04:00 (4)	03:58			05:12	05:27	05:39
	16:48	47	04:27 (7)	16:28	11	04:11 (4)	16:00			16:29	16:11	16:10
25	03:22		03:40 (7)	03:44		04:01 (4)	03:58			05:12	05:28	05:39
	16:47	48	04:28 (7)	16:28	10	04:11 (4)	15:59			16:29	16:11	16:11
26	03:23		03:40 (7)	03:44		04:01 (4)	03:59			05:13	05:28	05:39
	16:47	49	04:29 (7)	16:27	10	04:11 (4)	15:58			16:28	16:10	16:11
27	03:23		03:41 (7)	03:45		04:02 (4)	03:59			05:13	05:29	05:40
	16:47	49	04:30 (7)	16:26	9	04:11 (4)	15:57			16:27	16:10	16:11
28	03:24		03:41 (7)	03:45		04:03 (4)	03:59			05:14	05:29	05:40
	16:46	48	04:29 (7)	16:25	8	04:11 (4)	15:56			16:26	16:10	16:12
29	03:25		03:42 (7)				05:00			05:14	05:30	05:40
	16:46	48	04:30 (7)				16:55			16:25	16:10	16:12
30	03:26		03:43 (7)				05:00			05:15	05:30	05:40
	16:46	48	04:31 (7)				16:54			16:25	16:10	16:12
31	03:27		03:44 (7)				05:01				05:31	
	16:45	48	04:32 (7)				16:53				16:09	
Potential sun hours	420			364			380			345	337	317
Total, worst case		891			896			14				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: F - R7

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	Septembe	rOctober			November			December		
1	05:40	05:32	05:06	04:33			03:04		03:20 (7)	02:53		03:31 (7)
	16:13	16:26	16:40	16:52			16:08	42	04:02 (7)	16:30	23	03:54 (7)
2	05:40	05:31	05:05	04:32			03:04		03:20 (7)	02:53		03:33 (7)
	16:13	16:27	16:40	16:52			16:09	43	04:03 (7)	16:31	19	03:52 (7)
3	05:40	05:31	05:04	04:31			03:03		03:19 (7)	02:53		03:35 (7)
	16:13	16:27	16:41	16:53			16:10	44	04:03 (7)	16:32	16	03:51 (7)
4	05:40	05:30	05:03	04:30			03:02		03:18 (7)	02:53		03:37 (7)
	16:14	16:28	16:41	16:53			16:10	44	04:02 (7)	16:32	12	03:49 (7)
5	05:40	05:29	05:02	04:29			03:02		03:18 (7)	02:53		03:40 (7)
	16:14	16:28	16:42	16:54			16:11	45	04:03 (7)	16:33	7	03:47 (7)
6	05:40	05:29	05:01	04:28			03:01		03:17 (7)	02:53		
	16:14	16:29	16:42	16:54			16:12	46	04:03 (7)	16:34		
7	05:40	05:28	05:00	04:27			03:00		03:17 (7)	02:53		
	16:15	16:29	16:42	16:55			16:12	46	04:03 (7)	16:34		
8	05:40	05:27	04:59	04:26			03:00		03:16 (7)	02:53		
	16:15	16:30	16:43	16:55			16:13	47	04:03 (7)	16:35		
9	05:40	05:27	04:58	04:25			02:59		03:16 (7)	02:53		
	16:16	16:30	16:43	16:56			16:14	47	04:03 (7)	16:36		
10	05:40	05:26	04:56	04:24		04:39 (4)	02:59		03:15 (7)	02:54		
	16:16	16:31	16:44	16:56	2	04:41 (4)	16:15	47	04:02 (7)	16:36		
11	05:40	05:25	04:55	04:23		04:38 (4)	02:58		03:15 (7)	02:54		
	16:16	16:31	16:44	16:57	4	04:42 (4)	16:15	48	04:03 (7)	16:37		
12	05:39	05:24	04:54	04:22		04:37 (4)	02:58		03:14 (7)	02:54		
	16:17	16:31	16:44	16:57	5	04:42 (4)	16:16	48	04:02 (7)	16:38		
13	05:39	05:23	04:53	04:21		04:36 (4)	02:57		03:14 (7)	02:54		
	16:17	16:32	16:45	16:58	7	04:43 (4)	16:17	48	04:02 (7)	16:38		
14	05:39	05:23	04:52	04:20		04:35 (4)	02:57		03:14 (7)	02:55		
	16:18	16:32	16:45	16:58	8	04:43 (4)	16:17	48	04:02 (7)	16:39		
15	05:39	05:22	04:51	04:19		04:34 (4)	02:56		03:13 (7)	02:55		
	16:18	16:33	16:46	16:59	9	04:43 (4)	16:18	49	04:02 (7)	16:40		
16	05:39	05:21	04:50	04:18		04:33 (4)	02:56		03:13 (7)	02:55		
	16:19	16:33	16:46	16:59	10	04:43 (4)	16:19	49	04:02 (7)	16:40		
17	05:38	05:20	04:49	04:17		04:32 (4)	02:55		03:14 (7)	02:56		
	16:19	16:34	16:46	17:00	11	04:43 (4)	16:20	48	04:02 (7)	16:41		
18	05:38	05:19	04:48	04:16		04:31 (4)	02:55		03:14 (7)	02:56		
	16:20	16:34	16:47	17:00	11	04:42 (4)	16:20	47	04:01 (7)	16:41		
19	05:38	05:18	04:47	04:15		04:30 (4)	02:55		03:15 (7)	02:57		
	16:20	16:35	16:47	17:01	17	04:47 (7)	16:21	45	04:00 (7)	16:42		
20	05:37	05:18	04:45	04:14		04:30 (4)	02:54		03:17 (7)	02:57		
	16:21	16:35	16:47	17:01	21	04:51 (7)	16:22	43	04:00 (7)	16:43		
21	05:37	05:17	04:44	04:13		04:29 (4)	02:54		03:18 (7)	02:57		
	16:21	16:35	16:48	17:02	24	04:53 (7)	16:23	42	04:00 (7)	16:43		
22	05:37	05:16	04:43	04:12		04:28 (4)	02:54		03:18 (7)	02:58		
	16:22	16:36	16:48	17:02	26	04:54 (7)	16:23	41	03:59 (7)	16:44		
23	05:36	05:15	04:42	04:11		04:27 (4)	02:54		03:19 (7)	02:58		
	16:22	16:36	16:49	17:03	29	04:56 (7)	16:24	40	03:59 (7)	16:44		
24	05:36	05:14	04:41	04:11		04:26 (4)	02:53		03:20 (7)	02:59		
	16:22	16:37	16:49	17:04	31	04:57 (7)	16:25	38	03:58 (7)	16:45		
25	05:35	05:13	04:40	03:10		03:25 (4)	02:53		03:22 (7)	02:59		
	16:23	16:37	16:50	16:04	33	03:58 (7)	16:26	36	03:58 (7)	16:45		
26	05:35	05:12	04:39	03:09		03:25 (7)	02:53		03:23 (7)	03:00		
	16:23	16:38	16:50	16:05	34	03:59 (7)	16:26	34	03:57 (7)	16:45		
27	05:34	05:11	04:38	03:08		03:24 (7)	02:53		03:25 (7)	03:01		
	16:24	16:38	16:50	16:05	36	04:00 (7)	16:27	32	03:57 (7)	16:46		
28	05:34	05:10	04:37	03:07		03:23 (7)	02:53		03:26 (7)	03:01		
	16:24	16:38	16:51	16:06	37	04:00 (7)	16:28	30	03:56 (7)	16:46		
29	05:33	05:09	04:36	03:07		03:22 (7)	02:53		03:28 (7)	03:02		
	16:25	16:39	16:51	16:07	39	04:01 (7)	16:29	27	03:55 (7)	16:47		
30	05:33	05:08	04:34	03:06		03:22 (7)	02:53		03:29 (7)	03:02		
	16:25	16:39	16:52	16:07	40	04:02 (7)	16:29	25	03:54 (7)	16:47		
31	05:32	05:07		03:05		03:21 (7)				03:03		
	16:26	16:40		16:08	41	04:02 (7)				16:47		
Potential sun hours	331	348	358	393			401			425		
Total, worst case					475			1269			77	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

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Matos, Fonseca & associados
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Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: G - R10

Assumptions for shadow calculations

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	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: H - R12

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:19	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:09	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: I - R13

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

	January	February	March	April			May			June			July			August			Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01			05:15		05:33 (4)	05:31		05:53 (7)	05:40		05:58 (7)	05:32			05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52			16:24	5	05:38 (4)	16:09	29	06:22 (7)	16:13	34	06:32 (7)	16:26			16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02			05:16		05:33 (4)	05:32		05:53 (7)	05:40		05:58 (7)	05:31			05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51			16:23	4	05:37 (4)	16:09	30	06:23 (7)	16:13	34	06:32 (7)	16:27			16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02			05:16		05:34 (4)	05:32		05:52 (7)	05:40		05:58 (7)	05:31			05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50			16:22	2	05:36 (4)	16:09	32	06:24 (7)	16:13	34	06:32 (7)	16:27			16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03			05:17		05:34 (4)	05:33		05:52 (7)	05:40		05:58 (7)	05:30			05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49			16:22	1	05:35 (4)	16:09	32	06:24 (7)	16:14	34	06:32 (7)	16:28			16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03			05:17			05:33		05:52 (7)	05:40		05:58 (7)	05:29			05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48			16:21			16:09	33	06:25 (7)	16:14	34	06:32 (7)	16:28			16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04			05:18			05:33		05:51 (7)	05:40		05:58 (7)	05:29			05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47			16:20			16:09	34	06:25 (7)	16:14	34	06:32 (7)	16:29			16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04			05:19			05:34		05:52 (7)	05:40		05:59 (7)	05:28			05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46			16:20			16:09	34	06:26 (7)	16:15	33	06:32 (7)	16:29			16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04			05:19			05:34		05:52 (7)	05:40		05:58 (7)	05:27			04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45			16:19			16:08	34	06:26 (7)	16:15	33	06:31 (7)	16:30			16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05			05:20			05:35		05:53 (7)	05:40		05:59 (7)	05:27		05:43 (4)	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44			16:18			16:08	34	06:27 (7)	16:16	32	06:31 (7)	16:30	1	05:44 (4)	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05			05:20			05:35		05:53 (7)	05:40		06:00 (7)	05:26		05:42 (4)	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43			16:18			16:08	34	06:27 (7)	16:16	31	06:31 (7)	16:31	3	05:45 (4)	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06			05:21			05:35		05:53 (7)	05:40		06:01 (7)	05:25		05:42 (4)	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42			16:17			16:08	34	06:27 (7)	16:16	29	06:30 (7)	16:31	4	05:46 (4)	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06			05:21			05:36		05:54 (7)	05:39		06:01 (7)	05:24		05:41 (4)	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41			16:17			16:09	34	06:28 (7)	16:17	29	06:30 (7)	16:31	5	05:46 (4)	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07			05:22			05:36		05:54 (7)	05:39		06:02 (7)	05:23		05:40 (4)	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40			16:16			16:09	34	06:28 (7)	16:17	28	06:30 (7)	16:32	6	05:46 (4)	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07			05:22			05:37		05:54 (7)	05:39		06:03 (7)	05:23		05:39 (4)	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39			16:15			16:09	34	06:28 (7)	16:18	25	06:28 (7)	16:32	7	05:46 (4)	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08			05:23			05:37		05:55 (7)	05:39		06:04 (7)	05:22		05:38 (4)	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38			16:15			16:09	34	06:29 (7)	16:18	24	06:28 (7)	16:33	7	05:45 (4)	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08			05:23			05:37		05:55 (7)	05:39		06:05 (7)	05:21		05:37 (4)	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37			16:14			16:09	34	06:29 (7)	16:19	22	06:27 (7)	16:33	8	05:45 (4)	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09			05:24			05:37		05:55 (7)	05:38		06:07 (7)	05:20		05:37 (4)	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36			16:14			16:09	34	06:29 (7)	16:19	20	06:27 (7)	16:34	8	05:45 (4)	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09			05:24			05:38		05:56 (7)	05:38		06:08 (7)	05:19		05:36 (4)	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35			16:13			16:09	34	06:30 (7)	16:20	16	06:24 (7)	16:34	8	05:44 (4)	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10			05:25			05:38		05:56 (7)	05:38		06:10 (7)	05:18		05:35 (4)	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34			16:13			16:09	34	06:30 (7)	16:20	13	06:23 (7)	16:35	8	05:43 (4)	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10		05:27 (4)	05:25			05:38		05:56 (7)	05:37		06:14 (7)	05:18		05:34 (4)	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	4	05:31 (4)	16:13			16:10	34	06:30 (7)	16:21	6	06:20 (7)	16:35	8	05:42 (4)	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11		05:27 (4)	05:26			05:39		05:56 (7)	05:37			05:17		05:33 (4)	04:44	04:13	02:54	02:57
	16:48	16:31	16:04	16:32	7	05:34 (4)	16:12			16:10	34	06:30 (7)	16:21			16:35	7	05:40 (4)	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11		05:28 (4)	05:26			05:39		05:57 (7)	05:37			05:16		05:32 (4)	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	8	05:36 (4)	16:12			16:10	34	06:31 (7)	16:21			16:36	6	05:38 (4)	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11		05:28 (4)	05:27			05:39		05:57 (7)	05:36			05:15		05:31 (4)	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	8	05:36 (4)	16:11			16:10	34	06:31 (7)	16:22			16:36	3	05:34 (4)	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12		05:29 (4)	05:27		06:02 (7)	05:39		05:57 (7)	05:36			05:14			04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	8	05:37 (4)	16:11	10	06:12 (7)	16:10	34	06:31 (7)	16:22			16:37			16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12		05:29 (4)	05:28		06:00 (7)	05:39		05:57 (7)	05:35			05:13			04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	8	05:37 (4)	16:11	15	06:15 (7)	16:11	34	06:31 (7)	16:23			16:37			16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13		05:30 (4)	05:28		05:58 (7)	05:39		05:57 (7)	05:35			05:12			04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	8	05:38 (4)	16:10	18	06:16 (7)	16:11	34	06:31 (7)	16:23			16:38			16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13		05:30 (4)	05:29		05:57 (7)	05:40		05:57 (7)	05:34			05:11			04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	8	05:38 (4)	16:10	21	06:18 (7)	16:11	34	06:31 (7)	16:24			16:38			16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14		05:31 (4)	05:29		05:56 (7)	05:40		05:58 (7)	05:34			05:10			04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	7	05:38 (4)	16:10	23	06:19 (7)	16:12	34	06:32 (7)	16:24			16:38			16:51	16:06	16:28	16:46
29	03:25		05:00	05:14		05:31 (4)	05:30		05:55 (7)	05:40		05:58 (7)	05:33			05:09			04:36	03:07	02:53	03:02
	16:46		16:55	16:25	6	05:37 (4)	16:10	25	06:20 (7)	16:12	34	06:32 (7)	16:25			16:39			16:51	16:07	16:29	16:47
30	03:26		05:00	05:15		05:32 (4)	05:30		05:54 (7)	05:40		05:58 (7)	05:33			05:08			04:34	03:06	02:53	03:02
	16:46		16:54	16:25	6	05:38 (4)	16:09	27	06:21 (7)	16:12	34	06:32 (7)	16:25			16:39			16:52	16:07	16:29	16:47
31	03:27		05:01				05:31		05:54 (7)				05:32			05:07				03:05		03:03
	16:45		16:53				16:09	28	06:22 (7)				16:26			16:40				16:08		16:47
Potential sun hours	420	364	380	345			337			316			331			348			358	393	401	425
Total, worst case					78			179			1006			545			89					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Shadow receptor: J - R18

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	January	Jan. min	Jan. flicker	February	March	April	May	June	July	August	September	October	November	Nov. min	Nov. flicker	December	Dec. min	Dec. flicker
1	03:04		15:13 (2)	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04			02:53		15:15 (2)
	16:48	49	16:02 (2)	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:09			16:30	17	15:32 (2)
2	03:05		15:13 (2)	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04			02:53		15:12 (2)
	16:48	48	16:01 (2)	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:53	16:09			16:31	24	15:36 (2)
3	03:05		15:15 (2)	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03			02:53		15:10 (2)
	16:48	46	16:01 (2)	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10			16:32	28	15:38 (2)
4	03:06		15:16 (2)	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02			02:53		15:08 (2)
	16:48	44	16:00 (2)	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10			16:32	33	15:41 (2)
5	03:07		15:17 (2)	03:30	03:48	05:03	05:18	05:33	05:40	05:29	05:02	04:29	03:02			02:53		15:07 (2)
	16:49	42	15:59 (2)	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11			16:33	36	15:43 (2)
6	03:07		15:19 (2)	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01			02:53		15:05 (2)
	16:49	40	15:59 (2)	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12			16:34	39	15:44 (2)
7	03:08		15:21 (2)	03:32	03:49	05:04	05:19	05:34	05:40	05:28	05:00	04:27	03:00			02:53		15:04 (2)
	16:49	37	15:58 (2)	16:41	16:18	16:46	16:20	16:08	16:15	16:29	16:42	16:55	16:13			16:34	42	15:46 (2)
8	03:09		15:23 (2)	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00			02:53		15:04 (2)
	16:49	33	15:56 (2)	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13			16:35	43	15:47 (2)
9	03:09		15:25 (2)	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59			02:53		15:03 (2)
	16:49	30	15:55 (2)	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14			16:36	45	15:48 (2)
10	03:10		15:28 (2)	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59			02:54		15:03 (2)
	16:49	25	15:53 (2)	16:40	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15			16:37	48	15:51 (2)
11	03:11		15:31 (2)	03:35	03:51	05:06	05:21	05:36	05:40	05:25	04:55	04:23	02:58			02:54		15:03 (2)
	16:49	18	15:49 (2)	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15			16:37	48	15:51 (2)
12	03:12		15:38 (2)	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58			02:54		15:02 (2)
	16:49	6	15:44 (2)	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16			16:38	50	15:52 (2)
13	03:13			03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57			02:54		15:02 (2)
	16:49			16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17			16:39	51	15:53 (2)
14	03:13			03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57			02:55		15:02 (2)
	16:49			16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17			16:39	53	15:55 (2)
15	03:14			03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56			02:55		15:02 (2)
	16:49			16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18			16:40	53	15:55 (2)
16	03:15			03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56			02:55		15:02 (2)
	16:49			16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19			16:40	54	15:56 (2)
17	03:16			03:39	03:54	05:09	05:24	05:38	05:38	05:20	04:49	04:17	02:55			02:56		15:03 (2)
	16:49			16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20			16:41	54	15:57 (2)
18	03:16			03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55			02:56		15:02 (2)
	16:49			16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20			16:42	55	15:57 (2)
19	03:17			03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55			02:57		15:03 (2)
	16:49			16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21			16:42	56	15:59 (2)
20	03:18			03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54			02:57		15:03 (2)
	16:49			16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:48	17:01	16:22			16:43	56	15:59 (2)
21	03:19			03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54			02:57		15:03 (2)
	16:48			16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23			16:43	56	15:59 (2)
22	03:20			03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54			02:58		15:04 (2)
	16:48			16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23			16:44	56	16:00 (2)
23	03:20			03:42	03:57	05:12	05:27	05:39	05:36	05:15	04:42	04:11	02:54			02:58		15:04 (2)
	16:48			16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24			16:44	56	16:00 (2)
24	03:21			03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53			02:59		15:05 (2)
	16:48			16:29	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25			16:45	56	16:01 (2)
25	03:22			03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53			02:59		15:05 (2)
	16:47			16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26			16:45	56	16:01 (2)
26	03:23			03:44	03:59	05:13	05:28	05:40	05:35	05:12	04:39	03:09	02:53			03:00		15:07 (2)
	16:47			16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26			16:45	54	16:01 (2)
27	03:23			03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53			03:01		15:07 (2)
	16:47			16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27			16:46	54	16:01 (2)
28	03:24			03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53			03:01		15:08 (2)
	16:46			16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28			16:46	53	16:01 (2)
29	03:25				05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53			03:02		15:09 (2)
	16:46				16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29			16:47	53	16:02 (2)
30	03:26				05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53		15:21 (2)	03:02		15:10 (2)
	16:46				16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	3	15:24 (2)	16:47	51	16:01 (2)
31	03:27				05:01		05:31		05:32	05:07		03:05				03:03		15:11 (2)
	16:45				16:53		16:09		16:26	16:40		16:08				16:47	51	16:02 (2)
Potential sun hours	420			364	380	345	337	316	331	348	358	393	401			425		
Total, worst case		418												3			1481	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar

Shadow receptor: K - R21

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	January			February			March			April	May	June
1	03:04			03:27		14:58 (5)	03:46		14:57 (5)	05:01	05:15	05:31
	16:48			16:45	36	15:34 (5)	16:24	61	15:58 (5)	16:52	16:24	16:09
2	03:04			03:28		14:57 (5)	03:46		15:00 (5)	05:02	05:16	05:32
	16:48			16:44	40	15:37 (5)	16:23	58	15:58 (5)	16:51	16:23	16:09
3	03:05			03:29		14:55 (5)	03:47		15:03 (5)	05:02	05:16	05:32
	16:48			16:44	44	15:39 (5)	16:22	54	15:57 (5)	16:50	16:22	16:09
4	03:06			03:29		14:54 (5)	03:48		15:06 (5)	05:03	05:17	05:32
	16:48			16:43	47	15:41 (5)	16:21	52	15:58 (5)	16:49	16:22	16:09
5	03:07			03:30		14:52 (5)	03:48		15:09 (5)	05:03	05:17	05:33
	16:49			16:42	50	15:42 (5)	16:20	48	15:57 (5)	16:48	16:21	16:09
6	03:07			03:31		14:51 (5)	03:49		15:12 (5)	05:03	05:18	05:33
	16:49			16:42	53	15:44 (5)	16:19	47	15:59 (4)	16:47	16:20	16:08
7	03:08			03:32		14:50 (5)	03:49		15:15 (5)	05:04	05:18	05:34
	16:49			16:41	56	15:46 (5)	16:18	44	15:59 (4)	16:46	16:19	16:08
8	03:09			03:32		14:48 (5)	03:50		15:19 (5)	05:04	05:19	05:34
	16:49			16:41	59	15:47 (5)	16:17	40	15:59 (4)	16:44	16:19	16:08
9	03:09			03:33		14:47 (5)	03:50		15:21 (5)	05:05	05:19	05:35
	16:49			16:40	61	15:48 (5)	16:16	36	15:57 (4)	16:43	16:18	16:08
10	03:10			03:34		14:47 (5)	03:51		15:25 (5)	05:05	05:20	05:35
	16:49			16:39	63	15:50 (5)	16:15	32	15:57 (4)	16:42	16:18	16:08
11	03:11			03:34		14:46 (5)	03:51		04:08 (6)	05:06	05:20	05:35
	16:49			16:39	65	15:51 (5)	16:14	35	15:55 (4)	16:41	16:17	16:08
12	03:12			03:35		14:44 (5)	03:52		04:09 (6)	05:06	05:21	05:36
	16:49			16:38	67	15:51 (5)	16:13	33	15:55 (4)	16:40	16:16	16:08
13	03:12			03:36		14:44 (5)	03:52		04:09 (6)	05:07	05:22	05:36
	16:49			16:37	69	15:53 (5)	16:12	30	15:53 (4)	16:40	16:16	16:09
14	03:13			03:37		14:43 (5)	03:53		04:10 (6)	05:07	05:22	05:36
	16:49			16:37	71	15:54 (5)	16:11	25	15:53 (4)	16:39	16:15	16:09
15	03:14			03:37		14:42 (5)	03:53		04:10 (6)	05:08	05:23	05:37
	16:49			16:36	72	15:54 (5)	16:10	17	15:51 (4)	16:38	16:15	16:09
16	03:15			03:38		14:41 (5)	03:54		04:11 (6)	05:08	05:23	05:37
	16:49			16:35	74	15:55 (5)	16:09	9	15:51 (4)	16:37	16:14	16:09
17	03:16			03:39		14:41 (5)	03:54		15:45 (5)	05:09	05:24	05:37
	16:49			16:34	75	15:56 (5)	16:08	4	15:49 (4)	16:36	16:14	16:09
18	03:16			03:39		14:39 (5)	03:55			05:09	05:24	05:38
	16:49			16:33	77	15:56 (5)	16:07			16:35	16:13	16:09
19	03:17			03:40		14:39 (5)	03:55			05:09	05:25	05:38
	16:49			16:33	78	15:57 (5)	16:06			16:34	16:13	16:09
20	03:18			03:40		14:39 (5)	03:56			05:10	05:25	05:38
	16:49			16:32	78	15:57 (5)	16:04			16:33	16:12	16:09
21	03:19			03:41		14:38 (5)	03:56			05:10	05:26	05:38
	16:48			16:31	79	15:57 (5)	16:03			16:32	16:12	16:10
22	03:19			03:42		14:37 (5)	03:57			05:11	05:26	05:39
	16:48			16:30	81	15:58 (5)	16:02			16:31	16:12	16:10
23	03:20			03:42		14:37 (5)	03:57			05:11	05:27	05:39
	16:48			16:29	80	15:57 (5)	16:01			16:30	16:11	16:10
24	03:21			03:43		14:41 (5)	03:58			05:12	05:27	05:39
	16:48			16:28	77	15:58 (5)	16:00			16:29	16:11	16:10
25	03:22			03:44		14:44 (5)	03:58			05:12	05:28	05:39
	16:47			16:28	75	15:59 (5)	15:59			16:29	16:11	16:11
26	03:23			03:44		14:47 (5)	03:58			05:13	05:28	05:39
	16:47			16:27	71	15:58 (5)	15:58			16:28	16:10	16:11
27	03:23			03:45		14:50 (5)	03:59			05:13	05:29	05:40
	16:47			16:26	68	15:58 (5)	15:57			16:27	16:10	16:11
28	03:24			03:45		14:53 (5)	03:59			05:14	05:29	05:40
	16:46			16:25	65	15:58 (5)	15:56			16:26	16:10	16:11
29	03:25		15:07 (5)				05:00			05:14	05:30	05:40
	16:46	17	15:24 (5)				16:55			16:25	16:10	16:12
30	03:26		15:04 (5)				05:00			05:15	05:30	05:40
	16:45	25	15:29 (5)				16:54			16:24	16:09	16:12
31	03:26		15:01 (5)				05:01				05:31	
	16:45	31	15:32 (5)				16:53				16:09	
Potential sun hours	420			364			380			345	337	317
Total, worst case		73			1831			625				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: K - R21

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	September			October			November			December
1	05:40	05:32	05:06			04:33		04:48 (6)	03:04		14:16 (5)	02:53
	16:12	16:26	16:40			16:52	32	16:33 (4)	16:08	63	15:19 (5)	16:30
2	05:40	05:31	05:05			04:32		04:47 (6)	03:03		14:18 (5)	02:53
	16:13	16:27	16:40			16:52	35	16:34 (4)	16:09	60	15:18 (5)	16:31
3	05:40	05:30	05:04			04:31		16:04 (5)	03:03		14:18 (5)	02:53
	16:13	16:27	16:41			16:53	30	16:34 (4)	16:10	58	15:16 (5)	16:31
4	05:40	05:30	05:03			04:30		16:00 (5)	03:02		14:19 (5)	02:53
	16:14	16:28	16:41			16:53	35	16:35 (4)	16:10	56	15:15 (5)	16:32
5	05:40	05:29	05:02			04:29		15:57 (5)	03:01		14:21 (5)	02:53
	16:14	16:28	16:42			16:54	38	16:35 (4)	16:11	53	15:14 (5)	16:33
6	05:40	05:29	05:01			04:28		15:53 (5)	03:01		14:22 (5)	02:53
	16:14	16:29	16:42			16:54	43	16:36 (4)	16:12	50	15:12 (5)	16:34
7	05:40	05:28	05:00			04:27		15:50 (5)	03:00		14:24 (5)	02:53
	16:15	16:29	16:42			16:55	45	16:35 (4)	16:12	47	15:11 (5)	16:34
8	05:40	05:27	04:59			04:26		15:46 (5)	03:00		14:26 (5)	02:53
	16:15	16:30	16:43			16:55	47	16:33 (4)	16:13	43	15:09 (5)	16:35
9	05:40	05:26	04:57			04:25		15:43 (5)	02:59		14:28 (5)	02:53
	16:16	16:30	16:43			16:56	49	16:32 (5)	16:14	39	15:07 (5)	16:36
10	05:40	05:26	04:56			04:24		15:39 (5)	02:59		14:30 (5)	02:54
	16:16	16:30	16:43			16:56	53	16:32 (5)	16:14	35	15:05 (5)	16:36
11	05:39	05:25	04:55			04:23		15:36 (5)	02:58		14:33 (5)	02:54
	16:16	16:31	16:44			16:57	56	16:32 (5)	16:15	30	15:03 (5)	16:37
12	05:39	05:24	04:54			04:22		15:32 (5)	02:58		14:35 (5)	02:54
	16:17	16:31	16:44			16:57	60	16:32 (5)	16:16	24	14:59 (5)	16:38
13	05:39	05:23	04:53			04:21		15:29 (5)	02:57		14:40 (5)	02:54
	16:17	16:32	16:45			16:58	62	16:31 (5)	16:17	16	14:56 (5)	16:38
14	05:39	05:23	04:52			04:20		15:25 (5)	02:57			02:55
	16:18	16:32	16:45			16:58	66	16:31 (5)	16:17			16:39
15	05:39	05:22	04:51			04:19		15:21 (5)	02:56			02:55
	16:18	16:33	16:45			16:59	70	16:31 (5)	16:18			16:40
16	05:38	05:21	04:50			04:18		15:18 (5)	02:56			02:55
	16:19	16:33	16:46			16:59	72	16:30 (5)	16:19			16:40
17	05:38	05:20	04:49			04:17		15:14 (5)	02:55			02:56
	16:19	16:34	16:46			17:00	76	16:30 (5)	16:20			16:41
18	05:38	05:19	04:48			04:16		15:11 (5)	02:55			02:56
	16:20	16:34	16:47			17:00	78	16:29 (5)	16:20			16:41
19	05:38	05:18	04:46			04:15		15:08 (5)	02:55			02:56
	16:20	16:35	16:47			17:01	81	16:29 (5)	16:21			16:42
20	05:37	05:17	04:45			04:14		15:08 (5)	02:54			02:57
	16:20	16:35	16:47			17:01	80	16:28 (5)	16:22			16:42
21	05:37	05:17	04:44			04:13		15:09 (5)	02:54			02:57
	16:21	16:35	16:48			17:02	79	16:28 (5)	16:23			16:43
22	05:36	05:16	04:43			04:12		15:09 (5)	02:54			02:58
	16:21	16:36	16:48			17:02	78	16:27 (5)	16:23			16:43
23	05:36	05:15	04:42			04:11		15:09 (5)	02:54			02:58
	16:22	16:36	16:49			17:03	78	16:27 (5)	16:24			16:44
24	05:36	05:14	04:41			04:11		15:10 (5)	02:53			02:59
	16:22	16:37	16:49			17:03	76	16:26 (5)	16:25			16:44
25	05:35	05:13	04:40			03:10		14:10 (5)	02:53			02:59
	16:23	16:37	16:49			16:04	75	15:25 (5)	16:26			16:45
26	05:35	05:12	04:39		16:29 (4)	03:09		14:12 (5)	02:53			03:00
	16:23	16:37	16:50	3	16:32 (4)	16:05	73	15:25 (5)	16:26			16:45
27	05:34	05:11	04:38		16:26 (5)	03:08		14:12 (5)	02:53			03:00
	16:24	16:38	16:50	6	16:32 (4)	16:05	72	15:24 (5)	16:27			16:46
28	05:34	05:10	04:37		04:52 (6)	03:07		14:12 (5)	02:53			03:01
	16:24	16:38	16:51	14	16:33 (4)	16:06	71	15:23 (5)	16:28			16:46
29	05:33	05:09	04:35		04:50 (6)	03:06		14:13 (5)	02:53			03:02
	16:25	16:39	16:51	21	16:32 (4)	16:06	69	15:22 (5)	16:29			16:47
30	05:33	05:08	04:34		04:49 (6)	03:06		14:15 (5)	02:53			03:02
	16:25	16:39	16:52	29	16:33 (4)	16:07	66	15:21 (5)	16:29			16:47
31	05:32	05:07				03:05		14:15 (5)				03:03
	16:26	16:40				16:08	65	15:20 (5)				16:47
Potential sun hours	331	348	358			393			401			425
Total, worst case				73			1910			574		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar

Shadow receptor: L - R23

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

Day	January			February			March		
1	03:04			03:27			03:46		04:03 (6)
	16:48			16:44			16:24	27	16:05 (5)
2	03:04			03:28			03:46		04:04 (6)
	16:48			16:44			16:23	25	16:05 (4)
3	03:05			03:29			03:47		04:04 (6)
	16:48			16:43			16:22	21	16:03 (4)
4	03:06			03:29			03:48		04:05 (6)
	16:48			16:43			16:21	18	16:03 (4)
5	03:06			03:30			03:48		04:05 (6)
	16:49			16:42			16:20	12	16:01 (4)
6	03:07			03:31		15:59 (5)	03:49		15:54 (4)
	16:49			16:42	6	16:05 (5)	16:19	7	16:01 (4)
7	03:08			03:32		15:55 (5)	03:49		15:54 (4)
	16:49			16:41	14	16:09 (5)	16:18	5	15:59 (4)
8	03:09			03:32		15:52 (5)	03:50		15:56 (4)
	16:49			16:41	19	16:11 (5)	16:17	3	15:59 (4)
9	03:09			03:33		15:51 (5)	03:50		
	16:49			16:40	22	16:13 (5)	16:16		
10	03:10			03:34		15:50 (5)	03:51		
	16:49			16:39	25	16:15 (5)	16:15		
11	03:11			03:34		15:49 (5)	03:51		
	16:49			16:39	27	16:16 (5)	16:14		
12	03:12			03:35		15:47 (5)	03:52		
	16:49			16:38	30	16:17 (5)	16:13		
13	03:12			03:36		03:59 (6)	03:52		
	16:49			16:37	44	16:18 (5)	16:12		
14	03:13			03:37		03:57 (6)	03:53		
	16:49			16:37	49	16:18 (5)	16:11		
15	03:14			03:37		03:55 (6)	03:53		
	16:49			16:36	52	16:16 (5)	16:10		
16	03:15			03:38		03:55 (6)	03:54		04:11 (9)
	16:49			16:35	54	16:16 (5)	16:09	1	04:12 (9)
17	03:16			03:39		03:56 (6)	03:54		
	16:49			16:34	53	16:15 (5)	16:08		
18	03:16			03:39		03:56 (6)	03:55		
	16:49			16:33	52	16:14 (5)	16:07		
19	03:17			03:40		03:57 (6)	03:55		
	16:49			16:33	52	16:14 (5)	16:06		
20	03:18			03:40		03:58 (6)	03:56		
	16:49			16:32	51	16:13 (5)	16:04		
21	03:19			03:41		03:58 (6)	03:56		
	16:48			16:31	50	16:12 (5)	16:03		
22	03:19			03:42		03:59 (6)	03:57		
	16:48			16:30	48	16:11 (5)	16:02		
23	03:20			03:42		03:59 (6)	03:57		
	16:48			16:29	47	16:10 (5)	16:01		
24	03:21			03:43		04:00 (6)	03:57		
	16:48			16:28	45	16:10 (5)	16:00		
25	03:22			03:44		04:01 (6)	03:58		
	16:47			16:27	42	16:09 (5)	15:59		
26	03:23			03:44		04:01 (6)	03:58		
	16:47			16:27	39	16:08 (5)	15:58		
27	03:23			03:45		04:02 (6)	03:59		
	16:47			16:26	36	16:07 (5)	15:57		
28	03:24			03:45		04:02 (6)	03:59		
	16:46			16:25	31	16:06 (5)	15:56		
29	03:25						05:00		
	16:46						16:55		
30	03:26						05:00		
	16:45						16:54		
31	03:26						05:01		
	16:45						16:53		
Potential sun hours	420			364			380		
Total, worst case					888			119	

Day	April			May			June		
1	05:01			05:15			05:31		
	16:52			16:24			16:09		
2	05:02			05:16			05:32		
	16:51			16:23			16:09		
3	05:02			05:16			05:32		
	16:50			16:22			16:09		
4	05:03			05:17			05:32		
	16:49			16:22			16:09		
5	05:03			05:17			05:33		
	16:48			16:21			16:09		
6	05:03			05:18			05:33		
	16:47			16:20			16:08		
7	05:04			05:18			05:34		
	16:45			16:19			16:08		
8	05:04			05:19			05:34		
	16:44			16:19			16:08		
9	05:05			05:19			05:35		
	16:43			16:18			16:08		
10	05:05			05:20			05:35		
	16:42			16:18			16:08		
11	05:06			05:20			05:35		
	16:41			16:17			16:08		
12	05:06			05:21			05:36		
	16:40			16:16			16:08		
13	05:07			05:22			05:36		
	16:39			16:16			16:08		
14	05:07			05:22			05:36		
	16:39			16:15			16:09		
15	05:08			05:23			05:37		
	16:38			16:15			16:09		
16	05:08			05:23			05:37		
	16:37			16:14			16:09		
17	05:08			05:24			05:37		
	16:36			16:14			16:09		
18	05:09			05:24			05:38		
	16:35			16:13			16:09		
19	05:09			05:25			05:38		
	16:34			16:13			16:09		
20	05:10			05:25			05:38		
	16:33			16:12			16:09		
21	05:10			05:26			05:38		
	16:32			16:12			16:10		
22	05:11			05:26			05:39		
	16:31			16:12			16:10		
23	05:11			05:27			05:39		
	16:30			16:11			16:10		
24	05:12			05:27			05:39		
	16:29			16:11			16:10		
25	05:12			05:28			05:39		
	16:29			16:11			16:11		
26	05:13			05:28			05:39		
	16:28			16:10			16:11		
27	05:13			05:29			05:39		
	16:27			16:10			16:11		
28	05:14			05:29			05:40		
	16:26			16:10			16:11		
29	05:14			05:30			05:40		
	16:25			16:10			16:12		
30	05:15			05:30			05:40		
	16:24			16:09			16:12		
31				05:31					
				16:09					
Potential sun hours	345			337			317		
Total, worst case									

Day	July			August			September		
1	05:40			05:32			05:06		
	16:12			16:26			16:40		
2	05:40			05:31			05:05		
	16:13			16:27			16:40		
3	05:40			05:30			05:04		
	16:13			16:27			16:41		
4	05:40			05:30			05:03		
	16:13			16:28			16:41		
5	05:40			05:29			05:02		
	16:14			16:28			16:42		
6	05:40			05:28			05:01		
	16:14			16:29			16:42		
7	05:40			05:28			05:00		
	16:15			16:29			16:42		
8	05:40			05:27			04:58		
	16:15			16:30			16:43		
9	05:40			05:26			04:57		
	16:15			16:30			16:43		
10	05:40			05:26			04:56		
	16:16			16:30			16:43		
11	05:39			05:25			04:55		
	16:16			16:31			16:44		
12	05:39			05:24			04:54		
	16:17			16:31			16:44		
13	05:39			05:23			04:53		
	16:17			16:32			16:45		
14	05:39			05:23			04:52		
	16:18			16:32			16:45		
15	05:39			05:22			04:51		
	16:18			16:33			16:45		
16	05:38			05:21			04:50		
	16:19			16:33			16:46		
17	05:38			05:20			04:49		
	16:19			16:34			16:46		
18	05:38			05:19			04:48		
	16:19			16:34			16:47		
19	05:38			05:18			04:46		
	16:20			16:34			16:47		
20	05:37			05:17			04:45		
	16:20			16:35			16:47		
21	05:37			05:17			04:44		
	16:21			16:35			16:48		
22	05:36			05:16			04:43		
	16:21			16:36			16:48		
23	05:36			05:15			04:42		
	16:22			16:36			16:49		
24	05:36			05:14			04:41		
	16:22			16:37			16:49		
25	05:35			05:13			04:40		
	16:23			16:37			16:49		
26	05:35			05:12			04:39		
	16:23			16:37			16:50		
27	05:34			05:11			04:38		
	16:24			16:38			16:50		
28	05:34			05:10			04:37		
	16:24			16:38			16:51		
29	05:33			05:09			04:35		
	16:25			16:39			16:51		
30	05:33			05:08			04:34		
	16:25			16:39			16:51		
31	05:32			05:07					
	16:26			16:40					
Potential sun hours	331			348			358		
Total, worst case									

Day	October			November			December		
1	04:33			03:04		15:19 (5)	02:53		
	16:52			16:08	25	15:44 (5)	16:30		
2	04:32			03:03		15:21 (5)	02:53		
	16:52			16:09	22	15:43 (5)	16:31		
3	04:31			03:03		15:23 (5)	02:53		
	16:53			16:10	18	15:41 (5)	16:31		
4	04:30			03:02		15:25 (5)	02:53		
	16:53			16:10	13	15:38 (5)	16:32		
5	04:29		16:34 (4)	03:01		15:30 (5)	02:53		
	16:54	1	16:35 (4)	16:11	3	15:33 (5)	16:33		
6	04:28		16:31 (4)	03:01			02:53		
	16:54	5	16:36 (4)	16:12			16:34		
7	04:27		16:30 (4)	03:00			02:53		
	16:55	6	16:36 (4)	16:12			16:34		
8	04:26		16:29 (4)	03:00			02:53		
	16:55	8	16:37 (4)	16:13			16:35		
9	04:25		04:40 (6)	02:59			02:53		
	16:56	15	16:37 (4)	16:14			16:36		
10	04:24		04:39 (6)	02:59			02:54		
	16:56	19	16:37 (4)	16:14			16:36		
11	04:23		04:38 (6)	02:58			02:54		
	16:57	23	16:38 (4)	16:15			16:37		
12	04:22		04:37 (6)	02:57			02:54		
	16:57	25	16:38 (5)	16:16			16:38		
13	04:21		04:36 (6)	02:57			02:54		
	16:57	28	16:39 (5)	16:17			16:38		
14	04:20		04:35 (6)	02:57			02:55		
	16:58	33	16:39 (5)	16:17			16:39		
15	04:19		04:34 (6)	02:56			02:55		
	16:59	37	16:40 (5)	16:18			16:40		
16	04:18		04:33 (6)	02:56			02:55		
	16:59	39	16:40 (5)	16:19			16:40		
17	04:17		04:32 (6)	02:55			02:56		
	17:00	43	16:41 (5)	16:20			16:41		
18	04:16		04:31 (6)	02:55			02:56		
	17:00	45	16:41 (5)	16:20			16:41		
19	04:15		04:30 (6)	02:55			02:56		
	17:01	47	16:41 (5)	16:21			16:42		
20	04:14		04:29 (6)	02:54			02:57		
	17:01	49	16:42 (5)	16:22			16:42		
21	04:13		04:29 (6)	02:54			02:57		
	17:02	50	16:43 (5)	16:22			16:43		
22	04:12		04:28 (6)	02:54			02:58		
	17:02	52	16:44 (5)	16:23			16:43		
23	04:11		04:27 (6)	02:54			02:58		
	17:03	52	16:44 (5)	16:24			16:44		
24	04:10		04:26 (6)	02:53			02:59		
	17:03	52	16:44 (5)	16:25			16:44		
25	03:10		03:25 (6)	02:53			02:59		
	16:04	53	15:45 (5)	16:25			16:45		
26	03:09		03:24 (6)	02:53			03:00		
	16:05	53	15:45 (5)	16:26			16:45		
27	03:08		03:25 (6)	02:53			03:00		
	16:05	52	15:47 (5)	16:27			16:46		
28	03:07		03:27 (6)	02:53			03:01		
	16:06	48	15:47 (5)	16:28			16:46		
29	03:06		03:29 (6)	02:53			03:02		
	16:06	43	15:47 (5)	16:29			16:46		
30	03:06		15:18 (5)	02:53			03:02		
	16:07	29	15:47 (5)	16:29			16:47		
31	03:05		15:18 (5)				03:03		
	16:08	27	15:45 (5)				16:47		
Potential sun hours	393			401			425		
Total, worst case		934			81				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar

Shadow receptor: M - R24

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February			March			April	May	June	July	August	September			October			November			December
1	03:04	03:27			03:46			05:01	05:15	05:31	05:40	05:32	05:06			04:33			03:04		03:20 (6)	02:53
	16:48	16:44			16:24			16:52	16:24	16:09	16:12	16:26	16:40			16:52			16:08	31	03:51 (6)	16:30
2	03:04	03:28		04:01 (6)	03:46			05:02	05:16	05:32	05:40	05:31	05:05			04:32			03:03		03:20 (6)	02:53
	16:48	16:44	6	04:07 (6)	16:23			16:51	16:23	16:09	16:13	16:27	16:40			16:52			16:09	31	03:51 (6)	16:31
3	03:05	03:29		03:58 (6)	03:47			05:02	05:16	05:32	05:40	05:30	05:04			04:31			03:03		03:20 (6)	02:53
	16:48	16:43	14	04:12 (6)	16:22			16:50	16:22	16:09	16:13	16:27	16:41			16:53			16:10	30	03:50 (6)	16:31
4	03:06	03:29		03:56 (6)	03:48			05:03	05:17	05:32	05:40	05:30	05:03			04:30			03:02		03:21 (6)	02:53
	16:48	16:43	19	04:15 (6)	16:21			16:49	16:22	16:09	16:13	16:28	16:41			16:53			16:10	27	03:48 (6)	16:32
5	03:06	03:30		03:53 (6)	03:48			05:03	05:17	05:33	05:40	05:29	05:02			04:29			03:01		03:22 (6)	02:53
	16:49	16:42	23	04:16 (6)	16:20			16:48	16:21	16:09	16:14	16:28	16:42			16:54			16:11	26	03:48 (6)	16:33
6	03:07	03:31		03:52 (6)	03:49			05:03	05:18	05:33	05:40	05:28	05:01			04:28			03:01		03:24 (6)	02:53
	16:49	16:42	26	04:18 (6)	16:19			16:47	16:20	16:08	16:14	16:29	16:42			16:54			16:12	22	03:46 (6)	16:34
7	03:08	03:32		03:51 (6)	03:49			05:04	05:18	05:34	05:40	05:28	05:00			04:27			03:00		03:26 (6)	02:53
	16:49	16:41	28	04:19 (6)	16:18			16:45	16:19	16:08	16:15	16:29	16:42			16:55			16:12	19	03:45 (6)	16:34
8	03:09	03:32		03:50 (6)	03:50			05:04	05:19	05:34	05:40	05:27	04:58			04:26			03:00		03:28 (6)	02:53
	16:49	16:41	30	04:20 (6)	16:17			16:44	16:19	16:08	16:15	16:30	16:43			16:55			16:13	14	03:42 (6)	16:35
9	03:09	03:33		03:50 (6)	03:50			05:05	05:19	05:35	05:40	05:26	04:57			04:25			02:59		03:33 (6)	02:53
	16:49	16:40	31	04:21 (6)	16:16			16:43	16:18	16:08	16:15	16:30	16:43			16:56			16:14	5	03:38 (6)	16:36
10	03:10	03:34		03:51 (6)	03:51			05:05	05:20	05:35	05:40	05:26	04:56			04:24			02:59			02:54
	16:49	16:39	31	04:22 (6)	16:15			16:42	16:18	16:08	16:16	16:30	16:43			16:56			16:14			16:36
11	03:11	03:34		03:52 (6)	03:51			05:06	05:20	05:35	05:39	05:25	04:55			04:23			02:58			02:54
	16:49	16:39	31	04:23 (6)	16:14			16:41	16:17	16:08	16:16	16:31	16:44			16:57			16:15			16:37
12	03:12	03:35		03:52 (6)	03:52			05:06	05:21	05:36	05:39	05:24	04:54			04:22			02:57			02:54
	16:49	16:38	31	04:23 (6)	16:13			16:40	16:16	16:08	16:17	16:31	16:44			16:57			16:16			16:38
13	03:12	03:36		03:53 (6)	03:52			05:07	05:21	05:36	05:39	05:23	04:53			04:21			02:57			02:54
	16:49	16:37	30	04:23 (6)	16:12			16:39	16:16	16:08	16:17	16:32	16:45			16:57			16:17			16:38
14	03:13	03:37		03:54 (6)	03:53		04:10 (9)	05:07	05:22	05:36	05:39	05:23	04:52			04:20		04:35 (6)	02:57			02:55
	16:49	16:37	30	04:24 (6)	16:11	8	04:18 (9)	16:39	16:15	16:09	16:18	16:32	16:45			16:58	8	04:43 (6)	16:17			16:39
15	03:14	03:37		03:54 (6)	03:53		04:10 (9)	05:08	05:23	05:37	05:39	05:22	04:51			04:19		04:34 (6)	02:56			02:55
	16:49	16:36	29	04:23 (6)	16:10	10	04:20 (9)	16:38	16:15	16:09	16:18	16:33	16:45			16:59	12	04:46 (6)	16:18			16:40
16	03:15	03:38		03:55 (6)	03:54		04:11 (9)	05:08	05:23	05:37	05:38	05:21	04:50			04:18		04:33 (6)	02:56			02:55
	16:49	16:35	29	04:24 (6)	16:09	10	04:21 (9)	16:37	16:14	16:09	16:19	16:33	16:46			16:59	15	04:48 (6)	16:19			16:40
17	03:16	03:39		03:56 (6)	03:54		04:11 (9)	05:08	05:24	05:37	05:38	05:20	04:49			04:17		04:32 (6)	02:55			02:56
	16:49	16:34	28	04:24 (6)	16:08	11	04:22 (9)	16:36	16:14	16:09	16:19	16:34	16:46			17:00	17	04:49 (6)	16:20			16:41
18	03:16	03:39		03:56 (6)	03:55		04:12 (9)	05:09	05:24	05:38	05:38	05:19	04:48		05:03 (9)	04:16		04:31 (6)	02:55			02:56
	16:49	16:33	27	04:23 (6)	16:07	11	04:23 (9)	16:35	16:13	16:09	16:19	16:34	16:47	3	05:06 (9)	17:00	19	04:50 (6)	16:20			16:41
19	03:17	03:40		03:57 (6)	03:55		04:12 (9)	05:09	05:25	05:38	05:38	05:18	04:46		05:02 (9)	04:15		04:30 (6)	02:55			02:56
	16:49	16:33	26	04:23 (6)	16:06	10	04:22 (9)	16:34	16:13	16:09	16:20	16:34	16:47	5	05:07 (9)	17:01	21	04:51 (6)	16:21			16:42
20	03:18	03:40		03:58 (6)	03:56		04:13 (9)	05:10	05:25	05:38	05:37	05:17	04:45		05:00 (9)	04:14		04:29 (6)	02:54			02:57
	16:49	16:32	25	04:23 (6)	16:04	10	04:23 (9)	16:33	16:12	16:09	16:20	16:35	16:47	6	05:06 (9)	17:01	23	04:52 (6)	16:22			16:42
21	03:19	03:41		03:58 (6)	03:56		04:13 (9)	05:10	05:26	05:38	05:37	05:17	04:44		04:59 (9)	04:13		04:29 (6)	02:54			02:57
	16:48	16:31	24	04:22 (6)	16:03	9	04:22 (9)	16:32	16:12	16:10	16:21	16:35	16:48	8	05:07 (9)	17:02	24	04:53 (6)	16:22			16:43
22	03:19	03:42		03:59 (6)	03:57		04:14 (9)	05:11	05:26	05:39	05:36	05:16	04:43		04:58 (9)	04:12		04:28 (6)	02:54			02:58
	16:48	16:30	22	04:21 (6)	16:02	8	04:22 (9)	16:31	16:12	16:10	16:21	16:36	16:48	9	05:07 (9)	17:02	25	04:53 (6)	16:23			16:43
23	03:20	03:42		03:59 (6)	03:57		04:14 (9)	05:11	05:27	05:39	05:36	05:15	04:42		04:57 (9)	04:11		04:27 (6)	02:54			02:58
	16:48	16:29	21	04:20 (6)	16:01	7	04:21 (9)	16:30	16:11	16:10	16:22	16:36	16:49	9	05:06 (9)	17:03	26	04:53 (6)	16:24			16:44
24	03:21	03:43		04:00 (6)	03:57		04:14 (9)	05:12	05:27	05:39	05:36	05:14	04:41		04:56 (9)	04:10		04:26 (6)	02:53			02:59
	16:48	16:28	19	04:19 (6)	16:00	5	04:19 (9)	16:29	16:11	16:10	16:22	16:37	16:49	10	05:06 (9)	17:03	27	04:53 (6)	16:25			16:44
25	03:22	03:44		04:01 (6)	03:58		04:15 (9)	05:12	05:28	05:39	05:35	05:13	04:40		04:55 (9)	03:10		03:25 (6)	02:53			02:59
	16:47	16:27	16	04:17 (6)	15:59	3	04:18 (9)	16:29	16:11	16:11	16:23	16:37	16:49	10	05:05 (9)	16:04	28	03:53 (6)	16:25			16:45
26	03:23	03:44		04:01 (6)	03:58		04:15 (9)	05:13	05:28	05:39	05:35	05:12	04:39		04:54 (9)	03:09		03:24 (6)	02:53			03:00
	16:47	16:27	14	04:15 (6)	15:58	1	04:16 (9)	16:28	16:10	16:11	16:23	16:37	16:50	11	05:05 (9)	16:05	29	03:53 (6)	16:26			16:45
27	03:23	03:45		04:02 (6)	03:59			05:13	05:29	05:39	05:34	05:11	04:38		04:53 (9)	03:08		03:24 (6)	02:53			03:00
	16:47	16:26	10	04:12 (6)	15:57			16:27	16:10	16:11	16:24	16:38	16:50	11	05:04 (9)	16:05	29	03:53 (6)	16:27			16:46
28	03:24	03:45		04:02 (6)	03:59			05:14	05:29	05:40	05:34	05:10	04:37		04:51 (9)	03:07		03:23 (6)	02:53			03:01
	16:46	16:25	5	04:07 (6)	15:56			16:26	16:10	16:11	16:24	16:38	16:51	10	05:01 (9)	16:06	30	03:53 (6)	16:28			16:46
29	03:25				05:00			05:14	05:30	05:40	05:33	05:09	04:35		04:50 (9)	03:06		03:22 (6)	02:53			03:02
	16:46				16:55			16:25	16:10	16:12	16:25	16:39	16:51	9	04:59 (9)	16:06	30	03:52 (6)	16:28			16:46
30	03:26				05:00			05:15	05:30	05:40	05:33	05:08	04:34		04:49 (9)	03:06		03:22 (6)	02:53			03:02
	16:45				16:54			16:24	16:09	16:12	16:25	16:39	16:51	7	04:56 (9)	16:07	31	03:53 (6)	16:29			16:47
31	03:26				05:01				05:31		05:32	05:07				03:05		03:21 (6)				03:03
	16:45				16:53				16:09		16:26	16:40				16:08	31	03:52 (6)				16:47
Potential sun hours	420	364			380			345	337	317	331	348	358			393			401			425
Total, worst case			625			103								108			425			205		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar

Shadow receptor: N - R26

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

Day	January			February			March	April	May	June	July	August	September	October			November			December
1	03:04			03:27		03:44 (9)	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33			03:04		03:20 (9)	02:53
	16:48			16:44	21	04:05 (9)	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52			16:08	15	03:35 (9)	16:30
2	03:04			03:28		03:45 (9)	03:46	05:02	05:16	05:32	05:40	05:31	05:05	04:32			03:03		03:20 (9)	02:53
	16:48			16:44	20	04:05 (9)	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52			16:09	16	03:36 (9)	16:31
3	03:05			03:29		03:46 (9)	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31			03:03		03:19 (9)	02:53
	16:48			16:43	20	04:06 (9)	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53			16:10	17	03:36 (9)	16:31
4	03:06			03:29		03:47 (9)	03:47	05:02	05:17	05:32	05:40	05:30	05:03	04:30			03:02		03:18 (9)	02:53
	16:48			16:43	20	04:07 (9)	16:21	16:49	16:21	16:09	16:13	16:28	16:41	16:53			16:10	18	03:36 (9)	16:32
5	03:06			03:30		03:47 (9)	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29			03:01		03:18 (9)	02:53
	16:48			16:42	19	04:06 (9)	16:20	16:48	16:21	16:09	16:14	16:28	16:41	16:54			16:11	18	03:36 (9)	16:33
6	03:07			03:31		03:48 (9)	03:49	05:03	05:18	05:33	05:40	05:28	05:01	04:28			03:01		03:17 (9)	02:53
	16:49			16:42	18	04:06 (9)	16:19	16:46	16:20	16:08	16:14	16:29	16:42	16:54			16:12	19	03:36 (9)	16:34
7	03:08			03:32		03:49 (9)	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27			03:00		03:17 (9)	02:53
	16:49			16:41	18	04:07 (9)	16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:55			16:12	20	03:37 (9)	16:34
8	03:09			03:32		03:49 (9)	03:50	05:04	05:19	05:34	05:40	05:27	04:58	04:26			03:00		03:16 (9)	02:53
	16:49			16:41	17	04:06 (9)	16:17	16:44	16:19	16:08	16:15	16:30	16:43	16:55			16:13	20	03:36 (9)	16:35
9	03:09			03:33		03:50 (9)	03:50	05:05	05:19	05:35	05:40	05:26	04:57	04:25			02:59		03:16 (9)	02:53
	16:49			16:40	16	04:06 (9)	16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:56			16:14	20	03:36 (9)	16:36
10	03:10			03:34		03:51 (9)	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24			02:58		03:15 (9)	02:54
	16:49			16:39	14	04:05 (9)	16:15	16:42	16:18	16:08	16:16	16:30	16:43	16:56			16:14	21	03:36 (9)	16:36
11	03:11			03:34		03:52 (9)	03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23			02:58		03:15 (9)	02:54
	16:49			16:39	13	04:05 (9)	16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:56			16:15	21	03:36 (9)	16:37
12	03:12			03:35		03:52 (9)	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22			02:57		03:14 (9)	02:54
	16:49			16:38	11	04:03 (9)	16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57			16:16	21	03:35 (9)	16:38
13	03:12			03:36		03:53 (9)	03:52	05:07	05:21	05:36	05:39	05:23	04:53	04:21			02:57		03:14 (9)	02:54
	16:49			16:37	9	04:02 (9)	16:12	16:39	16:16	16:08	16:17	16:32	16:45	16:57			16:17	21	03:35 (9)	16:38
14	03:13			03:37		03:54 (9)	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20			02:57		03:13 (9)	02:55
	16:49			16:37	7	04:01 (9)	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58			16:17	20	03:33 (9)	16:39
15	03:14			03:37		03:54 (9)	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19			02:56		03:13 (9)	02:55
	16:49			16:36	4	03:58 (9)	16:10	16:38	16:15	16:09	16:18	16:33	16:45	16:58			16:18	20	03:33 (9)	16:40
16	03:15			03:38			03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18			02:56		03:14 (9)	02:55
	16:49			16:35			16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59			16:19	18	03:32 (9)	16:40
17	03:15			03:39			03:54	05:08	05:24	05:37	05:38	05:20	04:49	04:17			02:55		03:15 (9)	02:56
	16:49			16:34			16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00			16:19	15	03:30 (9)	16:41
18	03:16			03:39			03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16			02:55		03:17 (9)	02:56
	16:49			16:33			16:07	16:35	16:13	16:09	16:19	16:34	16:47	17:00			16:20	12	03:29 (9)	16:41
19	03:17			03:40			03:55	05:09	05:25	05:38	05:38	05:18	04:46	04:15			02:55		03:21 (9)	02:56
	16:49			16:33			16:05	16:34	16:13	16:09	16:20	16:34	16:47	17:01			16:21	5	03:26 (9)	16:42
20	03:18			03:40			03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14			02:54			02:57
	16:48			16:32			16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01			16:22			16:42
21	03:19			03:41			03:56	05:10	05:26	05:38	05:37	05:16	04:44	04:13			02:54			02:57
	16:48			16:31			16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02			16:22			16:43
22	03:19			03:42			03:57	05:11	05:26	05:39	05:36	05:16	04:43	04:12			02:54			02:58
	16:48			16:30			16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02			16:23			16:43
23	03:20		03:46 (9)	03:42			03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11			02:54			02:58
	16:48	5	03:51 (9)	16:29			16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03			16:24			16:44
24	03:21		03:43 (9)	03:43			03:57	05:12	05:27	05:39	05:36	05:14	04:41	04:10			02:53			02:59
	16:48	12	03:55 (9)	16:28			16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03			16:25			16:44
25	03:22		03:42 (9)	03:43			03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10			02:53			02:59
	16:47	15	03:57 (9)	16:27			15:59	16:28	16:11	16:11	16:23	16:37	16:49	16:04			16:25			16:45
26	03:23		03:40 (9)	03:44			03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09			02:53			03:00
	16:47	19	03:59 (9)	16:27			15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:05			16:26			16:45
27	03:23		03:40 (9)	03:45			03:59	05:13	05:29	05:39	05:34	05:11	04:38	03:08		03:24 (9)	02:53			03:00
	16:47	20	04:00 (9)	16:26			15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	5	03:29 (9)	16:27			16:46
28	03:24		03:41 (9)	03:45			03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07		03:23 (9)	02:53			03:01
	16:46	20	04:01 (9)	16:25			15:56	16:26	16:10	16:11	16:24	16:38	16:51	16:06	8	03:31 (9)	16:28			16:46
29	03:25		03:42 (9)				05:00	05:14	05:30	05:40	05:33	05:09	04:35	03:06		03:22 (9)	02:53			03:02
	16:46	21	04:03 (9)				16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:06	10	03:32 (9)	16:28			16:46
30	03:26		03:43 (9)				05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06		03:22 (9)	02:53			03:02
	16:45	21	04:04 (9)				16:54	16:24	16:09	16:12	16:25	16:39	16:51	16:07	12	03:34 (9)	16:29			16:47
31	03:26		03:44 (9)				05:01		05:31		05:32	05:07		03:05		03:21 (9)				03:03
	16:45	21	04:05 (9)				16:53		16:09		16:26	16:39		16:08	13	03:34 (9)				16:47
Potential sun hours	420			364			380	345	337	317	331	348	358	393			401			425
Total, worst case		154			227										48			337		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: O - R25

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January			February			March	April	May	June	July	August	Septembe	rOctober			November			December
1	03:04			03:27		16:08 (5)	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33			03:04		15:44 (5)	02:53
	16:48			16:44	16	16:24 (5)	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52			16:08	5	15:49 (5)	16:30
2	03:04			03:28		16:08 (5)	03:46	05:02	05:16	05:32	05:40	05:31	05:05	04:32			03:03		15:42 (5)	02:53
	16:48			16:44	16	16:24 (5)	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52			16:09	8	15:50 (5)	16:31
3	03:05			03:29		16:09 (5)	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31			03:03		15:41 (5)	02:53
	16:48			16:43	15	16:24 (5)	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53			16:10	10	15:51 (5)	16:31
4	03:06			03:29		16:09 (5)	03:47	05:02	05:17	05:32	05:40	05:30	05:03	04:30			03:02		15:40 (5)	02:53
	16:48			16:43	14	16:23 (5)	16:21	16:49	16:21	16:09	16:13	16:28	16:41	16:53			16:10	11	15:51 (5)	16:32
5	03:06			03:30		16:09 (5)	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29			03:01		15:40 (5)	02:53
	16:48			16:42	13	16:22 (5)	16:20	16:48	16:21	16:09	16:14	16:28	16:41	16:54			16:11	12	15:52 (5)	16:33
6	03:07			03:31		16:10 (5)	03:49	05:03	05:18	05:33	05:40	05:28	05:01	04:28			03:01		15:39 (5)	02:53
	16:49			16:42	12	16:22 (5)	16:19	16:46	16:20	16:08	16:14	16:29	16:42	16:54			16:12	13	15:52 (5)	16:34
7	03:08			03:32		16:11 (5)	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27			03:00		15:39 (5)	02:53
	16:49			16:41	11	16:22 (5)	16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:55			16:12	15	15:54 (5)	16:34
8	03:09			03:32		16:11 (5)	03:50	05:04	05:19	05:34	05:40	05:27	04:58	04:26			03:00		15:39 (5)	02:53
	16:49			16:41	9	16:20 (5)	16:17	16:44	16:19	16:08	16:15	16:30	16:43	16:55			16:13	15	15:54 (5)	16:35
9	03:09			03:33		16:13 (5)	03:50	05:05	05:19	05:35	05:40	05:26	04:57	04:25			02:59		15:39 (5)	02:53
	16:49			16:40	7	16:20 (5)	16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:56			16:14	16	15:55 (5)	16:36
10	03:10			03:34		16:15 (5)	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24			02:58		15:39 (5)	02:53
	16:49			16:39	5	16:20 (5)	16:15	16:42	16:18	16:08	16:16	16:30	16:43	16:56			16:14	16	15:55 (5)	16:36
11	03:11			03:34			03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23			02:58		15:40 (5)	02:54
	16:49			16:39			16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:56			16:15	16	15:56 (5)	16:37
12	03:12			03:35			03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22			02:57		15:40 (5)	02:54
	16:49			16:38			16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57			16:16	16	15:56 (5)	16:38
13	03:12			03:36			03:52	05:07	05:21	05:36	05:39	05:23	04:53	04:21			02:57		15:41 (5)	02:54
	16:49			16:37			16:12	16:39	16:16	16:08	16:17	16:32	16:45	16:57			16:17	17	15:58 (5)	16:38
14	03:13			03:37			03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20			02:57		15:41 (5)	02:55
	16:49			16:37			16:11	16:38	16:15	16:09	16:18	16:32	16:45	16:58			16:17	17	15:58 (5)	16:39
15	03:14			03:37			03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19			02:56		15:43 (5)	02:55
	16:49			16:36			16:10	16:38	16:15	16:09	16:18	16:33	16:45	16:58			16:18	15	15:58 (5)	16:40
16	03:15			03:38			03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18			02:56		15:45 (5)	02:55
	16:49			16:35			16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59			16:19	12	15:57 (5)	16:40
17	03:15			03:39			03:54	05:08	05:24	05:37	05:38	05:20	04:49	04:17			02:55		15:46 (5)	02:56
	16:49			16:34			16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00			16:19	9	15:55 (5)	16:41
18	03:16			03:39			03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16			02:55			02:56
	16:49			16:33			16:07	16:35	16:13	16:09	16:19	16:34	16:47	17:00			16:20			16:41
19	03:17			03:40			03:55	05:09	05:25	05:38	05:37	05:18	04:46	04:15			02:55			02:56
	16:49			16:33			16:05	16:34	16:13	16:09	16:20	16:34	16:47	17:01			16:21			16:42
20	03:18			03:40			03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14			02:54			02:57
	16:48			16:32			16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01			16:22			16:42
21	03:19			03:41			03:56	05:10	05:26	05:38	05:37	05:16	04:44	04:13			02:54			02:57
	16:48			16:31			16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02			16:22			16:43
22	03:19			03:42			03:57	05:11	05:26	05:39	05:36	05:16	04:43	04:12			02:54			02:58
	16:48			16:30			16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02			16:23			16:43
23	03:20			03:42			03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11			02:54			02:58
	16:48			16:29			16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03			16:24			16:44
24	03:21			03:43			03:57	05:12	05:27	05:39	05:36	05:14	04:41	04:10			02:53			02:59
	16:48			16:28			16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03			16:25			16:44
25	03:22		16:13 (5)	03:43			03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10			02:53			02:59
	16:47	9	16:22 (5)	16:27			15:59	16:28	16:11	16:11	16:23	16:37	16:49	16:04			16:25			16:45
26	03:23		16:12 (5)	03:44			03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09			02:53			03:00
	16:47	12	16:24 (5)	16:27			15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:05			16:26			16:45
27	03:23		16:10 (5)	03:45			03:59	05:13	05:29	05:39	05:34	05:11	04:38	03:08			02:53			03:00
	16:47	15	16:25 (5)	16:26			15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05			16:27			16:46
28	03:24		16:09 (5)	03:45			03:59	05:14	05:29	05:40	05:34	05:10	04:36	03:07			02:53			03:01
	16:46	17	16:26 (5)	16:25			15:56	16:26	16:10	16:11	16:24	16:38	16:51	16:06			16:28			16:46
29	03:25		16:09 (5)				05:00	05:14	05:30	05:40	05:33	05:09	04:35	03:06			02:53			03:02
	16:46	17	16:26 (5)				16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:06			16:28			16:46
30	03:26		16:09 (5)				05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06			02:53			03:02
	16:45	16	16:25 (5)				16:54	16:24	16:09	16:12	16:25	16:39	16:51	16:07			16:29			16:47
31	03:26		16:09 (5)				05:01		05:31		05:32	05:07		03:05		15:47 (5)				03:03
	16:45	16	16:25 (5)				16:53		16:09		16:26	16:39		16:08	2	15:49 (5)				16:47
Potential sun hours	420			364			380	345	337	317	331	348	358	393			401			425
Total, worst case		102			118										2			223		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Shadow receptor: P - R27

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	January			February			March	April	May	June	July	August	September	October	November			December		
1	03:04		03:21 (9)	03:27		03:44 (9)	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04			02:53		03:10 (9)
	16:48	25	03:46 (9)	16:44	9	03:53 (9)	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52	16:08			16:30	25	03:35 (9)
2	03:04		03:22 (9)	03:28		03:45 (9)	03:46	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:03			02:53		03:10 (9)
	16:48	25	03:47 (9)	16:44	7	03:52 (9)	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09			16:31	25	03:35 (9)
3	03:05		03:23 (9)	03:29		03:46 (9)	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31	03:03			02:53		03:11 (9)
	16:48	25	03:48 (9)	16:43	3	03:49 (9)	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10			16:31	25	03:36 (9)
4	03:06		03:23 (9)	03:29		03:47 (8)	03:47	05:02	05:17	05:32	05:40	05:30	05:03	04:30	03:02			02:53		03:11 (9)
	16:48	25	03:48 (9)	16:43	1	03:48 (8)	16:21	16:49	16:21	16:09	16:13	16:28	16:41	16:53	16:10			16:32	25	03:36 (9)
5	03:06		03:24 (9)	03:30			03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:01			02:53		03:11 (9)
	16:48	25	03:49 (9)	16:42			16:20	16:48	16:21	16:09	16:14	16:28	16:41	16:54	16:11			16:33	25	03:36 (9)
6	03:07		03:25 (9)	03:31			03:49	05:03	05:18	05:33	05:40	05:28	05:01	04:28	03:01			02:53		03:11 (9)
	16:49	25	03:50 (9)	16:42			16:19	16:46	16:20	16:08	16:14	16:29	16:42	16:54	16:12			16:34	25	03:36 (9)
7	03:08		03:25 (9)	03:32			03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00		03:17 (8)	02:53		03:11 (9)
	16:49	25	03:50 (9)	16:41			16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:55	16:12	1	03:18 (8)	16:34	25	03:36 (9)
8	03:09		03:26 (9)	03:32			03:50	05:04	05:19	05:34	05:40	05:27	04:58	04:26	03:00		03:16 (9)	02:53		03:11 (9)
	16:49	25	03:51 (9)	16:41			16:17	16:44	16:19	16:08	16:15	16:30	16:43	16:55	16:13	3	03:19 (9)	16:35	25	03:36 (9)
9	03:09		03:27 (9)	03:33			03:50	05:05	05:19	05:35	05:40	05:26	04:57	04:25	02:59		03:16 (9)	02:53		03:11 (9)
	16:49	25	03:52 (9)	16:40			16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:56	16:14	7	03:23 (9)	16:36	25	03:36 (9)
10	03:10		03:28 (9)	03:34			03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:58		03:15 (9)	02:53		03:12 (9)
	16:49	25	03:53 (9)	16:39			16:15	16:42	16:18	16:08	16:16	16:30	16:43	16:56	16:14	9	03:24 (9)	16:36	25	03:37 (9)
11	03:11		03:28 (9)	03:34			03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23	02:58		03:15 (9)	02:54		03:12 (9)
	16:49	25	03:53 (9)	16:39			16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:56	16:15	11	03:26 (9)	16:37	25	03:37 (9)
12	03:12		03:29 (9)	03:35			03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:57		03:14 (9)	02:54		03:12 (9)
	16:49	25	03:54 (9)	16:38			16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57	16:16	13	03:27 (9)	16:38	25	03:37 (9)
13	03:12		03:30 (9)	03:36			03:52	05:07	05:21	05:36	05:39	05:23	04:53	04:21	02:57		03:14 (9)	02:54		03:12 (9)
	16:49	25	03:55 (9)	16:37			16:12	16:39	16:16	16:08	16:17	16:32	16:45	16:57	16:17	15	03:29 (9)	16:38	24	03:36 (9)
14	03:13		03:31 (9)	03:37			03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57		03:13 (9)	02:55		03:14 (9)
	16:49	25	03:56 (9)	16:37			16:11	16:38	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16	03:29 (9)	16:39	23	03:37 (9)
15	03:14		03:31 (9)	03:37			03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56		03:13 (9)	02:55		03:14 (9)
	16:49	25	03:56 (9)	16:36			16:10	16:38	16:15	16:09	16:18	16:33	16:45	16:58	16:18	17	03:30 (9)	16:40	23	03:37 (9)
16	03:15		03:32 (9)	03:38			03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56		03:13 (9)	02:55		03:14 (9)
	16:49	24	03:56 (9)	16:35			16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	18	03:31 (9)	16:40	23	03:37 (9)
17	03:15		03:33 (9)	03:39			03:54	05:08	05:24	05:37	05:38	05:20	04:49	04:17	02:55		03:12 (9)	02:56		03:16 (9)
	16:49	24	03:57 (9)	16:34			16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:19	19	03:31 (9)	16:41	22	03:38 (9)
18	03:16		03:34 (9)	03:39			03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55		03:12 (9)	02:56		03:16 (9)
	16:49	24	03:58 (9)	16:33			16:07	16:35	16:13	16:09	16:19	16:34	16:47	17:00	16:20	20	03:32 (9)	16:41	22	03:38 (9)
19	03:17		03:34 (9)	03:40			03:55	05:09	05:25	05:38	05:37	05:18	04:46	04:15	02:55		03:12 (9)	02:56		03:16 (9)
	16:49	23	03:57 (9)	16:33			16:05	16:34	16:13	16:09	16:20	16:34	16:47	17:01	16:21	21	03:33 (9)	16:42	22	03:38 (9)
20	03:18		03:35 (9)	03:40			03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54		03:12 (9)	02:57		03:17 (9)
	16:48	23	03:58 (9)	16:32			16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01	16:22	22	03:34 (9)	16:42	22	03:39 (9)
21	03:19		03:36 (9)	03:41			03:56	05:10	05:26	05:38	05:37	05:16	04:44	04:13	02:54		03:11 (9)	02:57		03:17 (9)
	16:48	22	03:58 (9)	16:31			16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:22	22	03:33 (9)	16:43	22	03:39 (9)
22	03:19		03:37 (9)	03:42			03:57	05:11	05:26	05:39	05:36	05:16	04:43	04:12	02:54		03:11 (9)	02:58		03:18 (9)
	16:48	22	03:59 (9)	16:30			16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	23	03:34 (9)	16:43	22	03:40 (9)
23	03:20		03:37 (9)	03:42			03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54		03:11 (9)	02:58		03:18 (9)
	16:48	21	03:58 (9)	16:29			16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	23	03:34 (9)	16:44	22	03:40 (9)
24	03:21		03:38 (9)	03:43			03:57	05:12	05:27	05:39	05:36	05:14	04:41	04:10	02:53		03:11 (9)	02:59		03:19 (9)
	16:48	20	03:58 (9)	16:28			16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03	16:25	24	03:35 (9)	16:44	22	03:41 (9)
25	03:22		03:39 (9)	03:43			03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53		03:11 (9)	02:59		03:19 (9)
	16:47	19	03:58 (9)	16:27			15:59	16:28	16:11	16:11	16:23	16:37	16:49	16:04	16:25	24	03:35 (9)	16:45	22	03:41 (9)
26	03:23		03:40 (9)	03:44			03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53		03:11 (9)	03:00		03:20 (9)
	16:47	18	03:58 (9)	16:27			15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:05	16:26	24	03:35 (9)	16:45	22	03:42 (9)
27	03:23		03:40 (9)	03:45			03:59	05:13	05:29	05:39	05:34	05:11	04:38	03:08	02:53		03:11 (9)	03:00		03:20 (9)
	16:47	17	03:57 (9)	16:26			15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	25	03:36 (9)	16:46	22	03:42 (9)
28	03:24		03:41 (9)	03:45			03:59	05:14	05:29	05:40	05:34	05:10	04:36	03:07	02:53		03:10 (9)	03:01		03:20 (9)
	16:46	16	03:57 (9)	16:25			15:56	16:26	16:10	16:11	16:24	16:38	16:51	16:06	16:28	25	03:35 (9)	16:46	23	03:43 (9)
29	03:25		03:42 (9)				05:00	05:14	05:30	05:40	05:33	05:09	04:35	03:06	02:53		03:10 (9)	03:02		03:21 (9)
	16:46	15	03:57 (9)				16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:06	16:28	25	03:35 (9)	16:46	23	03:44 (9)
30	03:26		03:43 (9)				05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53		03:10 (9)	03:02		03:21 (9)
	16:45	13	03:56 (9)				16:54	16:24	16:09	16:12	16:25	16:39	16:51	16:07	16:29	25	03:35 (9)	16:47	23	03:44 (9)
31	03:26		03:44 (9)				05:01		05:31		05:32	05:07		03:05				03:03		03:21 (9)
	16:45	11	03:55 (9)				16:53		16:09		16:26	16:39		16:08				16:47	24	03:45 (9)
Potential sun hours	420			364			380	345	337	317	331	348	358	393	401			425		
Total, worst case		687			20											432			728	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: Q - R29

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27	03:46	05:01	05:16	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:09	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:53	16:09	16:31
3	03:05	03:29	03:47	05:02	05:17	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:49	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:11	16:32
5	03:07	03:30	03:48	05:03	05:18	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:34	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:19	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:08	16:15	16:29	16:42	16:55	16:13	16:35
8	03:09	03:32	03:50	05:05	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:09	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:57	04:24	02:59	02:54
	16:49	16:40	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:37
11	03:11	03:35	03:51	05:06	05:21	05:36	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:24	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:39
14	03:13	03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:18	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:38	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:42
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:46	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:48	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54	02:57
	16:49	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:12	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:29	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:13	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:40	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:46
27	03:23	03:45	03:59	05:13	05:29	05:40	05:35	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:34	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	316	331	348	358	393	401	426
Total, worst case												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: R - R35

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

Day	January			February			March			April	May	June
1	03:04		03:21 (6)	03:27		03:44 (6)	03:46		04:03 (9)	05:01	05:15	05:31
	16:48	37	03:58 (6)	16:44	36	16:23 (5)	16:24	11	04:14 (9)	16:52	16:24	16:09
2	03:04		03:22 (6)	03:28		03:45 (6)	03:46		04:04 (9)	05:02	05:16	05:32
	16:48	37	03:59 (6)	16:44	34	16:24 (5)	16:23	12	04:16 (9)	16:51	16:23	16:09
3	03:05		03:23 (6)	03:29		16:00 (5)	03:47		04:04 (9)	05:02	05:16	05:32
	16:48	37	04:00 (6)	16:43	24	16:24 (5)	16:22	13	04:17 (9)	16:50	16:22	16:09
4	03:06		03:23 (6)	03:29		16:00 (5)	03:48		04:05 (9)	05:03	05:17	05:32
	16:48	37	04:00 (6)	16:43	23	16:23 (5)	16:21	13	04:18 (9)	16:49	16:22	16:09
5	03:06		03:24 (6)	03:30		15:59 (5)	03:48		04:05 (9)	05:03	05:17	05:33
	16:49	37	04:01 (6)	16:42	23	16:22 (5)	16:20	13	04:18 (9)	16:48	16:21	16:09
6	03:07		03:25 (6)	03:31		15:59 (5)	03:49		04:06 (9)	05:03	05:18	05:33
	16:49	37	04:02 (6)	16:42	23	16:22 (5)	16:19	13	04:19 (9)	16:47	16:20	16:08
7	03:08		03:25 (6)	03:32		15:59 (5)	03:49		04:06 (9)	05:04	05:18	05:34
	16:49	36	04:01 (6)	16:41	23	16:22 (5)	16:18	12	04:18 (9)	16:45	16:19	16:08
8	03:09		03:26 (6)	03:32		15:59 (5)	03:50		04:07 (9)	05:04	05:19	05:34
	16:49	36	04:02 (6)	16:41	21	16:20 (5)	16:17	12	04:19 (9)	16:44	16:19	16:08
9	03:09		03:27 (6)	03:33		15:59 (5)	03:50		04:07 (9)	05:05	05:19	05:35
	16:49	36	04:03 (6)	16:40	21	16:20 (5)	16:16	11	04:18 (9)	16:43	16:18	16:08
10	03:10		03:28 (6)	03:34		16:00 (5)	03:51		04:08 (9)	05:05	05:20	05:35
	16:49	36	04:04 (6)	16:39	20	16:20 (5)	16:15	10	04:18 (9)	16:42	16:18	16:08
11	03:11		03:28 (6)	03:34		16:01 (5)	03:51		04:08 (9)	05:06	05:20	05:35
	16:49	35	04:03 (6)	16:39	19	16:20 (5)	16:14	8	04:16 (9)	16:41	16:17	16:08
12	03:12		03:29 (6)	03:35		16:01 (5)	03:52		04:09 (9)	05:06	05:21	05:36
	16:49	35	04:04 (6)	16:38	17	16:18 (5)	16:13	7	04:16 (9)	16:40	16:16	16:08
13	03:12		03:30 (6)	03:36		16:02 (5)	03:52		04:09 (9)	05:07	05:21	05:36
	16:49	35	04:05 (6)	16:37	16	16:18 (5)	16:12	5	04:14 (9)	16:39	16:16	16:08
14	03:13		03:31 (6)	03:37		16:03 (5)	03:53		04:10 (9)	05:07	05:22	05:36
	16:49	34	04:05 (6)	16:37	15	16:18 (5)	16:11	3	04:13 (9)	16:39	16:15	16:09
15	03:14		03:31 (6)	03:37		16:04 (5)	03:53			05:08	05:23	05:37
	16:49	34	04:05 (6)	16:36	12	16:16 (5)	16:10			16:38	16:15	16:09
16	03:15		03:32 (6)	03:38		16:06 (5)	03:54			05:08	05:23	05:37
	16:49	33	04:05 (6)	16:35	10	16:16 (5)	16:09			16:37	16:14	16:09
17	03:15		03:33 (6)	03:39		16:10 (5)	03:54			05:08	05:24	05:37
	16:49	33	04:06 (6)	16:34	5	16:15 (5)	16:08			16:36	16:14	16:09
18	03:16		03:34 (6)	03:39			03:55			05:09	05:24	05:38
	16:49	32	04:06 (6)	16:33			16:07			16:35	16:13	16:09
19	03:17		03:34 (6)	03:40			03:55			05:09	05:25	05:38
	16:49	32	04:06 (6)	16:33			16:06			16:34	16:13	16:09
20	03:18		03:35 (6)	03:40			03:56			05:10	05:25	05:38
	16:49	31	04:06 (6)	16:32			16:04			16:33	16:12	16:09
21	03:19		03:36 (6)	03:41			03:56			05:10	05:26	05:38
	16:48	30	04:06 (6)	16:31			16:03			16:32	16:12	16:10
22	03:19		03:37 (6)	03:42			03:57			05:11	05:26	05:39
	16:48	29	04:06 (6)	16:30			16:02			16:31	16:12	16:10
23	03:20		03:37 (6)	03:42			03:57			05:11	05:27	05:39
	16:48	29	04:06 (6)	16:29			16:01			16:30	16:11	16:10
24	03:21		03:38 (6)	03:43			03:57			05:12	05:27	05:39
	16:48	28	04:06 (6)	16:28			16:00			16:29	16:11	16:10
25	03:22		03:39 (6)	03:44			03:58			05:12	05:28	05:39
	16:47	26	04:05 (6)	16:27			15:59			16:28	16:11	16:11
26	03:23		03:40 (6)	03:44			03:58			05:13	05:28	05:39
	16:47	25	04:05 (6)	16:27			15:58			16:28	16:10	16:11
27	03:23		03:40 (6)	03:45			03:59			05:13	05:29	05:39
	16:47	29	16:13 (5)	16:26			15:57			16:27	16:10	16:11
28	03:24		03:41 (6)	03:45		04:05 (9)	03:59			05:14	05:29	05:40
	16:46	34	16:17 (5)	16:25	5	04:10 (9)	15:56			16:26	16:10	16:11
29	03:25		03:42 (6)				05:00			05:14	05:30	05:40
	16:46	36	16:19 (5)				16:55			16:25	16:10	16:12
30	03:26		03:43 (6)				05:00			05:15	05:30	05:40
	16:45	37	16:21 (5)				16:54			16:24	16:09	16:12
31	03:26		03:44 (6)				05:01				05:31	
	16:45	37	16:23 (5)				16:53				16:09	
Potential sun hours	420			364			380			345	337	317
Total, worst case		1040			347			143				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: R - R35

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	September			October			November			December		
1	05:40	05:32	05:06			04:33		04:48 (9)	03:04		15:29 (5)	02:53		03:10 (6)
	16:12	16:26	16:40			16:52	6	04:54 (9)	16:08	20	15:49 (5)	16:30	35	03:45 (6)
2	05:40	05:31	05:05			04:32		04:47 (9)	03:03		15:29 (5)	02:53		03:10 (6)
	16:13	16:27	16:40			16:52	8	04:55 (9)	16:09	21	15:50 (5)	16:31	36	03:46 (6)
3	05:40	05:30	05:04			04:31		04:46 (9)	03:03		15:29 (5)	02:53		03:11 (6)
	16:13	16:27	16:41			16:53	9	04:55 (9)	16:10	22	15:51 (5)	16:31	36	03:47 (6)
4	05:40	05:30	05:03			04:30		04:45 (9)	03:02		15:28 (5)	02:53		03:11 (6)
	16:13	16:28	16:41			16:53	10	04:55 (9)	16:10	23	15:51 (5)	16:32	36	03:47 (6)
5	05:40	05:29	05:02			04:29		04:44 (9)	03:01		15:29 (5)	02:53		03:11 (6)
	16:14	16:28	16:41			16:54	11	04:55 (9)	16:11	23	15:52 (5)	16:33	36	03:47 (6)
6	05:40	05:28	05:01			04:28		04:43 (9)	03:01		15:29 (5)	02:53		03:11 (6)
	16:14	16:29	16:42			16:54	12	04:55 (9)	16:12	23	15:52 (5)	16:34	37	03:48 (6)
7	05:40	05:28	05:00			04:27		04:42 (9)	03:00		15:30 (5)	02:53		03:11 (6)
	16:15	16:29	16:42			16:55	13	04:55 (9)	16:12	24	15:54 (5)	16:34	37	03:48 (6)
8	05:40	05:27	04:58			04:26		04:41 (9)	03:00		15:30 (5)	02:53		03:11 (6)
	16:15	16:30	16:43			16:55	13	04:54 (9)	16:13	24	15:54 (5)	16:35	37	03:48 (6)
9	05:40	05:26	04:57			04:25		04:40 (9)	02:59		03:16 (6)	02:53		03:11 (6)
	16:15	16:30	16:43			16:56	13	04:53 (9)	16:14	34	15:55 (5)	16:36	37	03:48 (6)
10	05:40	05:26	04:56			04:24		04:39 (9)	02:59		03:15 (6)	02:54		03:12 (6)
	16:16	16:30	16:43			16:56	13	04:52 (9)	16:14	36	15:54 (5)	16:36	37	03:49 (6)
11	05:39	05:25	04:55			04:23		04:38 (9)	02:58		03:15 (6)	02:54		03:12 (6)
	16:16	16:31	16:44			16:57	13	04:51 (9)	16:15	38	15:54 (5)	16:37	37	03:49 (6)
12	05:39	05:24	04:54			04:22		04:37 (9)	02:57		03:14 (6)	02:54		03:12 (6)
	16:17	16:31	16:44			16:57	12	04:49 (9)	16:16	37	15:52 (5)	16:38	37	03:49 (6)
13	05:39	05:23	04:53			04:21		04:36 (9)	02:57		03:14 (6)	02:54		03:12 (6)
	16:17	16:32	16:45			16:57	10	04:46 (9)	16:17	36	15:51 (5)	16:38	37	03:49 (6)
14	05:39	05:23	04:52			04:20			02:57		03:13 (6)	02:55		03:13 (6)
	16:18	16:32	16:45			16:58			16:17	34	15:49 (5)	16:39	37	03:50 (6)
15	05:39	05:22	04:51			04:19			02:56		03:13 (6)	02:55		03:13 (6)
	16:18	16:33	16:45			16:58			16:18	29	15:46 (5)	16:40	37	03:50 (6)
16	05:38	05:21	04:50			04:18			02:56		03:13 (6)	02:55		03:13 (6)
	16:19	16:33	16:46			16:59			16:19	25	03:38 (6)	16:40	37	03:50 (6)
17	05:38	05:20	04:49			04:17			02:55		03:12 (6)	02:56		03:14 (6)
	16:19	16:34	16:46			17:00			16:19	26	03:38 (6)	16:41	37	03:51 (6)
18	05:38	05:19	04:48			04:16			02:55		03:12 (6)	02:56		03:14 (6)
	16:19	16:34	16:47			17:00			16:20	28	03:40 (6)	16:41	37	03:51 (6)
19	05:38	05:18	04:46			04:15			02:55		03:12 (6)	02:56		03:14 (6)
	16:20	16:34	16:47			17:01			16:21	29	03:41 (6)	16:42	37	03:51 (6)
20	05:37	05:17	04:45			04:14			02:54		03:12 (6)	02:57		03:15 (6)
	16:20	16:35	16:47			17:01			16:22	29	03:41 (6)	16:42	37	03:52 (6)
21	05:37	05:16	04:44			04:13			02:54		03:11 (6)	02:57		03:15 (6)
	16:21	16:35	16:48			17:02			16:22	30	03:41 (6)	16:43	37	03:52 (6)
22	05:36	05:16	04:43			04:12			02:54		03:11 (6)	02:58		03:16 (6)
	16:21	16:36	16:48			17:02			16:23	31	03:42 (6)	16:43	37	03:53 (6)
23	05:36	05:15	04:42			04:11			02:54		03:11 (6)	02:58		03:16 (6)
	16:22	16:36	16:49			17:03			16:24	32	03:43 (6)	16:44	37	03:53 (6)
24	05:36	05:14	04:41			04:10			02:53		03:11 (6)	02:59		03:17 (6)
	16:22	16:37	16:49			17:03			16:25	32	03:43 (6)	16:44	37	03:54 (6)
25	05:35	05:13	04:40			03:10		15:38 (5)	02:53		03:11 (6)	02:59		03:17 (6)
	16:23	16:37	16:49			16:04	7	15:45 (5)	16:25	33	03:44 (6)	16:45	37	03:54 (6)
26	05:35	05:12	04:39			03:09		15:35 (5)	02:53		03:11 (6)	03:00		03:18 (6)
	16:23	16:37	16:50			16:05	10	15:45 (5)	16:26	33	03:44 (6)	16:45	37	03:55 (6)
27	05:34	05:11	04:38			03:08		15:34 (5)	02:53		03:11 (6)	03:00		03:18 (6)
	16:24	16:38	16:50			16:05	13	15:47 (5)	16:27	34	03:45 (6)	16:46	37	03:55 (6)
28	05:34	05:10	04:37			03:07		15:32 (5)	02:53		03:10 (6)	03:01		03:19 (6)
	16:24	16:38	16:51			16:06	15	15:47 (5)	16:28	34	03:44 (6)	16:46	37	03:56 (6)
29	05:33	05:09	04:35		04:50 (9)	03:06		15:31 (5)	02:53		03:10 (6)	03:02		03:20 (6)
	16:25	16:39	16:51	1	04:51 (9)	16:06	16	15:47 (5)	16:28	35	03:45 (6)	16:46	37	03:57 (6)
30	05:33	05:08	04:34		04:49 (9)	03:06		15:31 (5)	02:53		03:10 (6)	03:02		03:20 (6)
	16:25	16:39	16:51	4	04:53 (9)	16:07	18	15:49 (5)	16:29	35	03:45 (6)	16:47	37	03:57 (6)
31	05:32	05:07				03:05		15:30 (5)				03:03		03:21 (6)
	16:26	16:39				16:08	19	15:49 (5)				16:47	37	03:58 (6)
Potential sun hours	331	348	358			393			401			425		
Total, worst case				5			241			890			1141	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: S - R34

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	January			February			March			April	May	June
1	03:04		14:03 (9)	03:27		14:05 (9)	03:46		14:57 (9)	05:01	05:15	05:31
	16:47	115	16:01 (6)	16:44	134	16:19 (6)	16:24	43	15:40 (9)	16:52	16:24	16:09
2	03:04		14:03 (9)	03:28		14:05 (9)	03:46		14:59 (9)	05:02	05:16	05:31
	16:48	118	16:03 (6)	16:44	133	16:18 (6)	16:23	39	15:38 (9)	16:51	16:23	16:09
3	03:05		14:04 (9)	03:29		14:05 (9)	03:47		15:03 (9)	05:02	05:16	05:32
	16:48	118	16:04 (6)	16:43	133	16:18 (6)	16:22	34	15:37 (9)	16:50	16:22	16:09
4	03:06		14:04 (9)	03:29		14:04 (9)	03:47		15:06 (9)	05:02	05:17	05:32
	16:48	119	16:04 (6)	16:43	133	16:17 (6)	16:21	29	15:35 (9)	16:48	16:21	16:09
5	03:06		14:04 (9)	03:30		14:05 (9)	03:48		15:09 (9)	05:03	05:17	05:33
	16:48	122	16:06 (6)	16:42	131	16:16 (6)	16:20	24	15:33 (9)	16:47	16:21	16:08
6	03:07		14:05 (9)	03:31		14:05 (9)	03:49		04:08 (10)	05:03	05:18	05:33
	16:49	122	16:07 (6)	16:42	130	16:15 (6)	16:19	40	15:32 (9)	16:46	16:20	16:08
7	03:08		14:04 (9)	03:32		14:05 (9)	03:49		04:06 (10)	05:04	05:18	05:34
	16:49	123	16:07 (6)	16:41	129	16:14 (6)	16:18	47	15:29 (9)	16:45	16:19	16:08
8	03:09		14:05 (9)	03:32		14:04 (9)	03:50		04:07 (10)	05:04	05:19	05:34
	16:49	123	16:08 (6)	16:41	128	16:12 (6)	16:17	41	15:27 (9)	16:44	16:19	16:08
9	03:09		14:05 (9)	03:33		14:05 (9)	03:50		04:07 (10)	05:05	05:19	05:34
	16:49	125	16:10 (6)	16:40	125	16:10 (6)	16:16	32	15:24 (9)	16:43	16:18	16:08
10	03:10		14:05 (9)	03:34		14:05 (9)	03:51		04:08 (10)	05:05	05:20	05:35
	16:49	126	16:11 (6)	16:39	117	16:06 (6)	16:15	25	04:33 (11)	16:42	16:18	16:08
11	03:11		14:05 (9)	03:34		14:05 (9)	03:51		04:08 (10)	05:06	05:20	05:35
	16:49	126	16:11 (6)	16:39	108	15:53 (9)	16:14	21	04:29 (11)	16:41	16:17	16:08
12	03:12		14:05 (9)	03:35		14:05 (9)	03:52		04:09 (10)	05:06	05:21	05:36
	16:49	127	16:12 (6)	16:38	107	15:52 (9)	16:13	17	04:26 (11)	16:40	16:16	16:08
13	03:12		14:05 (9)	03:36		14:05 (9)	03:52		04:09 (10)	05:07	05:21	05:36
	16:49	128	16:13 (6)	16:37	107	15:52 (9)	16:12	13	04:22 (10)	16:39	16:16	16:08
14	03:13		14:05 (9)	03:36		14:08 (9)	03:53		04:10 (10)	05:07	05:22	05:36
	16:49	128	16:13 (6)	16:36	104	15:52 (9)	16:11	9	04:19 (10)	16:38	16:15	16:08
15	03:14		14:05 (9)	03:37		14:11 (9)	03:53		04:10 (10)	05:07	05:22	05:37
	16:49	129	16:14 (6)	16:36	100	15:51 (9)	16:10	5	04:15 (10)	16:37	16:15	16:09
16	03:15		14:05 (9)	03:38		14:15 (9)	03:54		04:11 (10)	05:08	05:23	05:37
	16:49	130	16:15 (6)	16:35	96	15:51 (9)	16:09	1	04:12 (10)	16:37	16:14	16:09
17	03:15		14:06 (9)	03:38		14:18 (9)	03:54			05:08	05:24	05:37
	16:49	130	16:16 (6)	16:34	93	15:51 (9)	16:08			16:36	16:14	16:09
18	03:16		14:06 (9)	03:39		14:21 (9)	03:55			05:09	05:24	05:38
	16:49	131	16:17 (6)	16:33	89	15:50 (9)	16:06			16:35	16:13	16:09
19	03:17		14:05 (9)	03:40		14:25 (9)	03:55			05:09	05:25	05:38
	16:49	132	16:17 (6)	16:33	85	15:50 (9)	16:05			16:34	16:13	16:09
20	03:18		14:05 (9)	03:40		14:27 (9)	03:56			05:10	05:25	05:38
	16:48	132	16:17 (6)	16:32	81	15:48 (9)	16:04			16:33	16:12	16:09
21	03:19		14:06 (9)	03:41		14:31 (9)	03:56			05:10	05:26	05:38
	16:48	132	16:18 (6)	16:31	77	15:48 (9)	16:03			16:32	16:12	16:10
22	03:19		14:06 (9)	03:42		14:34 (9)	03:56			05:11	05:26	05:39
	16:48	133	16:19 (6)	16:30	74	15:48 (9)	16:02			16:31	16:12	16:10
23	03:20		14:05 (9)	03:42		14:37 (9)	03:57			05:11	05:27	05:39
	16:48	133	16:18 (6)	16:29	69	15:46 (9)	16:01			16:30	16:11	16:10
24	03:21		14:05 (9)	03:43		14:41 (9)	03:57			05:12	05:27	05:39
	16:47	134	16:19 (6)	16:28	65	15:46 (9)	16:00			16:29	16:11	16:10
25	03:22		14:05 (9)	03:43		14:44 (9)	03:58			05:12	05:28	05:39
	16:47	134	16:19 (6)	16:27	61	15:45 (9)	15:59			16:28	16:11	16:10
26	03:22		14:06 (9)	03:44		14:47 (9)	03:58			05:13	05:28	05:39
	16:47	134	16:20 (6)	16:26	56	15:43 (9)	15:58			16:28	16:10	16:11
27	03:23		14:05 (9)	03:45		14:51 (9)	03:59			05:13	05:29	05:39
	16:47	134	16:19 (6)	16:26	52	15:43 (9)	15:57			16:27	16:10	16:11
28	03:24		14:05 (9)	03:45		14:53 (9)	03:59			05:14	05:29	05:40
	16:46	134	16:19 (6)	16:25	48	15:41 (9)	15:56			16:26	16:10	16:11
29	03:25		14:05 (9)				05:00			05:14	05:30	05:40
	16:46	135	16:20 (6)				16:55			16:25	16:10	16:12
30	03:26		14:05 (9)				05:00			05:15	05:30	05:40
	16:45	135	16:20 (6)				16:54			16:24	16:09	16:12
31	03:26		14:05 (9)				05:01				05:31	
	16:45	134	16:19 (6)				16:53				16:09	
Potential sun hours	420			364			380			345	337	317
Total, worst case		3976			2765			420				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar

Shadow receptor: S - R34

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

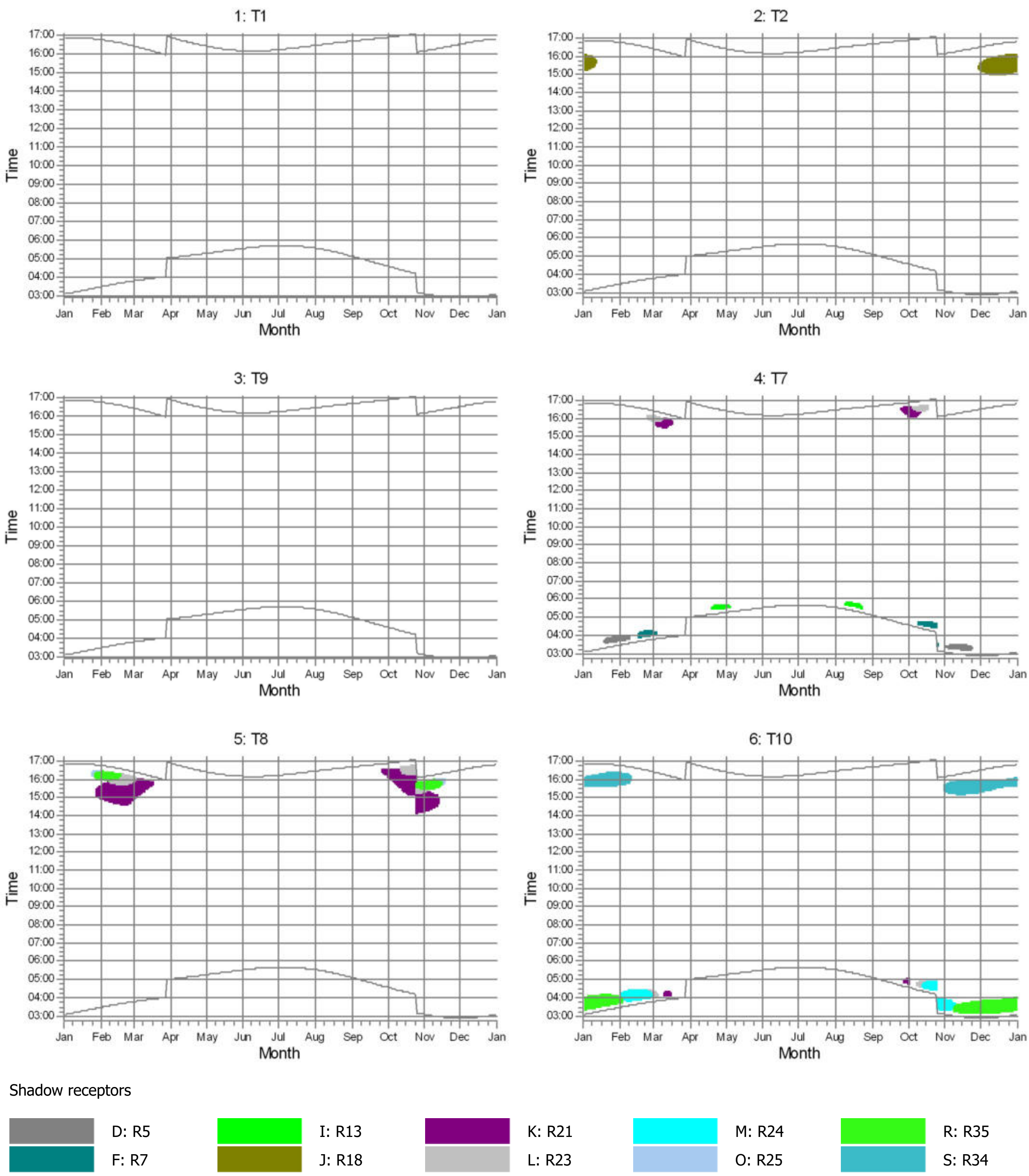
	July	August	September			October			November			December		
1	05:40	05:32	05:06			04:33		04:48 (10)	03:04		13:34 (9)	02:53		13:47 (9)
	16:12	16:26	16:40			16:52	15	05:03 (11)	16:08	119	15:36 (6)	16:30	126	15:53 (6)
2	05:40	05:31	05:05			04:32		04:47 (10)	03:03		13:34 (9)	02:53		13:47 (9)
	16:13	16:27	16:40			16:52	19	05:06 (11)	16:09	125	15:39 (6)	16:31	126	15:53 (6)
3	05:40	05:30	05:04			04:31		04:46 (10)	03:03		13:35 (9)	02:53		13:48 (9)
	16:13	16:27	16:41			16:53	23	05:09 (11)	16:10	127	15:42 (6)	16:31	125	15:53 (6)
4	05:40	05:30	05:03			04:30		04:45 (10)	03:02		13:34 (9)	02:53		13:50 (9)
	16:13	16:28	16:41			16:53	28	16:01 (9)	16:10	130	15:44 (6)	16:32	123	15:53 (6)
5	05:40	05:29	05:02			04:29		04:44 (10)	03:01		13:35 (9)	02:53		13:50 (9)
	16:14	16:28	16:41			16:54	37	16:03 (9)	16:11	131	15:46 (6)	16:33	123	15:53 (6)
6	05:40	05:28	05:01			04:28		04:43 (10)	03:01		13:35 (9)	02:53		13:51 (9)
	16:14	16:29	16:42			16:54	45	16:05 (9)	16:12	131	15:46 (6)	16:34	122	15:53 (6)
7	05:40	05:28	04:59			04:27		04:43 (10)	03:00		13:36 (9)	02:53		13:51 (9)
	16:15	16:29	16:42			16:55	44	16:06 (9)	16:12	132	15:48 (6)	16:34	122	15:53 (6)
8	05:40	05:27	04:58			04:26		04:45 (10)	03:00		13:35 (9)	02:53		13:52 (9)
	16:15	16:29	16:43			16:55	31	16:08 (9)	16:13	133	15:48 (6)	16:35	119	15:52 (6)
9	05:40	05:26	04:57			04:25		15:43 (9)	02:59		13:36 (9)	02:53		13:52 (9)
	16:15	16:30	16:43			16:55	26	16:09 (9)	16:14	134	15:50 (6)	16:36	119	15:52 (6)
10	05:39	05:26	04:56			04:24		15:39 (9)	02:58		13:36 (9)	02:53		13:52 (9)
	16:16	16:30	16:43			16:56	32	16:11 (9)	16:14	134	15:50 (6)	16:36	118	15:52 (6)
11	05:39	05:25	04:55			04:23		15:36 (9)	02:58		13:37 (9)	02:54		13:54 (9)
	16:16	16:31	16:44			16:56	36	16:12 (9)	16:15	134	15:51 (6)	16:37	116	15:53 (6)
12	05:39	05:24	04:54			04:22		15:32 (9)	02:57		13:36 (9)	02:54		13:54 (9)
	16:17	16:31	16:44			16:57	41	16:13 (9)	16:16	135	15:51 (6)	16:38	115	15:52 (6)
13	05:39	05:23	04:53			04:21		15:29 (9)	02:57		13:37 (9)	02:54		13:54 (9)
	16:17	16:32	16:45			16:57	45	16:14 (9)	16:17	135	15:52 (6)	16:38	114	15:52 (6)
14	05:39	05:22	04:52			04:20		15:25 (9)	02:56		13:37 (9)	02:54		13:56 (9)
	16:18	16:32	16:45			16:58	49	16:14 (9)	16:17	134	15:51 (6)	16:39	112	15:53 (6)
15	05:39	05:22	04:51			04:19		15:22 (9)	02:56		13:38 (9)	02:55		13:56 (9)
	16:18	16:33	16:45			16:58	53	16:15 (9)	16:18	134	15:52 (6)	16:39	111	15:52 (6)
16	05:38	05:21	04:50			04:18		15:18 (9)	02:56		13:39 (9)	02:55		13:56 (9)
	16:18	16:33	16:46			16:59	58	16:16 (9)	16:19	134	15:53 (6)	16:40	110	15:52 (6)
17	05:38	05:20	04:49			04:17		15:14 (9)	02:55		13:38 (9)	02:56		13:57 (9)
	16:19	16:34	16:46			16:59	63	16:17 (9)	16:19	134	15:52 (6)	16:41	110	15:53 (6)
18	05:38	05:19	04:47			04:16		15:11 (9)	02:55		13:39 (9)	02:56		13:58 (9)
	16:19	16:34	16:47			17:00	66	16:17 (9)	16:20	134	15:53 (6)	16:41	109	15:53 (6)
19	05:37	05:18	04:46			04:15		15:07 (9)	02:55		13:40 (9)	02:56		13:58 (9)
	16:20	16:34	16:47			17:01	71	16:18 (9)	16:21	133	15:53 (6)	16:42	107	15:52 (6)
20	05:37	05:17	04:45			04:14		15:04 (9)	02:54		13:41 (9)	02:57		13:59 (9)
	16:20	16:35	16:47			17:01	74	16:18 (9)	16:22	133	15:54 (6)	16:42	107	15:53 (6)
21	05:37	05:16	04:44			04:13		15:00 (9)	02:54		13:41 (9)	02:57		13:59 (9)
	16:21	16:35	16:48			17:02	78	16:18 (9)	16:22	132	15:53 (6)	16:43	107	15:53 (6)
22	05:36	05:16	04:43			04:12		14:57 (9)	02:54		13:41 (9)	02:58		14:00 (9)
	16:21	16:36	16:48			17:02	83	16:20 (9)	16:23	132	15:53 (6)	16:43	107	15:54 (6)
23	05:36	05:15	04:42			04:11		14:54 (9)	02:53		13:42 (9)	02:58		14:00 (9)
	16:22	16:36	16:48			17:03	86	16:20 (9)	16:24	132	15:54 (6)	16:44	107	15:54 (6)
24	05:36	05:14	04:41			04:10		14:50 (9)	02:53		13:43 (9)	02:59		14:01 (9)
	16:22	16:37	16:49			17:03	90	16:20 (9)	16:25	131	15:54 (6)	16:44	107	15:55 (6)
25	05:35	05:13	04:40			03:10		13:47 (9)	02:53		13:44 (9)	02:59		14:01 (9)
	16:23	16:37	16:49			16:04	93	15:20 (9)	16:25	130	15:54 (6)	16:45	107	15:55 (6)
26	05:35	05:12	04:39			03:09		13:43 (9)	02:53		13:44 (9)	03:00		14:01 (9)
	16:23	16:37	16:50			16:05	97	15:20 (9)	16:26	130	15:54 (6)	16:45	110	15:57 (6)
27	05:34	05:11	04:38			03:08		13:40 (9)	02:53		13:44 (9)	03:00		14:01 (9)
	16:24	16:38	16:50			16:05	101	15:21 (9)	16:27	129	15:53 (6)	16:46	110	15:57 (6)
28	05:34	05:10	04:36		04:51 (10)	03:07		13:37 (9)	02:53		13:45 (9)	03:01		14:02 (9)
	16:24	16:38	16:51	3	04:54 (10)	16:06	104	15:21 (9)	16:28	128	15:53 (6)	16:46	111	15:58 (6)
29	05:33	05:09	04:35		04:50 (10)	03:06		13:34 (9)	02:53		13:45 (9)	03:02		14:02 (9)
	16:25	16:39	16:51	7	04:57 (10)	16:06	107	15:21 (9)	16:28	128	15:53 (6)	16:46	111	15:58 (6)
30	05:33	05:08	04:34		04:49 (10)	03:06		13:34 (9)	02:53		13:46 (9)	03:02		14:03 (9)
	16:25	16:39	16:51	11	05:00 (10)	16:07	107	15:21 (9)	16:29	127	15:53 (6)	16:47	113	16:00 (6)
31	05:32	05:07				03:05		13:34 (9)				03:03		14:03 (9)
	16:26	16:39				16:08	108	15:22 (9)				16:47	114	16:01 (6)
Potential sun hours	331	348	358			393			401			425		
Total, worst case				21			1910			3935			3538	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG, graphical



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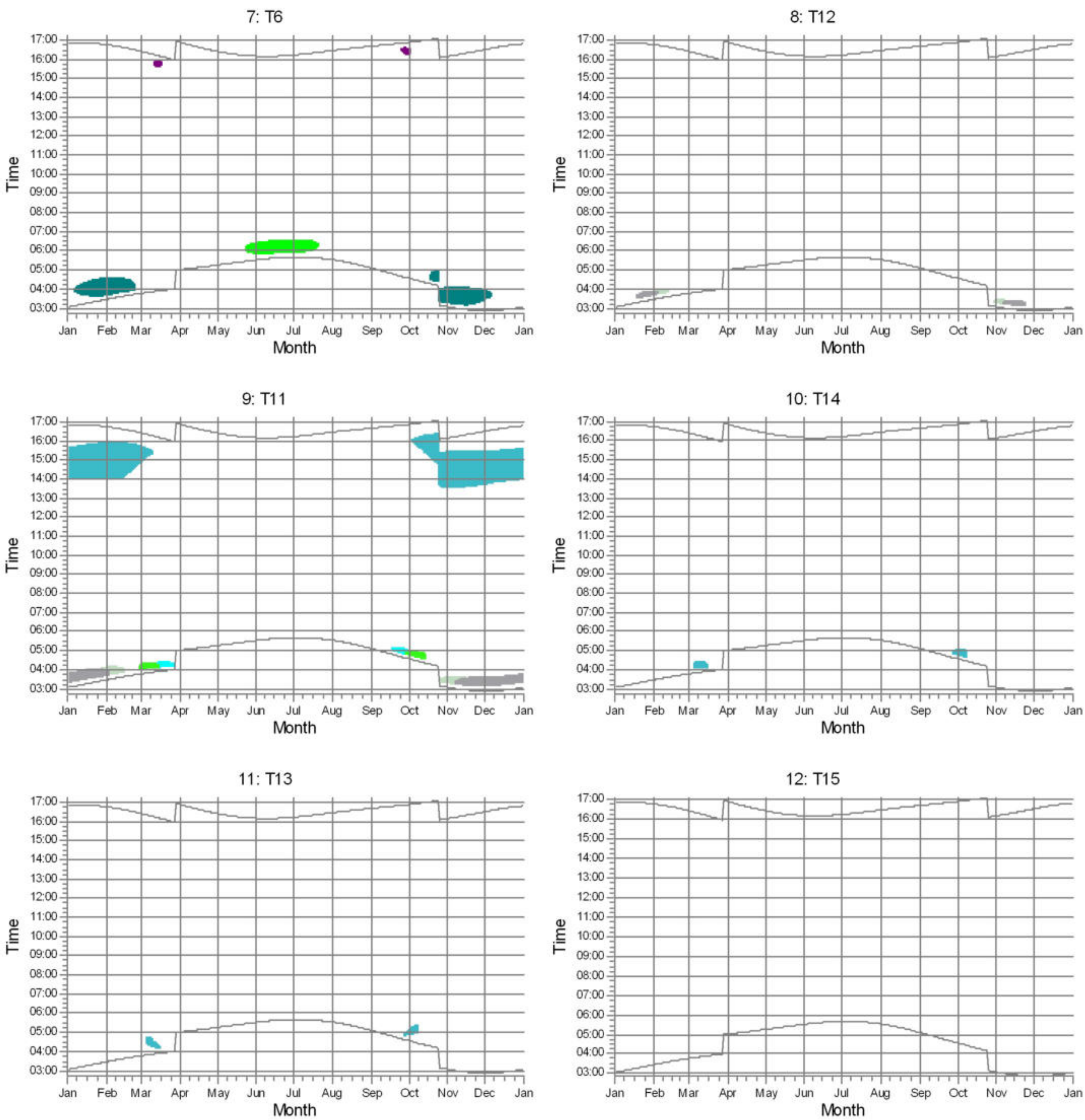
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

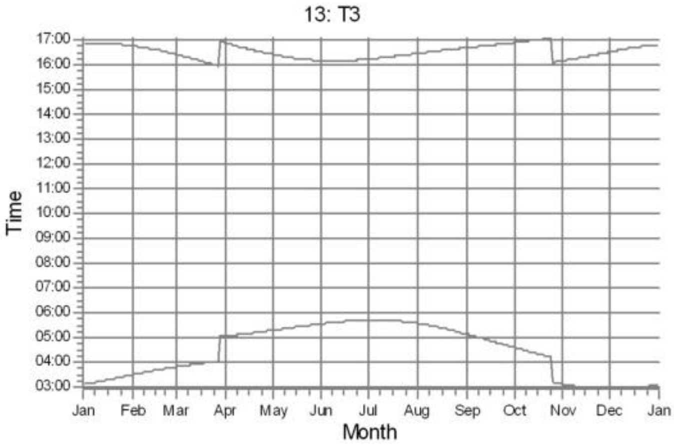
SHADOW - Calendar per WTG, graphical

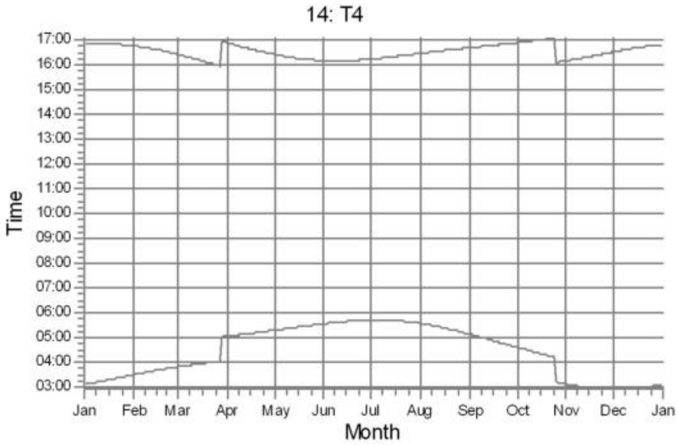


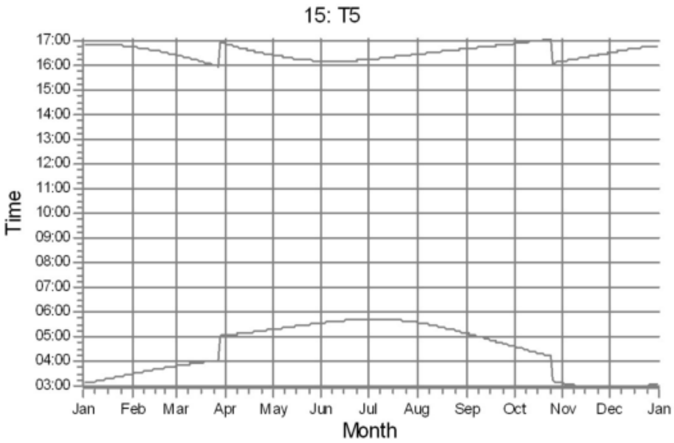
Shadow receptors

F: R7	K: R21	M: R24	P: R27	S: R34
I: R13	L: R23	N: R26	R: R35	

SHADOW - Calendar per WTG, graphical







Shadow receptors

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 1 - T1

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:16	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:09	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:53	16:09	16:31
3	03:05	03:29	03:47	05:02	05:17	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:49	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:11	16:32
5	03:07	03:30	03:48	05:03	05:18	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:34	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:19	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:13	16:35
8	03:09	03:32	03:50	05:05	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:57	04:24	02:59	02:54
	16:49	16:40	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:37
11	03:11	03:35	03:51	05:06	05:21	05:36	05:40	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:32	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:24	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:39
14	03:13	03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:18	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:38	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:42
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:46	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:48	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54	02:57
	16:49	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:12	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:29	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:13	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:40	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:46
27	03:23	03:45	03:59	05:14	05:29	05:40	05:35	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:34	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	316	331	348	358	393	401	426
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

SHADOW - Calendar per WTG

WTG: 2 - T2

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04 15:13-16:02/49	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53 15:15-15:32/17
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:09	16:30
2	03:05 15:13-16:01/48	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53 15:12-15:36/24
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:53	16:09	16:31
3	03:05 15:15-16:01/46	03:29	03:47	05:02	05:17	05:32	05:40	05:31	05:04	04:31	03:03	02:53 15:10-15:38/28
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06 15:16-16:00/44	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53 15:08-15:41/33
	16:49	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:11	16:32
5	03:07 15:17-15:59/42	03:30	03:48	05:03	05:18	05:33	05:40	05:29	05:02	04:29	03:02	02:53 15:07-15:43/36
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07 15:19-15:59/40	03:31	03:49	05:04	05:18	05:34	05:40	05:29	05:01	04:28	03:01	02:53 15:05-15:44/39
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08 15:21-15:58/37	03:32	03:49	05:04	05:19	05:34	05:40	05:28	05:00	04:27	03:00	02:53 15:04-15:46/42
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:13	16:35
8	03:09 15:23-15:56/33	03:32	03:50	05:05	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53 15:04-15:47/43
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:09 15:25-15:55/30	03:33	03:50	05:05	05:20	05:35	05:40	05:27	04:58	04:25	02:59	02:53 15:03-15:48/45
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10 15:28-15:53/25	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:57	04:24	02:59	02:54 15:03-15:51/48
	16:49	16:40	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:37
11	03:11 15:31-15:49/18	03:35	03:51	05:06	05:21	05:36	05:40	05:25	04:55	04:23	02:58	02:54 15:03-15:51/48
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12 15:38-15:44/6	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54 15:02-15:52/50
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:24	04:53	04:21	02:57	02:54 15:02-15:53/51
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:39
14	03:13	03:37	03:53	05:07	05:22	05:37	05:39	05:23	04:52	04:20	02:57	02:55 15:02-15:55/53
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:18	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55 15:02-15:55/53
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:39	05:21	04:50	04:18	02:56	02:55 15:02-15:56/54
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:38	05:38	05:20	04:49	04:17	02:55	02:56 15:03-15:57/54
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56 15:02-15:57/55
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:42
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57 15:03-15:59/56
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57 15:03-15:59/56
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:48	17:01	16:22	16:43
21	03:19	03:41	03:56	05:11	05:26	05:39	05:37	05:17	04:44	04:13	02:54	02:57 15:03-15:59/56
	16:49	16:31	16:04	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58 15:04-16:00/56
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:12	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58 15:04-16:00/56
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59 15:05-16:01/56
	16:48	16:29	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59 15:05-16:01/56
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:50	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:40	05:35	05:12	04:39	03:09	02:53	03:00 15:07-16:01/54
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:46
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01 15:07-16:01/54
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01 15:08-16:01/53
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02 15:09-16:02/53
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53 15:21-15:24/3	03:02 15:10-16:01/51
	16:46		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03 15:11-16:02/51
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	316	331	348	358	393	401	426
Sum of minutes with flicker	418	0	0	0	0	0	0	0	0	0	3	1481

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 3 - T9

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52	16:08	16:30
2	03:04	03:28	03:46	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:03	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:31
4	03:06	03:29	03:48	05:03	05:17	05:32	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:13	16:28	16:41	16:53	16:10	16:32
5	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:01	02:53
	16:49	16:42	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:03	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:08	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:44	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:09	03:33	03:50	05:05	05:19	05:35	05:40	05:26	04:57	04:25	02:59	02:53
	16:49	16:40	16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:42	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
11	03:11	03:34	03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:57	02:54
	16:49	16:38	16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57	16:16	16:38
13	03:12	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:39	16:16	16:08	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:45	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:33	16:07	16:35	16:13	16:09	16:19	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:09	05:25	05:38	05:38	05:18	04:46	04:15	02:55	02:56
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:34	16:47	17:01	16:21	16:42
20	03:18	03:40	03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54	02:57
	16:49	16:32	16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01	16:22	16:42
21	03:19	03:41	03:56	05:10	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:19	03:42	03:57	05:11	05:26	05:39	05:36	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:43
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:10	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03	16:25	16:44
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:27	15:59	16:29	16:11	16:11	16:23	16:37	16:49	16:04	16:26	16:45
26	03:23	03:44	03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:00
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:11	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:35	03:06	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:06	16:29	16:46
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:45		16:54	16:24	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:26		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	316	331	348	358	393	401	425
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 4 - T7

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June
1	03:04	03:27 03:44-03:55/11	03:46 15:53-16:05/12	05:01	05:15 05:33-05:38/5	05:31
	16:48	16:45	16:24 04:03-04:09/6	16:52	16:24	16:09
2	03:04	03:28 03:45-03:55/10	03:46 15:53-16:05/12	05:02	05:16 05:33-05:37/4	05:32
	16:48	16:44	16:23 04:04-04:09/5	16:51	16:23	16:09
3	03:05	03:29 03:46-03:55/9	03:47 15:42-16:03/21	05:02	05:16 05:34-05:36/2	05:32
	16:48	16:44	16:22 04:04-04:07/3	16:50	16:22	16:09
4	03:06	03:29 03:47-03:55/8	03:48 15:39-16:03/24	05:03	05:17 05:34-05:35/1	05:33
	16:48	16:43	16:21	16:49	16:22	16:09
5	03:07	03:30 03:47-03:54/7	03:48 15:36-16:01/25	05:03	05:17	05:33
	16:49	16:42	16:20	16:48	16:21	16:09
6	03:07	03:31 03:48-03:54/6	03:49 15:34-16:01/27	05:03	05:18	05:33
	16:49	16:42	16:19	16:47	16:20	16:09
7	03:08	03:32 03:49-03:53/4	03:49 15:32-15:59/27	05:04	05:18	05:34
	16:49	16:41	16:18	16:46	16:20	16:08
8	03:09	03:32 03:50-03:52/2	03:50 15:32-15:59/27	05:04	05:19	05:34
	16:49	16:41	16:17	16:45	16:19	16:08
9	03:09	03:33	03:50 15:30-15:57/27	05:05	05:19	05:35
	16:49	16:40	16:16	16:44	16:18	16:08
10	03:10	03:34	03:51 15:30-15:57/27	05:05	05:20	05:35
	16:49	16:39	16:15	16:43	16:18	16:08
11	03:11	03:35	03:51 15:29-15:55/26	05:06	05:21	05:35
	16:49	16:39	16:14	16:42	16:17	16:08
12	03:12	03:35	03:52 15:31-15:55/24	05:06	05:21	05:36
	16:49	16:38	16:13	16:41	16:16	16:08
13	03:12	03:36	03:52 15:33-15:53/20	05:07	05:22	05:36
	16:49	16:37	16:12	16:40	16:16	16:09
14	03:13	03:37	03:53 15:37-15:53/16	05:07	05:22	05:36
	16:49	16:37	16:11	16:39	16:15	16:09
15	03:14	03:37	03:53 15:39-15:51/12	05:08	05:23	05:37
	16:49	16:36	16:10	16:38	16:15	16:09
16	03:15	03:38	03:54 15:43-15:51/8	05:08	05:23	05:37
	16:49	16:35	16:09	16:37	16:14	16:09
17	03:16	03:39 03:56-04:04/8	03:54 15:45-15:49/4	05:09	05:24	05:37
	16:49	16:34	16:08	16:36	16:14	16:09
18	03:16	03:39 03:56-04:06/10	03:55	05:09	05:24	05:38
	16:49	16:34	16:07	16:35	16:13	16:09
19	03:17 03:38-03:39/1	03:40 03:57-04:08/11	03:55	05:10	05:25	05:38
	16:49	16:33	16:06	16:34	16:13	16:09
20	03:18 03:35-03:44/9	03:41 03:58-04:09/11	03:56	05:10 05:27-05:31/4	05:25	05:38
	16:49	16:32	16:05	16:33	16:13	16:09
21	03:19 03:36-03:46/10	03:41 03:58-04:10/12	03:56	05:10 05:27-05:34/7	05:26	05:38
	16:48	16:31	16:03	16:32	16:12	16:10
22	03:19 03:37-03:48/11	03:42 03:59-04:11/12	03:57	05:11 05:28-05:36/8	05:26	05:39
	16:48	16:30	16:02	16:31	16:12	16:10
23	03:20 03:38-03:50/12	03:42 04:00-04:11/11	03:57	05:11 05:28-05:36/8	05:27	05:39
	16:48	16:29	16:01	16:30	16:11	16:10
24	03:21 03:38-03:50/12	03:43 16:01-16:07/6	03:58	05:12 05:29-05:37/8	05:27	05:39
	16:48	16:28 04:00-04:11/11	16:00	16:29	16:11	16:10
25	03:22 03:39-03:51/12	03:44 15:58-16:09/11	03:58	05:12 05:29-05:37/8	05:28	05:39
	16:47	16:28 04:01-04:11/10	15:59	16:29	16:11	16:11
26	03:23 03:40-03:52/12	03:44 15:56-16:08/12	03:58	05:13 05:30-05:38/8	05:28	05:39
	16:47	16:27 04:01-04:11/10	15:58	16:28	16:10	16:11
27	03:23 03:41-03:53/12	03:45 15:55-16:07/12	03:59	05:13 05:30-05:38/8	05:29	05:40
	16:47	16:26 04:02-04:11/9	15:57	16:27	16:10	16:11
28	03:24 03:41-03:53/12	03:45 15:53-16:06/13	03:59	05:14 05:31-05:38/7	05:29	05:40
	16:46	16:25 04:03-04:11/8	15:56	16:26	16:10	16:11
29	03:25 03:42-03:54/12		05:00	05:14 05:31-05:37/6	05:30	05:40
	16:46		16:55	16:25	16:10	16:12
30	03:26 03:43-03:55/12		05:00	05:15 05:32-05:38/6	05:30	05:40
	16:45		16:54	16:25	16:09	16:12
31	03:26 03:44-03:55/11		05:01		05:31	
	16:45		16:53		16:09	
Potential sun hours	420	364	380	345	337	317
Sum of minutes with flicker	138	234	353	78	12	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 4 - T7

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	September	October	November	December
1	05:40	05:32	05:06	04:33 16:11-16:33/22	03:04	02:53
	16:12	16:26	16:40	16:52	16:08	16:30
2	05:40	05:31	05:05	04:32 16:07-16:34/27	03:04 03:20-03:21/1	02:53
	16:13	16:27	16:40	16:52	16:09	16:31
3	05:40	05:31	05:04	04:31 16:07-16:34/27	03:03 03:19-03:22/3	02:53
	16:13	16:27	16:41	16:53	16:10	16:32
4	05:40	05:30	05:03	04:30 16:07-16:35/28	03:02 03:18-03:22/4	02:53
	16:14	16:28	16:41	16:53	16:10	16:32
5	05:40	05:29	05:02	04:29 16:08-16:35/27	03:02 03:18-03:24/6	02:53
	16:14	16:28	16:42	16:54	16:11	16:33
6	05:40	05:29	05:01	04:28 16:08-16:36/28	03:01 03:17-03:24/7	02:53
	16:14	16:29	16:42	16:54	16:12	16:34
7	05:40	05:28	05:00	04:27 16:09-16:36/27	03:00 03:17-03:25/8	02:53
	16:15	16:29	16:42	16:55	16:12	16:34
8	05:40	05:27	04:59	04:26 16:10-16:37/27	03:00 03:16-03:25/9	02:53
	16:15	16:30	16:43	16:55	16:13	16:35
9	05:40	05:26 05:43-05:44/1	04:57	04:25 16:12-16:37/25	02:59 03:16-03:26/10	02:53
	16:16	16:30	16:43	16:56	16:14	16:36
10	05:40	05:26 05:42-05:45/3	04:56	04:24 16:14-16:37/23	02:59 03:15-03:26/11	02:54
	16:16	16:31	16:44	16:56 04:39-04:41/2	16:15	16:36
11	05:39	05:25 05:42-05:46/4	04:55	04:23 16:27-16:38/11 04:38-04:42/4	02:58 03:15-03:26/11	02:54
	16:16	16:31	16:44	16:57 16:19-16:23/4	16:15	16:37
12	05:39	05:24 05:41-05:46/5	04:54	04:22 16:27-16:38/11	02:58 03:14-03:26/12	02:54
	16:17	16:31	16:44	16:57 04:37-04:42/5	16:16	16:38
13	05:39	05:23 05:40-05:46/6	04:53	04:21 16:27-16:39/12	02:57 03:14-03:26/12	02:54
	16:17	16:32	16:45	16:58 04:36-04:43/7	16:17	16:38
14	05:39	05:23 05:39-05:46/7	04:52	04:20 16:27-16:39/12	02:57 03:14-03:26/12	02:55
	16:18	16:32	16:45	16:58 04:35-04:43/8	16:17	16:39
15	05:39	05:22 05:38-05:45/7	04:51	04:19 16:28-16:40/12	02:56 03:13-03:25/12	02:55
	16:18	16:33	16:45	16:59 04:34-04:43/9	16:18	16:40
16	05:38	05:21 05:37-05:45/8	04:50	04:18 16:29-16:40/11	02:56 03:13-03:25/12	02:55
	16:19	16:33	16:46	16:59 04:33-04:43/10	16:19	16:40
17	05:38	05:20 05:37-05:45/8	04:49	04:17 16:30-16:41/11	02:55 03:13-03:25/12	02:56
	16:19	16:34	16:46	17:00 04:32-04:43/11	16:20	16:41
18	05:38	05:19 05:36-05:44/8	04:48	04:16 04:31-04:42/11	02:55 03:12-03:24/12	02:56
	16:20	16:34	16:47	17:00	16:20	16:41
19	05:38	05:18 05:35-05:43/8	04:47	04:15 04:30-04:42/12	02:55 03:12-03:24/12	02:56
	16:20	16:35	16:47	17:01	16:21	16:42
20	05:37	05:17 05:34-05:42/8	04:45	04:14 04:30-04:42/12	02:54 03:12-03:23/11	02:57
	16:20	16:35	16:47	17:01	16:22	16:42
21	05:37	05:17 05:33-05:40/7	04:44	04:13 04:29-04:41/12	02:54 03:12-03:22/10	02:57
	16:21	16:35	16:48	17:02	16:23	16:43
22	05:37	05:16 05:32-05:38/6	04:43	04:12 04:28-04:39/11	02:54 03:11-03:20/9	02:58
	16:21	16:36	16:48	17:02	16:23	16:44
23	05:36	05:15 05:31-05:34/3	04:42	04:11 04:27-04:38/11	02:54 03:15-03:16/1	02:58
	16:22	16:36	16:49	17:03	16:24	16:44
24	05:36	05:14	04:41	04:11 04:26-04:36/10	02:53	02:59
	16:22	16:37	16:49	17:04	16:25	16:44
25	05:35	05:13	04:40	03:10 03:25-03:32/7	02:53	02:59
	16:23	16:37	16:49	16:04	16:26	16:45
26	05:35	05:12	04:39 16:29-16:32/3	03:09	02:53	03:00
	16:23	16:38	16:50	16:05	16:26	16:45
27	05:34	05:11	04:38 16:26-16:32/6	03:08	02:53	03:01
	16:24	16:38	16:50	16:05	16:27	16:46
28	05:34	05:10	04:37 16:22-16:33/11	03:07	02:53	03:01
	16:24	16:38	16:51	16:06	16:28	16:46
29	05:33	05:09	04:35 16:18-16:32/14	03:06	02:53	03:02
	16:25	16:39	16:51	16:07	16:29	16:47
30	05:33	05:08	04:34 16:14-16:33/19	03:06	02:53	03:02
	16:25	16:39	16:52	16:07	16:29	16:47
31	05:32	05:07		03:05		03:03
	16:26	16:40		16:08		16:47
Potential sun hours	331	348	358	393	401	425
Sum of minutes with flicker	0	89	53	487	197	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 5 - T8

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	January		February		March		April	May	June
1	03:04		03:27	16:01-16:24/23	03:46	14:57-16:05/68	05:01	05:15	05:31
	16:48		16:45	14:58-15:34/36	16:24		16:52	16:24	16:09
2	03:04		03:28	16:00-16:24/24	03:46	15:59-16:04/5	05:02	05:16	05:32
	16:48		16:44	14:57-15:37/40	16:23	15:00-15:58/58	16:51	16:23	16:09
3	03:05		03:29	16:00-16:24/24	03:47	15:03-15:57/54	05:02	05:16	05:32
	16:48		16:44	14:55-15:39/44	16:22		16:50	16:22	16:09
4	03:06		03:29	16:00-16:23/23	03:48	15:06-15:58/52	05:03	05:17	05:32
	16:48		16:43	14:54-15:41/47	16:21		16:49	16:22	16:09
5	03:07		03:30	15:59-16:22/23	03:48	15:09-15:57/48	05:03	05:17	05:33
	16:49		16:42	14:52-15:42/50	16:20		16:48	16:21	16:09
6	03:07		03:31	15:59-16:22/23	03:49	15:12-15:57/45	05:03	05:18	05:33
	16:49		16:42	14:51-15:44/53	16:19		16:47	16:20	16:08
7	03:08		03:32	15:55-16:22/27	03:49	15:15-15:56/41	05:04	05:18	05:34
	16:49		16:41	14:50-15:46/56	16:18		16:46	16:20	16:08
8	03:09		03:32	15:52-16:20/28	03:50	15:19-15:55/36	05:04	05:19	05:34
	16:49		16:41	14:48-15:47/59	16:17		16:45	16:19	16:08
9	03:09		03:33	15:51-16:20/29	03:50	15:21-15:54/33	05:05	05:19	05:35
	16:49		16:40	14:47-15:48/61	16:16		16:44	16:18	16:08
10	03:10		03:34	14:47-16:20/93	03:51	15:25-15:54/29	05:05	05:20	05:35
	16:49		16:39		16:15		16:42	16:18	16:08
11	03:11		03:35	14:46-16:20/94	03:51	15:27-15:53/26	05:06	05:21	05:35
	16:49		16:39		16:14		16:42	16:17	16:08
12	03:12		03:35	14:44-16:18/94	03:52	15:31-15:52/21	05:06	05:21	05:36
	16:49		16:38		16:13		16:41	16:16	16:08
13	03:12		03:36	14:44-16:18/94	03:52	15:33-15:51/18	05:07	05:22	05:36
	16:49		16:37		16:12		16:40	16:16	16:09
14	03:13		03:37	14:43-16:18/95	03:53	15:37-15:50/13	05:07	05:22	05:36
	16:49		16:37		16:11		16:39	16:15	16:09
15	03:14		03:37	14:42-16:16/94	03:53	15:39-15:49/10	05:08	05:23	05:37
	16:49		16:36		16:10		16:38	16:15	16:09
16	03:15		03:38	14:41-16:16/95	03:54	15:43-15:48/5	05:08	05:23	05:37
	16:49		16:35		16:09		16:37	16:14	16:09
17	03:16		03:39	14:41-16:15/94	03:54	15:45-15:46/1	05:09	05:24	05:37
	16:49		16:34		16:08		16:36	16:14	16:09
18	03:16		03:39	14:39-16:14/95	03:55		05:09	05:24	05:38
	16:49		16:33		16:07		16:35	16:13	16:09
19	03:17		03:40	14:39-16:14/95	03:55		05:09	05:25	05:38
	16:49		16:33		16:06		16:34	16:13	16:09
20	03:18		03:40	14:39-16:13/94	03:56		05:10	05:25	05:38
	16:49		16:32		16:04		16:33	16:13	16:09
21	03:19		03:41	14:38-16:12/94	03:56		05:10	05:26	05:38
	16:48		16:31		16:03		16:32	16:12	16:10
22	03:19		03:42	14:37-16:11/94	03:57		05:11	05:26	05:39
	16:48		16:30		16:02		16:31	16:12	16:10
23	03:20		03:42	14:37-16:10/93	03:57		05:11	05:27	05:39
	16:48		16:29		16:01		16:30	16:11	16:10
24	03:21		03:43	14:41-16:10/89	03:58		05:12	05:27	05:39
	16:48		16:28		16:00		16:29	16:11	16:10
25	03:22	16:13-16:22/9	03:44	14:44-16:09/85	03:58		05:12	05:28	05:39
	16:47		16:28		15:59		16:29	16:11	16:11
26	03:23	16:12-16:24/12	03:44	14:47-16:08/81	03:58		05:13	05:28	05:39
	16:47		16:27		15:58		16:28	16:10	16:11
27	03:23	16:08-16:25/17	03:45	14:50-16:07/77	03:59		05:13	05:29	05:40
	16:47		16:26		15:57		16:27	16:10	16:11
28	03:24	16:05-16:26/21	03:45	14:53-16:06/73	03:59		05:14	05:29	05:40
	16:46		16:25		15:56		16:26	16:10	16:11
29	03:25	16:04-16:26/22			05:00		05:14	05:30	05:40
	16:46	15:07-15:24/17			16:55		16:25	16:10	16:12
30	03:26	16:03-16:25/22			05:00		05:15	05:30	05:40
	16:45	15:04-15:29/25			16:54		16:25	16:09	16:12
31	03:26	16:02-16:25/23			05:01			05:31	
	16:45	15:01-15:32/31			16:53			16:09	
Potential sun hours	420		364		380		345	337	317
Sum of minutes with flicker		199		2393		563	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 5 - T8

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	September		October		November		December
1	05:40	05:32	05:06		04:33	16:11-16:31/20	03:04	14:16-15:49/93	02:53
	16:12	16:26	16:40		16:52		16:08		16:30
2	05:40	05:31	05:05		04:32	16:07-16:31/24	03:04	15:21-15:50/29	02:53
	16:13	16:27	16:40		16:52		16:09	14:18-15:18/60	16:31
3	05:40	05:30	05:04		04:31	16:04-16:31/27	03:03	15:23-15:51/28	02:53
	16:13	16:27	16:41		16:53		16:10	14:18-15:16/58	16:31
4	05:40	05:30	05:03		04:30	16:00-16:32/32	03:02	15:25-15:51/26	02:53
	16:14	16:28	16:41		16:53		16:10	14:19-15:15/56	16:32
5	05:40	05:29	05:02		04:29	15:57-16:32/35	03:01	15:29-15:52/23	02:53
	16:14	16:28	16:42		16:54		16:11	14:21-15:14/53	16:33
6	05:40	05:29	05:01		04:28	15:53-16:32/39	03:01	15:29-15:52/23	02:53
	16:14	16:29	16:42		16:54		16:12	14:22-15:12/50	16:34
7	05:40	05:28	05:00		04:27	15:50-16:32/42	03:00	15:30-15:54/24	02:53
	16:15	16:29	16:42		16:55		16:12	14:24-15:11/47	16:34
8	05:40	05:27	04:59		04:26	15:46-16:32/46	03:00	15:30-15:54/24	02:53
	16:15	16:30	16:43		16:55		16:13	14:26-15:09/43	16:35
9	05:40	05:26	04:57		04:25	15:43-16:32/49	02:59	15:31-15:55/24	02:53
	16:16	16:30	16:43		16:56		16:14	14:28-15:07/39	16:36
10	05:40	05:26	04:56		04:24	15:39-16:32/53	02:59	15:32-15:55/23	02:54
	16:16	16:30	16:44		16:56		16:14	14:30-15:05/35	16:36
11	05:39	05:25	04:55		04:23	15:36-16:32/56	02:58	15:33-15:56/23	02:54
	16:16	16:31	16:44		16:57		16:15	14:33-15:03/30	16:37
12	05:39	05:24	04:54		04:22	15:32-16:38/66	02:58	15:34-15:56/22	02:54
	16:17	16:31	16:44		16:57		16:16	14:35-14:59/24	16:38
13	05:39	05:23	04:53		04:21	15:29-16:39/70	02:57	15:36-15:58/22	02:54
	16:17	16:32	16:45		16:58		16:17	14:40-14:56/16	16:38
14	05:39	05:23	04:52		04:20	15:25-16:39/74	02:57	15:37-15:58/21	02:55
	16:18	16:32	16:45		16:58		16:17		16:39
15	05:39	05:22	04:51		04:19	15:21-16:40/79	02:56	15:41-15:58/17	02:55
	16:18	16:33	16:45		16:59		16:18		16:40
16	05:38	05:21	04:50		04:18	15:18-16:40/82	02:56	15:45-15:57/12	02:55
	16:19	16:33	16:46		16:59		16:19		16:40
17	05:38	05:20	04:49		04:17	15:14-16:41/87	02:55	15:46-15:55/9	02:56
	16:19	16:34	16:46		17:00		16:20		16:41
18	05:38	05:19	04:48		04:16	15:11-16:41/90	02:55		02:56
	16:20	16:34	16:47		17:00		16:20		16:41
19	05:38	05:18	04:46		04:15	15:08-16:41/93	02:55		02:56
	16:20	16:35	16:47		17:01		16:21		16:42
20	05:37	05:17	04:45		04:14	15:08-16:42/94	02:54		02:57
	16:20	16:35	16:47		17:01		16:22		16:42
21	05:37	05:17	04:44		04:13	15:09-16:43/94	02:54		02:57
	16:21	16:35	16:48		17:02		16:23		16:43
22	05:37	05:16	04:43		04:12	15:09-16:44/95	02:54		02:58
	16:21	16:36	16:48		17:02		16:23		16:44
23	05:36	05:15	04:42		04:11	15:09-16:44/95	02:54		02:58
	16:22	16:36	16:49		17:03		16:24		16:44
24	05:36	05:14	04:41		04:11	15:10-16:44/94	02:53		02:59
	16:22	16:37	16:49		17:03		16:25		16:44
25	05:35	05:13	04:40		03:10	14:10-15:45/95	02:53		02:59
	16:23	16:37	16:49		16:04		16:26		16:45
26	05:35	05:12	04:39		03:09	14:12-15:45/93	02:53		03:00
	16:23	16:37	16:50		16:05		16:26		16:45
27	05:34	05:11	04:38	16:26-16:29/3	03:08	14:12-15:47/95	02:53		03:00
	16:24	16:38	16:50		16:05		16:27		16:46
28	05:34	05:10	04:37	16:22-16:30/8	03:07	14:12-15:47/95	02:53		03:01
	16:24	16:38	16:51		16:06		16:28		16:46
29	05:33	05:09	04:35	16:18-16:30/12	03:06	14:13-15:47/94	02:53		03:02
	16:25	16:39	16:51		16:06		16:29		16:47
30	05:33	05:08	04:34	16:14-16:30/16	03:06	14:15-15:49/94	02:53		03:02
	16:25	16:39	16:52		16:07		16:29		16:47
31	05:32	05:07			03:05	14:15-15:49/94			03:03
	16:26	16:40			16:08				16:47
Potential sun hours	331	348	358		393		401		425
Sum of minutes with flicker	0	0	39		2196		954		0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 6 - T10

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January		February		March		April	May	June
1	03:04	15:38-16:01/23	03:27	15:41-16:19/38	03:46	04:03-04:18/15	05:01	05:15	05:31
	16:48	03:21-03:58/37	16:44	03:44-03:58/14	16:24		16:52	16:24	16:09
2	03:04	15:38-16:03/25	03:28	15:42-16:18/36 04:01-04:07/6	03:46	04:04-04:17/13	05:02	05:16	05:32
	16:48	03:22-03:59/37	16:44	03:45-03:55/10	16:23		16:51	16:23	16:09
3	03:05	15:39-16:04/25	03:29	15:44-16:18/34	03:47	04:04-04:14/10	05:02	05:16	05:32
	16:48	03:23-04:00/37	16:43	03:58-04:12/14	16:22		16:50	16:22	16:09
4	03:06	15:38-16:04/26	03:29	15:44-16:17/33	03:47	04:05-04:13/8	05:02	05:17	05:32
	16:48	03:23-04:00/37	16:43	03:56-04:15/19	16:21		16:49	16:21	16:09
5	03:06	15:38-16:06/28	03:30	15:45-16:16/31	03:48	04:05-04:09/4	05:03	05:17	05:33
	16:48	03:24-04:01/37	16:42	03:53-04:16/23	16:20		16:47	16:21	16:08
6	03:07	15:38-16:07/29	03:31	15:47-16:15/28	03:49		05:03	05:18	05:33
	16:49	03:25-04:02/37	16:42	03:52-04:18/26	16:19		16:46	16:20	16:08
7	03:08	15:37-16:07/30	03:32	15:49-16:14/25	03:49		05:04	05:18	05:34
	16:49	03:25-04:01/36	16:41	03:51-04:19/28	16:18		16:45	16:19	16:08
8	03:09	15:38-16:08/30	03:32	15:50-16:12/22	03:50		05:04	05:19	05:34
	16:49	03:26-04:02/36	16:41	03:50-04:20/30	16:17		16:44	16:19	16:08
9	03:09	15:38-16:10/32	03:33	15:53-16:10/17	03:50		05:05	05:19	05:35
	16:49	03:27-04:03/36	16:40	03:50-04:21/31	16:16		16:43	16:18	16:08
10	03:10	15:38-16:11/33	03:34	15:57-16:06/9	03:51		05:05	05:20	05:35
	16:49	03:28-04:04/36	16:39	03:51-04:22/31	16:15		16:42	16:18	16:08
11	03:11	15:37-16:11/34	03:34	03:52-04:23/31	03:51	04:08-04:15/7	05:06	05:20	05:35
	16:49	03:28-04:03/35	16:39		16:14		16:41	16:17	16:08
12	03:12	15:38-16:12/34	03:35	03:52-04:23/31	03:52	04:09-04:18/9	05:06	05:21	05:36
	16:49	03:29-04:04/35	16:38		16:13		16:40	16:16	16:08
13	03:12	15:38-16:13/35	03:36	03:53-04:23/30	03:52	04:09-04:19/10	05:07	05:21	05:36
	16:49	03:30-04:05/35	16:37		16:12		16:39	16:16	16:08
14	03:13	15:37-16:13/36	03:36	03:54-04:24/30	03:53	04:10-04:19/9	05:07	05:22	05:36
	16:49	03:31-04:05/34	16:36		16:11		16:38	16:15	16:09
15	03:14	15:37-16:14/37	03:37	03:54-04:23/29	03:53	04:10-04:15/5	05:08	05:23	05:37
	16:49	03:31-04:05/34	16:36		16:10		16:38	16:15	16:09
16	03:15	15:37-16:15/38	03:38	03:55-04:24/29	03:54	04:11-04:12/1	05:08	05:23	05:37
	16:49	03:32-04:05/33	16:35		16:09		16:37	16:14	16:09
17	03:15	15:38-16:16/38	03:38	03:56-04:24/28	03:54		05:08	05:24	05:37
	16:49	03:33-04:06/33	16:34		16:08		16:36	16:14	16:09
18	03:16	15:38-16:17/39	03:39	03:56-04:23/27	03:55		05:09	05:24	05:38
	16:49	03:34-04:06/32	16:33		16:07		16:35	16:13	16:09
19	03:17	15:37-16:17/40	03:40	03:57-04:23/26	03:55		05:09	05:25	05:38
	16:49	03:34-04:06/32	16:33		16:05		16:34	16:13	16:09
20	03:18	15:38-16:17/39	03:40	03:58-04:23/25	03:56		05:10	05:25	05:38
	16:48	03:35-04:06/31	16:32		16:04		16:33	16:12	16:09
21	03:19	15:38-16:18/40	03:41	03:58-04:22/24	03:56		05:10	05:26	05:38
	16:48	03:36-04:06/30	16:31		16:03		16:32	16:12	16:10
22	03:19	15:38-16:19/41	03:42	03:59-04:21/22	03:57		05:11	05:26	05:39
	16:48	03:37-04:06/29	16:30		16:02		16:31	16:12	16:10
23	03:20	15:38-16:18/40	03:42	03:59-04:21/22	03:57		05:11	05:27	05:39
	16:48	03:37-04:06/29	16:29		16:01		16:30	16:11	16:10
24	03:21	15:38-16:19/41	03:43	04:00-04:21/21	03:57		05:12	05:27	05:39
	16:48	03:38-04:06/28	16:28		16:00		16:29	16:11	16:10
25	03:22	15:39-16:19/40	03:43	04:01-04:21/20	03:58		05:12	05:28	05:39
	16:47	03:39-04:05/26	16:27		15:59		16:28	16:11	16:11
26	03:22	15:39-16:20/41	03:44	04:01-04:20/19	03:58		05:13	05:28	05:39
	16:47	03:40-04:05/25	16:27		15:58		16:28	16:10	16:11
27	03:23	15:39-16:19/40	03:45	04:02-04:20/18	03:59		05:13	05:29	05:39
	16:47	03:40-04:04/24	16:26		15:57		16:27	16:10	16:11
28	03:24	15:39-16:19/40	03:45	04:02-04:18/16	03:59		05:14	05:29	05:40
	16:46	03:41-04:03/22	16:25		15:56		16:26	16:10	16:11
29	03:25	15:40-16:20/40			05:00		05:14	05:30	05:40
	16:46	03:42-04:03/21			16:55		16:25	16:10	16:12
30	03:26	15:41-16:20/39			05:00		05:15	05:30	05:40
	16:45	03:43-04:02/19			16:54		16:24	16:09	16:12
31	03:26	15:41-16:19/38			05:01			05:31	
	16:45	03:44-04:00/16			16:53			16:09	
Potential sun hours	420		364		380		345	337	317
Sum of minutes with flicker		2060		953		91	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 6 - T10

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	July	August	September		October		November		December	
1	05:40	05:32	05:06		04:33	04:48-04:58/10	03:04	15:25-15:36/11	02:53	15:19-15:53/34
	16:12	16:26	16:40		16:52		16:08	03:20-03:51/31	16:30	03:10-03:45/35
2	05:40	05:31	05:05		04:32	04:47-04:55/8	03:03	15:21-15:39/18	02:53	15:20-15:53/33
	16:13	16:27	16:40		16:52		16:09	03:20-03:51/31	16:31	03:10-03:46/36
3	05:40	05:30	05:04		04:31		03:03	15:20-15:42/22	02:53	15:21-15:53/32
	16:13	16:27	16:41		16:53		16:10	03:20-03:50/30	16:31	03:11-03:47/36
4	05:40	05:30	05:03		04:30		03:02	15:17-15:44/27	02:53	15:23-15:53/30
	16:13	16:28	16:41		16:53		16:10	03:21-03:48/27	16:32	03:11-03:47/36
5	05:40	05:29	05:02		04:29		03:01	15:17-15:46/29	02:53	15:23-15:53/30
	16:14	16:28	16:41		16:54		16:11	03:22-03:48/26	16:33	03:11-03:47/36
6	05:40	05:28	05:01		04:28		03:01	15:15-15:46/31	02:53	15:24-15:53/29
	16:14	16:29	16:42		16:54		16:12	03:24-03:46/22	16:34	03:11-03:48/37
7	05:40	05:28	05:00		04:27		03:00	15:15-15:48/33	02:53	15:25-15:53/28
	16:15	16:29	16:42		16:55		16:12	03:26-03:45/19	16:34	03:11-03:48/37
8	05:40	05:27	04:58		04:26		03:00	15:14-15:48/34	02:53	15:26-15:52/26
	16:15	16:29	16:43		16:55		16:13	03:28-03:42/14	16:35	03:11-03:48/37
9	05:40	05:26	04:57		04:25	04:40-04:46/6	02:59	15:13-15:50/37 03:33-03:38/5	02:53	15:26-15:52/26
	16:15	16:30	16:43		16:56		16:14	03:16-03:26/10	16:36	03:11-03:48/37
10	05:40	05:26	04:56		04:24	04:39-04:48/9	02:58	15:13-15:50/37	02:53	15:27-15:52/25
	16:16	16:30	16:43		16:56		16:14	03:15-03:29/14	16:36	03:12-03:49/37
11	05:39	05:25	04:55		04:23	04:38-04:50/12	02:58	15:13-15:51/38	02:54	15:29-15:53/24
	16:16	16:31	16:44		16:56		16:15	03:15-03:32/17	16:37	03:12-03:49/37
12	05:39	05:24	04:54		04:22	04:37-04:51/14	02:57	15:12-15:51/39	02:54	15:29-15:52/23
	16:17	16:31	16:44		16:57		16:16	03:14-03:33/19	16:38	03:12-03:49/37
13	05:39	05:23	04:53		04:21	04:36-04:51/15	02:57	15:12-15:52/40	02:54	15:30-15:52/22
	16:17	16:32	16:45		16:57		16:17	03:14-03:35/21	16:38	03:12-03:49/37
14	05:39	05:22	04:52		04:20	04:35-04:52/17	02:56	15:11-15:51/40	02:55	15:32-15:53/21
	16:18	16:32	16:45		16:58		16:17	03:13-03:35/22	16:39	03:13-03:50/37
15	05:39	05:22	04:51		04:19	04:34-04:52/18	02:56	15:12-15:52/40	02:55	15:32-15:52/20
	16:18	16:33	16:45		16:58		16:18	03:13-03:37/24	16:40	03:13-03:50/37
16	05:38	05:21	04:50		04:18	04:33-04:52/19	02:56	15:12-15:53/41	02:55	15:33-15:52/19
	16:19	16:33	16:46		16:59		16:19	03:13-03:38/25	16:40	03:13-03:50/37
17	05:38	05:20	04:49		04:17	04:32-04:52/20	02:55	15:12-15:52/40	02:56	15:34-15:53/19
	16:19	16:34	16:46		17:00		16:19	03:12-03:38/26	16:41	03:14-03:51/37
18	05:38	05:19	04:48		04:16	04:31-04:52/21	02:55	15:12-15:53/41	02:56	15:34-15:53/19
	16:19	16:34	16:47		17:00		16:20	03:12-03:40/28	16:41	03:14-03:51/37
19	05:37	05:18	04:46		04:15	04:30-04:52/22	02:55	15:13-15:53/40	02:56	15:35-15:52/17
	16:20	16:34	16:47		17:01		16:21	03:12-03:41/29	16:42	03:14-03:51/37
20	05:37	05:17	04:45		04:14	04:29-04:52/23	02:54	15:13-15:54/41	02:57	15:36-15:53/17
	16:20	16:35	16:47		17:01		16:22	03:12-03:41/29	16:42	03:15-03:52/37
21	05:37	05:16	04:44		04:13	04:29-04:53/24	02:54	15:13-15:53/40	02:57	15:36-15:53/17
	16:21	16:35	16:48		17:02		16:22	03:11-03:41/30	16:43	03:15-03:52/37
22	05:36	05:16	04:43		04:12	04:28-04:53/25	02:54	15:14-15:53/39	02:58	15:37-15:54/17
	16:21	16:36	16:48		17:02		16:23	03:11-03:42/31	16:43	03:16-03:53/37
23	05:36	05:15	04:42		04:11	04:27-04:53/26	02:53	15:14-15:54/40	02:58	15:37-15:54/17
	16:22	16:36	16:49		17:03		16:24	03:11-03:43/32	16:44	03:16-03:53/37
24	05:36	05:14	04:41		04:10	04:26-04:53/27	02:53	15:15-15:54/39	02:59	15:38-15:55/17
	16:22	16:37	16:49		17:03		16:25	03:11-03:43/32	16:44	03:17-03:54/37
25	05:35	05:13	04:40		03:10	03:25-03:53/28	02:53	15:16-15:54/38	02:59	15:38-15:55/17
	16:23	16:37	16:49		16:04		16:25	03:11-03:44/33	16:45	03:17-03:54/37
26	05:35	05:12	04:39		03:09	03:24-03:53/29	02:53	15:16-15:54/38	03:00	15:38-15:57/19
	16:23	16:37	16:50		16:05		16:26	03:11-03:44/33	16:45	03:18-03:55/37
27	05:34	05:11	04:38		03:08	03:24-03:53/29	02:53	15:16-15:53/37	03:00	15:38-15:57/19
	16:24	16:38	16:50		16:05		16:27	03:11-03:45/34	16:46	03:18-03:55/37
28	05:34	05:10	04:36	04:52-04:55/3	03:07	03:23-03:53/30	02:53	15:17-15:53/36	03:01	15:38-15:58/20
	16:24	16:38	16:51		16:06		16:28	03:10-03:44/34	16:46	03:19-03:56/37
29	05:33	05:09	04:35	04:50-04:57/7	03:06	03:22-03:52/30	02:53	15:18-15:53/35	03:02	15:38-15:58/20
	16:25	16:39	16:51		16:06		16:28	03:10-03:45/35	16:46	03:20-03:57/37
30	05:33	05:08	04:34	04:49-04:59/10	03:06	03:22-03:53/31	02:53	15:19-15:53/34	03:02	15:38-16:00/22
	16:25	16:39	16:51		16:07		16:29	03:10-03:45/35	16:47	03:20-03:57/37
31	05:32	05:07			03:05	03:21-03:52/31			03:03	15:39-16:01/22
	16:26	16:39			16:08				16:47	03:21-03:58/37
Potential sun hours	331	348	358		393		401		425	
Sum of minutes with flicker	0	0	20		524		1853		1842	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 7 - T6

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January		February		March		April		May		June	
1	03:04		03:27	03:44-04:31/47	03:46		05:01		05:15		05:31	05:53-06:22/29
	16:48		16:45		16:24		16:52		16:24		16:09	
2	03:05		03:28	03:45-04:32/47	03:46		05:02		05:16		05:32	05:53-06:23/30
	16:48		16:44		16:23		16:51		16:23		16:09	
3	03:05		03:29	03:46-04:33/47	03:47		05:02		05:16		05:32	05:52-06:24/32
	16:48		16:44		16:22		16:50		16:22		16:09	
4	03:06		03:30	03:47-04:33/46	03:48		05:03		05:17		05:33	05:52-06:24/32
	16:48		16:43		16:21		16:49		16:22		16:09	
5	03:07		03:30	03:47-04:33/46	03:48		05:03		05:17		05:33	05:52-06:25/33
	16:49		16:43		16:20		16:48		16:21		16:09	
6	03:07		03:31	03:48-04:33/45	03:49		05:04		05:18		05:33	05:51-06:25/34
	16:49		16:42		16:19		16:47		16:20		16:09	
7	03:08	03:56-04:01/5	03:32	03:49-04:33/44	03:49		05:04		05:18		05:34	05:52-06:26/34
	16:49		16:41		16:18		16:46		16:20		16:08	
8	03:09	03:52-04:04/12	03:32	03:50-04:33/43	03:50		05:04		05:19		05:34	05:52-06:26/34
	16:49		16:41		16:17		16:45		16:19		16:08	
9	03:09	03:51-04:07/16	03:33	03:50-04:33/43	03:50		05:05		05:20		05:35	05:53-06:27/34
	16:49		16:40		16:16		16:44		16:18		16:08	
10	03:10	03:50-04:09/19	03:34	03:51-04:33/42	03:51		05:05		05:20		05:35	05:53-06:27/34
	16:49		16:39		16:15		16:43		16:18		16:08	
11	03:11	03:48-04:10/22	03:35	03:52-04:33/41	03:51		05:06		05:21		05:35	05:53-06:27/34
	16:49		16:39		16:14		16:42		16:17		16:08	
12	03:12	03:47-04:12/25	03:35	03:52-04:31/39	03:52	15:41-15:50/9	05:06		05:21		05:36	05:54-06:28/34
	16:49		16:38		16:13		16:41		16:16		16:09	
13	03:13	03:47-04:14/27	03:36	03:53-04:31/38	03:52	15:38-15:52/14	05:07		05:22		05:36	05:54-06:28/34
	16:49		16:37		16:12		16:40		16:16		16:09	
14	03:13	03:46-04:16/30	03:37	03:54-04:31/37	03:53	15:37-15:53/16	05:07		05:22		05:36	05:54-06:28/34
	16:49		16:37		16:11		16:39		16:15		16:09	
15	03:14	03:45-04:17/32	03:37	03:54-04:29/35	03:53	15:39-15:51/12	05:08		05:23		05:37	05:55-06:29/34
	16:49		16:36		16:10		16:38		16:15		16:09	
16	03:15	03:44-04:18/34	03:38	03:55-04:29/34	03:54	15:43-15:51/8	05:08		05:23		05:37	05:55-06:29/34
	16:49		16:35		16:09		16:37		16:14		16:09	
17	03:16	03:44-04:20/36	03:39	03:56-04:28/32	03:54	15:45-15:49/4	05:09		05:24		05:37	05:55-06:29/34
	16:49		16:34		16:08		16:36		16:14		16:09	
18	03:16	03:44-04:21/37	03:39	03:56-04:26/30	03:55		05:09		05:24		05:38	05:56-06:30/34
	16:49		16:34		16:07		16:35		16:13		16:09	
19	03:17	03:42-04:22/40	03:40	03:57-04:25/28	03:55		05:10		05:25		05:38	05:56-06:30/34
	16:49		16:33		16:06		16:34		16:13		16:09	
20	03:18	03:42-04:23/41	03:41	03:58-04:24/26	03:56		05:10		05:25		05:38	05:56-06:30/34
	16:49		16:32		16:05		16:33		16:13		16:10	
21	03:19	03:42-04:24/42	03:41	03:58-04:21/23	03:56		05:10		05:26		05:38	05:56-06:30/34
	16:48		16:31		16:03		16:32		16:12		16:10	
22	03:20	03:42-04:25/43	03:42	03:59-04:19/20	03:57		05:11		05:26		05:39	05:57-06:31/34
	16:48		16:30		16:02		16:31		16:12		16:10	
23	03:20	03:41-04:26/45	03:42	04:00-04:15/15	03:57		05:11		05:27		05:39	05:57-06:31/34
	16:48		16:29		16:01		16:30		16:11		16:10	
24	03:21	03:40-04:27/47	03:43		03:58		05:12		05:27	06:02-06:12/10	05:39	05:57-06:31/34
	16:48		16:28		16:00		16:29		16:11		16:10	
25	03:22	03:40-04:28/48	03:44		03:58		05:12		05:28	06:00-06:15/15	05:39	05:57-06:31/34
	16:47		16:28		15:59		16:29		16:11		16:11	
26	03:23	03:40-04:29/49	03:44		03:59		05:13		05:28	05:58-06:16/18	05:39	05:57-06:31/34
	16:47		16:27		15:58		16:28		16:10		16:11	
27	03:23	03:41-04:30/49	03:45		03:59		05:13		05:29	05:57-06:18/21	05:40	05:57-06:31/34
	16:47		16:26		15:57		16:27		16:10		16:11	
28	03:24	03:41-04:29/48	03:45		03:59		05:14		05:29	05:56-06:19/23	05:40	05:58-06:32/34
	16:46		16:25		15:56		16:26		16:10		16:12	
29	03:25	03:42-04:30/48			05:00		05:14		05:30	05:55-06:20/25	05:40	05:58-06:32/34
	16:46				16:55		16:25		16:10		16:12	
30	03:26	03:43-04:31/48			05:00		05:15		05:30	05:54-06:21/27	05:40	05:58-06:32/34
	16:45				16:54		16:25		16:09		16:12	
31	03:26	03:44-04:32/48			05:01				05:31	05:54-06:22/28		
	16:45				16:53				16:09			
Potential sun hours	420		364		380		345		337		317	
Sum of minutes with flicker		891		848		63		0		167		1006

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 7 - T6

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

Day	July		August	September		October		November		December	
1	05:40	05:58-06:32/34	05:32	05:06		04:33	16:19-16:30/11	03:04	03:20-04:02/42	02:53	03:31-03:54/23
	16:13		16:26	16:40		16:52		16:08		16:30	
2	05:40	05:58-06:32/34	05:31	05:05		04:32	16:23-16:26/3	03:04	03:20-04:03/43	02:53	03:33-03:52/19
	16:13		16:27	16:40		16:52		16:09		16:31	
3	05:40	05:58-06:32/34	05:31	05:04		04:31		03:03	03:19-04:03/44	02:53	03:35-03:51/16
	16:13		16:27	16:41		16:53		16:10		16:32	
4	05:40	05:58-06:32/34	05:30	05:03		04:30		03:02	03:18-04:02/44	02:53	03:37-03:49/12
	16:14		16:28	16:41		16:53		16:10		16:32	
5	05:40	05:58-06:32/34	05:29	05:02		04:29		03:02	03:18-04:03/45	02:53	03:40-03:47/7
	16:14		16:28	16:42		16:54		16:11		16:33	
6	05:40	05:58-06:32/34	05:29	05:01		04:28		03:01	03:17-04:03/46	02:53	
	16:14		16:29	16:42		16:54		16:12		16:34	
7	05:40	05:59-06:32/33	05:28	05:00		04:27		03:00	03:17-04:03/46	02:53	
	16:15		16:29	16:42		16:55		16:12		16:34	
8	05:40	05:58-06:31/33	05:27	04:59		04:26		03:00	03:16-04:03/47	02:53	
	16:15		16:30	16:43		16:55		16:13		16:35	
9	05:40	05:59-06:31/32	05:26	04:58		04:25		02:59	03:16-04:03/47	02:53	
	16:16		16:30	16:43		16:56		16:14		16:36	
10	05:40	06:00-06:31/31	05:26	04:56		04:24		02:59	03:15-04:02/47	02:54	
	16:16		16:31	16:44		16:56		16:15		16:36	
11	05:40	06:01-06:30/29	05:25	04:55		04:23		02:58	03:15-04:03/48	02:54	
	16:16		16:31	16:44		16:57		16:15		16:37	
12	05:39	06:01-06:30/29	05:24	04:54		04:22		02:58	03:14-04:02/48	02:54	
	16:17		16:31	16:44		16:57		16:16		16:38	
13	05:39	06:02-06:30/28	05:23	04:53		04:21		02:57	03:14-04:02/48	02:54	
	16:17		16:32	16:45		16:58		16:17		16:38	
14	05:39	06:03-06:28/25	05:23	04:52		04:20		02:57	03:14-04:02/48	02:55	
	16:18		16:32	16:45		16:58		16:17		16:39	
15	05:39	06:04-06:28/24	05:22	04:51		04:19		02:56	03:13-04:02/49	02:55	
	16:18		16:33	16:46		16:59		16:18		16:40	
16	05:38	06:05-06:27/22	05:21	04:50		04:18		02:56	03:13-04:02/49	02:55	
	16:19		16:33	16:46		16:59		16:19		16:40	
17	05:38	06:07-06:27/20	05:20	04:49		04:17		02:55	03:14-04:02/48	02:56	
	16:19		16:34	16:46		17:00		16:20		16:41	
18	05:38	06:08-06:24/16	05:19	04:48		04:16	04:32-04:42/10	02:55	03:14-04:01/47	02:56	
	16:20		16:34	16:47		17:00		16:20		16:41	
19	05:38	06:10-06:23/13	05:18	04:47		04:15	04:30-04:47/17	02:55	03:15-04:00/45	02:57	
	16:20		16:35	16:47		17:01		16:21		16:42	
20	05:37	06:14-06:20/6	05:18	04:45		04:14	04:30-04:51/21	02:54	03:17-04:00/43	02:57	
	16:21		16:35	16:47		17:01		16:22		16:43	
21	05:37		05:17	04:44		04:13	04:29-04:53/24	02:54	03:18-04:00/42	02:57	
	16:21		16:35	16:48		17:02		16:23		16:43	
22	05:37		05:16	04:43		04:12	04:28-04:54/26	02:54	03:18-03:59/41	02:58	
	16:21		16:36	16:48		17:02		16:23		16:44	
23	05:36		05:15	04:42		04:11	04:27-04:56/29	02:54	03:19-03:59/40	02:58	
	16:22		16:36	16:49		17:03		16:24		16:44	
24	05:36		05:14	04:41		04:11	04:26-04:57/31	02:53	03:20-03:58/38	02:59	
	16:22		16:37	16:49		17:04		16:25		16:45	
25	05:35		05:13	04:40		03:10	03:25-03:58/33	02:53	03:22-03:58/36	02:59	
	16:23		16:37	16:49		16:04		16:26		16:45	
26	05:35		05:12	04:39	16:29-16:32/3	03:09	03:25-03:59/34	02:53	03:23-03:57/34	03:00	
	16:23		16:38	16:50		16:05		16:26		16:45	
27	05:34		05:11	04:38	16:26-16:32/6	03:08	03:24-04:00/36	02:53	03:25-03:57/32	03:01	
	16:24		16:38	16:50		16:05		16:27		16:46	
28	05:34		05:10	04:37	16:22-16:33/11	03:07	03:23-04:00/37	02:53	03:26-03:56/30	03:01	
	16:24		16:38	16:51		16:06		16:28		16:46	
29	05:33		05:09	04:36	16:18-16:32/14	03:07	03:22-04:01/39	02:53	03:28-03:55/27	03:02	
	16:25		16:39	16:51		16:07		16:29		16:47	
30	05:33		05:08	04:34	16:17-16:32/15	03:06	03:22-04:02/40	02:53	03:29-03:54/25	03:02	
	16:25		16:39	16:52		16:07		16:29		16:47	
31	05:32		05:07			03:05	03:21-04:02/41			03:03	
	16:26		16:40			16:08				16:47	
Potential sun hours	331		348	358		393		401		425	
Sum of minutes with flicker		545	0		49		432		1269		77

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 8 - T12

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	November	December
1	03:04	03:27 03:44-03:50/6	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04 03:20-03:24/4	02:53
	16:47	16:44	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52	16:08	16:30
2	03:04	03:28 03:45-03:52/7	03:46	05:02	05:16	05:31	05:40	05:31	05:05	04:32	03:03 03:20-03:25/5	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29 03:46-03:53/7	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31	03:03 03:19-03:25/6	02:53
	16:48	16:43	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:31
4	03:06	03:29 03:47-03:54/7	03:47	05:02	05:17	05:32	05:40	05:30	05:03	04:30	03:02 03:18-03:24/6	02:53
	16:48	16:43	16:21	16:48	16:21	16:09	16:13	16:28	16:41	16:53	16:10	16:32
5	03:06	03:30 03:47-03:54/7	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:01 03:18-03:25/7	02:53
	16:48	16:42	16:20	16:47	16:21	16:08	16:14	16:28	16:41	16:54	16:11	16:33
6	03:07	03:31 03:48-03:55/7	03:49	05:03	05:18	05:33	05:40	05:28	05:01	04:28	03:01 03:17-03:24/7	02:53
	16:49	16:42	16:19	16:46	16:20	16:08	16:14	16:28	16:42	16:54	16:12	16:34
7	03:08	03:32 03:49-03:55/6	03:49	05:04	05:18	05:34	05:40	05:28	04:59	04:27	03:00 03:17-03:24/7	02:53
	16:49	16:41	16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32 03:49-03:55/6	03:50	05:04	05:19	05:34	05:40	05:27	04:58	04:26	03:00 03:16-03:23/7	02:53
	16:49	16:41	16:17	16:44	16:19	16:08	16:15	16:29	16:43	16:55	16:13	16:35
9	03:09	03:33 03:50-03:55/5	03:50	05:05	05:19	05:34	05:40	05:26	04:57	04:25	02:59 03:16-03:23/7	02:53
	16:49	16:40	16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:55	16:14	16:36
10	03:10	03:34 03:51-03:55/4	03:51	05:05	05:20	05:35	05:39	05:26	04:56	04:24	02:58 03:15-03:21/6	02:53
	16:49	16:39	16:15	16:42	16:17	16:08	16:16	16:30	16:43	16:56	16:14	16:36
11	03:11	03:34 03:52-03:54/2	03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23	02:58 03:15-03:21/6	02:54
	16:49	16:39	16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:56	16:15	16:37
12	03:12	03:35 03:52-03:53/1	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:57 03:14-03:21/7	02:54
	16:49	16:38	16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57	16:16	16:38
13	03:12	03:36	03:52	05:07	05:21	05:36	05:39	05:23	04:53	04:21	02:57 03:14-03:22/8	02:54
	16:49	16:37	16:12	16:39	16:16	16:08	16:17	16:32	16:45	16:57	16:17	16:38
14	03:13	03:36	03:53	05:07	05:22	05:36	05:39	05:22	04:52	04:20	02:56 03:13-03:21/8	02:54
	16:49	16:36	16:11	16:38	16:15	16:08	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:07	05:22	05:37	05:39	05:22	04:51	04:19	02:56 03:13-03:22/9	02:55
	16:49	16:36	16:10	16:37	16:15	16:09	16:18	16:33	16:45	16:58	16:18	16:39
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56 03:13-03:22/9	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:18	16:33	16:46	16:59	16:19	16:40
17	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:20	04:49	04:17	02:55 03:12-03:21/9	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	16:59	16:19	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:47	04:16	02:55 03:12-03:21/9	02:56
	16:49	16:33	16:06	16:35	16:13	16:09	16:19	16:34	16:46	17:00	16:20	16:41
19	03:17 03:34-03:38/4	03:40	03:55	05:09	05:25	05:38	05:37	05:18	04:46	04:15	02:55 03:12-03:21/9	02:56
	16:49	16:33	16:05	16:34	16:13	16:09	16:20	16:34	16:47	17:01	16:21	16:42
20	03:18 03:35-03:42/7	03:40	03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54 03:12-03:20/8	02:57
	16:48	16:32	16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01	16:22	16:42
21	03:19 03:36-03:44/8	03:41	03:56	05:10	05:26	05:38	05:37	05:16	04:44	04:13	02:54 03:11-03:19/8	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:22	16:43
22	03:19 03:37-03:45/8	03:42	03:56	05:11	05:26	05:39	05:36	05:16	04:43	04:12	02:54 03:11-03:18/7	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:43
23	03:20 03:37-03:46/9	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:53 03:11-03:15/4	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:48	17:03	16:24	16:44
24	03:21 03:38-03:47/9	03:43	03:57	05:12	05:27	05:39	05:36	05:14	04:41	04:10	02:53	02:59
	16:47	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03	16:25	16:44
25	03:22 03:39-03:48/9	03:43	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:27	15:59	16:28	16:11	16:10	16:23	16:37	16:49	16:04	16:25	16:45
26	03:22 03:40-03:49/9	03:44	03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:26	15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:05	16:26	16:45
27	03:23 03:40-03:48/8	03:45	03:59	05:13	05:29	05:39	05:34	05:11	04:38	03:08	02:53	03:00
	16:46	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24 03:41-03:49/8	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:36	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:11	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25 03:42-03:50/8		05:00	05:14	05:30	05:40	05:33	05:09	04:35	03:06	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:06	16:28	16:46
30	03:26 03:43-03:50/7		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06 03:22-03:23/1	02:53	03:02
	16:45		16:54	16:24	16:09	16:12	16:25	16:39	16:51	16:07	16:29	16:47
31	03:26 03:44-03:50/6		05:01		05:31		05:32	05:07		03:05 03:21-03:24/3		03:03
	16:45		16:53		16:09		16:26	16:39		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Sum of minutes with flicker	100	65	0	0	0	0	0	0	0	4	163	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 9 - T11

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January		February		March		April	May	June
1	03:04	14:03-15:35/92	03:27	14:05-15:52/107	03:46	14:57-15:40/43	05:01	05:15	05:31
	16:48	03:21-03:46/25	16:44	03:44-04:05/21	16:24	04:03-04:14/11	16:52	16:24	16:09
2	03:04	14:03-15:36/93	03:28	14:05-15:53/108	03:46	14:59-15:38/39	05:02	05:16	05:31
	16:48	03:22-03:47/25	16:44	03:45-04:05/20	16:23	04:04-04:16/12	16:51	16:23	16:09
3	03:05	14:04-15:37/93	03:29	14:05-15:53/108	03:47	15:03-15:37/34	05:02	05:16	05:32
	16:48	03:23-03:48/25	16:43	03:46-04:06/20	16:22	04:04-04:17/13	16:50	16:22	16:09
4	03:06	14:04-15:37/93	03:29	14:04-15:52/108	03:47	15:06-15:35/29	05:02	05:17	05:32
	16:48	03:23-03:48/25	16:43	03:47-04:07/20	16:21	04:05-04:18/13	16:49	16:21	16:09
5	03:06	14:04-15:38/94	03:30	14:05-15:53/108	03:48	15:09-15:33/24	05:03	05:17	05:33
	16:48	03:24-03:49/25	16:42	03:47-04:06/19	16:20	04:05-04:18/13	16:47	16:21	16:08
6	03:07	14:05-15:39/94	03:31	14:05-15:53/108	03:49	15:13-15:32/19	05:03	05:18	05:33
	16:49	03:25-03:50/25	16:42	03:48-04:06/18	16:19	04:06-04:19/13	16:46	16:20	16:08
7	03:08	14:04-15:39/95	03:32	14:05-15:53/108	03:49	15:15-15:29/14	05:04	05:18	05:34
	16:49	03:25-03:50/25	16:41	03:49-04:07/18	16:18	04:06-04:18/12	16:45	16:19	16:08
8	03:09	14:05-15:40/95	03:32	14:04-15:53/109	03:50	15:19-15:27/8	05:04	05:19	05:34
	16:49	03:26-03:51/25	16:41	03:49-04:06/17	16:17	04:07-04:19/12	16:44	16:19	16:08
9	03:09	14:05-15:41/96	03:33	14:05-15:53/108	03:50	15:21-15:24/3	05:05	05:19	05:34
	16:49	03:27-03:52/25	16:40	03:50-04:06/16	16:16	04:07-04:18/11	16:43	16:18	16:08
10	03:10	14:05-15:42/97	03:34	14:05-15:53/108	03:51	04:08-04:18/10	05:05	05:20	05:35
	16:49	03:28-03:53/25	16:39	03:51-04:05/14	16:15		16:42	16:18	16:08
11	03:11	14:05-15:41/96	03:34	14:05-15:53/108	03:51	04:08-04:16/8	05:06	05:20	05:35
	16:49	03:28-03:53/25	16:39	03:52-04:05/13	16:14		16:41	16:17	16:08
12	03:12	14:05-15:42/97	03:35	14:05-15:52/107	03:52	04:09-04:16/7	05:06	05:21	05:36
	16:49	03:29-03:54/25	16:38	03:52-04:03/11	16:13		16:40	16:16	16:08
13	03:12	14:05-15:43/98	03:36	14:05-15:52/107	03:52	04:09-04:14/5	05:07	05:21	05:36
	16:49	03:30-03:55/25	16:37	03:53-04:02/9	16:12		16:39	16:16	16:08
14	03:13	14:05-15:43/98	03:36	14:08-15:52/104	03:53	04:10-04:18/8	05:07	05:22	05:36
	16:49	03:31-03:56/25	16:36	03:54-04:01/7	16:11		16:38	16:15	16:09
15	03:14	14:05-15:44/99	03:37	14:11-15:51/100	03:53	04:10-04:20/10	05:07	05:22	05:37
	16:49	03:31-03:56/25	16:36	03:54-03:58/4	16:10		16:37	16:15	16:09
16	03:15	14:05-15:45/100	03:38	14:15-15:51/96	03:54	04:11-04:21/10	05:08	05:23	05:37
	16:49	03:32-03:56/24	16:35		16:09		16:37	16:14	16:09
17	03:15	14:06-15:46/100	03:38	14:18-15:51/93	03:54	04:11-04:22/11	05:08	05:24	05:37
	16:49	03:33-03:57/24	16:34		16:08		16:36	16:14	16:09
18	03:16	14:06-15:47/101	03:39	14:21-15:50/89	03:55	04:12-04:23/11	05:09	05:24	05:38
	16:49	03:34-03:58/24	16:33		16:07		16:35	16:13	16:09
19	03:17	14:05-15:47/102	03:40	14:25-15:50/85	03:55	04:12-04:22/10	05:09	05:25	05:38
	16:49	03:34-03:57/23	16:33		16:05		16:34	16:13	16:09
20	03:18	14:05-15:47/102	03:40	14:27-15:48/81	03:56	04:13-04:23/10	05:10	05:25	05:38
	16:48	03:35-03:58/23	16:32		16:04		16:33	16:12	16:09
21	03:19	14:06-15:48/102	03:41	14:31-15:48/77	03:56	04:13-04:22/9	05:10	05:26	05:38
	16:48	03:36-03:58/22	16:31		16:03		16:32	16:12	16:10
22	03:19	14:06-15:49/103	03:42	14:34-15:48/74	03:57	04:14-04:22/8	05:11	05:26	05:39
	16:48	03:37-03:59/22	16:30		16:02		16:31	16:12	16:10
23	03:20	14:05-15:49/104	03:42	14:37-15:46/69	03:57	04:14-04:21/7	05:11	05:27	05:39
	16:48	03:37-03:58/21	16:29		16:01		16:30	16:11	16:10
24	03:21	14:05-15:49/104	03:43	14:41-15:46/65	03:57	04:14-04:19/5	05:12	05:27	05:39
	16:47	03:38-03:58/20	16:28		16:00		16:29	16:11	16:10
25	03:22	14:05-15:50/105	03:43	14:44-15:45/61	03:58	04:15-04:18/3	05:12	05:28	05:39
	16:47	03:39-03:58/19	16:27		15:59		16:28	16:11	16:10
26	03:22	14:06-15:51/105	03:44	14:47-15:43/56	03:58	04:15-04:16/1	05:13	05:28	05:39
	16:47	03:40-03:59/19	16:27		15:58		16:28	16:10	16:11
27	03:23	14:05-15:50/105	03:45	14:51-15:43/52	03:59		05:13	05:29	05:39
	16:47	03:40-04:00/20	16:26		15:57		16:27	16:10	16:11
28	03:24	14:05-15:51/106	03:45	14:53-15:41/48	03:59		05:14	05:29	05:40
	16:46	03:41-04:01/20	16:25	04:05-04:10/5	15:56		16:26	16:10	16:11
29	03:25	14:05-15:52/107			05:00		05:14	05:30	05:40
	16:46	03:42-04:03/21			16:55		16:25	16:10	16:12
30	03:26	14:05-15:52/107			05:00		05:15	05:30	05:40
	16:45	03:43-04:04/21			16:54		16:24	16:09	16:12
31	03:26	14:05-15:52/107			05:01			05:31	
	16:45	03:44-04:05/21			16:53			16:09	
Potential sun hours	420		364		380		345	337	317
Sum of minutes with flicker		3809		2784		456	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 9 - T11

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	July	August	September	October	November	December
1	05:40	05:32	05:06	04:33 04:48-04:54/6	03:04 13:34-15:22/108	02:53 13:47-15:23/96
	16:12	16:26	16:40	16:52	16:08 03:20-03:35/15	16:30 03:10-03:35/25
2	05:40	05:31	05:05	04:32 04:47-04:55/8	03:03 13:34-15:22/108	02:53 13:47-15:24/97
	16:13	16:27	16:40	16:52	16:09 03:20-03:36/16	16:31 03:10-03:35/25
3	05:40	05:30	05:04	04:31 04:46-04:55/9	03:03 13:35-15:23/108	02:53 13:48-15:24/96
	16:13	16:27	16:41	16:53	16:10 03:19-03:36/17	16:31 03:11-03:36/25
4	05:40	05:30	05:03	04:30 16:00-16:01/1	03:02 13:34-15:22/108	02:53 13:50-15:25/95
	16:13	16:28	16:41	16:53 04:45-04:55/10	16:10 03:18-03:36/18	16:32 03:11-03:36/25
5	05:40	05:29	05:02	04:29 15:57-16:03/6	03:01 13:35-15:23/108	02:53 13:50-15:25/95
	16:14	16:28	16:41	16:54 04:44-04:55/11	16:11 03:18-03:36/18	16:33 03:11-03:36/25
6	05:40	05:28	05:01	04:28 15:53-16:05/12	03:01 13:35-15:23/108	02:53 13:51-15:25/94
	16:14	16:29	16:42	16:54 04:43-04:55/12	16:12 03:17-03:36/19	16:34 03:11-03:36/25
7	05:40	05:28	05:00	04:27 15:50-16:06/16	03:00 13:36-15:23/107	02:53 13:51-15:25/94
	16:15	16:29	16:42	16:55 04:42-04:55/13	16:12 03:17-03:37/20	16:34 03:11-03:36/25
8	05:40	05:27	04:58	04:26 15:46-16:08/22	03:00 13:35-15:23/108	02:53 13:52-15:25/93
	16:15	16:29	16:43	16:55 04:41-04:54/13	16:13 03:16-03:36/20	16:35 03:11-03:36/25
9	05:40	05:26	04:57	04:25 15:43-16:09/26	02:59 13:36-15:24/108	02:53 13:52-15:25/93
	16:15	16:30	16:43	16:55 04:40-04:53/13	16:14 03:16-03:36/20	16:36 03:11-03:36/25
10	05:39	05:26	04:56	04:24 15:39-16:11/32	02:58 13:36-15:23/107	02:53 13:52-15:25/93
	16:16	16:30	16:43	16:56 04:39-04:52/13	16:14 03:15-03:36/21	16:36 03:12-03:37/25
11	05:39	05:25	04:55	04:23 15:36-16:12/36	02:58 13:37-15:24/107	02:54 13:54-15:26/92
	16:16	16:31	16:44	16:56 04:38-04:51/13	16:15 03:15-03:36/21	16:37 03:12-03:37/25
12	05:39	05:24	04:54	04:22 15:32-16:13/41	02:57 13:36-15:23/107	02:54 13:54-15:26/92
	16:17	16:31	16:44	16:57 04:37-04:49/12	16:16 03:14-03:35/21	16:38 03:12-03:37/25
13	05:39	05:23	04:53	04:21 15:29-16:14/45	02:57 13:37-15:24/107	02:54 13:54-15:26/92
	16:17	16:32	16:45	16:57 04:36-04:46/10	16:17 03:14-03:35/21	16:38 03:12-03:36/24
14	05:39	05:22	04:52	04:20 15:25-16:14/49	02:56 13:37-15:23/106	02:55 13:56-15:27/91
	16:18	16:32	16:45	16:58	16:17 03:13-03:33/20	16:39 03:14-03:37/23
15	05:39	05:22	04:51	04:19 15:22-16:15/53	02:56 13:38-15:23/105	02:55 13:56-15:27/91
	16:18	16:33	16:45	16:58	16:18 03:13-03:33/20	16:39 03:14-03:37/23
16	05:38	05:21	04:50	04:18 15:18-16:16/58	02:56 13:39-15:24/105	02:55 13:56-15:27/91
	16:19	16:33	16:46	16:59	16:19 03:13-03:32/19	16:40 03:14-03:37/23
17	05:38	05:20	04:49	04:17 15:14-16:17/63	02:55 13:38-15:23/105	02:56 13:57-15:28/91
	16:19	16:34	16:46	16:59	16:19 03:12-03:31/19	16:41 03:16-03:38/22
18	05:38	05:19	04:47 05:03-05:06/3	04:16 15:11-16:17/66	02:55 13:39-15:23/104	02:56 13:58-15:28/90
	16:19	16:34	16:47	17:00	16:20 03:12-03:32/20	16:41 03:16-03:38/22
19	05:37	05:18	04:46 05:02-05:07/5	04:15 15:07-16:18/71	02:55 13:40-15:24/104	02:56 13:58-15:28/90
	16:20	16:34	16:47	17:01	16:21 03:12-03:33/21	16:42 03:16-03:38/22
20	05:37	05:17	04:45 05:00-05:06/6	04:14 15:04-16:18/74	02:54 13:41-15:24/103	02:57 13:59-15:29/90
	16:20	16:35	16:47	17:01	16:22 03:12-03:34/22	16:42 03:17-03:39/22
21	05:37	05:16	04:44 04:59-05:07/8	04:13 15:00-16:18/78	02:54 13:41-15:23/102	02:57 13:59-15:29/90
	16:21	16:35	16:48	17:02	16:22 03:11-03:33/22	16:43 03:17-03:39/22
22	05:36	05:16	04:43 04:58-05:07/9	04:12 14:57-16:20/83	02:54 13:41-15:23/102	02:58 14:00-15:30/90
	16:21	16:36	16:48	17:02	16:23 03:11-03:34/23	16:43 03:18-03:40/22
23	05:36	05:15	04:42 04:57-05:06/9	04:11 14:54-16:20/86	02:53 13:42-15:24/102	02:58 14:00-15:30/90
	16:22	16:36	16:49	17:03	16:24 03:11-03:34/23	16:44 03:18-03:40/22
24	05:36	05:14	04:41 04:56-05:06/10	04:10 14:50-16:20/90	02:53 13:43-15:24/101	02:59 14:01-15:31/90
	16:22	16:37	16:49	17:03	16:25 03:11-03:35/24	16:44 03:19-03:41/22
25	05:35	05:13	04:40 04:55-05:05/10	03:10 13:47-15:20/93	02:53 13:44-15:24/100	02:59 14:01-15:31/90
	16:23	16:37	16:49	16:04	16:25 03:11-03:35/24	16:45 03:19-03:41/22
26	05:35	05:12	04:39 04:54-05:05/11	03:09 13:43-15:20/97	02:53 13:44-15:24/100	03:00 14:01-15:32/91
	16:23	16:37	16:50	16:05	16:26 03:11-03:35/24	16:45 03:20-03:42/22
27	05:34	05:11	04:38 04:53-05:04/11	03:08 13:40-15:21/101	02:53 13:44-15:23/99	03:00 14:01-15:32/91
	16:24	16:38	16:50	16:05 03:24-03:29/5	16:27 03:11-03:36/25	16:46 03:20-03:42/22
28	05:34	05:10	04:36 04:51-05:01/10	03:07 13:37-15:21/104	02:53 13:45-15:23/98	03:01 14:02-15:33/91
	16:24	16:38	16:51	16:06 03:23-03:31/8	16:28 03:10-03:35/25	16:46 03:20-03:43/23
29	05:33	05:09	04:35 04:50-04:59/9	03:06 13:34-15:21/107	02:53 13:45-15:23/98	03:02 14:02-15:33/91
	16:25	16:39	16:51	16:06 03:22-03:32/10	16:28 03:10-03:35/25	16:46 03:21-03:44/23
30	05:33	05:08	04:34 04:49-04:56/7	03:06 13:34-15:21/107	02:53 13:46-15:23/97	03:02 14:03-15:34/91
	16:25	16:39	16:51	16:07 03:22-03:34/12	16:29 03:10-03:35/25	16:47 03:21-03:44/23
31	05:32	05:07		03:05 13:34-15:22/108		03:03 14:03-15:35/92
	16:26	16:39		16:08 03:21-03:34/13		16:47 03:21-03:45/24
Potential sun hours	331	348	358	393	401	425
Sum of minutes with flicker	0	0	108	1916	3758	3581

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 10 - T14

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March		April	May	June	July	August	September		October		Novembe	rDecember
1	03:04	03:27	03:46		05:01	05:15	05:31	05:40	05:31	05:06		04:33	04:48-05:02/14	03:04	02:52
	16:47	16:44	16:24		16:52	16:24	16:09	16:12	16:26	16:40		16:52		16:08	16:30
2	03:04	03:28	03:46		05:01	05:16	05:31	05:40	05:31	05:05		04:32	04:47-05:02/15	03:03	02:52
	16:48	16:44	16:23		16:51	16:23	16:09	16:13	16:27	16:40		16:52		16:09	16:31
3	03:05	03:29	03:47		05:02	05:16	05:32	05:40	05:30	05:04		04:31	04:46-05:01/15	03:03	02:52
	16:48	16:43	16:22		16:49	16:22	16:09	16:13	16:27	16:41		16:53		16:10	16:31
4	03:06	03:29	03:47		05:02	05:17	05:32	05:40	05:30	05:03		04:30	04:45-05:00/15	03:02	02:53
	16:48	16:43	16:21		16:48	16:21	16:08	16:13	16:28	16:41		16:53		16:10	16:32
5	03:06	03:30	03:48		05:03	05:17	05:33	05:40	05:29	05:02		04:29	04:44-04:59/15	03:01	02:53
	16:48	16:42	16:20		16:47	16:21	16:08	16:14	16:28	16:41		16:54		16:11	16:33
6	03:07	03:31	03:48	04:08-04:19/11	05:03	05:18	05:33	05:40	05:28	05:00		04:28	04:43-04:58/15	03:01	02:53
	16:49	16:42	16:19		16:46	16:20	16:08	16:14	16:28	16:42		16:54		16:12	16:33
7	03:08	03:31	03:49	04:06-04:21/15	05:04	05:18	05:34	05:40	05:28	04:59		04:27	04:43-04:56/13	03:00	02:53
	16:49	16:41	16:18		16:45	16:19	16:08	16:15	16:29	16:42		16:54		16:12	16:34
8	03:09	03:32	03:50	04:07-04:22/15	05:04	05:19	05:34	05:40	05:27	04:58		04:26	04:45-04:53/8	02:59	02:53
	16:49	16:40	16:17		16:44	16:19	16:08	16:15	16:29	16:43		16:55		16:13	16:35
9	03:09	03:33	03:50	04:07-04:23/16	05:05	05:19	05:34	05:40	05:26	04:57		04:25		02:59	02:53
	16:49	16:40	16:16		16:43	16:18	16:08	16:15	16:30	16:43		16:55		16:14	16:36
10	03:10	03:34	03:51	04:08-04:23/15	05:05	05:20	05:35	05:39	05:26	04:56		04:24		02:58	02:53
	16:49	16:39	16:15		16:42	16:17	16:08	16:16	16:30	16:43		16:56		16:14	16:36
11	03:11	03:34	03:51	04:08-04:23/15	05:06	05:20	05:35	05:39	05:25	04:55		04:23		02:58	02:54
	16:49	16:39	16:14		16:41	16:17	16:08	16:16	16:31	16:44		16:56		16:15	16:37
12	03:12	03:35	03:52	04:09-04:23/14	05:06	05:21	05:36	05:39	05:24	04:54		04:22		02:57	02:54
	16:49	16:38	16:13		16:40	16:16	16:08	16:17	16:31	16:44		16:57		16:16	16:38
13	03:12	03:36	03:52	04:09-04:22/13	05:06	05:21	05:36	05:39	05:23	04:53		04:21		02:57	02:54
	16:49	16:37	16:12		16:39	16:16	16:08	16:17	16:32	16:44		16:57		16:16	16:38
14	03:13	03:36	03:53	04:10-04:19/9	05:07	05:22	05:36	05:39	05:22	04:52		04:20		02:56	02:54
	16:49	16:36	16:11		16:38	16:15	16:08	16:18	16:32	16:45		16:58		16:17	16:39
15	03:14	03:37	03:53	04:10-04:15/5	05:07	05:22	05:37	05:38	05:22	04:51		04:19		02:56	02:55
	16:49	16:36	16:10		16:37	16:15	16:09	16:18	16:33	16:45		16:58		16:18	16:39
16	03:15	03:38	03:54	04:11-04:12/1	05:08	05:23	05:37	05:38	05:21	04:50		04:18		02:56	02:55
	16:49	16:35	16:09		16:36	16:14	16:09	16:18	16:33	16:46		16:59		16:19	16:40
17	03:15	03:38	03:54		05:08	05:23	05:37	05:38	05:20	04:49		04:17		02:55	02:55
	16:49	16:34	16:07		16:36	16:14	16:09	16:19	16:33	16:46		16:59		16:19	16:41
18	03:16	03:39	03:55		05:09	05:24	05:37	05:38	05:19	04:47		04:16		02:55	02:56
	16:49	16:33	16:06		16:35	16:13	16:09	16:19	16:34	16:46		17:00		16:20	16:41
19	03:17	03:40	03:55		05:09	05:24	05:38	05:37	05:18	04:46		04:15		02:54	02:56
	16:49	16:33	16:05		16:34	16:13	16:09	16:20	16:34	16:47		17:00		16:21	16:42
20	03:18	03:40	03:55		05:10	05:25	05:38	05:37	05:17	04:45		04:14		02:54	02:57
	16:48	16:32	16:04		16:33	16:12	16:09	16:20	16:35	16:47		17:01		16:22	16:42
21	03:18	03:41	03:56		05:10	05:26	05:38	05:37	05:16	04:44		04:13		02:54	02:57
	16:48	16:31	16:03		16:32	16:12	16:09	16:21	16:35	16:48		17:02		16:22	16:43
22	03:19	03:42	03:56		05:11	05:26	05:38	05:36	05:15	04:43		04:12		02:54	02:58
	16:48	16:30	16:02		16:31	16:12	16:10	16:21	16:36	16:48		17:02		16:23	16:43
23	03:20	03:42	03:57		05:11	05:27	05:39	05:36	05:15	04:42		04:11		02:53	02:58
	16:48	16:29	16:01		16:30	16:11	16:10	16:22	16:36	16:48		17:03		16:24	16:44
24	03:21	03:43	03:57		05:12	05:27	05:39	05:36	05:14	04:41		04:10		02:53	02:59
	16:47	16:28	16:00		16:29	16:11	16:10	16:22	16:36	16:49		17:03		16:25	16:44
25	03:22	03:43	03:58		05:12	05:28	05:39	05:35	05:13	04:40		03:10		02:53	02:59
	16:47	16:27	15:59		16:28	16:11	16:10	16:23	16:37	16:49		16:04		16:25	16:45
26	03:22	03:44	03:58		05:13	05:28	05:39	05:35	05:12	04:39		03:09		02:53	03:00
	16:47	16:26	15:58		16:28	16:10	16:11	16:23	16:37	16:50		16:04		16:26	16:45
27	03:23	03:45	03:59		05:13	05:29	05:39	05:34	05:11	04:37		03:08		02:53	03:00
	16:46	16:26	15:57		16:27	16:10	16:11	16:24	16:38	16:50		16:05		16:27	16:46
28	03:24	03:45	03:59		05:14	05:29	05:39	05:34	05:10	04:36	04:51-04:54/3	03:07		02:53	03:01
	16:46	16:25	15:56		16:26	16:10	16:11	16:24	16:38	16:51		16:06		16:28	16:46
29	03:25		05:00		05:14	05:30	05:40	05:33	05:09	04:35	04:50-04:57/7	03:06		02:53	03:02
	16:46		16:55		16:25	16:09	16:12	16:25	16:39	16:51		16:06		16:28	16:46
30	03:25		05:00		05:15	05:30	05:40	05:33	05:08	04:34	04:49-05:00/11	03:06		02:52	03:02
	16:45		16:54		16:24	16:09	16:12	16:25	16:39	16:51		16:07		16:29	16:47
31	03:26		05:01			05:30		05:32	05:07			03:05			03:03
	16:45		16:53			16:09		16:26	16:39			16:08			16:47
Potential sun hours	420	364	380		345	337	317	331	348	358		393		401	425
Sum of minutes with flicker	0	0		129	0	0	0	0	0		21		110	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 11 - T13

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:

The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March		April	May	June	July	August	September		October		Novembe	rDecember
1	03:04	03:27	03:46		05:01	05:15	05:31	05:40	05:32	05:06		04:33	04:54-05:03/9	03:04	02:52
	16:47	16:44	16:24		16:52	16:24	16:09	16:12	16:26	16:40		16:52		16:08	16:30
2	03:04	03:28	03:46		05:01	05:16	05:31	05:40	05:31	05:05		04:32	04:55-05:06/11	03:03	02:52
	16:48	16:44	16:23		16:51	16:23	16:09	16:13	16:27	16:40		16:52		16:09	16:31
3	03:05	03:29	03:47		05:02	05:16	05:32	05:40	05:30	05:04		04:31	04:56-05:09/13	03:03	02:53
	16:48	16:43	16:22		16:50	16:22	16:09	16:13	16:27	16:41		16:53		16:10	16:31
4	03:06	03:29	03:47		05:02	05:17	05:32	05:40	05:30	05:03		04:30	04:57-05:12/15	03:02	02:53
	16:48	16:43	16:21		16:48	16:21	16:09	16:13	16:28	16:41		16:53		16:10	16:32
5	03:06	03:30	03:48		05:03	05:17	05:33	05:40	05:29	05:02		04:29	04:58-05:15/17	03:01	02:53
	16:48	16:42	16:20		16:47	16:21	16:08	16:14	16:28	16:41		16:54		16:11	16:33
6	03:07	03:31	03:48	04:29-04:39/10	05:03	05:18	05:33	05:40	05:28	05:01		04:28	05:00-05:18/18	03:01	02:53
	16:49	16:42	16:19		16:46	16:20	16:08	16:14	16:28	16:42		16:54		16:12	16:33
7	03:08	03:32	03:49	04:24-04:42/18	05:04	05:18	05:34	05:40	05:28	04:59		04:27	05:02-05:17/15	03:00	02:53
	16:49	16:41	16:18		16:45	16:19	16:08	16:15	16:29	16:42		16:55		16:12	16:34
8	03:09	03:32	03:50	04:22-04:40/18	05:04	05:19	05:34	05:40	05:27	04:58		04:26	05:09-05:10/1	03:00	02:53
	16:49	16:41	16:17		16:44	16:19	16:08	16:15	16:29	16:43		16:55		16:13	16:35
9	03:09	03:33	03:50	04:20-04:36/16	05:05	05:19	05:34	05:40	05:26	04:57		04:25		02:59	02:53
	16:49	16:40	16:16		16:43	16:18	16:08	16:15	16:30	16:43		16:55		16:14	16:36
10	03:10	03:34	03:51	04:18-04:33/15	05:05	05:20	05:35	05:39	05:26	04:56		04:24		02:58	02:53
	16:49	16:39	16:15		16:42	16:17	16:08	16:16	16:30	16:43		16:56		16:14	16:36
11	03:11	03:34	03:51	04:17-04:29/12	05:06	05:20	05:35	05:39	05:25	04:55		04:23		02:58	02:54
	16:49	16:39	16:14		16:41	16:17	16:08	16:16	16:31	16:44		16:56		16:15	16:37
12	03:12	03:35	03:52	04:16-04:26/10	05:06	05:21	05:36	05:39	05:24	04:54		04:22		02:57	02:54
	16:49	16:38	16:13		16:40	16:16	16:08	16:17	16:31	16:44		16:57		16:16	16:38
13	03:12	03:36	03:52	04:14-04:22/8	05:07	05:21	05:36	05:39	05:23	04:53		04:21		02:57	02:54
	16:49	16:37	16:12		16:39	16:16	16:08	16:17	16:32	16:45		16:57		16:16	16:38
14	03:13	03:36	03:53	04:14-04:19/5	05:07	05:22	05:36	05:39	05:22	04:52		04:20		02:56	02:54
	16:49	16:36	16:11		16:38	16:15	16:08	16:18	16:32	16:45		16:58		16:17	16:39
15	03:14	03:37	03:53	04:13-04:15/2	05:07	05:22	05:37	05:39	05:22	04:51		04:19		02:56	02:55
	16:49	16:36	16:10		16:37	16:15	16:09	16:18	16:33	16:45		16:58		16:18	16:39
16	03:15	03:38	03:54		05:08	05:23	05:37	05:38	05:21	04:50		04:18		02:56	02:55
	16:49	16:35	16:09		16:36	16:14	16:09	16:18	16:33	16:46		16:59		16:19	16:40
17	03:15	03:38	03:54		05:08	05:23	05:37	05:38	05:20	04:49		04:17		02:55	02:55
	16:49	16:34	16:08		16:36	16:14	16:09	16:19	16:34	16:46		16:59		16:19	16:41
18	03:16	03:39	03:55		05:09	05:24	05:37	05:38	05:19	04:47		04:16		02:55	02:56
	16:49	16:33	16:06		16:35	16:13	16:09	16:19	16:34	16:46		17:00		16:20	16:41
19	03:17	03:40	03:55		05:09	05:25	05:38	05:37	05:18	04:46		04:15		02:55	02:56
	16:49	16:33	16:05		16:34	16:13	16:09	16:20	16:34	16:47		17:01		16:21	16:42
20	03:18	03:40	03:56		05:10	05:25	05:38	05:37	05:17	04:45		04:14		02:54	02:57
	16:48	16:32	16:04		16:33	16:12	16:09	16:20	16:35	16:47		17:01		16:22	16:42
21	03:19	03:41	03:56		05:10	05:26	05:38	05:37	05:16	04:44		04:13		02:54	02:57
	16:48	16:31	16:03		16:32	16:12	16:10	16:21	16:35	16:48		17:02		16:22	16:43
22	03:19	03:42	03:56		05:11	05:26	05:38	05:36	05:15	04:43		04:12		02:54	02:58
	16:48	16:30	16:02		16:31	16:12	16:10	16:21	16:36	16:48		17:02		16:23	16:43
23	03:20	03:42	03:57		05:11	05:27	05:39	05:36	05:15	04:42		04:11		02:53	02:58
	16:48	16:29	16:01		16:30	16:11	16:10	16:22	16:36	16:48		17:03		16:24	16:44
24	03:21	03:43	03:57		05:12	05:27	05:39	05:36	05:14	04:41		04:10		02:53	02:59
	16:47	16:28	16:00		16:29	16:11	16:10	16:22	16:37	16:49		17:03		16:25	16:44
25	03:22	03:43	03:58		05:12	05:28	05:39	05:35	05:13	04:40		03:10		02:53	02:59
	16:47	16:27	15:59		16:28	16:11	16:10	16:23	16:37	16:49		16:04		16:25	16:45
26	03:22	03:44	03:58		05:13	05:28	05:39	05:35	05:12	04:39		03:09		02:53	03:00
	16:47	16:26	15:58		16:28	16:10	16:11	16:23	16:37	16:50		16:05		16:26	16:45
27	03:23	03:45	03:59		05:13	05:29	05:39	05:34	05:11	04:38		03:08		02:53	03:00
	16:46	16:26	15:57		16:27	16:10	16:11	16:24	16:38	16:50		16:05		16:27	16:46
28	03:24	03:45	03:59		05:14	05:29	05:39	05:34	05:10	04:36	04:53-04:54/1	03:07		02:53	03:01
	16:46	16:25	15:56		16:26	16:10	16:11	16:24	16:38	16:51		16:06		16:28	16:46
29	03:25		05:00		05:14	05:30	05:40	05:33	05:09	04:35	04:54-04:57/3	03:06		02:53	03:02
	16:46		16:55		16:25	16:09	16:12	16:25	16:39	16:51		16:06		16:28	16:46
30	03:26		05:00		05:15	05:30	05:40	05:33	05:08	04:34	04:54-05:00/6	03:06		02:53	03:02
	16:45		16:54		16:24	16:09	16:12	16:25	16:39	16:51		16:07		16:29	16:47
31	03:26		05:01			05:30		05:32	05:07			03:05			03:03
	16:45		16:53			16:09		16:26	16:39			16:08			16:47
Potential sun hours	420	364	380		345	337	317	331	348	358		393		401	425
Sum of minutes with flicker	0	0		114	0	0	0	0	0		10		99	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

SHADOW - Calendar per WTG

WTG: 12 - T15

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:31	05:06	04:33	03:04	02:52
	16:47	16:44	16:24	16:52	16:24	16:09	16:12	16:26	16:40	16:52	16:08	16:30
2	03:04	03:28	03:46	05:01	05:16	05:31	05:40	05:31	05:05	04:32	03:03	02:52
	16:48	16:44	16:23	16:50	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31	03:03	02:52
	16:48	16:43	16:22	16:49	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:31
4	03:06	03:29	03:47	05:02	05:17	05:32	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:48	16:21	16:08	16:13	16:27	16:41	16:53	16:10	16:32
5	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:01	02:53
	16:48	16:42	16:20	16:47	16:21	16:08	16:14	16:28	16:41	16:54	16:11	16:33
6	03:07	03:31	03:48	05:03	05:18	05:33	05:40	05:28	05:00	04:28	03:01	02:53
	16:49	16:42	16:19	16:46	16:20	16:08	16:14	16:28	16:42	16:54	16:12	16:33
7	03:08	03:31	03:49	05:04	05:18	05:34	05:40	05:28	04:59	04:27	03:00	02:53
	16:49	16:41	16:18	16:45	16:19	16:08	16:15	16:29	16:42	16:54	16:12	16:34
8	03:08	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:58	04:26	02:59	02:53
	16:49	16:40	16:17	16:44	16:19	16:08	16:15	16:29	16:43	16:55	16:13	16:35
9	03:09	03:33	03:50	05:05	05:19	05:34	05:39	05:26	04:57	04:25	02:59	02:53
	16:49	16:40	16:16	16:43	16:18	16:08	16:15	16:30	16:43	16:55	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:39	05:25	04:56	04:24	02:58	02:53
	16:49	16:39	16:15	16:42	16:17	16:08	16:16	16:30	16:43	16:56	16:14	16:36
11	03:11	03:34	03:51	05:06	05:20	05:35	05:39	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:41	16:17	16:08	16:16	16:31	16:44	16:56	16:15	16:37
12	03:11	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:57	02:54
	16:49	16:38	16:13	16:40	16:16	16:08	16:17	16:31	16:44	16:57	16:16	16:38
13	03:12	03:36	03:52	05:06	05:21	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:39	16:16	16:08	16:17	16:32	16:44	16:57	16:16	16:38
14	03:13	03:36	03:53	05:07	05:22	05:36	05:39	05:22	04:52	04:20	02:56	02:54
	16:49	16:36	16:11	16:38	16:15	16:08	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:07	05:22	05:37	05:38	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:37	16:15	16:09	16:18	16:33	16:45	16:58	16:18	16:39
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:36	16:14	16:09	16:18	16:33	16:46	16:59	16:19	16:40
17	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:20	04:49	04:17	02:55	02:55
	16:49	16:34	16:07	16:35	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:41
18	03:16	03:39	03:55	05:09	05:24	05:37	05:38	05:19	04:47	04:16	02:55	02:56
	16:49	16:33	16:06	16:35	16:13	16:09	16:19	16:34	16:46	17:00	16:20	16:41
19	03:17	03:40	03:55	05:09	05:24	05:38	05:37	05:18	04:46	04:15	02:54	02:56
	16:49	16:32	16:05	16:34	16:13	16:09	16:20	16:34	16:47	17:00	16:21	16:42
20	03:18	03:40	03:55	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54	02:57
	16:48	16:32	16:04	16:33	16:12	16:09	16:20	16:35	16:47	17:01	16:22	16:42
21	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:16	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:09	16:21	16:35	16:48	17:02	16:22	16:43
22	03:19	03:42	03:56	05:11	05:26	05:38	05:36	05:15	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:43
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:53	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:48	17:03	16:24	16:44
24	03:21	03:43	03:57	05:12	05:27	05:39	05:35	05:14	04:41	04:10	02:53	02:59
	16:47	16:28	16:00	16:29	16:11	16:10	16:22	16:36	16:49	17:03	16:25	16:44
25	03:22	03:43	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:09	02:53	02:59
	16:47	16:27	15:59	16:28	16:11	16:10	16:23	16:37	16:49	16:04	16:25	16:45
26	03:22	03:44	03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:26	15:58	16:28	16:10	16:11	16:23	16:37	16:50	16:04	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:39	05:34	05:11	04:37	03:08	02:53	03:00
	16:46	16:25	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:39	05:34	05:10	04:36	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:11	16:24	16:38	16:50	16:06	16:28	16:46
29	03:25		05:00	05:14	05:29	05:40	05:33	05:09	04:35	03:06	02:53	03:01
	16:46		16:55	16:25	16:09	16:12	16:25	16:39	16:51	16:06	16:28	16:46
30	03:25		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:05	02:52	03:02
	16:45		16:54	16:24	16:09	16:12	16:25	16:39	16:51	16:07	16:29	16:47
31	03:26		05:01		05:30		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:39		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt
Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 13 - T3

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:43	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:20	05:35	05:40	05:26	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:39	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:09	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:18	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:43
21	03:19	03:41	03:56	05:10	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:45
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:49	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:45		16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Calendar per WTG

WTG: 14 - T4

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:47	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:31	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:32
4	03:06	03:30	03:48	05:03	05:17	05:33	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:42	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:04	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:09	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:19	05:35	05:40	05:26	04:58	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:39	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:09	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
14	03:13	03:37	03:53	05:07	05:22	05:36	05:39	05:23	04:52	04:20	02:57	02:55
	16:49	16:37	16:11	16:39	16:15	16:09	16:18	16:32	16:45	16:58	16:17	16:39
15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
	16:49	16:36	16:10	16:38	16:15	16:09	16:18	16:33	16:46	16:59	16:18	16:40
16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:42
21	03:19	03:41	03:56	05:10	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:22	16:36	16:48	17:02	16:23	16:44
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:04	16:25	16:44
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:49	16:04	16:26	16:45
26	03:23	03:44	03:59	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:11	16:11	16:23	16:38	16:50	16:05	16:26	16:45
27	03:23	03:45	03:59	05:13	05:29	05:40	05:34	05:11	04:38	03:08	02:53	03:01
	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:45		16:54	16:25	16:10	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

SHADOW - Calendar per WTG

WTG: 15 - T5

Assumptions for shadow calculations

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	Septembe	rOctober	Novembe	rDecember
1	03:04	03:27	03:46	05:01	05:15	05:31	05:40	05:32	05:06	04:33	03:04	02:53
	16:48	16:45	16:24	16:52	16:24	16:09	16:13	16:26	16:40	16:52	16:08	16:30
2	03:05	03:28	03:46	05:02	05:16	05:32	05:40	05:31	05:05	04:32	03:04	02:53
	16:48	16:44	16:23	16:51	16:23	16:09	16:13	16:27	16:40	16:52	16:09	16:31
3	03:05	03:29	03:47	05:02	05:16	05:32	05:40	05:30	05:04	04:31	03:03	02:53
	16:48	16:44	16:22	16:50	16:22	16:09	16:13	16:27	16:41	16:53	16:10	16:31
4	03:06	03:30	03:48	05:03	05:17	05:32	05:40	05:30	05:03	04:30	03:02	02:53
	16:48	16:43	16:21	16:49	16:22	16:09	16:14	16:28	16:41	16:53	16:10	16:32
5	03:07	03:30	03:48	05:03	05:17	05:33	05:40	05:29	05:02	04:29	03:02	02:53
	16:49	16:42	16:20	16:48	16:21	16:09	16:14	16:28	16:42	16:54	16:11	16:33
6	03:07	03:31	03:49	05:03	05:18	05:33	05:40	05:29	05:01	04:28	03:01	02:53
	16:49	16:42	16:19	16:47	16:20	16:09	16:14	16:29	16:42	16:54	16:12	16:34
7	03:08	03:32	03:49	05:04	05:18	05:34	05:40	05:28	05:00	04:27	03:00	02:53
	16:49	16:41	16:18	16:46	16:20	16:09	16:15	16:29	16:42	16:55	16:12	16:34
8	03:09	03:32	03:50	05:04	05:19	05:34	05:40	05:27	04:59	04:26	03:00	02:53
	16:49	16:41	16:17	16:45	16:19	16:08	16:15	16:30	16:43	16:55	16:13	16:35
9	03:10	03:33	03:50	05:05	05:19	05:35	05:40	05:26	04:57	04:25	02:59	02:53
	16:49	16:40	16:16	16:44	16:18	16:08	16:16	16:30	16:43	16:56	16:14	16:36
10	03:10	03:34	03:51	05:05	05:20	05:35	05:40	05:26	04:56	04:24	02:59	02:54
	16:49	16:39	16:15	16:43	16:18	16:08	16:16	16:31	16:44	16:56	16:15	16:36
11	03:11	03:35	03:51	05:06	05:21	05:35	05:39	05:25	04:55	04:23	02:58	02:54
	16:49	16:39	16:14	16:42	16:17	16:08	16:16	16:31	16:44	16:57	16:15	16:37
12	03:12	03:35	03:52	05:06	05:21	05:36	05:39	05:24	04:54	04:22	02:58	02:54
	16:49	16:38	16:13	16:41	16:17	16:09	16:17	16:31	16:44	16:57	16:16	16:38
13	03:13	03:36	03:52	05:07	05:22	05:36	05:39	05:23	04:53	04:21	02:57	02:54
	16:49	16:37	16:12	16:40	16:16	16:09	16:17	16:32	16:45	16:58	16:17	16:38
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15	03:14	03:37	03:53	05:08	05:23	05:37	05:39	05:22	04:51	04:19	02:56	02:55
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16	03:15	03:38	03:54	05:08	05:23	05:37	05:38	05:21	04:50	04:18	02:56	02:55
	16:49	16:35	16:09	16:37	16:14	16:09	16:19	16:33	16:46	16:59	16:19	16:40
17	03:16	03:39	03:54	05:09	05:24	05:37	05:38	05:20	04:49	04:17	02:55	02:56
	16:49	16:34	16:08	16:36	16:14	16:09	16:19	16:34	16:46	17:00	16:20	16:41
18	03:16	03:39	03:55	05:09	05:24	05:38	05:38	05:19	04:48	04:16	02:55	02:56
	16:49	16:34	16:07	16:35	16:13	16:09	16:20	16:34	16:47	17:00	16:20	16:41
19	03:17	03:40	03:55	05:10	05:25	05:38	05:38	05:18	04:47	04:15	02:55	02:57
	16:49	16:33	16:06	16:34	16:13	16:09	16:20	16:35	16:47	17:01	16:21	16:42
20	03:18	03:41	03:56	05:10	05:25	05:38	05:37	05:17	04:45	04:14	02:54	02:57
	16:49	16:32	16:05	16:33	16:13	16:10	16:21	16:35	16:47	17:01	16:22	16:42
21	03:19	03:41	03:56	05:10	05:26	05:38	05:37	05:17	04:44	04:13	02:54	02:57
	16:48	16:31	16:03	16:32	16:12	16:10	16:21	16:35	16:48	17:02	16:23	16:43
22	03:20	03:42	03:57	05:11	05:26	05:39	05:37	05:16	04:43	04:12	02:54	02:58
	16:48	16:30	16:02	16:31	16:12	16:10	16:21	16:36	16:48	17:02	16:23	16:43
23	03:20	03:42	03:57	05:11	05:27	05:39	05:36	05:15	04:42	04:11	02:54	02:58
	16:48	16:29	16:01	16:30	16:11	16:10	16:22	16:36	16:49	17:03	16:24	16:44
24	03:21	03:43	03:58	05:12	05:27	05:39	05:36	05:14	04:41	04:11	02:53	02:59
	16:48	16:28	16:00	16:29	16:11	16:10	16:22	16:37	16:49	17:03	16:25	16:44
25	03:22	03:44	03:58	05:12	05:28	05:39	05:35	05:13	04:40	03:10	02:53	02:59
	16:47	16:28	15:59	16:29	16:11	16:11	16:23	16:37	16:49	16:04	16:26	16:45
26	03:23	03:44	03:58	05:13	05:28	05:39	05:35	05:12	04:39	03:09	02:53	03:00
	16:47	16:27	15:58	16:28	16:10	16:11	16:23	16:38	16:50	16:05	16:26	16:45
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	16:47	16:26	15:57	16:27	16:10	16:11	16:24	16:38	16:50	16:05	16:27	16:46
28	03:24	03:45	03:59	05:14	05:29	05:40	05:34	05:10	04:37	03:07	02:53	03:01
	16:46	16:25	15:56	16:26	16:10	16:12	16:24	16:38	16:51	16:06	16:28	16:46
29	03:25		05:00	05:14	05:30	05:40	05:33	05:09	04:36	03:07	02:53	03:02
	16:46		16:55	16:25	16:10	16:12	16:25	16:39	16:51	16:07	16:29	16:47
30	03:26		05:00	05:15	05:30	05:40	05:33	05:08	04:34	03:06	02:53	03:02
	16:45		16:54	16:25	16:09	16:12	16:25	16:39	16:52	16:07	16:29	16:47
31	03:27		05:01		05:31		05:32	05:07		03:05		03:03
	16:45		16:53		16:09		16:26	16:40		16:08		16:47
Potential sun hours	420	364	380	345	337	317	331	348	358	393	401	425
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

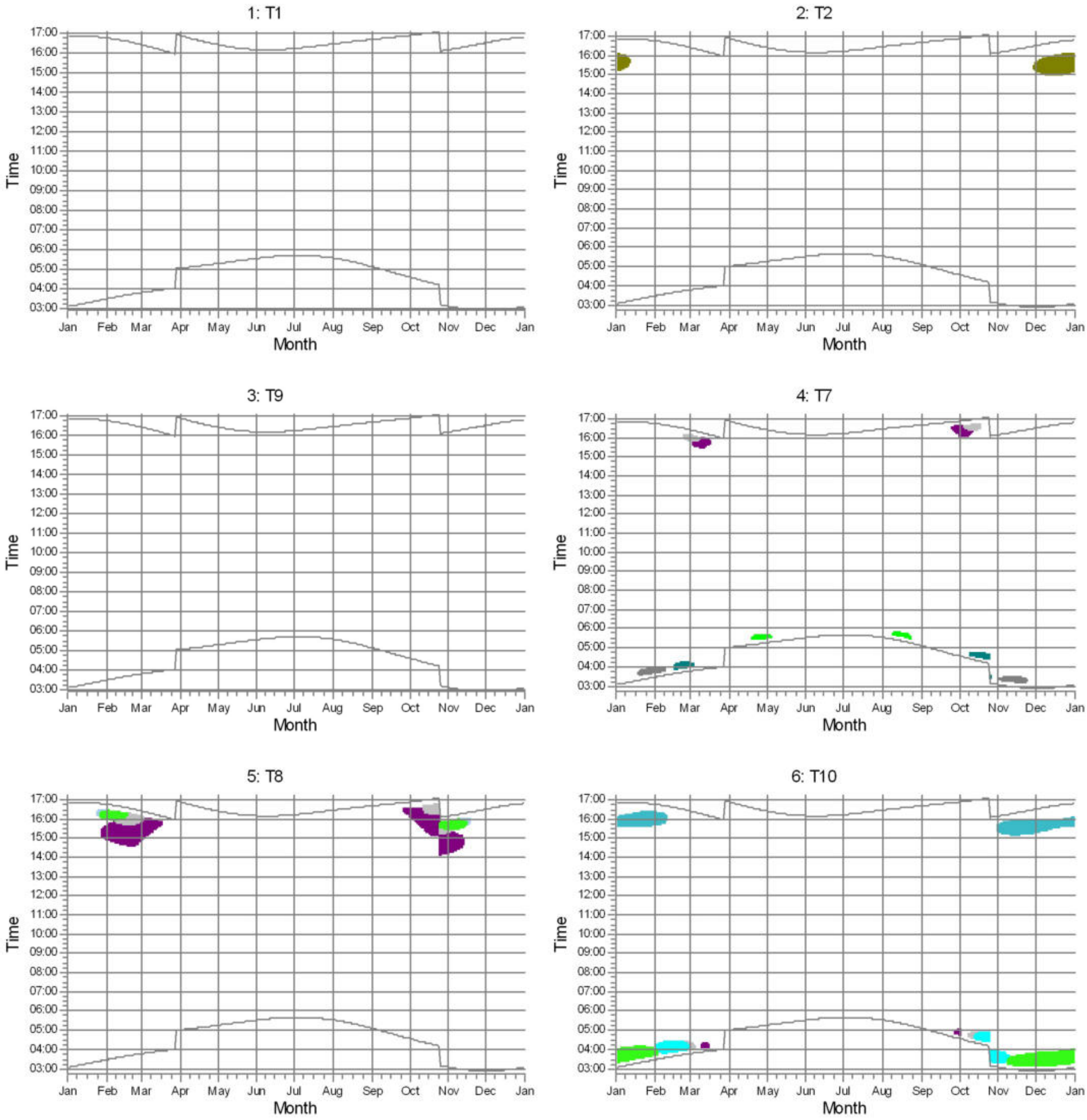
Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

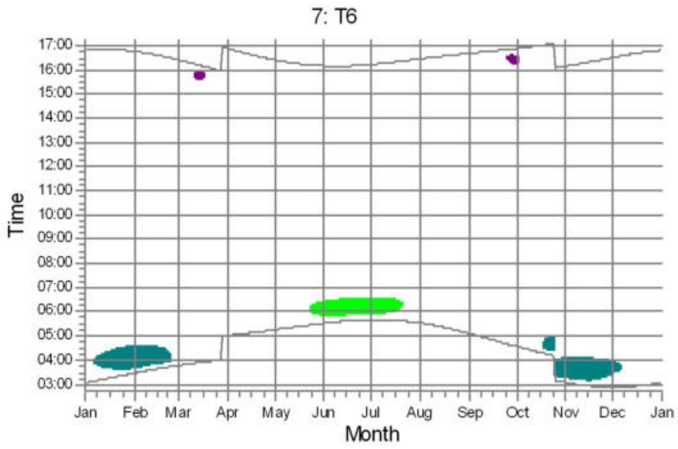
SHADOW - Calendar per WTG, graphical

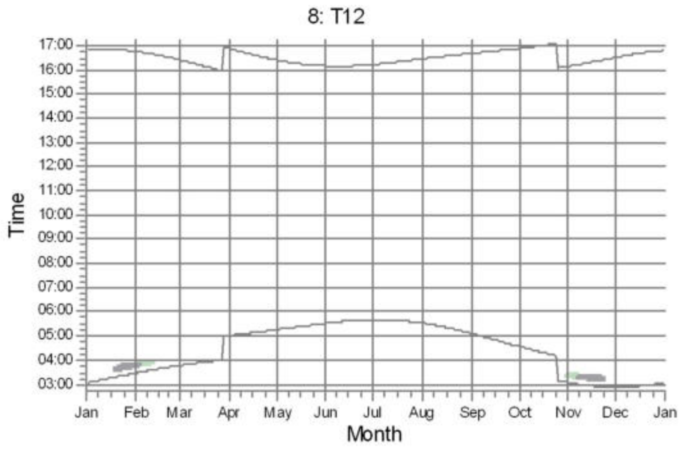


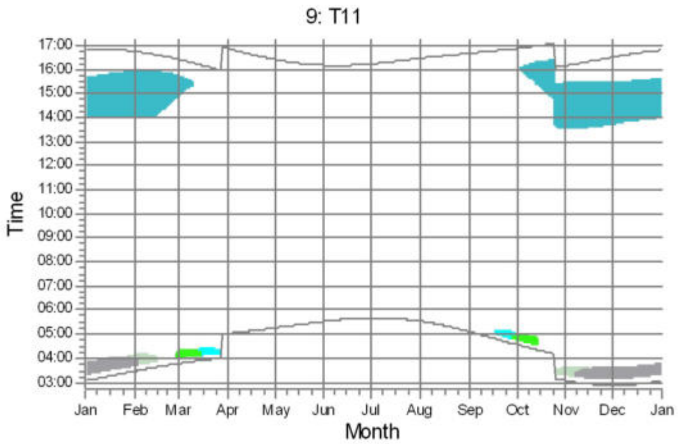
Shadow receptors

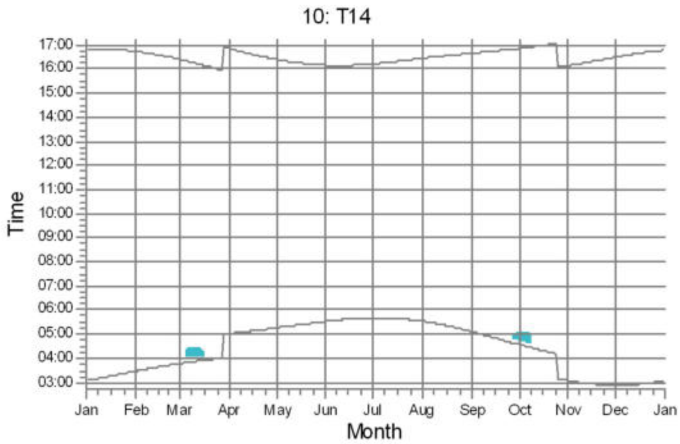
D: R5	I: R13	K: R21	M: R24	R: R35
F: R7	J: R18	L: R23	O: R25	S: R34

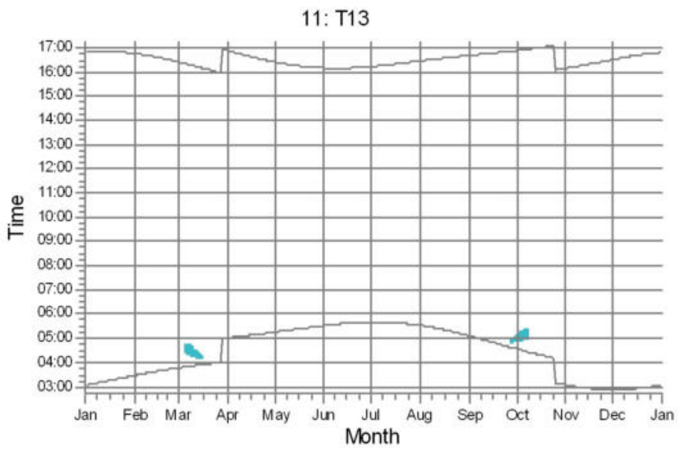
SHADOW - Calendar per WTG, graphical

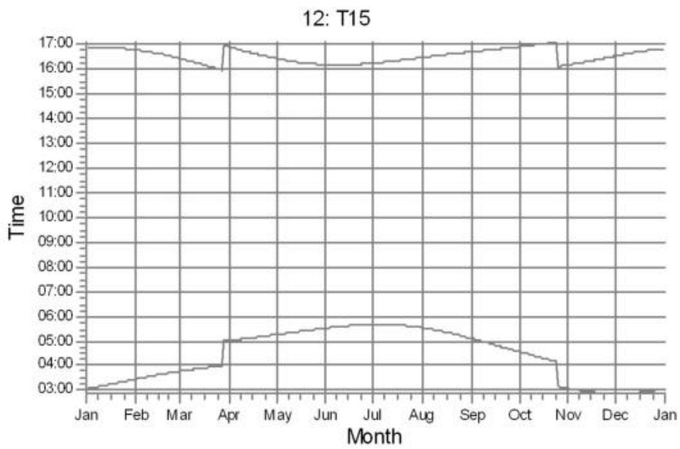










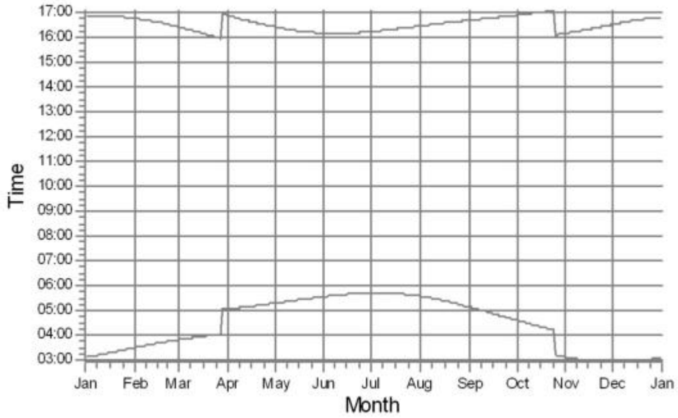


Shadow receptors

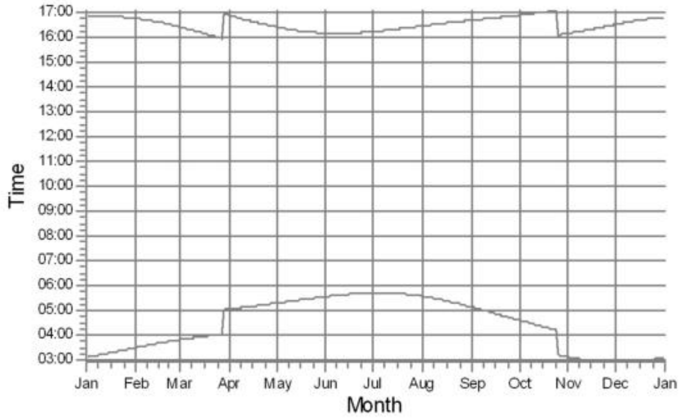
F: R7
I: R13
K: R21
L: R23
M: R24
N: R26
P: R27
R: R35
S: R34

SHADOW - Calendar per WTG, graphical

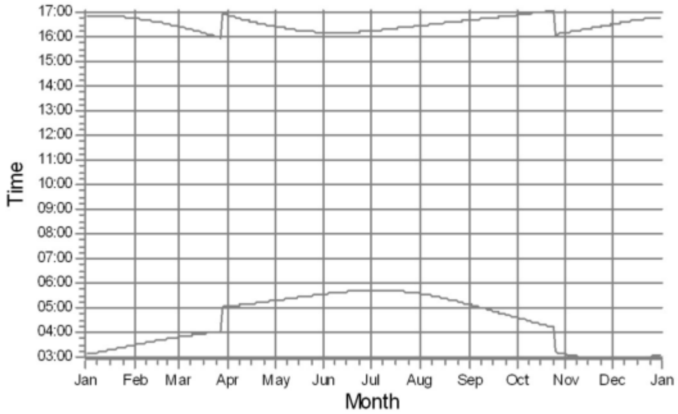
13: T3



14: T4



15: T5



Shadow receptors

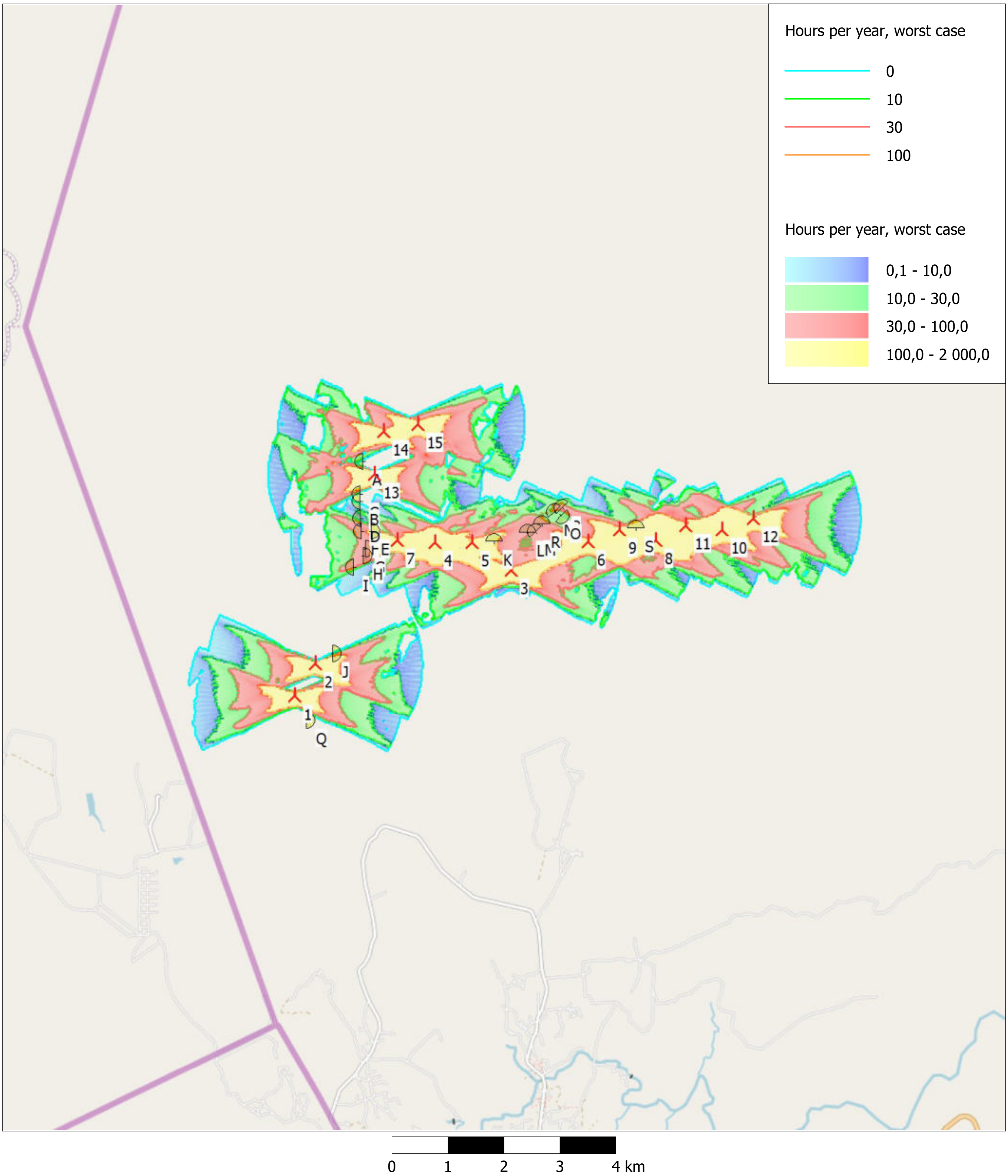
Project:
Namaacha_20_11_12

Description:
Worst case scenario

Licensed user:
Matos, Fonseca & associados
MORADA Estdª de Polima, 673, Moradia 1ºand. Parque Indust. Meramar I
PT-2785 Abóboda
214531969
António Marques / amarques@mfassociados.pt

Calculated:
19/11/2020 16:47/3.3.261

SHADOW - Map



Map: EMD OpenStreetMap , Print scale 1:100 000, Map center Geo WGS84 East: 32°00'53,89" E North: -25°52'49,73" N

New WTG Shadow receptor

Flicker map level: Elevation Grid Data Object: Namaacha_1_EMDGrid_0.wpg (1)

Annex 5

PUBLIC CONSULTATION REPORT

REPORT – 1st PUBLIC CONSULTATION

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

Environmental Pre-feasibility and Scoping Study for the Namacha Power Plant

1st Public Consultation Report

Central Eléctrica da Namaacha, SA

February, 2019

CONTENTS

1 INTRODUCTION

This document consists of the Public Consultation Report for the Environmental Pre-feasibility and Scoping Study of the Namaacha Power Plant Project, to be located in Maputo province, Namaacha district, in accordance with the procedure established in the Regulation on the Environmental Impact Assessment Process, approved by Decree No. 54/2015, of 31 December.

The Project Developer of the Namaacha Power Plant is Central Eléctrica da Namaacha, S.A.

Central Eléctrica da Namaacha, S.A. is owned by Globeleq Africa Ltd (Globeleq) (formerly Globeleq Advisors Limited) in partnership with Source Capital, SA (Source Capital).

Source Capital, founded in 2015, is an investment management and private equity services provider focused on Real Estate, Energy and Private Equity in general, acquiring and managing assets across Lusophone Africa, namely Mozambique, Angola and South Africa and in Portugal.

Globeleq, founded in 2002, is a company with extensive experience in the development and implementation of power projects in Africa. It currently has operational assets in Tanzania, Ivory Coast, South Africa, Cameroon and Kenya. Jointly owned by CDC Group PLC (70%) and Norfund (30%) (UK and Norwegian development finance institutions), Globeleq is focused exclusively on Africa and has expertise in the development and operation of wind, solar, oil and natural gas power generation and continues to develop renewable and conventional projects across the continent. As a responsible company, Globeleq develops projects in accordance with the International Finance Corporation (IFC) Performance Standards and the World Bank's Environment, Health and Safety (EHS) Guidelines.

In order to prepare all the necessary documentation for the Environmental Impact Assessment (EIA) process, Central Eléctrica da Namaacha, S.A. hired Matos, Fonseca & Associados, Moçambique, Estudos e Projectos, Lda., a limited liability company, based in Maputo, Mozambique, founded in 2012 (registered with MICOA, now Ministry of Land, Environment and Rural Development - MITADER - under No. 05/2019).

The Namaacha Power Plant Project has been classified as a Category A activity by MITADER, through the Maputo Provincial Directorate of Land, Environment and Rural Development, which requires the Environmental Impact Assessment (EIA) process. This classification implies the obligation to carry out a Public Consultation Process (PP).

This legal requirement is under the Regulation of the Environmental Impact Assessment Process (Decree 45/2004 of 29 September). The Public Consultation (PC) is an integral part of the EIA process for projects classified as Category A, as stipulated in the aforementioned Decree Law 54/2015 of 31 December, in Article 10(2), paragraph i), which indicates that it must be done in accordance with the stipulations of Article 15(9).

The Environmental Impact Assessment (EIA) for this project is also carried out under the terms of the Environmental Law (Law no. 20/97 of 1 October). This Law is intended to enforce the Constitution through Article 135(1) of the country which gives every Citizen the right to live in a balanced environment as well as the right to defend it. Thus, in the Definitions Article 1(1), point 1, activity is any public or private initiative action related to the use or exploitation of environmental components, the application of technologies or production processes, plans, programmes, legislative or regulatory acts which affects or may affect the environment.

The implementation area of the Namaacha Power Plant Project is located in the District of Namaacha, which is bordered to the west by Swatini and South Africa, to the east by the district of Boane, and to the south/southeast by the district of Matutíne and to the north by the district of Moamba. The Project does not intersect any protected area or environmental reserve. This report is intended to provide details of the Public Consultation held at the local level (Namaacha District), involving the Interested and Affected Parties (I&AP), at the time represented by the various State bodies, District Government, as well as representatives of local communities and individuals directly or indirectly affected

2 PUBLIC PARTICIPATION PROCESS

2.1 OBJECTIVES OF THE PUBLIC CONSULTATION

This process aims to disseminate information about the Project and the studies carried out by the experts involved in the EIA process to the Interested and Affected Parties (I&AP) during the environmental assessment of the Project. It also aims to identify and understand the concerns of the Interested and Affected Parties (I&AP) on how the Project will be developed and how it may affect their lives. It also aims to provide information on how the entire Environmental Impact Assessment process will be developed. It is also the aim of this Public Consultation to record all concerns, questions and answers, as well as suggestions or comments, that are raised, and these will be duly submitted for analysis by the assessor.

2.2 PUBLIC PARTICIPATION PROCESS

This section outlines the Methodology followed to carry out the Public Consultation. Copies of all the documents relating to this process are attached, namely the list identifying the Interested and Affected Parties (I&AP), invitation letter templates, the notice published in a national newspaper, the questions and answers asked at the time of the consultation, the suggestions or comments made by the Interested and Affected Parties (I&AP), as well as the participants' registration lists (see Annex II).

As for the Methodology used in this Public Consultation Process and in order to fulfil the objectives described in point 2.1, it was as follows:

- ❑ Identification of Interested and Affected Parties (I&AP)
- ❑ Information Dissemination and I&APs' engagement
- ❑ Collection and Recording of I&AP inputs
- ❑ Preparation of the Public Participation Process Report

2.3 INFORMATION DISSEMINATION

In order to carry out this Public Consultation on the EPDA Report, all the identified PI&As were contacted between one month and fifteen days before the Consultation, as well as the National Directorate of Environment and the Provincial Directorate of Land, Environment and Rural Development of Maputo. For the IP&A, as well as for the two directorates, letters of invitation were sent, which were delivered by hand, and "draft" of the EPDA, in Portuguese, were made available.

The notice of the Consultation was also published in the Jornal de Notícias, fifteen days before the Consultation, as required by Decree 54/2015, in article 15, point 7. The notice includes, in addition to the news of the holding of the Public Consultation, the name of the company authoring the EPDA, the indication of the Place and Time, and where the documents for the Public Consultation can be consulted. The notice, which was published on the sixth day of February 2019, can be found in Annex 1.

3 SUMMARY OF THE PUBLIC CONSULTATION

The Public Consultation was held at the Namaacha Teacher Training Institute - Rua da Igreja, Namaacha Municipality, on 21 February 2019, starting at 10:00 am.

It was attended by the representative of the Proponent (Central Eléctrica de Namaacha), Pedro Coutinho, the Environmental Consultants (from the company responsible for the EPDA, Matos, Fonseca & Associados - Mozambique) Margarida Fonseca, Nuno Matos, Sandra Gouveia and José Gravata, the representatives of the Government of Mozambique, namely the Mayor of Namaacha Municipality, Mr. Elias Munguambe, from the Namaacha District Government, Mrs Suzete Alberto Dança, from the District Directorate of Planning and Infrastructure, Mrs Deolinda Saíde, from the Maputo Provincial Directorate of Mineral Resources and Energy, Mr Pedro Caixote, the EDM Representative, Leopoldo Khadyhale.

Also present were the Officials of the District Directorate of Planning and Infrastructures, Graziela Lopes Menete, Cecília João Carlos Uqmusse Luís Jacinto Mondlane, representing the National Directorate of Environment, the Officials, Atália Muvelo and Rosalina Niquice, of the Provincial Directorate of Land, Environment and Rural Development of Niassa, the Official Maria da Glória Morais, as well as the other representatives of the Local Community such as the Head of the Locality Adriano Fondo, the Ruler Filimone Malhalela.

The meeting took place in both Changana and Portuguese, so that all participants could have access to all the information presented and so that all participants had the opportunity to understand, participate and transmit to members of their community who were not at the meeting. At the beginning of the meeting, the attendance list was distributed and signed by all participants (see Annex II).

The Public Consultation took place with the aid of a projector where the presentations of the Proponent and the Environmental Consultants were projected. The presentations were made in a simple and clear way, with little recourse to very technical language, so that it was easy to understand and easy to translate.

The meeting started with a welcome by the Mayor, Mr Elias Munguambe, in changane. This was followed by the representative of the Proponent, Mr Pedro Coutinho, who presented the Project, the main characteristics and the reasons for the selection of the site for the implementation of the wind power plant. Representing the Environmental Consultants, Margarida Fonseca presented the justifications of the

activity, the main characteristics of the plant, as well as the plant area and its surroundings, and the main impacts during the construction and operational phases.

The various participants were then given the opportunity to ask any questions, doubts, concerns or comments arising from the presentation or consultation of the draft EPDA. The questions were answered by the speakers, Pedro Coutinho, Margarida Fonseca and Nuno Matos. The meeting ended with comments from the MFA representative, José Gravata, thanks to the Source Capital representative, as well as all government and local representatives.

All questions/answers and comments can be found in Annex III. No written comments or questions have been received to date, and this period started with the notice in the media and distribution of the invitation letters, and lasts for 30 days.

In the following photos some moments of the Public Consultation can be seen.

REDACTED

Photo 1

Photo 2

REDACTED

Photo 3

Photo 4

REDACTED

Photo 5 Photo 6

Maputo, 6 July 2019

Margarida Fonseca Nuno Ferreira Matos

Annex I

Newspaper Notice

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

CENTRAL ELÉCTRICA DA NAMAACHA

AVALIAÇÃO DE IMPACTO AMBIENTAL
CONSULTA PÚBLICA

A empresa Matos, Fonseca & Associados – Moçambique – Estudos e Projectos, Lda foi contratada para a elaboração do Estudo de Impacto Ambiental da CENTRAL ELÉCTRICA DA NAMAACHA.

Como parte do processo e cumprindo o estipulado no Decreto 54/2015 e na Directiva 130/2006 sobre o processo de participação pública, está em curso o processo de consulta pública.

Assim sendo são convidadas todas as partes interessadas e o público em geral a participar na reunião pública a ter lugar na seguinte localização e calendarização:

Cidade	Local	Data / Hora
Namaacha	Instituto de Formação de Professores da Namaacha – Rua da Igreja	21 Fevereiro 2019 /9:00h

Os documentos referentes a esta fase do processo poderão ser consultados na DPTADER – Direcção Provincial da Terra, Ambiente e Desenvolvimento Rural de Maputo.

Para mais informações contactar:

Matos, Fonseca & Associados – Moçambique – Estudos e Projectos, Lda
Tel:+258 86 3085706; Email: mfonseca@mfassociados.pt

2064

SAIBA O QUE ACONTECE NO SEU MUNICÍPIO
O NOTÍCIAS DEDICA DIARIAMENTE UMA PÁGINA À CIDADE DE NAMPULA
sn

Annex II

Invitation Letter and Guest List

NOME DAS PESSOAS A CONVIDAR

CENTRAL ELÉCTRICA DA NAMAACHA

N/O	INSTITUIÇÃO	NOMES
1	MUNICIPIO DA NAMAACHA	JORGE RAFAEL TINGA (CESSANTE)
2	MUNICIPIO DA NAMAACHA	ELIAS MUNGUAMBE (ACTUAL)
3	GOVERNO DO DISTRITO	SUZETE ALBERTO DANÇA
4	DIRECTOR DE AGRICULTURA	HORACIO MIGUEL LANGA
5	DIRECTOR INFRA-ESTRUTURAS	DEOLINDA SAIDE
6	DIRECTOR DE SAUDE	NELSON DA SILVA
7	DIRECTOR DE EDUCACAO	ANTONIO RAUL CÂNDIDO
8	INSTITUTO DE FORM. PROFESSORES	AO CUIDADO DO DIRECTOR
9	CHEFE DA LOCALIDADE	ADRIANO FONDO
10	REGULO	FILIMONE MALHALELA
11	SECRETARIO	SIMIÃO SIMÃO
12	JORNALISTA	AO CUIDADO DO DELEGADO DISTRITAL
13	DELEGADO DA EDM	AO CUIDADO DO DELEGADO DISTRITAL
14	COMANDANTE DA PRM	
15	ASSEMBLEIA MUNICIPAL	AMANCIO ERNESTO BUCA
16	PELOURO DE URBANIZACAO	VEREADOR
17	REPRESENTANTE -AGENTES ECONOMICOS	
18	REPRESENTANTE DA CTA	AO CUIDADO DO DIRECTOR
19	AGUAS DA NAMAACHA	AO CUIDADO DO DIRECTOR
20	AGUAS DE MONTEMOR	SRA. ARLETE
21	HOTEL ACACIAS	AO CUIDADO DO PRESIDENTE
22	HOTEL LIBOMBO	AO CUIDADO DO PRESIDENTE
23	ASSOCIAÇÃO DOS AGRICULTORES	AO CUIDADO DO DIRECTOR
24	CHEFE DO POSTO ADMINISTRATIVO	ADRIANO PELEMBE
25	C. REPARTIÇÃO DO ORD. TERRITORIAL	CECILIA UAMUSSE
26	C.DA REPARTIÇÃO DO AMBIENTE	GRAZIELA MENETE
27	TECNICO DO AMBIENTE	LUIS MONDLANE
28	TECNICO DE TERRAS	SERGIO ALMEIDA
29	MIREME	Eng Pedro Caixote
30	EDM	Engª Olga Utchavo
31		Engº Gil Vilaculos
32		Engº Pedro Nguelume
33		Engº Mário Jonas
34	FUNAE	Engº Herminio Massingue

Lista de Participantes

Projecto da Central Eléctrica da Namaacha

1ª Consulta Pública

Fase de EPDA e TdR

Município da Namaacha
Data – 21 de Fevereiro de 2019

Nome	**Impressão Digital**	**Nome**	**Impressão Digital**

Lista de Participantes

Projecto da Central Eléctrica da Namaacha

1ª Consulta Pública

Fase de EPDA e TdR

Município da Namaacha

Data – 21 de Fevereiro de 2019

Nome	Instituição	Função	Telemóvel	Email

REDACTED

REDACTED

REDACTED

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS, LDA

REDACTED

REDACTED

REDACTED

Annex III

Report of Questions and Answers from the Public Consultation

Name/ Organization	Question/Comment	Answer
RT - SDEJT – (Photo – 1)	He welcomed and thanked the presentation. Where will the line that will take the energy to Maputo pass through? Will there be interference with mobile phone communications? Will there be restrictions on agricultural activity?	Pedro Coutinho - PP CEN (Photo 2) The line is still under study but one of the options will be to run about 90 % of it along the existing EDM line. The remaining 10 %, if it affects people's farms, will be compensated accordingly. Nuno Matos – CA MFA The new line does not influence communications, and there will be no interference with telephones or mobile phones. Pedro Coutinho – PP CEN Any restrictions that may exist will be during the construction phase. After the turbines are built, the wind farm will not be fenced off, so agricultural activity can continue.
FM– Traditional Ruler (Photo -3)	Will turbine noise affect people's lives? Which area will not be used by people and livestock?	Pedro Coutinho - PP Central Eléctrica da Namaacha, S.A. Turbines will not be placed close to people's homes so that they are not affected by noise or shadows. In any case if anyone is affected they will be compensated accordingly. The area that will be lost is only the concrete base on which the turbine will be placed. All other land can be used for agriculture and livestock. The turbines do not harm vegetation.

(Continues)		
(Continued)		
Name/ Organization	**Question/Comment**	**Answer**
PC	What will be the social responsibility of the project? Here there is a lot of poverty, the school has no conditions and the children have to walk a long way to come to school in the village or stay with relatives. How will the people to be employed be recruited?	Pedro Coutinho - PP Central Eléctrica da Namaacha, S.A. The project will contribute each year to a yet to be defined body, which will receive these funds and decide where they will be used. We, the developers of the project, will be part of it, but we will have to fit in with the rules of the municipality and the government. We will always contribute to the basic needs of the population through the project. We'll start by recruiting in Namacha, and then work our way out until we find the people we need. We will start by talking to the chiefs in the localities who can refer us to the best people.
SS	What will be the area affected by the project and how will the localities be affected. Is this an area of high poverty?	Pedro Coutinho - PP CEN The area affected will be small because the wind farm is not closed. It is only during the construction phase that the affected area is larger.
(Continues)		

(Continued)		
Name/ Organization	**Question/Comment**	**Answer**
EG (Photo 4)	As you know the project area is a community pasture, how are we going to access it? There are still many services missing for the population such as a school, so they don't have to come to the village, jobs and a hospital.	Pedro Coutinho - PP Central Eléctrica da Namaacha, S.A. During construction the area will be fenced off as needed. Once the construction is finished the whole park will be a free access area for everyone.
CJCU – SDAE (Photo 5)	How will you arrange to have land for livestock during the construction phase? How many people will you need to work on the project?	Pedro Coutinho – PP CEN During the construction phase the grazing area has to be adjusted. But then the livestock can graze where they have always grazed. During the construction phase about 250 people. In the next phase about 20 workers. Security guards and cleaners and accountants. But they will be more indirect jobs.
Rosalina Niquice - DINAB	How will you set up the generators?. How will we handle noise during the trial phase?	Pedro Coutinho - PP CEN The generators will come in several pieces and will be assembled on site. Only, the turbines come in whole pieces and in special transport.

(Continues)		
(Continued)		
	How will the population benefit from the energy produced here at Namacha?	Margarida Fonseca – CA MFA (Photo 6) We know how much noise each turbine makes and we will use the models to move the turbines away from houses and people so that they are not affected. We have information on climate, wind direction and wind speed. The power will go to Maputo to the substation and then come back to Namacha. It is not possible to use the energy produced here because it has very high output power. Only after it has been transformed can it be used in the houses.
Name/ Organization	**Question/Comment**	**Answer**
JG - MFA	Social issues such as hospitals, schools are the most important for the population. The traditional ruler, the municipality and the government are the ones who have to demand that the health centre and the school be built. So that the mistrust that the population has is not justified. The traditional ruler has to be aware of what is going to be done with the money to be spent on what the population needs.	

REDACTED

Photo 1 Photo 2 Photo 3

REDACTED

Photo 4 Photo 5 Photo 6

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS, LDª

REPORT – 2ND PUBLIC CONSULTATION

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

Environmental Impact Assessment

Namaacha Power Plant

2nd Public Consultation Report

Central Eléctrica da Namaacha, SA

December, 2019

CONTENTS

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1 INTRODUCTION

This document consists of the Report of the Public Consultation for the Environmental Impact Assessment Namaacha Power Plant, to be located in the province of Maputo, district of Namaacha, in accordance with the procedure established in the Regulation on the Environmental Impact Assessment Process, approved by Decree No. 54/2015, of 31 December.

The developer of the Namaacha Power Plant Project is Central Eléctrica da Namaacha (CEN), S.A.

CEN is based on Globeleq Africa Ltd (Globeleq) (formerly Globeleq Advisors Limited) in partnership with Source Capital, SA (Source Capital).

Source Capital, founded in 2015, is an investment management and private equity services provider focused on Real Estate, Energy and Private Equity in general, acquiring and managing assets across Lusophone Africa, namely Mozambique, Angola and South Africa and in Portugal.

Globeleq, founded in 2002, is a company with extensive experience in the development and implementation of power projects in Africa. It currently has operational assets in Tanzania, Ivory Coast, South Africa, Cameroon and Kenya. Jointly owned by CDC Group PLC (70%) and Norfund (30%) (UK and Norwegian development finance institutions), Globeleq is focused exclusively on Africa and has expertise in the development and operation of wind, solar, oil and natural gas power generation and continues to develop renewable and conventional projects across the continent. As a responsible company, Globeleq develops projects in accordance with the International Finance Corporation (IFC) Performance Standards and the World Bank's Environment, Health and Safety (EHS) Guidelines.

In order to prepare all the necessary documentation for the Environmental Impact Assessment (EIA) process, CEN hired Matos, Fonseca & Associados, Moçambique, Estudos e Projectos, Lda., a private limited liability company based in Maputo, Mozambique, founded in 2012 (registered with MICOA, now Ministry of Land, Environment and Rural Development - MITADER - under No. 05/2019).

The Namaacha Power Plant Project has been classified as a Category A activity by MITADER, through the Maputo Provincial Directorate of Land, Environment and Rural Development, which requires the Environmental Impact Assessment (EIA) process. This classification implies the obligation to carry out a Public Consultation Process (PP). This legal requirement is under the Regulation of the Environmental Impact Assessment Process (Decree 45/2004 of 29 September). The Public Consultation (PC) is an integral part of the EIA process for projects classified as Category A, as stipulated in the aforementioned Decree Law 54/2015, of 31 December, in article 10(2), paragraph i), which indicates that it must be done as stipulated in article 15(9).

The Environmental Impact Assessment (EIA) for this project is also carried out under the terms of the Environmental Law (Law no. 20/97 of 1 October). This Law is intended to enforce the Constitution through Article 135(1) of the country which gives every Citizen the right to live in a balanced environment as well as the right to defend it. Thus, in the Definitions Article 1(1), point 1, activity is any public or private initiative action related to the use or exploitation of environmental components the application of technologies or production processes, plans, programmes, legislative or regulatory acts which affects or may affect the environment.

The Namaacha Power Plant Project site is located in the District of Namaacha, which is bordered to the west by eSwatini and South Africa, to the east by the District of Boane, and to the south/southeast by the District of Matutíne and to the north by the District of Moamba. The Project does not intersect any protected areas or environmental reserves. This report is intended to provide details of the Public Consultation held at the local level (Namaacha District), involving the Interested and Affected Parties (I&AP), at the time represented by the various State bodies, District Government, as well as representatives of local communities and individuals directly or indirectly affected.

2 PUBLIC PARTICIPATION PROCESS

2.1 OBJECTIVES OF THE PUBLIC CONSULTATION

This process aims to disseminate information about the Project and the studies carried out by the experts involved in the EIA process to the I&APs during the environmental assessment of the Project. It also aims to identify and understand the concerns of the I&APs on how the Project will be developed and how it may affect their lives. It also aims to provide information on how the entire Environmental Impact Assessment process will be developed. It is also the aim of this Public Consultation to record all concerns, questions and answers, as well as suggestions or comments, that are raised, and these will be duly submitted for analysis by the assessor.

2.2 PUBLIC PARTICIPATION PROCESS

This section outlines the Methodology followed to carry out the Public Consultation. Copies of all the documents relating to this process are attached, namely the identification list of the I&APs, invitation letter templates, the notice published in a national newspaper, the questions and answers asked at the time of the consultation, the suggestions or comments made by the I&APs, as well as the participants' registration lists (see Annex II).

As for the Methodology used in this Public Consultation Process and in order to fulfil the objectives described in point 2.1, it was as follows:

- ☐ Identification of Interested and Affected Parties (I&AP)
- ☐ Information Dissemination and I&AP Involvement
- ☐ Collection and Recording of Inputs from I&AP
- ☐ Preparation of the Public Participation Process Report

2.3 INFORMATION DISSEMINATION

In order to carry out this Public Consultation within the scope of the EIA Report, all the identified I&APs were contacted between one month and fifteen days before the Consultation, as well as the National Directorate of Environment and the Provincial Directorate of Land, Environment and Rural Development of Maputo. For the I&AP, as well as for the two directorates, letters of invitation were sent, which were delivered by hand, and "draft" of the EIA were made available, in Portuguese.

The notice of the Consultation was also published in the Jornal de Notícias, fifteen days before the Consultation, as required by Decree 54/2015, in article 15, point 7. The notice includes, in addition to the news of the Public Consultation, the name of the company that authored the EIA, the indication of the Place and Time, and where the documents for the Public Consultation can be consulted. The notice, which was published on the fourteenth day of November 2019, can be found in Annex 1.

3 SUMMARY OF THE PUBLIC CONSULTATION

The Public Consultation was held at the Namaacha Teachers Training Institute - Rua da Igreja, Namaacha Municipality, on 2 December 2019, starting at 11:00am.

It was attended by the representative of the Proponent (Tetereane Power Plant, Source Capital, SA), Mr Pedro Coutinho, the Environmental Consultants (from the company responsible for the EIA, Matos, Fonseca & Associados - Mozambique) Margarida Fonseca, Nuno Matos, Sandra Gouveia and José Gravata of the representatives of the Government of the Republic of Mozambique, namely, from the Namaacha District Government, Ms Suzete Alberto Dança, from the District Directorate of Planning and Infrastructure, Ms Deolinda Saíde, from the Maputo Provincial Directorate of Mineral Resources and Energy, Mr Pedro Caixote, the EDM Representative, Leopoldo Khadyhale.

Also present were the Officials of the District Directorate of Planning and Infrastructure, Graziela Lopes Menete, Cecília João Carlos Uqmusse Luís Jacinto Mondlane, representing the National Directorate of Environment, the Technicians, Rosalina Langa and Alima Ibraimo, of the Provincial Directorate of Land, Environment and Rural Development of Niassa, the Official Maria da Glória Morais, as well as other representatives of the Local Community as the Head of the Locality Adriano Fondo, the Ruler Filimone Malhalela.

The meeting took place in Changane and in Portuguese, so that all participants could have access to all the information presented and so that all participants had the opportunity to understand, participate and pass on to members of their community who were not at the meeting. At the beginning of the meeting, the attendance list was distributed and signed by all participants (see Annex II).

The Public Consultation took place with the aid of a projector where the presentations of the Proponent and the Environmental Consultants were projected. The presentations were made in a simple and clear way, with little recourse to very technical language, so that it was easy to understand and easy to translate.

The meeting started with a welcome given by the Project Proponent Pedro Coutinho, in Portuguese, with translation into Changane. He then presented the Project, the main characteristics and the reasons for the selection of the site for the implementation of the wind power plant. Representing the Environmental Consultants, Margarida Fonseca presented the justifications of the activity, the main characteristics of the plant, as well as the plant area and its surroundings, and the main impacts during the construction and operation phases.

Next, the various participants were given the opportunity to ask any questions, doubts, concerns or comments arising from the presentation or consultation of the draft EIA. The questions were answered by the speakers, Mr Pedro Coutinho and Ms Margarida Fonseca. The meeting ended with comments from the Namaacha District Government Representative, Mrs Suzete Alberto Dança, as well as thanks to all participants and representatives of the population, as well as all government and local representatives.

All questions/answers and comments can be found in Annex III. No written comments or questions have been received to date, and this period started with the notice in the media and distribution of the invitation letters, and lasts for 30 days.

Following the Public Consultation, an informal visit was made to the post installed for meteorological monitoring, i.e. to measure wind direction and speed in order to make the best use of the future power plant.

In the following photos some moments of the Public Consultation and the informal visit can be observed.

REDACTED

Photo 1

Photo 2

Photo 3 Photo 4

REDACTED

Photo 5 Photo 6

Maputo, 14 de Dezembro de 2019

Margarida Fonseca Nuno Ferreira Matos

maria margarida rocha da fonseca

Annex I

Newspaper Notice

Quinta-feira, 14 de Novembro de 2019

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

CENTRAL ELÉCTRICA DA NAMAACHA

AVALIAÇÃO DE IMPACTO AMBIENTAL

CONSULTA PÚBLICA

A empresa Matos, Fonseca & Associados – Moçambique – Estudos e Projectos, Lda foi contratada para a elaboração do Estudo de Impacto Ambiental da CENTRAL ELÉCTRICA DA NAMAACHA.

Como parte do processo e cumprindo o estipulado no Decreto 54/2015 e na Directiva 130/2006 sobre o processo de participação pública, está em curso o processo de consulta pública.

Assim sendo são convidadas todas as partes interessadas e o público em geral a participar na reunião pública a ter lugar na seguinte localização e calendarização:

Cidade	Local	Data / Hora
Namaacha	Instituto de Formação de Professores da Namaacha – Rua da Igreja	2 Dezembro 2019 /10:00h

Os documentos referentes a esta fase do processo poderão ser consultados na DPTADER – Direcção Provincial da Terra, Ambiente e Desenvolvimento Rural de Maputo.

Para mais informações contactar:

Matos, Fonseca & Associados – Moçambique – Estudos e Projectos, Lda
Cel:+258 86 3085706; Email: mfonseca@mfassociados.pt

9072

Annex II

Invitation Letter and Guest List

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

Ao Governo do Distrito

21 de Novembro de 2019 Refª11319

Assunto: Consulta Pública para o projeto da CENTRAL ELÉCTRICA DA NAMAACHA

Exª Srª. SUZETE ALBERTO DANÇA NHANGUMELE

Sandra Maria Brás Ventura Rebordão Gouveia de nacionalidade Portuguesa, portador do DIRE nº 11PT00070769, emitido em Maputo, aos 11/06/2019, da empresa Matos, Fonseca & Associados, Lda. Contratada pelo promotor da actividade CENTRAL ELÉCTRICA DA NAMAACHA, SA vem por este meio convidar sua Excelência, para a consulta pública no âmbito do Processo de Avaliação de Impacto Ambiental, do projecto CENTRAL ELÉCTRICA DA NAMAACHA, Distrito da Namaacha, Província de Maputo. A consulta serve de modo a incluir no EIA, todas as alterações que se revelem necessárias em resultado do processo de participação pública das Partes Interessadas & Afetadas.

A consulta pública decorrerá no dia 02 de Dezembro, no município da Namacha. No Instituto de Formação de Professores da Namaacha – Rua da Igreja, às 10:00 da manhã.

Para qualquer esclarecimento adicional contactar as pessoas abaixo indicadas:
Consultor Ambiental - Matos, Fonseca e Associados, Lda
Sandra Gouveia - +258 847534043
sgouveia@mfassociados.pt

Promotor - CENTRAL ELÉCTRICA DA NAMAACHA, SA
Pedro Coutinho - +258 21 321806; +258 84 3342815
pedro.coutinho@quantum.power.com

Pede deferimento

Maputo, aos 21 de Novembro de 2019

Assinatura

Matos, Fonseca & Associados, Lda
Estudos e Projectos
MOÇAMBIQUE

Av Patrice Lumumba, 747 1º Porta 3
Maputo-Moçambique
NUIT 400383960

Cel: +258 86 3085706
Email: mfassociados@mfassociados.pt
Web: www.mfassociados.pt

Licença de Consultor Ambiental MITADER
nº05/2019
Licença de actividade nº 7260/11/01/PS/2012

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

Direcção Nacional de Ambiente - Maputo

21 de Novembro de 2019 Refª11019

Assunto: Consulta Pública para o projeto da CENTRAL ELÉCTRICA DA NAMAACHA

Exª Srª. Directora da Direcção Nacional de Ambiente

Sandra Maria Brás Ventura Rebordão Gouveia de nacionalidade Portuguesa, portador do DIRE nº 11PT00070769, emitido em Maputo, aos 11/06/2019, da empresa Matos, Fonseca & Associados, Lda. Contratada pelo promotor da actividade CENTRAL ELÉCTRICA DA NAMAACHA, SA vem por este meio pedir a sua Excelência, para destacar o número de técnicos que achar necessários para a consulta pública no âmbito do Processo de Avaliação de Impacto Ambiental, do projecto CENTRAL ELÉCTRICA DA NAMAACHA, localizada no Distrito da Namaacha, Província de Maputo. A consulta serve de modo a incluir no EIA, todas as alterações que se revelem necessárias em resultado do processo de participação pública das Partes Interessadas & Afetadas.

A consulta pública decorrerá no dia 02 de Dezembro, no município da Namacha. No Instituto de Formação de Professores da Namaacha – Rua da Igreja, às 10:00 da manhã.

Para qualquer esclarecimento adicional contactar as pessoas abaixo indicadas:
Consultor Ambiental - Matos, Fonseca e Associados, Lda
Sandra Gouveia - +258 847534043
sgouveia@mfassociados.pt

Promotor - CENTRAL ELÉCTRICA DA NAMAACHA, SA
Pedro Coutinho - +258 21 321806; +258 84 3342815
pedro.coutinho@quantum.power.com

Pede deferimento

Maputo, aos 21 de Novembro de 2019

Assinatura

Matos, Fonseca & Associados, Lda
Estudos e Projectos
MOÇAMBIQUE

REDACTED

Lista de Participantes

Projecto da Central Eléctrica da Namaacha

CENTRAL ELÉCTRICA NAMAACHA

2ª Consulta Pública

Fase de EIA

MATOS, FONSECA & ASSOCIADOS ESTUDOS E PROJECTOS LDA MOÇAMBIQUE

Município da Namaacha
Data – 2 de Dezembro de 2019

Nome	Impressão Digital	Nome	Impressão Digital

Lista de Participantes

Projecto da Central Eléctrica da Namaacha

CENTRAL ELÉCTRICA NAMAACHA

2ª Consulta Pública

Fase de EIA

MATOS, FONSECA & ASSOCIADOS ESTUDOS E PROJECTOS LDA MOÇAMBIQUE

Município da Namaacha

Data – 2 de Dezembro de 2019

Nome	Instituição	Função	Telemóvel	Email

REDACTED

REDACTED

REDACTED

REDACTED

Annex III

Report of Questions and Answers from the Public Consultation

Name/ Organization	Question/Comment	Answer
HM (Photo - 1)	He welcomed and thanked the presentation and even the fact that this third meeting what was spoken by the proponent has been fulfilled. He just asked for attention and to honour the commitment to hire in the communities and localities closest to the project.	Pedro Coutinho - PP CEN (Foto – 2) Hiring for the construction phase will take place within the communities and localities closest to the project, as has already happened in these small jobs that have taken place up to the present day.
FM – Ruler (Photo – 3)	He emphasised the importance of the three meetings held to date with the project proponent. And that he has been very pleased that from day one he has fulfilled what he has promised. He apologises because the people of Namaacha have not always fulfilled their obligations at work. And that the population must stop being disrespectful to those who are bringing a project of this importance to the District of Namaacha, as well as to the country. As has been seen in the small works carried out so far. With workers who have turned up drunk at the workplace. Community leaders are asked to validate people before nominating them for the project. So that our community does not look bad to the project proponent.	Pedro Coutinho - PP CEN I thank the Ruler for his words, and he says as the Project Proponent that he always intends to fulfil what he has promised. And that he only says what he is going to do when he knows he can fulfil it, that he does not promise what he can not do. And that he intends to do the same in labour hire.

(Continues)		
(Continued)		
Name/ Organization	**Question/Comment**	**Answer**
PC- MIREME (Photo – 4)	If there is an overlap of DUAT's? What is the procedure for regularising this overlap? What is the social impact of the project?	Pedro Coutinho - PP CEN The initial demarcation of the project was a much larger area than today. The area that the project occupies today was defined because there is no DUAT in this area. Therefore, there is no overlapping DUAT. What there is is people who live and work in the area and will be able to continue to live and do what they do today. Some resettlement may have to be done for any impact that may occur. But in this situation there will be compensation. What we are guaranteeing is that no more constructions appear than those already registered. Regarding the social impact of the project in relation to labour is to ensure that hiring is done in the communities living near the project area. And even this will be done in accordance with Mozambican and World Bank legislation. In relation to health, hygiene and safety of workers and the population, all the rules defined by the World Bank will be followed and are a priority for the project.
(Continues)		
(Continued)		

Name/ Organization	Question/Comment	Answer
MZ– CTA (Foto – 6526)	Knowing that the project will have a big impact on the social area, what kind of specialisations and grades will be needed for the workers? We needed to know this information in order to prepare the community members.	Pedro Coutinho - PP CEN The project prepares other works outside the project area. Because after the wind speed and direction measuring masts are placed, we have to have measurements for a year to be able to define the exact location of the wind turbines. Then comes the negotiation with EDM, only then comes the construction phase. It is possible that this phase will begin in mid-2021. However, it is already defined that six months before the construction there will be a meeting where rules will be defined and indicated all the specialisations and grades that will be necessary for the construction phase.
LK- EDM (Foto – 6)	The power project will have several agreements between the proponent and EDM. But, the final say will always be with the government.	

CA – Environmental Consultant

PP – Proponent

CEN – Central Eléctrica de Namaacha

MFA – Matos, Fonseca & Associad

Photo 1

Photo 2

REDACTED

Photo 3

Photo 4

Photo 5

Photo 6

Annex 6

EMP

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA

Environmental Impact Assessment of the Namaacha Power Plant

Environmental Management Plan

Central Eléctrica da Namaacha, S.A.

November 2020 (modified in January 2022)

CONTENTS

1 INTRODUCTION

This Environmental Management Plan focuses on the management of the main environmental, socio-economic and health and safety impacts identified in the phases of the project under study "Namaacha Power Plant" - construction, operation and decommissioning.

In this way, the EMP identifies a set of measures with obligations and responsibilities of each of the parties involved in the project, its methodology and which procedures should be followed.

2 SCOPE AND OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PLAN

The EMP is regulated by a number of laws including the Constitution of Mozambique, the Environmental Law (Law No. 20/97 of 1 October) and the Regulation on the Environmental Impact Assessment Process - Decree No. 54/2015 of 31 December.

The overall objectives of the EMP are to ensure that project activities are developed and conducted in an environmentally responsible manner.

The specific objectives of the plan presented in here are to establish practical procedures for the mitigation of expected and significant negative impacts. It should also respond to and identify actions, responsibilities and monitoring measures for the most important issues, including social aspects related to health and safety of all employees and those involved in the project, in order to ensure that this activity is carried out in a sustainable manner.

In summary, this document should fulfil the following objectives:

- Provide Central Eléctrica da Namaacha, S.A. with guidelines regarding its environmental and social responsibilities at all stages of the project;

- Provide the Ministry of Land, Environment and Rural Development (MITADER) with a tool to assist in the assessment of proposed measures to minimise the impacts studied, taking into account national environmental legislation, specifically related to the project.

3 ENVIRONMENTAL POLICY AND LEGAL FRAMEWORK

Central Eléctrica da Namaacha, S.A. will have as its basic principle the sustainability of the project, which implies that it is based on the defence of the social, environmental and economic components. These three aspects are evident in the philosophy of action of this company and will be embodied in the future in a sustainability policy where there is a commitment to legal compliance, improvement of the quality of the environment and the correct environmental management of the project, associated with a concern for the social component, both in terms of training and safety and health of its workers, and in terms of concerns for the surrounding communities.

Chapter 3 of the EIA presents the legal framework of the project, referring below to that which is considered most directly applicable.

The main environmental impact legislation is set out below.

- Environment Law (Law 20/97 of 1 October), defines the legal bases for the correct use and management of the environment and its components;
- General Directive for the Preparation of Environmental Impact Assessments, Ministerial Diploma No. 129/2006, of 19 July;
- The Regulation on Environmental Inspection, Decree no. 11/2006, of 15 June.
- The General Directive for Public Participation in the Environmental Impact Assessment Process, Ministerial Diploma No. 130/2006 of 19 July;
- Regulation on the Environmental Audit Process, Decree no. 25/2011, of 15 June;
- Ministerial Diploma no. 182/2010 of 3 November, which regulates the organisation and functioning of the Official Evaluation Commissions;
- Decree no. 54/2015, of 31 December, approving the Regulation on the Environmental Impact Assessment Process.

The following is the main generalised legislation that may be of interest in the field.

- Water Law (Law no. 16/91 of 3 August);

- Local Municipal Law (Law no. 2/97 of 18 February), approves the legal framework for the establishment of local municipalities;
- Resolution 5/98 of 3 March. Approves the energy policy;
- Law on Forestry and Wildlife (Law No 10 of 1999 of 07 July);
- Regulation on Forestry and Wildlife Law (Decree No 12/2002 of 6 June);
- Decree No 11/2003 of 25 March 2003. Amends Article 20(5), Article 21(1)(g) and Article 29(e) of the Forestry and Wildlife Law Regulation;
- Regulation on Environmental Quality and Effluent Emission Standards (Decree No. 18/2004 of 2 June 2004 and Decree No. 67/2010 of 31 December 2010 amending Articles 23 and 24 and Annexes I and V, referred to in Article 7 and Article 16(3) of Decree No. 18/2004 and approving Annexes IA and IB);
- Regarding noise, the Regulation on Environmental Quality and Effluent Emission Standards defines that MICOA (now MITADER) should approve the noise standards, and to date, these standards have not been published
- Regulation establishing the rules relating to the planning, financing, construction, ownership, maintenance and operation of electricity generation, transmission, distribution and commercialisation facilities (Decree no. 42/2005, of 29 November);
- Decree no. 94/2014 of 31 December - Regulation on the Management of Urban Solid Waste,
- Decree no. 83/2014, of 31 December approves the Regulation on Hazardous Waste Management;
- Ministerial Diploma No. 129/2006, of 19 July and Ministerial Diploma No. 130/2006, of 19 July establish the principles for the preparation of the EIA and the Public Participation Process (PPP) during the ESIA process;
- Land Use Planning Law (Law 19/2007, of 18 July) - which, among other things, reaffirms the right and need for citizen participation in the process in the

planning process, the use of the precautionary principle, environmental sustainability and protection of land use rights by local communities (Article 4);

- Decree 24/2008 of 1 July. Approves the Regulation on the Management of Substances that Deplete the Ozone Layer;
- Decree 23/2008 of 1 July. Approves the Regulation of the Land Use Planning Law;
- Energy Strategy (Resolution 10/2009 of 4 June);
- National Strategy for Adaptation and Mitigation of Climate Change (ENAMMC).

4 ENVIRONMENTAL MANAGEMENT STRUCTURE

The overall organisational structure for the environmental management of the Project identifies and defines the responsibilities and authority of the various organisations and individuals involved in the project. The structure of the Project and associated staff should be sufficient to ensure the required environmental performance standards.

The following is the structure of the Environmental Management to be implemented for the Project.

- Chapter 7 presents the environmental monitoring plan for the construction phase in more detail,
- In Chapter 8 the waste management plan;
- In Chapter 9 the recovery plan for intervened areas;
- Chapter 10 presents the minimisation measures to be complied with in the operation phase;
- Chapter 11 presents the planned monitoring plans.

4.1 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

Responsibilities of the MITADER

MITADER is the entity responsible for coordinating all environmental activities at the national level and therefore should be the main driver for promoting environmental and social sustainability in all projects and for all national resources. This body will have the responsibility to set the standards of acceptance for the various environmental indicators through new legislation; and it should coordinate, evaluate, and monitor together the measures and actions proposed in the EMP in order to prepare the environmental audits as soon as the appropriate management deems it necessary.

Responsibilities of the Proponent – Central Eléctrica da Namaacha, S.A.

Central Eléctrica da Namaacha, S.A. undertakes to ensure that the activity is carried out in accordance with the recommendations set out in this report, always respecting the environmental components. All operations involved will be managed in such a way as to ensure that the environment, health and safety of workers and all other stakeholders involved in the project are protected.

Central Eléctrica da Namaacha, S.A. shall:

- Adopt this EMP, respecting and putting into practice the recommendations contained therein;
- Take overall responsibility for the implementation of the EMP, ensuring its compliance with legislative and contractual requirements. Ensure that any issue that is not in line with the EMP is fully corrected through the implementation of corrective measures;
- Make the EMP available to all parties involved in the activity, contractors, subcontractors and workers in general;
- Ensure that relations between project stakeholders are conducted in accordance with the principles of cordiality and mutual interest, as provided for in Mozambican law;
- Ensure that managers, supervisors, workers and visitors are informed about safety, health and environmental requirements;
- Monitor, evaluate the performance of the contractor, subcontractors and workers in general in the areas of environmental protection, health and safety.

Responsibilities of the Hired Contractor

The contractor hired to carry out the activities related to the construction of the Namaacha Power Plant shall fulfil the following obligations:

- Liaise with and respond to representatives of Central Eléctrica da Namaacha, S.A. on all issues relevant to the implementation of the EMP;
- Implement the mitigation measures contained in this Environmental Management Plan and put into practice techniques and methods of operationalisation that will ensure compliance with it. The contractor shall endeavour to minimise environmental damage, control waste, prevent pollution and all other aspects that endanger the environment;

- Organise work plans, transport logistics and equipment necessary to conduct activities in a way that complies with environmental requirements;

- Prevent or minimise the occurrence of accidents and incidents that may cause harm to the environment;

- Comply with environmental audits conducted by Central Eléctrica da Namaacha, S.A. and by relevant government agencies, and provide where necessary information to facilitate the audit;

- If the government authorities consider that the operational activities carried out by the contractor cause damage to the environment, the contractor shall consult with Central Eléctrica da Namaacha, S.A. and the competent authorities to reach a consensus on the minimisation measures to be implemented. The agreed measures should be implemented as soon as possible in order to avoid subsequent damage and to repair any damage that has occurred;

- Ensure the employment of experienced staff with a high sense of responsibility to deal with Environmental, Health and Safety issues during activities.

<u>Responsibilities of the Environment and Safety Supervisor (environmental monitoring of works)</u>

The Environment and Safety Officer assigned to the Project has the following responsibilities:

- Ensure the fulfilment of the measures foreseen in the Environmental Management Plan and report to Central Eléctrica da Namaacha, S.A. and MITADER whenever necessary on the degree of implementation of the EMP;

- Ensure that subcontractors during the construction phase as well as operation are informed and held accountable for implementing the recommendations set out in the EMP;

- Ensure that the Namaacha Power Plant has an Emergency Response Plan;

- Ensure that the Namaacha Power Plant is equipped to comply with the Environmental Management Plan;

- Ensure and facilitate permanent liaison between the relevant institutions such as MITADER among others;

- Provide monthly reports that include the assessment of the fulfilment of the EMP, which shall be provided to Central Eléctrica da Namaacha, S.A. and MITADER;

- Prepare an Environmental Management Report at the end of each phase of the project, providing an assessment of the degree of fulfilment of the recommendations set out in the EMP;

- Establish procedures for collecting and channelling complaints submitted during the construction and operation phase.

4.2 PROCEDURES, CO-ORDINATION AND REPORTING

The structure of all communication, correspondence and reporting between project stakeholders should be defined at the start of the Project with the Contractor(s).

All records of monitoring results, monitoring reports, incident logs, audit reports shall be kept by Central Eléctrica da Namaacha, S.A.

All reporting requirements should be agreed at the start of the Project with the Contractors.

4.3 PERFORMANCE EVALUATION AND PREVENTIVE ACTIONS

The performance evaluation of this project comprises the following main objectives:

- Confirmation of compliance with the requirements described in the EMP, i.e. the performance of Central Eléctrica da Namaacha, S.A. and subcontractors;
- Measuring environmental performance (the level of success of the EMP and its specifications);
- Identification and remediation of any EMP deficiencies.

These objectives will be achieved through important tools such as the monitoring process described above, as well as inspections and audits. Inspections and audits will be carried out to assess compliance with the requirements of the EMP.

Corrective actions will be key to ensuring that any identified problem areas are effectively addressed.

4.4 SITE INSPECTIONS

The Environmental and Safety Officer will make regular inspections, where necessary, of all works (including subcontractor sites) in the construction phase and the operation phase in order to identify any activities or components of the project that are causing, or are likely to cause, a potential environmental impact.

Inspections should be constant and should be part of the duties of the Environmental Monitoring Officer, who will immediately notify the Developer's Representative of any non-compliance, who will immediately notify the party responsible for rectifying such identified cases.

All problem areas will be recorded and managed in accordance with the requirements set out in subchapter 4.6 (Preventive and Corrective Actions).

4.5 AUDITS

According to Decree No. 25/2011 of 15 November, which approves the Regulation on the Environmental Audit Process, this tool can be carried out in a public or private manner, depending on the decision by MITADER.

There are some requirements for the preparation of audits, and following the legislation cited in the previous paragraph, this cannot be carried out by a person (official) who has participated as an environmental consultant in the EIA process. In this context, Central Eléctrica da Namaacha, S.A. should hire someone for this purpose who will be responsible for preparing environmental audit reports.

The auditor must prepare a full report in triplicate, meeting the criteria set out in Article 8 of Decree 25/2011 of 11 November. These must be submitted to MITADER and must be carried out at least once a year.

According to Decree N° 32/2003 Article 4, the Auditor is responsible for assessing:

- The impacts of the activity on the environment;
- Accident risks and contingency plans for the evacuation and protection of workers;

- The degree of compliance of the exercise of development activities with the parameters defined for their implementation in the environmental licensing process and their compliance with the regulations and technical standards in force;

- The actual or potential levels of pollution or environmental degradation resulting from the implementation of the development activity;

- The operating and maintenance conditions of the equipment;

- Measures to be taken to restore the environment and human health;

- Training of those responsible for the operation and maintenance of routine systems, installations and equipment to protect the environment and human health;

- The management and conservation of energy, raw material and water sources;

- The reuse, recycling, reduction, transport and disposal of waste;

- Noise and vibration inside and outside the premises;

- The selection of new production methods and modification of existing methods including industrial process and continuous monitoring systems to reduce pollutant levels;

- Measures to prevent and limit environmental accidents.

4.6 PREVENTIVE AND CORRECTIVE ACTIONS

The need for corrective action will result from divergences in the fulfilment of the EMP requirements.

In this context, Central Eléctrica da Namaacha, S.A., including the Environmental Officer, and the subcontractor(s) during the construction and operation phase must present corrective and preventive measures in accordance with the procedure established for these phases.

The procedure to be developed includes the following aspects:

- Ensure the recording of incidents/cases of non-compliance;

- Providing information on incidents/cases of non-compliance to environmental organisations;

- The identification of corrective and preventive actions/measures.

Corrective actions should be identified in relation to reported incidents/cases of non-conformity and in the results of EMP monitoring, management assessments and/or EMP audits.

The corrective measures should result in:

- Implementing a specific action to remedy the identified deficiency(ies); or
- A change in the performance standards or targets set out in the EMP;
- In a sequence of supporting documents that can be audited.

4.7 COMPETENCE, TRAINING AND AWARENESS-RAISING

All persons involved in activities that may result in environmental impact(s) should receive appropriate training and sensitisation.

Employees of Central Eléctrica da Namaacha, S.A. and subcontractors must ensure that the training provided is carried out in such a way that all persons are aware of the commitment of Central Eléctrica da Namaacha, S.A. to carry out the proposed activities while respecting the local population and avoiding unnecessary damage to their land and resources.

Training should consist of, but not be limited to: introductory training, the use of educational posters and daily meetings to discuss certain topics in relation to the environment before the start of each shift. During these training sessions, the following principles should be presented/discussed:

- The policies of Central Eléctrica da Namaacha, S.A. in relation to the environment, health and safety and applicable Mozambican environmental regulations, as well as the relevant IFC Standards;
- Statement and clarification of the communication policies of Central Eléctrica da Namaacha, S.A;
- The commitments of the EMP;
- Project restrictions and procedures;
- Procedures for firefighting and emergency response;
- Procedures for reporting and dealing with incidents.

4.8 EMERGENCY PREPAREDNESS AND RESPONSE

The Emergency Response Plan (ERP) should be prepared prior to the construction phase, based on a risk analysis and assessment, the health and safety and environmental management system of Central Eléctrica da Namaacha, S.A., and also considering the organisational structure of the company for the implementation of the project.

This Plan should contain at least the following components:

- A summary of the results of the risk assessment and the likely accident scenarios that the plan covers;
- A description of the facility or establishment to which the ERP applies, with site plans indicating safety-relevant information such as escape routes, assembly areas or points and emergency equipment;
- Updated contacts for all areas and staff;
- Access to private information of all staff, including family members and place of residence;
- A description of the emergency organisation that will respond to emergencies and the facilities and equipment that are available for emergency response, including means of communication and reference to:
    - Emergency controllers/coordinators;
    - First Aid/Emergency Medical Services;
    - Fire & Rescue Services;
    - Environmental, safety and occupational health professionals;
    - Security.
- A description of security monitoring, early warning, incident or emergency detection and incident reporting mechanisms, procedures, protocols and minimum standards;
- A description of the notification and activation procedures;

- A description of an incident management procedure;
- The set of forms and templates that will be used during an emergency;
- Post incident reporting requirements, including discussions/communications and updating or improving procedures;
- An explanation of how often exercises and training will be organised to test procedures, and what types of exercises and training will be required;
- A description of the procedure for maintaining, analysing and updating the ERP.

The ERP provides an overview of the actions to be taken in the event of an accident/emergency situation scenario.

5 BRIEF PROJECT DESCRIPTION

5.1 LOCATION

The Namaacha Power Plant is located in the south of Mozambique, near its border with South Africa and Swaziland, in Montes Libombos, district of Namaacha, Maputo province, relatively close to the urban settlement of Namaacha village.

5.2 MAIN CHARACTERISTICS

The Namaacha Power Plant, which aims to produce electricity from a renewable and non-polluting source - wind, consists of the installation of 15 wind turbines with a unit power of 4.2 MW, in the vicinity of the village of Namaacha, with a total power of 63 MW.

The location of the connection to the power plant grid has not yet been defined. Two connection options are being studied, one to the Boane substation (66 kV) and the other to the Belulane substation (275 kV). The choice of the substation to be connected will result from grid connection studies to identify the best location for this connection.

From a technical point of view, the project consists of the following structural elements: wind turbines, internal electrical cable network (underground), accesses and control building/substation.

Most of the equipment that makes up the wind farm is expected to arrive in Mozambique by sea, the nearest port of reference to the Project being the Port of Maputo. From this point, the equipment will be transported by lorries to the project site. The planned route will be via the EN2 from Maputo to the village of Namaacha. This road, which is a privileged axis of access to the border post (border with Swaziland), has characteristics suitable for the transport of materials and equipment necessary for the installation of the Project, and no intervention is foreseen on it.

Contractors (civil construction, electromechanics, transport team, assembly), Supervision Teams, Owner, among others, is about 250 workers. It is estimated that the operation of the Namaacha Power Plant will create 20 permanent jobs.

The planned operational phase (useful life) of the Namaacha Power Plant Project is 25 years.

5.3 PLANNED SCHEDULE FOR EXECUTION OF THE WORKS

Construction of the Project is expected to commence in the second quarter of 2021 and construction will last for 15 months.

6 DESIGN PHASE - PRIOR TO CONSTRUCTION

At this stage of project development, although the following measures have already been considered in the definition of the layout of the Namaacha Power Plant, it is recommended that they be maintained in the definition of the execution project:

- Moving wind turbines away from dwellings, leaving a protection area of at least 400 m around the wind turbine;
- Compensation for individuals and households whose dwellings are exposed to noise levels above the WHO limits and the limits of the IFC standards for the shadow effect;
- Implement the process of resettlement/relocation of people/households whose dwellings are exposed to noise levels above WHO limits and IFC standard limits for shadow effect;
- Moving the wind turbines away from the church, leaving a protective area around it and ensuring access to it;
- Maintain continuous access to the church wherever possible or, as a last resort, provide an alternative access route to ensure safe access for people attending the church;
- The projected paths should, where possible, utilise those already existing in the study area;

7 ENVIRONMENTAL MONITORING PLAN - WORKS PHASE

7.1 ENTITIES INVOLVED IN ENVIRONMENTAL MONITORING AND THEIR RESPONSIBILITIES

The following entities are involved in the process of Environmental Monitoring of the Works:

- Owner of the Works;
- Contractor;
- Environmental Monitoring Team (EMT);
- MITADER team.

The following is a description of the competences and responsibilities of the above entities.

Owner of the Works

The Owner of the Works is the first entity with obligations and responsibilities in terms of Environmental Monitoring of the Works, namely:

- Ensure compliance with the provisions of the Environmental Permit;
- Provide the PAAO and other entities involved in the Environmental Monitoring of the Works;
- Hire the EMT;
- Monitor the implementation of the PAAO;
- Distribute forms to collect complaints and requests for clarification regarding the Project, in the District of Namaacha and make weekly contacts with these entities in order to find out if there is any critical situation, transmit to the EMT the information collected, and proceed with the necessary steps to respond to the requests that exist;
- Be present, whenever necessary, at the periodic meetings of the Environmental Monitoring of the Works;

- Ensure the information, to the other parties involved in the Works, of any communications from external entities (e.g. official entities) that may have implications for the process of Environmental Monitoring of the Works;

- Send to MITADER, the Environmental Monitoring Reports of the Works (RAAO) with the periodicity defined in the PAAO.

Contractor

The Contractor's obligations and responsibilities extend to all subcontractors who may be involved in the works:

- Ensure the necessary resources for an adequate Environmental Management of the Works;

- Keep the Owner and the EMT informed of the schedule and progress of the works;

- Ensure compliance with all current environmental legislation applicable to the Works Contract;

- Implement the minimisation measures provided for in the Environmental Licence, and in the PAAO, applicable to its activity, as well as those stipulated in the WMP and the PRAI;

- Develop environmental awareness actions for all employees;

- Implement corrective measures that may be recommended by the EMT and approved by the Owner;

- Report to the EMT and the Owner any complaints and/or grievances that may be addressed to them;

- Ensure that all site workers, including any subcontractors, are aware of the information relating to the Environmental Monitoring of the Works;

- Inform the EMT of any difficulties that may be experienced in the implementation of the minimisation measures recommended in the Environmental Permit and the PAAO, or others that may be recommended during the course of the work;

- Be present at all meetings relevant to the Environmental Monitoring of the Works.

Environmental Monitoring Team

Should it prove necessary, the Environmental Monitoring Team will be reinforced by specialist Officials.

The person responsible for environmental monitoring of the work is responsible for:

- Ensure and verify the implementation, by the Contractor, of what is set out in the PAAO, which will include the verification of the adequate implementation of the minimisation measures contained in the EIA and also of any measures that may be indicated in the Environmental Permit;

- Verify compliance with the WMP and the PRAI;

- Analyse the information received from the Owner regarding any complaints or requests for clarification regarding the Project, and take the necessary steps, in conjunction with the Owner and the Contractor, to resolve any critical situation that may be identified;

- Provide training for all workers, covering at least the following topics: health and safety at work, protected species; waste management plan; communication measures on site; signage; and communication management in crisis situations;

- Ensure the existence of an Environmental Dossier on site, which will include at least the Environmental Permit, the PAAO, the PRAI, the WMP, and all the documentation produced within the scope of the Environmental Monitoring of the Work. This Dossier will be accessible to all stakeholders;

- Ensure that reports on the monitoring visits carried out, as well as other relevant documents related to the environmental monitoring/enforcement action, are forwarded to all stakeholders;

- Correct, if necessary, the procedures applied to implement the minimisation measures;

- Identify the need to define and implement other minimisation measures to ensure the resolution of concrete and/or unforeseen situations that may arise during the course of the works;

- Ensure compliance with applicable environmental legislation in force;

- Attend site meetings to which he/she is called;

- Identify and submit for approval by the Owner, the revision of minimisation measures recommended in the PAAO, if necessary;

- Communicate to the Contractor any changes to the PAAO, in particular with regard to the minimisation measures recommended therein;

- Carry out site visits, the frequency of which is defined in this PAAO, but which may be adjusted according to the development of the work;

- Proceed, in each visit carried out, and whenever applicable, to the registration of Environmental Findings - identification of situations that constitute Non-Conformities with the environmental legislation in force, with the Environmental Licence or with the PAAO, or situations that do not yet constitute Non-Conformities, but that require the taking of additional minimisation measures with a view to their correction/improvement;

- Prepare a summary report after each site visit;

- Prepare three reports for submission to MITADER (one at the beginning of the works, one approximately halfway through the works and one at the end of the works).

7.2 SCHEDULING THE ENVIRONMENTAL MONITORING OF THE PROJECT

The environmental monitoring official will visit the site weekly (two days per week) during the initial and final phases, and once a week during the remaining period. The duration of their stay on site for each visit will be according to the needs of the site.

The Owner will have a Works Supervision Team, which will be on site almost continuously. This team will collaborate with the EMT in order to monitor compliance with environmental constraints and measures in the absence of the EMT.

The frequency defined may be adjusted as necessary during the development of the work, and there is always the possibility of extraordinary visits to resolve specific situations.

7.3 CONTENT AND FREQUENCY OF THE REPORTS TO BE PREPARED

The environmental monitoring summary reports for each visit carried out during the works will address the following aspects:

- Progress of construction work;
- Conformities and non-conformities detected during the on-site inspection;
- Occurrences of environmental accidents and corrective measures taken;
- Difficulties expressed by the Contractor that may have led to non-compliance changes;
- Aspects for improvement by the Contractor;
- Measures and procedures not foreseen but which may prove necessary;
- Recommendations and suggestions to ensure continuous improvement of the Contractor's environmental performance;
- Complaints from official entities, associations or individuals, and steps taken to resolve critical situations.

The content of the summary reports will be adapted where it is necessary to include additional relevant information not specified. These reports will include, where relevant, a photographic record of the visits carried out.

The following timeframe is foreseen for the submission of reports:

- Report 1 - will be delivered 15 days after the first visit to the Project site, to be carried out by the EMT, Owner, Designer and Contractor, after the Project has been duly staked, and will include the information necessary for MITADER to be aware of any adjustments that the Project may undergo and the performance of the entire team assigned to the work;
- Report 2 - will be delivered approximately halfway through the construction period and will include all the information necessary for a good understanding of the progress of the works and how the minimisation measures have been met;

- Report 3 - will be delivered at the end of the work and will include, in addition to the type of information provided for in the previous reports, the final result of the measures related to the recovery of the intervened areas.

7.4 IDENTIFICATION OF MINIMISATION MEASURES APPLICABLE TO THE WORKS

The following is the set of minimisation measures proposed in the Environmental Impact Assessment for the construction phase.

At each site visit, the environmental monitoring team should check and record the outcome of the assessment carried out for each measure.

7.4.1 Measures for the construction phase

General Measures

Preparation phase prior to the execution of the works

- Disseminate the programme of execution of the works to the populations concerned, in particular the population living in the surrounding area. The information provided should include the purpose, nature, location of the works, the main actions to be carried out, their timetable and any impact on the population, in particular the impact on accessibility;

- Implement a public service mechanism to clarify any doubts and address any complaints;

- Carry out environmental and safety training and awareness-raising activities for workers and foremen involved in the execution of the works regarding the actions likely to cause environmental impacts and the minimisation measures to be implemented, namely standards and precautions to be taken during the course of the works (included in the Environmental Management Plan and in the Safety and Health Plan (SHP));

- Prepare a Work Plan for all the works assigned to the contract that includes, among other relevant aspects of the contract, the phases foreseen for earthmoving, for clearing and deforestation actions and for the crossing of water lines;

- Prepare a Landscape Integration Plan for the Works, in order to ensure the appropriate landscape framework that guarantees the attenuation of the visual affectations associated with the presence of the works. of the works and their integration into the surrounding area;

- Implement the Works Environmental Monitoring Plan, consisting of the planning of the execution of all elements of the works and the identification and detailing of the minimisation measures to be implemented during the execution phase of the works, and their respective timetable;

- Correctly signpost accesses to the intervention area with speed reduction indications. Properly signpost the 30 km/h speed limits within the works area.

Site and materials yard implementation

- The location of the construction site, if different from the one foreseen in this EIA, should be chosen avoiding areas within 50 m of permanent water lines, avoiding the destruction of tree species;
- The site should be organised in the following areas:
  - Social areas (support containers for technical teams present on site);
  - Waste disposal: two types of containers should be placed - containers intended for Urban Solid Waste and similar and container intended for construction waste;
  - Storage of polluting materials (oils, lubricants, fuels): this area should be properly dimensioned, waterproofed and covered in order to prevent overflows and that, in the event of accidental spillage, contamination of adjacent areas does not occur (it should have a drainage system for a leak-proof retention basin);
  - Car and equipment parking;
  - Deposition of construction materials.
- The construction site areas should be fenced off, or if this is not possible, the area allocated to it should be demarcated with visible signs. Warning signs should be placed on the fencing, including the safety rules to be observed and the schedule of works;
- The construction site and the different work fronts must be equipped with all the necessary materials and means to respond to environmental incidents/accidents, including accidental spillages of polluting substances. They must be waterproofed and with effective drainage, easily accessible;

- Access by personnel not assigned to the works must be avoided or, if possible, prohibited. Therefore, intervention areas intersecting public roads and paths must be signposted in accordance with municipal traffic regulations and, where appropriate, fenced off;
- Measures should be adopted in the field of information signalling and traffic regulation on the roads crossed by the Work Contract, aiming at safety and information during the construction phase, complying with the National Regulations in force and the best international rules on the matter;
- A rainwater drainage system should be established around the construction site area.

Deforestation, cleaning and stripping of soils

- The deforestation and soil stripping works should be limited to the areas strictly necessary for the execution of the works, and the vegetation cover of each intervention area should be reconstituted as soon as the earthworks (which are not expected to be significant) are completed, in particular in the excavation and embankment areas. This measure is particularly important in the areas of the working platforms for the construction of the control building and the substation and in the construction sites of the power line support foundations. In this way, some potential direct affectations of the subsurface hydrogeological system of local scope will also be taken care of;
- Prior to earthmoving works, strip the live earth and store it in pargas for later re-use in areas affected by the works;
- Pargas of topsoil from surface stripping should not exceed two metres in height and should be located in the vicinity of the sites from which the topsoil was removed, on flat, well-drained areas, for later use in recovery actions;
- Plant biomass and other waste resulting from these activities should be and reused wherever possible;
- Earthmoving and machinery movements should, as far as possible, favour the use of existing accesses or those less sensitive to soil compaction and waterproofing, avoiding the movement of machinery indiscriminately over the entire site.

Excavations and earthworks

- Excavation and backfill works should be started as soon as the soil is clean, avoiding repetition of actions on the same areas;
- Land clearing and stripping, earthmoving and exposure of bare soil should, where possible, be reduced during periods when heavy rainfall is most likely to occur, to minimise water-borne erosion and the consequent transport of sediment to major watercourses;
- The execution of excavations and embankments should be interrupted during periods of high rainfall and precautions should be taken to ensure the stability of the slopes and to avoid landslides;
- Where possible, use materials from excavations as backfill material in order to minimise the volume of surplus land (to be transported outside the intervention area);
- Excavation material that cannot be utilised, or that is in excess, should be stored in suitable storage facilities;
- In areas where works are carried out that may affect water lines, measures should be implemented to minimise interference with the water regime, pre-existing vegetation cover and bank stability. The natural flow of the water line should never be interrupted. All interventions in the water domain that are necessary during the course of the work must be previously licensed;
- During the temporary storage of earth, it must be protected with waterproof coverings. The height of earth piles should be such as to ensure their stability.

Construction and rehabilitation of access roads

- Favour the use of existing paths to access the construction sites. If new access roads or improvements to existing access roads are required, the works should be carried out in such a way as to minimise changes in land use outside the areas that will subsequently be occupied by the access road;
- Ensure correct compliance with safety regulations and signalling of works on the public roads, taking into account safety and minimising disruption to the activities of the population;
- Non-waterproofing materials should be used for the access roads to be built;
- Ensure that paths or access roads in the vicinity of the Project area are not obstructed or in poor condition, enabling their normal use by the local population;
- Where traffic diversions are expected to be necessary, submit the respective modification plans in advance to the competent authority for authorisation;
- Ensure the regular cleaning of accesses and the area affected by the work, in order to avoid the accumulation and re-suspension of dust, either by the action of the wind or by the action of the circulation of vehicles and work equipment;
- Any work at night should be avoided.

Movement of vehicles and operation of machinery

- When crossing inhabited areas, moderate speeds should be adopted in order to minimise dust emissions;
- Ensure that dusty or particulate materials are transported in suitable vehicles with the load covered to prevent the dispersion of dust.;
- Ensure that construction methods and equipment are selected that give rise to the least possible noise;
- Ensure that only equipment that is in a good state of repair/maintenance is present on site;

- Carry out maintenance and periodic overhaul of all machinery and vehicles assigned to the work, in order to maintain normal operating conditions and ensure the minimisation of gaseous emissions, risks of soil and water contamination, and in order to comply with noise emission standards. Ensure that the noisiest operations carried out in the vicinity of dwellings are restricted to the daytime and on working days;

- Parking areas for machinery and vehicles must be paved or waterproofed;

- Regular and controlled sprinkling of water, especially during dry and windy periods, in the work areas and in the access roads used by the various vehicles, where the production, accumulation and re-suspension of dust may occur;

- Structural and construction solutions for bodies and buildings, and installation of soundproofing systems for equipment and/or buildings housing the noisiest equipment, should be adopted to ensure compliance with the limits set out in the IFC standards.

Final phase of the works

- Decommission the area allocated to the works for the execution of the project, with the dismantling of the construction sites and removal of all equipment, support machinery, material deposits, among others. Clean up these sites, at least restoring them to the conditions existing before the start of the works;

- Part of the area around each of the wind turbine assembly platforms should be restored, leaving only one lane around each wind turbine, necessary for the circulation of vehicles assigned to maintenance operations;

- Recovering paths and roads used as access to construction sites;

- Ensure the replacement of any existing infrastructure, equipment and/or services in the areas under construction and adjacent areas, which are affected during the course of the works;

- Ensure the unblocking and cleaning of all hydraulic drainage elements that may have been affected by the construction works;

- Restore and landscape the degraded surrounding area, if applicable, through reforestation with native species and the restoration of natural infiltration conditions, with the decompression and aeration of soils;

- Carry out landscape restoration of borrow pits, if materials from outside the intervention area are required.

The following are the measures considered to be of a specific nature.

Geology and hydrogeology

- The execution of excavations and embankments should be interrupted in periods of high rainfall and due precautions should be taken to ensure the stability of the slopes and to avoid ravines and/or landslides/slips;

- In the vicinity of the site planned for the construction of the platforms of wind turbines No. 3 and No. 10, 11, 12, 13, 14 and 15, and their respective accesses, special care should be taken in earthmoving to avoid the dragging of soils into the hydrographic network, namely the Maxongoluluane River in the northern sector of the N-S ridge (wind turbine No. 3) and the tributaries of the Mixumene, Mitesandene, Libunzene, Macuabane rivers in the eastern sector of the W-E ridge that drain the area of wind turbines No. 10 to 15 and their access roads;

- Any storage of the stripped topsoil horizon, despite its reduced thickness, should be carried out in an appropriate place, duly protected by covers to prevent its mobilisation by rainwater and wind, and should be replaced later during the recovery phase of the affected areas, especially the excavation and embankment slopes of the wind turbine platforms, substation and access roads;

- The height of the earth heaps must ensure their stability and the cover must ensure that the soil is aerated. This measure is highly effective in protecting the soil and reduces the cost of restoring the affected sites, since the soil layer of the intervention site contains seeds of local plant species that will easily develop. At the same time, the use of the stripped soils for restoration of affected areas will avoid the use of other soils of good quality and consequently the movement of earth;

- The land resulting from the excavations should be used, whenever possible and that the materials have adequate geotechnical characteristics, in materials have suitable geotechnical characteristics, in construction works where landfill is required, namely in the regularisation of the platforms of the accesses to be built and in the construction and regularisation of the platforms of the wind turbines and substation;

- In view of the proximity of a well identified in the vicinity of the access to be regularised (approximately 400 m to the south of the site planned for wind turbine no. 6), it should be signposted and a protection and safety area demarcated to prevent it from being affected;

- The handling of oils during the construction phase and machinery maintenance operations must be conducted with the necessary care to limit any spillages that could cause contamination of soil and groundwater. In this sense, it is recommended that these operations take place in the area of the construction site, specifically designed for this purpose, isolated from the natural drainage network and prepared (waterproofed and capped) to be able to retain any possible spillage. In addition, it is recommended that waste oils are stored in suitable, leak-proof containers for further treatment by a licensed operator;

- In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be removed immediately and the spillage should be directed to an appropriate final destination. This prevents contamination of the underlying soil layers and deep penetration of the substances involved, which could also contaminate groundwater;

- Ensure the appropriate final destination for domestic effluents from the site, in accordance with the legislation in force, with collection in leak-proof removable devices and subsequently forwarded for treatment, thus avoiding the possibility of infiltration into the soil and potential affectation of groundwater and surface water;

- The discharge of the water resulting from the cleaning of the concrete mixers should be carried out in places to be indicated by the environmental monitoring team and never in places close to water lines. Depending on the site under consideration, the opening of a retention basin may be indicated, preferably in a place where the concrete mixers must pass. The retention basin should be waterproofed and may have a layer of gravel, which after some washing can be removed and used for backfill and replaced in the retention basin.

Surface water resources

- Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control the flow of water in the work areas in order to reduce their erosive capacity;

- Ensure natural drainage at all stages of site development;

- The site area should not be waterproofed, with the exception of places for handling and storing polluting substances;

- It is recommended that oil and fuel handling operations take place in the site area, specifically designed for that purpose, and prepared (waterproofed and capped) to be able to retain any spills;

- It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be immediately removed and the spillage directed to an appropriate final destination;

- In the event of accidental spillage outside the substance storage areas, a layer of absorbent material should be applied immediately and removal of the affected soil should be arranged to a suitable destination to be indicated by the entity responsible for environmental supervision, where no additional environmental damage will result;

- The discharge of water resulting from the cleaning of concrete mixers shall be carried out in places approved by the environmental monitoring team;

- Carry out temporary crossings of water lines in such a way as not to cause obstruction to the normal flow of water;

- If applicable, the necessary water abstraction licences should be applied for.

Soils and land use

- The layers of vegetable soil or live soil resulting from stripping should be deposited in flat areas, stored in pargas, in a place not in conflict with the works and with the areas of greatest ecological sensitivity, preferably as close as possible to the place where they are to be applied and should not be trampled by vehicles;
- Carry out appropriate modelling of the slopes and cover them with vegetable soil. Place live soil to allow and stimulate the growth of native vegetation, with a view to conserving and/or rehabilitating habitats;
- In order to avoid situations where the soil remains uncovered for long periods of time, the works should be properly planned, i.e. immediately after a stripping action the coating works should take place. These actions should be carried out successively in small sections, in order to avoid stripping large areas at once;
- Controlled removal of all spoils from stripping, deforestation/deforestation necessary for the implementation of the Project shall be ensured and may be used for soil fertilisation;
- Adequate decompaction of soils that have been compacted by the movement of machinery and vehicles, thus facilitating the regeneration of soils, vegetation and favouring the recovery of habitats.

Ecology

- Promote awareness-raising among workers not to harvest or damage plant specimens and address the ecological value of flora, vegetation and habitats;
- Avoid affecting areas of riparian vegetation;
- Concentrate site works in time, especially those that cause the most disruption;
- Inform workers and foremen of the possible consequences of a negligent attitude towards the minimisation measures identified, by instructing them on the environmentally appropriate procedures to be followed on site (environmental awareness);

- Avoid leaving roots uncovered and unprotected in trenches and excavations;
- Limit the removal of vegetation to the areas strictly necessary for the execution of the works and preserve the largest number of trees and shrubs;
- Trees to be preserved that are in the vicinity of the areas to be intervened must be identified and signposted before the start of the work and must be preserved until the end of the work that may cause damage to them;
- If the use of explosives proves necessary, pre-cutting techniques and the use of micro-retarders should be used, thus attenuating the intensity of the vibrations produced;
- Plan the timing of the works to minimise impacts on the different wildlife species relevant to this area;
- All tree and shrub species that do not affect the execution of the work must be safeguarded;
- Felling of trees with timber interest should be avoided, as well as marula trees, as they are an important source of food for the local community. Where possible, felling of these trees should be compensated by planting in a nearby area;
- Only the area of graminial strictly necessary should be affected;
- Affecting the remaining forest patch should be avoided;
- Affecting individuals of C*optosperma nigrescens* should be avoided;
- Wherever possible, the impact agricultural areas should be avoided, minimising the loss of agricultural production services;
- Carry out landscape restoration as soon as possible after the end of the operations on the intervened land and other areas that have been affected by the work (construction site area, substation surroundings, among others). This will prevent erosion and infestation by unwanted species (exotic and weeds);
- Develop maintenance actions in the areas under restoration to ensure that conditions are created for the normal development of natural habitats;

- Implement a landscape restoration plan that includes the use of native species belonging to the vegetation type described in this report.

Socioeconomy

- Employment principles and procedures should prioritise the employment of skilled local workers, contributing to local job and wealth creation;
- Employment policies should ensure the principle of gender equality;
- Training should be provided for workers in order to promote their skills;
- In case there are local expectations for employment that cannot be met by the Project, the limited availability of places should be made known to stakeholders through local authorities and community representatives;
- Employment requirements should be transparent, following pre-established and recognised criteria, and properly advertised before the recruitment process starts and respected by the contractor, so as not to limit opportunities to apply. For a better impact on communities this process should be conducted with the involvement of local leaders;
- For each position, the exact number of jobs available, the period applicable and the remuneration to be awarded for each type of work should be disclosed;
- As much training as possible should be given to local workers to perform semi-skilled tasks in order to reduce the number of workers hired from outside for this purpose;
- Specific roads/routes and timetables should be defined for the circulation of heavy vehicles involved in the construction of the Namaacha Power Plant in order to reduce pressure on other roads and traffic jams at peak times;
- Where necessary, repair roads damaged during the construction phase;

- Favour, whenever possible, the procurement of local or regional services, thus fostering the greatest added value for the local economy;
- Warn people living in and frequenting the areas most affected by the work about the timing of the work, especially to avoid constraints due to the increased movement of vehicles;
- Create safety areas with limited access and properly signposted, in order to reduce the risk of accidents, by the approach of people to the work area;
- There should be a group among the local workers responsible for communication with the community, which will be particularly important in cases of conflict. This group should be familiar with the project in general and be able to properly iron out any difficulties or pass on any complaints/grievances;
- Develop and implement a Health and Safety Plan. This plan should include training plans for workers in the area of health and safety at work;
- Provide Personal Protective Equipment (PPE) to all workers;
- The use of PPE will be mandatory (helmet, safety jacket, footwear, among others);
- Ensure that all construction vehicles and equipment (including mobile equipment) are suitable for the specific activity and comply with current legislation and standards. Regular maintenance should be carried out;
- All construction equipment must be operated by operators who have been previously trained and certified for this purpose;
- All temporary electrical installations should be assembled using the same safety specifications as for fixed electrical installations;
- All temporary electrical installations shall be inspected at least once a week by a competent person and this inspection shall be recorded;
- A competent person should be appointed for the control of temporary electrical installations on a construction site;
- All flammable liquids used on the construction site must be properly stored in order to prevent stored in such a way as to avoid fire or explosion. The storage area should be well ventilated;

- Smoking will be prohibited on site and this information should be properly signposted;
- Suitable fire fighting equipment should be provided, this equipment should be well located and labelled on site.

Sound environment

- Noise and vibration awareness raising actions for all on-site personnel, including subcontractors as part of the general worksite induction;
- Reduce lorry movements required by careful planning of construction material needs;
- Do not leave vehicles running or idling on site for longer than the minimum time necessary to complete site activities.

7.4.2 Camping methodology

As already mentioned, at each visit to the site, the team responsible for environmental monitoring should verify and record the result of the evaluation carried out for each measure, provided for in this PAAO and following the model table below filled in only as an example.

Table 7.1

Model Table of Environmental Minimisation Measures and the respective phase of the work in which they are applied

Work Development Phase	*Description of the different minimisation measures (examples filled in)* **Minimisation Measures**	**Person responsible for implementing the measure –** *examples filled in*	**Verification**			
			Compliant	Non-Compliant	Not Applicale	Remark
It should set out the different phases in which the minimisation measures will be implemented. **Example: Planning of works, construction site and areas to be intervened.**	1- Implement the Environmental Monitoring Plan for the Work of this EIA	Owner; Contractor				
	2- Concentrate site works in time, especially those that cause the most disruption	Contractor				
	3-Clearing and general earthmoving works should be programmed to minimise the period of time during which soils are uncovered and should preferably take place during the dry season. Otherwise, the necessary measures should be taken to control flows in the areas of works, with a view to reducing their erosive capacity	Contractor				
	4- Ensure natural drainage at all stages of site development	Contractor				

The final environmental monitoring report should include a systematised status report on the implementation of the environmental measures and constraints set out in the Environmental Permit, and the demonstration of the implementation of the environmental measures and constraints should be supported by objective evidence, namely written, photographic and cartographic elements. An assessment should also be made of the means required/utilised, as well as the effectiveness achieved.

8 WASTE MANAGEMENT PLAN - WORKS PHASE

This document constitutes the Waste Management Plan (WMP) that the contractor will have to fulfil during the execution of the construction works of the Namaacha Power Plant, without prejudice to the fact that it may be complemented with other obligations that the contractor will have to fulfil within the scope of any certifications it may hold.

The waste generated during the different activities to be carried out for the installation of the aforementioned project is identified and classified here, and the objectives and tasks to be carried out in managing it are also described, as well as the associated responsibilities and the means involved.

The WMP is therefore an important tool to ensure the correct prevention and management of construction waste, in order to minimise the associated environmental impacts and ensure compliance with all applicable legal requirements.

The WMP is subject to change during the course of the works in order to better adapt to the realities and circumstances of the project during its construction phase. Changes will always be recorded and a new version of the plan will be circulated to all parties involved.

The Contractor shall designate the Waste Manager who will be responsible for the implementation of the WMP, i.e., for the management of segregated waste on site, both in terms of collection and temporary packaging on site, as well as in terms of transport and final destination, using licensed operators, whose list is presented in Annex (Annex 1) to this plan (List of Licensed Hazardous Waste Transport Companies and Operators).

8.1 LEGAL FRAMEWORK

The legal framework for the accountability of Mozambican municipalities in the management of municipal solid waste is supported by Law No. 2/97 of 18 February where, in Article 6, it defines that the duties of local authorities respect the own, common and specific interests of their populations (MICOA (2006) cited in Fernando, 2013).

At national level, the legal acts related to urban solid waste management are:

- Decree no. 94/2014, of 31 December, approved the Regulation on Urban Solid Waste Management;
- Decree no. 83/2014, of 31 December, approved the Regulation on Hazardous Waste Management;

- Technical directive for the establishment and operation of sanitary landfills, 2010;

- Integrated Urban Solid Waste Management Strategy;

- Decree No 8/2003 of 18 February 2003 - Regulation on the management of bio-medical waste.

8.1.1 Urban Solid Waste

Decree No. 94/2014, of 31 December - Regulation on the management of urban solid waste, establishes the rules for the management of urban solid waste in the territory of Mozambique and is applicable to all natural and legal persons, public and private who are involved in the production and management of urban solid waste or industrial and hospital waste equivalent to urban waste.

Excluded from the scope of the Regulation are (i) hazardous industrial waste, (ii) biomedical waste, (iii) radioactive waste, (iv) effluent emissions and discharges, (v) waste water and (vi) other wastes subject to specific regulations.

Urban solid waste is classified according to the Mozambican Standard NM339 - Solid Waste - Classification. This Decree covers Urban Waste, Special Waste, Bioresidues, Bulky Domestic Waste, Commercial Domestic Waste, Industrial Domestic Solid Waste equivalent to urban waste and Hospital Solid Waste equivalent to domestic waste.

The competences for urban solid waste management are divided between the Ministry that oversees the Environment Sector and the Municipal Councils and District Governments, in their respective areas of jurisdiction. The competences of each entity are described in Table 8.1.

Table 8.1

Urban Solid Waste Management Competences

Ministry that oversees the Environment Sector	**Municipal Councils and District Governments, within their respective areas of jurisdiction**
• Issuing and publicising rules on procedures to be followed in the management of municipal solid waste; • Carry out surveys of urban solid waste storage and/or disposal facilities or sites; • Ensure the involvement of other institutions in carrying out the planned surveys; • Ensure access to relevant information on urban solid waste management;	• Ensure proper management of urban solid waste (USW); • Drafting and approving Municipal Bylaws and Regulations on Urban Solid Waste and Urban Cleaning, as well as other specific rules; • Define the procedures for the collection, transport, treatment and final disposal of USW; • Promote good USW management practices (recycling, composting, separate collection and landfill); • Setting fees for USW collection, transport, treatment and disposal services;

Ministry that oversees the Environment Sector	Municipal Councils and District Governments, within their respective areas of jurisdiction
• Promote good urban solid waste management practices at country level (recycling, composting, selective collection and sanitary landfills); • Prepare and keep updated the National Register of all public and private entities handling urban solid waste; • Adopt, in co-ordination with municipalities or district governments, the necessary measures to stop the storage, disposal or transport of urban waste, carried out illegally and/or in conditions that pose a danger to public health or the environment; • Penalise managers of Municipalities or District Governments when situations of inadequate management of urban solid waste are detected; • Monitor and enforce compliance with the provisions of the Regulation on urban solid waste management.	• Register the public or private entities handling USW within its area of jurisdiction; • Adopt, in coordination with the supervisory sectors, the necessary measures to suspend the storage, disposal or transport of USW carried out illegally and/or in conditions that pose a danger to public health or the environment; • Ensure compliance with the provisions of the Regulation on urban solid waste management; • Penalise offenders in accordance with established rules and regulations.

All facilities for the treatment and final disposal of municipal solid waste are subject to prior environmental licensing under the Regulation on the Environmental Impact Assessment Process. According to the Regulation on urban solid waste management, the environmental licensing process consists of three steps:

- Issuance of the Provisional Environmental Licence, issued after approval of the EPDA for EIA;
- Issuance of the Environmental Installation Licence, issued after approval of the Environmental Impact Study and submission of the Resettlement Plan;
- Issuance of the Environmental Operating Licence, issued after verification/inspection of full compliance with the EIA versus constructed enterprise and full implementation of the Resettlement Plan, if required.

When the environmental feasibility of the activity is proven, the competent bodies notify the applicant to pay the appropriate fees referred to in Article 27 of the Regulation on urban solid waste management within 90 days, and the Environmental Impact Assessment Authority issues the respective environmental licence within 15 working days.

If the environmental feasibility of the activity is not proven, in cases of serious objections, the Environmental Impact Assessment Authority may: totally disapprove the implementation of the proposed activity, with due scientific and legal grounds; partially disapprove the proposed activity with due scientific and legal grounds, or; change the category of the proposed activity. In such cases, the Environmental Impact Assessment Authority shall notify the interested parties within five working days, and the costs associated with the reformulation of the activity proposal shall be the sole responsibility of the proponent.

According to the provisions of Article 22 of the Regulation on Urban Solid Waste Management, the Environmental Licence expires two years after its issuance if the activity has not actually started. In case the proponent is still interested in implementing the activity, he/she must request the extension of the respective Environmental Licence to the Environmental Impact Assessment Authority within 90 days of its expiry. Following this application, the decision of the Environmental Impact Assessment Authority may be to extend the licence for an equal period of time, to partially update the EIA or EAS specifying the component that needs to be amended, or to carry out a new EIA or EAS in accordance with the Regulation on municipal solid waste management.

The Provisional Environmental Licence is valid for two years and is not renewable. The Installation Environmental Licence, on the other hand, is valid for two years and may be renewed subject to justification. The Environmental Licence for activities in operation is valid for a period of five years and is renewable for an equal period of time, subject to an updated application and payment of the respective fee.

The entities responsible for the management of municipal solid waste carry out actions that must be controlled by them, fulfilling their obligations and duties, from producers to transporters and operators. Therefore, according to Article 11 of Decree No. 94/2014, of 31 December, the following are obligations of producers, transporters and operators of USW:

- Minimise USW production;
- Train workers involved in waste handling on health, safety and the environment;
- Ensure segregation and packaging of waste into different categories in accordance with the provisions of Article 14 of the Regulation on urban solid waste management;
- Ensure the treatment of USW before its proper final disposal;
- Ensure the protection of all workers involved in USW management against accidents and diseases resulting from their exposure to the risk of contamination;
- Ensure that the transport of waste is carried out in an appropriate manner, ensuring that there is no dispersion of waste along the route to the final destination;
- Ensure that the disposal of waste, both on and off site, does not have a negative impact on the environment or on public health and safety;
- Keep a detailed annual record of the origins, quantities and types of waste handled, transported, treated, recovered or disposed of.

The entities responsible for waste management must inform the Municipal Council or District Government in the event of accidental spillage of urban solid waste, as well as the measures taken, within 24 hours of the incident.

The specific methods or processes for the collection and transport of USW are established by the Municipal Councils or District Governments, in accordance with the legislation in force, and the competent authorities are free to adopt the collection and transport system that they find technically most appropriate for each situation and type of waste to be collected.

The transport of waste must be done in appropriate vehicles, in order to minimise the risks to the workers involved, the general public and the environment. The routes, frequencies and schedules for the collection and transport of waste are defined and approved by the Municipal Councils or District Governments, which must subsequently be informed to the residents or population of the area of jurisdiction about the places and times of placement and collection of waste.

The separate collection system must be approved by the Municipal Councils or District Governments, and waste must be separated according to the following categories:

- Organic matter;
- Pape ror cardboard;
- Rubble;
- Plastic;
- Glass;
- Metal;
- Textiles;
- Rubber;
- Bulky household waste;
- Special waste.

The urban solid waste treatment and recovery system is established and approved by the Municipal Councils or District Governments.

The final disposal of urban solid waste complies with the operational standards established by the Ministry that oversees the Environment Sector and must be carried out in sanitary or controlled landfills.

According to Article 5 of the Regulation on urban solid waste management, the competent entities for the management of urban solid waste have the responsibility and obligation to:

- Ensure that USW is not dumped on beaches, in the sea, watercourses and bodies of water, or in other places that may pose a danger to public health and the environment;
- Ensure that solid waste is not deposited or burnt in the open or in facilities and equipment not licensed for that purpose;
- Ensure compliance with the obligations concerning producers, transporters and operators of urban solid waste, as provided for in Article 11 of the Regulation on urban solid waste management;
- Keep an annual record of the origins, quantities and types of waste handled, transported, treated, recovered or disposed of, in accordance with the minimum requirements set out in Annex II;
- Ensure compliance with the other provisions of the Regulation on urban solid waste management.

All public and/or private entities carrying out activities related to the management of urban solid waste are obliged to draw up and implement an integrated management plan for the urban solid waste they manage, containing at least the information in Annex I of the Regulation on urban solid waste management.

Integrated urban solid waste management plans must describe the current situation of waste management, define the measures to be adopted to improve treatment and disposal in an environmentally sound manner. To this end, Annex I of Decree 94/2014, of 31 December, indicates the minimum requirements of an Integrated Urban Solid Waste Management Plan, which must include the following elements:

- Characterisation of the Municipality/District;
- Objectives and targets of the Plan during the five years of its validity;
- Organisational aspects related to waste management, including a description of the sharing of responsibilities between the actors involved in waste management, indicating the expenditure of the sector and proposals for sustainability/options to increase revenue;

- Current Status of Municipal/District Urban Solid Waste Management;
- Analysis of strengths, weaknesses, threats and opportunities;
- Proposals for proper management of urban solid waste;
- Proposals for actions to carry out awareness-raising and information campaigns aimed at the general public or specific consumer groups;
- Annexes;
- Bibliography.

8.1.2 Hazardous Waste

Decree No. 83/2014, of 31 December - Regulation on hazardous waste management establishes the rules for the generation and management of hazardous waste in the territory of Mozambique and is applicable to all natural and legal persons, both public and private involved in the management of hazardous waste and the import, distribution and marketing of used and new expired tyres.

Excluded from the scope of the Regulation are (i) biomedical waste, (ii) radioactive waste, (iii) effluent emissions and discharges other than those with hazardous characteristics in accordance with Annex III to the Regulation, (iv) waste water other than those with hazardous characteristics in accordance with Annex III to the Regulation and (v) other hazardous waste subject to specific regulation.

The Ministry overseeing the Environment Sector holds the competences for hazardous waste management.

Hazardous waste is categorised according to the different types of activity as listed in Annex IX (waste defined by a six-digit code). For export purposes, according to the Regulation, hazardous waste is classified according to the provisions of the Basel Convention which are listed in Annex X of the Regulation.

Associated with this waste is a list of prohibitions and obligations for producers, transporters and operators of hazardous waste, summarised in Table 8.2 below.

Table 8.2

Prohibitions and obligations for producers, transporters and operators of hazardous waste

Prohibitions	Obligations of producers, transporters and operators of hazardous waste
Article 7 of Decree 83/2014 of 31 December: • the recycling and use of plastic packaging and materials contaminated by pesticides and obsolete chemicals, except for packaging where the concentration of active ingredients is below the limits set out in Annex IX(3); • The recycling and use of plastic packaging and materials contaminated by agrochemicals and obsolete chemicals for the manufacture of household utensils and all drinking water pipework; • The import of empty packaging contaminated by pesticides and obsolete chemicals; • The import, distribution and marketing of all types of used tyres and new expired tyres on the national market, with the exception of tyres with dimensions equal to or greater than 750R/16 within the expiry date, including tyres used in aviation.	Article 8 of Decree 83/2014 of 31 December: • Ensure compliance with the general principles of hazardous waste, as set out in Article 4; • Minimise the generation of hazardous waste; • Ensure proper segregation and packaging of the different categories of waste; • Ensure that all waste to be transported carries minimal potential risk of contamination to the workers involved, the general public and the environment; • Ensure proper treatment of waste prior to disposal, using good practice and recommended technological options; • Ensure that the temporary storage and disposal of waste, both on and off site, does not have a negative impact on the environment or on public health and safety. • Ensure the protection of all workers involved in the handling of hazardous waste against accidents and illnesses resulting from their exposure to contamination risks; • Train its employees on health, safety and the environment; • Inform, within 24 hours, the Ministry overseeing the Environment Sector in case of accidental spills of hazardous waste; • Provide the public with accessible information on product reuse and recycling options.

Licensing and Certification

Installations and equipment intended for the preliminary storage, transport, deposition, treatment, recovery or disposal of hazardous waste are subject to prior environmental licensing, in accordance with the Regulation on the Environmental Impact Assessment Process and other legislation in force. The application for the licence must be submitted to the competent bodies, in accordance with the terms of the same Regulation and following the formal procedures described therein, and must be accompanied by the Waste Management Plan. The procedure for assessing the licence application will be carried out in accordance with the Regulation on the Environmental Impact Assessment Process.

In addition to the licences legally required for operators and transporters of hazardous waste, they must submit an application for certification to carry out their activities to the Ministry overseeing the Environment Sector (Table 8.3).

Table 8.3

Information to be included in the application for hazardous waste operator certification

Operators	Transporters
• Full operator identification; • Taxpayer number (NUIT); • Hazardous Waste Management Plan; • Documents proving that the applicant has facilities for waste management operations; • Documents proving ownership, authorisation note or certified copy of the contract with the owners or managers of the final disposal site authorising the operator to use the site for the final disposal of hazardous waste, stating the period of validity of the contract or authorisation note; • Proof of the existence of appropriate protective equipment for the activity and of a health plan covering all workers involved in hazardous waste management operations; • Documentation referred to in points (g) and (h) of the NUIT for the case where the operator is at the same time the transporter.	• Full identification of transporter; • Taxpayer number (NUIT); • Hazardous waste transport operations plan in accordance with the rules and procedures set out in Annex VIII, without prejudice to the provisions of specific legislation in force; • Documents proving ownership, authorisation note or certified copy of the contract with the owners of the premises for the parking of their hazardous waste vehicles, mentioning the period of validity of the contract or authorisation note; • Detailed sheet containing information on the place of departure, time, type of waste, quantities and place of final destination of the transported waste and number and expiry date of the certification of the operators involved; • Proof of the existence of appropriate protective equipment for the activity and of a health plan covering all workers involved in hazardous waste transport operations; • Number, type, technical specifications, capacity and identification of the vehicles to be used in carrying out this activity; • Declaration under oath that the hazardous waste transport vehicles to be certified will not be used for other types of cargo, or application for authorisation to use these vehicles for the transport of other types of cargo to be specified, indicating that this activity does not present any risk of contamination for the other types of cargo transported; • Declaration under oath that the hazardous waste transported in the course of the activity has as its final destination the site indicated in the form referred to in point 5 above.

Segregation of Hazardous Waste

Hazardous waste must be segregated according to the classification set out in Annex III and IX to the Regulation, and each producer or handler of such waste must have, as a minimum, technical conditions for the packaging of the waste in its possession.

Packaging

The process of identifying and packaging hazardous waste, as well as its transport, should be in accordance with the international principles and standards assumed by the country in international conventions on hazardous waste management.

The packaging of this waste must be carried out in accordance with technical standards established by specific instructions, and must at least be in containers capable of withstanding normal storage and transport operations, which are hermetically sealed to prevent their contents from escaping to the outside, must not be damaged by their contents, must not form hazardous substances after contact with their contents and must be properly labelled with the symbols provided for in Annex IV to the Regulation.

Collection

The collection of hazardous waste is the sole responsibility of the producers. Therefore, any producer and holder of hazardous waste must entrust their waste to a private or public collection service that carries out the operations and is duly licensed to carry out these activities.

When collecting hazardous waste, a manifest in Annex VI must be completed in quadruplicate stating the quantity, quality and destination of the waste collected. Of the four copies required, one should be kept by the waste generator, one by the waste transporter, one by the product recipient and the last one should be sent to the Ministry overseeing the Environment Sector every six months.

Transport

The movement of hazardous waste must be analysed in two different situations, according to Articles 15 and 16 of Decree No. 83/2014, of 31 December: When it happens inside the facilities of the producing entity and when it happens outside the facilities of the producing entity.

When hazardous waste is moved within the production organisations, its generation, packaging site, storage and treatment must be carried out using appropriate equipment or vehicles with a base and walls capable of containing it. All equipment used must be washed and decontaminated properly, and the water resulting from this washing must be treated in accordance with the legislation in force.

When the hazardous waste is moved outside the producer's premises, it must be carried out with the necessary adaptations, complying with the provisions of the Road Traffic Code, if done on public roads. This movement of hazardous waste can only be carried out by transporters duly certified by the Ministry that oversees the Environment Sector or by the armed forces, in compliance with the specific legislation on the matter.

If the movement is transboundary through national territory, an agreement is required with the constraints imposed by Resolution 18/96 of 28 November, which ratified the Basel Convention on transboundary movements of hazardous wastes and their disposal, the instructions on the matter being to be approved by the Ministry overseeing the Environment Sector.

Movement of Hazardous Waste

Movement of Hazardous Waste Within the Producer's Premises

- The movement of hazardous waste within the premises of producing entities, from the point of its generation to the places of packaging, storage and treatment must be carried out using appropriate equipment or vehicles with a solid base and walls and which are capable of containing it;
- Equipment or vehicles used for the above operations should be suitable to allow adequate washing and decontamination;
- Water resulting from the washing of equipment or vehicles used in transport must be treated in accordance with current legislation.

Movement of Hazardous Waste Outside the Producer's Premises:

- The movement of hazardous waste on public roads will be carried out with the necessary adaptations, in compliance with the provisions of the Road Traffic Code, on the movement of vehicles carrying out special transport operations;
- Hazardous waste may only be moved outside the premises of the producing entities by transporters duly certified by the Ministry overseeing the Environment Sector, in accordance with the provisions of Article 10 of this Regulation;
- The transport of hazardous waste carried out by the armed forces will comply with the specific legislation on the matter;
- The transboundary movement of hazardous waste through the national territory is carried out in accordance with the constraints imposed by Resolution no. 18/96, 28 November, which ratified the Basel Convention on the transboundary movement of hazardous waste and its disposal and in the instructions on the matter to be approved by the Ministry that oversees the Environment Sector.

Treatment, Disposal and Deposition

According to Article 17 of Decree No. 83/2014, of 31 December, entities involved in the treatment, disposal, deposition and/or energy recovery of hazardous waste must carry out a risk assessment during the development or revision of the Waste Management Plan, demonstrating the environmental feasibility of the operation to be adopted for the specific case, determining the most advisable deposition option.

Where the most advisable disposition option is to landfill hazardous waste, this should be done in industrial landfills. The co-processing of hazardous waste in cement kilns should only take place when the objective is the utilisation of alternative materials and energy recovery.

Any entities involved in the hazardous waste deposition process must review their Hazardous Waste Management Plan every five years, with the aim of achieving the technically and scientifically advisable method of deposition.

Specific Obligations of Entities Handling Hazardous Waste

In addition to the generic obligations set out in Table 8.2, as well as those arising from compliance with the procedures set out in Chapter II (Licensing and Certification), it is a specific obligation for entities generating or handling hazardous waste to appoint a coordinator responsible for the area of hazardous waste management. And they are responsible for adhering to the following recording and reporting requirements:

- Conduct and maintain a thorough annual record of the origins, quantities and types of waste generated, transported, treated, recovered, disposed of or exported, and of the occurrence of accidents;
- The annual register referred to in the previous paragraph must be submitted to the Ministry that oversees the Environment Sector by the end of the first quarter of the following year and must be kept for five years.

Hazardous Waste Management Plan

All public and/or private entities carrying out activities related to the management of hazardous waste shall develop a hazardous waste management plan, based on the general principles set out in Article 4 and containing as a minimum the information contained in Annex II, before commencing their activities.

This Plan must be submitted to the entity that oversees the Environment Sector for consideration, which must take place within a maximum of 30 days from the date of receipt of the file. Once approved, the hazardous waste management plan is valid for a period of five years, counted from its approval by the entity that oversees the Environment Sector, and during this period any changes to the elements previously provided for consideration must be communicated to that entity.

The hazardous waste management plan must be updated and submitted to the Ministry overseeing the Environment Sector no later than 90 days before its expiry date, and this institution must renew the respective environmental licence. An updated hazardous waste management plan, taking into account the findings of public or private environmental audits carried out during the period covered by the plan, must be attached to the application for renewal. The entity intending to recycle plastic pesticide packaging must submit, during the licensing process, specific authorisation from the ministries overseeing the Agriculture and Environment Sectors.

Information to be included in hazardous waste management plans:

<u>Landfills</u>

Written Pieces

Descriptive and Justification Statement

a) Object of the project.

b) Planning, site selection and project bases, including area and volumes occupied.

c) Geological, geotechnical and hydrogeological characteristics of the site;

d) Typology and quantity of waste;

e) Risk management processes;

f) Procedures to be followed for the prevention and minimisation of waste generation;

g) Techniques, equipment and procedures to be observed for waste treatment;

h) Location and characteristics of the waste storage site, as well as storage procedures, including information on the type and characteristics of storage containers;

i) Type, characteristics of means of transport and procedures to be followed for the transport of waste from the point of its generation to the place of its deposition;

j) Procedures to be followed for the deposition or disposal of waste;

k) Waterproofing system;

l) Rainwater and leachate drainage systems;

m) Leachate treatment, prediction of leachate quantity and quality;

n) Monitoring of leachate and groundwater to prevent contamination thereof;

o) Drainage and treatment of biogas, if necessary;

p) Landfill operation plan;

q) Staff structure and working hours

r) Safety plan for populations and workers in the system;

s) Waste acceptance plan;

t) Waste collection plan;

u) Final cover, landscape restoration and post-closure monitoring;

v) Procedures in case of accidents, spillages, discharges and accidental leakages;

w) Means and responsibilities for carrying out the activities set out in the waste management plan.

Sizing

a) Sizing and calculation of waterproofing barriers;

b) Sizing and calculations of the leachate treatment plant.

Designed Pieces

A. Location plan (scale of 1:25 000)

B. General plan of the landfill (with clear indications of all infrastructure components, including siting of the waste disposal cell and pre-treatment sites)

C. Details of the waterproofing stratigraphy and final cover of the landfill.

Other Waste Management Operations

Written Pieces

Descriptive statement, which should include:

a) Location of the facility where the waste management operations take place, including the site address, province, district and locality, telephone, fax number;

b) Waste handled, its foreseeable origin, qualitative and quantitative characterisation and its classification according to this Regulation;

c) Identification and classification of other substances used in the process;

d) Indication of quantities and characteristics of finished products;

e) Indication of the number of workers, social, occupational health and sanitary facilities;

f) Description of facilities, including storage facilities;

g) Identification of apparatus, machinery and other equipment with indication of the main sources of noise and vibration emissions;

h) Identification of pollutant emission sources;

i) Quantitative and qualitative characterisation of liquid and gaseous effluents and waste resulting from the activity;

j) Description of the internal measures for minimisation, reuse and recovery of the waste produced with an indication of its qualitative and quantitative characterisation, where possible;

k) Identification of the destination of internally generated waste, with indication of its qualitative and quantitative characterisation and description of storage at the place of production itself, if applicable;

l) Document proving the willingness of the intended consignee to accept the waste;

m) Description of the environmental measures proposed to minimise and treat liquid effluents and their monitoring, indicating the proposed final destination;

n) Description of the environmental measures proposed to minimise and treat the gaseous effluents, their monitoring, characterisation and chimney sizing;

o) Internal and external sources of risk, security organisation and means of prevention and protection, in particular with regard to fire and explosion risks.

Designed Pieces

A. Location plan of the facility (on a scale not smaller than 1:25 000)

In the case of hazardous waste management operations and incineration of non-hazardous waste, this plan shall indicate, within a radius of 10 km from the facility, the main buildings such as hospitals and schools.

B. Location plan of the facility to which the operation relates (on a scale not smaller than 1:2 000)

It should indicate the location of waste management areas, effluent treatment systems and the location of their final discharge points, workshops, depots, offices and other infrastructure.

8.2 PREVENTION OF WASTE GENERATION

When choosing suppliers, products and equipment to be used on site, it is important to consider minimising the production of waste. To this end, the following criteria should be adopted:

- Re-use in the site itself, as backfill material, the inert material from excavation activities which should be deposited in the surroundings of the sites from which it was removed;
- The materials used and not consumed must be reused within the work itself or in external works, subject to prior authorisation;
- In the environmental and landscape restoration of mining and quarrying operations;

- In the cover of landfills for waste.

These materials are therefore not categorised as waste, but their generation and transport must be recorded, as explained in the following chapters.

8.3 WORKER TRAINING AND AWARENESS-RAISING

The Contractor must ensure that all his employees, as well as the employees of the subcontractors, are informed about the existence of the WMP and the obligation to comply with all the waste management rules identified therein.

The Contractor shall prepare and carry out, whenever deemed necessary, awareness-raising campaigns for workers.

8.4 MINIMISATION MEASURES

In terms of waste production, the implementation and practice of the general minimisation measures defined in subchapter 11.3 of the EIA should be ensured. The following should be emphasised:

1. Implement the Waste Management Plan and the respective minimisation measures contained therein, in accordance with the provisions of the EMP;

2. Ensure the correct temporary storage of the waste generated, according to its typology and in accordance with the legislation in force. Provision must be made for the containment/retention of any run-off/spillages. It is not permissible to deposit waste, even temporarily, on the banks, beds of water lines and areas of maximum infiltration;

3. Open burning of waste is prohibited;

4. Waste produced in social areas and comparable to urban solid waste must be deposited in containers specifically designated for this purpose and must be sent to an appropriate final destination to be agreed with the municipality;

5. Construction and demolition waste and similar non-hazardous industrial waste shall be sorted and separated into its recyclable components and subsequently recovered;

6. Used oils, lubricants, paints, adhesives and resins should be stored in suitable, leak-proof containers and then sent to an appropriate final destination, preferably recycling;

7. Keep an updated record of the quantities of waste generated and their final destinations,

based on the documentation provided for in the legislation;

8. Ensure proper final disposal of domestic effluent from the site, collection in tanks or leak-proof pits;

9. The product storage area and the car parking area must be drained into a retention basin, sealed and isolated from the natural drainage network, in order to prevent accidental spillage of oils, fuels or other hazardous products from contaminating soil and water. This retention basin must be equipped with a hydrocarbon separator;

10. The storage of fuels and/or other polluting substances is only permitted in watertight containers, properly secured and within the site area prepared for that purpose. Containers must be clearly identified and labelled to indicate their contents;

11. Where a chemical spill occurs on the ground, the contaminated soil should be collected, if necessary with the aid of a suitable absorbent, stored and sent for final disposal or collection by a licensed operator;

12. If generators are to be used during the work, to supply electricity to the site, for testing the wind turbines or for other purposes, they must be properly maintained in order to avoid contamination of the soil;

13. Maintenance and washing of machinery and vehicles should not be carried out in the project area. If necessary, conditions should be created to ensure that the soil is not contaminated.

In addition, the following specific minimisation measures should be adopted:

8.4.1 Construction phase

1. The waste resulting from the various construction works (cardboard, plastic and metal packaging, frames, formwork, among others) must be temporarily stored in a container in the construction site area, for later transport to an authorised location;

2. Waste shall be sent to duly licensed companies as described in subchapter 7.10.1 and Annex 1;

3. The segregated waste must be collected daily from the work fronts and temporarily stored on site, properly conditioned and in places specifically prepared for this purpose;

4. Inert material from excavation operations should be deposited in the surroundings of the sites from which it was removed, to be used later in backfilling operations;

5. The site for the temporary waste storage facility should be clearly defined and labelled for this purpose. Access to this site must be restricted. Waste must be segregated and stored separately according to its characteristics and final destination. The storage locations for the different types of waste must be identified. The storage of waste on site must be done under appropriate conditions, as established in the applicable legislation in force;

6. All waste classified as hazardous, namely waste oils, lubricants, as well as waste contaminated by oils, should be properly conditioned and stored in an appropriate place. The construction/implementation of a retention basin should be considered in order to minimise the impact of any spills. Subsequently, they should be taken for appropriate treatment by a company licensed for this purpose (list of waste operators - Annex 1);

7. The temporary storage of waste oils and fuels should be carried out in a waterproofed and covered place, with an accidental spillage retention basin, separating used hydraulic and motor oils for differentiated management. Containers should have clearly identified on the outside the different types of oil;

8. The rejection of any type of waste into water lines or soil should be prohibited. Hazardous waste must be managed individually, in accordance with the law;

9. Select companies to treat and dispose of the different segregated waste that are included in the lists of units accredited for this purpose;

10. Provide the site with waste collection equipment in number, capacity and type, appropriate to the waste produced.;

11. Remove and properly dispose of solid and liquid waste produced on site (list of waste operators - Annex 1).

8.4.2 Operation phase

1. Waste must be stored in an appropriate manner, separating hazardous waste from non-hazardous waste, under technical conditions that prevent the contamination of the environment by such waste;

2. The waste shall be sent to duly licensed companies as described in subchapter 7.10.1;

3. The forwarding to a duly authorised final destination of the waste generated in these operations.

9 RESTORATION PLAN FOR INTERVENED AREAS - WORKS PHASE

9.1 INTRODUCTION

This Plan aims to establish the guidelines for the implementation of restoration actions in the areas intervened during the construction works of the Namaacha Power Plant, ensuring the appropriate environmental conditions, which contribute to the minimisation of the negative impacts potentially introduced.

After the completion of the execution and assembly works of the wind turbines, including the backfilling of the trenches necessary for the installation of all the associated cabling, the electrical power conditioning systems, the electrical installation of the substation and control building, the paths and respective drainage system, and the fencing of the control building / substation, there will be a landscape recovery of the intervened areas where there are no definitive infrastructures on the surface of the land.

The restoration of these areas aims to re-establish native vegetation which in turn promotes the minimisation of the impact on the landscape, and the minimisation of the erosive action of winds and rains.

Through simple options, which are fundamentally based on the implementation of actions that favour natural regeneration, the following objectives are pursued:

- Enhance the landscape in its most global meaning (carrier of an ecological and cultural structure), whose quality has been diminished by the execution of the work, which consequently contributes to human comfort, both for visitors and for residents in the vicinity of the Project;

- Protect embankments and excavation slopes from water and wind erosion.

The recovery of the intervened areas could be achieved more slowly by a process of natural regeneration, or it could be accelerated by the use of hydro-sowing.

In the present situation of the Namaacha Power Plant, and taking into account the local conditions, it is proposed that the recovery of the intervened areas be carried out only at the expense of their covering with vegetable soil in the manner defined in the following points.

At the end of two years, if the vegetation regenerates poorly, then a reassessment of the natural condition of the land will be carried out and additional restoration measures proposed, if appropriate.

The scope of this Intervention Area Recovery Plan (PRAI) focuses on the construction phase of the Project, and the assessment and monitoring of vegetation recovery will take place during the first two years of the exploration phase, and may be extended if additional corrective measures are implemented at the end of the two years.

9.2 AREAS TO BE RESTORED

Under this Plan, the following areas will be restored and renaturalised:

- Site location;
- Storage sites for miscellaneous and inert materials;
- Surrounding the wind turbines (foundation base and assembly support platforms);
- Surrounding the substation and control building (including the foundations of the fence to be built around them);
- Cable trenches;
- Excavation and embankment slopes.

9.3 INTERVENTIONS TO BE IMPLEMENTED

9.3.1 Actions to be implemented at the beginning of the construction phase

In order to ensure the necessary conditions for a correct recovery of the intervened areas, the Contractor will have to ensure from the beginning of the work and throughout its development the realisation of some measures related to the actions of deforestation and stripping and storage of topsoil, as described in the following points.

Deforestation and stripping actions

Controlled removal of all spoils from deforestation and stripping actions necessary for the implementation of the Project shall be ensured, and these may be used for soil fertilisation. With the exception of woody material, which must be duly recovered.

The land surfaces to be excavated or landfilled must be previously cleared of debris and woody vegetation (trees and shrubs), while retaining the sub-shrub and herbaceous vegetation to be removed by stripping. Clearing and deforestation also includes the storage and transport of materials from this operation to an area pre-defined by the environmental inspection team.

Deforestation and soil stripping works shall be limited to strictly necessary areas. The areas adjacent to the areas intervened in the framework of the Project, even if they can be used as support areas, must not be deforested or stripped.

The stripping of the areas of land to be excavated or landfilled, which allows the topsoil necessary for the restoration of the intervened areas to be obtained, must take place immediately before the earthmoving works and will concern the areas of soils richer in organic matter and with a light texture, in a thickness that varies according to the characteristics of the land, comprising only the removal of topsoil.

Storage of topsoil

Topsoil stripped from the surface of the soil should not exceed two metres in height and should be located in the vicinity of the sites from which the topsoil was removed, on flat, well-drained areas for later use in restoration actions.

The loading and unloading of the topsoil stored in the pargas must be carried out in such a way that the vehicles used for these operations do not block the pargas.

Only the application of topsoil from the site itself is authorised.

9.3.2 Restoration actions to be carried out after completion of construction works

At the end of the work, the following restoration actions stand out:

- **Cleaning of the Work Fronts:** after completion of the civil construction works and assembly of the equipment, the contractor must clean all the work fronts. This will include actions such as the dismantling of the construction site, removal of any waste, removal of construction materials and equipment unnecessary for the environmental restoration actions of the intervened areas.

- **Terrain Modelling:** All areas to be re-naturalised that have been subject to intervention during the construction works should be modelled before site preparation works commence.

  The ground should be placed at the final design levels using the inert resulting from the excavations, endeavouring to establish surfaces in perfect connection with the natural terrain and in order to avoid erosion phenomena and to enhance the installation of vegetation.

- **Construction Site and Support Areas:** the surfaces that are occupied, when not rocky, if compacted, must be mobilised to a depth of 0.30 m by ploughing or scarifying followed by harrowing. External materials that have been used to cover the natural ground, such as tout-venant and/or gravel, must be removed beforehand.

- **Slopes:** on the existing slopes along the access roads, as well as in the entire area surrounding them that has undergone deforestation or soil compaction, a layer of vegetable soil should be applied as soon as possible after the earthmoving operations.

- **Wind turbine assembly platforms:** once the equipment assembly work has been completed, the platform should be renaturalised, with the application of a layer of topsoil, in order to ensure the natural repopulation by native vegetation, leaving an area around the wind turbine uncovered, in tout-venant, in order to ensure the movement of vehicles of the maintenance teams.

- **Substation and control building:** upon completion of the construction works, assembly of structures and equipment, a layer of topsoil should be applied in the surrounding areas to ensure the natural repopulation of these areas by native vegetation.

- **Cable trenches:** after backfilling the trenches opened for the installation of underground cables, with the earth from their excavation, a layer of topsoil should be placed to enhance the restoration of the native vegetation cover in a natural way.

- **Spreading of topsoil:** the topsoil should only be spread after the ground surface has been properly prepared. Immediately before spreading the topsoil, the ground surface should be rough enough to allow good adhesion to the topsoil layer and show no signs of surface erosion. If there is evidence of erosion, a slight surface mobilisation of the soil to a depth of about 10 cm should be carried out to fill in the furrows and ravines at points already eroded.

9.4 MONITORING OF REDEVELOPED AREAS

The restoration of the intervened areas that were subject to environmental rehabilitation at the end of the work will be monitored for a period of 2 years. To this end, visits will be made to the project site, the first at the end of the work and the others during the first two years of the operating phase of the Namaacha Power Plant.

The report corresponding to the end of the construction phase will portray the general verification of the redevelopment work carried out by the contractor, and will also include the bases that will constitute the reference situation for comparison with future situations of the state of evolution of the vegetation. To this end, the Official responsible for monitoring the recovery of the intervened areas that have been subjected to environmental redevelopment will travel to all the work fronts in order to select the sites that will serve as a reference for the evaluation of the subsequent restoration, and to make the necessary records in order to have a reference situation suitable for the purpose in view.

In the operation phase, the same Official will visit the Project site once a year, in mid-spring, adjusting the timing to the most favourable season for carrying out floristic inventories, but also taking into account the time that has elapsed since the completion of the requalification works. At this stage annual reports will be delivered, one after 1 year and the other after 2 years.

The reports will include the results of the vegetation assessment to determine whether the vegetation is evolving in accordance with the intended objective (total cover of the intervened areas) or whether, on the contrary, it will be necessary to intervene in the area to induce the colonisation of the spaces intervened by the Project. These reports will describe the evolution of the vegetation in the affected and surrounding areas, identify the areas that have not recovered and the reasons for this, and propose minimisation measures and new campaigns, if appropriate.

Any additional measures to be taken will depend on the results obtained over the two years of monitoring. If after two years there is no or poor recovery of the vegetation and/or erosion areas, corrective measures should be proposed, for example, the application of hydroseeders.

Any measures proposed should be subject to a restoration verification campaign for one year after their realisation.

10 MEASURES IN THE OPERATIONAL PHASE

10.1 GEOLOGY AND HYDROGEOLOGY

1. Decommission the area allocated to the works for the execution of the project, with the dismantling of the construction sites and removal of all equipment, support machinery, material deposits, among others. Clean up these sites, at least restoring them to the conditions existing before the start of the works;

2. In the operation phase it is recommended that all maintenance operations are carried out with due care to avoid accidental spillages of oils, fuels or other substances;

3. Waterproofed areas should be reduced to the minimum necessary, promoting the decompaction of the soils of the work areas after completion of the works, in places where future use for maintenance actions of the enterprise is not foreseen. This measure will have an impact on the easier infiltration of precipitation water;

4. During the operation phase, consideration should be given to emergency and safety plans to deal with any accidental spills that may affect the hydrogeological environment of the study area.

10.2 SURFACE WATER RESOURCES

5. Oil handling operations, in the case of maintenance and repair of structures, should take place in an area specifically designed for that purpose, and prepared (waterproofed and capped) to be able to retain any spillages;

6. It is recommended that waste oils are stored in suitable, leak-proof containers. In the event of an accidental spillage of oils, fuels or other substances, the affected soil layer should be removed immediately and the spillage directed to a suitable location;

7. In the event of accidental spillage outside the substance storage and equipment maintenance areas, a layer of absorbent material shall be applied immediately and removal of the affected soil shall be arranged to a suitable destination to be indicated by the entity responsible for environmental supervision, where no additional environmental damage will result;

8. If erosive phenomena are identified, corrective solutions should be implemented, to be studied on a case-by-case basis, to control erosion;

9. If applicable, application for the necessary licences for water abstraction should be made.

10.3 ECOLOGY

10. During the operation phase, maintenance actions should be carried out, namely:

- Areas that have been restored (areas that have been affected by the works or areas where environmental rehabilitation has been carried out). This will continue to prevent erosion, promote the re-establishment of vegetation units with conservation value and prevent infestation by unwanted species such as exotic weeds;

- Accesses should be maintained to ensure a barrier to the spread of possible fires and to allow access and circulation of fire-fighting vehicles;

- Watercourse protection strips: elimination of exotic weed species, correction of erosion hotspots, encouragement of natural regeneration.

11. Lighting of wind turbines should be reduced to the minimum recommended for aviation safety, also avoiding attraction to birds or bats;

12. If considerable mortality of sensitive bat species, or very considerable mortality of other species, occurs, the adoption of more direct mortality risk minimisation measures, such as the use of acoustic deterrents to ward off chiropterans, should be assessed (Arnett *et al.*, 2013b).

10.4 SOCIOECONOMY

At the socio-economic level, the developer will be responsible for implementing the following measures:

13. Favour, whenever possible, the procurement of services (maintenance, supply of materials, supply of goods and services) from local or regional companies, thus fostering permanent and indirect employment derived from the operation of the Namaacha Power Plant;

14. Accessibility to the church between T6 and T2 should be ensured;

15. Employment principles and procedures should, as far as possible, prioritise the employment of skilled local workers, contributing to local job and wealth creation;

16. Employment policies should ensure the principle of gender equality;

17. Training should be provided for employees to promote their skills;

18. Health care and safety measures shall be ensured for the workers of the Namaacha Power Plant, taking into account the specific risks of each role;

19. Involve local community representatives in the management of the support and funding that will be given to social development activities that will be implemented in co-ordination with the District and local government.

10.5 SOUND ENVIRONMENT

20. Regular/periodic and effective maintenance of vehicles, machinery and equipment to ensure they are in good working order and their use does not generate excess noise/vibration;

21. Control the speed of vehicles on the roads leading to the Namaacha Power Plant (30 km/h).

10.6 WASTE MANAGEMENT

In addition to the measures already mentioned in the chapter on general measures and water resources, the implementation of the following measures should be ensured:

22. Waste must be stored appropriately, separating hazardous waste from non-hazardous waste under technical conditions that prevent it from contaminating the environment;

23. The waste must be sent to duly licensed companies as described in subchapter 9.10 of the Technical Report of the EIA;

24. The forwarding to a duly authorised final destination of the waste generated in these operations.

11 PLANS AND MONITORING

11.1 PLANS

As already mentioned in previous chapters of this Environmental Management Plan, different Plans should be defined and implemented, **to be developed by the Proponent and the Contractor, based on more detailed elements of the work,** summarising below their contents and the guidelines to be ensured:

- Resettlement Plan. This Plan will only be developed if resettlements are indeed required as foreseen in the minimisation measures of the project phase.
    - This Plan should be developed in accordance with the Mozambican Legislation on Resettlement and Compensation (Constitution of the Republic and the Regulation on the Resettlement Process Resulting from Economic Activities) and international standard of legislation on Resettlement and Compensation (IFC - World Bank Standards);
    - The Regulation on the Resettlement Process Resulting from Economic Activities (Decree 31/2012) provides rules and principles for resettlement, with a view to promoting the quality of life of citizens and protecting the environment;
    - The national legislation guiding compensation Decree 181/2010 and Regulation 66/1998 set out the various guidelines and standards for the expropriation process for land use planning purposes due to development activities of public interest or public utility;
    - The Resettlement Plan to be developed should take into account the actions already undertaken in contacting people;
- Environmental Monitoring Plan
    - This plan, for the construction phase, is defined in point 7 of this EMP. It should be adapted according to the detail of the works to be defined later and in conjunction with the contractor. It will include as an annex the following Plans.

- Environmental Management Plan
  - This Plan to be defined for the operation phase, should define the environmental management procedures defined in the chapter on minimisation measures for the operation phase (Chapter 10 of this EMP).
- Emergency Response Plan
  - This Plan should be defined and implemented for both the construction and operation phases, identifying all possible accident situations and defining the procedures necessary for action in each situation. More details of this plan are given in chapter 4.8 of this document;
  - It should take into account the health and safety and environmental management system of each contractor and, in the operation phase, of the Namaacha Power Plant.
- Waste Management Plan
  - This Plan should follow the guidelines already defined in Chapter 8 of this EMP for the construction phase. It should be adapted according to the waste management procedures of each contractor;
  - For the operation phase, working procedures should be defined that include the measures referred to in subchapter 10.6 and ensure compliance with the legislation.
- Awareness Raising and Training Plan
  - This Plan, also to be prepared for the construction and operation phase, should ensure the guidelines set out in sub-chapter 4.7 of this EMP (for the construction phase) and the measures set out in Chapter 10 for the operation phase.

- Health and Safety Plan
    - This Plan, to be defined in accordance with Mozambican legislation and taking into account IFC guidelines, should include the measures already indicated in subchapter 7.4 for the construction phase and in Chapter 10 for the operation phase.
- Sócio-economic Plan
    - This Plan should define the methodologies for monitoring the socio-economic impacts of this Project, namely in terms of employment, training, safety and health and the utilisation of the value to be delivered by the developer to support and finance social development activities.

11.2 MONITORING

The negative environmental impacts identified for this Project are, in general, not significant and are still reduced by the adoption and implementation of the minimisation measures identified in the previous Chapter, focusing mainly on the construction phase. However, it is identified the need to implement Monitoring Plans in the phases prior to construction, construction and operation for the descriptors Sound Environment and Ecology - Avifauna and Bats, and monitoring in the phase prior to construction and construction, for the descriptor Air Quality.

11.2.1 Sound Environment

General considerations

The Noise Monitoring Plan, which is implemented here, aims to determine whether the activities carried out during the construction and operation phase of the Wind Farm, are inducing significant changes to the sound environment that is currently registered in the study area, namely at the main sensitive receptors present in the surroundings of the study area.

Parameters to be monitored

The monitoring campaigns to be carried out will determine the ambient noise values for the equivalent continuous sound level with an A-weighting mesh, (LAeq), in 1/3 octave bands. The statistical parameters 95% and 50% percentile level will also be recorded.

Sampling locations and frequency

Figure 11.1 shows the location of the measurement points to be carried out as part of this monitoring, adjusted to the sensitive receptors identified in the Technical Report.

Legenda: ● Locais de monitorização - Ambiente Sonoro
● Locais de monitorização - Qualidade do Ar

In the absence of national standardisation, WHO or IFC (International Finance Corporation) guidelines should be adopted.

Prior to the start of the construction phase, a monitoring campaign should be carried out to assess the acoustic baseline and to establish the residual noise as a basis for the acoustic assessment.

During the construction phase, bimonthly campaigns shall be planned. For any of the campaigns listed here, sufficient measurements should be taken to ensure the statistical representativeness of the measurements, given the characteristics of the acoustic signal(s), of the environment to be characterised.

During the operation phase, biannual campaigns should be planned, during the first two years of operation and under conditions representative of the average wind speeds present in the study area.

Equipment to be used

The measurement system shall be based on a digital integrating sound level meter with a high sensitivity broadband microphone and spectral and statistical analysis filters. The system shall be equipped with a wind shield to eliminate spurious signals due to wind and a tripod to ensure stability. The system shall be type-approved and shall belong to accuracy class 1.

Data evaluation criteria

The criterion for evaluating the data collected will be compliance with the limits set by the World Health Organisation's environmental guidelines that impacts on environmental noise should not exceed the levels shown in Table 11.1, or result in a maximum increase in the noise levels characterising the (existing) reference ACUSTIC framework by more than 3dB at the nearest location to the identified sensitive receptor.

Table 11.1

Noise levels according to the "Guidelines for Community Noise", World Health Organization (WHO), 1999

Receptor	One Hour LAeq [dB(A)]	
	Day 7:00-22:00	Night 22:00-07:00
Environmental Conditions	Maximum increase in base levels of 3 dB at the location closest to the off-site receptor	
Residential/Institutional/Educational	55	45
Industrial/Commercial	70	70

11.2.2 Ecology

It is planned to implement an Avifauna and Bats Monitoring Plan for the pre-construction, construction and operation phase as follows.

Birds

The following is the Bird Monitoring Plan for the Namaacha Power Plant. Taking into account the confirmed and potential threatened species in the study area, as well as the insertion of the study area in an EBA and the values characterising it, it is considered that the avifauna monitoring plan at the

Namaacha Power Plant should cover the bird community in general and birds of prey and other large gliders.

Objectives

The aim of this monitoring plan is to find out how birds use the area where the Namaacha Power Plant is located, to assess any impacts resulting from the implementation of the project and to obtain data that will enable possible mitigation measures to be established.

The monitoring plan should cover the three phases of the project: pre-construction, construction and operation, during the first three years. Monitoring of the bird community in the pre-construction phase was carried out between October 2018 and August 2019.

Parameters do be monitored

In line with the stated objectives, monitoring of the following parameters is considered important:

- Birds in general:
    - Relative abundance (number of individuals per sampling site);
    - Specific richness (number of species per sampling site);
    - Diversity (Shannon-Wiener diversity index);
- Birds of prey:
    - Relative abundance (number of contacts per sampling site);
    - Specific richness (number of species per sampling site);
    - Mapping of movements by species;
    - Abundance per 500x500m grid in the sampled area (no. of contacts/individuals per grid);
    - Abundance per 500x500m grid in the sampled area of each observed flight type (no. of contacts/individuals per flight type per grid);

  - Abundance of flights at blade level (no. of contacts/individuals in flight between 30 and 180m);

- Mortality, which corresponds to the count of the number of bat corpses near the wind turbines;

- Removal rate of corpses, which corresponds to the determination of the rate of consumption or removal of corpses per time interval;

- Corpse detection efficiency, which corresponds to the estimate of the relative proportion of corpses not detected by the technicians;

- Prospectability classes, which corresponds to the determination and mapping of the degree of difficulty of progression provided by the terrain and visibility that the vegetation allows.

Sampling sites

For the monitoring of the bird community in general, 14 pedestrian transects should be carried out distributed among the different vegetation types according to their representativeness (percentage of cover) in the study area (Bibbly *et al.*, 2000).

Sampling for birds of prey and other gliders should be carried out using observation points, which, given the relatively gentle terrain of the study area, should be set at the highest points of the terrain so that the entire surrounding area can be seen (Hardey *et al.*, 2006).

In the pre-construction phase six observation points were defined and a sampling effort of 36 hours was carried out, however given the apparent low density of birds of prey using the study area the volume of data obtained was small which makes it difficult to analyse the use of the area by birds of prey, in particular threatened species. As such, it is recommended for the following phases to intensify the sampling effort and to define a greater number of sampling points. At least one of the observation points in the western part of the study area should provide good visibility of the more enclosed and relatively less disturbed valley.

Given the scarcity of current data on the utilisation of the Goba vulture colony it is recommended that in the following phases the monitoring of this colony be added to the sampling scheme.

Sampling for mortality estimation should be carried out within a minimum radius of 50m around the wind turbines, however this radius should be adjusted to the prospecting conditions of the terrain (ease of progression vs visibility), in particular the percentage of non-prospectable area.

Sampling period and frequency

Monitoring of the bird community in general and birds of prey should be done on a monthly basis. Thus increasing the sampling effort for better detection of endangered species and better understanding of the birds' use of the study area.

Mortality estimation will be carried out during the first three years of operation of the wind farm, with: weekly sampling during the 12 months of the year to search for carcasses; at least one sampling per team in each season (dry and wet), to determine the efficiency of detection of carcasses; and four samplings to determine the rate of removal of carcasses (two in each season), these last in the first two years of operation.

Sampling methods and materials

Bird surveys in general should consist of walking transects about 100m long and lasting 10 minutes, which will allow adequate detection of all birds using these open spaces dominated by herbaceous vegetation, in particular passerines, but also all other species.

In each sampling campaign, the observer should move to the beginning of each transect with the aid of GPS and, before starting the count, remain still and silent for a few minutes, in order to allow the return of birds potentially scared away by his presence (Sutherland, 1996). You should then walk each transect at a maximum speed of 2km/h during the census period and record, with the aid of binoculars, all birds observed and heard, by species and respective number of individuals, by distance class from the transect (<50m; 50-100m; >100m) (Bibby *et al.*, 2000). The following parameters should also be collected per transect: date and time of the transect, observer, duration of the count and the abiotic conditions during the transect (temperature, wind direction and speed, presence of rain and cloudiness).

All sampling should be carried out during periods of peak passerine activity, i.e. the first 3 to 4 hours after sunrise and the last hour before sunset (Bibby *et al.*, 2000).

The sampling of birds of prey should be based on the realisation of observation points lasting one hour, with no fixed distance limit, in order to determine the use of the study area by this group.

At each sampling point and campaign, all birds observed and their movements in the study area should be recorded with the aid of binoculars and telescope. For each observation, the species and the number of individuals observed, their age and sex, their behaviour, flight height (0, 0-30, 30-105, 105-180 and >180m) and flight direction should be recorded, as well as movement mapping. The following parameters should also be collected per observation point: date and time it was carried out, observer and the abiotic conditions under which it was carried out (temperature, wind direction and speed, presence of rain, cloudiness and visibility).

All observation points should be carried out during the hottest hours of the day, with the exception of hours of extreme heat, since the formation of rising thermal currents begins, which are used by this group to move in the field.

All areas with potential for nesting of these species should also be pre-identified in GIS and prospected in the field in all sampling campaigns.

In relation to mortality estimation, the search for carcasses will consist of random walks through the area to be searched. Whenever a bat corpse is found, its location will be recorded (at least the GPS coordinate, ideally also the distance and orientation in relation to the wind turbine), its state of decomposition, date and the wind turbine where it was found will be noted. Dead bodies or remains will be collected for later identification, and freezing or placing in alcohol after collection is recommended. To determine the effectiveness of the observers' detection of carcasses, bat models will be randomly scattered within a radius equivalent to that of the carcasses survey (location unknown to the observers), and then each observer will start the normal carcasses survey and note the number of models detected. The methodology for the carcass removal rate will consist of randomly scattering rat carcasses in the wind farm footprint and recording their location. Daily visits will then be made to record the removal status of each carcass for a maximum period of 10 days. If the carcasses to be used are of species that may occur in the wild in the region, they should be marked in a way that allows them to be associated with the study, but in a way that does not facilitate or indicate their location to possible consumers.

Data processing methods

In order to characterise the avifauna community present in the study area, the parameters calculated, in particular for passerines, should be the relative abundance per species, per season and per biotope (average number of individuals up to 100m away from the transects), the relative specific richness per season and per biotope (average number of species up to 100m away from the transects), the Shannon-Wiener diversity index – $H' = -\Sigma_{pi} \log pi$, where *pi* is the proportion of species recorded out of the total within 100m of the transect, per season and per biotope.

Data from the various phases of the project should be compared with each other using statistical methods, such as multivariate and time series analyses, in order to detect differences between phases.

For the characterisation of the community of birds of prey and other gliders using the study area, the absolute abundance per species (average number of contacts per season), relative abundance per point and season (average number of contacts per point) and relative specific richness per point and season (average number of species per point) should be calculated.

A grid with UTM 500x500m squares should be defined in the area visible through the sampling points. This grid should serve as a basis for mapping abundance per grid per sampling campaign, abundance per flight type (circular, gliding, passing, perched, display,...) and abundance of flights at blade height (30 to 180m). The movements of the species detected per sampling campaign should also be mapped.

The abundance and species richness of vultures in the Goba colony per sampling campaign should also be calculated, as well as their movements mapped.

Data from the various phases of the project should be compared with each other using statistical methods, such as multivariate and time series analyses, in order to detect differences between phases.

For the estimation of mortality, specific estimators will be used such as those proposed by Erickson *et al.* (2004), Huso (2010) and Korner-Nievergelt *et al.* (2011). These estimators use data on detected mortality, detection efficiency and removal rate as the basis for estimating mortality in a wind farm. Given that it will not be possible to prospect for carcasses in the entire area planned, mortality in areas not prospected should also be estimated, following for example that proposed by Huso & Dalthorp (2014).

Bats

The following is the Bat Monitoring Plan for the Namaacha Power Plant. This plan has taken into account the guidelines proposed by the International Finance Corporation and pela South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility.

Objectives

The purpose of this monitoring plan is to find out how bats use the area where the Namaacha Power Plant is located, to assess any impacts resulting from the implementation of the project and to obtain data to establish possible mitigation measures, thus covering three different situations:

- determine the list of existing bat species and their population status (number of colonies/individuals, location of occupied/potential shelters and assessment of activity in the study area);
- analyse the influence of environmental variables on bat activity (e.g. wind intensity and air temperature); and
- assess the impacts of the project on bats.

The monitoring plan is divided into two phases, covering the period before the construction of the wind farm (Phase 1) and the initial period of operation (Phase 2).

With Phase 1 (before construction), it is intended to inventory the bat species occurring in the area of influence of the wind farm; to assess bat activity in the wind farm footprint (at ground level and at height); to assess the seasonal occupancy of bat shelters within a maximum radius of 10 km around the project footprint. This phase started in October 2018, with the work described in this report, and is planned to continue until September 2020 with the continuation of the assessment of activity at height.

The objectives of Phase 2 (operational phase, duration 3 years) are to monitor bat colonies detected; assess bat activity in the wind farm area (at ground level and at height); estimate bat mortality caused by the wind farm; and assess the effectiveness of the minimisation measures adopted, as well as the need to modify them.

Parameters to be monitored

In line with the stated objectives, monitoring of the following parameters is considered important:

- Specific richness, which corresponds to the determination of the species or groups of species of bats that occur in the area of the Namaacha Power Plant;
- Activity, which corresponds to the determination of the number of bat encounters per unit time, in the wind farm area;

- Mortality, which corresponds to the count of the number of bat carcasses near the wind turbines;
- Removal rate of carcasses, which corresponds to the determination of the rate of consumption or removal of carcasses per time interval;
- Carcasse detection efficiency, which corresponds to the estimate of the relative proportion of corpses not detected by the technicians;
- Causes of death, i.e. determination of the probable cause of death of detected carcasses (where this is possible);
- Prospectability classes, which corresponds to the determination and mapping of the degree of difficulty of progression provided by the terrain and visibility that the vegetation allows;
- Air temperature, precipitation, wind direction and intensity, coinciding with the sampling periods.

It will also be necessary to obtain some parameters characterising bat sound emissions, which will be described in more detail below.

To collect these parameters, the following sampling will be carried out: bat surveys and shelters; hand-held ultrasonic detector surveys (assessment of ground-level activity); automatic ultrasonic detector surveys (assessment of activity at height); and mortality estimation (survey, removal tests and carcass detection tests).

Sampling sites

The prospection of shelters will be carried out within an approximate radius of 10km around the line of implantation of the wind turbines, but special attention will be given to the area closest to the wind farm (radius of 5km) and to the most important shelters. These should include the Namaacha I shelter, although it is about 11km away from the planned location of the wind turbines.

Sampling with nebula nets was carried out in Phase 1 in the area of the wind farm, but no areas with greater suitability for their capture were found, such as water lines or ponds, riparian galleries, or in their absence, in areas of vegetation more favourable to the passage of bats. As such, this methodology was abandoned.

Sampling to assess activity at ground level (with hand-held detector) will be carried out at 22 fixed points distributed throughout the wind farm area, in order to cover the main vegetation units existing there.

The acoustic sampling at height (with automatic detector) will be carried out in a meteorological tower located in the wind farm deployment area. Two ultrasound detectors and their microphones will be installed in this tower, in order to sample the area of rotation of the wind turbine blades (microphone at about 55m height) and the area near the ground (the microphone at 3m height slightly oriented downwards).

Sampling for mortality estimation should be carried out within a minimum radius of 50m around the wind turbines, however this radius should be adjusted to the prospecting conditions of the terrain (ease of progression vs visibility), in particular the percentage of non-prospectable area.

Sampling period and frequency

With regard to shelters, a minimum of one sampling per season (dry and wet) will be carried out at the sites referenced with bats. Surveying for new shelters will be carried out throughout the year (coinciding with ground level activity assessment).

surveys will be carried out in at least 8 months of the year (4 months of each season), during the first 3 years of the operation phase. Sampling will last 5 minutes at each site. Sampling will not be carried out in adverse meteorological conditions (rain, fog, winds exceeding 5 m/s at ground level) or in situations of obvious risk to the technicians responsible.

For the assessment of activity at height, monthly scans with automatic ultrasound detectors will be carried out for 7 days per month, every month, during the first 3 years of the operation phase. Sampling will take place continuously throughout the period from 30 minutes before sunset to sunrise.

Mortality estimation will be carried out during the first three years of operation of the wind farm, with: weekly sampling during the 12 months of the year to search for carcasses; at least one sampling per team in each season (dry and wet), to determine the efficiency of carcass detection; and four samplings to determine the rate of carcass removal (two in each season), the last two in the first two years of operation.

Sampling methods and materials

With regard to shelters, sites that apparently have conditions for harbouring bats (natural and artificial cavities, abandoned buildings, sheds, bridges, inland escarpments, fruit trees, large trees, ...) will be monitored by consulting cartography, aerial photography, bibliography, fieldwork and interviews with local populations. Where possible, daytime visits to the inventoried sites shall be made, recording the species and the number of individuals present. Where this is not possible (for security reasons, because it is private property), visits should be replaced by sampling with an ultrasonic detector over a period of at least 30 to 45 minutes, starting just before sunset. In these samplings, the number of individuals leaving the shelter will be counted (by direct observation) and the species detected will be identified (through sound recordings). If capture is necessary, the bats will be temporarily stored in individual cloth bags, before being handled for identification and biometric data collection.

Data collection for the assessment of ground level activity will be carried out by means of full spectrum ultrasonic detector eavesdropping. In order to allow comparison with data collected in the pre-construction phase. Sampling will be carried out by continuous recording of the 5 minutes. For the collection of temperature and wind data (intensity and orientation) at ground level, a pocket anemometer and a compass will be used. These values will be collected at the beginning of each sampling, and if possible, also throughout the sampling period.

For the assessment of the use of activity at height, 2 automatic detectors of the full spectrum type will be installed. The detectors will be programmed for the sampling periods previously indicated, and to record all detected contacts for 3 seconds, with no interval between two consecutive recordings. The following settings are recommended: gain - 12dB; filter below 16kHz - no; sampling rate - 384kHz; minimum duration - 1.5ms; maximum duration: none; minimum trigger frequency - 10kHz; trigger strength - 12dB; trigger window - 3s; maximum duration: 3s. Meteorological data will be obtained through the measuring equipment available in the meteorological tower itself.

In acoustic sampling, bat encounters will be counted, i.e. the sequence of at least two sound pulses within a maximum interval of 500ms between consecutive pulses (Sowler *et al.*, 2017), as well as the presence of social pulses and feeding buzzes (sequence of pulses emitted with a high repetition rate, which indicate the final phase of approach to an insect).

In relation to the estimation of mortality, the search for carcasses will consist of random walks through the area to be searched. Whenever a bat carcass is found, its location will be recorded (at least the GPS coordinate, ideally also the distance and orientation in relation to the wind turbine), its state of decomposition, date and the wind turbine where it was found will be noted. The carcasses will be collected for later identification, and it is recommended to freeze or place them in alcohol after collection. To determine the effectiveness of the observers' detection of carcasses, bat models will be randomly scattered within a radius equivalent to the carcass search (location unknown to the observers), and then each observer will begin the normal carcass search and note the number of models detected. The methodology for the carcass removal rate will consist of randomly scattering rat carcasses in the wind farm site area, recording their location. Daily visits will then be made to record the removal status of each carcass for a maximum period of 10 days. If the carcasses to be used are of species that may occur in the wild in the region, they should be marked in a way that allows them to be associated with the study, but in a way that does not facilitate or indicate their location to possible consumers.

Data processing methods

The analysis of the sound recordings obtained in the sampling of the use of space at ground level and at height will be carried out using sound analysis software, which will allow the main variables characterising the sound emissions of bats to be obtained, such as the type of frequency (constant, modulated or quasi-constant), the frequency of maximum energy (kHz), the frequency range (kHz), the pulse duration (ms), the interval between pulses (ms) and the shape of the pulse. The parameters collected will then be compared to baselines (Fenton *et al.*, 2014; Monadjem *et al.*, 2017n; Monadjem *et al.*, 2010; Taylor *et al.*, 2013), so that the species present, or group of possible species, can be determined.

In the specific case of sampling with a hand-held detector, taking into account that the entire sampling will be recorded continuously, before analysing for species identification, it will be necessary to previously select the sequences with bats present in the recordings (presence of at least two pulses with a maximum interval of two seconds between consecutive pulses) and then divide these sequences into three-second portions.

Regarding the sampling with automatic detector, taking into account the high number of recordings that these originate and the fact that a large part of them correspond only to noise, before proceeding to the analysis and identification of the species present, it will be necessary to carry out a screening to separate the recordings with noise from those with bats. This sorting can be done manually or automatically (by means of special software), in the latter case it is necessary to validate at least 5% of the files classified as noise, in order to determine the percentage of software error (percentage of recordings with bats, wrongly classified as noise). On the other hand, as the number of bat files is potentially high, it may be impractical to analyse all of them, in which case samples should be analysed. In this case, it is suggested that nights with fewer encounters be analysed in their entirety, and that nights with the highest number of encounters be analysed by sampling, with recordings of all hours with activity always selected. It is suggested that samples are selected by stratified random selection procedures, for example using the programme R v3.2.0, as described in Cochran (1977), Lohr (1999) and Pereira (2001).

Subsequently, when assessing activity, activity indices (number of encounters/h) will be calculated by species, species groups and/or overall, and the variation between samplings and period of the year (month) will also be considered. Meteorological data will also be presented taking into account the variation between samplings and period of the year (month). Appropriate statistical processing of the collected data will also be carried out in order to assess the influence of the measured parameters on bat activity and, if possible, specific richness.

Specific estimators such as those proposed by Erickson *et al.* (2004), Huso (2010) and Korner-Nievergelt *et al.* (2011) will be used to estimate mortality. These estimators use data on detected mortality, detection efficiency and removal rate as a basis for estimating the mortality occurring in a wind farm. Given that it will not be possible to prospect for carcasses in the entire area planned, mortality in areas not prospected should also be estimated, following for example that proposed by Huso & Dalthorp (2014).

11.2.3 Air quality

General considerations

The purpose of the Air Quality Monitoring Plan, which is set out herein, is to determine whether the activities carried out during the construction phase of the Project will lead to significant changes in the air quality currently being recorded in the study area, particularly at the main sensitive receptors present in and around the study area. These will only be carried out in the event of situations that give rise to complaints from the population.

Parameters to be monitored

The monitoring campaigns to be carried out will determine the ambient air quality values for the parameters Total Suspended Particles. These campaigns will be carried out in case of complaints from the population.

Sampling should be carried out for 24 h. This sampling time may be adjusted as long as it allows comparison with the legislation in force (according to Article 7 of Chapter II of the Regulation on Environmental Quality and Effluent Emission of Decree No 18/2004 of 2 June). These results should also allow comparison with the IFC standards.

Sampling sites and frequency

The sampling sites are shown in Figure 1. IFC - International Finance Corporation guidelines should be adopted in addition to Mozambican national legislation (from Decree No 18/2004 of 2 June).

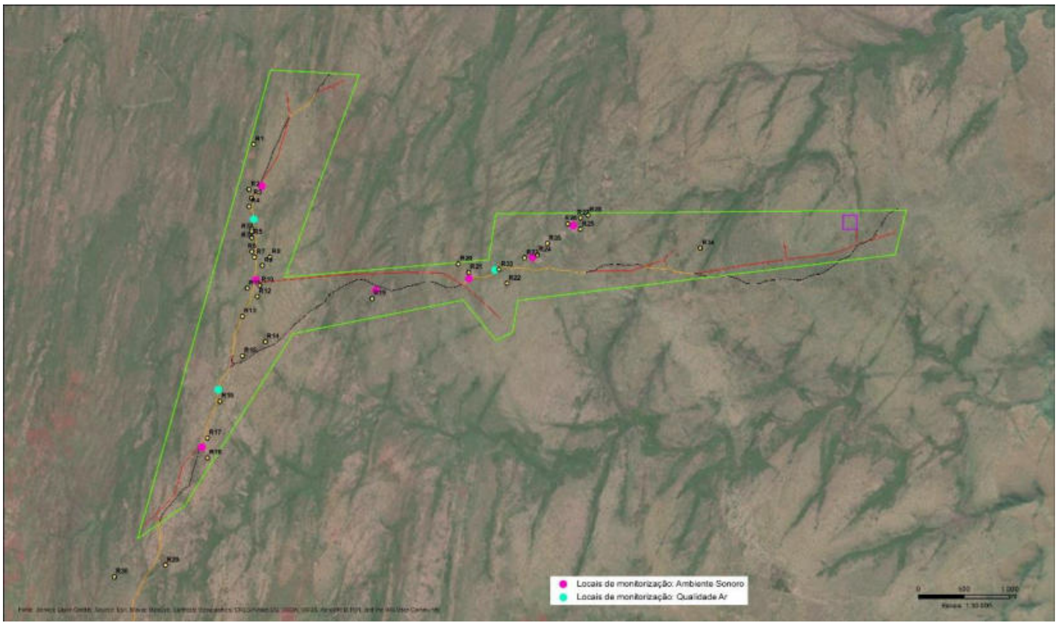

Figure 1 – Proposed noise and air quality monitoring sites

Maputo, 23 November 2020

Margarida Fonseca

Nuno Ferreira Matos

Annex 1

LIST OF LICENSED HAZARDOUS WASTE TRANSPORTERS AND OPERATORS

REPUBLIC OF MOZAMBIQUE

MINISTRY OF LAND, ENVIRONMENT AND RURAL DEVELOPMENT

NATIONAL DIRECTORATE OF ENVIRONMENT

LIST OF LICENSED HAZARDOUS WASTE TRANSPORTERS AND OPERATORS

No.	NAME OF COMPANY	TYPE OF ACTIVITY	PROVINCE	CITY / MUNICIPALITY
01	Enviroserv	Transporter	Maputo City	Maputo City
02	Transportes Auro Sociedade Uimipessoa, Lda.	Transporter	Nampula	Nampula
03	Count consultorias, Lda.	Transporter	Maputo City	Maputo City
04	Oasis Moçambique Refinary, Lda.	Transporter	Maputo Province	Matola
05	Dionísio Calisto Armando	Transporter	Maputo Province	Matola
05	Fuerte fumigacoes sociedade unipessoal,Lda	Transporter	Maputo City	Maputo City
06	Visaqua-gestao de infra-estruturas e serviços ambientais	Transporter	Maputo City	Maputo City

07	CENPA- Sociedade Unipessoa, Lda.	Transporter	Maputo City	Maputo City
08	MJA Consultores	Transporter	Maputo Province	Matola
09	Ecolife, SA	Transporter	Maputo Province	Matola
10	Enviroserv	Operator	Maputo Province	Matola
11	Selected supplis, Lda	Transporter	Maputo City	Maputo City
12	MOZ enveromental	Transporter	Cabo Delgado	Pemba
13	International facilities services Mozambique	Transporter	Sofala	Beira
14	3R-Amor	Transporter	Maputo City	Maputo City

Annex 7

MITADER Letter and Response Document

MATOS, FONSECA & ASSOCIADOS
ESTUDOS E PROJECTOS LDA
MOÇAMBIQUE

Environmental Impact Assessment of the Namaacha Power Plant

Response to MITADER's request for details

Central Eléctrica da Namaacha, S.A.

January 2022

CONTENTS

1 INTRODUCTION

Matos, Fonseca & Associados, Moçambique Lda, the consultant responsible for the preparation of the Environmental Impact Assessment (EIA) for Central Eléctrica da Namaacha, SA, hereby responds to the request for further details formulated by DINAB/MITADER, in the context of the letter with reference MTA/266/DINAB/GDN/252/21, dated 02/03/2021, which is presented in the Annex.

This document accompanies a new version of the EIA (consolidated version integrating all requested elements), this being a volume integrated in the reissue of the EIA that fully responds to the requests of MITADER and at the same time clearly identifies all the changes made to the initial EIA.

2 RESPONSES TO THE REQUEST FOR DETAILS

a) **The proponent states on page 1, that "*the location and connection to the power grid of the Power Plant is not yet defined and two connection options are being studied, one to the Boane substation (66 kV) and the other to the Beluluane substation (275 kV). The choice of the substation to be connected will result from grid connection studies to identify the best location for this connection. This connection will subsequently be studied environmentally*". Taking into account that the process is in the last stages of environmental licensing, it is requested to indicate the location of the connection to the electricity grid and the respective alternative studies.**

The connection point for the Namaacha Power Plant will be the Boane substation as shown on page 1 of the EIA.

b) **The document under review does not present the plans listed on page 446. In addition, the environmental monitoring plan should also be submitted.**

The following plans are listed on page 446:

- Environmental Management Plan;
- Resettlement Plan;
- Emergency Response Plan;
- Awareness Raising and Training Plan;
- Health and Safety Plan;
- Socio-economic Plan.

These Plans are referred to in Annex 6 - Environmental Management Plan (EMP) and set out the main guidelines and contents thereof. At a later stage they should be finalised, with more detailed information on the work, by the proponent and the contractor.

With regard to the Monitoring Plans, these are described in chapter 11.2 of the Environmental Management Plan, and the following are foreseen: avifauna and bats, air quality and sound environment.

c) Regarding ecosystem services, the document mentions the collection of information from services (survey of local population), presents a lot of information from literary sources. However, it does not present the result of collecting this information on the ground.

There is actually an imprecision in the document when it talks about surveys of the local population. No formal surveys were carried out, but more informal conversations with the population during the fieldwork where we were realising the reality of these people.

This information is included in chapters 7.8.1, page 136 and 7.8.6, page 196 of the EIA Technical Report.

d) Most of the maps presented in the document do not show source and scale

The maps presented in the document include source and scale. In some cases the scale is graphic or in others there is no scale because it is a figure without scale (s/e). In some cases the indication (s/e) was missing and has been added. As for the source, all figures include the respective source, some of them, such as the figures of ecology, landscape, noise and shadow study, as they are authored by the team, the source is the EIA itself, however, the basis of work is indicated, and others correspond to schemes made by the consultant.

The sources and scales of the different figures are summarised below for clarity.

Figure 1.1 has been constructed by the EIA team on a given base that is indicated: "Source: Extract from the Military Map of Mozambique, scale 1/50,000, sheets no. A1187, A1188 and A1189, National Directorate of Geography and Cadastre".

The same is true for Figure 1.2 whose working basis is indicated: Source: Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

The scales are graphical.

Figure 3.1 – scheme constructed by the consultant

Figure 3.2 - Source: Namaacha District Profile Maputo Province - 2014 Edition – graphic scale

Figure 5.1 - Source: Mozambique Renewable Energy Atlas – graphic scale

Figure 5.2 – Source EDM – no scale

Figure 5.3 – Source: Mozambique Renewable Energy Atlas – graphic scale

Figures 6.1 and 6.2 – Source: Sevion

Figure 6.3 - Project

Figure 7.2 – Source: Precipitation Atlas of Mozambique (INAM, 2018)

Figure 7.3 – Graph made by the consultant

Figures 7.4, 7.5 and 7.6– Source: Mozambique Renewable Energy Atlas (2013) – graphic scales

Figure 7.7 - Soure: MICOA, 2012

Figure 7.8 - Source: WebGIS of Mozambique – Embrapa – no scale

Figure 7.9 - Source: Google Earth satellite image (no scale)

Figure 7.10 - Source: WebGIS of Mozambique developed by the company Embrapa (no scale)

Figure 7.11 – Prepared by the consultant

Figure 7.12 - Source: Extract from the Geological Map of Mozambique, National Directorate of Geology of Mozambique, 2008 – graphic scale

Figure 7.13 - Source: UNESCO, 2007 – graphic scale

Figure 7.14 - adapted from USGS, 2006) (s/e)

Figure 7.15 - http://portals.flexicadastre.com/mozambique/pt/

Figure 7.16 - Source: Extract from the Hydrogeological Map of Mozambique, scale 1/1 000 000, southern sheet, National Water Directorate, 1987 – graphic scale

Figure 7.17 – Prepared by the consultant

Figure 7.18 - Source: Mozambique Hydrogeological Map Explanatory Note. DNA, 1987. graphic scale

Figure 7.19 – prepared by the consultant based on: Source: Extract from the Military Map of Mozambique, scale 1/50,000, sheets no. A1187, A1188 and A1189, National Directorate of Geography and Cadastre - graphic scale

Figure 7.20 - Source: (Albino, 2012) - graphic scale

Figure 7.21 - Source: Extract from the Maputo Province Soil Map, scale 1:1 000 000, INIA/DTA, 1994 - graphic scale

Figures 7.22 to 7.25, 7.28, 7.40 and 7.41, 7.45 and 7.46, 7.61 to 7.67, 9.1 to 9.5 – prepared by the consultant based on Source: Extract from the Military Map of Mozambique, scale 1/50,000, sheets no. A1187, A1188 and A1189, National Directorate of Geography and Cadastre - graphic scale

Figures 7.26 and 7.27 – schemes prepared by the consultant based on google earth – no scale

Figures 7.28 to 7.39 and 7.42 and 7.43, 7.47 – graphs prepared by the consultant

Figures 7.48 to 7.60 – graphs adapted from INE - Source: INE

e) **The document does not present the results of the samples collected for identification at the UEM herbarium, according to page 139.**

All species, both those identified in the field and those identified in the herbarium, were integrated into the flora list presented in Appendix 3.1 of Annex 3 - Ecology.

This information has been integrated in chapter 7.8.1, page 139, of the EIA Technical Report.

f) **The EIAR shall present the results of the samples collected during the bird census (page 140)**

The results of the bird census sampling can be found in Appendix 3.8 of Annex 3 - Ecology.

This reference has been integrated in chapter 7.8.4, page 172, of the EIA Technical Report.

Annex I

MITADER's Opinion

REPUBLIC OF MOZAMBIQUE

NATIONAL DIRECTORATE FOR THE ENVIRONMENT

To:
Central Electrica de Namaacha,

Maputo

N/Ref N º /MTA/ /DINAB/GDN/252/21 Maputo: 02-03-2021

Subject: Environmental Impact Assessment Report of the Namaacha Power Plant Project

Dear Sirs,

The National Directorate for the Environment (DINAB) has received from you the document with the above subject, which has deserved due attention. From its analysis, it was found that it presents some relevant aspects that deserve to be improved.

Taking into account that this is a consultation document and of a public nature, the consultant responsible for its preparation should proceed to its reformulation and improvement taking into account the following aspects:

a) The proponent states on page 1, that "*the location of the connection to the power grid of the Power Plant is not yet defined and two connection options are being studied, one to the Boane substation (66 Kv) and the other to the Beluluane Substation (275 kv). The choice of the substation to be connected will result from grid connection studies to identify the best location for this connection and it will subsequently be studied environmentally*." Taking into account that the process is in the last stages of environmental licensing, it is requested to indicate the place of *connection to the electricity grid* and the respective studies of alternatives;

b) The document under review does not present the plans listed on page 446. In addition, it should also present the environmental monitoring plan;

c) Regarding ecosystem services, the document mentions the collection of information from services (survey of local population), presents a lot of information from literary sources (Table 7.12). However, it does not present the result of collecting this information in the field;

d) Most of the maps presented in the document do not show the source and the scale;

e) The document does not present the results of the samples collected for identification in the herbarium of the UEM, according to page 139;

f) The EIAR shall present the results of the samples collected during the bird census (page 140).

The reformulated document shall be submitted to DINAB in two (02) copies in A4 paper format, including the respective electronic format. One (01) copy of the same document shall be submitted to the Provincial Environmental Service of Maputo.

In order to facilitate the review of the redrafted document and reduce the review time, the answers to the questions raised should also be presented separately, and with an indication of the pages where they are located in the EIAR.

Best regards.

The National Director

C.C: Matos, Fonseca & Associados - Environmental Consultancy Firm